



**PHILIPS**

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***abridged  
catalogue  
of professional  
equipment***

1966





# PHILIPS

## abridged catalogue of professional equipment

Since their foundation in 1891 the Philips company have expanded their activities to cover pretty nearly the whole world. More than a quarter of a million people are employed in all the 68 countries concerned and the value of annual sales has exceeded the £ 700 000 000 mark. The company thus belong to the ten largest outside the U.S.A.

Hundreds of graduate scientists and engineers in the company's research laboratories are laying the foundations for the creation of new products and already have many spectacular inventions to their names in a number of fields. These inventions, applied to the needs of industry, have given rise to the design of many of our products. Thus our range of products embraces not only very large installations, such as cyclotrons, but also very small components, for example, those required for computers. Precision-engineering techniques and mass-production methods are used side by side.

Close attention is paid to product quality and a worldwide service organisation is at the call of users.

This abridged catalogue has been compiled to offer professional customers the advantages of a quick survey of what the company produce to meet the needs of engineering science, industry, research, business and central and local government bodies. These products include equipment for factories and laboratories, the engineering, textile, chemical, oil, electrical and electronic industries, equipment for universities, marine and aeronautical navigation, railways and telecommunications, hospitals, sports centres, hotels, theatres, concert halls, cinemas, department stores, banks, etc. In addition to the products set forth in this catalogue, the company manufacture many more for personal and household use such as, for example, decorative fittings and lamps for home lighting, radio and television receivers, gramophones, records, electronic musical instruments, dryshavers, hair driers, electric blankets, electric irons, washing machines, dish washers, refrigerators, microwave ovens, fans, stoves and kerosene kitchen ranges, floor polishers, vacuum cleaners, coffee mills, mixers, irradiation equipment, hearing aids and pharmaceutical products. A comprehensive Subject Index of our products is fitted into this catalogue.

There are more detailed catalogues available which we shall be glad to send you on request. Please contact the relevant national organisation (for addresses, see overleaf) or:

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# 1. ELECTRONIC BUILDING BRICKS FOR PROFESSIONAL APPLICATIONS

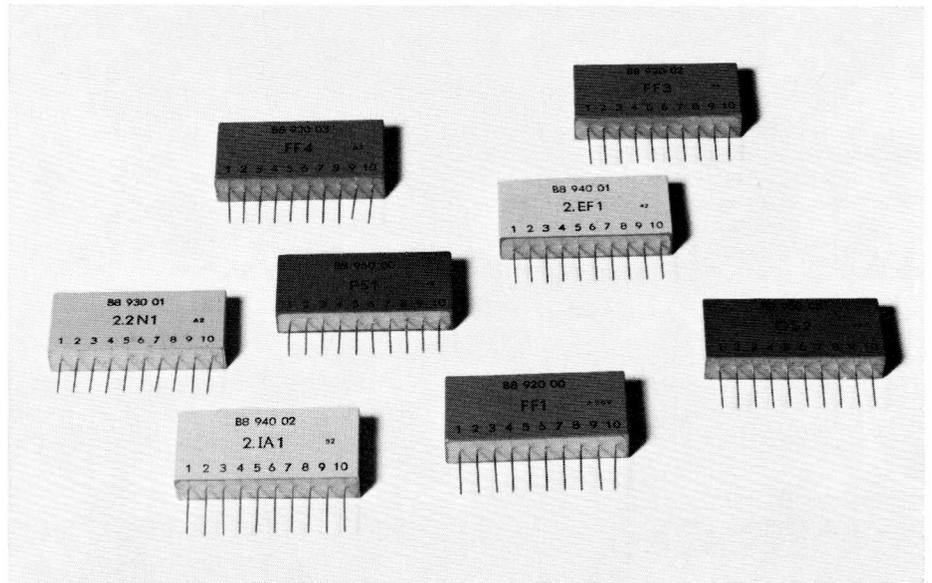
## CIRCUIT BLOCKS

**100-series**  
Standard units for medium speed (max. frequency 100 kc/s)

Circuit blocks can in general be used in all digital data-handling equipment such as for signalling, computing, controlling, measuring and testing, data handling, laboratory uses, etc.

A circuit block is a small encapsulated unit containing basic electronic components, designed to accept and operate upon a specific type of input signal and to produce a specific type of electrical output. A number of different blocks can be combined to form larger parts of a reliable, electronic digital system. The dimensions of all circuit blocks are approximately 54 mm × 24 mm × 11 mm.

Out of one side of 54 mm × 11 mm emerge ten wire terminals of 0.7 mm diameter and 15 mm length. The distances between the wires are 5.08 mm (0.2 in) in accordance with the I.E.C. standard hole grid for printed-wiring boards. The blocks are colour-coded, a different colour being used for each group of functions.



Circuit blocks 100-series.

Available types of circuit block-standard range (max. frequency 100 kc/s)

function	colour code	description		type	type number
memory	red	bi-stable multivibrators (flip-flops)	2 separate trigger inputs	FF1 FF3 <sup>1</sup>	B8 920 00 B8 920 02
			2 separate gate inputs	FF2 FF4 <sup>1</sup>	B8 920 01 B8 920 03
		decade counter 4 × FF1	DC1 <sup>3</sup>	B8 850 00	
		2 decade counter (1-2-4-8 code)	2 DCA2 <sup>3</sup>	B8 850 01	
		reversible counter 5 × FF4 + 5 × 2.PL2	RCA1 <sup>3</sup>	B8 850 02	
signal generating and pulse shaping	green	mono-stable multivibrators (one shot)		OS1 OS2 <sup>1</sup>	B8 950 01 B8 950 03
		pulse shaper generator		PS1 PG1 <sup>2</sup>	B8 950 00 B8 950 02
gating (AND, OR)	orange	twin 2 input	voltage negative	2.2N1	B8 930 01
			voltage positive	2.2P1	B8 930 03
		3 input	voltage negative	2.3N1	B8 930 00
			voltage positive	2.3P1	B8 930 02
		pulse logic, 2 a.c. inputs for		FF1, FF2 FF3, FF4	2.PL1 2.PL2
selection gate			SG1 <sup>2</sup>	B8 930 05	
amplifying and inversion (NOT)	yellow	twin emitter follower	non inverting buffer amplifier	2EF1	B8 940 01
			non inverting gate amplifier	2EF2	B8 940 03
		inverter amplifier		2IA1	B8 940 02
		inverter gate amplifier/power amplifier		2IA2	B8 940 05
	emitter follower/inverter amplifier		EF1/IA1	B8 940 00	
read amplifier		RA1 <sup>2</sup>	B8 940 06		
read amplifier		RA2A + RA2B	2P 727 62A 2P 727 62B		
	—	power amplifier		PA1	B8 900 00
miscellaneous	blue	twin selection switch		2SS1	B8 960 00

<sup>1</sup> Improved performance such as: improved loadability, improved insensitivity to disturbing signals, improved applicability, improved economy, improved reliability.

<sup>2</sup> For memory ferrite core operation.

<sup>3</sup> Special circuit.

## 10-series

These highly compact units have been designed for low speed applications; the maximum clock frequency for triggered logic applications is 30 kc/s. Operation in a d.c. logic mode of various elements up to a frequency of 70 kc/s is possible.

## 20-series

A new series, the "20-series", forming part of the same system as the "10-series" is in development. This series, based upon the same 19-pin technology as the "10-series", is intended for high-speed applications.

In these highly compact units, use is made of double-diffused silicon planar epitaxial transistors.

Storage temperature:  $-55^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$

Operating temperature:  $0^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$  (derating curve for temperature below  $0^{\circ}\text{C}$ )

Test specifications according to MIL 202A and IEC68

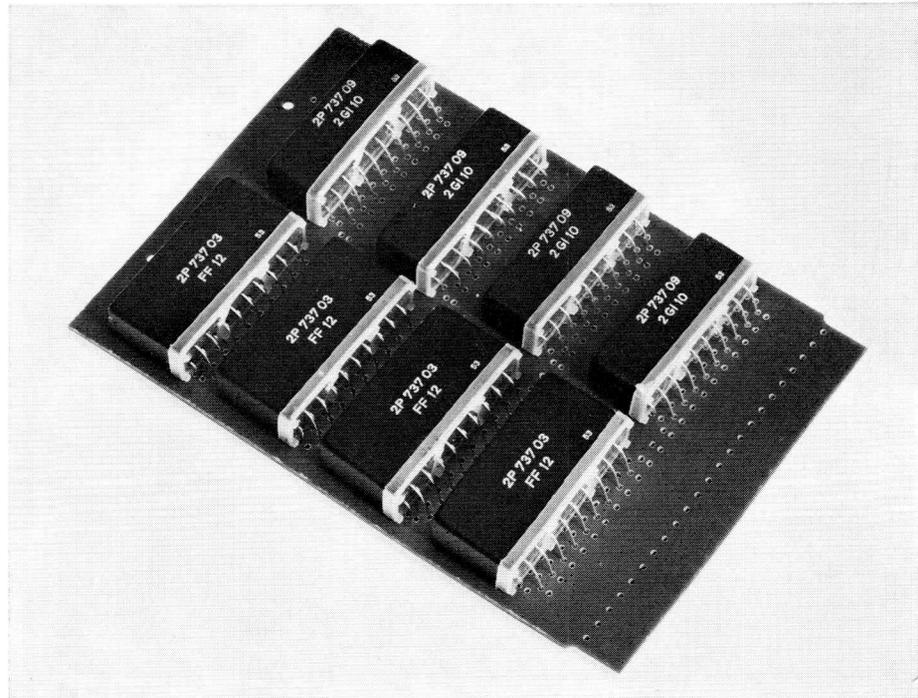
## COUNTING UNITS FOR PROGRAMMED CONTROL

Automation in industry by control of single and more complicated processes at the same time.

In the booklet "Counting units for programmed control" examples are given for use in automatic number-machines, time control equipment, and automatic distribution installations.

## Standard units 10-series

	type	type number	description
gate inverters	2GI10	2P 737 09	
	2GI11	2P 737 17	
	2GI12	2P 737 10	
flip-flops	FF10	2P 737 01	
	FF11	2P 737 02	
	FF12	2P 737 03	
trigger gates	2TG10	2P 737 12	
	2TG11	2P 737 15	
	4TG12	2P 737 11	
timing unit	OS10	2P 737 05	one-shot multivibrator (delay time 5 $\mu\text{s}$ to 30 ms)
	TU10	2P 737 06	timer unit for delays of 30 ms to 60 s
output amplifiers	RD10	2P 737 16	relay driver giving max. 100 mA at max. $-60$ V
	PA10	2P 737 07	power amplifier giving max. 1.6 A at max. $-60$ V
	PA11	2P 737 08	power amplifier giving max. 6 A at max. $-60$ V (to be driven by type PA10)
miscellaneous	PS10	2P 737 13	pulse shaper
	PD10	2P 737 14	pulse driver, max. pulse duration 5 ms
	2GA10	2P 737 04	twin gate/amplifier for amplification of the gate output level after N-N or N-P gate chains



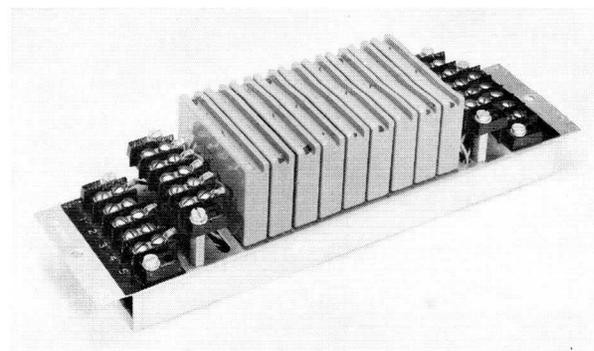
Circuit blocks 10-series.

## NORBITS for industrial control

Norbits are standardized static switching elements of special design and with the following features: high reliability, long life, easy mounting, dust-proof, etc. They can be used in industrial control systems, such as lift control, traffic control, machine control, process control, recording control, transfer line control, alarm and annunciator systems.

It is possible to perform a large number of control functions with a small number of types.

The basic element, the NOR-unit, is capable of performing the logical functions AND/OR and NOT, whilst sequential logic circuits such as flip-flops can be built up from two or more of these NOR-units. The series of Norbits further includes ancillary elements for adaptation to industrial equipment.



Triple binary counter.

## MAGNETIC MEMORY CORES

All data-handling systems employ some sort of device for the storage of information. Such a "memory" can accept, store and supply the information at any required moment. For this purpose a magnetic core memory is very often used.

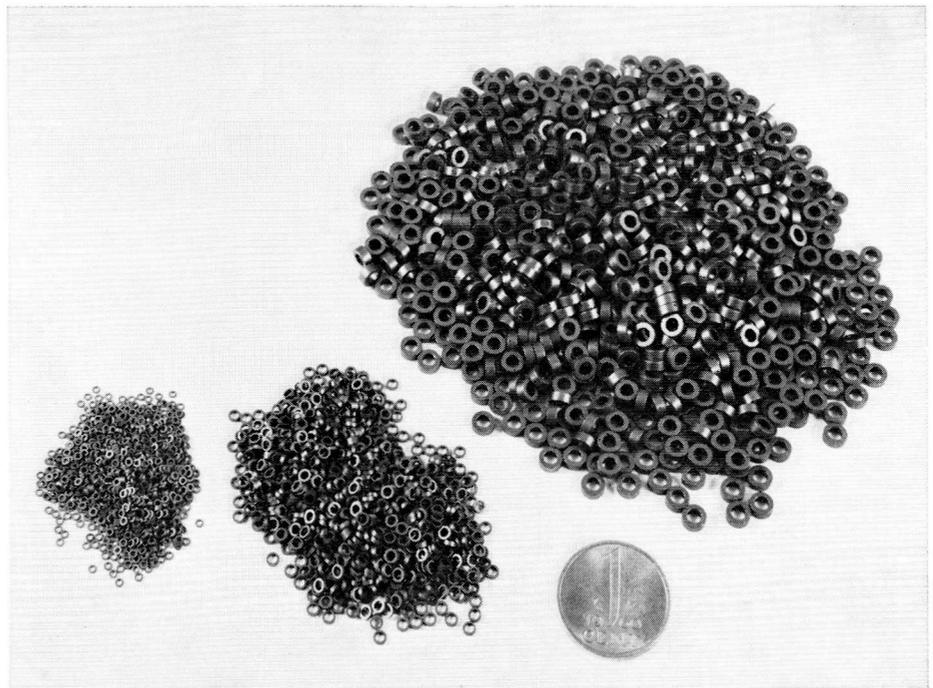
The storage capacity of a magnetic core is the result of its property to assume either of two stable magnetic states. One magnetic state is maintained, until it is made to change into the other.

The main features which can be distinguished are as follows:

1. read/write cycle time of only a few micro-seconds,
2. random access,
3. the information can be stored for an indefinite period,
4. storage of large quantities of information in a small volume.

The properties of the cores are such that the cores are specially designed for use in coincident current memories.

We have available cores with a wide temperature range, the electrical properties of which are nearly constant over the entire temperature range.



*Magnetic memory cores.*

## MATRIX PLANES, STACKS AND BOXES FOR COINCIDENT CURRENT MEMORIES

The matrices and stacks are specially designed for coincident current operation. The matrix planes consist of a number of magnetic cores arranged in rows and columns through which 4 copper wires are threaded according to the MIT system, namely:

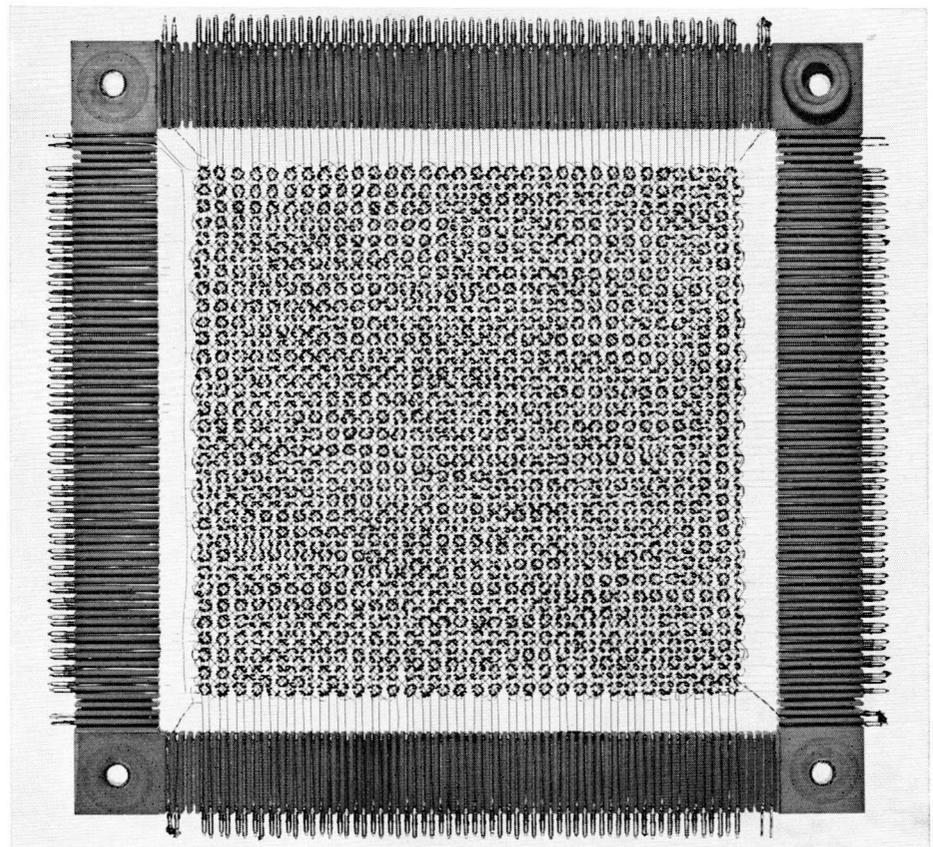
- 2 drive wires (X wire, Y wire)
- 1 inhibit wire (Z wire)
- 1 sense wire (S wire)

Matrices with 30 mil, 50 mil and 80 mil cores are available in standard executions. Matrices with 150 mil cores are only available on request.

To facilitate the stacking of matrix planes two versions of each type are available. These types are mirror-symmetrical and are called left- and right-hand planes.

Stacks are delivered with interconnected drive lines.

Matrix planes, which do not contain the number of cores mentioned in the standard ranges, or matrix planes which are wired according to e.g. word address systems, can be ordered on request.



*Matrix plane with 50 mil core.*

## 2. RESISTORS

### LINEAR RESISTORS, FIXED AND VARIABLE

#### Carbon resistors

Resistors of the cracked-carbon film construction have superior figures for stability of resistance, noise level and temperature coefficient as compared with resistors of carbon-composition construction.

Two classes of carbon resistors are available:  
 1. *insulated types*, resistance tolerance 5%, 10% power rating at 70°C: 0.1, 0.125, 0.25, 0.5, 1, 2 W  
 2. *high stability types*, resistance tolerance 1% power rating at 70°C: 0.125, 0.25, 0.5, 1 W

#### Carbon resistors

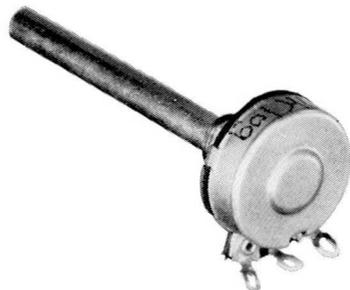
resistance range	tolerance %	power rating at 70°C W	type number
<i>insulated types</i>			
10 Ω—10 MΩ	± 5, ± 10	0.10	B8 305 00
3.3 Ω—220 kΩ	± 5, ± 10	0.125	B8 305 04
3.3 Ω—10 MΩ	± 5, ± 10	0.25	B8 305 05
10 Ω—22 MΩ	± 5, ± 10	0.50	B8 305 06
10 Ω—22 MΩ	± 5, ± 10	1	B8 305 07
10 Ω—10 MΩ	± 5, ± 10	2	B8 305 08
<i>high-stability types</i>			
10 Ω—0.62 MΩ	± 1	0.125	E00 3AB
10 Ω—1 MΩ	± 1	0.25	E00 3AC
10 Ω—1.6 MΩ	± 1	0.50	E00 3AD
10 Ω—1.6 MΩ	± 1	1	E00 3AG

#### Wire-wound resistors

##### Brown enamelled types

These light-weight, brown enamelled, wire-wound resistors have been designed with the main object of obtaining maximum reliability and great mechanical strength. As a consequence of their small dimensions, these resistors can be mounted in the wiring of the apparatus. The resistors are tropic proof.

Rating: 5.5, 8, 10, 16 W



Single carbon potentiometer.



Wire-wound potentiometer, 2 W.

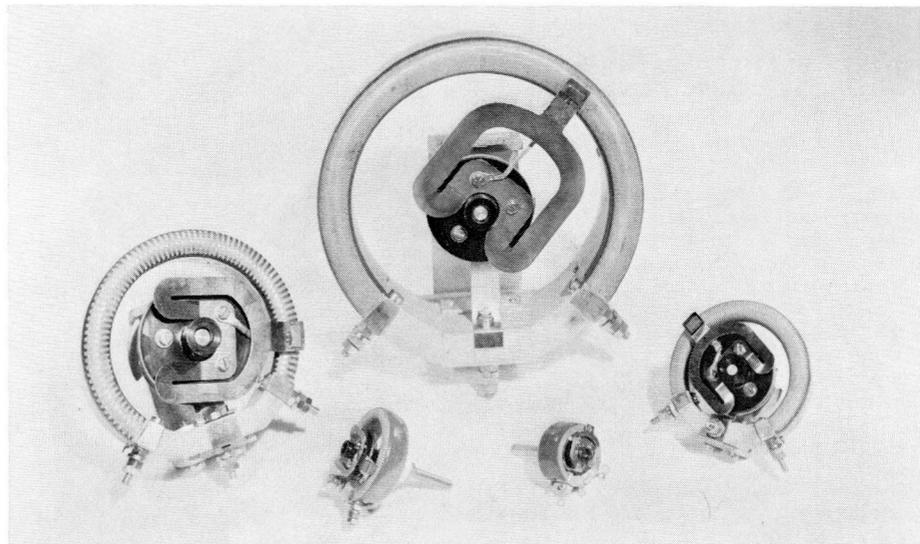
##### Adjustable and non adjustable types

Rating: 8—250 W

##### Cemented section types, made to customers specification

These space-saving load resistors consist of a resistor body on which two or more (maximum nine) wire resistor elements can be wound, either separately or interconnected. They can be used to advantage in electric and electronic apparatus in which more than one load resistor is applied, e.g. in t.v. sets. The resistors must be loaded at least with 60% of the nominal load to protect them against humidity influences.

Features: low price, simple mounting, space saving, high permissible loading, non-inflammable.



Wire-wound potentiometers, cemented types.

#### Single carbon potentiometers

These single carbon potentiometers without switch, outer diameter 23 mm, are particularly suitable for use in military and industrial equipment. The type fulfils MIL-R 94-A and CCTU-05-01 requirements.

On request other resistance values according to MIL-R-94A can also be supplied.

Permissible load:

linear potentiometer: 0.25

logarithmic potentiometer: 0.125

#### Wire-wound potentiometers

##### Cemented types

Rating: 25, 40, 100, 250, 630 W

##### Dust-free sealed type

The dust-free sealed potentiometer type is most suitable for professional electric and electronic equipment where accurate and gradual resistance regulation and high stability are required.

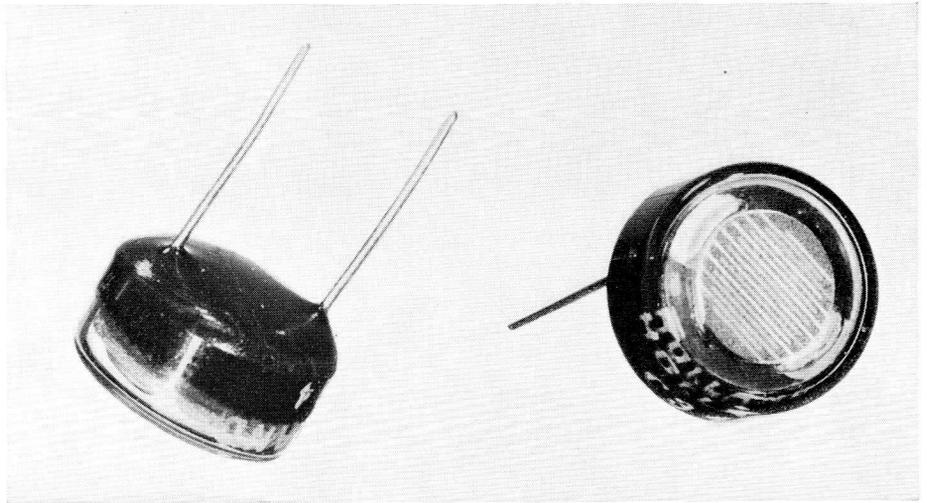
Rating: 2 W (70°C ambient temperature)

**NON-LINEAR RESISTORS**

Types: LDR, NTC, VDR, PTC

**LDR, Light-dependent resistors**

Light-dependent resistors, such as type LDR-03, type number B8 731 03, and type LDR-05, typenumber B8 731 05, are virtually small photoconductive cells, encapsulated in glass and special synthetic resin, and provided with two tinned copper connecting leads (0.6 mm  $\varnothing$   $\times$  15 mm). The type LDR-05 is small and light. The cell is sealed by means of a special plastic coating.



Light-dependent resistor, type LDR-03.

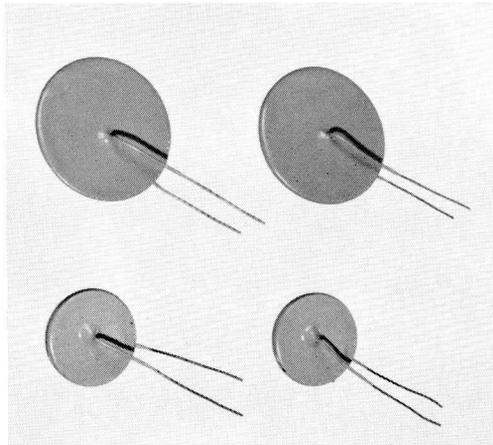
**NTC, Negative temperature coefficient resistors**

Our range of NTC resistors consists of the following types:  
 standard disc type,  
 standard rod type,  
 miniature type,  
 types for special applications.

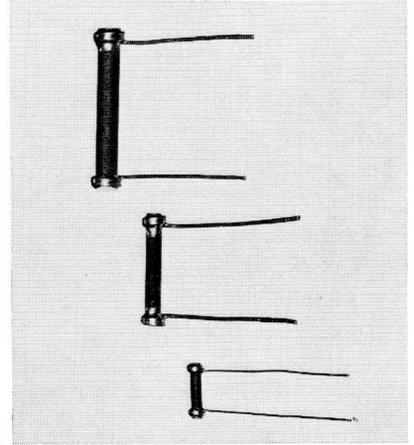
Choice of type:

When an NTC resistor is to be selected for a certain purpose, the following questions have to be considered:

1. Which form is best suited for the purpose? The normal types are tubular rods, discs or beads. Other shapes can be supplied if they can be manufactured by either method.
2. Which resistance value and which temperature coefficient is required? How great is the required change in resistance over a given temperature interval?
3. How high is the power to be dissipated:
  - a. without perceptible change in resistance value due to heating up,
  - b. with maximum change in resistance value?



Standard disc type.

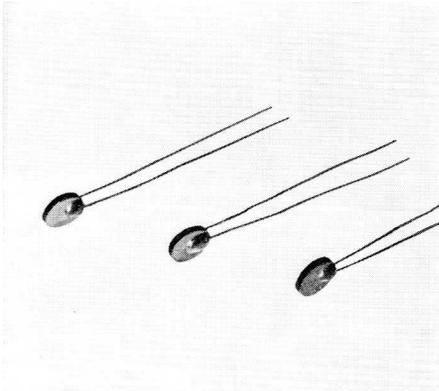


Standard rod types.

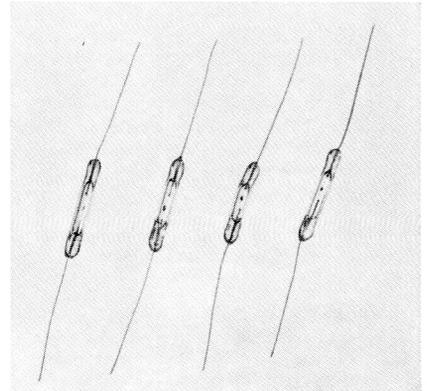
**VDR, voltage-dependent resistors**

The standard range of VDR resistors consists of the following types:  
 standard disc type,  
 standard rod type,  
 special small plate type.

All types are lacquered and colour-coded. Only some of the most important types are mentioned in this survey. Special types can be made on request. Tolerances: normal tolerance on voltage  $\pm$  20%. Voltage-dependent resistors with a tolerance of  $\pm$  10% can also be supplied.



Standard disc types.



Miniature types.

**P-series PTC, positive temperature coefficient resistors**

Four standard types are available, besides special adapted types for various applications (e.g. motor control, current limiters, compensation).

The dissipation constant of all types is approx. 10 mW/ $^{\circ}$ C

### 3. CAPACITORS

#### TUBULAR POLYESTER CAPACITORS

Small dimensions are among the star features of polyester capacitors. They are therefore extremely useful in modern electronic engineering, where low-volume by-pass and general-purpose capacitors are required for transistorized and other small-size equipment. Thanks to the low dielectric losses and the high insulation resistance (even under the most adverse climatic conditions), the superior quality and long service-life of these capacitors, they are widely used in radio and t.v. receivers, and also in industrial equipment. In conjunction with printed wiring, their employment leads to an appreciable simplification of print lay-out. The capacitors comply with the RCS tropical-exposure test H1.

#### MOULDED MIDGET MICA CAPACITORS

Thanks to their close tolerances, their high stability, low temperature coefficient and small h.f. losses, mica capacitors provide the very best capacitances available for tuned circuits where frequency stability must be maintained, also in humid surroundings.

The mica capacitors described here, which excel in superior all-round qualities and small dimensions, are especially recommended for communications equipment, measuring instruments, military devices, etc. They can be mounted in the wiring of the apparatus and, owing to their insulated body and their flat shape, be placed close together or against a metal plate.

The capacitors are in accordance with the J.A.N. specifications C5 (class D).

#### LONG-LIFE MIDGET ELECTROLYTIC CAPACITORS

It is a well-known fact that, even in the case of items of superior quality, the service life of common electrolytic capacitors is generally inferior to that of paper and ceramic capacitors. This range of long-life midget electrolytic capacitors is intended for those applications where long and trouble-free service is required.

Of course it is impossible to guarantee a certain life under specified conditions before the results of, say, 20 years will be available. Nevertheless, the capacitors in point have been developed for a life expectancy identical to that for high-class paper capacitors, and all life-test figures lead to believe that this aim has been amply achieved.

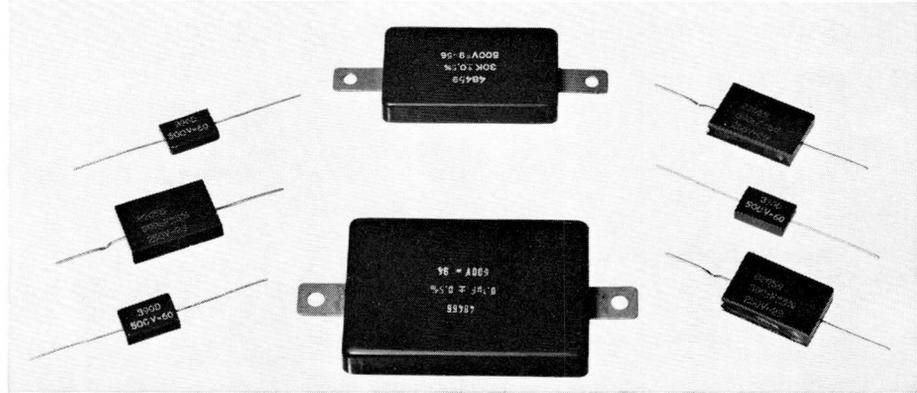
In addition to outstanding electrical performances (e.g. a remarkably low leakage current), long-life midget electrolytic capacitors have high resistance to vibration and impact and, as a consequence of the minimum permissible external pressure being 150 mm mercury, they can be used at high altitudes.

#### MOULDED PRECISION MICA CAPACITORS

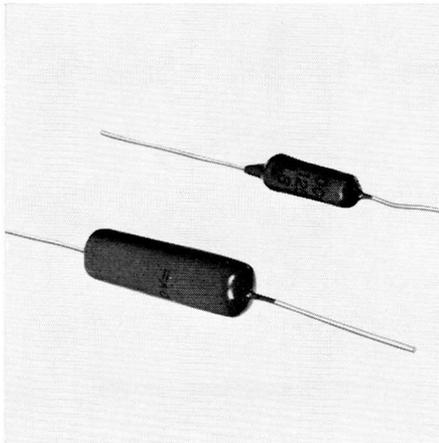
The moulded precision mica capacitors have been designed with the aim of obtaining the

optimum attainable as regards accuracy, consistency and low losses. Therefore, they are suitable for applications which impose the

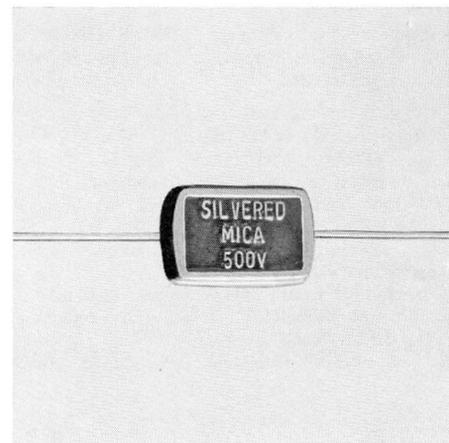
highest requirements in this respect, such as e.g. measuring, control and communications equipment.



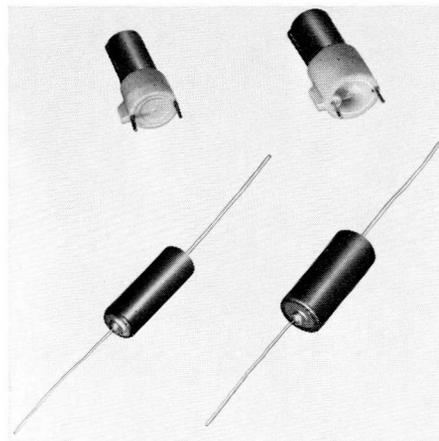
Moulded precision mica capacitors.



Tubular polyester capacitors.



Moulded midget mica capacitor.



Long-life midget electrolytic capacitors.

## TANTALUM CAPACITORS

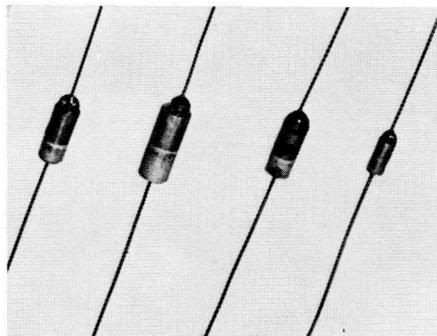
Minute dimensions are the star feature of these electrolytic capacitors for by-passing, coupling and smoothing purposes. Therefore, they are specifically suitable for transistorized and other miniaturized equipment where space considerations are at a premium, e.g. hearing aids and other small-size personal sets. The capacitors have a high resistance to vibrations and impact and, as a consequence of the minimum permissible external pressure being 150 mm mercury, they can be employed at high altitudes.

## TRIMMERS

### Tubular ceramic trimmers

The tubular ceramic trimmers of a simple but very sturdy and fully adequate design are distinguished by a low zero capacitance, accuracy of adjustment and high breakdown voltage. They are therefore suitable for professional apparatus wherever accurate adjustments have to be made with very small changes in capacitance, especially at very high frequencies.

On account of their small cross section and volume, tubular ceramic trimmers are a boon for applications where space considerations are at a premium.

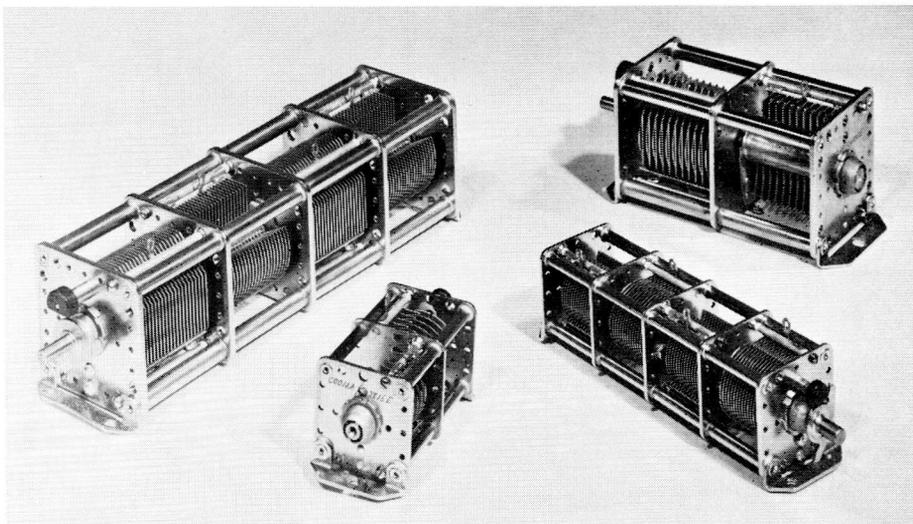


Tantalum capacitors.

### Concentric air-gap trimmers

The concentric air-gap trimmers, of rather unconventional but highly efficient design, have proven their adequacy during many years in very divergent fields of application. They are distinguished by a matchless stability, small dimensions and accuracy of adjustment. Thus, they are the obvious means for adjusting h.f. tuned circuits with very small changes in capacitance, wherever a high degree of constancy is required.

The types with the rotor non-conductively connected to the fixture are eminently appropriate for very high frequencies. The central mounting is very practical.

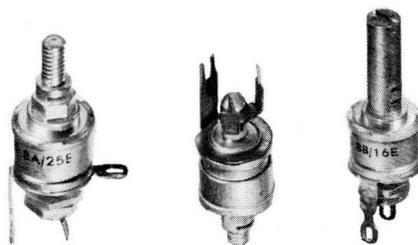


Tuning capacitors.

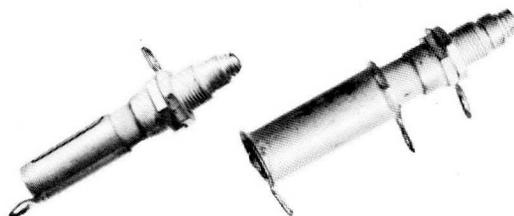
## TUNING CAPACITORS

The tuning capacitors are variable air capacitors, and are suitable for use in professional electronic equipment. They are applicable wherever high accuracy is demanded in regulating, e.g. tuning circuits, either single or multiple, and where a high degree of stability is essential. They are widely used in the most diverse kinds of telecommunications, radar and similar equipment ashore, at sea and in the air, in h.f. heating devices, electro-medical and measuring apparatus, electro-acoustical installations, etc.

Owing to their being built up entirely of standardized parts and as the packs are placed symmetrically with regard to the four sides, the capacitors are highly versatile and offer unusual facilities to the circuit engineer: non-listed combinations having, for instance, non-standard capacitances, extra compartments, thicker and/or longer spindle ends (protruding up to 50 mm from both faces) and different connections are easily feasible.



Concentric air-gap trimmers.

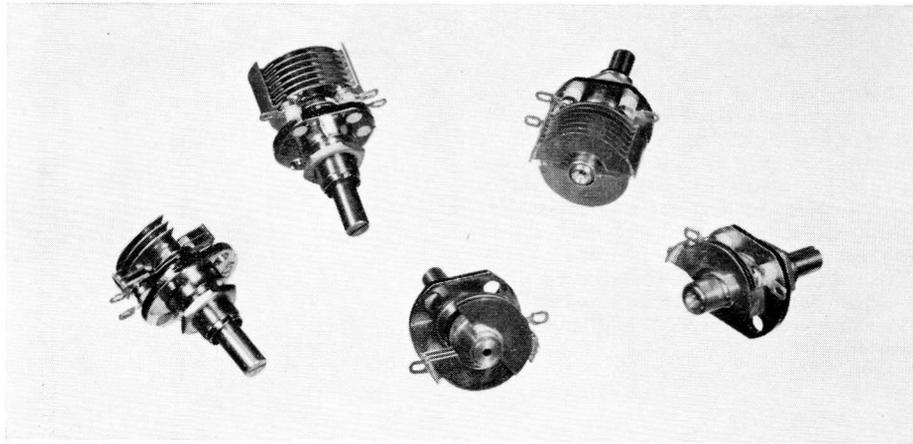


Tubular ceramic trimmers.

## CORRECTING CAPACITORS

The correcting capacitors are variable air-capacitors, they are suitable for professional electronic equipment, wherever accurate regulations have to be made with very small changes in capacitance as, for instance, in tuned circuits.

The capacitors are fully qualified for being frequently operated by means of a knob. The central mounting is very practical.



Correcting capacitors.

## PAPER CAPACITORS

### For a.c. voltages in all-metal can

This is the latest development stage of economical high-reliability long-life capacitors for low a.c. powers (40 — 60 c/s).

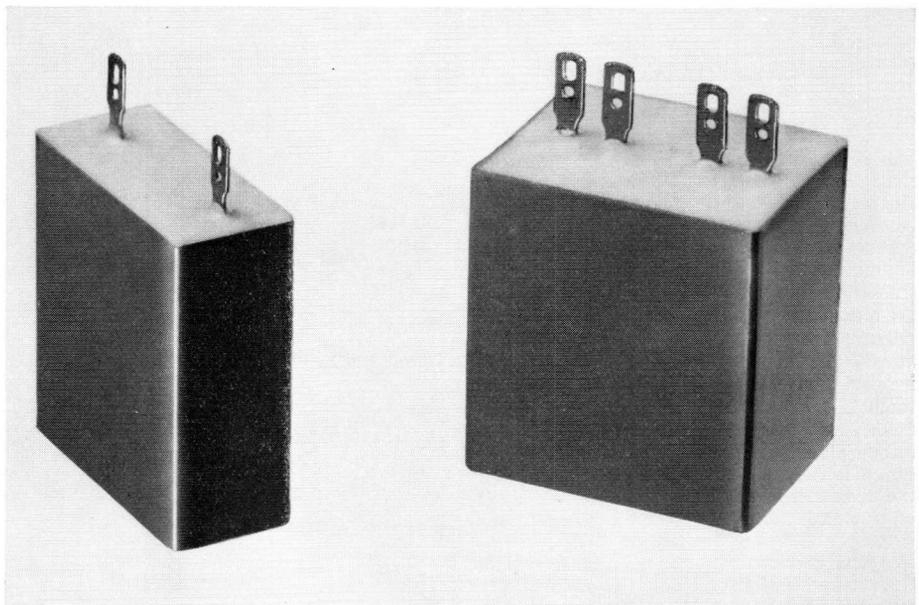
They have been specifically designed for ballasts of luminous discharge lamps and adapted to the current fluorescent-lighting fixtures. They are, furthermore, suitable for equipment on which the severest demands are made, and they have an extensive field of application, e.g. as starting capacitor for single-phase asynchronous motors and as power-factor capacitor for low power devices.



Paper capacitors for a.c. voltages in all-metal can.

### Can-type paper capacitors for telephony

These capacitors are specifically suitable for multiple assembly in the bays of standard European telephone exchanges, where they are utilized for general purposes. Pertinent applications are, for example, coupling and decoupling in repeaters, shunting relays for spark quenching, the use in RC systems for time switching and as blocking capacitor in telephones. They amply comply with the high standards of quality required in that domain. The capacitors combine the favourable cost-price of open capacitors with the durability of those in all-metal boxes; the excellent properties are preserved under the most adverse climatic conditions.



Can-type paper capacitors for telephony.

# 4. VARIABLE TRANSFORMERS

Variable transformers provide a relatively inexpensive means of regulating low-frequency alternating voltages. As compared with resistors, they have the paramount advantage of low energy losses, and an almost unlimited life; unlike tapped transformers, they permit accurate adjustment. They are extremely easy to operate and require a minimum of maintenance.

From the wealth of applications, two principal uses emerge:

- a. adjusting varying a.c. voltages to their nominal value,
- b. transforming a.c. supply voltages to a liberal value between 0 and 120 % of their actual value.

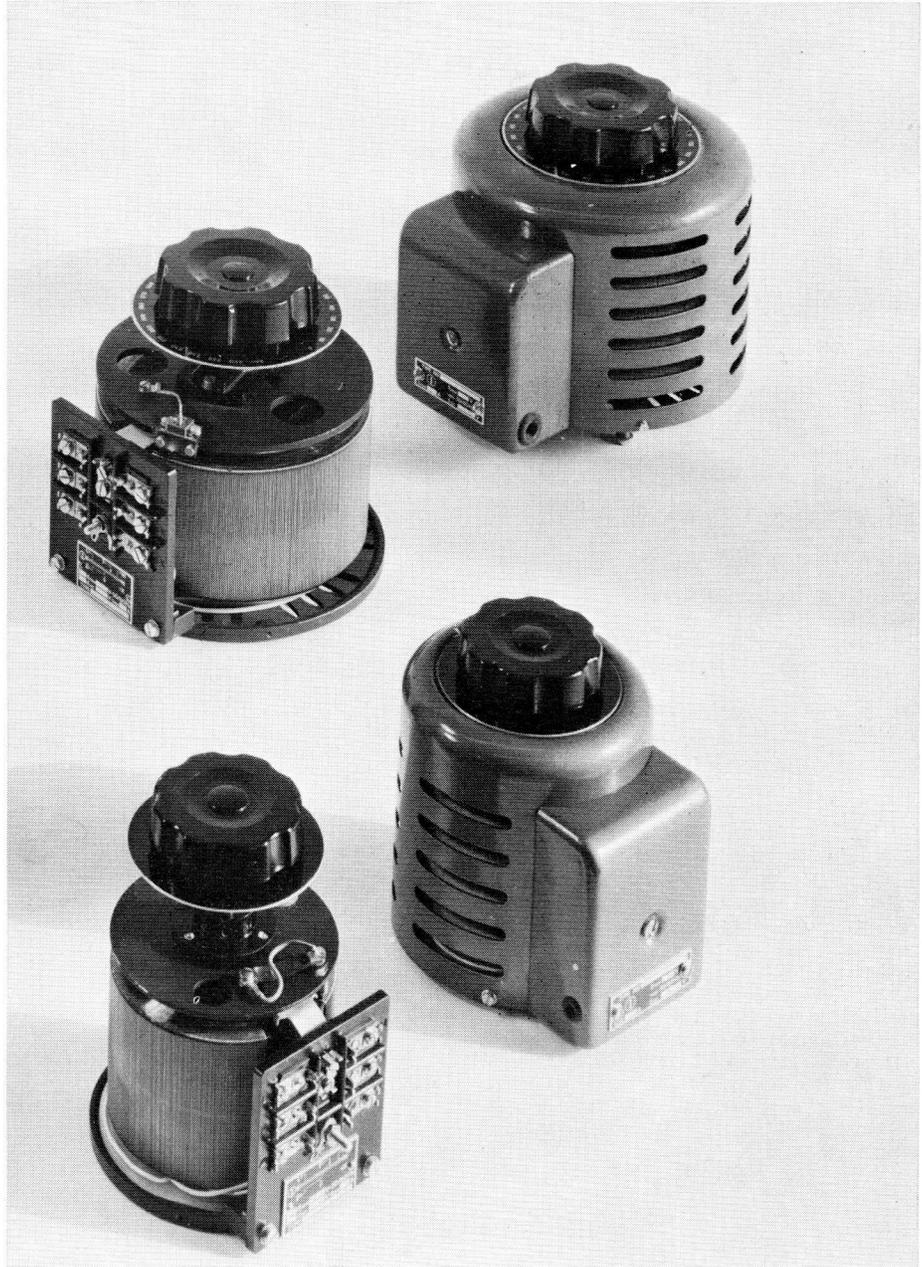
Innumerable variable transformers are employed either panelmounted or for bench use in factories, works and repair shops, laboratories, test stations, checking establishments, educational institutions, halls and studios, for electric and electronic equipment of most divergent kinds, etc. On account of their ability to accurately regulate a.c. voltages, variable transformers are, inter-alia, eminently suitable for controlling light intensities (e.g. of shopwindows and stage lighting, festive illuminations and sky-signs), temperatures (e.g. of electric heating and melting devices, inclusive of h.f. heating equipment) and (in combination with a rectifier) the speed of d.c. motors and galvanic processes. With the aid of coupling sets for ganging variable transformers combinations can be made of two or three panel-mounting transformers in order either to multiply the output tating or to regulate three-phase voltages.

## Miniature variable transformers

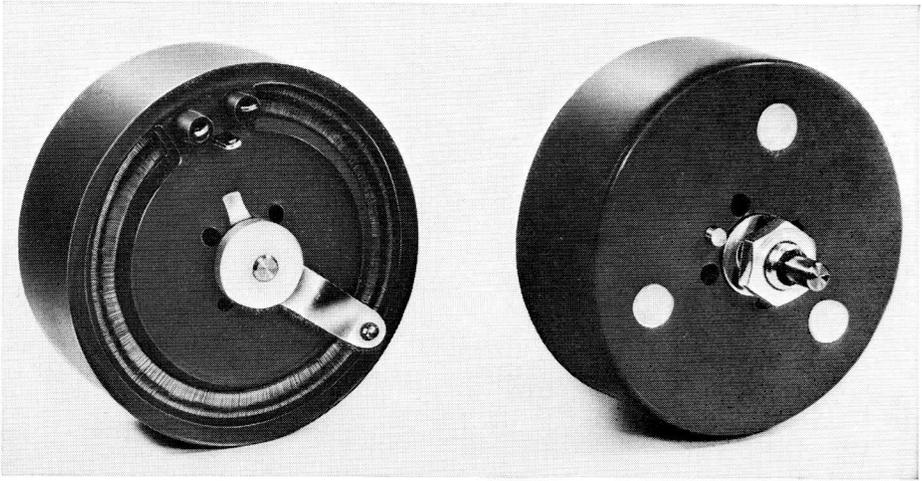
The range of miniature variable transformers has been developed to fill the need for a small and inexpensive voltage regulator. These transformers will find their main application in those cases, where up till now inefficient load potentiometers or adjustable series resistors are used. Besides, they can successfully replace tapped transformers in some types of inductive voltage control.

Fields of application are:

- Lighting continuous control of small incandescent lamps.
- Power speed control of small motors.
- Temperature control of small electric heating elements.
- Measurements voltage control in small power supplies and in measuring circuits.



Variable transformers.



Miniature variable transformer.

## 5. SMALL SYNCHRONOUS MOTORS

New constructions have been developed for small synchronous motors, and these have resulted in a range of eight basic types. The main advantages offered by these are enumerated below:

closed casing;

high torques in relation to the dimensions; six torques between 5 cmg and 375 cmg at spindle speed, or between 1250 cmg and 100 000 cmg at 1 rev/min;

slow running (250 rev/min), giving reduced wear and simpler gearboxes;

instant starting after switching on;

instant stopping after switching off;

self-lubricating bearings, requiring no maintenance;

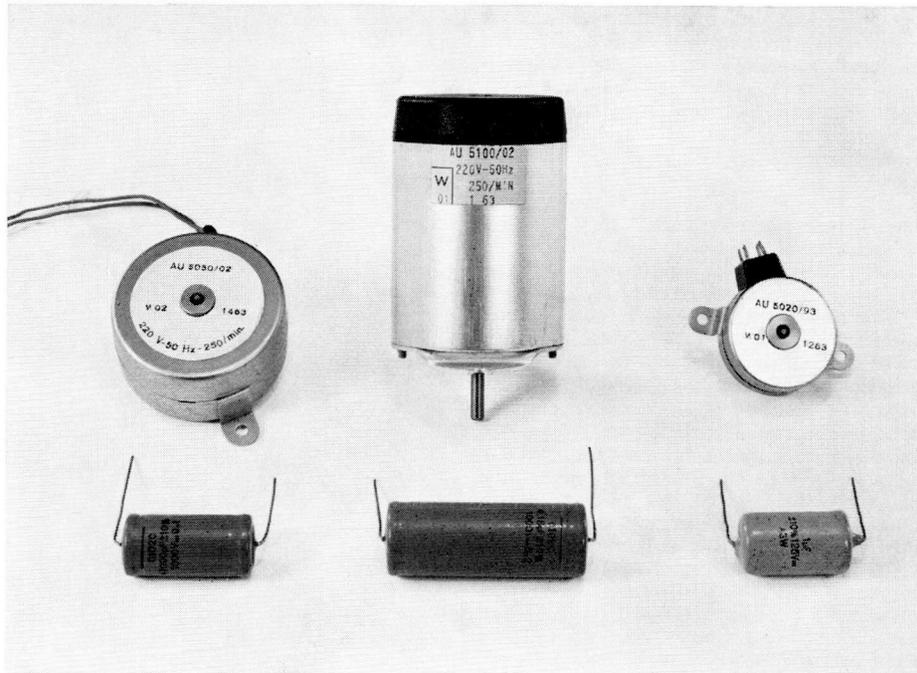
electrically determined direction of rotation with no mechanical ratchets;

special type available for high ambient temperature;

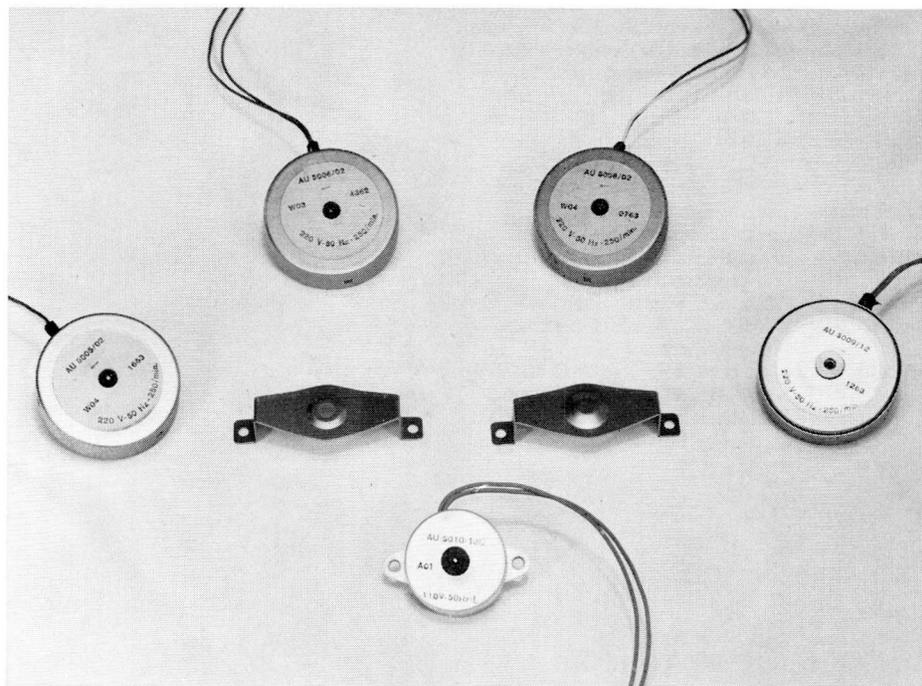
special type available for 30% undervoltage;

available for different voltages and frequencies.

In addition to these advantages, special gearboxes are available for industrial applications and domestic appliances. Sixty-three different gear ratios can be applied for quantities from 1 piece or more, and ten different possibilities for mass applications for quantities of thousands. Furthermore, specific versions are possible for very small and very big quantities. All the motors have a permanent magnetic ferroxdure rotor with 24 poles. The patented construction of the stator poles makes it possible to determine the direction of rotation electrically. Stray fields in all types, except in the AU5100, are low.

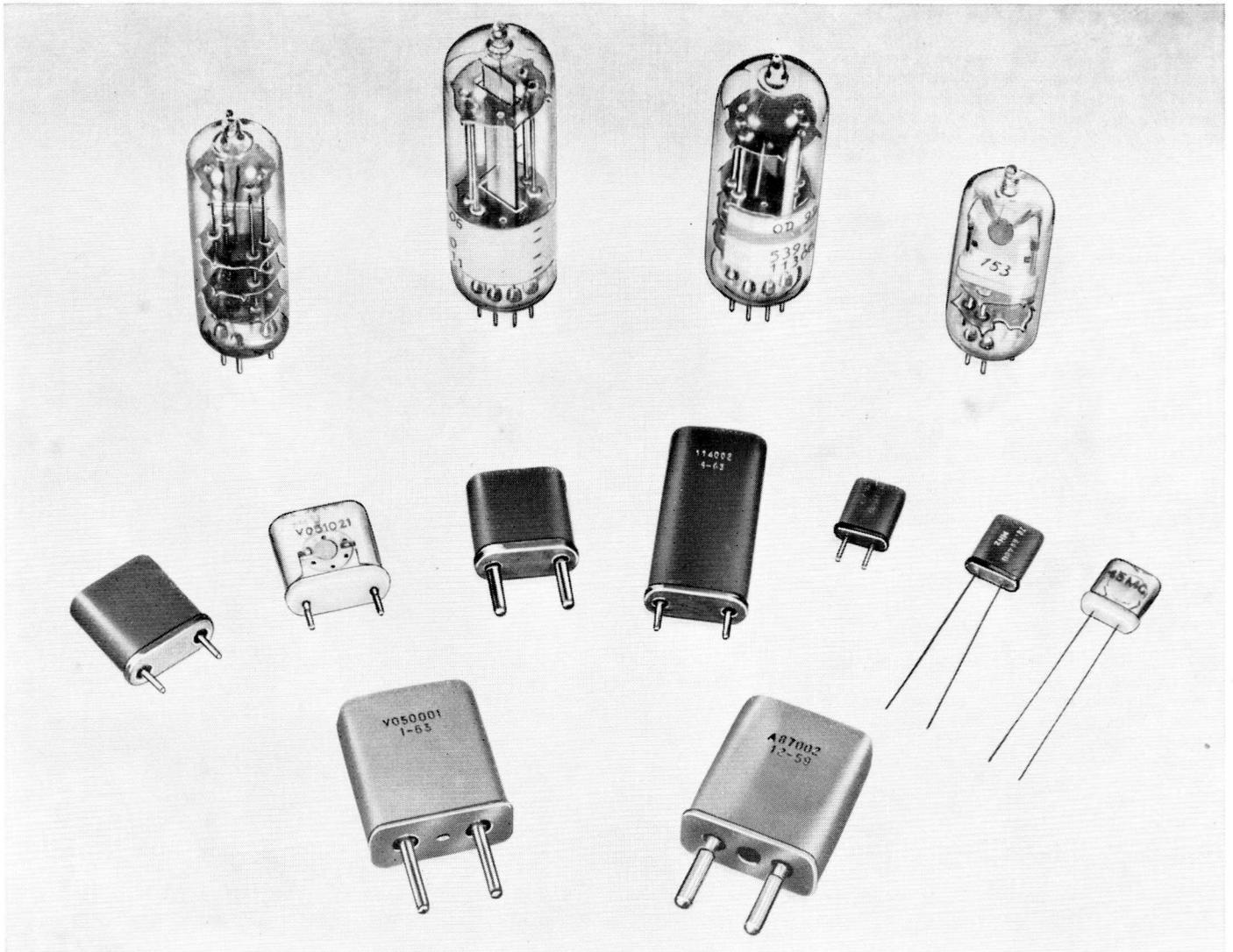


Electrically reversible synchronous motor. Types AU5020, AU5050, AU5100.



Synchronous motors with one direction of rotation. Types AU5005, AU5006, AU5008, AU5009, AU5010.

## 6. QUARTZ-CRYSTAL UNITS



Quartz-crystal units for frequency stabilization.

### Quartz-crystal units for frequency stabilization

The frequency generated by an oscillator can be stabilized by means of a quartz-crystal unit. This means that, in spite of substantial temperature variations, shocks or mechanical vibrations, the frequency will remain constant within narrow limits.

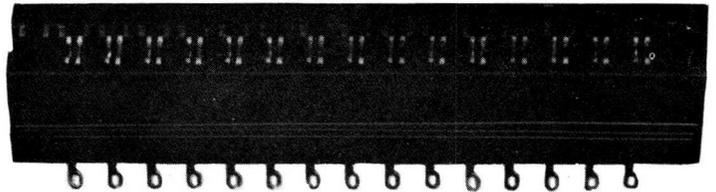
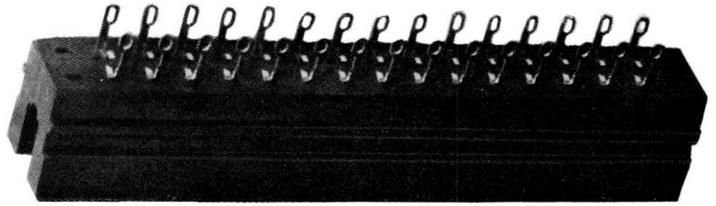
The dimensions given to the quartz plate are such that the frequency of mechanical resonance matches the frequency specified as perfectly as possible. The mechanical resonance may be a fundamental mode of vibration (fundamental crystals), or a third or a fifth overtone of this (third-overtone and fifth-overtone crystals).

## 7. COMPONENTS FOR MOUNTING AND CONTROL

### PRINTED-WIRING CONNECTORS

In modern electronic equipment such as monitoring and control equipment, computers and the like, standardized circuits on plug-in printed-wiring boards are freely used in order to economize the cost of assembling and servicing. The prints are linked up with the other parts of the equipment by means of printed-wiring connectors.

A printed-wiring connector must be a masterpiece of precision engineering because any failure of any contact may have grave consequences. The connectors series F045 have been designed so as to represent the optimum in reliability, sturdiness and versatility.



*Printed-wiring connectors.*

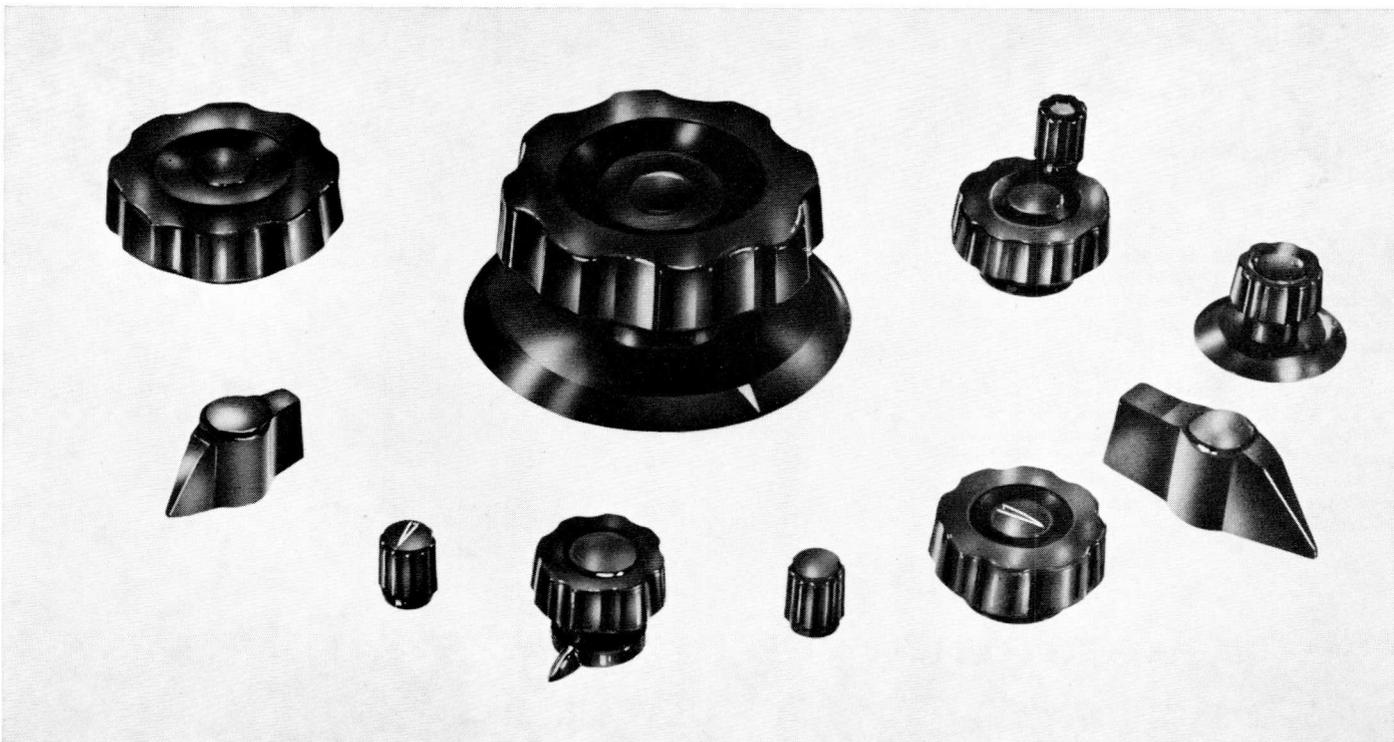
### CLAMPING-COLLET CONTROL KNOBS

The construction of the clamping-collet control knobs is simple but very efficient and rugged. They have been specially designed for professional equipment. Their star feature is the fact that they are fixed by means of a clamping collet. This method renders it superfluous to machine the shaft; it greatly facilitates the fixing and removal of the knobs, and ensures a permanently reliable attachment. It thus does away with the troubles often caused by locking screws and by knobs which work loose.

A great variety of knobs are available for various shaft diameters, so that they can be used in all cases where a practical and sturdy control knob with an everlasting attractive appearance is required.

The knobs are suitable for use under any climatic conditions.

*Clamping-collet control knobs.*



## 8. ELECTRON TUBES AND SEMICONDUCTORS

Available is an extensive range of high quality electron tubes and semiconductors destined for application in the entertainment field as well as in the professional and industrial section.

This catalogue contains a selection of preferred types only, but in case complete data and a survey of the total range of electron tubes and semiconductors are wanted, extensive information will be made available upon request.

### ELECTRON TUBES

#### Receiving tubes for a.m. and f.m. radio and audio

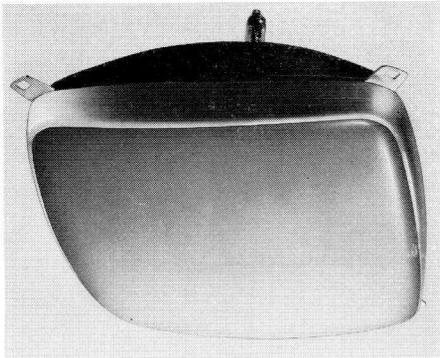
	f.m. tuner		a.m. mixer	i.f. ampl.		det./audio ampl.		a.f. ampl. phase inverter	audio output		rectifier		tuning/ level indicator
	r.f. ampl.	mixer		single	det./ i.f. ampl.	a.m./f.m.	a.m.		single	pre-ampl. and output	half wave	full wave	
diode												UY89	
double diode													EZ80 EZ81 GZ34
double/triple diode triode						EABC80 UABC80	EBC81 UBC81						
double triode	ECC85 UCC85	ECC85 UCC85						ECC82 ECC83					
pentode				EF89 UF89				EF86		EL84 UL84 EL86 EL503			
double diode pentode					EBF89 UBF89								
triode pentode										ECL86 UCL82			
triode heptode			ECH81 UCH81										
tuning indicator													EM87

#### Receiving tubes for t.v.

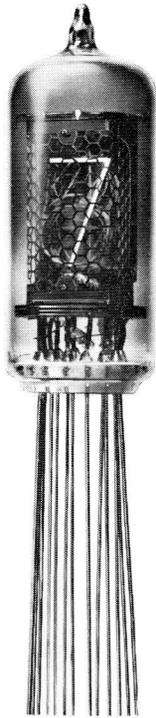
	tuner		i.f. ampl. and misc.	video output and misc.	sound output and ampl.	vert. output and osc.	horizont. output	booster	e.h.t. rect.	sync. sep.	horizont. osc.	pulse circuits
	u.h.f. ampl.	v.h.f. ampl.										
diode								PY81 EY88 PY88	DY51 DY87			
triode	EC88 PC88	EC900 PC900	EC86 PC86									ECC82
double triode		ECC189 PCC189										
pentode			EF183 EF184				EL81 PL81 EL500 PL500					
double pentode				EFL200 PFL200								
triode pentode			ECF801 PCF801	ECF200 PCF200 ECF201 PCF201	ECL86 PCL86	ECL85 PCL85					ECF802 PCF802	ECF80 PCF80
triode heptode										ECH200 PCH200		

T.V. picture tubes

screen cm	diameter in	monochrome
47	19	A47-11W
59	23	A59-11W



The Direct Vision picture tube with integral protection eliminates the need for a protective screen.



Numerical indicator tube ZM1080.

Small types for industrial and communication services

	critical applications	measuring equipment	switching and counting	indicating
diode		EA52 EA53 5642		
double diode	5726			
triode	5842 E88C	EC81 5718 5719 EC1000		
double triode	E80CC E90CC E180CC E182CC E188CC ECC2000 6201* 6189**	6021 6111 6112		
triode pentode	E80CF			
pentode	E80F E186F E810F 5654	5639 5840 5899		
power pentode	E55L E80L E130L	5902		
"gate tube"	5636 5725			
electrometer triode		4065 4069		
electrometer tetrode		4066		
electrometer pentode		4067 4068		
fluorescent indicator			DM160	
small thyratron	5643 5696 PL5727 PL2D21	5643 5696 PL5727 PL2D21	5643 5696 PL5727 PL2D21	
trigger tube	Z803U Z805U Z806W 5823	Z803U Z805U Z806W 5823	Z803U Z805U Z806W 5823	
subminiature trigger tubes and diodes	Z70U Z70W Z71U ZA1000 ZA1001 ZA1002	Z70U Z70W Z71U ZA1000 ZA1001 ZA1002	Z70U Z70W Z71U ZA1000 ZA1001 ZA1002	ZA1003 ZA1004
decimal counter/selector tube			ET51 E1T Z504S Z505S	E1T Z504S Z505S
numerical indicator tube				ZM1020 ZM1021 ZM1030 ZM1040 ZM1050 ZM1080
voltage stabilising and reference tube	OA2 OA2WA OB2 OB2WA 75C1 90C1 150B2 83A1 85A2 ZZ1000	OA2 OA2WA OB2 OB2WA 75C1 90C1 150B2 83A1 85A2 ZZ1000		

\* can also be supplied as 12AT7WA

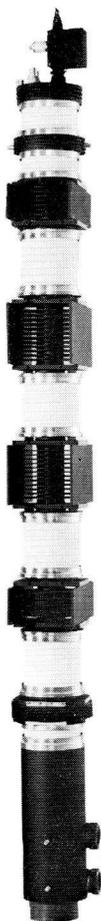
\*\* can also be supplied as 12AU7WA



Travelling wave tube 7537.

### C.R. instrument tubes

screen diameter		persistence of phosphor			
cm	in	short	medium	long	very long
3	1		DH3-91		
7	3	DB7-11 DB7-78	DH7-11 DG7-31 DG7-32 DH7-78	DN7-11 DN7-78	DP7-11 DP7-78
10	4	D10-12BE E10-12BE	D10-12GH E10-12GH	D10-12GP E10-12GP	D10-12GM E10-12GM
13	5	D13-15BE D13-16BE D13-17BE D13-19BE D13-21BE  D13-24BE D13-26BE	D13-15GH D13-16GH D13-17GH D13-19GH D13-21GH D13-23GH  D13-26GH D13-27GH	D13-15GP D13-16GP D13-17GP D13-19GP D13-21GP  D13-26GP	D13-15GM   D13-19GM D13-21GM



Klystron.

### Tubes for microwave and u.h.f. - t.v. equipment

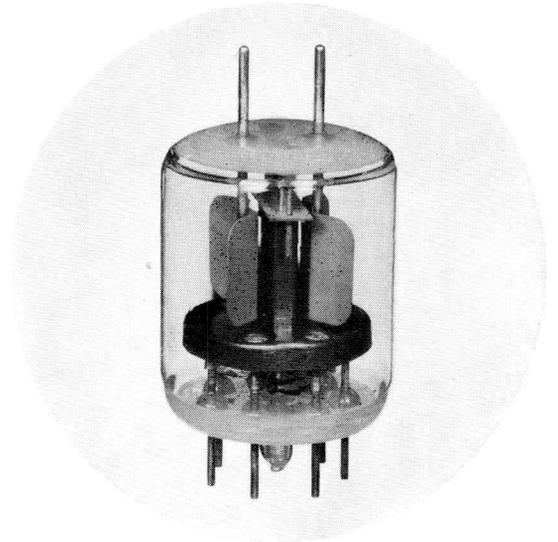
	radar	microwave and r.f. heating	links	measuring equipment	t.v. transmitters band IV, V
diode	K50A K51A 8020			EA52 EA53 K50A K51A	
disc-seal triode			EC157 EC158		
tetrode					QBL3.5/2000
magnetron	JP9-2.5D JP9-2.5E JP9-7D JP9-15 JP9-15B JP9-15D 2J42 2J51A 4J50 4J52A 5J26 6972 55029 55030 55031/01 55031/02 55032/01 55032/02 YJ1000 YJ1010 YJ1020	7090 7091 7292 55125 DX206			
klystron	2K25 6975 55335 KS9-20B KS9-20D KS9-40 KS9-40D			YK1010 55335	YK1001 YK1002
hydrogen thyatron	3C45 4C35A 5C22 5949	5949			
travelling- wave tube			7537 55340		
cathode- ray tube	F16-10LD F21-10LD F31-10LC MF41-10 ML41-10 ML53-10				

## T.V. studio tubes

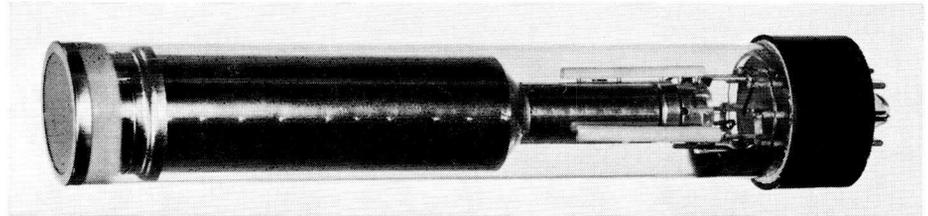
flying spot scanner		MC13-16 MK13-16
monitor tube		AW17-20 M21-11W M36-11W MW43-48
camera tubes	vidicon	55850
	plumbicon	55875 55876

## T.V. projection tubes

	screen diameter	
	6 cm (2½ in)	13 cm (5 in)
monochrome		MW13-38
blue	MU6-2	MU13-38
red	MY6-2	MY13-38
green	MG6-2	MG13-38



Quick-heating transmitting tube YL 1020



Plumbicon 55875 and 55876

## Transmitting tubes

triode			tetrode pentode		double tetrode		high voltage rectifier		
	communi- cations	r.f. heating		communi- cations		communi- cations	communi- cations	r.f. heating	
up to 2.5 kW	TB2.5/400 TB3/750 TBL2/500	TB2.5/400 TB3/750 TB4/1500 TB5/2500 TBL2/300 TBL2/400	up to 150 W	PE/100 QC05/35 QE05/40 QE05/40F QE05/40H QE05/40K YL1000 YL1100 YL1101 YL1102 YL1103 YL1150 YL1200	up to 100 W	QQC03/14 QQE02/5 QQE03/12 QQE03/20 QQE04/5 QQE06/40 YL1020 YL1060 YL1070 YL1071 YL1080 YL1130	mercury filled	DCG4/1000G DCG5/5000GB DCG5/5000GS DCG6/18 DCG7/100 DCG7/100B DCG9/20 DCG12/30 ZT1000	DCG4/1000G DCG5/5000GB DCG5/5000GS DCG6/18 DCG7/100 DCG7/100B DCG9/20 DCG12/30 ZT1000
2.5 kW—120 kW	TBL6/20 TBW6/20 TBL6/6000 TBW6/6000 TBL7/8000 TBW7/8000 TBL12/40 TBL12/100 TBW12/100 YD1140 YD1141	TBH6/14 TBL6/14 TBW6/14 TBL6/4000 TBH6/6000 TBH7/8000 TBL7/8000 TBW7/8000 TBH7/9000 TBL7/9000 TBW7/9000 TBL12/25 TBW12/25 TBL12/38 TBW12/38 TBL12/100 TBW12/100 YD1140 YD1141	150 W—5 kW	QB3/200 QB3/300 QB3.5/750 QB4/1100 QB5/1750 QB5/2000 QBL3.5/2000 QBL4/800 QBL5/3500 QBW5/3500 QE08/200 QE08/200H QEL2/200 QEL2/275 YL1110 YL1121 YL1230 YL1280	xenon filled	DCX4/1000 DCX4/5000	DCX4/1000 DCX4/5000		
120 kW	YD1010	YD1010							

## Industrial tubes

### thyratrons

5696	PL260	PL5632
PL2D21	PL1607	PL5684
PL3C23-A	PL5544	PL5727
PL105	PL5545	PL6574
PL106	PL5557	PL6755-A
PL255	PL5559	

### ignitrons

PL5551-A
PL5552-A
PL5553-B
PL5555
PL5822-A
ZX1000

## Photosensitive devices

### phototube

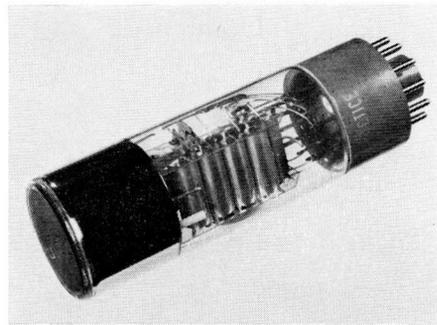
vacuum	92AV 90CV 150AV 150CV 150UV
gas filled	92AG 90CG 155UG

### photo conductive cell

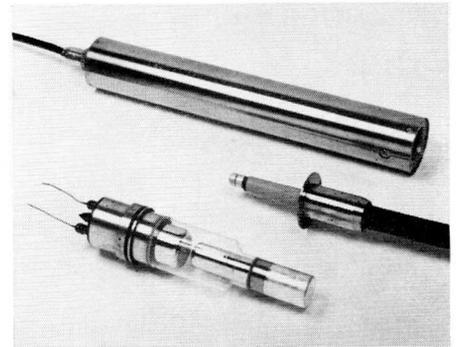
indium antimonide	ORP10	ORP13
lead sulphide	61SV	
cadmium sulphide	ORP11 ORP12 ORP50 ORP60 ORP61 ORP62 ORP63 ORP90	RPY13 RPY14 RPY17 RPY18 RPY19 RPY20 RPY27

## Photomultipliers

53AVP	XP1004
53UVP	XP1005
54AVP	XP1010
56AVP	XP1011
56CVP	XP1020
56TVP	XP1021
56UVP	XP1030
57AVP	XP1031
58AVP	XP1032
58UVP	XP1040
60AVP	XP1110
150AVP	XP1111
150CVP	XP1112
150UVP	XP1113
152AVP	XP1120
152UVP	XP1121
153AVP	XP1122
XP1000	XP1123
XP1001	XP1130
XP1002	XP1131
	XP1150



Photomultiplier XP1010



Neutron generator tube 18600

## Neutron generator tube

Type 18600

## Radiation counter tubes

	alfa beta gamma	alfa beta	beta gamma	beta	gamma	X-ray	cosmic ray	thermal neutrons
end-window counter	18505 18526	18515 18536	18504 18506	18516 18546		18507 18537 18538		
cylinder counter			18509 18529 18550 18552 18553		18503 18520 18522 18545			
proportional counter						18511		ZP1000 ZP1001 ZP1010 ZP1020
cosmic ray guard counter							18517 18518 18548	
liquid counter			18524 18525 ZP1080 ZP1081	18510	18508			

## SEMICONDUCTORS

### Transistors

U.H.F.

*Germanium*  
AF186

V.H.F.

*Germanium*  
AF102, AF178, AF180, AF186, AFZ12,  
ASZ21, ASZ23, AFY19

*Silicon*  
BSY38, BSY39

H.F.

*Germanium*  
AF114-117, AF121, AF124-127, AF179, AF181,  
AF185, AF118  
AU103  
ASZ20, AUY10

*Silicon*  
BSY10, BSY11, BFY10, BFY11, BF109

M.F.

*Germanium*  
ASY26-29, OC139-141, OC122, OC123,  
OC22 ...OC24

*Silicon*  
BDY10, BDY11

L.F.

*Germanium*  
OC57-60, AC172, AC125-128, AC130, AC132,  
AC127/132  
AC127/128, AD139, AD149  
ASY76, ASY77, ASY80, ASZ15-18, ADZ11,  
ADZ12, ADY26, 2N1100

*Silicon*  
BCZ10-14, BCY30-34, BCY10-12, BCY38-40  
BC107

### Signal diodes

*Germanium*  
OA70, OA79, OA90, AA119, AAY11, AAY21,  
AAZ12, AAZ13, AAZ17, AAZ18, OA47,  
OA92, AAZ15, OA81, OA85, OA91, OA95

*Silicon*  
BA102, BA109, BA114, BAY33, BAY38,  
BAY39, BA100, BAY32, OA200, OA202,  
BY118

### Zener diodes

*Silicon*  
BZY56-59, BZZ10-13, OAZ200-213,  
BZZ14-29, BZY74-76

### Rectifiers

*Silicon*  
BYX10, BYX11, BY114, BYY10, BY100,  
BYZ10-13, BYY24, BYY67, BYY22, BYY21,  
BYX13 series, BYX14 series, BYX15, BYY75,  
BYY15, BYY73, BYZ14

*Germanium*  
OA31

### Silicon controlled rectifiers

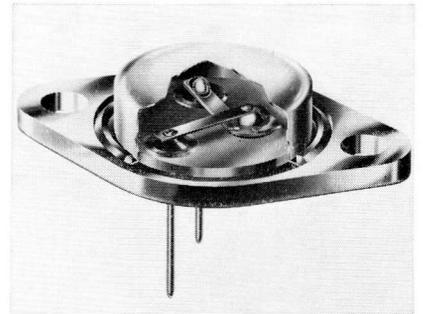
BTY79...81,	BTY84...86,	BTY87...400R,
BTY88...90,	BTY91/400R,	BTX12/100R,
BTX12/200R,	BTX12/300R,	BTX12/400R,
BTX13/100R,	BTX13/200R,	BTX13/300R,
BTX13/400R,	BTY95/100R,	BTY95/200R,
BTY95/300R,	BTY95/400R,	BTY99/100R,
BTY99/200R,	BTY99/300R,	BTY99/400R

### Photo transistor

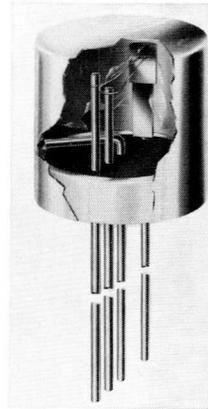
*Germanium*  
OCP70

### Photo diode

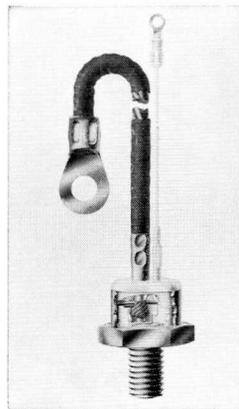
*Germanium*  
OAP12



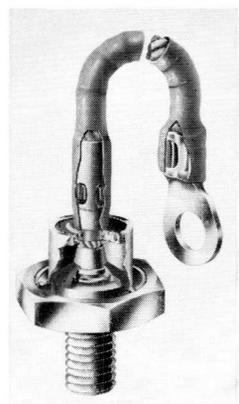
ASZ15-ASZ18 Ge-alloy p-n-p power transistor (in TO-3)



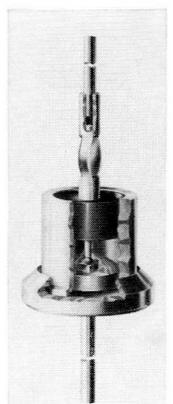
AF102 Ge alloy-diffused H.F. transistor.



BTX12/BTX13 Si diffused controlled rectifier.



BYZ family Si diffused power rectifier.



BY100 Si diffused rectifier.

## 9. PUBLIC ADDRESS EQUIPMENT

### MICROPHONES

The microphone makes the sound installation match the circumstances under which the sound is to be picked up. Therefore, a good choice is very important. Our range of microphones offers sufficient opportunity to choose the right microphone for each application.

#### Microphones

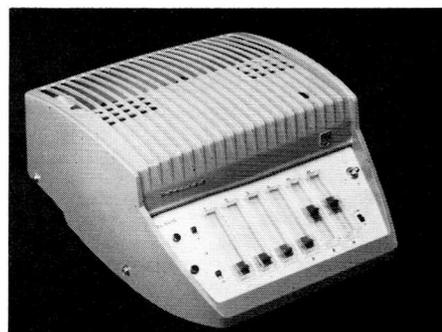
type	description	impedance $\Omega$	sensitivity mV/ $\mu$ bar	frequency range c/s + 3 dB
EL 6014	omni-directional moving-coil	500 25 000	0.2 1.4	so as to obtain a maximum intelligibility of speech
EL 6021		50 500 10 000	0.12 0.35 1.6	80 ... 15 000
EL 6022	cardioid, moving-coil	60	0.1	40 ... 16 000
EL 6031	hypercardioid, moving-coil	500 25 000	0.2 1.2	70 ... 15 000
EL 6032		50 200 500 10 000	0.07 0.14 0.2 0.9	40 ... 16 000
EL 6040	omni-directional, moving-coil	50 500 25 000	0.04 0.13 0.9	60 ... 20 000
EL 6041	cardioid, moving-coil	200	0.18	60 ... 17 000
EL 6061	noise-cancelling	500		200 ... 10 000
EL 6062	hypercardioid, moving-coil for custom-built mounting	500	0.21	150 ... 9 000
ET 1045	neck microphone	50 25 000	0.9 0.04	140 ... 9 000
EL 6121	omni-directional, moving-coil	50 10 000	0.12 1.6	80 ... 15 000
EL 6150	condenser microphone	50 200	1.3	40 ... 18 000



High-quality speech-microphone EL 6031.

### AMPLIFIERS

The amplifier is the heart of a sound installation. It pumps the required energy through the loudspeakers. A Philips amplifier, however, is even more than that. It is also a means of matching the sound to varying circumstances. Thus, for example, an SQ-amplifier has four inputs, each of which has a sound-volume potentiometer of its own. The signals simultaneously fed to more than one input can be mixed. Tone controls are provided for low- and high tones separately. Apart from the universal SQ-amplifiers, other types of special purpose amplifiers are available. The professional amplifiers are also available in a version for 19 in rack mounting.



35 W amplifier with four inputs which can be mixed. Each input has a volume potentiometer.

## Amplifiers

type	description	power W	frequencies c/s	distortion in % at 1000 c/s and rated power
EL 6401	two input channels	18	70 ... 11 000	10
EL 6405	SQ-amplifier, four input channels	20	40 ... 17 000	0.8
EL 6415 EL 6425 EL 6435 EL 6434	SQ-amplifiers with four input channels	35 70 140 280	30 ... 17 000	0.8*
EL 6602	transistor amplifier for 12 and 24 V d.c. supply	5	**	5
EL 6603	transistor amplifier for 6, 12 and 24 V d.c. supply	10	***	5
EL 6611	two inputs. Normal a.c. mains and 6 V d.c. supply	18	70 ... 11 000	10
EL 6621	two input channels, a.c. supply	10, 15	45 ... 15 000	
EL 6622	three input channels, a.c. and 24 V d.c.	20, 30	45 ... 15 000	
EL 6623	four input channels, a.c. supply	35, 50	45 ... 15 000	

\* at 80 % of rated power

\*\* giving optimum intelligibility of speech

\*\*\* giving a clear reproduction even in buses, trains and cars

## High-power amplifiers

High-power amplifiers differ from normal amplifiers not only by their larger output but also by the fact that they are capable of supplying this power continuously. On the other hand, they have a feature in common with standard-type amplifiers: the input signal need not necessarily be sinusoidal. Generally speaking, these amplifiers are used as a.c. energy sources with two specific and equally important aspects, one being the continuous supply of the required energy and the other the easy variability of frequency, voltage and shape of the output signal.

The shape and frequency of the output voltage supplied only depends on the signal source used at the input of the amplifier. These high-power amplifiers are applied in, e.g., the following fields:

As *energy source* for the supply of electro-dynamic vibration tables for testing materials and instruments (fatigue, reliability and accuracy tests). For this purpose, sinusoidal signals with fixed and variable frequencies as well as a particular signal shape recorded on tape and noise signals are applied (random noise).

As *power supply* in laboratories, research centres, factories, universities, etc.

Various specifications can be met, viz:

The frequency of the power supply may be different from, or equal to that of the normal mains, but stringent demands are made on the accuracy of the frequency (drive of synchronous motors, counting mechanisms, calibration of instruments for which stable frequencies are required, etc.).

The frequency of the power supply should be easy to vary (e.g. by turning the knob for the frequency of the signal source). This possi-

bility may be applied in processes which are motor-driven, but the speed of which should be adjustable. Other applications include the investigation of fluorescent effects, gas discharges, etc.

The voltage (waveform) should be very regular in shape and should approach a sine wave as closely as possible (a distortion of less than 2 % can be achieved).

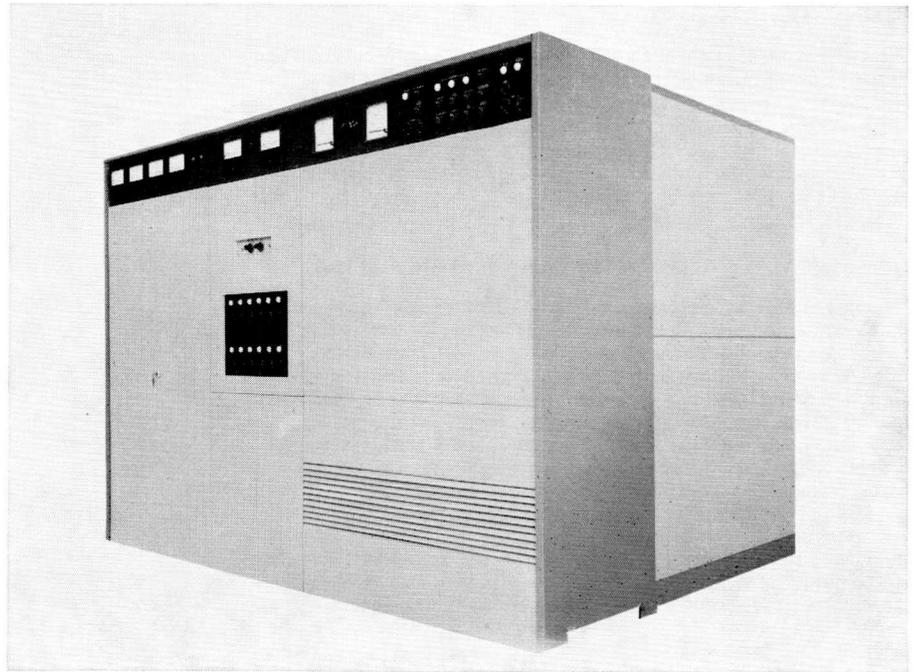
This specification applies, e.g., to the calibration of meters and the investigation as to the effect of a supply voltage distortion on the working and accuracy of an instrument.

The voltage should be not only very regular in shape but also very stable at varying loads (to be achieved by inserting a stabilizer), the frequency being either fixed or variable. This may be very important when calibrating meters, or when used as supply source for instruments which are not only sensitive to voltage variations but also to distortions of the supply voltage.

Applications for which abnormal voltages conform a very accurate sine wave are required (roughly between 10 and 2000 V and, if necessary, with variable frequencies, for example, from 5 c/s to 10 000 c/s or higher).

Combinations of the above specifications.

The above mentioned possibilities serve to give an idea of some of the known applications of high power amplifiers. It is, however, always feasible to meet special requirements for applications not mentioned above. Power amplifiers are available with powers from 250 W up to 200 kVA. More detailed information is given in our brochure "Philips High Power Amplifiers".



50 kVA high-power amplifier.

### Transistorized amplifier elements

For special applications amplifier installations can be assembled from a wide range of standard elements. Such elements, ranging from the simplest kinds of plugs, racks and panels to the largest power amplifiers, are supplied by us. As in various kinds of applications large numbers of similar amplifier elements are used, it is of importance

that they should be of small dimensions and easy to replace in case of damage or breakdown. For large installations in particular a series of all-transistor plug-in amplifier elements of modern design, fitted with printed wiring is available.

### LOUDSPEAKERS

type	description	power W	impedance $\Omega$	frequency range c/s
EL 7002	4 in	3	5	140 ... 15 000
EL 7003	7 in	2	5, 5000	110 ... 12 000
EL 7011	8 in	6	5, 425, 850, 1700	50 ... 15 000
EL 7015	7 in	6	5	70 ... 16 000
EL 7024	8 in	10	7	30 ... 18 000
EL 7023	8 in	10	5, 250, 490, 1000	45 ... 15 000
EL 7032	12 in twin-cone	20	7	35 ... 17 000
EL 7150	loudspeaker in walnut cabinet	2	3, 5000	
EL 7170	ceiling loudspeaker for flush mounting, $\phi$ 135 mm	3	5	95 ... 15 000
EL 7171	ceiling loudspeaker for flush mounting, $\phi$ 216 mm	6	5	60 ... 15 000
EL 6244	loudspeaker panel with volume control programme selector	3	3	
EL 7130	circophone for use with any 7 in or 8 in cone loudspeaker	10	100, 500	250 ... 15 000
EL 7160	metal outdoor sound column	10	100, 500	250 ... 15 000
EL 7162	sound column with six 5 in loudspeakers	8	500, 1000	150 ... 10 000
EL 7126	driver unit with flat polyester horn	5	16	400 ... 5 000
EL 7123	re-entrant horn, $\phi$ 42 cm, for driver EL 7052	10	16, 490, 1000	250 ... 9 000
EL 7125	re-entrant horn with driver EL 7052 for use on board ships	10	16, 490, 1000	250 ... 9 000
EL 7311	pair of headphones	0.001	$2 \times 400$	30 ... 20 000
EL 7312	combination of headphones and microphone	0.001	$2 \times 400$	30 ... 20 000
EL 6241	miniature loudspeaker with earshell	0.2	500, 5000	

## INDUCTIVE RECEIVER

The current flowing through a loop connected to the output of an amplifier produces an alternating magnetic field. When the receiver EL 7360/01 is brought into this field, the amplifier signal is induced in the receiver and, after amplification, is converted into sound in the earphone supplied with the receiver. Applications are found for: installations for persons hard of hearing, command installations, bilingual interpreting systems, guide systems for museums, exhibitions, etc.

## UNIVERSAL SYSTEM OF GROUP HEARING AIDS

For class tuition of children who are deaf or hard of hearing, the simplest method is to provide each child with a hearing aid. Then, however, the sound it hears is the weaker and will contain the more ambient sound the larger the distance between the teacher and the pupil is. To eliminate this drawback, use has been made of inductive sound transmitters with wireless receivers and of a wired system with earphones connected via a cable to an amplifier. A further step even, is the Philips universal system which is a combination of wireless and wired system, and which combines most of the advantages of both systems and eliminates its drawbacks. Its advantages are:

children with different degrees of deafness can be brought together in one class;  
there is no interference with wireless systems in adjacent rooms.

## SOUND-DELAY MACHINE

The sound-delay machine, type EL 6911/01 operates with a short endless loop of magnetic tape. When in operation, each point of the tape successively passes: a recording head, two groups of four play-back heads each and an erase head. A signal recorded can thus be played back at four different time intervals. For a given tape speed the delay times between the original signal and the individual repetitions depend on the distances between the recording head and the various adjustable play-back heads.

For reverberation purposes a special feedback circuit is provided enabling the whole pattern of repetitions to be repeated again for a variable number of times, and, hence, to obtain long reverberation times (up to 7 seconds).

The machine allows for connecting a microphone or any other sound signal source and will drive power amplifiers directly, if required. It is extremely versatile and flexible in operation. It may be used for:

correction of disturbing differences in travelling time of sound (e.g. on railway platforms);

adding artificial reverberation to a "dry" auditorium;

ambiophonics, the technique of the complete sound impression;

elimination of "dead spots" (e.g. in concert halls);

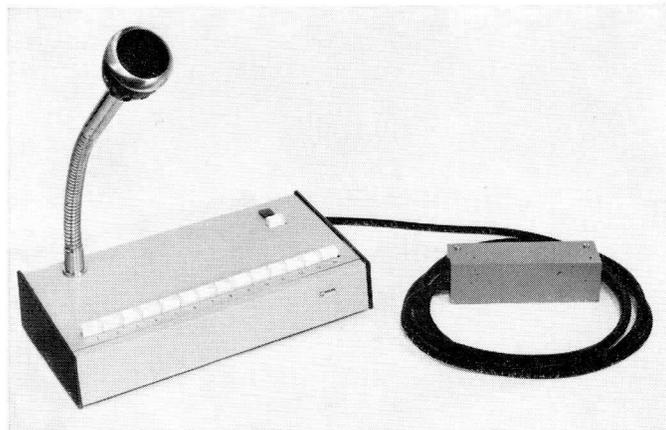
producing special sound effects (e.g. in studios and theatres);

research work in audiology and other fields.

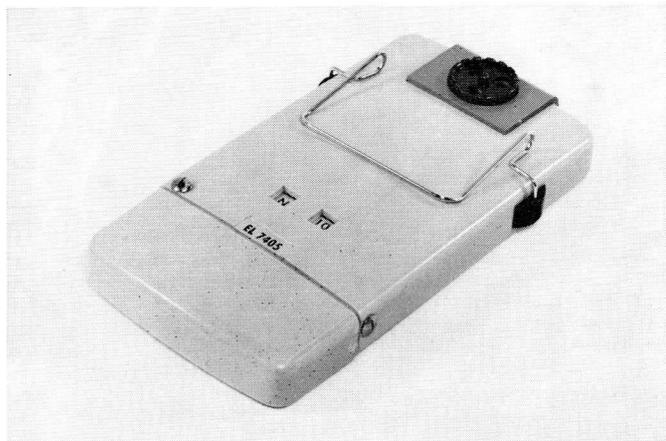
## PAGING SYSTEM

Our h.f. paging system offers an extraordinary simple method for finding up to 159 persons within a distance of 2.5 km from a central station, wherever they may be. The system comprises a transmitter and 159 small receivers. By means of the transmitter it is possible to establish radio contact with a person, who carries a receiver. When a call signal for a particular person has been transmitted, the relevant person will hear a whistle coming from his receiver. After the whistling a spoken message can be conveyed to him. He may, e.g., be told that he is wanted at the telephone, or has to go to some place.

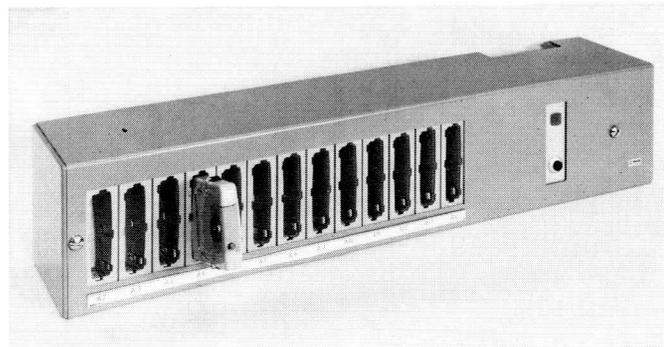
The transmitter is controlled by means of a control box. It is possible to have one transmitter controlled by up to 7 control boxes. At the private telephone exchange a control box may be needed; in the porter's lodge may be a second one, the managing director might want to have the third, etc.



Control box for h.f. paging system.



Miniature receiver for h.f. paging system.



Storing-rack in which the receivers are recharged, when not in use.

## INTERCOMMUNICATION SYSTEMS

Intercommunication systems offer instantaneous conversation facilities between any two points, or between a central point and a number of others.

They complement a telephone system, which gives less rapid facilities but covers a greater number of points.

Two systems are available:

1. Master station (type EL 7322) with 5, 10 or 20 remote stations (type EL 7324), or interconnected master stations;
2. Master station (type EL 7320) with a single remote station (type EL 7321).

Characteristics of these systems are: Convenient push-key operation. Simple installation with any 2-core cable. Power supplied for months by a set of torch batteries. Fully transistorized. Can be fed from a.c. mains if desired. Preset volume control.

### Industrial intercommunication system

Modern industry brought with it larger factory halls. In addition automation reduced the number of employees. Thus communication in the works often became a problem. For such cases the Industrial intercommunication system is the obvious solution. It combines in one system general call facilities (call signals with e.g. buzzers or spoken messages via loudspeakers) and individual conversations.

Noise-cancelling microphones prevent background-noise from drowning the conversations or the calls.

The installation is assembled from self-contained transistorized units of standardized dimensions. They are enclosed in sturdy, dripwater-tight, metal housings. The installation is easy to operate and can readily be installed by local contractors.

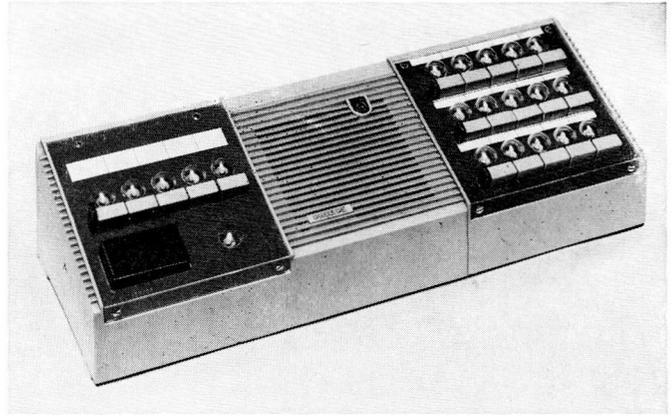
## SIMULTANEOUS INTERPRETING SYSTEMS

The use of the simultaneous interpreting systems enable the participants of a conference to hear speeches and discussions immediately, via headphones, in the language of their preference, as the interpreters translate the original speech simultaneously with the delivery of the original address.

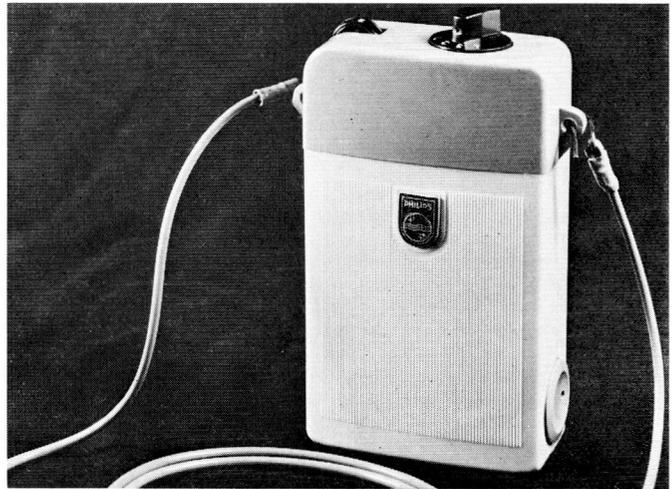
A number of microphones are usually installed in the conference hall; the operator sees that only the speech desired is switched on so that the interpreters are not disturbed by noise in the hall. The interpreters in their booths hear the original via the microphone which has been switched on, an amplifier and a headphone. To relay the translations to the participants either wiring is necessary to each chair or wireless transmitting equipment, for which each participant carries a receiver.

The number of languages, the number of participants and of microphones in the hall vary for each type of installation.

The Universal simultaneous interpreting system consists partly of standard articles e.g. microphones, headphones and amplifiers. Some other components e.g. the operator's control desk must be adapted to the requirements of the users and to the characteristics of the conference hall. Such components are assembled from a number of standardized units especially developed for this system.



Intercommunication master station, type EL 7322 for up to 20 remote stations.



Wireless receiver for simultaneous interpreting installations.

## 10. FUNCTIONAL MUSIC

Throughout history, music – vocal and instrumental – has played a dominant part in man's social and cultural development. Man has at all times translated his joy, his sorrow, his anger, and his triumphs into music. Music has been invaluable in war and peace, in religion and everyday activities, at work and at play. Wherever a particular mood has been vital, music has helped to produce it. Today, when nerves are too often strained by the speed of life and the pressures of living and working, music continues to make its own unique contribution to man's well-being.

In many industries, boredom and mental fatigue affect workers and, consequently, their output or standard of work. This is particularly so where repetition processes are involved. Often time drags, minds wander, and the employers become clock-watchers.

The use of music as a background to work has long been proving its worth in every kind of industry. Carefully selected and produced it can create the right atmosphere. Softly stimulating, "Music while you work" releases the mind from tension, alleviates fatigue and boredom, without inhibiting movement.

Research has shown that within the general framework of "Music while you work" there is a considerable scope for improvement, both in the music selected and in its timing. This research together with a deep understanding of moodchanges, an up-to-date knowledge of people's preferences in music, forms the basic for the functional music programme that suit today's needs.

It is the scientific, professional, and thoroughly objective approach that has led to Philips Functional Music becoming the leading development in its field, and to its rapid acceptance by management in many countries.

### Sound installations

Sound equipment for every kind of organization, from the smallest workshops and offices to the largest industrial complexes, from one-man shops to huge supermarkets is available. Since all installations will be working more or less continuously, they are ruggedly built for long-life dependability. Every part is made to precision standards, and all equipment is designed to operate with the maximum efficiency.

Naturally, too frequent repetition of any type of music can adversely influence the enjoyment a person derives from a programme. To overcome this difficulty, a regular programme service may be hired at a basic rental. This provides for an initial supply of six 2-hour programmes, of which three are changed every four weeks. Extra programmes can be supplied at a moderate charge.



Automatic functional music playback machine, type EL 6922.

## 11. TAPE RECORDING

### PROFESSIONAL RECORDING

The complete range of studio equipment comprises tape recorders with the addition of custom-built tape duplicators, turntables, mixing desks and a wide variety of microphones, loudspeakers and headphones.

The studio recorder programme consists of a high quality range, a heavy duty range, and a special range for transcription of records on 3 or 4 track,  $\frac{1}{2}$  in tape.

#### High quality range

The high quality range is available in two versions, viz. as a portable recorder, model Pro'20, and as a stationary recorder, model Pro'25, for console or rack mounting.

These recorders are used by broadcasting and t.v. companies and commercial stations, as well as for playback purposes by theatres, filmstudios, music production studios and music clubs.

The Pro'20 and Pro'25 recorders are of compact and uncomplicated construction, but make no concessions as far as high quality recording and reproduction and reliability are concerned.

Tape speeds: 19.05 and 38.10 cm/s ( $7\frac{1}{2}$  and 15 in/s)

Wow and flutter measured with EMT 418

at 15 in/s: 0.12 %; at  $7\frac{1}{2}$  in/s: 0.18 %

r.m.s. value measured with Gaumont Kalee

at 15 in/s: 0.07 %; at  $7\frac{1}{2}$  in/s: 0.10 %

Tape width: 6.35 mm ( $\frac{1}{4}$  in)

Max. reel diameter: 295 mm (11.6 in)

Frequency response

40 ... 15 000 c/s at 15 in/s:  $\pm 2$  dB

40 ... 12 000 c/s at  $7\frac{1}{2}$  in/s:  $\pm 2$  dB

Signal-to-noise ratio measured at

15 in/s, 30 ... 15 000 c/s and 200 mMx: better than 58 dB

measured according to DIN 45510: better than 63 dB

Mains voltages: 110, 125, 145, 200, 245 V,  $\pm 10$  %

Mains frequency: 50 or 60 c/s

#### Heavy duty range

The Pro'50 recorders of the heavy duty range are of attractive design, with extensive operational and editing facilities, including for example, the automatic tape-lifting device. This device makes it possible to lift the tape free from the recording head, reproducing head or erase head optionally or from all of them. These recorders meet

the most vigorous requirements of large broadcasting corporations and record manufacturers.

Tape speeds: 19.05 and 38.10 cm/s ( $7\frac{1}{2}$  and 15 in/s)

or 38.10 and 76.20 cm/s (15 and 30 in/s)

Wow and flutter measured with EMT

at 15 in/s: 0.10 %; at  $7\frac{1}{2}$  in/s: 0.15 %

measured with Gaumont Kalee type 1740

at 15 in/s: 0.055 %; at  $7\frac{1}{2}$  in/s: 0.075 %

Tape width: 6.25 mm ( $\frac{1}{4}$  in)

Max. reel diameter: 295 mm (11.6 in)

Frequency response

40 ... 15 000 c/s at 15 in/s:  $\pm 2$  dB

40 ... 12 000 c/s at  $7\frac{1}{2}$  in/s:  $\pm 2$  dB

Background noise measured at 15 in/s; 30 ... 15 000 c/s and 200 mMx:

better than 60 dB

measured according to DIN 45510: better than 66 dB

Mains voltages: 110 and 220 V,  $\pm 10$  %

Mains frequency: 50 or 60 c/s

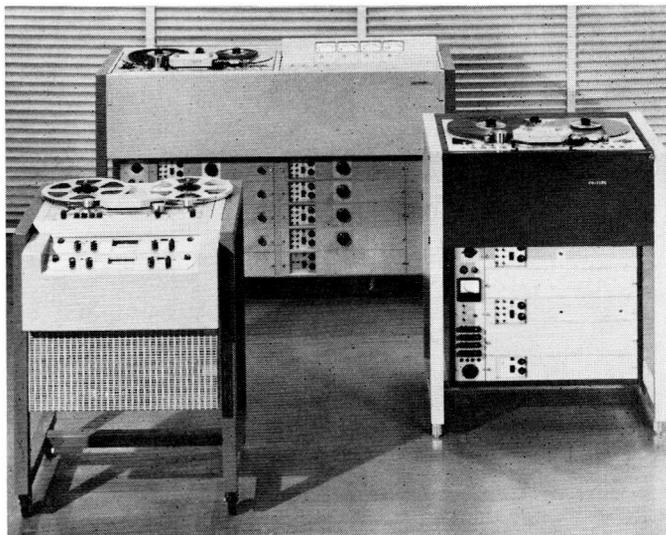
#### Special range

The special range consists of the model Pro'70 studio recorders for three or four track operation on  $\frac{1}{2}$  in tape. These recorders offer great flexibility and make for economy in the production of stereophonic and monophonic master recordings.

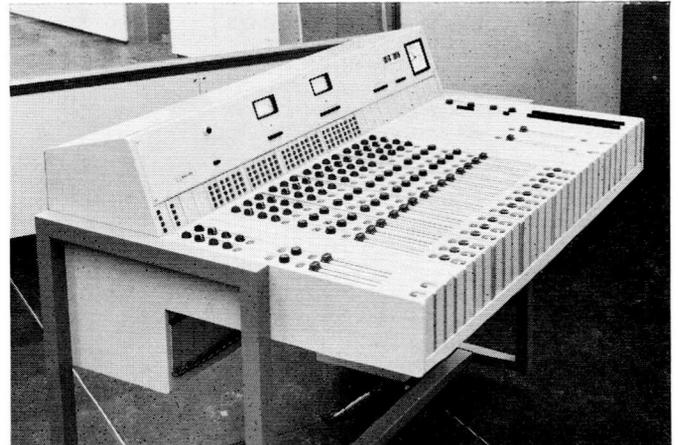
#### Transistorized audio mixing desks

The audio mixing desks are available in a high quality version and a heavy duty version. In the mixing desks of the heavy duty range the widest possible use is made of the modular design. The mixing desk is built up from a standard frame work and a number of microphone channel units, available in several versions: reverberation channels, group channels, monitoring channels, etc. All units are fully transistorized. Each channel unit is built up from a number of plug-in units. As a result maximum reliability is obtained, and each installation can be manufactured in complete accordance with customers' specifications. Besides complete desks for studio control rooms and recording vans, separate units can also be supplied, enabling customers to use them in their own systems.

The high quality range comprises a number of standard mixing desks. Each desk offers room for seven transistorized plug-in control panels. On special request twelve-channel models can be supplied too.



Studio tape recorders. In the foreground a Pro'25 recorder (left) and a Pro'50 recorder (right). At the rear a Pro'70 recorder is shown.



Fourteen-channel mixing desk of the heavy duty range.

## Studio turntables

A new studio transcription turntable based on a B.B.C. design and complying with the highest demands, completes the studio programme. Starting time: 0.5 s

Speeds:  $33\frac{1}{3}$ , 45 and 78 rev/min

Fine adjustment of speeds: approx. 1 rev/min at  $33\frac{1}{3}$  and 45 rev/min; approx. 2 rev/min at 78 rev/min

Wow: less than 0.2%; flutter: less than 0.05%; signal-to-noise ratio: -66 dB; pressure: adjustable

Mains voltages: 100, 110, 115, 125, 200, 220, 240 V; mains frequency: 50 or 60 c/s.

## Tape duplicator systems

Two tape duplicator systems can be supplied: System ETD for reproducing very large numbers of pre-recorded tapes.

Applications are found in the commercial and entertainment sector (functional music) as well as in the educational field (libraries for the blind).

System STD for the production of a limited number of copy tapes for use in studios and radio broadcasting (programming services).

The installations of both systems are fully transistorized and have plug-in amplifier units. The maximum speed during duplication is 8 times the normal playback speed. Mono, stereo and 4-track copies can be made, having playback speeds of  $15\frac{1}{2}$ ,  $3\frac{3}{4}$  or  $1\frac{7}{8}$  in/s.

## COMMUNICATIONS RECORDERS

The range of communications recorders comprises the multichannel communications recorders and the weather reports dissemination systems.

### Multichannel communications recorders

The multichannel communications recorders provide continuous recording (automatic logging) of spoken information, e.g. the recording of communication channels on airports, in communication centres, fire brigades, railroad centres and in industry. The low tape speed ( $\frac{15}{16}$  in/s) considerably reduces tape consumption and ensures very economic operation. The elaborate fault-detection and alarm system incorporated in these recorders, together with automatic change-over to stand-by units, ensure utmost reliability.

Three types of recorders can be supplied, fitted with two or three tape decks as required, and suitable for the recording of 7 channels on  $\frac{1}{4}$  in tape, 15 channels on  $\frac{1}{2}$  in tape or 31 channels on 1 in tape.

### Weather reports dissemination system

The weather reports dissemination system has been developed for automatic transmission of weather reports and forecasts from major airports and their "neighbouring" airfields. Three basic versions are available, incorporating 10, 6 or 2 repeaters. If required the installations can be fitted with a log recorder for filing all messages that have been transmitted. The systems comply with ICAO recommendations.

## Message repeater

The message repeater is a recorder for the continuous or intermittent repetition of spoken messages with a duration of a few seconds up to half an hour. By means of a simple external command the message on tape can be repeated as often as required without any delay. Any new information replacing an old message is recorded simply by speaking it onto the tape that contains the old message. The old information is then automatically erased. The message repeater is a self-supporting unit, to be considered as a building component for custom-built systems.

## DATA RECORDING

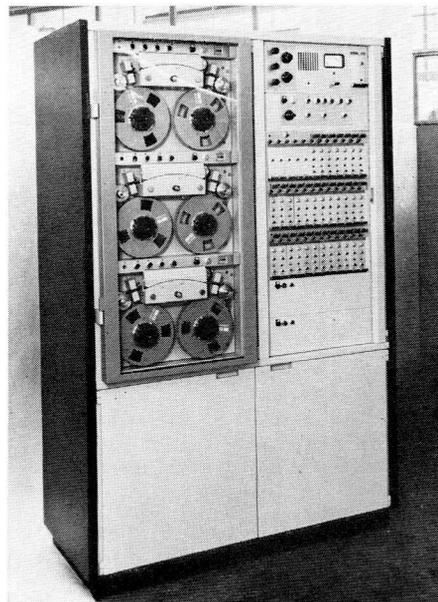
For simultaneous recording of several parameters an analogue instrumentation recorder has been developed. Apart from its use as a filing instrument for space flight data, the recorder can also be employed in medical examinations, telemetric projects, research laboratories and technical development centres. Recording possibilities: direct recording from 50 c/s to 300 kc/s, FM recording from 0 ... 20 kc/s

Tape speeds: 60, 30, 15,  $7\frac{1}{2}$ ,  $3\frac{3}{4}$ ,  $1\frac{7}{8}$  and  $\frac{15}{16}$  in/s

Tape width:  $\frac{1}{2}$  or 1 in

Number of channels: 7 or 14 (IRIG)

Wow and flutter: 0 ... 10 000 c/s: within 0.3 %



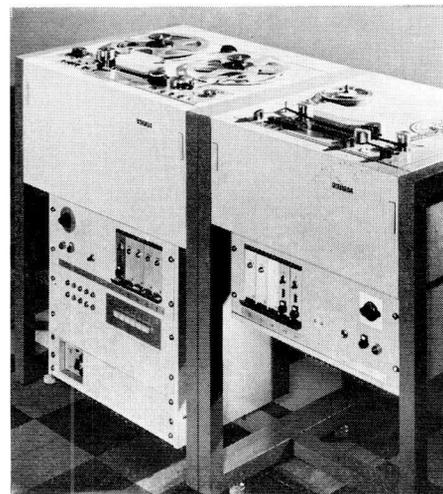
31-Channel communications recorder.

## GENERAL PURPOSE RECORDING

For the use in offices for the recording of conferences, in hotels and canteens, for educational purposes, and for domestic use the following types of recorders are available:

### Tape recorder EL 3551

System 4 tracks, max. playing time  $4 \times 90$  min, monophonic recording and playback, tape speed 9.5 cm/s, max reel diameter 15 cm ( $5\frac{3}{4}$  in), loudspeaker built-in 4 in diameter, inputs for microphone gramophone and radio, outputs for extension loudspeaker radio/amplifier, all transistor amplifier, power output 1.5 W, tropicalized.



Tape duplicator with one slave.

Frequency response:

80—13 000 c/s  $\pm 3$  dB

Mains voltages:

110, 127, 220, 245 V, 50 c/s; adaptable for 60 c/s

Dimensions:

35.5 cm  $\times$  28.5 cm  $\times$  15.6 cm  
(14 in  $\times$  11 in  $\times$  6 in)

### Tape recorder EL 3548

System 4 tracks, max. playing time  $4 \times 4$  h, monophonic recording and playback, two tape speeds 4.75 and 9.5 cm/s, max. reel diameter 18 cm (7 in), loudspeaker built-in 4 in  $\times$  6 in elliptical, inputs for microphone gramophone and radio, outputs for extension loudspeaker headphones radio set and stereo pre-amplifier, power output 2.2 W, tropicalized.

Frequency response:

60—10 000 c/s  $\pm 3$  dB at 4.75 cm/s,

60—15 000 c/s  $\pm 3$  dB at 9.5 cm/s

Mains voltages:

110, 220, 245 V, 50 c/s; adaptable for 60 c/s

Dimensions:

40 cm  $\times$  35 cm  $\times$  17 cm  
( $15\frac{3}{4}$  in  $\times$   $13\frac{3}{4}$  in  $\times$   $6\frac{3}{4}$  in)

### Tape recorder EL 3547

System 4 tracks, max. playing time  $4 \times 3$  h for monophonic recording, monophonic and stereophonic recording and playback, two tape speeds 4.75 and 9.5 cm/s, max. reel diameter 15 cm ( $5\frac{3}{4}$  in), 2 loudspeakers built in 4 in circular and 4 in  $\times$  6 in elliptical, inputs for microphone gramophone and radio, outputs for extension loudspeakers headphones and radio sets, all transistor amplifier, power output  $2 \times 1$  W, tropicalized.

Frequency response:

80—10,000 c/s  $\pm 3$  dB at 4.75 cm/s

80—15,000 c/s  $\pm 3$  dB at 9.5 cm/s

Mains voltages:

110, 117, 127, 220, 245 V, 50 and 60 c/s

Dimensions:

39 cm  $\times$  32.5 cm  $\times$  18 cm  
( $15\frac{3}{8}$  in  $\times$   $12\frac{7}{8}$  in  $\times$  7 in)

### Tape recorder EL 3549

System 4 tracks, max. playing time  $4 \times 8$  h, monophonic recording and playback, four tape speeds 2.4 4.75 9.5 19 cm/s, max. reel diameter 18 cm (7 in), loudspeaker built in

5 in × 7 in elliptical, inputs for microphone gramophone and radio, outputs for extension loudspeaker, headphones, radio set and stereo pre-amplifier, all transistor amplifier, power output 2.5 W, tropicalized.

Frequency response:

- 60—4 500 c/s ± 3B at 2.4 cm/s
- 60—10 000 c/s ± 3B at 4.75 cm/s
- 60—13 000 c/s ± 3B at 9.5 cm/s
- 60—16 000 c/s ± 3B at 19 cm/s

Mains voltages:

- 110, 127, 220, 245 V, 50 c/s; adaptable for 60 c/s

Dimensions:

- 42 cm × 39 cm × 21 cm
- (16½ in × 15½ in × 8¼ in)

### Tape recorder EL 3534

System 4 tracks, max. playing time 4 × 8 h, monophonic and stereophonic recording and playback, four tape speeds 2.4, 4.75, 9.5 and 19 cm/s, max. reel diameter 18 cm (7 in), 2 loudspeakers built in 7 in circular and 5 in × 7 in elliptical, inputs for microphone gramophone and radio, outputs for extension loudspeakers, headphones and radio sets, all transistor amplifier, power output 2 × 3 W, tropicalized. Frequency response:

- 60—4 500 c/s ± 3 dB at 2.4 cm/s
- 60—10 000 c/s ± 3 dB at 4.75 cm/s
- 60—16 000 c/s ± 3 dB at 9.5 and 19 cm/s

Mains voltages:

- 110, 127, 220, 245 V, 50 c/s; adaptable for 60 c/s

Dimensions:

- 47 cm × 38 cm × 21 cm
- (18½ in × 15 in × 8½ in)

## DICTIONATION RECORDING

### Dictation machines

The tropic-proof Dictation machine type EL 3582 with full remote control from the microphone for normal operation can be supplied with accessories, allowing to record conferences and phone conversations. The small cassettes take 2 × 20 min of dictation. Tape is automatically threaded.

Mains voltages:

- 110, 117, 127, 220, 245 V

Playing time: 2 × 20 min

Dimensions: 280 mm × 182 mm × 70 mm

### Portable dictation machine

The portable dictation machine, type EL 3583 weighs only 2 kg (4 lb 7 oz). It records in any position. The microphone is a noise-cancelling type for top recording clarity in high-noise areas and serves also as a playback speaker. It is equipped with a wide start-stop bar switch. Available accessories include adapters for use with 6 or 12 V car batteries and 110 V a.c. and a carrying case with shoulder strap. The same tape cassettes as used on the mains operated EL 3582. Automatic tape threading.

Battery:

- 6 C-cells, voltage 9 V, life 15—20 h

Dimensions:

- 200 mm × 170 mm × 65 mm
- (8 in × 6⅝ in × 2½ in)

Recording time:

- 2 × 20 min



Tape recorder, type EL 3547, for monophonic and stereophonic recording and playback.



Dictation machine EL 3582.



Portable dictation machine EL 3583.

## 12. EDUCATIONAL EQUIPMENT

### LANGUAGE LABORATORY

No teacher need be told of the growing importance of foreign language study. It is a well-known fact too that the spoken language is gaining predominance over the written one. At the same time new methods of teaching living languages are emerging. It may be said that the development of the tape recorder has been a major factor in this process as seen from the technical point of view. The professional linguist will give pride of place, however, to the great advantages made in undertaking the essence of languages. Anyhow, tape recorders have become a major item in modern language study.

It is good to realize that a tape recorder can never replace a teacher. Only in the hands of a competent teacher can it be an enormous useful implement. This principle is the basis of the three systems developed by Philips for teaching languages with tape recorders: the audio-passive (AP), the audio-active (AA) and the audio-active-comparative (AAC) system. With all three systems the pupils sit in cabins or booths with sound absorbing walls. All of them have headphones over which they listen to a tape recorder playing-track e.g. pronunciation exercises.

With the AP-system the teacher has a recorder to play-back a lesson for all students simultaneously.

With the AP-system the students have a microphone added to their headphones in which they repeat the exercises from the teacher's master recorder. The teacher can listen in to any of the students, he can communicate with them etc. via his own microphone and headphones. Moreover he has a test recorder in which to record a student's exercises. As a rule the teacher has several (up to six) master recorders and test recorders.

With the AAC system each student has a recorder of its own in addition to his headphones with microphones. This is a two-track recorder especially made by Philips for language laboratories. Now the student can play-back a lesson, recorded on track one and at the same time record his own exercise on track two-afterwards he can play-back both track one and two and compare his exercises with the original.

### ELECTRONICS TRAINERS

The training of electronics engineers and technicians is as important to the user as it is to the manufacturer of electronic equipment. As manufacturers, and recognizing that the rapidly advancing electronic applications call for large numbers of well trained engineers, Philips assists education by making available electronics training equipment that may be utilized at all levels of instruction, ranging from universities and technical colleges to trade schools and general science classes.

#### Master trainer

The Master trainer is installed in front of the class and is employed as aid in the teaching of electronic theories. By means of multi-circuit panels a great number of circuit configurations can be constructed. These are presented

schematically and are fully operative because the correct voltages are automatically applied. With the aid of commonly used instruments, such as multi-meters, generators and oscilloscopes, the teacher may augment his lectures by practical experiments, providing proof of theoretical derivations and phenomena, or by plotting curves or characteristics in front of the class.

#### Multi-circuit panels

The multi-circuit panels are available individually or in conveniently arranged groups. The total range of panels covers fundamental theories, valve- and transistor characteristics, low and high frequency amplification, valve and transistor a.m. and f.m. reception, passive networks, sinusoidal and non-sinusoidal oscillators, pulse shaping networks, transmitter techniques, television circuitry, basic logic, and so on.

The dark-green panels show in highly contrasting yellow lines the permanent "skeleton wiring" as found at the back. At carefully selected locations sockets are provided into which plug-in elements may be inserted. These carry components, such as capacitors, resistors, inductances, artificial loads, transistors, etc. The plug-in elements show, also in yellow lines, the symbol of the component they carry and large enough to be easily recognisable from the back of the class. The value of the particular component is indicated by dots, situated next to the symbol, and coloured according to the convention. A colour code system.

By means of a small number of multi-circuit panels a very large number of circuit configurations can thus be constructed.

#### Student trainers

In addition to the Master trainer, and allowing individual practical training of students, smaller sized Student trainers are available.

The student trainers, employing multi-circuit panels of the same lay-outs as the panels of the Master trainer, may also be adapted to any level of instruction. Two versions are available, namely, a ten-panel frame and a three-panel frame. In the ten-panel frame elaborate circuit arrangements may be built, such as complete receivers, amplifiers or pulse shaping circuits; the three-panel frames provide experience on smaller and more individual circuits.

The Student trainers are installed in practice classrooms and are operated by one or two students at the same time.

#### Publications

##### *Trainer manual*

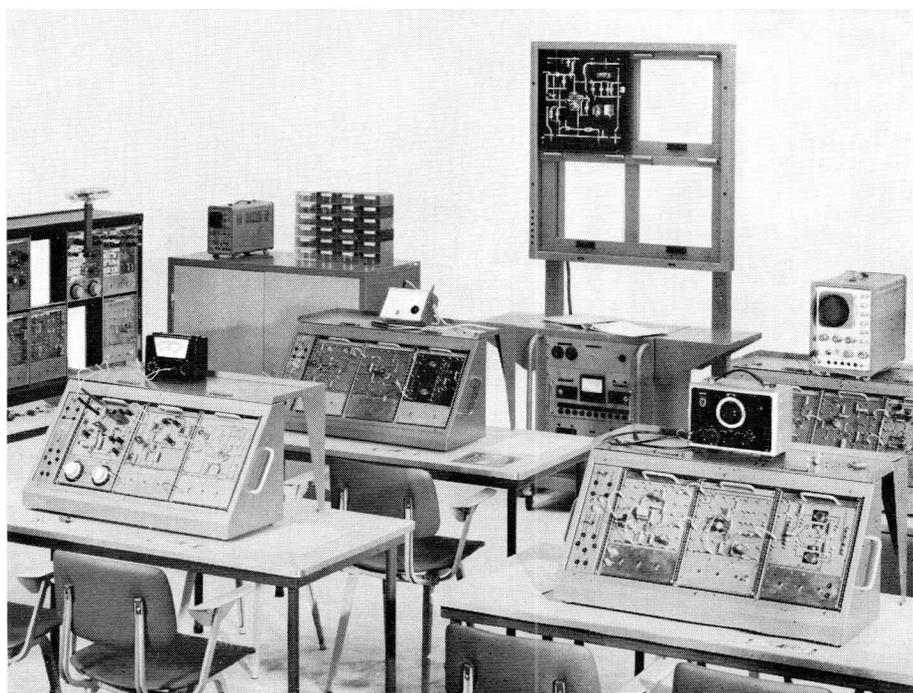
A loose-leaf binder accommodates theoretical treatises on the fundamentals of electronics, as covered by the multi-circuit panels. Every subject is followed by a series of detailed descriptions of experiments giving full instructional information to the lecturer, including the type of measuring apparatus to be used and the results to be expected.

##### *Selected circuits*

As it is practically not feasible to give theoretical descriptions on all circuit configurations that may be constructed, a large number has been presented in the four volumes of "Selected circuits". A list of the required components and suggestions for the measuring apparatus to be used in experimental work, accompany each circuit.

##### *Circuit blocks*

All basic skeleton circuits, as shown schematically in yellow lines on the facade of the multi-circuit panels and on the loose "Philite" templates of the panels for the Student trainers, have been reproduced in note blocks. These sheets are utilised for numerous purposes and are of great help to the teachers as well as to the students.



Electronics trainers, typical classroom lay-out.

## 13. FILM PROJECTION EQUIPMENT

### DP 70 70/35 mm projector

Winner of an Academy Award for outstanding technical achievement. Accommodates all 70 mm film processes such as Panavision 70, Ultra Panavision, Technirama 70, Camera 65, Dimensions 150, Cinerama single lens, Todd AO and the latest Panavision/Technicolor print-up. Converts to 35 mm in less than 4 minutes.

### FP 20 35 mm projector

Precision-built compact projector with efficient single blade shutter and simplified mechanical design.

Accommodates arc lamps. Water cooling available. Has built-in changeover; unified construction. Easy to install. 2000 ft or 6000 ft capacity magazines.

### FP 20S pulsed discharge lamp 35 mm projector

The first truly new 35 mm projector in 40 years. No shutter, no flicker, no carbons or exhaust system needed, simple and inexpensive to operate. Picture to 40 ft wide. Perfect for small and medium size theatres, screening rooms, studios, etc. Uses new SPP 800 and SPP 1000 pulsed discharge lamp, water cooled.

### FP 22S super pulsed discharge lamp 35 mm projector

Similar to FP 20S except uses two SPP pulsed discharge lamps in tandem. To be used in bigger theatres.

### FP 20G 35 mm projector

Similar construction and features as model FP 20 except that it is equipped with 1000 W incandescent projection lamps, forced draft cooled in dual mounting with either manual or optional automatic replacement of first lamp. 2000 ft or 6000 ft capacity magazines. Models for Tele-cine use.

### Pulsator

The pulsator provides the SPP projection lamp with pulsating direct current at rate of 72 pulses per second, or 3 pulses per frame, each with a duration of 2 milliseconds. Light is produced only during these current pulses. The unit may be installed in an adjoining room. The consumption of the lamp is adjustable by means of a control on the projector. A cross-over switch can be provided for emergency operation.

### EL 4465 pulsed discharge lamp house

Has same features and is similar to Pulse lamp house used on model FP 20S projector. Adaptable to many existing projectors thereby eliminating shutter, carbon arc lamp house, exhaust system, etc.

### 16 mm professional projectors

Our 16 mm sound-film projectors are designed and constructed with the same precision as our 70 and 35 mm mechanisms. Suitable for

optical and magnetic sound. Brilliant, steady picture. Easy operation, perfect reliability, quiet running. Supplied with two high fidelity, large baffle speakers.

#### Model EL 5001/15

Portable. Suitable for optical sound. Built-in 20 W amplifier.

#### Model EL 5001/19

Portable. Provided with optical and magnetic soundheads and with a pre-amplifier for both optical and magnetic tracks. Built-in power amplifier in speaker case.

#### Model EL 5060

For permanent installations in large auditoriums. Accommodates both optical and magnetic sound. Can be used with arc and SPP lamps.

### Sound systems

#### Single channel

Compact single channel output models with dual inputs, using both transistors and vacuum tubes. Built-in exciter supply accommodates many Philips types of projectors. Installation is simple, efficient.

#### Multi-channel

The most flexible all transistorized sound system. High level noiseless switching, multi-input, plug-in circuitry. Models for 6 — 4 — 1 — 4 — 1 and single channel sound. Compact wall mounted cabinets. No floor space required. High output capacity. Built-in switching and exciter lamp power supplies.

### 8710 portable 35 mm projector

All the outstanding qualities of 35 mm theatre equipment plus ease of portability. Weighs only 67 lb. Compact, simple, rugged, easy to assemble. Available with sturdy carrying case and with 2000 ft or 6000 ft capacity magazines.

### Closed circuit t.v. and tele-cine

The projectors of the FP 20S, FP 20G and 16 mm types can be supplied for Tele-cine application. The EL 8000 or EL 8010 H-Q cameras are compact and transistorized for adaptation to projectors. Display can be via a regular t.v. receiver or special monitors. FP 20S and FP 20 adaptations can be arranged for projection on a large screen and simultaneous display on a t.v. tube.

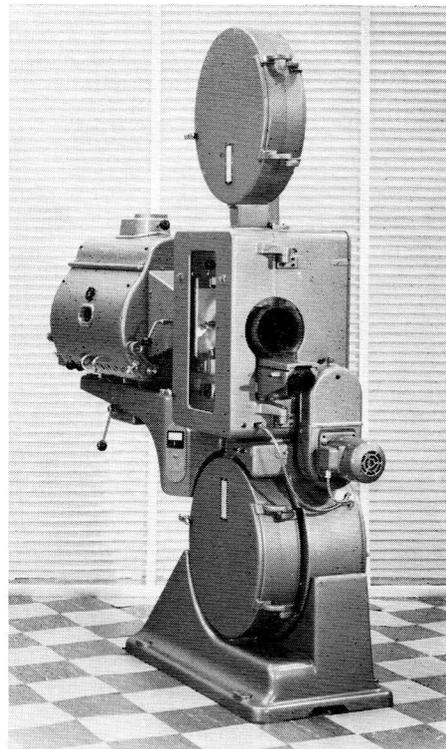
### Lenses

BF lenses for 70 mm projection. Most widely used in the world. 4 in diameter, focal lengths from 2.14 to 6.9 in. Afocal attachments available to provide stepless range of focal lengths for tailoring picture size to screen without cropping.

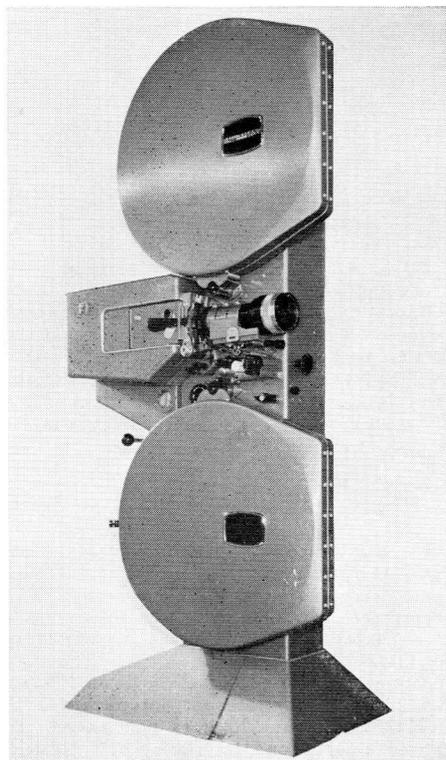
SP and SK lenses for 35 mm projection. Super fast f 1.6 lenses in focal lengths from 1.8 to 4.15 in, f 1.7 in EF 4.35 and 4.55 in, and f 1.8 in EF 4.75 in, f 2 in longer lengths.

Kiptar Anamorphic for CinemaScope projection. This anamorphic lens is of the preferred spherical construction. Focuses for distances down to 17 ft.

High speed f 1.5 lens for 16 mm projection in focal lengths of 1.4, 2, 2.5, 3, 3.55 and 3.95 in.



DP 70 projector.



FP 22S projector with two SPP 1000 lamps.

## 14. PROFESSIONAL TELEVISION

### CLOSED CIRCUIT EQUIPMENT

#### Compact t.v. camera

This Vidicon television camera is a self-contained camera that requires no more than a standard television receiver to provide a simple but complete closed circuit t.v. chain. Operation is very simple, even for non-experts.

System: 625 lines per picture random interlaced, 50 c/s, or 525 lines per picture random interlaced, 60 c/s.

Mains voltages: 110, 117, 125, 145, 220, 245 V a.c.

Power consumption: 13.5 W

Resolution (RTMA test slide): 7 Mc/s (550 lines)

Dimensions (length × width × depth):  
330 mm × 175 mm × 100 mm  
(13 in × 7 in × 4 in)



Compact television camera.

#### Vidicon t.v. camera with separate cylindrical head

This camera is a derived version of the Compact camera, designed especially for those applications where operating t.v. personnel or even the equipment itself would obstruct the action to be observed. Its main applications will be found in hospitals and laboratories, for televising surgical or dental operations or fine laboratory work. For technical data see under Compact camera.

#### H-Q t.v. camera chain

The H-Q Vidicon television camera, together with the Camera control unit and the Synchronising pulse generator, constitute a transistorised camera chain, particularly suited for applications requiring a high picture quality.

System: CCIR Standard: 625 lines per picture, 25 pictures per second, interlacing 2:1; RTMA Standard: 525 lines per picture, 30 pictures per second, interlacing 2:1

Mains voltages: 110, 117, 220 or 234 V ± 10% a.c., 50 or 60 c/s

Power consumption: 25 W

Definition (centre of picture)

without aperture correction:

35% modulation depth at 5 Mc/s

with aperture correction:

100% modulation depth at 5 Mc/s

Dimensions (height × width × depth)

Camera: 104 mm × 175 mm × 315 mm

(4<sup>1</sup>/<sub>8</sub> in × 6<sup>7</sup>/<sub>8</sub> in × 12<sup>3</sup>/<sub>8</sub> in)

Camera control unit:

92 mm × 175 mm × 325 mm

(3<sup>3</sup>/<sub>8</sub> in × 6<sup>7</sup>/<sub>8</sub> in × 12<sup>3</sup>/<sub>8</sub> in)

#### Synchronising pulse generator

The Synchronising pulse generator meets all the requirements specified in the CCIR Standard or RTMA Standard for this kind of equipment. It is suitable for use in studios and in closed circuit systems as well as in mobile equipment.

System: CCIR Standard: 625 lines per picture, 25 pictures per second, interlacing 2:1; RTMA Standard: 525 lines per picture, 30 pictures per second, interlacing 2:1

Horizontal frequency: 15 625 kc/s or 15 750 kc/s

Line duration: 64 μs or 63.5 μs

Mains voltages: 110, 117, 220 or 234 V ± 10% a.c., 50 or 60 c/s

Power consumption: 2.7 W

Dimensions (height × width × depth):

92 mm × 175 mm × 315 mm

(3<sup>3</sup>/<sub>8</sub> in × 6<sup>7</sup>/<sub>8</sub> in × 12<sup>3</sup>/<sub>8</sub> in)

#### 6 and 8 in Video monitor

These fully transistorized monitors are used for checking the picture quality of a television camera and as viewing monitors especially when the viewing distance is small or when several monitors have to be observed at the same time. The 6 in model can be fitted to the top of a Compact or H-Q television camera to serve as an electronic viewfinder. The wide frequency response of these monitors permits them to be used as precision monitors.

System: CCIR Standard: 625 lines, 50 c/s; RTMA Standard: 525 lines, 60 c/s

Mains voltages: 110, 117, 127, 220, 245 V a.c., 50 or 60 c/s

Power consumption: 35 W

Frequency response: 5 Mc/s ± 1 dB, 7 Mc/s — 3 dB

Dimensions (height × width × depth)

6 in monitor: 205 mm × 177 mm × 358 mm  
(8 in × 7 in × 14 in)

8 in monitor: 235 mm × 230 mm × 358 mm  
(9<sup>1</sup>/<sub>4</sub> in × 9 in × 14 in)

#### 14 in Video monitor

This monitor with its outstanding quality is used both in television studios and closed circuit systems as a control and subsidiary monitor.

System: CCIR Standard: 625 lines, 50 c/s; RTMA Standard: 525 lines, 60 c/s

Mains voltages: 110, 125, 145, 200, 220 or 245 V a.c., 50 or 60 c/s

Power consumption: 140 W

Frequency response: 5 Mc/s — 0.5 dB, 9 Mc/s — 3 dB

Dimensions (height × width × depth):

450 mm × 340 mm × 550 mm

(17<sup>3</sup>/<sub>4</sub> in × 13<sup>1</sup>/<sub>2</sub> in × 21<sup>3</sup>/<sub>4</sub> in)

#### 17 in Video monitor

This universal large screen monitor can be used as a general-purpose monitor in television studios and closed circuit installations. Due to its wide frequency response it can be used as a precision instrument. The screen of this monitor can be turned 90 degrees, which is an advantage for televising documents and other objects the height of which exceeds their width.

System: CCIR Standard: 625 lines, 50 c/s; RTMA Standard: 525 lines, 60 c/s

Mains voltages: 110, 117, 125, 220 or 245 V a.c., 50 or 60 c/s

Power consumption: 250 W

Frequency response: 5 Mc/s ± 1 dB, 8 Mc/s — 3 dB

Dimensions (height × width × depth):

475 mm × 460 mm × 540 mm

(18<sup>3</sup>/<sub>4</sub> in × 18<sup>1</sup>/<sub>8</sub> in × 21<sup>1</sup>/<sub>4</sub> in)

#### Wave-form monitor

This oscilloscope for supervising video signals permits the control of various levels, such as synchronisation amplitude, black level and white level. It is particularly suitable for operational monitoring.

System: CCIR Standard: 625 lines, 50 c/s; RTMA Standard: 525 lines, 60 c/s

Mains voltages: 110, 117 or 220 V a.c., 50 or 60 c/s

Power consumption: 17 W

Dimensions (height × width × depth):

105 mm × 175 mm × 315 mm

(4<sup>1</sup>/<sub>8</sub> in × 6<sup>7</sup>/<sub>8</sub> in × 12<sup>3</sup>/<sub>8</sub> in)

#### Black and white large-screen t.v. projectors

Large-screen television allows community-viewing of t.v. pictures either "off the air" (normal transmitted programmes) or via a closed circuit connection (point-to-point telecasts).

Three projectors are available:

1. Television table projector.
2. Mammoth large-screen projector.
3. The Eidophor super large-screen projector.

#### Television table projector

This projector for small audiences provides a picture size of 1.60 m × 1.20 m (5<sup>1</sup>/<sub>4</sub> ft × 3 ft). It is very simple to operate. Sound, focusing and brightness can be remote-controlled.

System: CCIR Standard: 625 lines, 50 c/s

Mains voltages: 110 or 220 V a.c., 50 c/s

Power consumption: 200 W

Dimensions (height × width × depth):

420 mm × 276 mm × 540 mm

(16<sup>1</sup>/<sub>2</sub> in × 10<sup>7</sup>/<sub>8</sub> in × 21<sup>1</sup>/<sub>4</sub> in)

#### Mammoth large-screen projector

This projector gives pictures up to 3 m × 4 m (10 ft × 13 ft). The basic projection unit is separated from the control unit so as to facilitate installation and to make the projector adaptable for manifold applications.

The projector can be remote-controlled.  
 System: CCIR Standard: 625 lines, 50 c/s;  
 RTMA Standard: 525 lines, 60 c/s  
 Mains voltages: 110, 125, 145, 200, 220 or  
 245 V a.c., 50 or 60 c/s  
 Dimensions (height × width × depth)  
 Control unit: 1230 mm × 590 mm × 370 mm  
 (49<sup>3</sup>/<sub>16</sub> in × 23<sup>9</sup>/<sub>16</sub> in × 14<sup>10</sup>/<sub>16</sub> in)  
 Projection unit:  
 1190 mm × 600 mm × 1000 mm  
 (49<sup>9</sup>/<sub>16</sub> in × 24 in × 40 in)

### Eidophor super large-screen projector

This type is capable of projecting pictures up to 7 m × 9 m (21 ft × 27 ft). As regards the method used for making the electronic signal visible, the projector differs completely from current television equipment. Whereas normal t.v. receivers produce light and image in the same process, the Eidophor projector first produces an image comparable with a slide, which is illuminated and projected afterwards by means of a separate light source.

System: 625 lines, 50 c/s; 525 lines, 60 c/s;  
 819 lines, 50 c/s.  
 Mains voltages: 190, 205, 220 or 235 V single-phase, 50 or 60 c/s  
 Power consumption: 3 kVA without rectifier  
 Projection angle: +10° to -20°  
 Dimensions (height × width × depth):  
 1920 mm × 700 mm × 1270 mm  
 (76 in × 28 in × 50 in)

### Electronic accessories

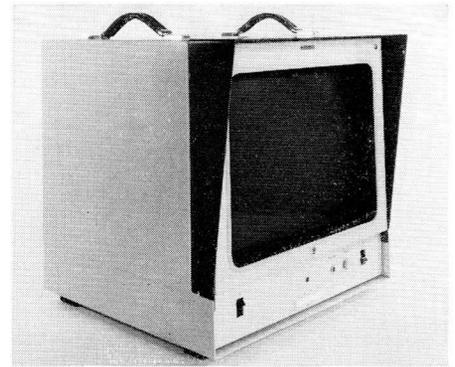
For selecting, distributing, mixing and fading of video signals, the programme contains the following apparatus. A 5 input/1 output Video selector; a Distribution amplifier comprising 4 plug-in amplifiers for distributing video, composite video or pulse waveforms to various items of equipment; a Filter crossbar for switching up to 8 video sources to 1-5 monitors; an 8-input Video mixer for cutting and crossfading between video signals as well as for previewing a signal source. All these units can be built into 19 in standard racks.

### Mechanical and optical accessories

Remote control of lens adjustments can be carried out by means of Lens driving units in combination with a Remote control unit. For continuous aperture control a special Automatic diaphragm control unit is available. Together with one of the Pan and Tilt heads the remote control unit can also be used for governing the camera movements. A great variety of lenses (including tele and zoom lenses) and a Weather-proof camera housing, provided with an automatic cooling and heating system, complete this abridged survey.



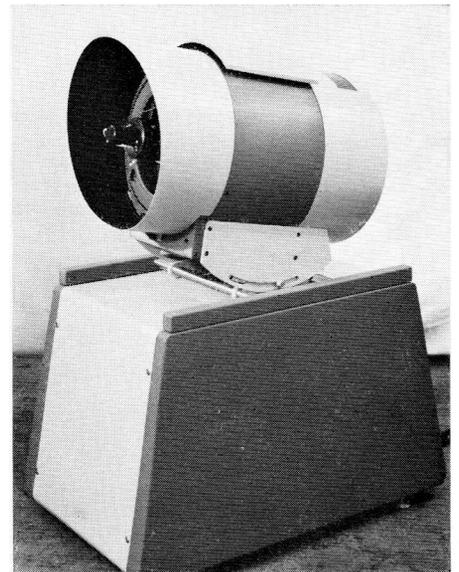
6 in Video monitor.



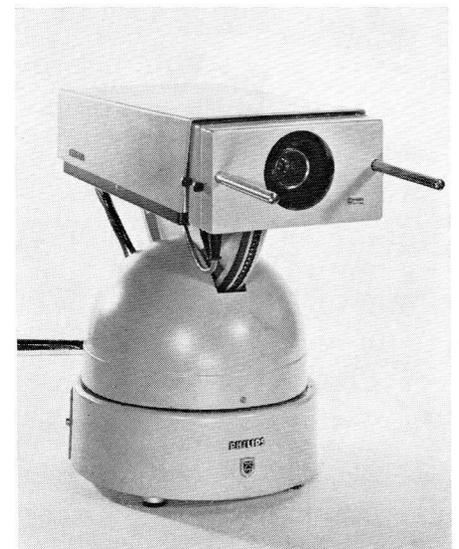
17 in Video monitor.



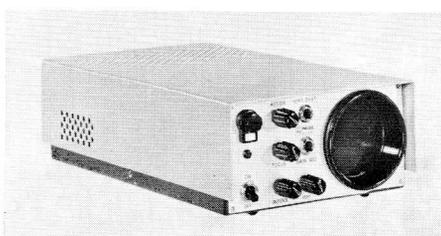
Eidophor super large-screen projector.



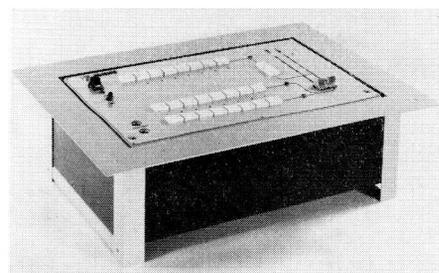
Mammoth large-screen projector.



Compact camera with Lens driving units mounted on an Indoor pan and tilt mechanism.



Wave-form monitor.



Video mixer.

### Television document viewer

The Television document viewer provides a convenient means for rapid and accurate transmission of visual data. It can be used in closed circuit installations as well as in studios.

### Film and slide scanning

For film and slide scanning in closed circuit operation several equipments are available. Film and slide projectors (either manually operated or automatic) have been specially adapted for use in conjunction with a Compact or H-Q camera. For simultaneous scanning and projection of 16- mm and 35- mm films, special mounting arrangements for projector and camera are available.

### Closed circuit television and microscopy

Practically all microscopes are suitable for adaptation to closed circuit television. For a wide variety of purposes special adaptations have been designed: a universal adaptation, a stand for research microscopes and one special microscope arrangement for televising ear operations.

### Cheque verification system

Each cheque is placed downwards on the glass plate of the installation which is viewed by a Compact camera. The ledger department is warned by a buzzer that a cheque is appearing on the monitor screen. After inspection and if it is found to be correct, the teller is instructed to cash the cheque. The system is equipped with a stamping device to identify the authorised official.

### Electronic blackboard

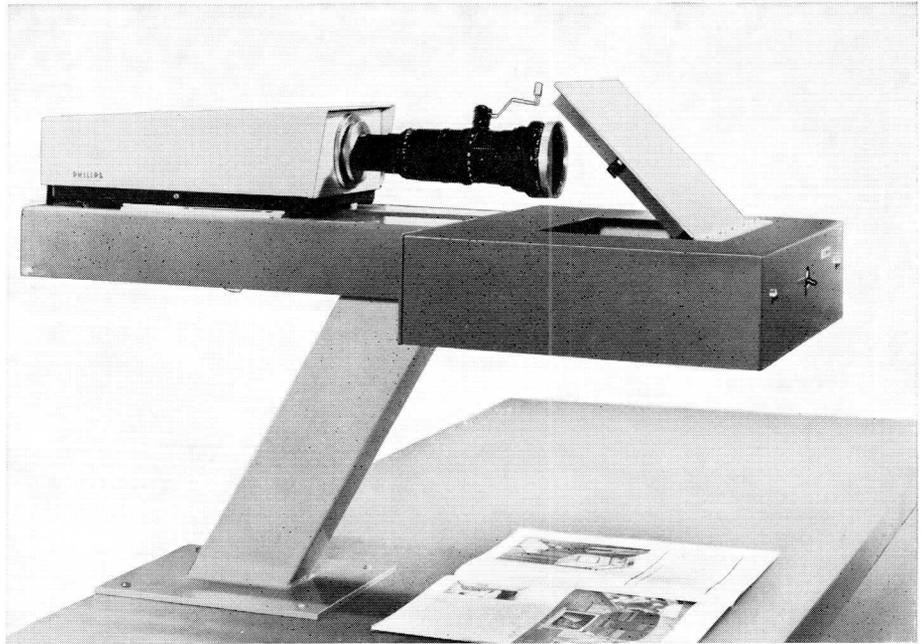
The information to be conveyed to a remote location is written or drawn on the perspex plate of an electronic blackboard by means of a grease pencil. The information is picked up by the camera, mounted under the plate, and distributed to the connected monitors.

## COLOUR EQUIPMENT

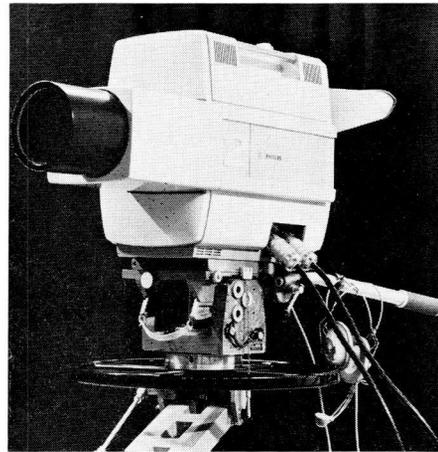
### Plumbicon colour t.v. camera

This entirely new, fully transistorized colour t.v. camera has been specially designed for studio work. The plumbicon tube gives the camera high sensitivity and excellent signal-to-noise ratio combined with optical efficiency, small dimensions and ease of operation.

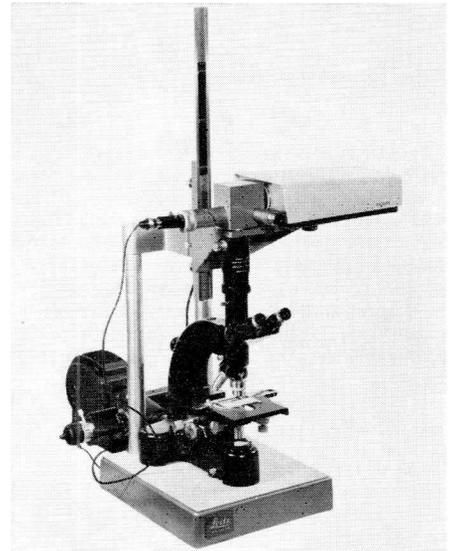
The camera is provided with a zoom lens whose focal length can be varied between 18 mm and 180 mm. The focal distance can be adjusted by means of five push-buttons, four of which offer preset values while the fifth serves for switching to manual adjustment. In the latter case zooming can be effected by rotating the grip on the handle. The diaphragm is adjusted from the control desk. The viewfinder fitted in the camera comprises a  $6\frac{1}{2}$  in cathode ray tube. By means of push-buttons the viewfinder permits a choice between the R, G and B signal. The camera contains the video pre-amplifiers and the output stages of the line time bases. No electrical adjustment in the camera being needed, the camera can be lined up by one man from the CCU.



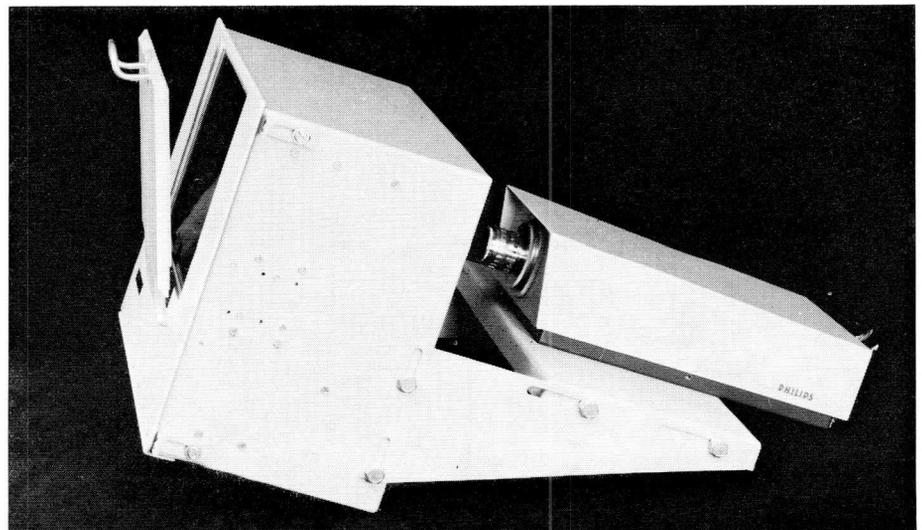
Television document viewer.



Plumbicon colour television camera.



Compact camera in use for televising microscope pictures.



Cheque verification system.

### Colour t.v. camera chain

This three-vidicon colour t.v. camera equipment is mainly intended for use in closed circuit systems for educational purposes, specifically in the teaching of medicine. It allows a large number of students to witness surgical operations, and also for example microscopic, endoscopic or dental examinations. The equipment consists of two main items: the camera and the control rack.

#### The camera

The colour-splitting section consists of cemented glass prisms with colour-selective layers for splitting the incident light into its red, green and blue components. The result is a system of extremely small dimensions, impermeable to air and dust. The three components of the light leaving the colour-splitting system fall onto three vidicon tubes. Three pre-amplifiers bring the amplitude of the three video signals to the prescribed level and ensure a very low noise level and great stability.

#### The control rack

The control rack is a standard 19 in rack with doors at the side and at the rear. From top to bottom the rack contains:

A 14 in black and white monitor for checking definition, picture geometry and superposition of the red, green and blue picture.

A 5 in cathode ray oscilloscope for checking the amplitude, black level and gradation of the three signals.

A video amplifier providing aperture correction, gamma correction of the vidicon tubes and the cathode ray tube, addition of the blanking signal and output amplification.

Apart from the above-mentioned controls for the amplifiers, the control panel includes controls for signal-electrode voltages and for the beam currents of the vidicon tube as well as the zoom lens controls.

A deflection unit comprising the circuits for magnetic and electrostatic beam focusing, beam alignment, horizontal and vertical deflection, beam suppression, picture shift, and for correcting parallelogram distortion.

A power supply unit and a pulse generator.

### Colour t.v. monitor

This 21 in Colour t.v. monitor is a high-quality instrument that can serve a wide variety of purposes. It can be used as a precision instrument in colour t.v. studios for monitoring and adjusting various signal sources; as a display set for small audiences in closed circuit systems; or as a checking unit in factories producing t.v. sets and shadow-mask tubes.

Systems: CCIR Standard 625 lines, 50 c/s, interlaced; RETMA Standard 525 lines, 60 c/s, interlaced.

Overall frequency response of each channel: 7 Mc/s flat, 10 Mc/s — 3 dB

Resolution: better than 500 lines

Mains voltages: 115, 127, 220 or 240 V, 50 or 60 c/s

Power consumption: 400 VA

Dimensions (height × width × depth):

762 mm × 584 mm × 724 mm

(30 in × 23 in × 26<sup>1</sup>/<sub>2</sub> in)

### Large-screen colour t.v. projector

This compatible colour t.v. projector, providing a picture of 2.75 m × 3.60 m (9 ft × 12 ft), is designed to meet the requirements of television projection for large audiences. The projector is suitable for use in theatres, universities and for other applications where t.v. viewing capacity has to be extended.

System: CCIR Standard 625 lines, 50 c/s, interlaced; RETMA Standard 525 lines, 60 c/s, interlaced.

Mains voltages: 117 or 220 V ± 5% a.c., 50 or 60 c/s.

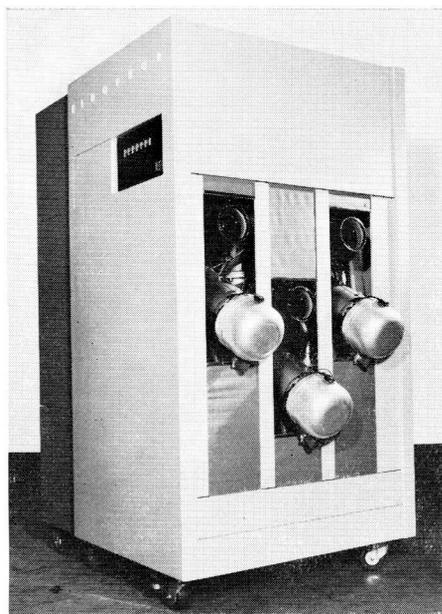
Optical system: 3 projection systems with Schmidt optical arrangement, mirror diameter 15<sup>3</sup>/<sub>4</sub> in (40 cm)

Projection angle: adjustable from +10° to +22°; if desired this range can be changed.

Dimensions (height × width × depth):

1540 mm × 1740 mm × 800 mm

(52<sup>1</sup>/<sub>2</sub> in × 68<sup>1</sup>/<sub>2</sub> in × 32 in)



Compatible colour t.v. Eidophor projector.

### Compatible colour t.v. Eidophor projector

This is the ideal projector for reproducing high-fidelity colour t.v. pictures in the largest auditoriums, meeting the highest requirements of a critical public used to modern large-screen motion picture techniques. It provides a high light output, true colour rendering, perfect linearity and excellent picture geometry. The projector consists of three parts: the projector unit, the electronics unit and the power supply unit.

System: CCIR Standard 625 lines, 50 c/s, interlaced; RETMA Standard 525 lines, 60 c/s, interlaced.

Mains voltages: 208 V or 220 V or single phase 380 V three phase with neutral 50 or 60 c/s

Power consumption: 3 kVA (excluding rectifier for the gas-discharge lamp)

Projection angle: 10° up, 25° down

Dimensions (height × width × depth):

Projector unit: 1960 mm × 1000 mm × 840 mm

(77<sup>3</sup>/<sub>16</sub> in × 39<sup>3</sup>/<sub>8</sub> in × 33<sup>1</sup>/<sub>16</sub> in)

Electronics unit:

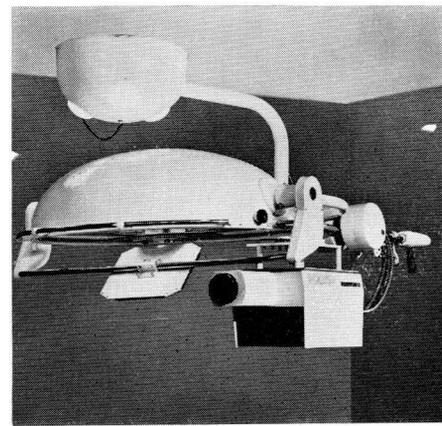
1940 mm × 1000 mm × 400 mm

(76<sup>3</sup>/<sub>8</sub> in × 39<sup>3</sup>/<sub>8</sub> in × 15<sup>3</sup>/<sub>4</sub> in)

Power supply unit:

1280 mm × 550 mm × 450 mm

(50<sup>3</sup>/<sub>8</sub> in × 21<sup>3</sup>/<sub>8</sub> in × 17<sup>1</sup>/<sub>16</sub> in)



Vidicon colour t.v. camera mounted under operating lamp.



Large-screen colour television projector.

### Colour t.v. flying-spot slide scanner

This Colour slide scanner is an excellent signal source for colour television studios and laboratories, the colour signals produced being inherently free from registration errors. It provides extremely faithful colour reproduction, excellent signal-to-noise ratio (also in the red channel) and high definition, thus meeting in every respect the requirements of high-class professional t.v. studio equipment.

System: CCIR Standard: 625 lines, 50 c/s, interlaced; RETMA Standard: 525 lines, 60 c/s, interlaced.  
Mains voltage: 220 V, 50 or 60 c/s  
Overall frequency response of each video channel: 10 Mc/s  $\pm$  1 dB  
Dimensions (height  $\times$  width  $\times$  depth): 1670 mm  $\times$  560 mm  $\times$  600 mm (65<sup>3</sup>/<sub>4</sub> in  $\times$  22 in  $\times$  23<sup>1</sup>/<sub>2</sub> in)

### Encoder and subcarrier generator

The transistorised colour encoder and Chrominance subcarrier generator, mounted together in a metal housing with 19 in front panels, carry out the complete process of encoding colour t.v. signals in accordance with the NTSC system. This combined unit fully complies with the highest requirements of professional colour t.v. studios.

System: NTSC, European version, with subcarrier frequency on 4.429687  $\pm$  10% Mc/s or NTSC, American version, with subcarrier frequency on 3.579545  $\pm$  10% Mc/s  
Mains voltages: 110, 117, 220 or 240 V, 50 or 60 c/s.  
Power consumption: 40 VA  
Dimensions (height  $\times$  width  $\times$  depth): 320 mm  $\times$  530 mm  $\times$  410 mm (13 in  $\times$  21 in  $\times$  16 in)

### Colour-bar generator

The main application of this Colour-bar generator is the use as a signal source for checking and adjusting an encoder-decoder system. It is indispensable not only in colour t.v. studios and research laboratories but also in setmaking factories.

System: CCIR Standard 625 lines, 50 c/s, interlaced; RETMA Standard 525 lines, 60 c/s, interlaced; British Standard: 405 lines, 50 c/s, interlaced.  
Mains voltages: 115, 127, 145, 220 or 240 V, 50 or 60 c/s.  
Dimensions (height  $\times$  width  $\times$  depth): 90 mm  $\times$  175 mm  $\times$  310 mm (3<sup>1</sup>/<sub>2</sub> in  $\times$  7 in  $\times$  12<sup>1</sup>/<sub>2</sub> in)

### Decoder

This transistorised Decoder has been designed for professional use both for closed circuit colour television and for broadcasting applications. Due to its very small dimensions the decoder can easily be built into existing colour television projectors and colour television monitors.

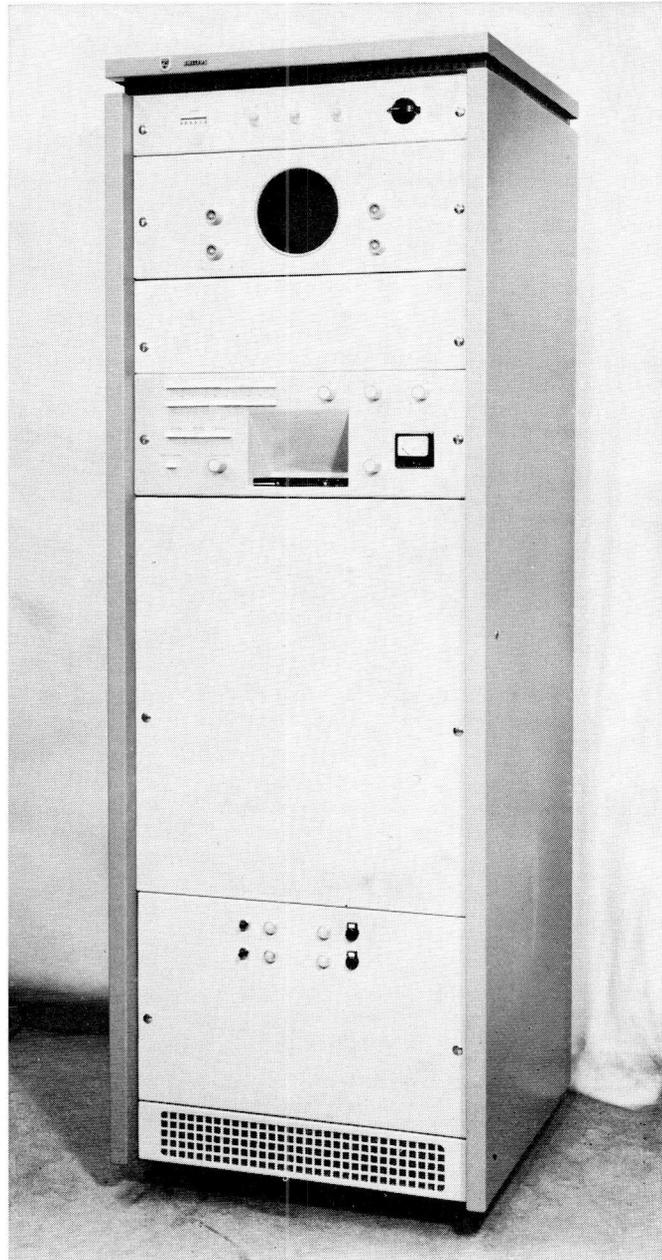
System: NTSC Standard with subcarrier on 3.579 Mc/s; NTSC Standard with subcarrier on 4.429 Mc/s  
Mains voltages: 117, 220 V; 50 or 60 c/s.  
Dimensions (height  $\times$  width  $\times$  depth): 76 mm  $\times$  214 mm  $\times$  410 mm (3 in  $\times$  8<sup>3</sup>/<sub>8</sub> in  $\times$  16<sup>1</sup>/<sub>8</sub> in)

### Test signal generator

The Test signal generator is an auxiliary instrument intended for the adjustment of colour t.v. equipment and also of black and white camera and monitoring equipment.

It provides grid patterns for adjusting time base linearity and registration of colour t.v. display equipment, dot patterns for checking spot astigmatism, and a sawtooth signal for adjusting the tracking of the three channels of colour t.v. equipment.

System: CCIR Standard 625 lines, 50 c/s, interlaced; RETMA Standard 525 lines, 60 c/s, interlaced; British Standard 405 lines, 50 c/s interlaced.  
Mains voltages: 110, 117, 127, 220 and 245 V  $\pm$  5%  
Mains frequency: 50 or 60 c/s  
Dimensions (height  $\times$  width  $\times$  depth): 175 mm  $\times$  92 mm  $\times$  315 mm (6<sup>7</sup>/<sub>8</sub> in  $\times$  3<sup>5</sup>/<sub>8</sub> in  $\times$  12<sup>3</sup>/<sub>8</sub> in)



Colour t.v. flying-spot slide scanner.

## 15. TELECOMMUNICATION SYSTEMS



In the control tower of Bogotá Airport (Columbia) a multiplicity of Philips telecommunication equipment — arranged in systems — has been installed.

Our production programme takes in practically all types of telecommunication equipment, a short survey of which is presented in the chapters 16 ... 25.

In addition to telecommunication equipment however, we also manufacture telecommunication systems. If we think of the equipment as building elements, the systems may be likened to the buildings that can be constructed from those elements. And just as structures differing greatly from each other as to function, use, fittings, location, size, etc. can be erected from the same building elements, so, too, can a great diversity of systems be achieved using the same types of equipment. In the building world of telecommunication we function not only as suppliers of bricks but also as architects and bricklayers. Our specialized knowledge and experience of every aspect of telecommunication have resulted in:

- a. having a complete and up-to-date production programme for telecommunication purposes;
- b. being able to solve in the most efficient manner possible — anywhere in the world — any problem that has to do with telecommunication.

The very fact that in designing telecommunication systems we cater for the individual needs of the customer, the local situation and other special circumstances, makes it impossible to give a survey of those systems in the same way in which that is done for individual products in the chapters which follow.

In order, nevertheless, to give some idea of the very numerous possibilities, we append several brief descriptions of telecommunication projects which have been carried out. In addition, many of the illustrations included in the above-mentioned chapters on telecommunication equipment are taken from actual projects or parts of such projects.

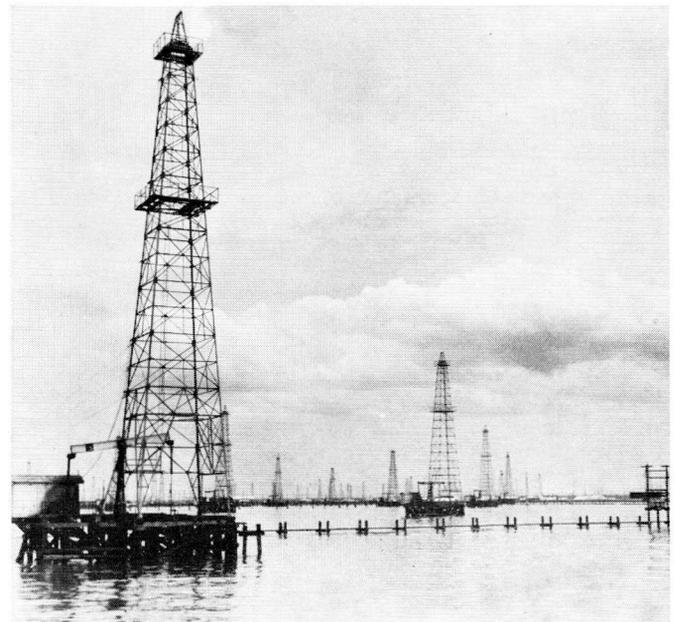
### VENEZUELA

#### Telecommunication system for the oil industry

Today there is an ever increasing need for oil and oil products which is forcing the oil industry to even greater efforts than it is at present making. One of the many technical aids that are being used on a steadily mounting scale by this progressive industry is telecommunications. One such technical aid for Venezuela, a country rich in oil, has been supplied by Philips.

Telephone exchanges employed by oil companies are usually PAX's, PABX's, PMX's or PMBX's, but it is not uncommon for large networks of linked exchanges to be set up when the extraction area is very extensive.

In Venezuela 25 telephone exchanges of very widely differing sizes are coupled to form the fully automatic "Western Division" network in which the automatic circuits are not all physical lines but frequently radio circuits offering the same facilities as the normal ones. The exchanges range in capacity from 25 to 1,5000 connections. They are spread over an area of some 2,000 square miles. The network uses self-contained numbering schemes and comprises three zones: Maracaibo, La Concepción and Lagunillas. For geographical reasons most of the links between the various exchanges are maintained by



Drilling barges of "Compañía Shell de Venezuela en Lake Maracaibo", equipped with direct-dialling radio telephones.

multichannel radio transmitters with type STR 130 carrier equipment at the channel ends. Two-way relay sets permit dialling in either direction.

A modern telex network is available for the exchange of necessary data on products, refining, etc. This large, fully transistorized telegraph network runs parallel to the telephone network. Moreover, a system on a party-line basis is being used on Lake Maracaibo so that the drilling barges can be contacted by dialling and can converse with each other.

Finally, the Western Division Network is linked to the group of refineries at Punta Cardón via Maracaibo, which in turn is linked with the head office at Caracas. The Maracaibo-Cardón route is served by a scatter link; the Cardón-Caracas and Caracas-Maracaibo routes are served by microwave links.

## ARGENTINA

### Nation-wide telecommunication network

Argentina has been supplied with various kinds of telecommunication equipment which together form a national network. The centre is Buenos Aires.

The main arteries of this network are the radio connections between Buenos Aires and twenty-nine important towns. These links are equipped with 5 and 10 kW ISB transmitters, which can handle high-power telephony and telegraphy simultaneously. The telegraph circuits are guarded by completely electronic TOR (automatic error detection and correction) equipment. The 29 towns in turn form what are known as zone stations, with seventy 1 kW transmitters and the corresponding receivers.

The stations in the national network act as centres for rural network (11 in all) to which 64 outlying stations will be connected.

In addition, there are 20 mobile rural stations in operation. The Buenos Aires centre comprises — besides the national communication equipment — two local telegraph exchanges.

For purposes of international traffic, the national press and ocean and inland navigation five 10 kW and five 60 kW transmitters have been installed (AI and FI).

## AUSTRALIA

### Sydney-Melbourne coaxial cable system

On April 14th, 1959, the Postmaster-General of Australia announced the award of a multi-million pound contract to associated and affiliated companies of the Philips organization. The contract was for the supply of a coaxial cable communication system between Sydney and Melbourne. The length of the cable route is 590 miles. The cable contains 3 pairs of coaxial tubes, one pair catering for 960 simultaneous telephone channels (which can be increased to 1,260) and the second for TV transmission, while the third is a stand-by for the other two.

Channels may be injected and extracted at any of the 13 intermediate stations. The tubes are pressurized with an inert gas, and the 102 unattended repeater stations are remotely controlled. The repeater stations are sited at intervals of 5.6 to 5.8 miles and are power-fed via the coaxial cable. This project has attracted attention in many countries, and upon completion will meet an urgent need for more and more telephone channels. It also will make possible the interchange of TV and radio programmes between the states of New South Wales and Victoria. The equipment is being installed, adjusted and tested by specially selected engineers from the TCA laboratories and factories at Hendon, Sydney, and by others from FGF, Nuremberg, a cable company associated with the Philips organization, which is the main supplier of the terminal equipment. Installation started in February 1960 and will be completed some time in the near future.

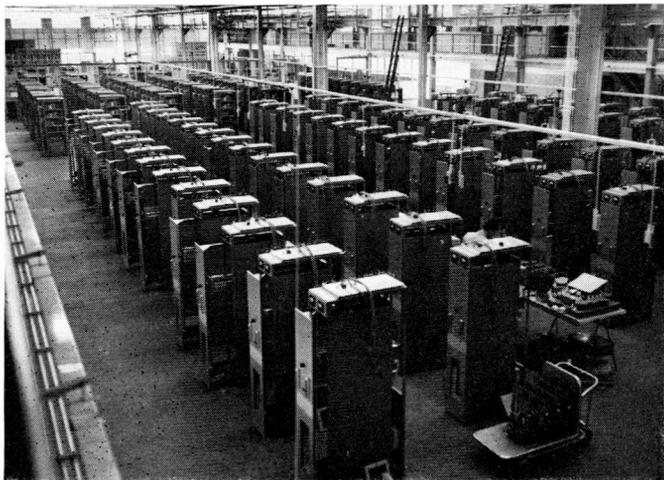
## ELDO

### Earth satellite telemetering

Various West European countries are to co-operate in launching a space satellite for scientific purposes.

Philips share in this project is to provide telesupervision of the third stage of the rocket. This involves manufacturing airborne equipment and fitting out a ground station.

The airborne equipment has to meet very special requirements, while it has also to be as compact as possible. The latest techniques of microminiaturisation are therefore being employed.



Large numbers of 1 and 10 kW transmitters were manufactured in the works of Philips Telecommunication Industry and installed in Argentina.



View of a field camp set up during the Sydney-Melbourne cable operation.

## Integrated railway signalling and telecommunication system



*Railway siding with radio-relay station in the Liberian jungle.*

A project in which almost the complete production-programme is represented has been carried out in Liberia.

In November 1963 the Liberian president, Dr. W. V. S. Tubman, officially opened a 270 km (170 mile) railway for the transport of ore. This railway links the rich iron-ore mining area near Nimba with the harbour specially constructed for the shipment of iron ore at Lower Buchanan on the Atlantic coast.

The contract awarded to Philips was for the supply and installation of an integrated railway signalling and telecommunication system. This is used to control and supervise all traffic on the railway from one central point at Nimba. It proved possible to restrict the railway to a single track with nine "sidings".

The railway is represented diagrammatically on a large control panel which also carries all the switches for operating points and signals along the line.

To link the central control station to the nine sidings a radio-relay system was installed with transmitter/receiver stations erected in the immediate vicinity of the sidings. The same radio-relay system is used to pass on from one post to another the information which

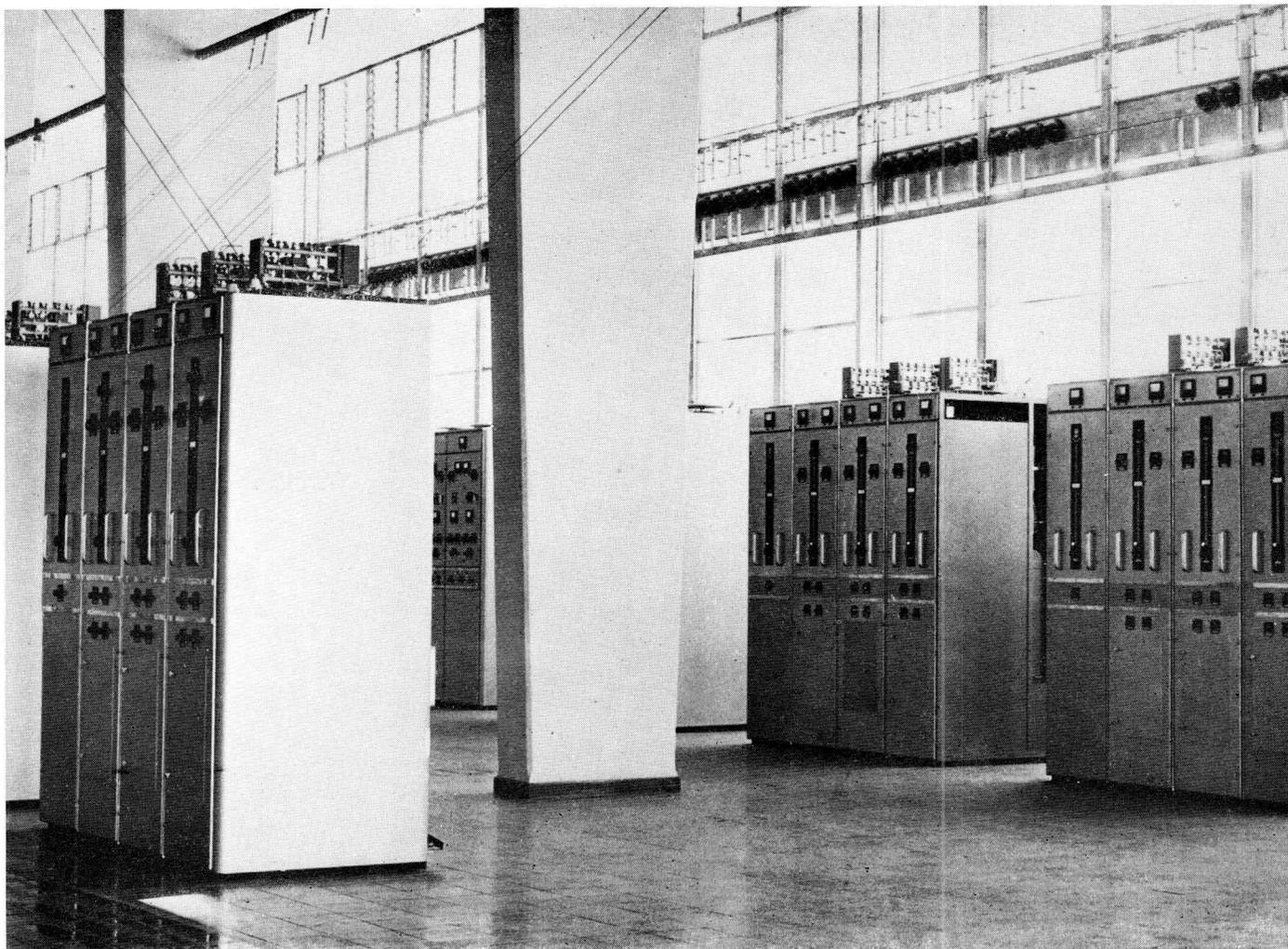
ensures failsafe interlocking of the railway sections between successive sidings. Other functions of the radio-relay system are: to link the automatic telephone networks, also supplied by us, at Nimba and Lower Buchanan; to provide telephone communication on a party-line basis with all sidings; to carry a telex circuit between the mining centre and the harbour; to remotely control and supervise the normally unattended sidings and radio-relay stations; and to extend radiotelephone (mobilophone) calls.

Four independent radiotelephone networks were installed: one for contact between the engine-drivers and the despatcher at Nimba; one for maintenance personnel operating along the railway and one portophone network which can be put into operation wherever it is needed.

In addition to the electronic equipment we also supplied the point-machines, the light-signals and the other electromechanical fittings for the railway.

The actual installation of the equipment was preceded by a very intensive investigation of the terrain.

## 16. RADIOCOMMUNICATION



5 and 10 kW communication transmitters at the General Pacheco Station, Buenos Aires, Argentina.

Radiocommunication is a very comprehensive subject. Even if, as in this catalogue, broadcasting, mobile radio and radio relay are dealt with in separate sections, a great variety of equipment still remains to be described. Our radiocommunication programme — based on over 40 years' experience — is kept very extensive to enable us to satisfy any demand. It ranges from small transmitter/receivers for local networks to powerful transmitters and extremely sensitive receivers for world-wide communications, from individual installations to complicated integrated networks. More detailed information about the products described here will be found in our section catalogues "Radio Communication" and "Military Radio", and separate brochures.

### H.F. COMMUNICATION TRANSMITTERS

Our range of modern standard transmitters is designed to satisfy international demands for communication transmitters suitable for universal applications. The equipment consists of combination of basic units (e.g. power supply, r.f., exciter, frequency conversion and a.f. amplifier units), so that any required combination of operational facilities can be obtained. The units of smaller transmitters are

housed in single 19 in cabinets. The bigger transmitters consist of sets of cabinets. They are completely aircooled, simple to operate and suitable for remote control and remote supervision.

250/300 W telegraph/telephone transmitter, type 8RZ 811

300 W telegraph transmitter, type 8RZ 812

300 W SSB/ISB transmitter, type 8RZ 813

800/1000 W telegraph/telephone transmitter, type 8RZ 151

800 W SSB/ISB transmitter, type 8RZ 153

1 kW telegraph transmitter, type 8RZ 152

5 kW telegraph/telephone transmitter, type 8RZ 518 (channelized).

5 kW telegraph transmitter, type 8RZ 518 (channelized).

5 kW ISB transmitter, type 8RZ 518 (channelized).

5 kW telegraph/telephone transmitters, types 8RZ 507, 8RZ 508 (continuous tuning).

5 kW telegraph transmitters, types 8RZ 507, 8RZ 508 (continuous tuning).

5 kW ISB transmitters, types 8RZ 507, 8RZ 508 (continuous tuning).

10 kW telegraph/telephone transmitter, type 8RZ 519 (channelized).

10 kW telegraph transmitter, type 8RZ 519 (channelized).

10 kW ISB transmitter, type 8RZ 519 (channelized).

10 kW telegraph/telephone transmitters, types 8RZ 502, 8RZ 506 (continuous tuning).

10 kW telegraph transmitters, types 8RZ 502, 8RZ 506 (continuous tuning).

10 kW ISB transmitters, types 8RZ 502, 8RZ 506 (continuous tuning).

30 kW transmitters, type 8RZ 510

## H.F. TRANSISTORIZED RECEIVER ELEMENTS

Older receiving stations often show a great diversity of equipment in a lay-out which is necessarily illogical. The new Philips h.f. receiving system consists of a series of small functional units of standardized dimensions, giving a great degree of flexibility. Modern construction methods guarantee easy maintenance. The equipment is channelized and suitable for centralized and remote control. The series also comprises terminal equipment and transmitter drive units.

R.F. unit, type 8RE 900

I.F.-A.F. unit, type 8RY 900

R.F. oscillator, type 8RG 726

I.F. oscillator, type 8RG 901

Aerial multicoupler, type 8RV 716

Power supply unit, type 8RD 724

FSK diversity unit, type 8RY 902

FSK adapter, type 8RY 901

ISB adapter, type 8RY 903

Teleprinter drive unit, type 8RY 506

VODAS unit, type NT 07760

VOGAD unit, type 8RY 755

Control unit, type NT 07761

Speech inverter, type 8RY 756

Ringing unit, type 8RL 720

Diplex modulator, type 8RY 722

Diplex demodulator, type 8RY 723

V.F./A.M. modulator, type 8RC 728

V.F./A.M. demodulator, type 8RC 729

Measuring unit, type 8RM 725

V.F./F.M. modulator, type 8RC 735

Limiting amplifier, type 8RV 721

Line amplifier, type 8RV 715

Power supply unit, type 8RD 727

I.S.B. premodulator, type 8RC 731

Telegraphy premodulator, type 8RC 733

Frequency conversion unit, type 8RE 730

## OTHER H.F. AND V.H.F. EQUIPMENT

Transistorized 50 W h.f. SSB transmitter/receiver, type 8RR 555

H.F. communications receiver, type 8RO 501

50 W v.h.f. transmitter, type SFZ 341

205 W v.h.f. transmitter, type BRZ 802

V.H.F. receiver, type 8RO 970

Transmitting and receiving aerials.

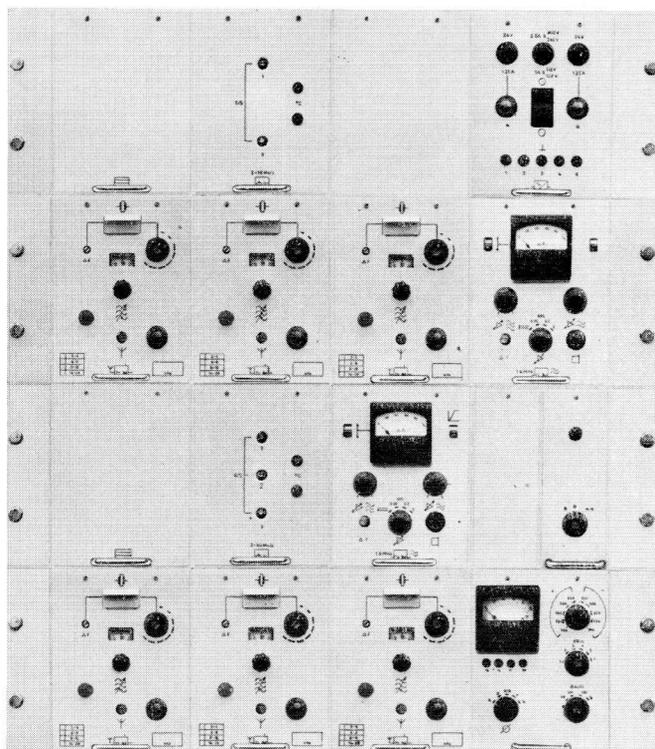
H.F. dummy aerials.

1 kW and 5 kW matching transformers.

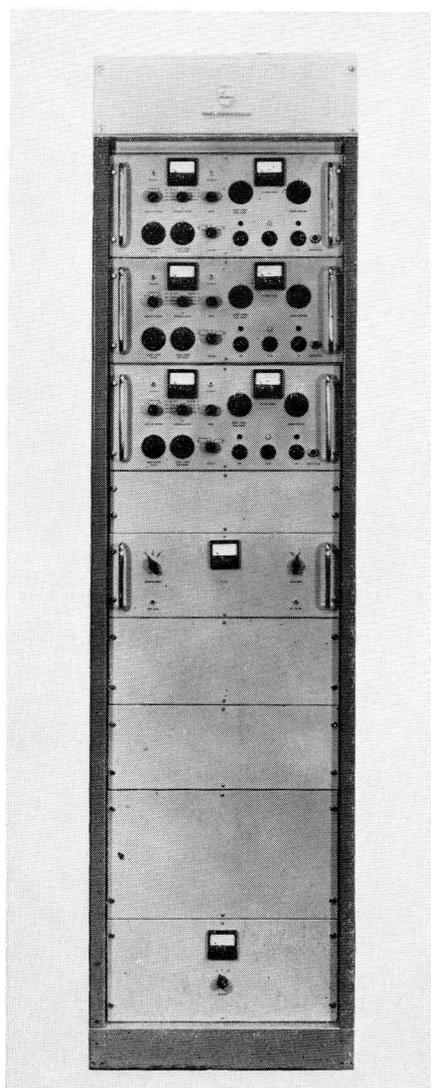
Test equipment.

## MILITARY RADIO

Details on our programme on military radio are available on request.

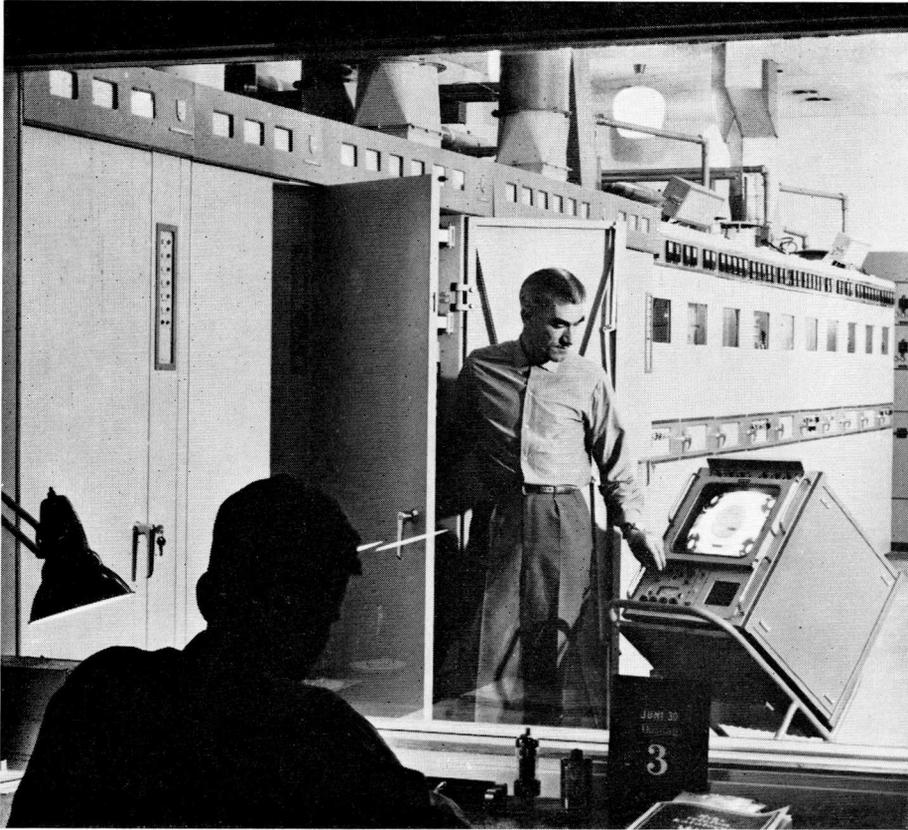


FSK receiver for dual space diversity reception of three frequencies on high stability circuits. The receiver is composed of standard elements.



300 W SSB/ISB transmitter, type 8RZ 813.

## 17. TRANSMITTERS FOR SOUND AND TELEVISION BROADCASTING



20 kW band IV television transmitter, installed at Crebro, Sweden.

Our experience in sound and television broadcasting dates back to 1923 and 1935 respectively. Unfortunately, there is not enough space here to tell how the Netherlands broadcasting system grew from an experimental factory transmitter. Nowadays Philips transmitters are to be found operating in stations all over the world. Whether in their modest initial stages or in later periods of expansion, sound broadcasting and television services can be completely equipped with transmitters from our standard ranges.

More detailed information about the products described in this paragraph will be found in our section catalogues "Broadcasting" and "Television", and separate brochures.



50 kW short-wave and 20 kW medium-wave broadcast installations at Lima, Peru.

### SOUND BROADCAST TRANSMITTERS

All transmitters are air-cooled. They are fitted with high-performance tubes, satisfy the relevant CCIR specifications, are easy and safe to operate and to maintain, are suitable for continuous unattended operation and, if desired, can be remotely controlled. Full metering facilities are provided. The smallest types are constructed according to the "block-building" system. The larger ones have an ornamental front behind which the components are housed in easily accessible compartments. The programme also includes a wide variety of accessories.

5 kW amplitude modulation, medium-wave broadcast transmitter, type 8FZ 518

10 kW amplitude modulation, medium-wave broadcast transmitter, type 8FZ 519

25 kW amplitude modulation, medium-wave broadcast transmitter, type 8FZ 511

50 kW amplitude modulation, medium-wave broadcast transmitter, type 8FZ 516

120 kW amplitude modulation, medium-wave broadcast transmitter, type 8FZ 517

5 kW amplitude modulation, short-wave channelized broadcast transmitter, type 8FZ 508

10 kW amplitude modulation, short-wave channelized broadcast transmitter, type 8FZ 509

10 kW amplitude modulation, short-wave broadcast transmitter for continuous tuning, type 8FZ 701

25 kW amplitude modulation, short-wave channelized broadcast transmitter, type 8FZ 510

25 kW amplitude modulation, short-wave broadcast transmitter for continuous tuning, type 8FZ 513

50 kW amplitude modulation, short-wave broadcast transmitter for continuous tuning, type 8FZ 701

120 kW amplitude modulation, short-wave broadcast transmitter for continuous tuning, type 8FZ 515

250 W frequency modulation broadcast transmitter, type SOZ 334

1 kW frequency modulation broadcast transmitter, type SOZ 335

5 kW frequency modulation broadcast transmitter, type 8FZ 705

6.5 kW frequency modulation broadcast transmitter, type SOZ 336

10 kW frequency modulation broadcast transmitter, type 8FZ 706

12 kW frequency modulation broadcast transmitter, type SOZ 337

Frequency modulation transmitter, specially designed as studio-broadcast transmitter link equipment, can also be used as low-power broadcast transmitter in shaded or isolated areas.

type 8FZ 505: 10 W, single version.

type 8FZ 365: 50 W, single version.

type 8FZ 506: 10 W, twin version.

type SFZ 403/00: 50 W, twin version.

type 8FZ 507: 10 W, twin version with automatic change-over facilities.

type SFZ 403/01: 50 W, twin version with automatic change-over facilities.

Aerials for broadcast transmitters have to be adapted to local needs and circumstances; backed by long experience we are in an excellent position to work out complete projects for any type of transmitter.

H.F. dummy aerials types 8RT 501, 8RT 502, 8FT 506; for use as artificial loads.

V.H.F. coaxial accessories; f.m. monitors, coaxial switches, reflectometers, reflection safety devices and dummy loads.

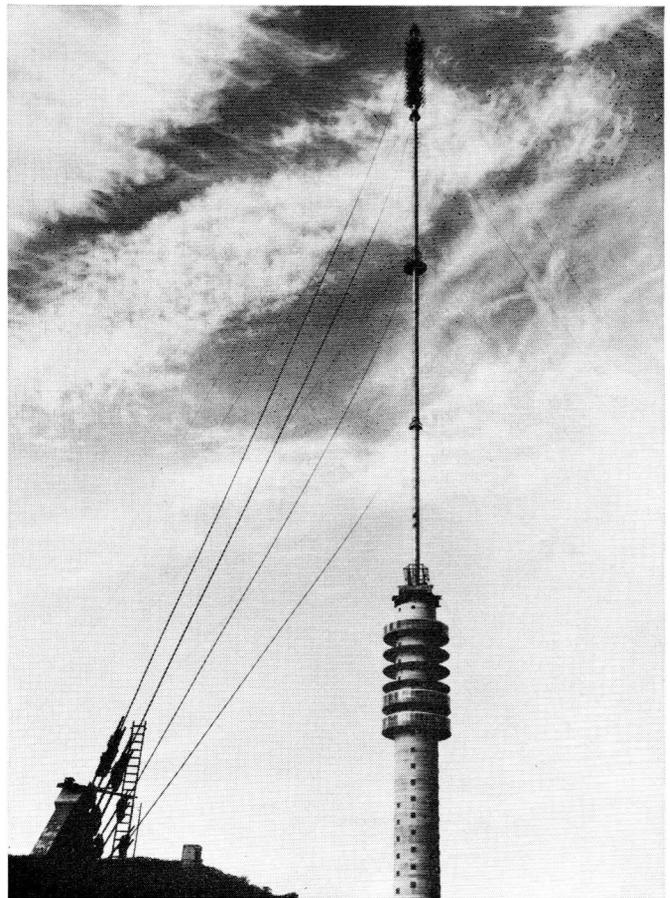
Diplexer, type SFE 272; for the simultaneous transmission of two separate f.m. programmes from a single aerial.

Harmonic filter, type SFE 368; to prevent band II f.m. broadcast transmissions from interfering with band III t.v. programmes.

Transmitter audio control equipment, type 8FV 501; to be used when centralized control of incoming programmes for one or more transmitters in the same station is needed.

## TELEVISION TRANSMITTERS

What has been said of sound broadcast transmitters is basically also applicable to television transmitters. Philips television transmitters comply with either CCIR or EIA regulations, but adaptation to special requirements is possible. All transmitters are built upon the same principle: a number of uniform cabinets, each housing a main unit. Control desks are available for extensive installations, while in this case, too, an extensive selection of accessories is available.



The towers of the Dutch television and f.m. sound broadcasting network are equipped with Philips transmitters. The main tower at Lopik has a height of approx. 400 m.

75 W television transmitter for band I or III, type 8BZ 750

500 W television transmitter for band I (CCIR and EIA), type SBZ 152

4 kW television transmitter for band I (EIA), type 8BZ 707

5 kW television transmitter for band I (CCIR), type 8BZ 711

5 kW television transmitter for band I (EIA), type 8BZ 709

10 kW television transmitter for band I (CCIR), type 8BZ 712

10 kW television transmitter for band I (EIA), type 8BZ 713

25 kW television transmitter for band I (CCIR), type 8BZ 503

25 kW television transmitter for band I (EIA), type 8 BZ 502

Filterplexer for band I (CCIR and EIA), type 8BE 571

Paralleling cabinet, type 8BL 504; for switching, monitoring and phasing duplicated band I television transmitters.

Nyquist demodulator for band I, type SBO 108

500 W television transmitter for band III (CCIR and EIA), type SBZ 131

5 kW television transmitter for band III (CCIR), type 8BZ 716

5 kW television transmitter for band III (EIA), type 8BZ 715

Diplexer for band III (CCIR and EIA), type 8BE 580

Filterplexer for band III (CCIR and EIA), type SBE 564

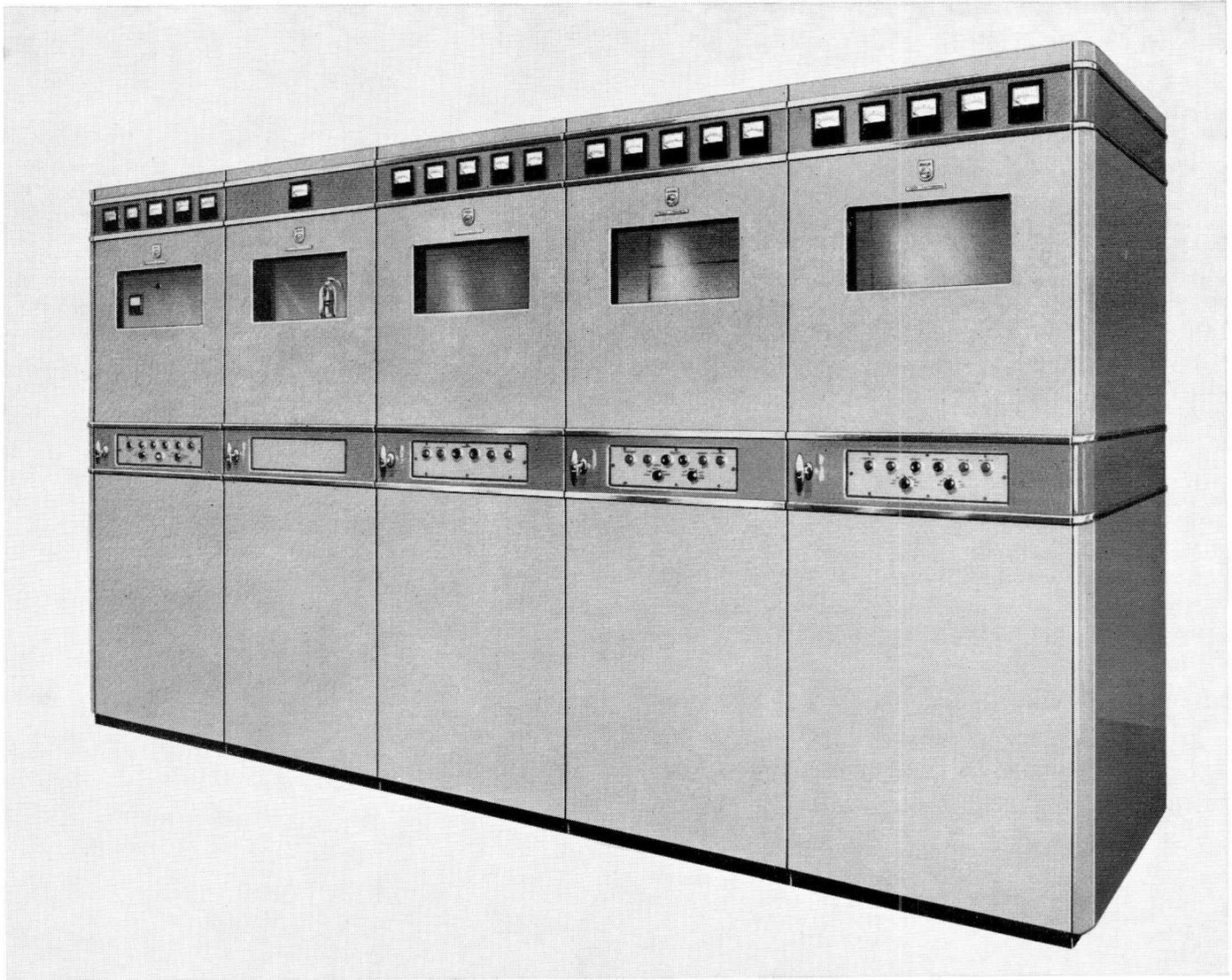
Paralleling cabinet, type 8BL 503, for switching, monitoring and phasing duplicated band III television transmitters.

Nyquist demodulator for band III, type SBO 109

2 kW television transmitter for band IV and band V, type 8BZ 402

10 kW television transmitter for band IV and band V, type 8BZ 410

20 kW television transmitter for band IV and band V, type 8BZ 421



5 kW band I television transmitter, type 8BZ 711.

Paralleling equipment for switching, monitoring and phasing duplicated band IV and band V television transmitters.

Nyquist demodulators for band IV and band V

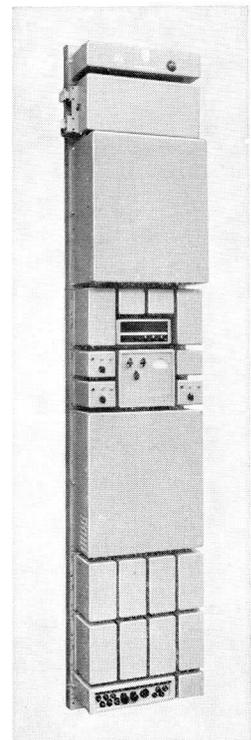
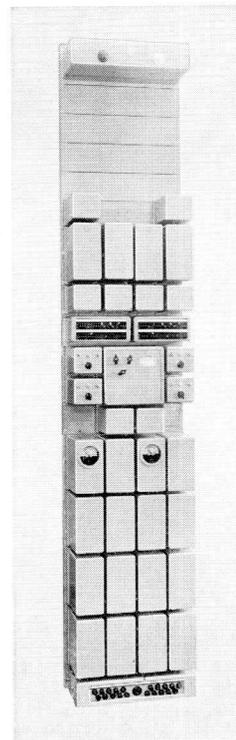
V.H.F. coaxial accessories; f.m. monitors, coaxial switches, reflectometers, reflection safety devices and dummy loads.

Transmitter audio control equipment, type 8FV 501; to be used when centralized control of incoming programmes for one or more transmitters in the same station is needed.

Transmitter video and audio input equipment, type SBK 128; forming a practically indispensable link between a television transmitter and the incoming video and audio lines.

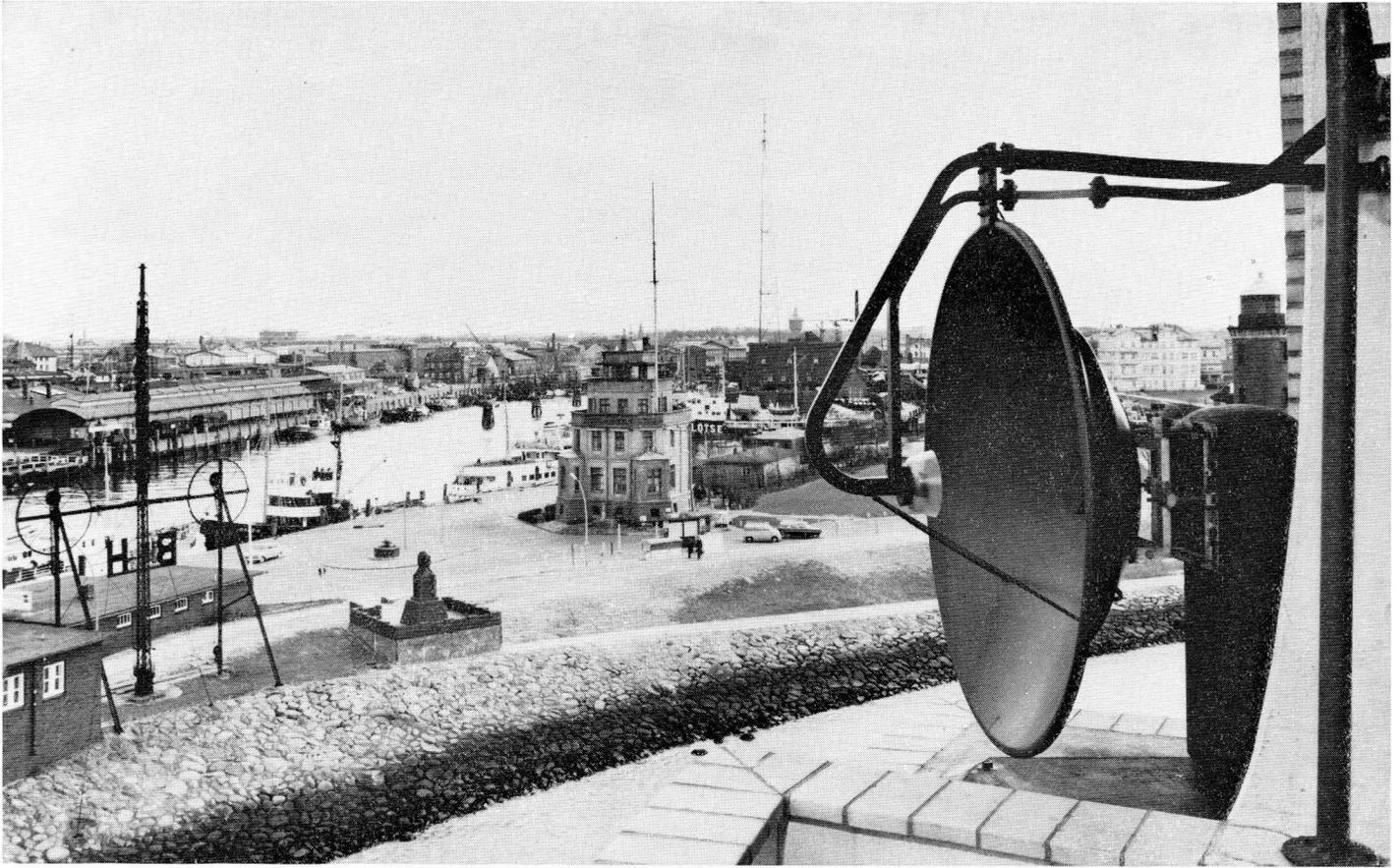
Video test rack, type SBM 112; equipped with all instruments required for a thorough check on the proper operation of a television station.

Television monitor, type SBM 509; permitting a complete check on the video signal in transmitter stations, relay stations and studios.



The left bay contains two modulators and two demodulators, type 8SC 521, the right bay is equipped with a transmitter and a receiver, type 8SR 520.

## 18. RADIO RELAY



The rivers Elbe and Weser in W. Germany are equipped with Philips radar chains. For the transmission of radar signals a 7000 Mc/s radio-relay system is used. This picture shows one of the aerials at the Cuxhaven station.

The last few years have seen a rapid growth of the communication medium known as radio relay. "Wireless cables" have proved the ideal means not only for linking sound and t.v. broadcast transmitters in national and international networks (e.g. Eurovision) but also for relaying radar pictures and transmitting multichannel telephony and telegraphy signals. The advantages offered by radio relay are many. For example, installation and maintenance work can be limited to known, fixed sites. Since the stations often have to operate unattended for long periods, we have increased the reliability of the equipment to the limit of what is possible. Flawless signal transmission can thus be guaranteed in all circumstances and in any climate. More detailed information about the products described in this paragraph will be found in our section catalogue "Radio relay", and separate brochures.

400 Mc/s radio-relay equipment, type 8SR 800; intended for use in multichannel telephone networks and permitting the transmission of up to 24 telephone channels.

460 Mc/s radio-relay equipment, type 8SR 840; transistorized, intended for the transmission of 6 telephone channels, each of which may be used as a transmission path for up to 24 duplex telegraph channels.

4000 Mc/s radio-relay equipment, types 8SR 520, 8SC 521; for the transmission of up to 960 telephone channels or 1 television signal; the type 8SR 520 equipment consists of a transmitter and a receiver for use in repeater stations, the type 8SC 521 equipment includes modulators and demodulators for use in terminal stations.

7000 Mc/s radio-relay equipment, types 8SZ 405, 8SO 405; for very reliable transmission of broadband signals such as: (colour) television signals, multichannel high-quality sound, radar video signals, broadband pulse signals; based on the frequency diversity principle, the

type 8SZ 405 equipment comprises two transmitters, the type 8SO 405 equipment comprises two receivers.

7000 Mc/s radio-relay equipment, type 8SR 410; for the transmission of 24—60 telephone channels, duplicated equipment on a frequency-diversity basis.

7000 Mc/s radio-relay equipment, type 8SR 411; for the transmission of 60—120 telephone channels, duplicated equipment on a frequency-diversity basis.

7000 Mc/s radio-relay equipment, type 8SR 412; for the transmission of 300 telephone channels or 1 television signal, duplicated equipment on a frequency-diversity basis.

Aerials for radio-relay systems; high quality corner reflector aerials, parabolic reflector aerials, horn radiators and passive reflectors.

## 19. MOBILE RADIO



Semaphore receiver, in this photograph used in a car.

A special form of radio communication is that in which mobile radio equipment is used. This equipment can be divided into: Mobilophones (mobile radio telephones) for use in water and land vehicles.

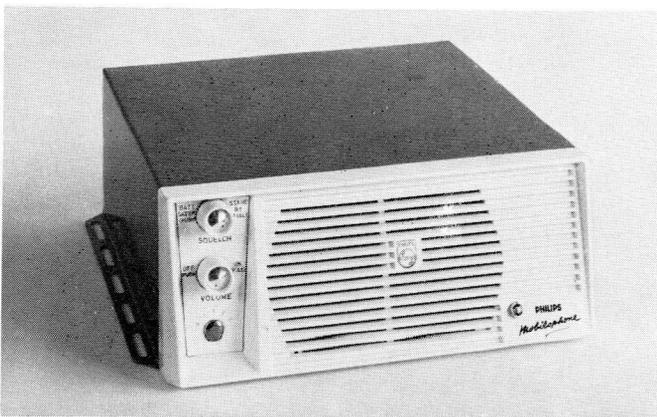
Portophones (portable Mobilophones).

Fixed station equipment for use in Mobilophone and Portophone networks (a fixed station can, for example, be a simple means of linking a mobile network to a "normal" telephone network).

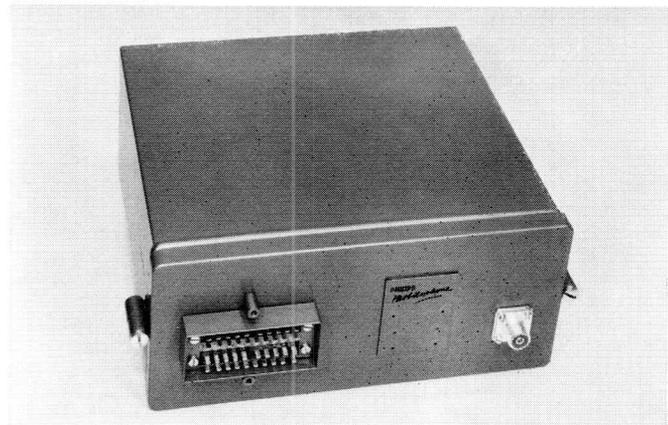
Semaphones (portable sets for the selective reception of individual code calls).

Our mobile radio programme is complete and by its versatility permits maximum efficiency in any application, under all circumstances and in any climate.

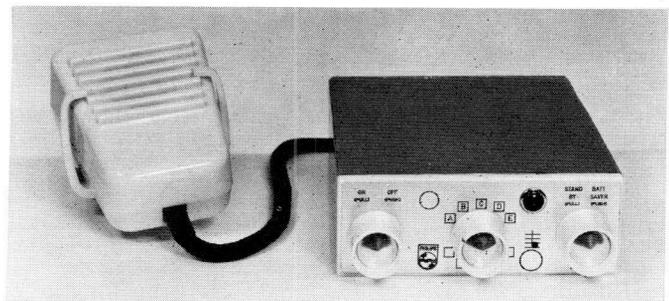
More detailed information about the products described in this chapter will be found in our section catalogue "Mobile radio", and separate brochures.



1



2



3

The mobilophone type ZPH is manufactured in several versions.

1: front-controlled, single channel version.

2: remote-controlled multichannel version in airtight cabinet.

3: midget control box with microphone.

## MOBILOPHONES

Transistor front-controlled mobilophone, type *ZPH*; mobile v.h.f. f.m. transmitter/receiver with extremely low power consumption; available in several versions, a.o.: output power 10 W, 25 W, frequency channels 1, 2—5, 2—12, power supply 6—12 V d.c., 12—24 V d.c.

Transistor remotely-controlled mobilophone, type *ZPH*; as previous item but housed in blind (standard or airtight) cabinet to be connected to separate control box, loudspeaker and microphone c.q. handset.

Midget control box, type *8ML 700*; for the remotely-controlled mobilophone type *ZPH*

Multi-purpose control box, type *8ML 709*; for the remotely-controlled mobilophone type *ZPH*

Power supply unit, type *27UAR 3*; input: 125, 220 V a.c., output: 13.8 V d.c. highly stabilized, for mobilophones type *ZPH* when used stationary.

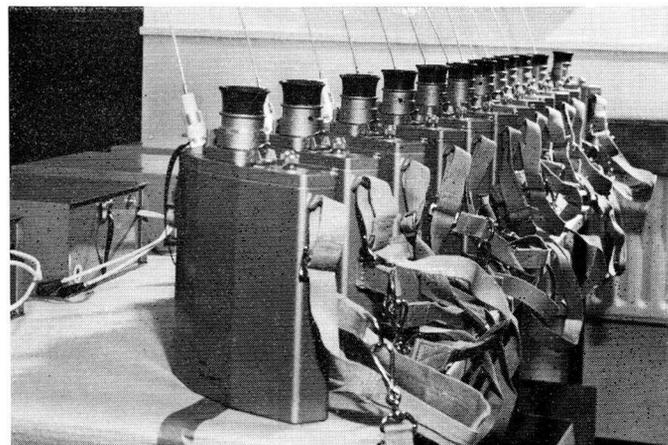
Microphones, handsets and loudspeakers for use with mobilophones type *ZPH*

## PORTOPHONES

Transistor portophone, type *TPR*; portable v.h.f. f.m. transmitter/receiver with up to 6 frequency channels; built-in batteries or accumulator with mains-powered charger, small, light-weight, dust and splash-proof, easy to handle.

Transistor portophone, type *NST*; portable v.h.f. f.m. transmitter/receiver for single-channel operation; built-in batteries or accumulators; the special curved shape of the cabinet makes the set very suitable for wearing on the person without encumbrance.

Mains-powered charger, type *8MD 320*; for charging the nickle-cadmium accumulators of up to 2 portophones type *NST*



A series of portophones type *NST*, ready for action with the Dutch Red Cross organisation.

## FIXED STATION EQUIPMENT

Transistor desk fixed station, (mobilophone), type *ZPH*; as described with "Mobilophones"; output power 10 W, power supply 110, 115 or 220 V a.c., 50—60 c/s

Transistor universal fixed station, type *PFT*; v.h.f. f.m. transmitter/receiver for use as simplex or duplex base station in mobile radio networks, as fixed station for a point-to-point single channel radio-telephone or multi-channel radio-telegraph connection or as automatic repeater station; power output 50 W, suitable for continuous operation.

Special quality transmitter, type *8MZ 650*; v.h.f. f.m. transmitter for use as base station in mobile radio networks when top performance and least possible maintenance are required, power output 60 W.

Special quality receiver, type *8MO 650*; v.h.f. f.m. receiver for use in combination with the special quality transmitter type *8MZ 650*

Special quality radio terminal, type *8ME 650*; for establishing and throughlinking of calls from a mobile radio base station into a trunk-telephone switchboard.

Desk telephone set, type *8ML 105*; for local or extended control of fixed stations type *ZPH* and type *PFT*, equipped with loudspeaker for voice calling.

Remote control equipment; line connection box, type *8MU 107*, and amplifier unit, type *8MU 106*; to be used in combination with desk telephone set type *8ML 105* for remote control of fixed stations type *ZPH*, type *PFT* and "special quality" via a 2-wire telephone line.

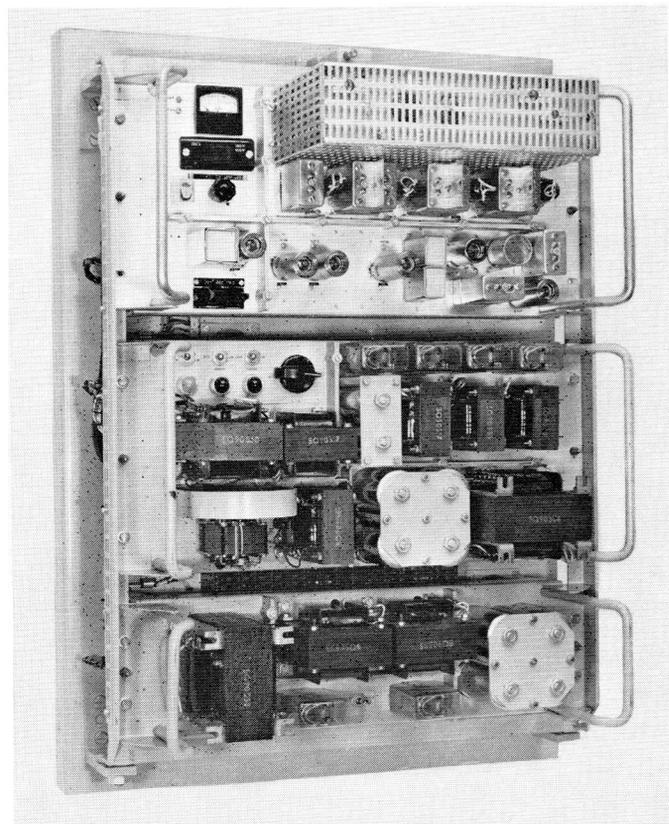
Selective calling and tone signalling equipment is available in several versions for application in mobile radio networks operating type *ZPH*, type *PFT* and "special quality" equipment.

Coaxial cavity resonators, type *1564*; with extremely high Q factor for use as filters in aerial circuits of v.h.f. transmitters and receivers. Reflectometer, type *8RM 167*

## SEMAPHONES

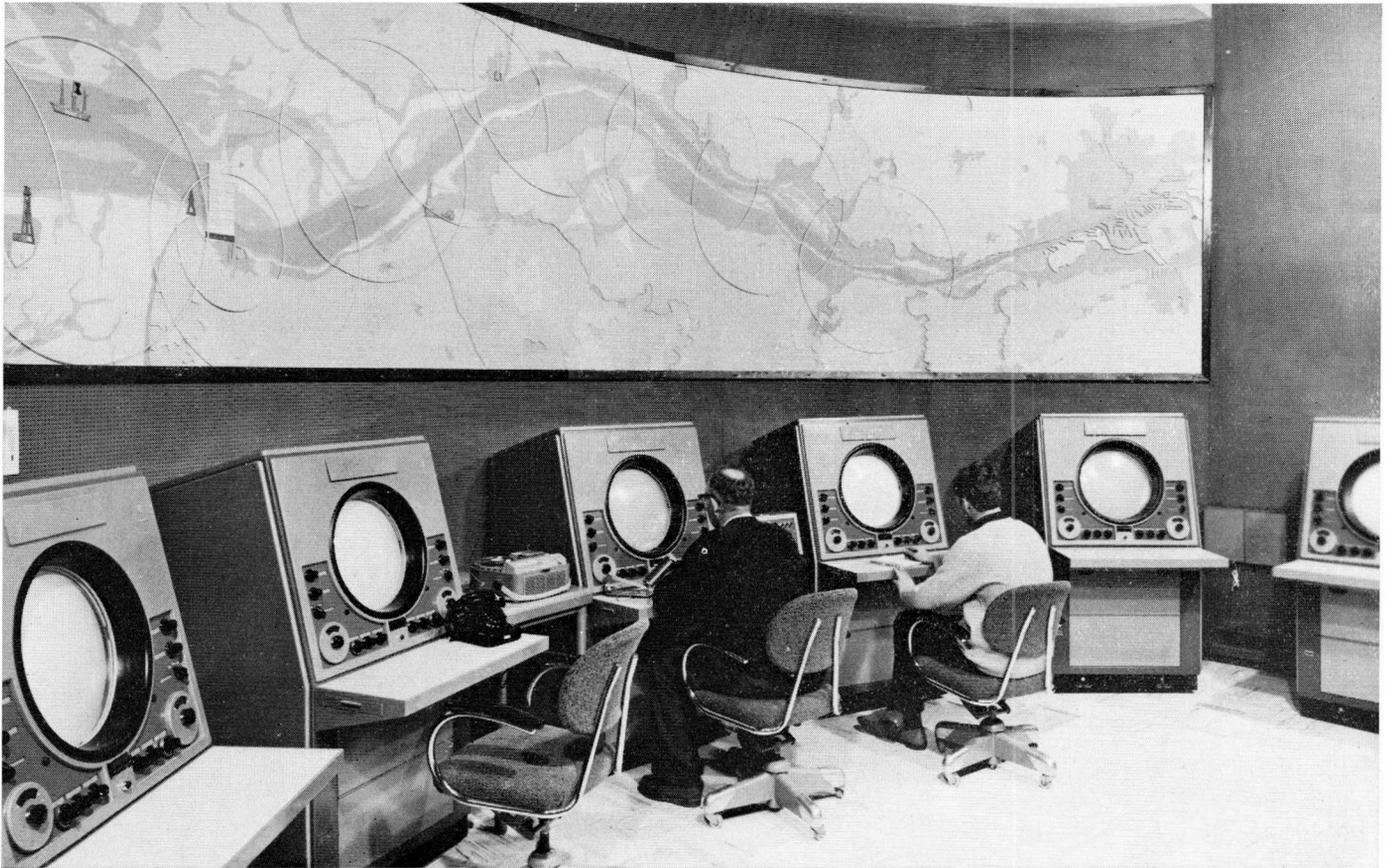
Transistor semaphore, type *ESC*; mobile and portable v.h.f. f.m. receiver for the selective reception and recording of a coded paging call.

Semaphore encoder, type *8MG 520*; generates the coded paging calls which are broadcast via a v.h.f. f.m. transmitter for alarming a semaphore type *ESC*; the max. number of selective calls is over 24 000.



SQ transmitter, type *8MZ 650* (cover removed).

## 20. RADAR AND NAVIGATIONAL AIDS



Operators' room of the river Elbe waterway supervision radar system. The signals from the individual radarstations are transmitted to this room by means of a radio relay system.

Even before the second World War Philips were carrying out experiments which led, inter alia, to the development of a magnetron. As soon as the war ended, that work was resumed on a large scale, often in close co-operation with N.V. Hollandse Signaalapparaten, which now forms part of the Philips Concern. The first great project undertaken was the development and manufacture of radar equipment for the re-organized Netherlands Naval Forces. In the civil field — to which this catalogue is confined — successes were also soon being reported. Orders were received for harbour and waterway supervision and air route surveillance radar. The navigational radar programme includes 9 mm river radar.

Closely related to radar is the equipment needed, especially in the aviation sector, for data processing. In this connection particular attention is drawn to the SATCO system developed by N.V. Hollandse Signaalapparaten.

More detailed information about the products described in this chapter will be found in our section catalogues "Radar" and "Radio communication", and separate brochures dealing with various subjects.

### WATERWAY SUPERVISION RADAR SYSTEMS

In areas of dense traffic a fixed shore-based radar system has several advantages over ship-borne radars (e.g. optimum siting of the stations; operators who are completely familiar with the local situation; co-ordination of stations in a chain; no space problems, so larger aerials and duplication of equipment are possible, etc.).

3 cm radar transmitter/receiver, type 8RG 275; peak pulse power 30 kW, pulse length 0.08  $\mu$ s, p.r.f. approx. 2300 pulses/s, with adjustable s.t.c. and f.t.c.

Slotted waveguide antenna, type 8GA 120; especially designed for the transmitter/receiver type 8GR 275, hor. beamwidth 0.6° or 0.4°

Waveguide switch, type 8GT 124; to connect a duplicated 3 cm transmitter/receiver installation to a common antenna.

Main display unit, type 8GM 252; screen diameter 40 cm (16 in), very high resolving power, fixed coil deflection system, range scales from 3 up to 16 km, adjustable range rings, off-centring, high-precision calibration marks; optional video mapping facilities.

Master deflection unit, type 8GE 1550; for optimal synchronization between antenna and up to 3 main display units type 8GM 252

Display unit, type 8GM 251; for monitoring radar installations, also suitable for normal operational use, screen diameter 31 cm (12 in); optional video mapping facilities.

Reflection plotter, type NX 12670; for very accurate plotting of moving objects, to be mounted over the screen of the display unit, available in any size.

Radar/radio-relay converter, types 8GE 144, 8GE 2101; to convert the information obtained by a (remote) radar station into a form suitable for transmission via a radio-relay system (to a display centre).

Radio-relay/radar converter, types 8GE 2150, 8GE 2151; to convert information transmitted via a radio-relay system back into a complete radar signal.

3 cm radar test equipment; for measurements and adjustments on all types of 3 cm radar equipment: radar oscilloscope, switchable test set, noise generator, power supply unit, double directional coupler, dummy loads, thermistors, waveguide switches and several other accessories.

## NAVIGATIONAL RADAR

In the marine radar sector we can supply equipment which has been specially developed as river radar, with its attendant advantages for every form of short-range navigation (in-shore sailing, close-quarter manoeuvring and station-keeping).

9 mm transistorized river radar, type 8GR 260/00; authorized navigational aid on inland shipping routes, extremely high definition, very compact equipment; peak pulse power 20 kW, pulse length 0.04  $\mu$ s, p.r.f. 2500 pulses/s, hor. beamwidth 0.6°, scanner speed 40 rev/min, 31 cm (12 in) display with range scales from 600 up to 5000 m, range rings, off-centring, switchable f.t.c., power consumption less than 500 W



Antenna, mounted directly to the watertight transmitter/receiver cabinet of a 9 mm high-definition radar installation on board an inland water tanker.

## AIR ROUTE SURVEILLANCE AND TERMINAL AREA RADAR

While it is beyond doubt that it has become an indispensable aid to air traffic control, radar has to be carefully co-ordinated with other parts of the ATC system. The products in the following list are consequently designed to be entirely suitable for co-operating with those in the "Operational control equipment" programme.

25 cm air route surveillance radar, type 8GR 200; complete system for very long range, comprising two transmitters, two receivers, antenna, waveguide switch, two test sets, power supply, Ward-Leonard aggregate and remote control panel; good height coverage, extensive measures have been taken against interference; peak pulse power 600 kW; pulse length 2 or 5  $\mu$ s, p.r.f. 500 or 250 pulses/s, hor. beamwidth 1°

10 cm terminal area radar (STAR), type 8GR 550; complete system for medium and long range, comprising transmitter/receiver, MTI + ISU unit, antenna, power supply and remote control panel; good height coverage, extensive measures have been taken against interference; peak pulse power 500 kW, pulse length 1  $\mu$ s, p.r.f. 800—1000 or 500—550 pulses/s (staggered), hor. beamwidth 1.2°

10 cm terminal area radar (STAR), type 8GR 552; as previous item, but comprising a duplicate transmitter/receiver with a diplexer.

10 cm terminal approach radar, type 8GR 500; complete system for medium and long range, comprising transmitter, receiver, antenna, power supply and remote control box; good height coverage,

extensive measures have been taken against interference; peak pulse power 750 kW, pulse length 0.5 or 2.3  $\mu$ s, p.r.f. 1000 or 250 pulses/s, hor. beamwidth 1.2°

9 mm transistorized ASDE radar, type 8GR 260/41; complete system for short range, comprising transmitter, receiver, antenna, indicator, power supply; extremely high definition; peak pulse power 20 kW, pulse length 0.03  $\mu$ s, p.r.f. 6000 pulses/s, hor. beamwidth 0.3°, 31 cm (12 in) display with range scales from 600 up to 5000 m, range rings, rainclutter suppression.

Main display unit, type 8GM 310; transistorized, screen diameter 40 cm (16 in), high definition, fixed coil deflection system, 4 range scales, range marker, angle markers, off-centring, pushbutton operation, interscan presentation of markers, optional facilities for video mapping, interconsole marking, picture magnification and joystick.

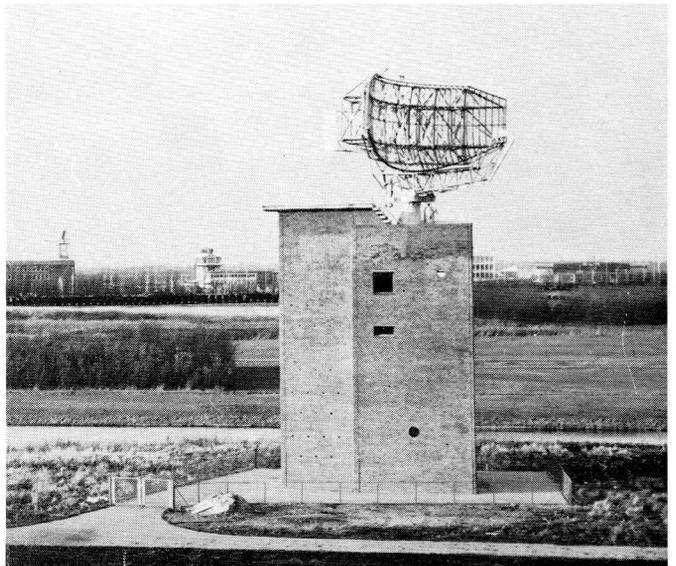
Display unit, type SGM 103; general purpose indicator, tropicalized and drip-proof, screen diameter 31 cm (12 in), adjustable range scales, calibration rings.

Display unit, type 8GM 145; transistorized, for monitoring radar installations, screen diameter 12 cm (5 in)

Video map unit, type 8GE 2003; for generating video signals which can be used to display additional information in the raw radar picture (coastlines, airfield runways, etc.).

Parametric amplifier unit, type 8GV 130; for connection to existing 25 cm radar receiver equipment, giving gain in range.

10 cm radar test equipment; for measurements on all types of 10 cm radar equipment: radar oscilloscope, switchable test set, noise generator, power supply unit, double directional coupler, dummy loads, thermistors, waveguide switches and several other accessories.



25 cm air route surveillance radar at Schiphol Airport near Amsterdam.

## OPERATIONAL CONTROL EQUIPMENT

The air traffic services constitute an overall system embracing several functions: air traffic control (area, approach and aerodrome control), flight information service and alerting service. For less busy ATC units three varieties of positions have been designed. In busier ATC units the task of each controller has become so extensive that part of it has to be taken over by a computer. The latter was the basic idea underlying the development of the SATCO system.

Air traffic control operator's position, type 8RL 512

Approach control operator's desk, type 8RL 509

Air/ground control operator's desk, type 8RL 502

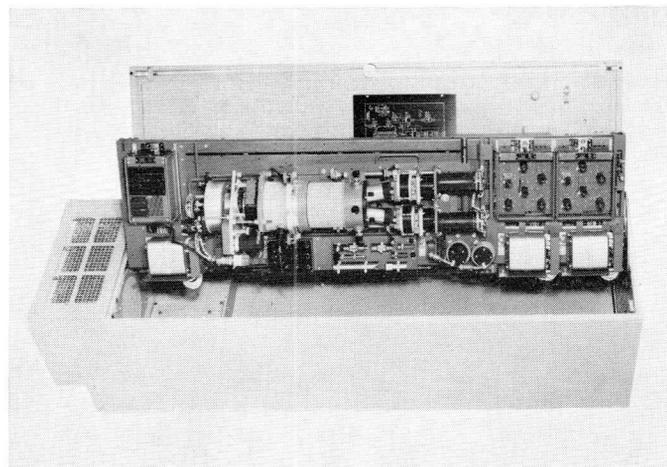
Tower control operator's desk, type 8RL 511

Automatic air traffic control system SATCO, consisting of a logical combination of groups of equipment as computer system, radar equipment, automatic flight progress, tower and approach display boards, teleprinters, etc.; each SATCO system design is "tailored"

for the organisation for which it is destined and to the requirements that have to be met; the SATCO system is self-checking throughout and complies with the guidance requirements of the ICAO.

SATCO computer, fully transistorized, general purpose digital computer, specially adapted to ATC problems; Ferrite core memories are used for arithmetic data and the program; magnetic drums constitute the flight data memory.

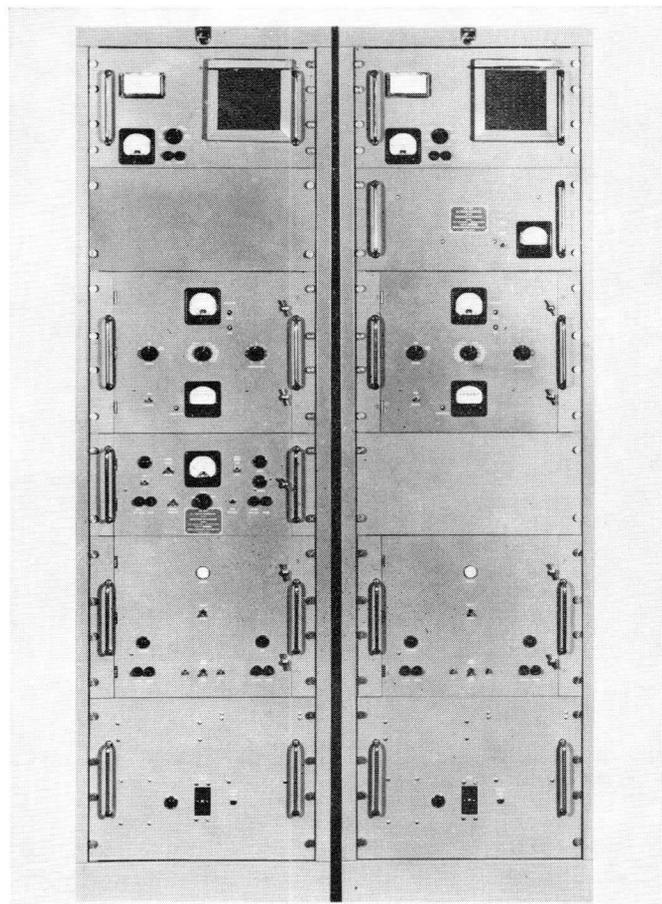
SATCO automatic flight-progress boards, both tabular and panoramic displays are used; on the tabular boards the display is effected with electro-mechanical indicators, arranged in groups to form strips; for the panoramic displays PPI's may be used on which synthetic (computer) information may be added to the radar video.



Video map unit type 8GE 2003, in open position.



Air traffic control operators' positions manufactured for Bogotá Airport, Columbia.



1 kW dual radio beacon, type 8RB 551.

## RADIO BEACONS

One of the earliest radio aids to navigation is the non-directional beacon. It enables the navigator to use his direction-finder (ADF) or radio compass.

50 W dual low or medium-frequency radio beacon, type 8RB 550; a land-based navigational aid for use at remote unattended stations; satisfies ICAO recommendations.

1 kW dual low or medium-frequency radio beacon, type 8RB 551; a land-based navigational aid for use at remote unattended stations; satisfies ICAO recommendations.

Radio beacon monitor receiver, type 8RO 550; to monitor radiated signals from non-directional radio beacon transmitters in accordance with the monitoring requirements of ICAO.

## 21. TELEGRAPHY



Operators room of the SITA telegraph centre at Paris.

The oldest form of telecommunication is undoubtedly telegraphy. Fire and smoke signals, flags, etc. had been in use for thousands of years until Samuel Morse put electricity to use to span distances. Although it was soon largely superseded by telephony, telegraphy is winning back much of its lost ground in modern times. The chief reasons for this recovery are:

new transmission techniques make high signalling speeds possible; new switching techniques enable connections to be set up quickly and faultlessly and messages to be forwarded immediately or stored temporarily, depending on their priority and the state of the line; because of automation, public authorities and business organizations are experiencing a growing need to exchange information in standardized form (e.g. flight information in the aviation sector); the information is received in a permanent form (e.g. in black and white on a telex machine), so that the correspondence is recorded and in the temporary absence of the addressee no messages are lost. With regard to the new techniques Philips are in many respects the pacemakers.

More detailed information about the products described in this chapter will be found in our section catalogues "Telegraph transmission", "Automatic error detection and correction" and "Telegraph switching", and separate brochures.

### TELEGRAPH TRANSMISSION

Duplex traffic, i.e. simultaneous transmission in both directions, is possible with all Philips transmission equipment. When need exists for only a simplex circuit, it is sufficient to install only part of the equipment. For use on routes with low traffic requirements systems for the simultaneous transmission of speech and telegraphy have been developed (speech + duplex systems).

Voice-frequency telegraph system, type *STR 114*, operating with frequency shift, providing up to 24 duplex 50 baud telegraph channels per 4 wire telephone circuit.

Voice-frequency telegraph systems, types *BTR 510*, *BTR 513*, transistorized, operating with amplitude modulation, providing up to 24 duplex 50 baud telegraph channels per 4 wire telephone circuit.

Voice-frequency telegraph system, type *3TR 1100*, transistorized, operating with amplitude modulation, providing up to 24 duplex 50 baud telegraph channels per 4 wire telephone circuit.

Voice-frequency telegraph systems, types *BTR 520*, *BTR 523*, transistorized, operating with frequency shift, providing up to 24 duplex 50 baud telegraph channels per 4 wire telephone circuit.

Voice-frequency telegraph system, type *BTR 547*, transistorized, operating with frequency shift, providing up to 12 duplex 100 baud telegraph channels or up to 6 duplex 200 baud telegraph channels per 4 wire telephone circuit.

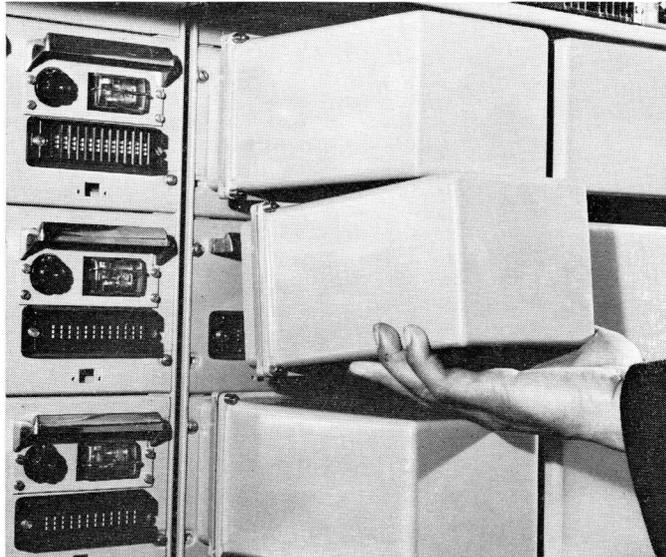
Speech + duplex telegraph system, type *BTR 524*, transistorized, operating with frequency shift, enables the addition of 1 frequency

modulated 50 baud telegraph channel to an existing 2 wire telephone circuit.

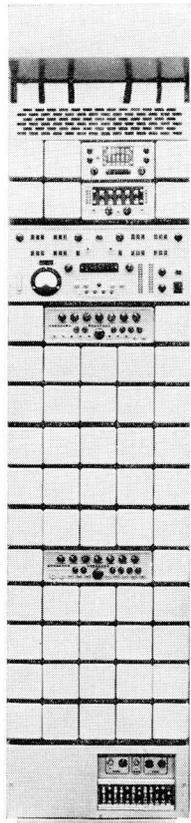
Speech + duplex telegraph system, type *BTR 515*, transistorized, operating with amplitude modulation, enables the addition of 1 or 2 voice-frequency 50 baud telegraph channels to an existing 4 wire telephone circuit.

Speech + duplex telegraph system, type *BTR 525*, transistorized, operating with frequency shift, enables the addition of 1 or 2 voice-frequency 50 baud telegraph channels to an existing 4 wire telephone circuit.

Power supply panels, types *8TD 102*, *8TD 103*, used for the supply of d.c. power to teleprinter, telegraph and similar circuits.



The components of our transmission equipment are housed in "conclave" units, which can be fitted or removed with a simple movement of the hand.



Transistorized 7-element TOR, type *24TR 100*.

## AUTOMATIC ERROR DETECTION AND CORRECTION EQUIPMENT

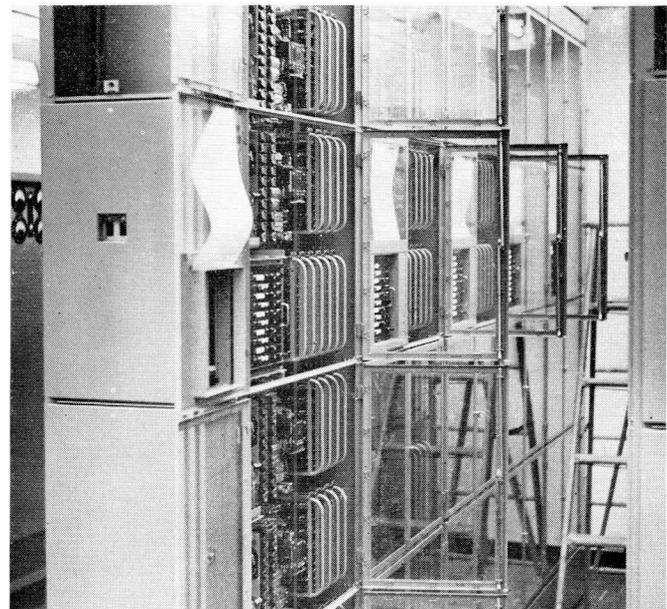
For long-haul telegraphy radio transmission is being used on an ever increasing scale. But instability of propagation conditions, atmospheric disturbances, etc., necessitate continuous supervision of the received information to ensure that any mistakes which occur are detected and corrected. We supply two types of equipment which provide ample protection for "telegraphy on radio" (TOR).

7 element TOR, type *24TR 100*, transistorized, accepts standard 5 unit code and converts to 7 unit code; to meet various terminating requirements a complete range of transistorized ancillary equipment is available.

5 element TOR, type *8AX 30*, transistorized, operates on full duplex basis, the equipment can work at five different speeds up to a maximum of 100 bauds.

## TELEGRAPH SWITCHING

Our telegraphy switching equipment — known as the ES (electromagnetic storage) system — can be supplied in a number of versions, varying from a semi-automatic torn tape system to a fully automatic version. After a particular version has been installed, both its degree of automation and its capacity can be increased without any interruption in the service.



Combined receiving and transmitting units of the ES exchange in the State Department at Washington (U.S.A.).

Automatic message switching system, type *ES-0*; torn-tape relay combined with automatic switching, using individual address stores.

Automatic message switching system, type *ES-1*; torn-tape relay combined with automatic switching, using a common address store and individual message stores for waiting telegrams.

Automatic message switching system, type *ES-2*; semi-automatic non-torn-tape relay concentrated on a few sitting positions, combined with automatic switching as in the previous case.

Automatic message switching system, type *ES-3*; fully automatic relay, combined with automatic switching as in the previous case.

Prefix transmitter, type *8AX 5658*; for message numbering in telegraph networks.

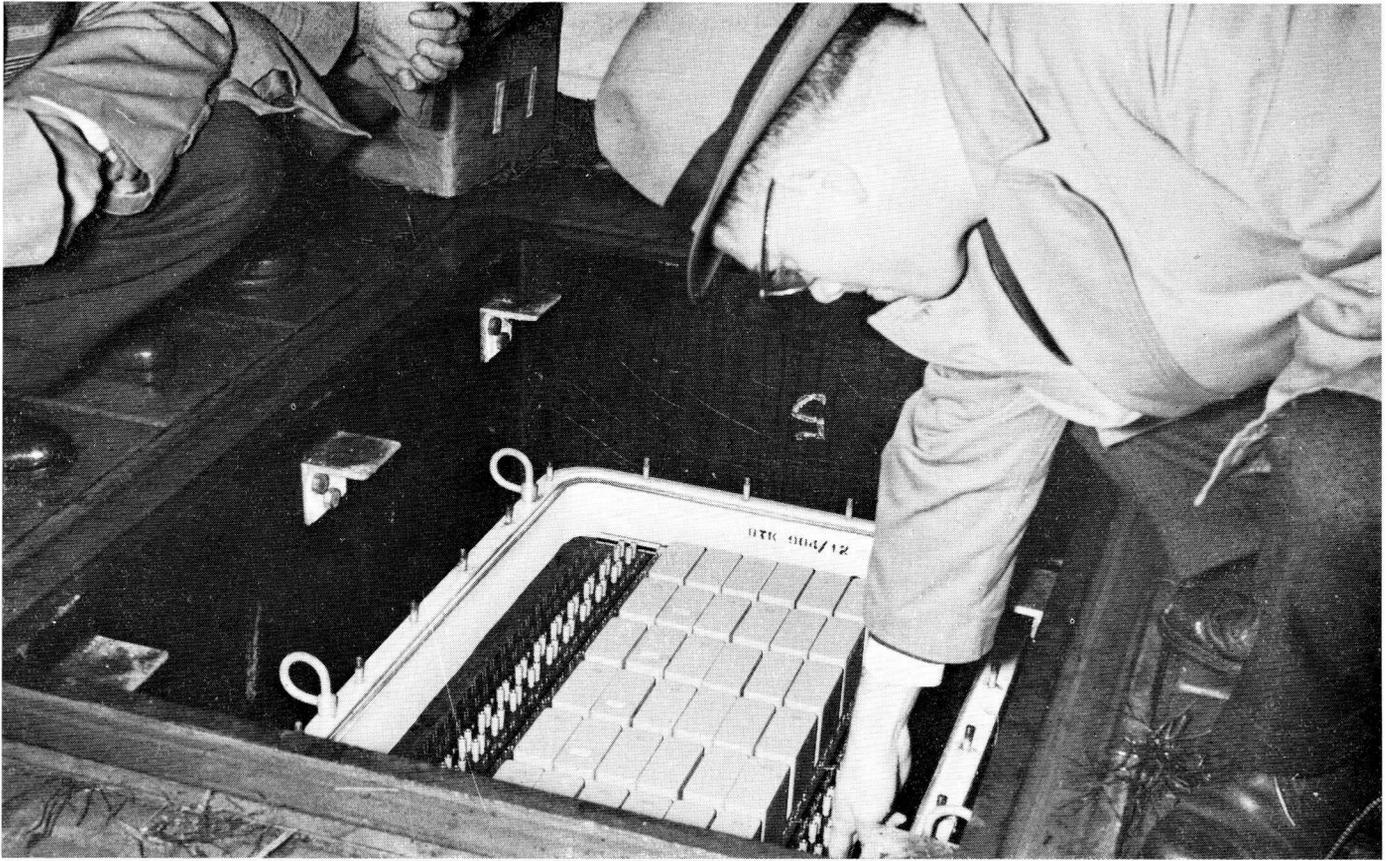
Circuit-continuity check system, type *8AX 1084*

Combined receiving and transmitting unit, type *8AX 4207*; with 5000 or 10 000 cores for storage of 1000 resp. 2000 telegraph characters.

Magnetic tape store, type *MBO 51*; for storage of 40 000 characters on an exceptionally small area of tape.

Programmed selector, type *8AX 10*; for starting remote transmitters automatically from a central point and at the proper time.

## 22. TELEPHONY



Inspection of an underground repeater.

As long ago as 1930 Philips were active in the field of carrier telephony. The invention of Ferroxcube was one milestone on the road of progress, and in the course of the years a wide variety of products have become available. But transmission equipment is not the only branch of telephony in which Philips have built up a world-wide reputation. Telephone switching equipment is also prominently represented in their programme by high-speed telephone exchanges for public or private use and with small or large capacities.

More detailed information about the products described in this chapter will be found in our section catalogues "Telephone transmission", "Public telephone exchanges" and "Private telephone exchanges and equipment", and separate brochures.

### TELEPHONE TRANSMISSION

The main items in this part of the programme are:  
V.F. equipment and carrier equipment for open-wire, cable and radio transmission.

Loading coils and loading-coil cases for insertion at regular intervals in voice-frequency telephone cables in order to reduce the attenuation and linear distortion on these circuits; coils available with several types of Ferroxcube pot cores; cases for manhole and for pole mounting.

Negistor equipment, type *8TR 137*, constituting a 2 wire series-shunt negative-impedance repeater, fully transistorized.

Carrier telephone equipment, type *FTR 133*, long-haul system for use on open-wire lines, providing 3 channels in addition to the physical circuit.

Carrier telephone equipment, type *FTR 135*, long-haul system for use on open-wire lines, providing 12 channels.

Carrier telephone equipment, type *7TR 001*, transistorized system for use on open-wire lines, cables and compound circuits, providing 10 stackable channels.

Carrier telephone equipment, type *8TR 202*, transistorized medium and short-haul system for use on single deloaded voice-frequency or carrier cables, providing 12 channels.

Carrier telephone equipment, type *8TR 301*, transistorized long-haul system for use on a four-wire circuit in balanced twin carrier cables, providing 120 channels.

Carrier telephone equipment, type *8TR 310*, transistorized short-haul system for use on selected circuits in single voice-frequency cables, providing 60 channels.

Carrier telephone equipment, type *STR 113*, multiplexing equipment for use on radio-relay systems, providing 16 channels.

Carrier telephone equipment, type *8TR 206*, transistorized multiplexing equipment for use on radio-relay systems, providing 24 channels.

Carrier telephone equipment, type *8TR 309*, transistorized multiplexing equipment for use on radio-relay systems, providing 120 channels.

Carrier telephone equipment, type *8TR 308*, transistorized multiplexing equipment for use on radio-relay systems, providing 300 channels.

Carrier telephone equipment, type *8TR 305*, transistorized multiplexing equipment for use on radio-relay systems, providing 1800 channels.

Programme modulating equipment, type *STR 119*, for the transmission (e.g. from studio to transmitter) of audio signals via carrier telephone circuits.

## TELEPHONE SETS AND ANCILLARY EQUIPMENT

Telephone set, type 8AE 3000, modern looking set, available for push-button or dial selection.

Series telephone equipment, types 8AH 940-950, the cheap and economic "private branch exchange" for offices, etc., with a limited number of staff, capacities ranging from 1—1—11 to 3—5—11.

Secretary circuits, types 8AH 953-955, to enable a secretary to screen all incoming calls for her chief.

Telephone equipment, type 85, especially designed for use in houses, flats, hotels, etc.

Luminous call equipment for noiseless display of information in hospitals, offices, hotels, etc.

A range of components, comprising the types U 45b and U 55 non-homing uniselectors, the universal relay T 51, the high-speed relay S 50, luminous display units, subscriber meters, desk and field-telephone sets, installation equipment, etc.

Television modulating equipment, type STR 120, for the transmission of video signals by cable.

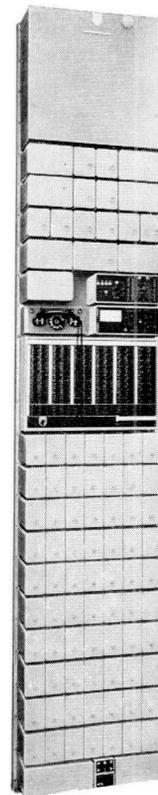
500/20 c/s ring-down signalling equipment, type 8TR 138, for use on carrier circuits or repeated voice-frequency circuits.

Voice-frequency terminating equipment, type 8TR 140, for linking-up the 4-wire terminals of a Philips carrier telephone system with an exchange or for through-connecting to another carrier telephone system.

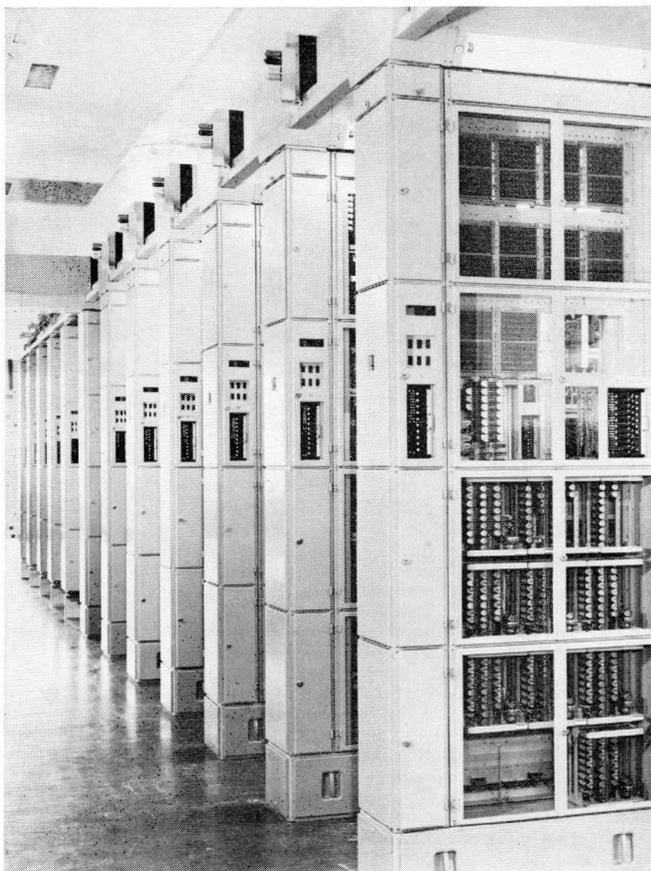
Speech compandor equipment type FTV 131230, to improve the signal-to-noise ratio on open-wire lines, cables or radio-relay systems.

Auxiliary h.f. equipment, type 8TR 210, comprising through-working, branching and balancing equipment.

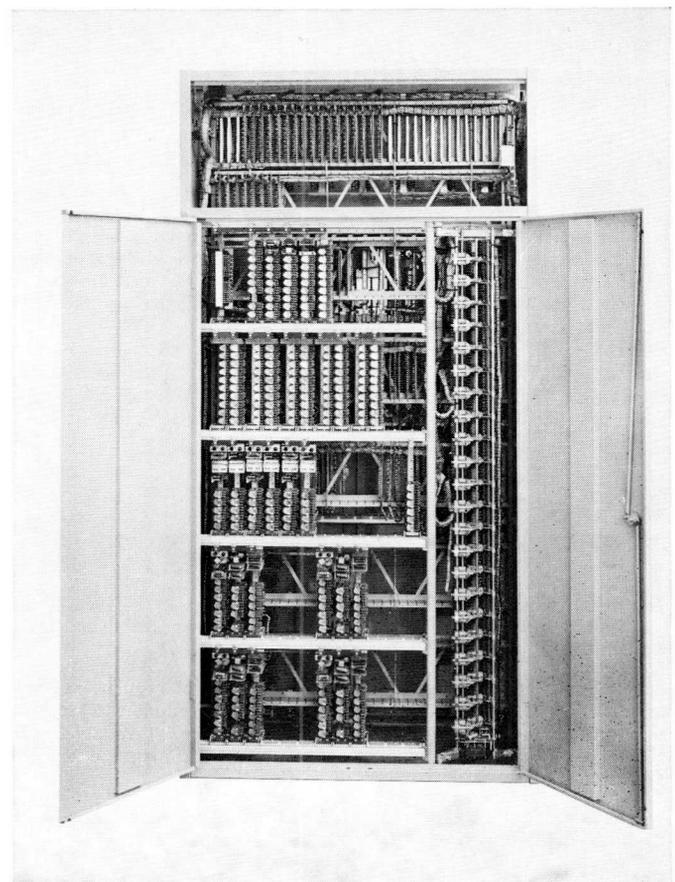
Transmission measuring set, type 8TM 141, especially intended for measurements on Philips transistorized carrier telephone systems.



Carrier telephone equipment, type 8TR 309.



Telephone traffic in the Netherlands is fully automatic. This photograph shows one of the type UR 49a public exchanges in use in Amsterdam.



This type UH PABX asks for no more space than an office cabinet.

## TELEPHONE SWITCHING

Philips developed two types of central-driven non-homing high-speed uniselectors, the 100 point type U 45b with a speed of 300 contacts per second and the 54 point type U 55 with a speed of 150 contacts per second. The type U 45b uniselector is the heart of several types of big automatic exchanges with unlimited capacity, the type U 55 is used for smaller automatic exchanges. In addition to this a number of step-by-step and manual exchanges is available.

Public automatic exchange, type UR 49a, direct system employing the type U 45b uniselector; suitable for exchanges of all capacities, can be provided with all equipment that is necessary for trunk traffic or for interworking with other types of exchanges, routing registers may be introduced for discrimination, translation and tariff-determining purposes; housed in racks.

Private automatic branch exchange type UB 49a, register system employing the type U 45b uniselector; especially intended for large offices and works requiring any number of extensions from about 200 up to several thousands; housed in racks, attractive cordless operator's position(s) provided with a key-set for rapid local calling.

Private automatic exchange type UB 49a, as previous item but for works and offices requiring internal traffic only, available for complete key-set dialling.

Public automatic exchange, type UD 1, common-control system employing the type U 55 uniselector; designed for areas with small centres of population, lowest system capacity 50 lines, expandable to 300 lines, up to two systems can be coupled, incorporates all modern facilities; housed in cabinets.

Private automatic branch exchange, type UH 300, indirect system employing the type U 55 uniselector, intended for medium sized organizations requiring from about 30 up to 300 extensions; housed in cabinets; attractive cordless operator's position(s) provided with a key-set for rapid local calling.

Private automatic exchange, type UP, as previous item but for organizations requiring internal traffic only, available for complete key-set dialling.

Private automatic branch exchange, type UH 30, indirect system employing the type U 55 uniselector, intended for small organizations requiring a maximum of 30 extensions; housed in a cabinet; attractive cordless operator's position provided with a key-set for rapid local calling.

Private automatic branch exchange, type UH 45, indirect system employing the type U 55 uniselector; intended for small organizations requiring a maximum of 45 extensions; housed in a cabinet; attractive cordless operator's position provided with a key-set for rapid local calling.

Public automatic exchange, type F, step-by-step system, suitable for unlimited expansion.

Private automatic branch exchange, type CC, step-by-step system, capacity 5—4—27.

Private automatic branch exchange, type BC, step-by-step system capacity 2—3—18 (max. 3—3—27).

Private automatic branch exchange, type BB, step-by-step system, capacity 1—2—29 or 2—2—29.

Private automatic exchange, type ITA, step-by-step system, capacity max. 0—3—27.

Private manual branch exchange, type 8AH 960, non expandable central battery exchange, capacity max. 5—5—50.

Private manual branch exchange, type 8AH 990, non expandable central battery exchange, capacity 0—18—150 or 6—12—150.

Trunk switch board, type 8AQ 9301, one position, double cord type.

Radio telephone switchboard, type 8AQ 9360, one position, double cord type for 2 and 4 wire radio links.

Power supplies for telephone exchanges.

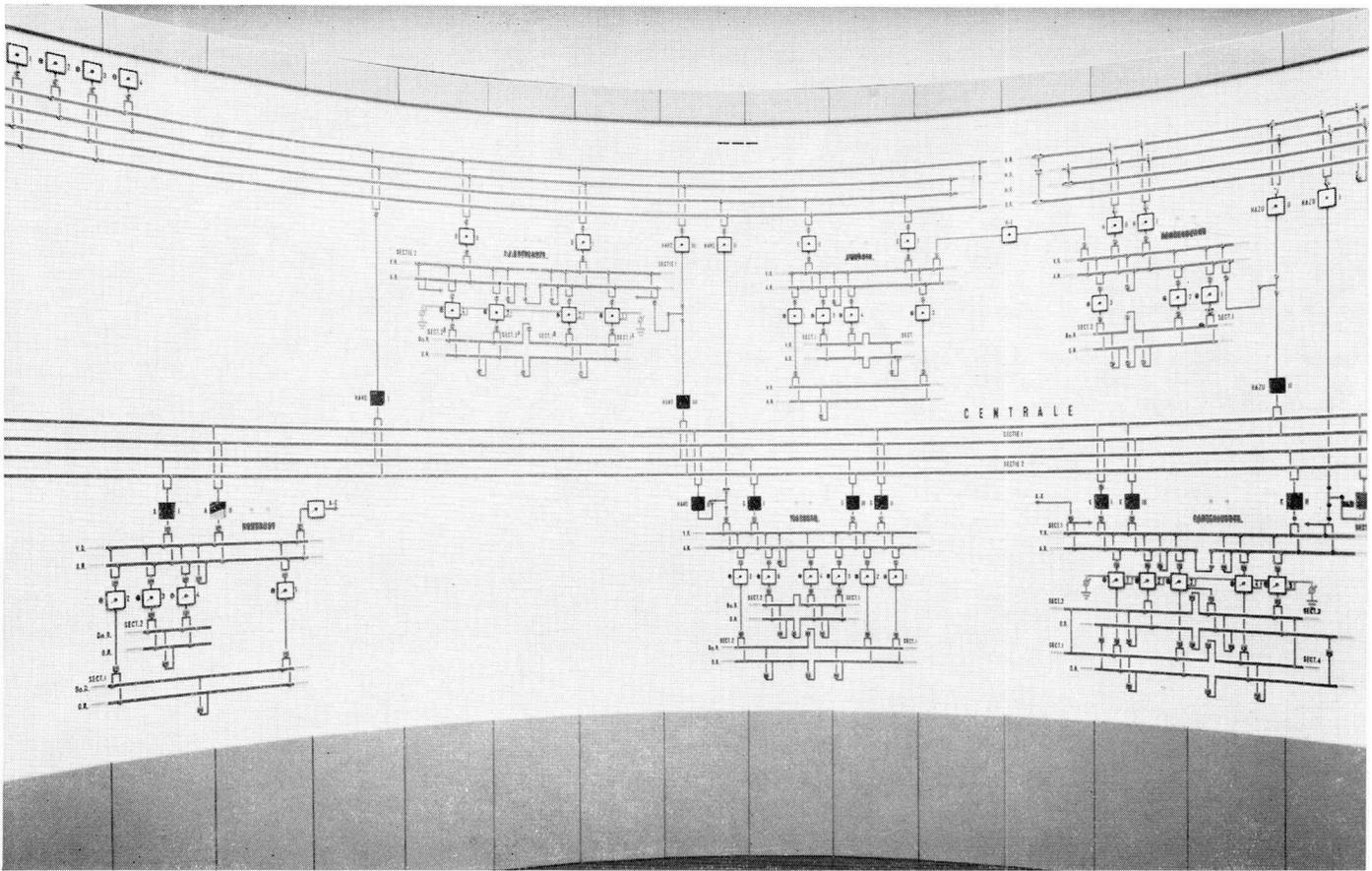


Operators' desk of a PABX with great capacity.



The new Philips table-type telephone set, push-button version.

## 23. TELESUPERVISION



Control and display panel of a telesupervision system for electricity distribution.

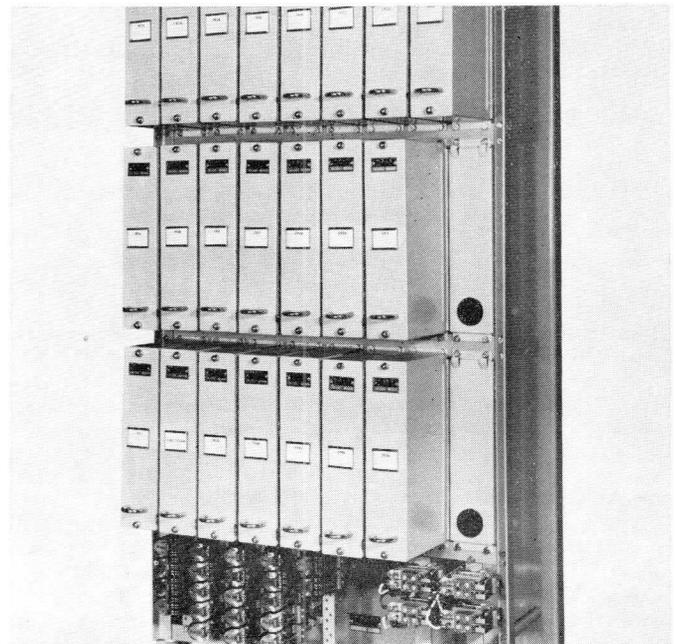
The term "telesupervision" covers the art of controlling and supervising equipment at a distance, control signals being transmitted from a central station to remote equipment (telecontrol), and information concerning positions, alarms, etc. (teleindication) and measured values (telemetry) being conveyed in the return direction. Important fields of application for telesupervision include radio-relay systems, the petroleum and natural gas industries (supervision of hundreds of miles of pipelines and distribution stations), the electricity industry (supervision of sub-stations and distribution or junction networks). We produce a range of equipment enabling telesupervision to be conducted with maximum efficiency. The present chapter only gives a survey of the equipment needed for "translating" control, indication and metering signals into a form suitable for transmission. The actual transmission of these signals can be effected in very different ways, e.g. by radio relay or by telegraph circuits. More detailed information about the products described in this paragraph will be found in our section catalogue "Telesupervision", and separate brochures.

Telecontrol and teleindication equipment, types BTR 600, BTR 601, transistorized, based on the principle of frequency-division multiplex, i.e. the information is conveyed in the form of "tone" signals which can be transmitted over a telephone channel or similar circuit; both systems provide up to 31 channels.

Telecontrol and teleindication equipment, type BTR 604, transistorized, based on the principle of time-division multiplex, i.e. non-sequential data are converted into a sequential form and vice versa; the transmission medium may be a normal 50 baud telegraph circuit

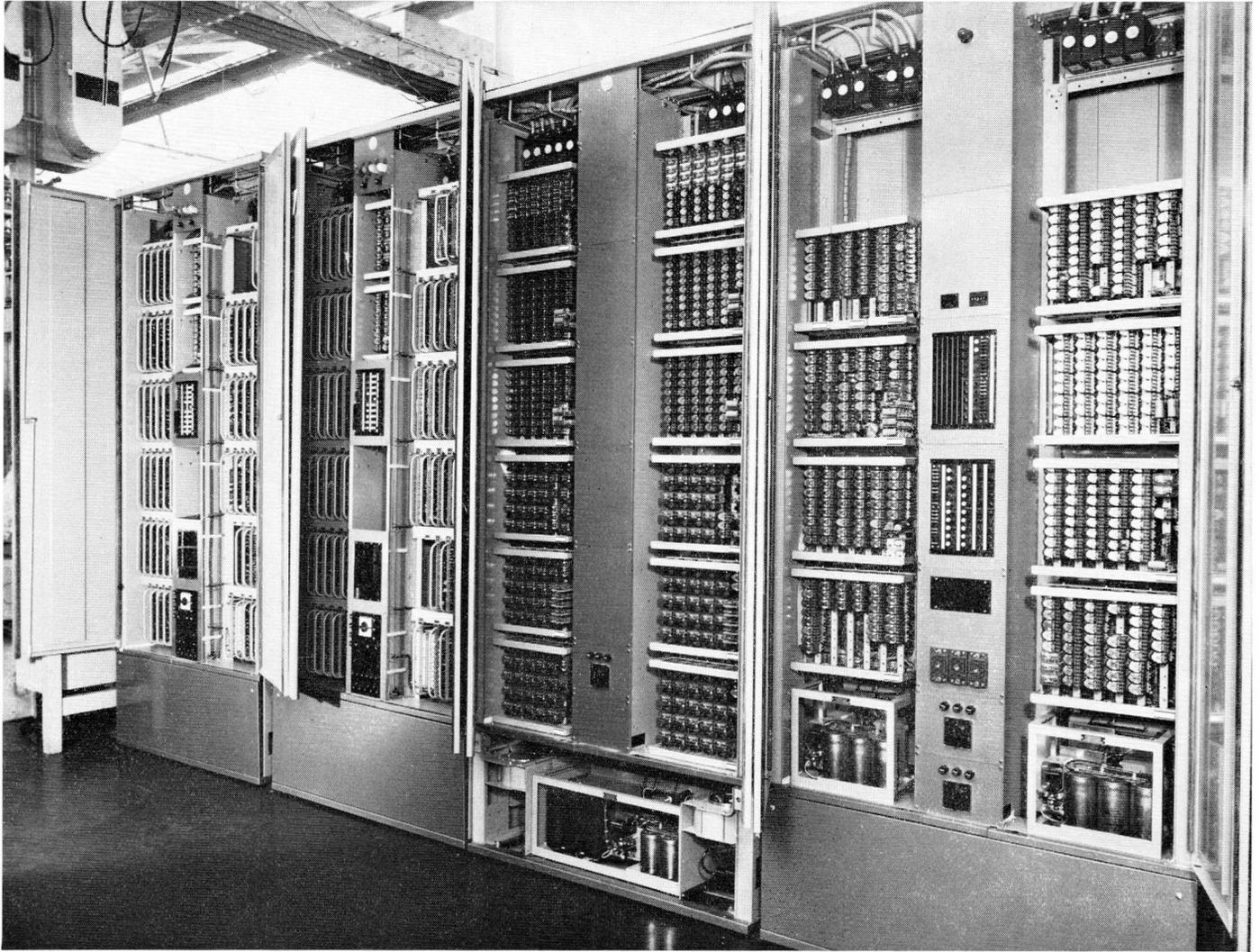
Telecontrol and teleindication equipment, type BTR 606, transistorized, based on the principle of time-division multiplex for fully electronic bothway transmission over a voice-frequency telegraph channel of a limited number of items of binary information.

Telemetry equipment, types BTR 708, BTR 709, transistorized, based on the principle of time-division multiplex; analogue information is converted into a digital form, transmitted over a normal 50 baud telegraph circuit and reconverted into analogue values.

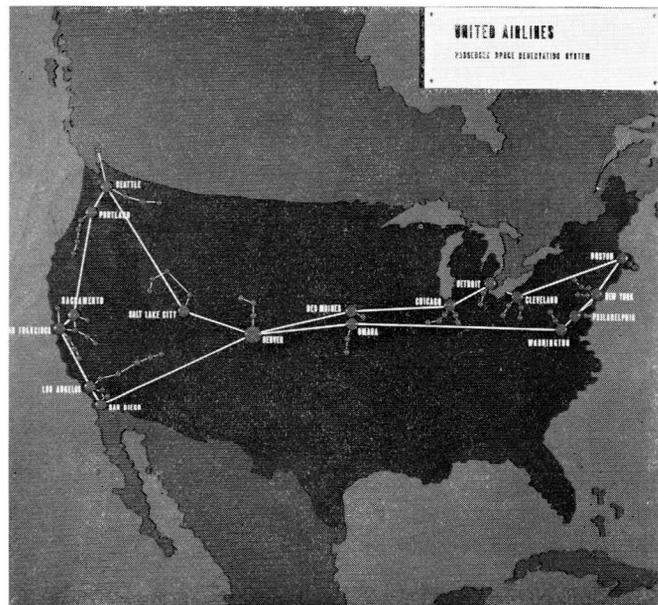


Bay with type PTR 600 telecontrol equipment.

## 24. DATA COMMUNICATION



Concentrator station for United Airlines seat reservation system. This system reaches from coast-to-coast in the USA.



Now that automation has found its way into the administrative field, there are many sectors of business and industrial life where a need has arisen for a rapid exchange of data in standard form. This was a point we observed in the paragraph on Telegraphy. A special form of data transmission is that whereby — if possible, using existing circuits such as public telephone lines — a central administrative machine (e.g. a computer in a head office) is connected to one or more subordinated machines (e.g. the branches of a large business). This still relatively young offshoot from the telecommunication tree is generally referred to as data communication. Philips are applying themselves successfully to this new activity.

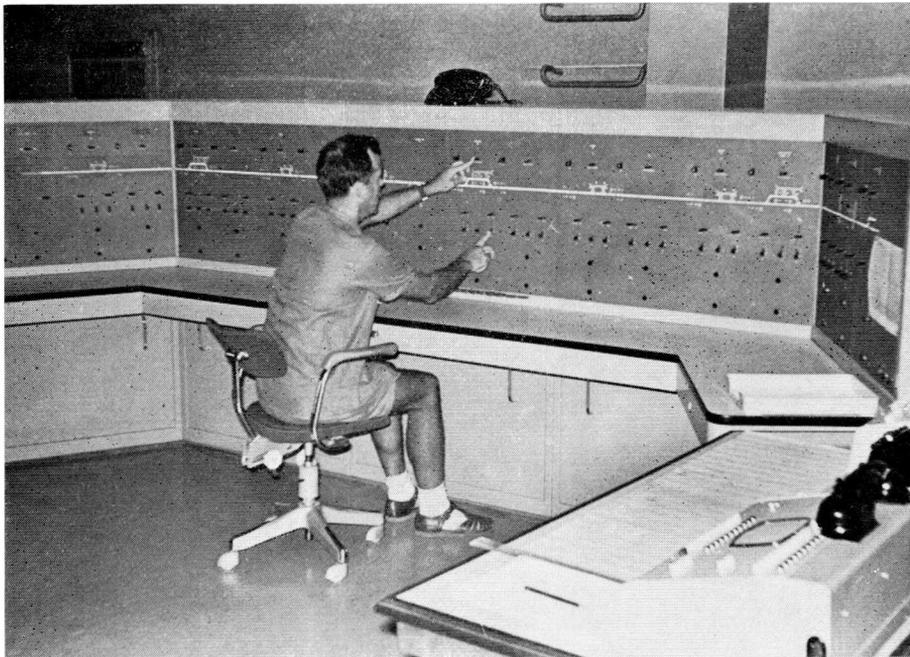
More detailed information about the products described in this paragraph will be found in our section catalogue "Data conveying", and separate brochures.

Data transceiver, type 8AA 950, for data transmission at speeds between 600 and 2000 bauds between data-handling points via point-to-point circuits or via circuits forming part of a switched telephone network.

Frequency modulation system, type 8AA 99, modulator-demodulator (modem) for the transmission of data signals at speeds up to 1200 bauds via a voice-frequency-circuit; if connections are to be established by telephone the modem can be fitted with a digitphone unit.

Phase modulation system, type 8AA 10, modulator-demodulator (modem) for the transmission of data signals at speeds up to 1200 bauds via a voice-frequency-circuit.

## 25. RAILWAY SIGNALLING



In Liberia a 270 km railway is controlled by one operator, sitting in front of a CTC control panel.



Type Velsin route or speed indicator (photograph by kind permission of Netherlands Railways)

Once signalling and route-setting systems were built up by all kinds of mechanical equipment. Semaphores and hand-operated points were connected to a lever frame in a signal box by steel wires running along the tracks. Chains, pulleys, wheel carriers, etc., completed the transmission from the operation room to the points and signals outside.

In modern signalling, electric point machines and multi-aspect colourlight signals are operated on long distance by pressing the push-buttons of a control panel. Track circuits, radio relay and telecommunication form the basic elements of various systems, giving greater safety with faster and more frequent train traffic.

More detailed information about the products described in this chapter will be found in our section catalogue "Railway Signalling and Telecommunications", and separate brochures.

### SYSTEMS

**Centralized traffic control**, by means of which the movements of trains over routes on a designated section are directed by signals controlled from a central post. The codes for controlling the various field-stations are transmitted by electronic time multiplex

transmitters via a common transmission channel, whereas all field-stations have allotted separate transmission channels for indications. The system is highly satisfactory and economical; an important advantage lies in the speed of signalling back to the control panel, which bears a miniature reproduction of the whole section with lamps continuously indicating the position of all trains, condition of signals and points, etc.

**Automatic train control**, to increase safety and eliminate human errors. Impulses with a certain frequency are generated over the tracks to a receiver unit of the train. The receiver translates the code into an automatic train acceleration, deceleration or stop, whatever corresponding frequency has been chosen. In the cabin the train driver receives the information by light or illuminated number-indication. Even if he neglects the warning of a signal, serious accidents are impossible since the train will stop automatically.

**Wagon identification system**, for the efficient control of many trains on a frequent section or quick arrival at destination of goods-carrying wagons. The system is reliable under all climatic and operational conditions. The equipment consists of a wayside transmit-

ter loop, inducing power in a corresponding receiver loop of the wagon-unit, which has an identity number up to 12 decimal figures. Individual carrier frequencies for each of the figures are transmitted simultaneously by the wagon-unit and received and detected by the wayside receiver. The read-out time is very short and the procedure is independent of the train direction.

### COMPONENTS

Control panels.

S Relays for safety circuits.

Flasher relays.

Signals.

Level crossing installations.

Electric point machines.

Point detectors and point locks.

Impedance bonds.

Racks, cases, and housings.

## 26. X-RAY AND MEDICAL EQUIPMENT

### DIAGNOSTICS

#### "Practix"

A portable, self-rectified X-ray tank unit with double-focus tube. It combines high output with low weight and small dimensions. To meet individual requirements a choice can be made of four control devices: footswitch, control box and two control desks. The "Practix" can be mounted on various types of stands, thus providing complete fluoroscopic and/or radiographic installations, stationary or mobile. Output (max):

20 mA at 90 kV with control desk 90/20

15 mA at 80 kV with control desk 80/15

Foci:

0.6 mm  $\times$  0.6 mm and 1.8 mm  $\times$  1.8 mm

Timer:

electronic, with control desk 90/20: 0.04–5 s

mechanical, with control desk 80/15: 0–0.9

and 1–8 s

#### Mobile, dismantlable column stand

Lightweight, easily manoeuvrable stand to carry the "Practix" throughout the hospital for radiography. For domiciliary visits it dismantles quickly and fits into the luggage boot of any private car. The control desk carriage locks to the stand.

#### DS 4

A sturdy mobile column stand for radiography in the ward or plaster room for bed and stretcher patients. The support for the control desk forms an integral part of the stand.

#### "Unipractix"

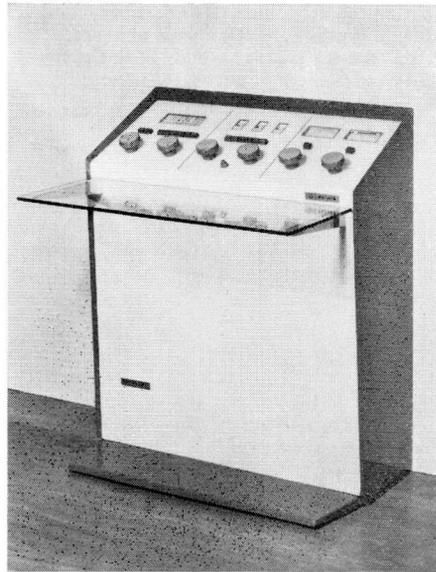
Mobile stand for fluoroscopy and radiography of standing and recumbent patients. The stand carries a rotatable cross-arm with "Practix" and fluorescent screen. It is in fact the simplest Philips general-purpose diagnostic stand.

#### "Practoscope"

Lightweight stand for fluoroscopy and radiography of standing patients, with facilities for simple spot-film work (two exposures on 13 cm  $\times$  18 cm film), stretcher radiography and for exposures on a wall stand. "Practoscope" de luxe for use with a "Rotalix" tube and 6" Image intensifier.

#### Pneumoscope

Booth-type fluoroscopic stand with facilities for radiography; incorporates its own radiation protection, eliminating protective clothing. The standing patient is observed on the fixed 40 cm  $\times$  70 cm fluorescent screen and scanned by moving the tank unit and adjusting the diaphragm. Sliding panels in the front open to permit positioning of the patient. The tank unit can be rotated for stretcher radiography.



X-ray generator Super 100.

#### Examix

Single-tube, hand-tilted examination table with "Practix" tank unit or "Rotalix" tube and separate generator for routine fluoroscopy and radiography. Tube can be used for under table as well as over-table work. Cassettes up to 35.6 cm  $\times$  35.6 cm can be inserted into the screen holder. A serial device for two exposures on 13 cm  $\times$  18 cm film is available.

#### "Rotapractix"

Full-wave rectified X-ray tank unit with "Rotalix" O-55 inset tube. Operated with either a stationary, mobile or transportable control desk. Facilities for mounting on various tables and stands to provide complete stationary or mobile installations.

Output (max):

100 mA at 50 kV, 50 mA at 125 kV

Focus: 0.8 mm  $\times$  0.8 mm

Time settings: 0.04–5 s (electronic timer)

Provision for up to two auxiliary apparatus.

#### "Rotapractix" Stand

Mobile column stand for use in operating theatre, plaster room, at the bedside and as stand-by unit during the peak hours in radiological departments. The "Rotapractix" tank unit is mounted on a double-articulated bracket arm; ease of positioning and storage.

#### Medio 20, 20 M and 20 T

Full-wave, semiconductor rectified X-ray generators. Power one or two double-focus rotating anode tubes. Free selection of voltage (kV), current (mA) and time, with current-time (mAs) pre-indication and automatic overload protection.

Mobile and transportable versions available.

Output: 200 mA at 100 kV, 100 mA at 125 kV

Time settings: 0.02–6 s (electronic timer)

Provision for connexion of up to three auxiliary apparatus.

#### Medio 30 and 30 M

Full-wave, semi-conductor rectified X-ray generators capable of satisfying every demand of routine diagnostic practice. Power one or two double-focus rotating anode tubes.

Free selection of kV, mA and time with mAs pre-indication and automatic overload protection.

Output: 300 mA at 90 kV, 200 mA at 125 kV

Time settings: 0.02–6 s (electronic timer)

Provision for connexion of up to three auxiliary apparatus.

#### Medio 50

Full-wave rectified X-ray generator. Two versions available viz. for max. 125 kV and 150 kV. Both power up to three double-focus rotating anode tubes.

Output: 500 mA at 90 kV, 300 mA at 125 kV,

200 mA at 150 kV

Time settings: 0.01–6 s; exposure rate 8 exp./s

Provision for connexion of up to five auxiliary apparatus.

#### Super 70

Three-phase X-ray generator. Powers up to three double-focus rotating anode tubes.

Output: 700 mA at 60 kV, 600 mA at 90 kV,

300 mA at 125 kV

Time settings: 0.01–6 s, exposure rate 8 exp./s

Provision for connexion of up to seven auxiliary apparatus.

#### Super 100

Three-phase X-ray generator, meets the highest demands of modern radiodiagnostics. Powers up to four double-focus rotating anode tubes.

Special version for bi-plane techniques, with one or two H.T. transformers and timers; exposure rate 8 exp./s

Versions for 200 kV or 12 exp./s can be supplied.

Output: 1000 mA at 100 kV, 600 mA at 125 kV,

300 mA at 159 kV

Time settings: 0.003–6 s; exposure rate 8

exp./s

Provision for connexion of up to ten auxiliary apparatus.

#### DL 2, bucky table

For all kinds of bucky exposures of recumbent patients. Flanigraphy can be employed as well. Bucky travels entire length of tabletop.

#### Pedestal bucky

Mobile unit for specialized (pelvimetry and skull) and general bucky radiography. Bucky assembly can be tilted from horizontal to vertical. Motor-driven height adjustment.

#### Universal bucky stand

For all kinds of bucky exposures with bucky in vertical, horizontal as well as oblique positions. Counterbalanced height adjustment over 110 cm.

### DL 40, tilting bucky table

Universal in application. Motor-driven table tilt from vertical to 10° Trendelenburg. In horizontal position the table can be used with the Philips motor-driven planigraphic attachment.

### Diagnost 20

A simple hand-tilted examination table. The X-ray tube can be used for both under- and over-table techniques. Manually operated serial device. Maximum of two exposures on 13 cm × 18 cm film.

### Diagnost 40

Motor-tilted examination table for routine work; with 10° Trendelenburg. Manually operated semi-automatic serial changer. Maximum of four exposures on 18 cm × 24 cm film. Image intensification techniques possible.

### Diagnost 50

Medium-class examination table for the general diagnostic practice. Maximum Trendelenburg position 15°. Motor-power for table-tilt and for sliding the tabletop. Serial changer, semi or fully automatic at choice. Maximum of four exposures on 18 cm × 24 cm film. Image intensification techniques possible.

### Diagnost 60

Universal motor-driven diagnostic table with automatic depth diaphragm. Maximum Trendelenburg position 30°. Floating tabletop simplifies patient positioning. Excellent X-ray protection. Left-hand loading and control arrangement, to facilitate image intensification techniques. Motor-driven serial changer available in two versions for different programmes. Maximum of six exposures on 24 cm × 30 cm film.

### Diagnost 65

First-line universal tilting table with automatic depth diaphragm. Maximum Trendelenburg position 90°. Tabletop shifts to both ends. Serial changer as with Diagnost 60. Image intensification techniques possible.

### Diagnost 70

Ultimate concept with integrated 9"/5" Image intensifier. Choice of two serial changers: one for use with separate image intensifier. 90° Trendelenburg, floating tabletop, automatic depth diaphragm. Left-hand loading and control arrangement. Maximum of six exposures on 24 cm × 30 cm film.

### Tele-Diagnost 70

A universal top-class radiodiagnostic unit, with fully remote-controlled table and serial changer, retaining facilities for direct control from serial changer itself.

### Ring stand

Remote controlled 90/90 tilting table with over-table X-ray tube and undertable 9"/5" Image intensifier. Facilities for t.v. fluoroscopy, cine and 70 mm fluorography, bucky, full-size, spot-film and stereo-radiography; oblique beam technique included.

The only stand for geometrical enlargement technique; electronic enlargement with 9"/5" Image intensifier. Auxiliary control desk for positioning patient and X-ray tube in bucky radiography.

### Examination table for cardiovascular diagnostics

Fixed under-table tube. Manual shift of fully floating tabletop, electromagnetically braked. Clamping rails for attachment of accessories—fitted to both sides and ends of the tabletop. Unobstructed patient access from all sides.

### Aorto-Arteriograph

For radiological studies of the arteries of the lower extremities. Uses ten 35.5 cm × 71 cm cassettes, loaded with normal 35.5 cm × 35.5 cm film. Semi-automatic operation; patient shifted once or twice automatically; programme selector.

### Angiography table

Equipped with motordriven cassette changer for serial exposures. The film size is 40 cm × 40 cm with a maximum of four films per series. Table also suitable for bucky radiography. In arteriography of the lower extremities tabletop is shifted by motor drive.

### Automatic cassette changer

For radiological studies of either the extremities or abdomen, using four 20 cm × 96 cm or 30 cm × 40 cm cassettes. Choice of single or serial operation.

### DS 5, tube stand

Moves effortlessly in floor and ceiling rails. The X-ray tube is attached to a telescopic cross-arm which enables track to be laid close to the wall. 180° swing of cross-arm around column. Operation is by handlebar in front of the tube shield. Suitable for Philips motor-driven planigraphic attachment.

### DS 7, tube stand

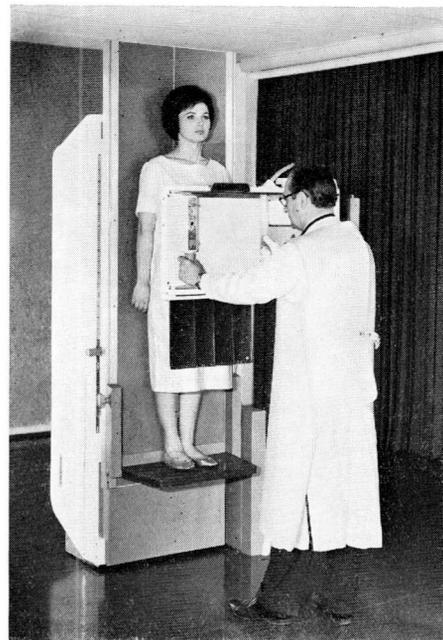
A lightweight construction, moving in floor and ceiling rails. 90° swing of cross-arm around column. Vertical, longitudinal and transversal movements electromagnetically braked from control box situated on the tube shield; other movements locked with snap-in positions. Suitable for Philips motor-driven planigraphic attachment.

### Ceiling-suspended tube columns

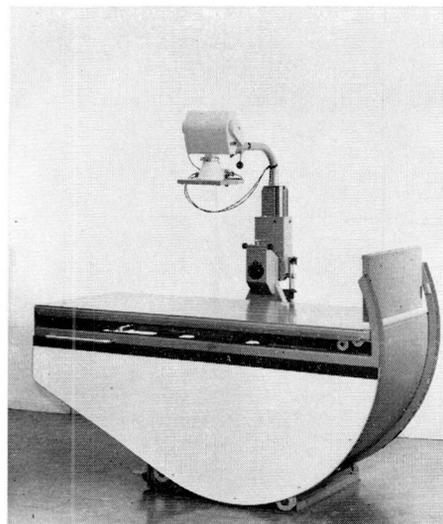
A series of four installations for efficient use of the over-table tube. Three are mobile, one is stationary. The longitudinal travel of X-ray tube in the mobile versions is at least 310 cm, the transversal travel is, at choice: 75, 150 or 300 cm. The columns can be adapted to any ceiling height and are surprisingly smooth in movement, extremely stable in use. Operation is centralized.

### Neuro-diagnost

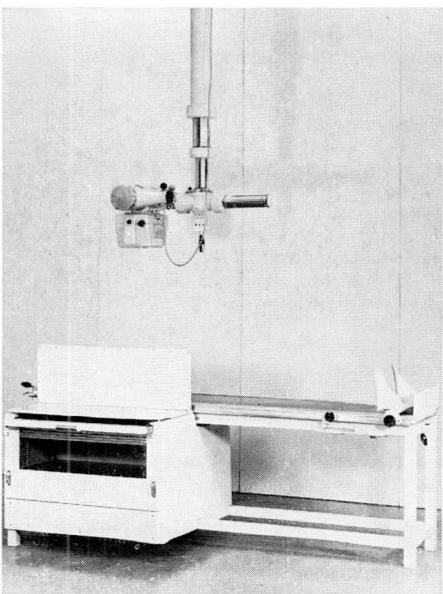
Specialized and advanced universal stand for neuro-radiology. Integrated image intensifier for t.v. controlled positioning and cinefluorography. X-ray beam adjustable in any direction and always centred on image intensifier. Used in e.g. skull radiography, pneumoencephalography, cerebral angiography, myelography and tomography.



Examination table Diagnost 50.



Examination table, type Examix.



Aorto-Arteriograph.

## Diagnost C

Ceiling-suspended image intensification unit for traumatology, angiology and cardiology. The latest electrotechnical refinements are built-in; 9"/5" Image intensifier—providing detail enlargement—and transistorized X-ray t.v. chain with Plumbicon camera tube. T.V. fluoroscopy combined with to 70 mm or cine fluorography at choice.

A cassette holder attached to the Image intensifier provides for routine radiography.

## Motor-driven planigraphic attachment

Provides facilities for horizontal tomography with our routine examination and bucky tables. Two angles of swing each with two speed: 40° in 1 or 3 s, 20° in 0.5 or 1.5 s. Layer height adjustable from 2 to 25 cm. Used in combination with either DS 5 or DS 7 tube stand. Column returns to initial position after termination of exposure.

## Pneumotome

Motor-driven stand for tomography, fluoroscopy and radiography of standing and sitting patients. Largest angle of swing 60° in 1.3 s min. and 3.1 s max. Smallest angle of swing 30° in 0.6 s min. and 1.6 s max. Layer height adjustable between 0–25 cm. Max. of nine exposures on 35 cm × 35 cm film.

## Radiotome

Stand for transversal tomography. The sitting patient is rotated about his vertical axis, the horizontal cassette rotates synchronously while the X-ray tube remains stationary. Any angle between 20° and 30° can be used. Cassettes: 24 cm × 30 cm up to 35.6 cm × 43.2 cm.

## MT 2

Universal motor-driven stand for remote-controlled routine tomography in all positions. Also suitable for tomography and bucky, tele- and stereoradiography. Table tilts from vertical to 10°. Trendelenburg. Largest angle of swing 44° in 1 s min. or 8 s max. Smallest angle of swing 20° in 0.4 s min. or 3.7 s max. Layer height adjustable between 2 and 25 cm. Max. of six exposures on 24 cm × 30 cm film with optionally available seriograph.

## Horizontal polytome

For high-precision tomography and bucky radiography of recumbent patients including oblique beam techniques and stereoradiography. It gives a choice of four blurring movements. Two of these are exclusive to the Polytome series viz. hypocycloidal blurring and circular zonography (0–20°). Floating tabletop. Angles of swing: hypocycloidal 48°, elliptical max. 40°, circular 29° or 36°, linear up to 50°. Layer height adjustable by motor drive between 0 and 23 cm by raising or lowering tabletop. Max. of six exposures on 24 cm × 30 cm with optionally available seriographs.

## Universal polytome

The most versatile precision tomograph giving a choice of four different blurring movements; linear with an angle of swing up to 50°, elliptical with a fixed angle of 40°, circular with

a choice of 29° or 36°, hypocycloidal with a swing of 48°, it includes circular zonography (0–20°). Table—with sliding top—tilts from vertical to horizontal. Motor-driven adjustment of layer height between 0 and 23 cm by raising or lowering tabletop. Max. of six exposures on 24 cm × 30 cm film with optionally available seriographs.

## RRT

Full-wave transportable X-ray tank unit for mass chest surveys. Four semi-conductor rectifiers. "Rotalix" O-55 rotating anode tube with 0.8 mm × 0.8 mm focal spot. Built-in automatic density control. Output: 70 mA at 50 kV and 40 mA at 120 kV. Time settings: 0.02–0.8 s.

## Photofluorographic stand

For stationary use in anti-TB clinics, sanatoria, public centres, etc. and as mobile unit in vans. Height adjustment of patient by a motor-driven platform. Can be combined with: RRT, standard X-ray generator with tube and any suitable existing diagnostic installation. Cameras: 70 mm or 100 mm Philips Odelca. Three versions: 1) Basic unit with X-ray tube on separate column. 2) Basic unit—with provision for attachment of X-ray tube. 3) As 2)—but with addition of protective cabin with sliding doors, latter hand or motor operated.

## Double-column stand

Dismantleable stand for use in photofluorographic mass chest surveys. Combines with RRT tank unit or any standard X-ray generator with "Rotalix" tube. Easy assembling and dismantling. Simultaneous motor-driven height adjustment for camera and tank unit. Choice of three focus-screen distances: 90, 120 and 150 cm. For use with Philips Odelca 70 mm and 100 mm cameras.

## Transmobile mass chest survey unit

Comprises an examination stand, Philips Odelca 70 mm camera and the RRT X-ray tank unit; all contained in a four-wheel-drive LandRover. Installation can be extended by second LandRover with electric generator. Two versions: in one the examination part can be used in or out of van; with the other the examination equipment is used in van only. Quickly assembled. Simultaneous motor-driven height adjustment for camera and tank unit. Automatic beam-limitation diaphragm for gonad protection and additional, lateral diaphragm.

## IMAGE INTENSIFICATION

### 6" Image intensifier

Lightweight and compact unit, adaptable to almost any diagnostic table. Binocular observation by Wide-angle viewer. T.V. or cine camera can be used instead. A two-channel attachment is available for simultaneous connexion of a viewing and recording unit. Switch-over from one to the other is immediate.

Automatic density control possible.

### 9"/5" Image intensifier

The most advanced X-ray Image intensifier; provides electronic detail enlargement of nearly 2 ×. A variety of viewing and recording units available: Wide-angle viewer, t.v., cine and 70 mm Spot-film camera. Single, two or three channel attachment at choice. Automatic transit exposure rate stabilization at option. Simple, centralized operation. Automatic density control possible.

### 9" Image intensifier

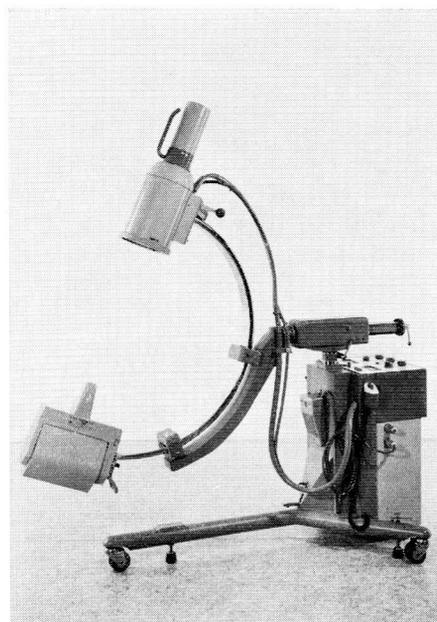
Philips 9" Image intensifier tubes are now contained in the new, restyled shield and will thus accept all the viewing and recording units employed with the 9"/5" model.

### Wide-angle viewer

System for natural observation of intensified fluoroscopic images. The exit pupil is so wide that it gives a full view of the image. Flexibility of adjustment for comfortable viewing.



Transistorized X-ray t.v. chain.



BV 20 S mobile surgical X-ray unit.

## Transistorized X-ray t.v. chain

For use with our Image intensifiers for t.v. fluoroscopy in routine examinations, catheterization and surgery. Automatic brightness stabilization over complete field or central area only, with additional facilities for manual operation with or without remote control. Left/right reversal and up/down inversion of image also possible. Camera can be equipped with either a Vidicon or Plumbicon pick-up tube. Several types of monitors available.

## Medical video recorder

Stores t.v. X-ray images and additional sound signals on magnetic tape. Perfect synchronization system, ample bandwidth and lack of interference signals result in a recorded image of excellent quality. Facilities for rapid starting and remote control; presentation of still images also possible. Recording/play-back time: 45 min for 50 c/s mains, 40 min for 60 c/s mains.

## Cine cameras

As instruments of outstanding quality Philips Image intensifiers are complemented by a wide range of high precision cine cameras. A choice can be made of 16 mm or 35 mm types giving medium or high frame speeds and suitable for either pulsed or non pulsed emission of X-rays.

## 70 mm Spot-film camera

Fluorographs made on 70 mm roll-film of the image obtained with the 6", 9" and 9"/5" Image Intensifiers can replace conventional full-size radiographs. Dose reduction, saving in film and filing space, full utilization of small foci, relatively short exposure times, and a rapid working procedure are the applicational features.

## Cine control unit

All the control elements necessary for smooth and reliable operation of the cinefluorographic equipment are centralized in a compact volume. Logical arrangement of meters and controls permits swift and easy operation, frame speed selection and adaptation to films of differing sensitivities. Brightness and density stabilization possible during fluoroscopy and filming respectively.

## Cine pulse unit

Set-up for pulsing X-rays synchronously with opening of cine camera shutter. Effective use of X-rays prevents unnecessary irradiation of patients. Extremely short exposure times from 1-10 milliseconds give razor-sharp images. Can be combined with any X-ray cine installation. Brightness and density stabilization possible during fluoroscopy and filming respectively.

## BV 20 S

Mobile image intensification unit for surgical radiology. Equipped with 6" Image intensifier and "Practix" tank unit. Easy handling and great flexibility render it eminently suitable for use in e.g. operating theatre, plaster room and in the wards. The BV 20 S is also available in a version in which the C-arm plus adjuncts is attached to a ceiling-suspended column.

## THERAPY

### CT Apparatus RT 50

Mobile unit for X-ray contact, Grenz ray, superficial and intracavity therapy. Extremely flat isodose curves and a high output (10 400 R at 2 cm FSD) are its characteristics. Fixed voltage (kV)/filter combinations with safety device eliminate any error in treatment adjustment. Wide range of applicators at choice. The light-weight, air-cooled tube assembly permits fixed-position or "straight-from-the-hand" irradiation.

Tube current: 2 mA  
Voltage (kV) settings: 10, 15, 20, 30, 50 kV; constant potential  
Time settings: 0-15 min; in steps of 0.01 min  
F.S.D. min. 2 cm

### RT 100

X-ray apparatus for superficial and endotherapy. Wide choice of radiation qualities. High output and versatility in application. Filter safety device excludes irradiation errors. Many applicators at choice.

Tube current: 0-10 mA  
Voltage (kV) settings: 10-100 kV in 8 steps, constant potential  
Time settings: 0-15 min, in steps of 0.01 min

### RT 250

X-ray apparatus for superficial, intermediate and deep-therapy. It features exclusive, high degree of exposure-rate stability and error preventing technique selector. Supplied with the unit are five filters, while a large range of applicators meet individual requirements.

Tube current: 5-25 mA, continuously adjustable  
Voltage (kV) settings: 75-250 kV, continuously adjustable, constant potential  
Time settings: 0-15 min, in steps of 0.01 min  
F.S.D. min. 30 cm

### Therapy column stand

For wall or ceiling fixation. It provides for extreme flexibility of the therapy tube, which can be chosen in accordance with applicational needs. Focus-floor distance adjustable from 50 to 178 cm.

### Therapy treatment table

A table featuring a practical combination of low weight and rigidity. It can be supplied with fixed or with freely floating tabletop. Floor and tabletop brakes operable from both sides of the table.

### Universal cobalt-60 units

For precision gamma radiation with rotational, pendulum, tangential and stationary beam. Rotation can be carried out continuously without end-stop. Installation is without any brickwork or cementing whatsoever. The units are available for 3000 or 4500 Rhm source capacity with a source-rotation axis distance of either 60 or 75 cm. The unit may be equipped with beam-absorber or counterweight at choice. The sideways swivel of the radiation head may be complemented by a head tilt movement at option; motordrive available. The treatment table - adjunct to the unit - is

isocentrically coupled to the stand and has a loading tabletop which enhances quick setting up. Patients and personnel are fully protected against mechanical and radiation hazards. Safety devices exclude risk of treatment error.

### Linear accelerator SL 75

Apparatus for rotational X-ray and electron irradiation. Efficient and easy setting-up is obtained by a modern approach in its medical design. The accelerating part proper is mounted on a ring stand which permits rotation through 360°. The compact design and facility to rotate is obtained by bending the electron beam through 90° before it hits the X-ray target. A choice is given of two versions: Version a: 6 MeV X-rays and 8 MeV electrons  
Version b: 8 MeV X-rays and 10 MeV electrons  
Maintenance is simplicity itself.

### Universal simulator

Set-up for quick treatment planning with Linear accelerator and Co-60 therapy units. It consists of a rotatable yoke, which carries an X-ray source diametrically opposed to an Image intensifier (6" or 9" at choice); viewing via the Wide-angle viewer or transistorized X-ray t.v. chain. Focus-rotation distance 60, 75 or 100 cm, floor or wall fixation at choice.

### Universal dosimeter

For accurate measurements of exposure and exposure rate of X- and  $\gamma$ -rays from the very soft Grenz rays up to the hard Co-60 radiation. The overall accuracy of the instrument is within 2%.

A series of ten ionization chambers and six condenser chambers is available; among them are types for transit exposure measurements, for measuring the output of contact therapy tubes and the activity of radioisotopes. An interesting accessory is the H.V.T. meter which measures half-value thicknesses from 0.1 mm to 11 mm Cu or Al equiv.

### Personnel monitor

A charger/reader instrument used in combination with condenser chambers. A series of six chambers ensures exact adaptation of the monitor to any field of application in the care and supervision of personnel. It is also suitable for checking suspected leakages and for intracavity measurements. The Twin condenser chamber, consisting of two separate sensitive volumina with two measuring ranges viz. 100 and 1000 mR is recommended for personnel monitoring.

### Portable transistorized radiation monitor, type XL 1000

Measures directly and immediately exposure as well as exposure-rate in: radiodiagnostic and therapy centres  
radioisotope laboratories  
nuclear research centres.  
It is characterized by its very high sensitivity; most sensitive range (of three) extends from 0-1 mR/h  
Calibrated for 20 keV to 1.25 MeV plus Cs-137 and Co-60 radiation; accuracy within 15%.

### Mobile single-column stand

Stand with scintillation detector for use in in-vivo measurements. The detector is contained

in a high-efficiency lead shield to which interchangeable collimators can be fitted. For measuring the function of two organs simultaneously, e.g. the kidneys, the stand can be converted to a double-column version by adding an identical column with adaptation base.

### Single and two-channel recorders

For registration of e.g. thyroid and kidney functions in combination with our rate meter systems. Paper speeds up to 6000 mm/h can be obtained with the single-channel recorder. With the two-channel recorder the function of both kidneys can be registered simultaneously.

### Universal scintillation scanner

Precision instrument for processing information on the isotope distribution in a patient's organ under examination. It produces scintigrams or photogammagrams either separately or simultaneously. Scanning may be in the horizontal and vertical planes as well as in all intermediate positions. The scans are extremely contrasty, thanks to effective lead shielding of the scintillation detector, high resolution multichannel collimators and use of a channel discriminator. Choice can be made of a  $1\frac{3}{4}$  in or 3 in scintillation detector.

### Automatic sample changer

Apparatus for measurements of fifty liquid or powdered radioactive samples. The whole process: taking vial with sample from the storage tray, placing it in the well of the scintillation detector, bottoming, measuring and returning to the tray is automatic. Contribution of relatively strong waiting samples to the background of weak ones in the same batch is constant. The data accumulated in the counting equipment can be printed out by the High-speed digital printer.

### Blood volume meter

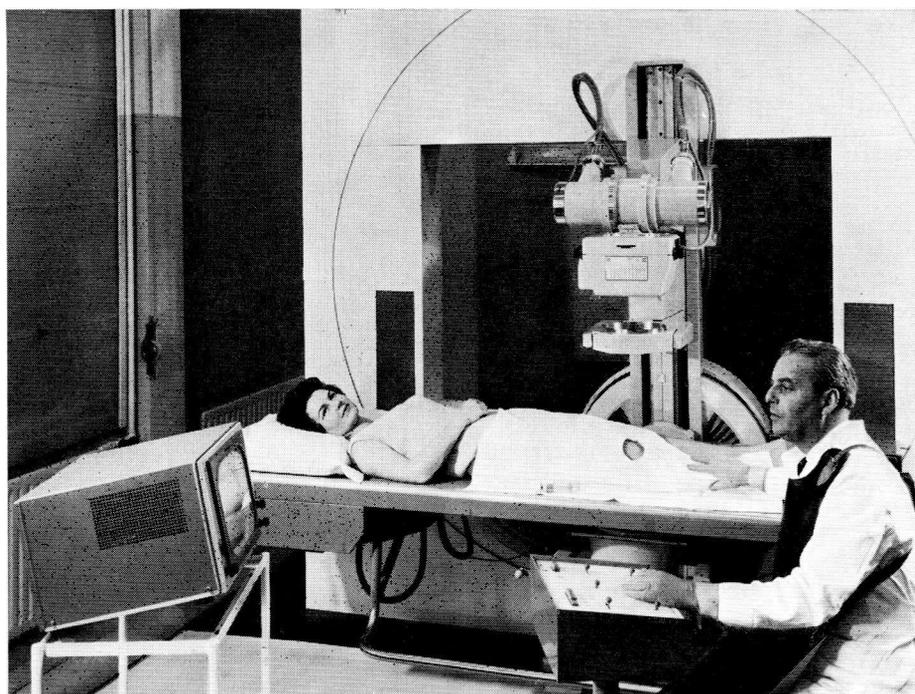
For quick and accurate measurement of the patient's blood volume. Use in made of 1-131 human serum albumin, which is injected. The calculating time for the entire measurement is extremely short. A transistorized computer makes the calculations and corrects the data for e.g. activities remaining in the injection syringe as well as background radiation.

### Microcuriometer

Operates with either Ionization chamber 37497 or XL 2000. The set-up measures the gamma and/or beta activity of radioisotopes of  $10 \mu\text{Ci}$ - $1 \text{Ci}$  (full-scale deflection). Measuring ranges: 10, 30, 100, 300  $\mu\text{Ci}$ , 1, 3, 10, 30 mCi, 1 Ci.

### Nuclear pharmaceuticals

Philips-Duphar, the pharmaceutical-chemical division of the Philips concern, supply a complete range of nuclear-pharmaceutical compounds. The radionuclides are produced in a reactor or in a cyclotron and are separated from the irradiated material by means of chemical-pharmaceutical methods. The compounds are prepared under conditions identical to those usual for the preparation of non-radioactive pharmaceuticals. For a complete list of compounds, reference and standard sources see section Philips-Duphar radioisotopes.



Ring stand, positioning under t.v. fluoroscopic control.

## ELECTROMEDICAL EQUIPMENT

### Cardiopan 1

Single-channel, direct-writing electrocardiograph.

### Cardiopan 1 special

Single-channel, direct-writing electrocardiograph extended with separate a.c. and d.c. input, heart preamplifier and pulse transmission unit. Connexions for electrical stethoscope and oscilloscope.

### Cardiopan 2

Two-channel, direct-writing electrocardiograph with two independent lead selectors, built-in heart sound pre-amplifier and pulse transmission unit. Separate a.c. and d.c. input. Connexions for electrical stethoscope and oscilloscope.

### Cardiopan 3

Three-channel, direct-writing electrocardiograph with heavy-duty push-button lead programme selection, built-in heart sound pre-amplifier and pulse transmission units. The sixth channel incorporates a high frequency writing system. Three separate a.c. and d.c. inputs. Connexions for two electrical stethoscopes and one oscilloscope.

### Cardiopan 6

Six-channel, direct-writing electrocardiograph with heavy-duty push-button lead programme selection, built-in heart sound pre-amplifier and pulse transmission units. The sixth channel incorporates a high frequency writing system. Six separate a.c. and d.c. inputs. Connexions for two electrical stethoscopes and one oscilloscope.

### Cardiopan 531

Portable single-channel direct-writing electrocardiograph. Light-weight, transistorized and cordless. Battery and mains operation.

### Electromanometer 2000

Fully transistorized apparatus for measuring intracardiac pressures. Stabilized against temperature and mains variations. Fully stable zero and exact indication of the measured pressure. Measuring range: 20, 40, 80, 150, 300, 600 mm Hg. Connexions for second indicating meter, electrocardiograph and oscilloscope.

### Cardioscope

Oscilloscope for continuous visualization of cardiac phenomena. Can operate in conjunction with any electrocardiograph. Addition of an extra two-channel amplifier unit makes the Cardioscope independent of an electrocardiograph.

### Large-screen cardioscope

Visualizes six cardiac phenomena - supplied from any multichannel electrocardiograph - simultaneously on a 47 cm screen. Its inherent sensitivity is such that 50 mV gives full-screen deflection. Monitor with pivot mount - for comfortable viewing - is placed on the 19 in control cabinet, available either in a stationary or in a mobile version. A second 47 cm screen monitor can be connected via an additional slave control unit.

### Cardiophon

For reproduction of foetal heart sounds picked up with a highly sensitive microphone and made audible via a built-in loudspeaker. An extra loudspeaker can be connected and provision is made for recording the sounds on tape. Also suitable for keeping continuous check on the heart activity of patients during surgical operations.

## Accessories for Cardiopan electrocardiographs

With the Cardiopan electrocardiographs accessories can be supplied for: phonocardiography, sphygmography, plethysmography, electromanometry, ballistocardiography, encephalography and pulsoscillography.

### Electrosurgical unit

For coagulating and cutting, fulguration and dessication. It incorporates a tube generator providing undamped h.f. current and a spark-gap generator providing damped h.f. current. The two current forms can be blended to promote or suppress coagulation at the edges of the wound during cutting. Endoscopes can be connected.

### "Oscilloflux" 2000

Mobile apparatus for short-wave therapy in general practice and in clinics. No warming up. Power adjustment in eleven steps, with or without automatic tuning unit. Meets strictest requirements relating to safety and interference suppression. Output 400 W. Wavelength stabilized at 11.06 m.

### Microwave apparatus MW 125

Internal application of heat in physical therapy by means of microwaves. Wavelength 12.5 cm (2400 Mc). Output 200 W. With circular, rectangular and body cavity radiators. Built-in automatic switching treatment timer.

### Decimetrewave apparatus DW 690

For decimetrewave therapy with maximum heat development inside the body. Wavelength 69 cm (433.9 Mc). Output 300 W, adjustable in six steps by pushbutton selector. Built-in automatic switching treatment timer.

### Heart function monitoring systems

The growing medical need for measuring, recording or monitoring physiological data has led to combinations of different apparatus being integrated into systems. For the sake of simplicity four combination systems have been selected as more or less standard versions. The user is, however, free to select the constituent parts from an ample range of additional apparatus and so to build up his own version.

The main features of the systems are:

All units are rack-mounted in 19 in mobile cabinets.

All cabinets have the Cardiopan 3 electrocardiograph as basic unit.

**System 1:**

3-channel electrocardiograph Cardiopan 3  
electromanometer

a.c. pre-amplifier

2-channel Cardioscope

pulse-rate meter

**System 2:**

3-channel electrocardiograph Cardiopan 3

two electromanometers

2-channel Cardioscope

pulse-rate meter

**System 3:**

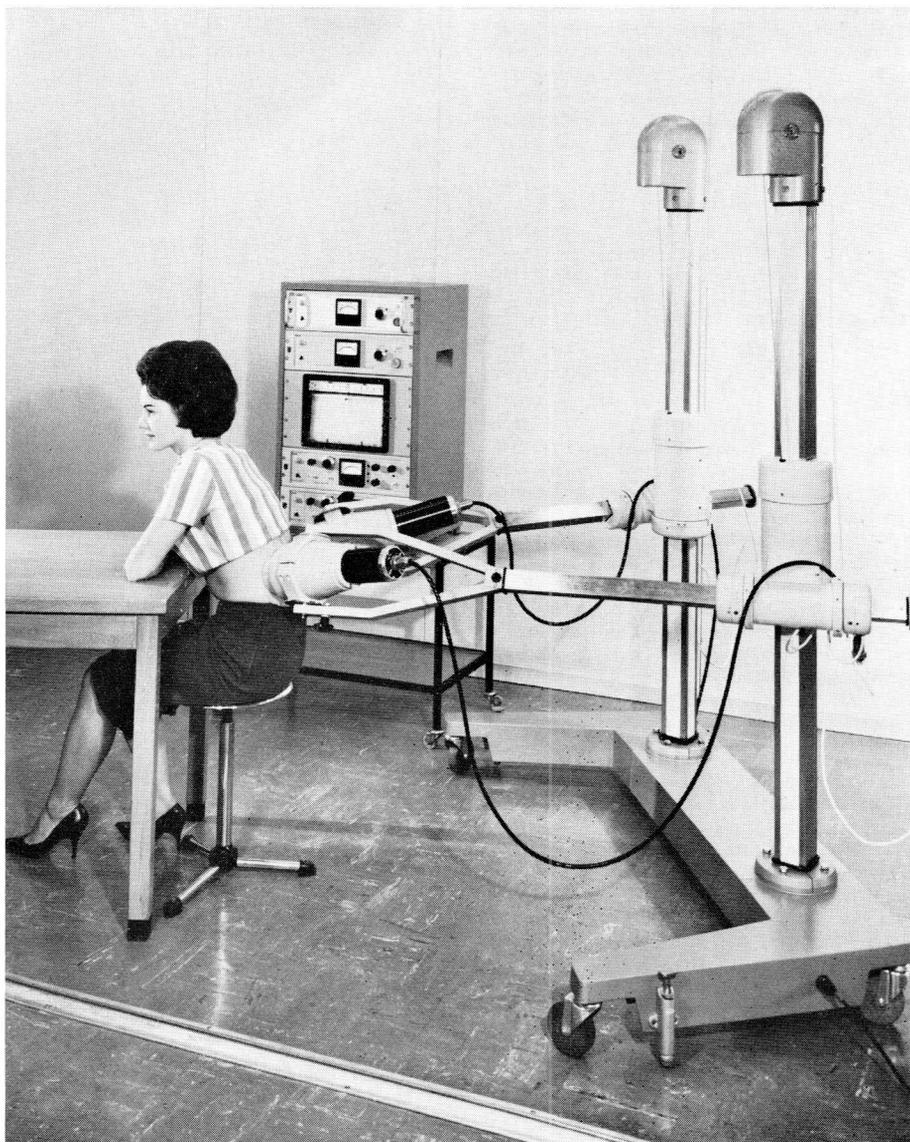
3-channel electrocardiograph Cardiopan 3

electromanometer

a.c. pre-amplifier

simple pulse-rate meter

single-channel Cardioscope



Double column stand for scintillation detectors.

### Defibrillator-pacemaker DPI

For the treatment of cardiac arrest. D.C. defibrillation with external and internal electrodes. External defibrillation from 500–2500 V d.c. Pacemaker for internal as well as external electrodes. Electrode contact controlled by magic eye.

Built-in Cardioscope with E.C.G. amplification for observation before and after defibrillation. Automatic protection during defibrillation provided.

### Vital data monitoring system

For providing accurate measurements of a number of basic physiological data in intensive care patients, either continuously or frequently. The basic physiological data are given by the electrocardiogram, pulse rate, body temperature, systolic and diastolic blood pressure and respiration rate and type of respiration. The individual units for obtaining these data are combined in 19" cabinets according to the specific requirements of the hospital in question.

### DENTISTRY

#### "Oralix"

Self-contained dental X-ray unit pairing short

exposure times with high exposure capacity. focus and selected voltage (kV) give razor-sharp radiographs of optimum contrast. A four-position turret diaphragm – an exclusive feature – enhances safety and limits fogging of film. Emission of X-rays indicated.

Output: 7 mA at 50 kV

Time settings: 0–3 s in steps of 0.05 s

The "Oralix" can be mounted on a mobile pedestal – for universal application – onto the wall – the reach being 150 cm (60 in) and with extension piece 190 cm (76 in) – or on the dental unit itself. In all cases a double-articulated arm provides extreme flexibility.

## 27. ELECTRON MICROSCOPES

Electron microscopy is established as a method of scientific investigation in many fields and is being increasingly applied to routine analysis in industry. Our range of electron microscopes includes three types of microscope which together fully cover the various applications.

### EM 200

The EM 200 electron microscope has been designed to provide ultimate picture quality with a high degree of working efficiency and versatility in ultra-micro-structural research studies. A large range of accessories and built-in facilities for specimen manipulation fully meet the requirements of both metallurgists and biologists. The high electrical stability ensures efficient operation independent of variations in external conditions.

#### Characteristics:

Guaranteed point resolution of 8 Å or better. The full range of magnification up to 200 000× can be obtained without changing pole pieces. Rapid compensation of astigmatism at any time with electro-magnetic objective stigmator. Double condenser lens system includes an electrically adjustable and centrable stigmator and an independent electromagnetic centering device. Ease of operation allows the operator to concentrate fully on the object of his study. A circuit monitoring system enables operating conditions to be checked at any time. The microscope can be easily opened for occasional cleaning. Realignment after cleaning takes only a few minutes. Special accessories include a specimen rotation tilting stage, an all-round goniometer stage, and a specimen chamber cooling device.

### EM 100 C

The EM 100 C electron microscope is a universal instrument. It has a high standard of performance combined with great efficiency, reliability and simplicity of operation. The construction of the column guarantees high mechanical stability.

#### Characteristics:

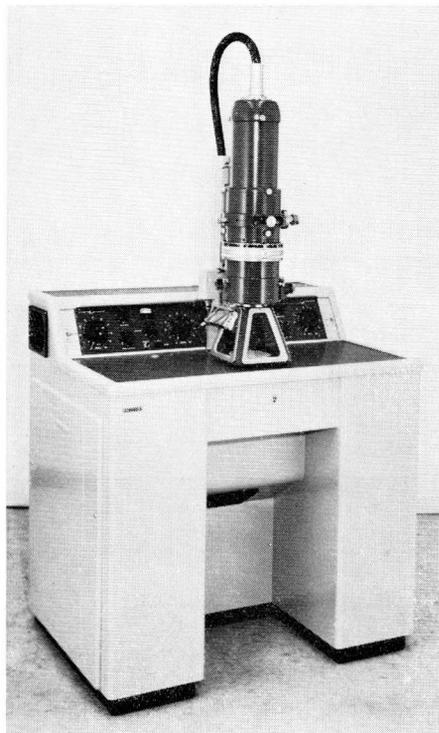
A point resolution 15 ... 20 Å is easily and consistently obtained. The electromagnetic lenses provide a continuously variable magnification up to 90 000×. Fast and smooth operation. Provision for selected area electron diffraction of crystals. Wide field scanner momentarily reduces the magnification for selection of a particular specimen area.

### EM 75 C

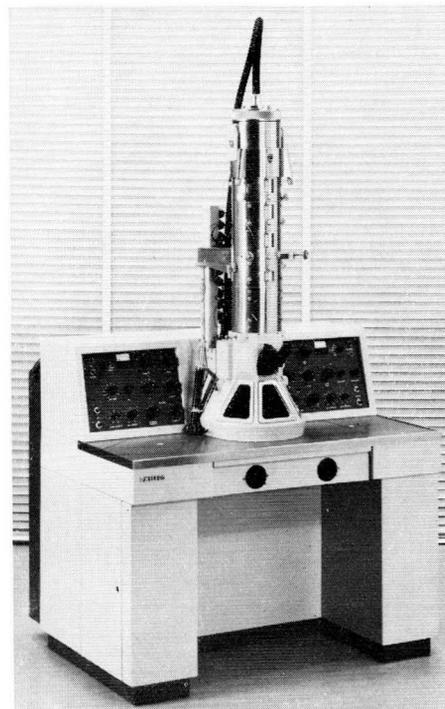
The EM 75 C electron microscope bridges the gap between optical microscopes and high-resolution electron microscopes. The simple design, the range of electron microscopical facilities and the provision for multiple viewing make the instrument suitable for training purposes. However, the versatility and high performance of the microscope also meet the requirements for experimental studies.

#### Characteristics:

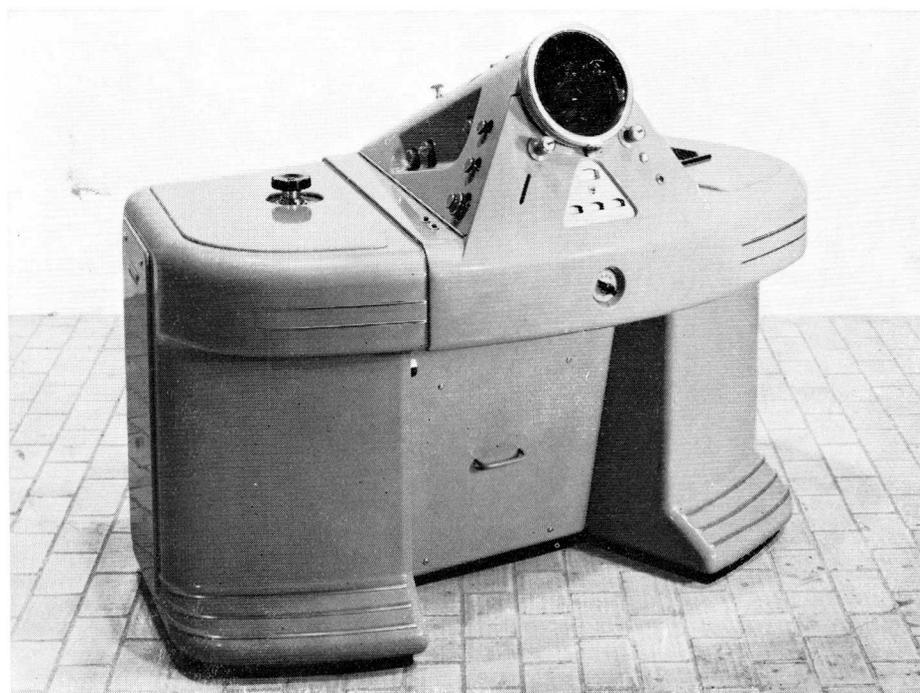
Point resolution 45 ... 50 Å  
Magnification continuously variable between 1 200 and 12 000 ×  
Provision for low-voltage microscopy.  
Film and plate recording facilities.



Electron microscope, type EM 200.



Electron microscope, type EM 75 C.



Electron microscope, type EM 100 C.

## 28. NUCLEAR EQUIPMENT

### DETECTORS

Measurement of ionizing radiation requires a variety of equipment, such as detectors, probes, sample holders and changers, lead shieldings and associated electronic instrumentation.

Philips produce not only the basic equipment, but also combinations of matched elements, from simple Geiger Müller (G.M.) counters, scintillation counter probes, up to custom engineered equipment.

#### Geiger Müller detectors

Geiger Müller detectors are used for quantitative measurement of alpha, beta and gamma radiation. They exist of a G.M. counter tube, mounted in a probe. A complete range of G.M. counter tubes is available, with a matching set of standard probes. The envelopes of the probes are of anodized aluminium, for easy decontamination.

#### Scintillation detectors

For use in conjunction with our electronic counting equipment and associated instrumentation a complete line of scintillation

detectors for both end — on and well-type counting techniques is available. Applications are either in industrial, scientific or medical practices.

#### Solid scintillators for alpha detection

These exist of a metacrylate disc carrying a polycrystalline layer of silver activated zinc sulphide, covered with a metal layer. A full range of these scintillators is available to match the window diameters of the photomultipliers applied.

#### Solid scintillators for gamma and beta detection

These scintillators are composed of polystyrene, polymerized in the presence of p-terphenyl and tetraphenyl butadiene (TPB). A range of standard discs, cylinders, blocks, and sheets of various dimensions is available. Models to meet client's specific demands optional.

#### Scintillators for fast neutron detection

Composed of polystyrene, polymerized in the presence of zinc sulphide. To match the window diameters of the photomultipliers applied, a complete range of these scintillators is available.

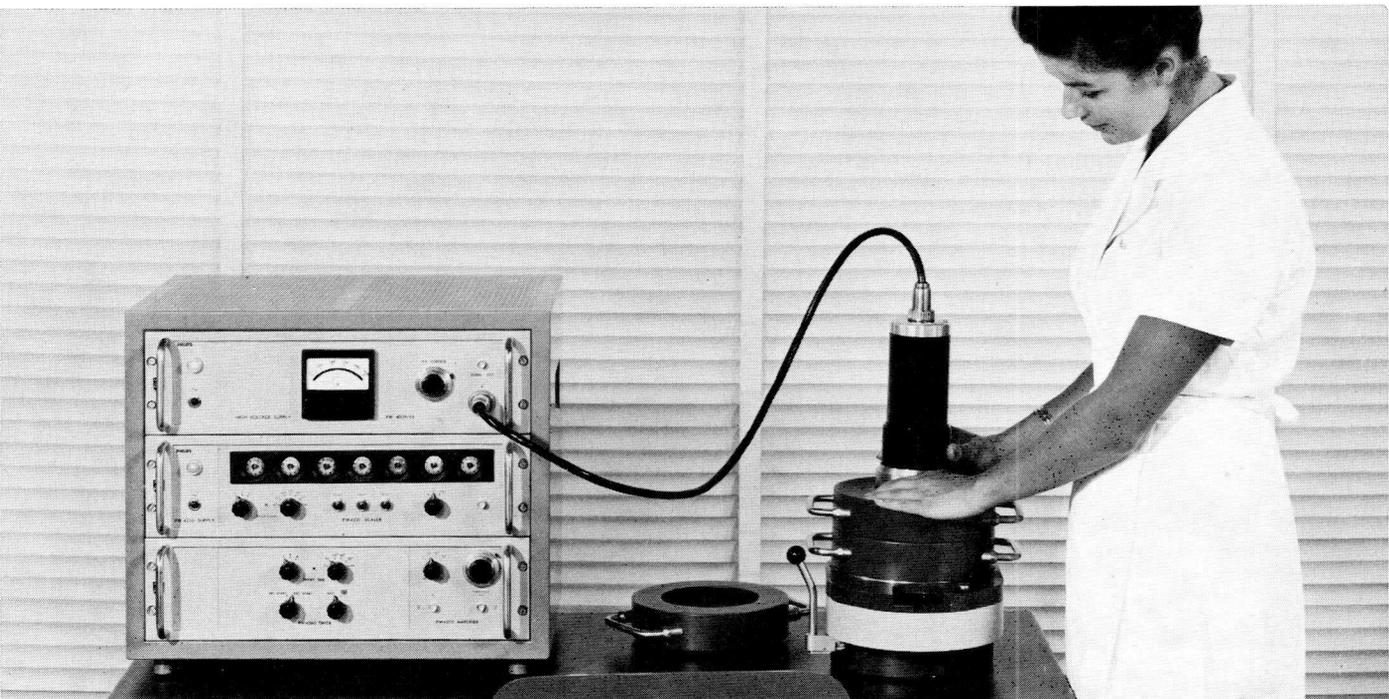
#### Geiger Müller detectors

type number		applications	effective area of window mm <sup>2</sup>
probe	G.M. counter tube		
PW 4107/20	18 536	alpha, beta	650
PW 4107/01	18 526	alpha, beta, gamma	650
PW 4147	18 546	beta	2100
PW 4107/20	18 516	beta	650
PW 4107/01	18 506	beta, gamma	650

#### Scintillation detectors

type	applications	scintillator	photo-multiplier tube
PW 4111/00	high efficiency counting of gamma radiation	Nal(Tl) crystal	50 AVP
PW 4119/03	alpha, beta, gamma and fast neutrons detection. With built-in cathode follower	several types applicable	153 AVP
PW 4119/10	gamma spectrometry (diam. 1 3/4 in)	Nal(Tl) crystal	153 AVP
PW 4119/20	gamma spectrometry (diam. 3 in)	Nal(Tl) crystal	crystal detector assemblies
L 313	monitoring of benches, floors, clothing, hands. Approved by U.K. Atomic Energy Authority	zinc sulphide on metacrylate	153 AVP
PW 4319/10	with large size crystal	matched crystal tube assembly	
PW 4319/20	well type detector with large size crystal	matched crystal tube assembly	

High speed preset time counting assembly utilizing scintillation detector PW 4119/20.



## LOW-INTENSITY AND LOW-ENERGY DETECTORS

### Gas flow detector for Geiger and proportional counting, type PW 4141

For efficient counting of alpha- and beta radiation from  $^{14}\text{C}$ ,  $^{204}\text{Tl}$  and  $^{239}\text{Pu}$  sources. The detector is provided with an extra thin, replaceable window for maximum sensitivity at measuring low-energy low-level radiation.

### Low-intensity beta-counting probe assembly, type PW 4149

Assembly for low-intensity measurements comprising an automatic or manual sample changer, two radiation sensitive tubes, preferably of the very sensitive type PW 4340, and a probe PW 4149. The manual sample changer is the PW 4001, the automatic changer is of the type PW 4320. As G.M. tubes the types 18 518, 18 516 and 18 536 may be used.

### Large-area, low intensity beta detector assemblies, type PW 4341

Anti-coincidence detector assembly with a large sensitive area ( $156\text{ mm}^2$ ) and a background of 0.1 count/min per  $\text{cm}^2$ . Specially suited for low specific activity counting techniques, such as contamination monitoring of water and food.

### Liquid scintillation beta counting assembly, type 111.557

A manually operated assembly for high efficiency counting of soft beta emitting samples such as those containing  $^{14}\text{C}$ , tritium, etc.

### Low intensity beta counting assembly, type PW 4127

Assembly with the extremely low background of less than 1 count/min. The electrically driven sample holder ensures absolute reproducibility of the sample position. For measuring the radiation of  $^{14}\text{C}$ ,  $^{60}\text{Co}$ ,  $^{204}\text{Tl}$ ,  $^{210}\text{B}$  and  $^{234}\text{Pa}$ .

## ACCESSORIES

### Lead shieldings

These lead shieldings accommodate a variety of radiation detectors. Their sectional construction makes them extremely flexible in use. Wall thicknesses are 35 and 50 mm respectively. The lead shieldings are mounted on the sample changers or detector stands.

### Manual sample changer, type PW 4122

Intended for use with G.M. probes, scintillation detectors and gas-flow detectors. The counting chamber is provided with 6 slots for insertion of the sample slide. Parts of meta-crylate for minimum beta backscatter.

### Manual gas-tight sample changer, type PW 4140

For use with the gas-flow detector type PW 4141. This gas-tight, stainless steel sample changer has a provision for pre-flushing of waiting samples; for use with lead shielding of 35 mm.

### Universal manual sample changer, type PW 4320/00

A universal instrument that accepts a variety of sample pans. The rotating holder accepts Anglo-American standard pans as well as those according to German DIN standard 44423.

### Automatic sample changer, type PW 4001

The instrument accommodates 40 sample pans (1 in) or 20 sample pans (2 in). Driving mechanism with connection to the counting equipment for fully automatic operation.

### Automatic sample changer, type PW 4003

For liquid samples. Equipped with a well type scintillation detector. Capacity 50 liquid or powered sample bottles maximum. Operates in conjunction with the counting arrangements.

### Paper chromatograph assembly, type number PW 4129

A strip feeder for paper chromatography which is interchangeable with the sample slide assembly of the manual sample changer PW 4122. The chromatograph accommodates G.M. scintillation and gas-flow detectors.

### Sample pans, planchets and bottles

Various types made of aluminium, stainless steel, glass, plastic, with diameters ranging between 5 and 145 mm.

### 35 mm lead shielding

type number	description
PW 4321/20	base plate
PW 4124	ring, for probes with an outer diameter of 80 mm max.
PW 4123	cover plate, with recess for the detector cable. May be used as a base as well
PW 4125/00	tripod, for use with the well type scintillation detectors in 35 mm lead shielding
PW 4126	stainless steel isotope container, to be equipped with three lead rings, cover and base plate

### 50 mm lead shieldings

type number	description
PW 4321/01	base plate
PW 4324	ring, for probes with an outer diameter of 105 mm max.
PW 4323	cover plate, existing of an end type ring with a lid
PW 4321	probe height adjustment sleeve, for adjusting the distance between the sample and the radiation detector
PW 4325	table for well-type scintillation probes, dimensions 400 mm × 750 mm

## COUNTERS

### Counter-ratemeter, type PW 4251

This counter-ratemeter combines in one unit a linear amplifier, an integral and differential discriminator, a stabilized h.v. supply (30—3000 V) and an electronic timer. Input facilities comprise a G.M. and an anti-coincidence input. With printer control PW 4200 print-outs of measuring results can be obtained. Five decimal scaling stages, max. counting speed 1000 counts/s.

### Utility counter, type PW 4038

For direct connection G.M. counter tubes, anti-coincidence detector assemblies, and scintillation detectors. Equipped for use in automatically operating measuring systems to handle large quantities of radio-active samples.

### Automatic preset-count preset-time counter, type 111.630

The instrument contains a linear amplifier for scintillation detector or proportional counter tube output pulses; a threshold discriminator, h.v. supply. Output pulses are suited for operating a printer, tape- or punch card machines, data transmission equipment or data handling apparatus for machine analysis. Version 111.630/30 provides for a high voltage supply of 300—3000 V, version 111.630/40 supplies a high voltage of 500—6000 V. Both instruments are recommended for: single or repeated measurements on a single sample or measurements on batches of samples with the automatic sample changer PW 4001. In order to obtain printed identification numbers with the recorded measuring results, the instrument may be extended with a numerator module. Then the type numbers are 111.630/31 and 111.630/41 respectively. Seven decimal scaling stages, a resolution of 1  $\mu$ s are general features. For use with the liquid sample changer, type PW 4003, the special versions 111.630/32 or 111.630/42 are recommended.

### Automatic preset-count preset-time counter, type 111.631

Seven-decades counting instrument with display, for single and automatic measurements. Results are printed on tape. The instrument, type 111.632 is equivalent to type 111.632, however, it comprises a timer with display instead of a blind timer. Resolution 1  $\mu$ s.

### High-speed counter, type 111.633

Seven-decade high resolution counter for use with all radiation detectors. Built-in amplifier-threshold discriminator permits high precision counting with scintillation probes or proportional detectors. Resolution better than 1  $\mu$ s.

### Preset-count preset-time counter, type 111.635

Seven-decade counter with high resolution and high input sensitivity combined with ample registering capacity. Digital display of counts and time is performed by cold cathode indicating tubes. By means of both input attenuator and threshold discriminator, the input sensitivity can be varied between 1 mV and 10 mV. Type 111.634 is equivalent, however, it comprises a timer without display, for

preset time measurements only. Resolution better than 1  $\mu$ s.

### Preset-count preset-time counter with ratemeter, type 111.636

Instrument for both preset-count and preset-time measurements. The operation is stopped at any preset-time or preset-count, depending on which occurs first. The count rate is indicated on a moving coil meter, the instrument incorporates two independent outputs for the connection of remote indicating instrument or strip-chart recorders. A threshold discriminator permits effective reduction of background and scatter. Resolution better than 1  $\mu$ s, seven decimal scaling stages.

### Energy selective counter, type 111.650/20

Counting instrument for operation with automatic sample changers, to be tuned in on a specific energy level. The analyser serves as an integral or as a differential discriminator. Counter and timer are stopped when pre-selected number of pulses has been reached, or preset time has elapsed, whichever occurs first. Output pulses are standardized for operating a printer, tape- or card punch machines, data transmission equipment or other data handling apparatus. Resolution better than 1  $\mu$ s, seven decimal scaling stages.

### Energy selective counter for preset-count preset-time measurements, type 111.655/20

The apparatus is equipped to stop the counting action at any preset time or preset count, whichever occurs first. Digital display of registered counts and elapsed time is performed by cold cathode indicating tubes. The pulse height analyser is equipped to operate as an integral or differential discriminator. Resolution better than 1  $\mu$ s, seven decimal scaling stages.

### Energy selective counter, type 111.653/20

The instrument combines high resolution ( $< 1 \mu$ s) and high input sensitivity with ample registering capacity. By tuning in on a specific energy level the background and scatter radiating are effectively reduced. Seven decimal scaling stages.

### Preset-count preset-time spectrometer and ratemeter, type 111.656/20

A versatile instrument for a great variety of measurements to be made with a high degree of accuracy. Direct indications are provided of pulse counts, elapsed time and count rate. Pulses are also fed into a loudspeaker for aural observation. Resolution better than 1  $\mu$ s, seven decimal scaling stages.

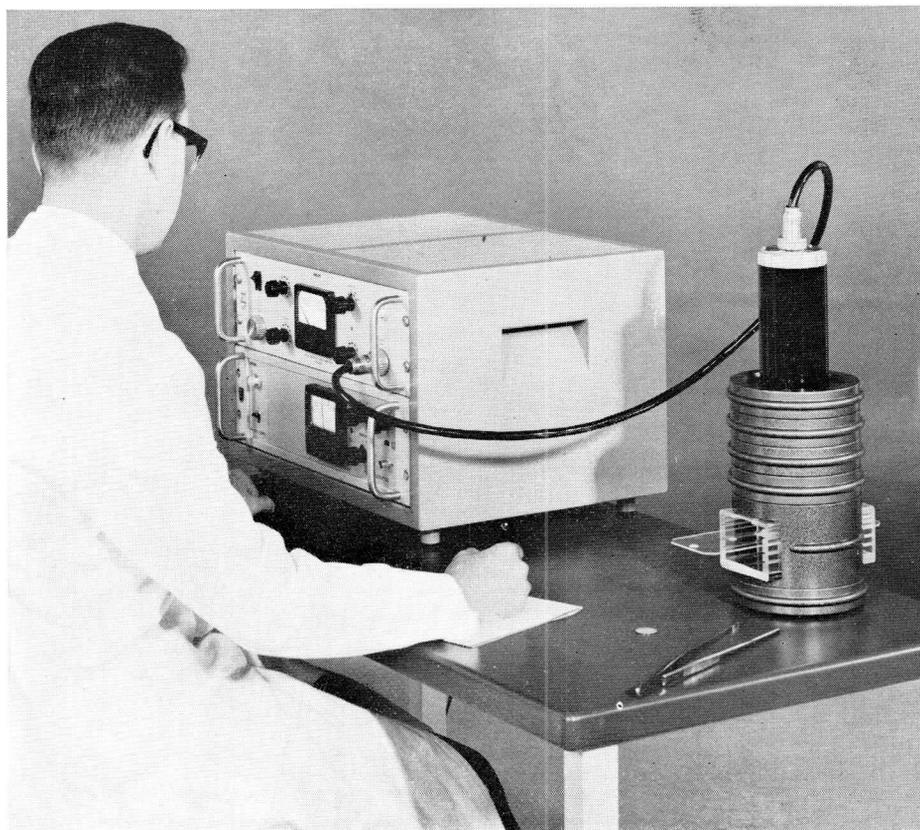
## RATEMETERS

### Linear count ratemeter, type 111.637

The instrument indicates counts per second on a moving coil meter, scale width 90 mm. For aural observation a loudspeaker is built in. The discrimination threshold is continuously adjustable by means of a three-turn helical potentiometer. The instrument also comprises a four-position input attenuator. Resolution better than 1  $\mu$ s.

### Linear count ratemeter, for energy selective measurements, type 111.657/20

Instrument for direct indication of the average count rate, with built-in pulse amplitude analyser. Equipped for operation as integral or differential discriminator. Effective background and scatter radiation suppression by tuning into a specific energy level is possible. Resolution better than 1  $\mu$ s.



Ratemeter, type 111.637, with scintillation detector, type PW 4111, mounted in manual sample changer, type PW 4122/00 with 3.5 cm lead shielding.

## AUTOMATIC SPECTROMETERS

### 400 channel pulse amplitude analyser, type 111.500

A versatile instrument for a variety of measuring and analysing techniques, such as "add" or "subtract" operations and mössbauer studies. The instrument automatically corrects for deadtime losses. Functional units for special measuring techniques may be added.

### Automatic single-channel gamma spectrometer, type 111.670

Transistorized gamma spectrometer for automatic scanning of gamma-energy spectra. The instrument comprises a sliding channel differential or integral discriminator with window amplifier. An X-T recorder is part of the equipment, an X-Y plotter is optional. Stability is excellent, the halfvalue width is better than 8.5% for the 662 keV photopeak of  $^{137}\text{Cs}$ .

### Automatic digital single-channel gamma spectrometer, type 111.673

This spectrometer produces a printed numerical record of gamma energy spectra. A differential or integral discriminator with window amplifier maintains a very high accuracy.

### Automatic digital single-channel gamma spectrometer, type 111.672

identical to type 111.673, but utilizing a counter without display.

### Automatic single-channel gamma spectrometer, type 111.674

Automatic single-channel gamma spectrometer, for both stepwise and continuous scanning, with digital and analogue output. This instrument is a combination in a single unit of the two spectrometers, type 111.674 and type 111.673.

## INTEGRATED SYSTEMS AND CUSTOM-ENGINEERED EQUIPMENT

System integration is especially important for isotope laboratories where measurements are carried out on large quantities of varied samples. Utilizing the PW 4200 series of modules, the most suited equipment for each measuring position may be applied and yet data processing can be fully automatized. The measuring results of the various assemblies are then printed out in any required sequence.

## MONITORS

### Portable radiation monitor, type PW 4012/01

A rugged, watertight, battery powered instrument for direct checking of gamma radiation or X-ray level. For alpha or beta radiation counting a special detector is available. An earphone may be connected. Weight 1.8 kg.

### Transistorized pocket radiation monitor, type PW 4014

This monitor is intended for use in general surveyal, location, and measurement of gamma radiation and X-rays. A gamma sensitive G.M. tube, is built in. For measuring beta

radiation or in case the access to the radioactive source is difficult, a separate probe is available. For audible detection an earphone is optional. Extension of the measuring range can be provided for by using an optional probe. Weight 0.6 kg.

### Portable monitor, type XL 1000

Measures alpha, beta, gamma and X-rays. Easy-to-handle instrument, for measuring dose-rate and accumulated dose. Check source for calibration is built in. Weight 0.6 kg.

### Contamination meter, type PW 4015

Particularly intended for indication of radioactive contamination of areas and buildings. Also for personnel equipment, food, water, etc., and to check the effectiveness of decontamination measures. Apart from the application for civil defence and military use it is a basic instrument for a variety of measurements. Auxiliaries available.

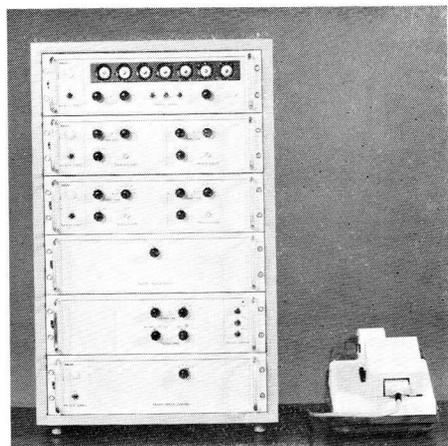
### Gamma alarm monitor, type PW 4044

A fully transistorized instrument for continuous monitoring of gamma or X-ray radiation level in industry, isotope laboratories, nuclear energy plants, etc., in the range from 0.1 mR/h to 10 mR/h.

Has facilities for auxiliary equipment. Exceeding of a pre-determined level is indicated by means of a red lamp. Connection with remote indicating instrument or alarm device is provided for.

### Hand contamination monitor, type PW 4215

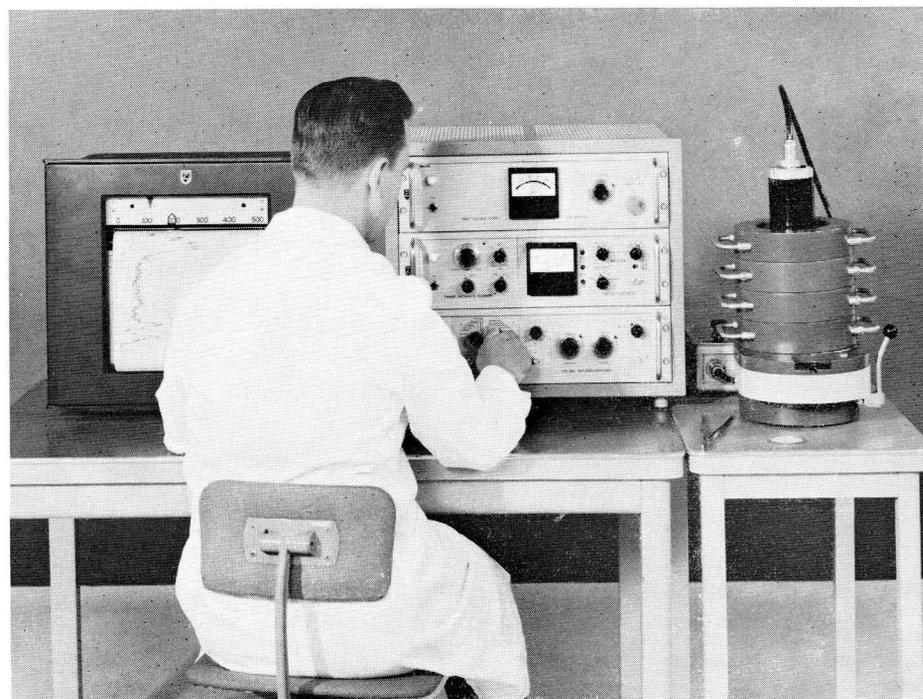
A wall-mounting instrument for detection of skin contamination. Both sides of the hands are tested simultaneously for low level alpha and beta-gamma contamination. A trend test clears uncontaminated persons very rapidly. The full counting period is required for marginal or excessive contamination only. The instrument is fully transistorized, and is easy to be decontaminated.



Multi-counter arrangement, equipped with five counters (7 decades, 1 Mc/s).



The possible contamination of maize is checked with a contamination monitor.



Automatic single-channel gamma spectrometer, type 111.670 employing the sliding channel mode of operation.

### **Clothing contamination monitor, type PW 4216**

Instrument for checking alpha and beta-gamma contamination on clothing, especially for quick checking of large numbers of personnel. Fully transistorized, and is easy to be decontaminated.

### **Ionisation chamber for isotope (gamma) calibration, type 37.497**

For calibration of gamma sources, with direct indication in millicuries. Delivered with Philite jigs for needle shaped sources, for vials and small bottles, calibration curves for  $^{60}\text{Co}$ ,  $^{131}\text{I}$ ,  $^{198}\text{Au}$  and  $^{236}\text{R}$ . Calibrations for other isotopes available.

### **Ionisation chamber for isotope (beta and gamma) calibration, type XL 2000**

Identical to type 37.497, but with an additional sample slide at the bottom.

### **MODULES**

An extensive range of modular units provide a simple solution for almost any instrumentation problem. Apart from the circuit for their specific function, they include a logic section. Consequently, any required mode of operation can be obtained by merely making the necessary patch connections. In addition, automatic, pre-programmed operation can be arranged in conjunction with a great variety of peripheral equipment. Included in this series of modules, are units which convert the measuring results into standardized pulses to operate printers, tape or card punch machines or any other data handling or transmission apparatus.

### **CABINETS, RACKS AND MODULE HOUSINGS**

The constructional practice applied for housing our equipment for the measurement of nuclear radiation is based on the consequent design of the separate modules of the 19 in standard panels, and of the cabinets and racks.

### **COMPACT NEUTRON GENERATORS**

Compact and simple instruments for the production of a continuous variable neutron flux of over  $10^8$  neutrons/s, energy approx. 14 MeV (DT-reaction). For education and training, study of reactor kinetics, activation analysis, biological irradiations, etc. To suit specific requirements, a generator is available in four versions: for continuous output operation, with or without neutron flux monitoring equipment and for continuous and pulsed operation with or without measuring facilities.

### **CYCLOTRONS**

Philips have gained extensive experience of designing, manufacturing and using cyclotrons. The first accelerator of this type was put into operation in 1948 and since then an impressive range of machines has been built. Thanks to this experience, we are in a position to offer cyclotrons of various types on which a guaranteed performance specification is given. Full assistance is given to architects who are commissioned with the designing of the

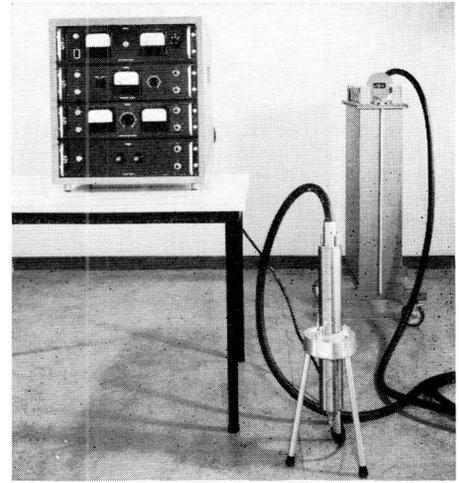
premises in which the accelerator is to be installed. For installations at site, experienced engineers are available for supervision and for putting the equipment into operation. If desired, training of the customers staff in the operation of the machine is provided. After completion of the installation of the cyclotrons, a full year's guarantee is given.

Apart from being used for purely fundamental research the family of accelerators of the cyclotron type are widely applied nowadays in sciences involving medicine, metallurgy, agriculture, etc.

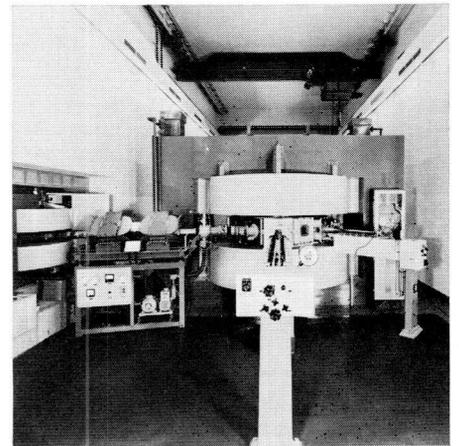
### **REACTOR CONTROL AND SUPERVISING INSTRUMENTS**

Philips are generally acting as subcontractor of the reactor constructor for integrated instrumentation systems including instrument panels, control desks and interlock facilities and are prepared to work out proposals for complete instrumentation systems for any type of reactor. A range of fully transistorized instruments is available.

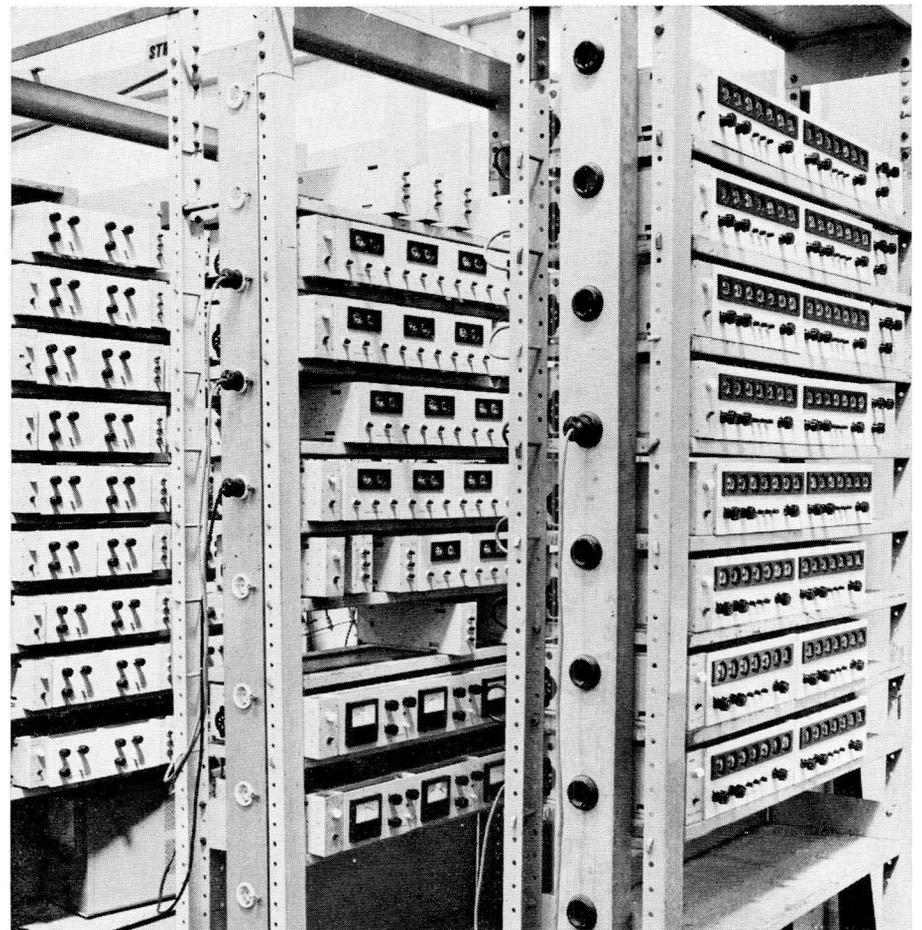
*28 MeV deuteron synchro-cyclotron with focusing magnets and deflection system installed at the University of Göttingen, Germany.*

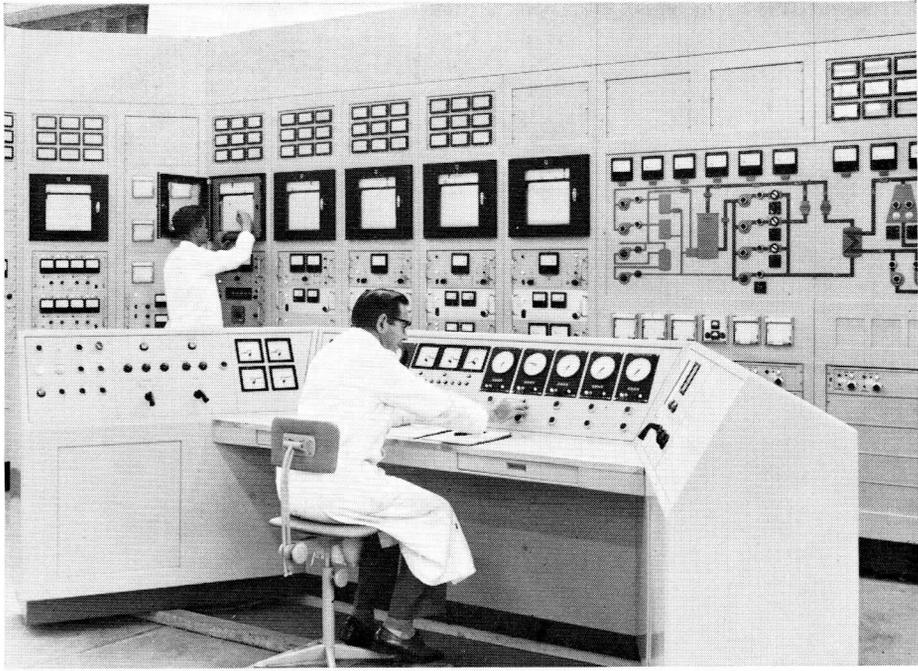


*Compact neutron generator, type 111.593 complete with measuring channel.*

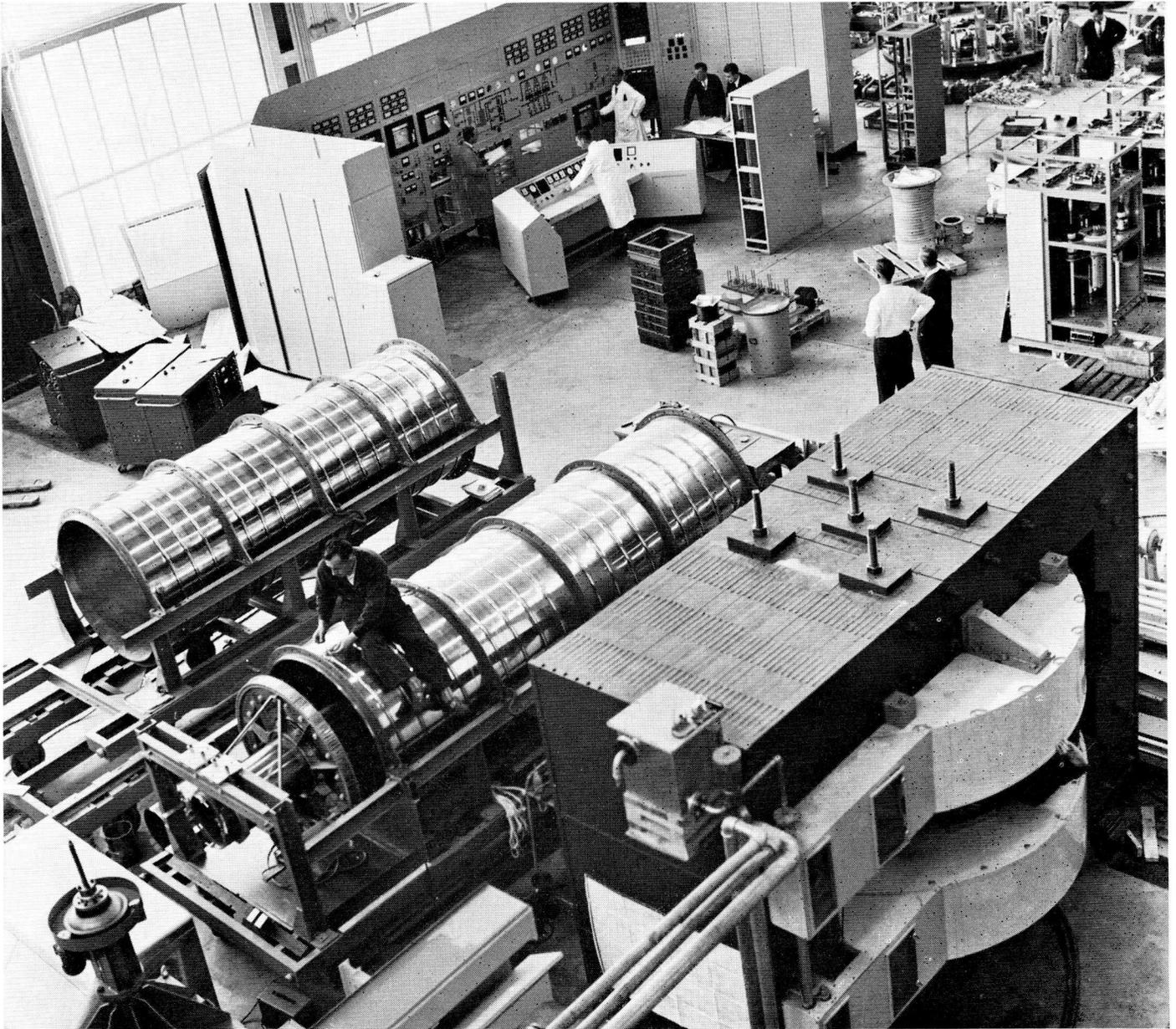


*Part of a test bench on which modules of the PW 4200 range are run continuously during 300 hours at full operation conditions, before they leave the factory.*

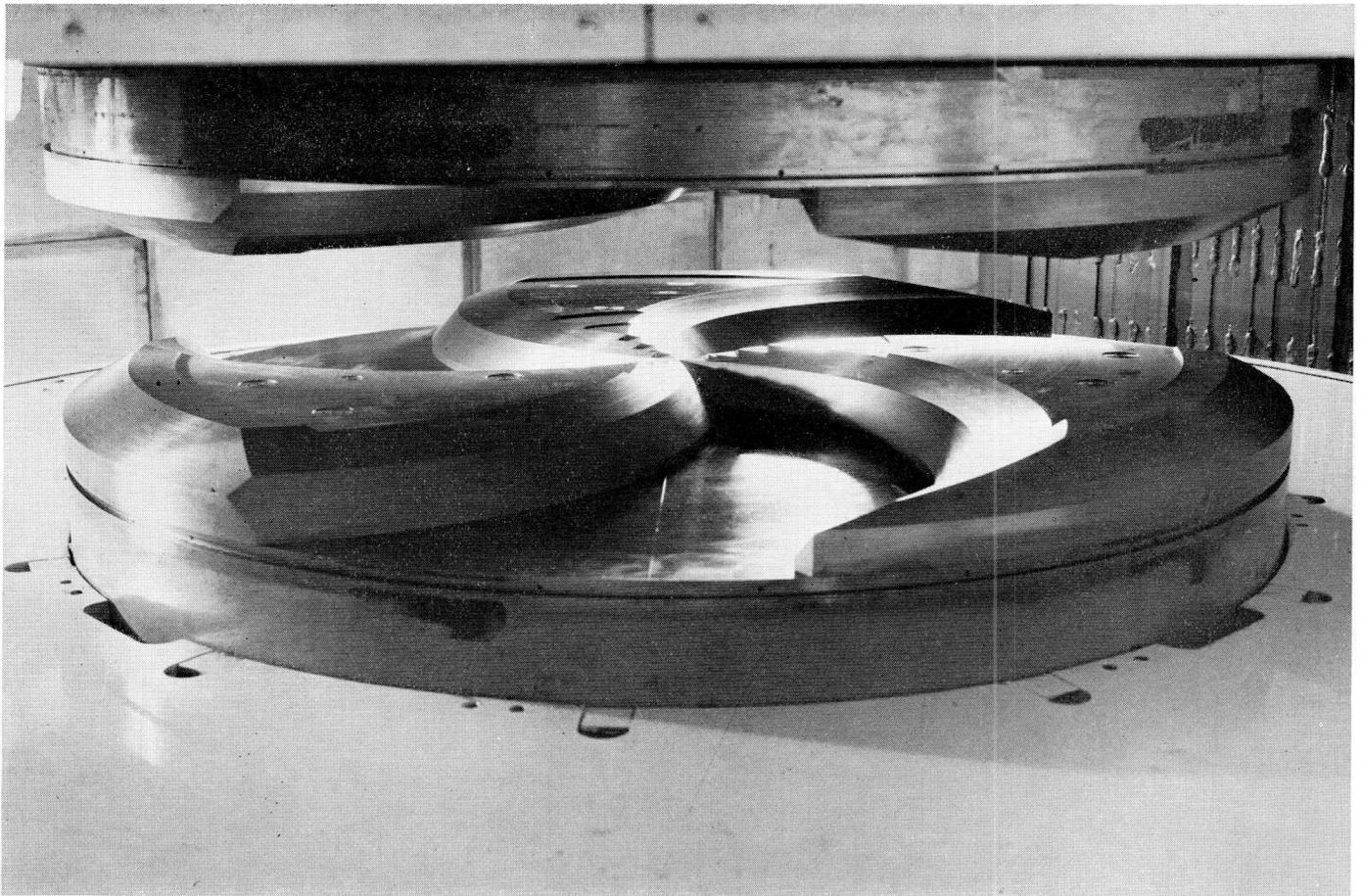




Operator's console and instrument panels for a high flux research reactor.

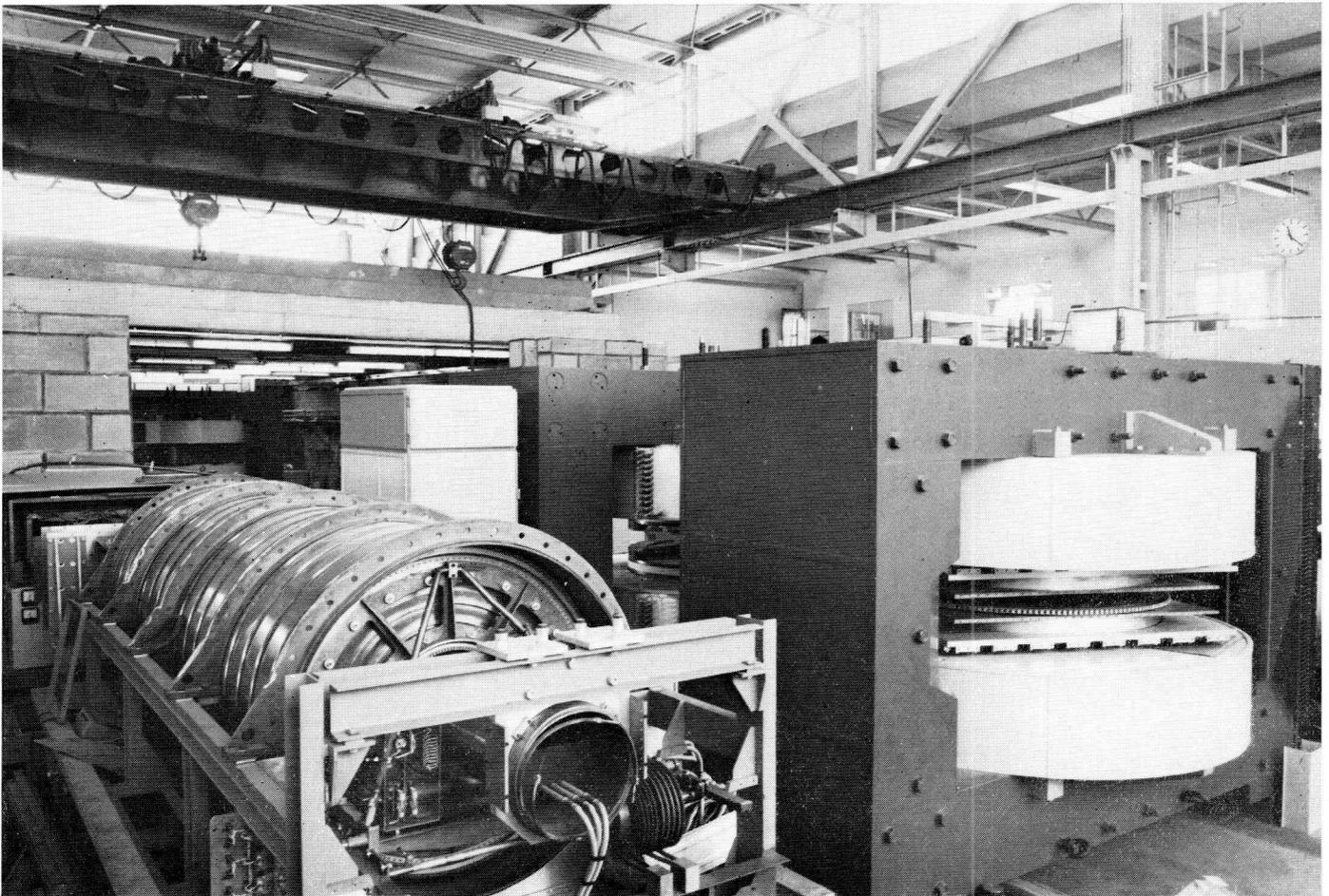


Interior of the assembly hall in the cyclotron factory at Eindhoven. In the foreground magnet and radio-frequency liners are shown whereas in the background the control panel built for a nuclear reactor can be seen.



*The pole pieces of an AVF cyclotron (cloverleaf). Accelerators of this type are in use for, e.g., radio-isotope production.*

*Series production of synchro-cyclotrons.*



## 29. RADIOACTIVE ISOTOPES

Philips-Duphar, the pharmaceutical-chemical division of the Philips group of industries, supply a complete range of nuclear pharmaceuticals. For research and industrial use a very extensive programme of tracers and sources can be offered.

### NUCLEAR PHARMACEUTICALS

- DRN 3301 Sodium arsenate ( $^{74}\text{As}$ ) injection  
localization of brain lesions
- DRN 7900 Gold colloid ( $^{198}\text{Au}$ ) injection  
therapy of ascites  
infiltration of tumours  
determination of liver blood flow  
scintigraphy of the liver
- DRN 8305 Bismuth acetate ( $^{208}\text{Bi}$ ) injection  
localization of brain lesions  
diseases of the R.E.S. e.g.  
lymphatic leukaemia, chronic myeloid leukaemia,  
Hodgkin's disease
- DRN 2717 Vitamin B12 ( $^{57}\text{Co}$ ) oral  
vitamin B12 resorption test
- DRN 2714 Vitamin B12 ( $^{57}\text{Co}$ ) capsules  
vitamin B12 resorption test
- DRN 2715 Vitamin B12 ( $^{58}\text{Co}$ )  
vitamin B12 resorption test
- DRN 2712 Vitamin B12 ( $^{58}\text{Co}$ ) capsules  
vitamin B12 resorption test
- DRN 2713 Vitamin B12 ( $^{60}\text{Co}$ )  
vitamin B12 resorption test
- DRN 2704  $^{60}\text{Co}$  tubes  
therapy of tumours
- DRN 2705  $^{60}\text{Co}$  needles  
therapy of tumours
- DRN 2407 Sodium chromate ( $^{51}\text{Cr}$ ) injection  
determination of erythrocyte life-span  
determination of blood volume
- DRN 2410 Chromium labelled human serum albumin ( $^{51}\text{Cr}$ ) injection  
diagnosis of gastroenteropathy
- DRN 2604 Ferrous citrate ( $^{59}\text{Fe}$ ) injection  
diagnosis of haematologic disorders
- DRN 8007 Neohydrin ( $^{197}\text{Hg}$ ) injection  
renal scintigraphy  
localization of brain lesions
- DRN 5300 Sodium iodide ( $^{131}\text{I}$ ) oral  
diagnosis of the thyroid function  
therapy of the thyroid disorders
- DRN 5303 Sodium iodide ( $^{131}\text{I}$ ) injection  
diagnosis of the thyroid function  
therapy of the thyroid disorders
- DRN 5305 Human serum albumin ( $^{131}\text{I}$ ) injection  
determination of blood and plasma volume  
radiocardiography  
radiocirculography  
radioencephalography
- DRN 5316 Hippuran ( $^{131}\text{I}$ ) injection  
test of the renal function
- DRN 5312 Rose Bengal ( $^{131}\text{I}$ ) injection  
test of liver function  
scintigraphy of the liver
- DRN 5304 Triolein ( $^{131}\text{I}$ ) oral  
test of pancreas function
- DRN 5306 Oleic acid ( $^{131}\text{I}$ ) oral  
test of pancreas function
- DRN 5310 1—3, 5, 5'-Triiodothyronine ( $^{131}\text{I}$ ) diagnostic  
in vitro thyroid function test
- DRN 5332 Sodium iodide ( $^{132}\text{I}$ ) column  
diagnosis of placenta praevia  
radiocardiography  
radiocirculography
- DRN 1500 Sodium ortho phosphate ( $^{32}\text{P}$ ) oral  
polycythaemia vera
- DRN 1503 Sodium ortho phosphate ( $^{32}\text{P}$ ) injection  
diagnosis of eye tumours  
localization of brain tumours during operation  
polycythaemia vera
- DRN 1526 Chromic phosphate ( $^{32}\text{P}$ ) suspension injection  
treatment of ascites

- DRN 3801 Strontium chloride ( $^{85}\text{Sr}$ ) injection  
determination of calcium metabolism  
scintigraphy of bone diseases
- DRN 3903 Yttrium oxide ( $^{90}\text{Y}$ ) grains  
hypophysectomy

A catalogue containing complete information about the nuclear pharmaceuticals listed above and some others is available on request.

### INDUSTRIAL RADIOACTIVE ISOTOPES

#### Industrial Radiography

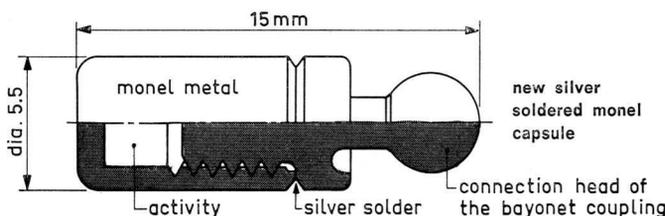
- DRN 7700  $^{192}\text{Ir}$  Radiographic sources

Source dimensions (diameter × height)	Activity Ci
1 × 1	5—10
2 × 2	10—50
3 × 3	50—150

Highest specific activity resulting in smallest focus and sharpest radiographs.

New source holder with unique features: smallest dimensions enable construction of cameras of minimum weight; monel capsule protects against corrosion; no contamination of equipment because active iridium pellet is sealed in inactive source holder; X-ray testing of capsules.

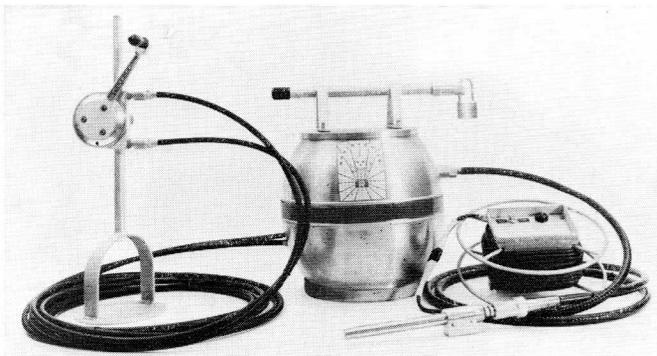
Delivery from stock or at short notice.



- DI 10 Radiographic camera, portable, with remote control handling.

Container: diameter 30 cm, height 40 cm, weight 23 kg  
Accessories in canvas bag: 50 cm × 40 cm × 15 cm, weight 10 kg  
Capacity: up to 50 Ci  $^{192}\text{Ir}$

Construction: fireproof, in accordance with I.A.T.A. regulations for airtransport.



Radiographic camera DI 10.

## Sources for industry

DRN 2709  $^{60}\text{Co}$  sources for industry }  
 DRN 5501  $^{137}\text{Cs}$  sources for industry } made to specification

## Tracers

DRN 5199  $^{124}\text{Sb}$ , triphenyl stibine }  
 DRN 2798  $^{60}\text{Co}$ , cobalt naphthenate } oil soluble tracers  
 DRN 5307  $^{131}\text{I}$ , labelled peanut oil }  
 DRN 2105  $^{146}\text{Sc}$ , labelled Ionac } tracer for sand and sedi-  
 ment porosity testing in  
 boreholes

## CARBON-14 AND TRITIUM LABELLED COMPOUNDS

A special catalogue describing more than 800  $^{14}\text{C}$  compounds can be supplied on request.

## REFERENCE AND STANDARD SOURCES

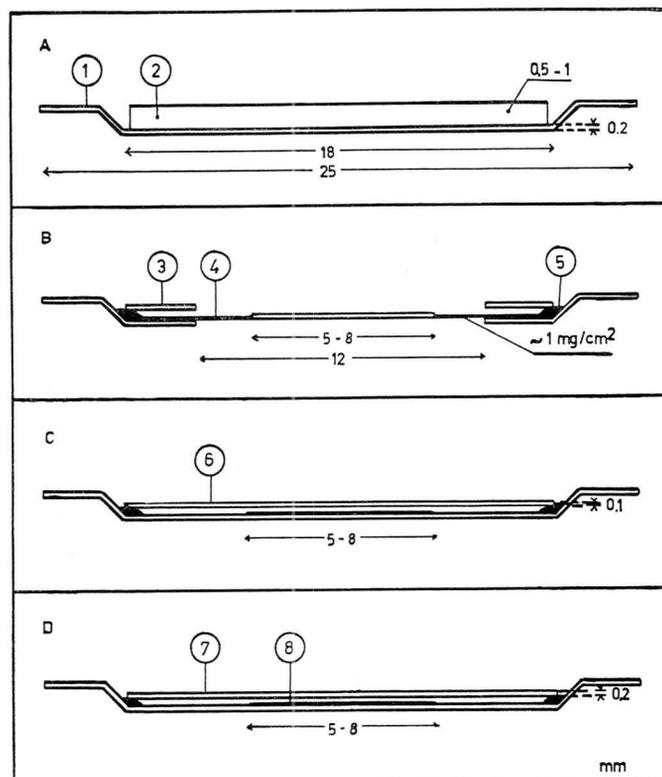
### Reference sources

code	nuclide	$\mu\text{Ci}$ approx.	type
beta sources			
DRN 3821	$^{90}\text{Sr}$	0.05	D
DRN 8121	$^{204}\text{Tl}$	0.06	C
gamma sources			
DRN 8321	$^{207}\text{Bi}$	3	D
DRN 4821	$^{109}\text{Cd}$	15	D
DRN 5521	$^{137}\text{Cs}$	10	D
DRN 2421	$^{51}\text{Cr}$	10	B
DRN 2721	$^{60}\text{Co}$	3	D
DRN 7921	$^{198}\text{Au}$	10	D
DRN 2621	$^{55}\text{Fe}$	5	B, D
DRN 2521	$^{54}\text{Mn}$	5	B
DRN 1121	$^{22}\text{Na}$	10	C
DRN 3021	$^{65}\text{Zn}$	5	D

### Standard sources

code	nuclide	$\mu\text{Ci}$ approx.	type	standard error
beta sources				
DRN 9620	$^{14}\text{C}$	0.04 0.2 4	A	$\pm 3\%$
DRN 1720	$^{38}\text{Cl}$	0.06	C	$\pm 5\%$
DRN 8220	$^{210}\text{Pb}$	0.06	C	$\pm 5\%$
DRN 3820	$^{90}\text{Sr}$	0.1	C	$\pm 5\%$
DRN 8120	$^{204}\text{Tl}$	0.06	C	$\pm 5\%$
DRN 9220	$^{238}\text{U}$	0.03	C	$\pm 3\%$
gamma sources				
DRN 8322	$^{207}\text{Bi}$	3	D	$\pm 10\%$
DRN 4822	$^{109}\text{Cd}$	5	C	$\pm 10\%$
DRN 5522	$^{137}\text{Cs}$	5	C	$\pm 5\%$
DRN 2422	$^{51}\text{Cr}$	10	B	$\pm 5\%$
DRN 2722	$^{60}\text{Co}$	10	D	$\pm 3\%$
DRN 7922	$^{198}\text{Au}$	10	D	$\pm 5\%$
DRN 2622	$^{55}\text{Fe}$	5	B, D	$\pm 5\%$
DRN 2522	$^{54}\text{Mn}$	5	B	$\pm 5\%$
DRN 8822	$^{228}\text{Ra}$	10	D	$\pm 3\%$
DRN 1122	$^{22}\text{Na}$	10	C	$\pm 3\%$
DRN 3022	$^{65}\text{Zn}$	5	D	$\pm 10\%$
Simulated sources				
DRN 1531	as $^{32}\text{P}$	0.03	C	$\pm 5\%$

### Planchets for reference and standard sources



Dimensions in mm

1. Aluminium sample holder, PW 4133, thickness about 50  $\text{mg}/\text{cm}^2$ .
2. Disc of polymethylmethacrylate  $^{14}\text{C}$ .
3. Aluminium ring.
4. Nylon foil, thickness about 1  $\text{mg}/\text{cm}^2$ .
5. Polymer lute.
6. Aluminium foil, thickness about 25  $\text{mg}/\text{cm}^2$ .
7. Aluminium foil, thickness about 50  $\text{mg}/\text{cm}^2$ .
8. Active area, diameter 5-8 mm.

### Absorber set

Comprising 20 individually calibrated aluminium absorbers in transparent plastic box, covering a thickness range of 0-2000  $\text{mg}/\text{cm}^2$ .

## 30. X-RAY ANALYTICAL EQUIPMENT

X-ray diffraction, X-ray diffractometry and X-ray spectrometry, originally used primarily in research, have been applied on an increasing scale to industrial and product control. Industrial demands for analytical tools performing rapid routine non destructive analysis jobs on alloys, pure metals, cements, oils, ores, basic chemicals, etc., have resulted in the development and production of a wide range of X-ray analytical instrumentation. Basic X-ray generators, X-ray spectrometers, goniometers, cameras, electronic counting and measuring equipment and an extensive range of accessories are available for the various X-ray analytical techniques.

### Transistorized electronic circuit panel, type PW 1352/00

This basic unit, a universal transistorized electronic circuit panel, is hardly always required for every technique of X-ray analysis. It is built up of a number of functional units which fit into a 19 in cabinet. The panel is designed for strip-chart recording, preset time and preset count measurements. Separately available functional combinations, such as timer and counter, pulse-height analyzer, printer and stepscanning control, can be added to suit the circuit panel for specific requirements.

## X-RAY DIFFRACTION

### Generators

A unique instrument for X-ray diffraction is the ultra-stable high-voltage generator PW 1310, the X-ray diffraction tube of which can be run at its full rated power of 2 kW. Counting techniques have been considerably improved due to the high intensities of this X-ray source. The excellent stabilization of the generator ensuring optimum reproducibility is essential to the refined crystallographic work of to-day.

Leading in the range of the 1 kW generators is the constant potential X-ray generator

PW 1010. Owing to its high degree of stabilization this generator is intensively applied for quantitative diffractometry work (and X-ray spectrometry).

A constant potential generator PW 1009 enables high quality recording of diffraction spectra to be done with all types of cameras. In addition, its stabilization permits qualitative as well as semi-quantitative X-ray diffractometry.

Along with these more automatic types, a self rectifying table model X-ray generator PW 1008, is a fundamental tool for structural analysis utilizing film measurement techniques.

### X-ray diffraction cameras

#### Debye-Scherrer cameras

PW 1024/10 large powder camera  $\varnothing$  114.83 mm  
PW 1026/10 small powder camera  $\varnothing$  57.54 mm  
The diameters of the cameras are chosen so that one degree corresponds to 2 mm of developed and stretched film for the large camera and to 1 mm for the small camera. The cameras are designed for the Straumanis method of film measuring and take 35 mm film.



Complete instrumentation for X-ray diffraction and diffractometry based on the X-ray diffraction generator, type PW 1310 equipped with two tube shields.

On the left separate control cabinet type PW 1320.

For X-ray diffractometry the transistorized electronic circuit panel, type PW 1352/00 is used with the generator.

### X-ray diffraction generators

type	high voltage	tube current	stabilization	time switch	mains
PW 1310	10—100 kV, in steps of 1 kV or 10—60 kV, in steps of 1 kV	4, 4.5, 5, 6, 7, 8, 9, 10, 12, 14, 16, 18, 20, 24, 28, 32, 36 mA (current adjustments are variable from 0 to +20%)	tube current and high voltage are stabilized within 0.03 % for mains fluctuations of $\pm 10$ %	0—16 h accuracy $\pm 20$ s	95—160 V, 175—260 V, 365—395 V 50 and 60 c/s
PW 1010	10—54 kV, adjustable in steps of 1 kV from 10 to 27 kV and in steps of 3 kV from 20 to 54 kV	6—36 mA, adjustable in steps of 2 mA	high voltage and tube current are stabilized to within 0.1 % for mains fluctuations of $\pm 10$ %	0—16 h accuracy $\pm 20$ s	95—160 V, 175—260 V, 365—395 V 50 and 60 c/s
PW 1009	0—55 kV, continuously adjustable	0—40 mA, continuously adjustable	filament current stabilizer	plug-in timers 0—23.5 h, accuracy $\pm 30$ s	190, 220, 240 V 50 and 60 c/s
PW 1008	25—50 kV in 10 steps of 2.5 kV	4—40 mA, continuously adjustable	magnetic filament current stabilizer	plug-in timer 0—23.5 h, accuracy $\pm 30$ s	220 V 50 and 60 c/s

*Universal flat plate camera, type PW 1030/10*

Type PW 1030/10, equipped with "Astbury" cassette for forward and back-reflection techniques and Laue studies of single crystals.

*Weissenberg goniometer, type PW 1034*

An integrating type which makes possible rotation diagrams and goniometer techniques according to Weissenberg-Böhm using the normal beam, equi-inclination or flat cone methods. The integrating mechanism can be disconnected. Three collimators of different diameter are supplied with the instrument, and adjustment of the crystals is facilitated by a monocular viewer.

*Buerger precession goniometer, type PW 1086*

For taking undisturbed photographs of reciprocal lattice planes parallel to the axis of rotation or diverging slightly from it. It can be advantageously applied when investigating complicated structures of crystals with poor scattering characteristics.

**Goniometers**

*Wide range high and low angle goniometer, type PW 1050*

For Geiger Müller, proportional, or scintillation-counter analysis in X-ray diffractometry and X-ray spectrometry. Operation between preset limits and continuous with increasing or decreasing angle. It can also be used with a step advancement mechanism for fixed count or fixed time measurements. A large variety of accessories is available for use with the goniometer including a texture attachment, diffraction set, curved crystal monochromator, specimen rotation device, aligning devices.

- scanning range :  $-38^\circ \dots +180^\circ$  ( $2\theta$ ) uninterrupted
- scanning speeds :  $\frac{1}{8}^\circ, \frac{1}{4}^\circ, \frac{1}{2}^\circ, 1^\circ$  and  $2^\circ$  ( $2\theta$ ) per minute
- tolerance :  $\pm 0.0025^\circ$
- reading accuracy : to  $0.01^\circ$  ( $2\theta$ )
- operation : unidirectional and oscillatory

*Texture attachment, type PW 1078*

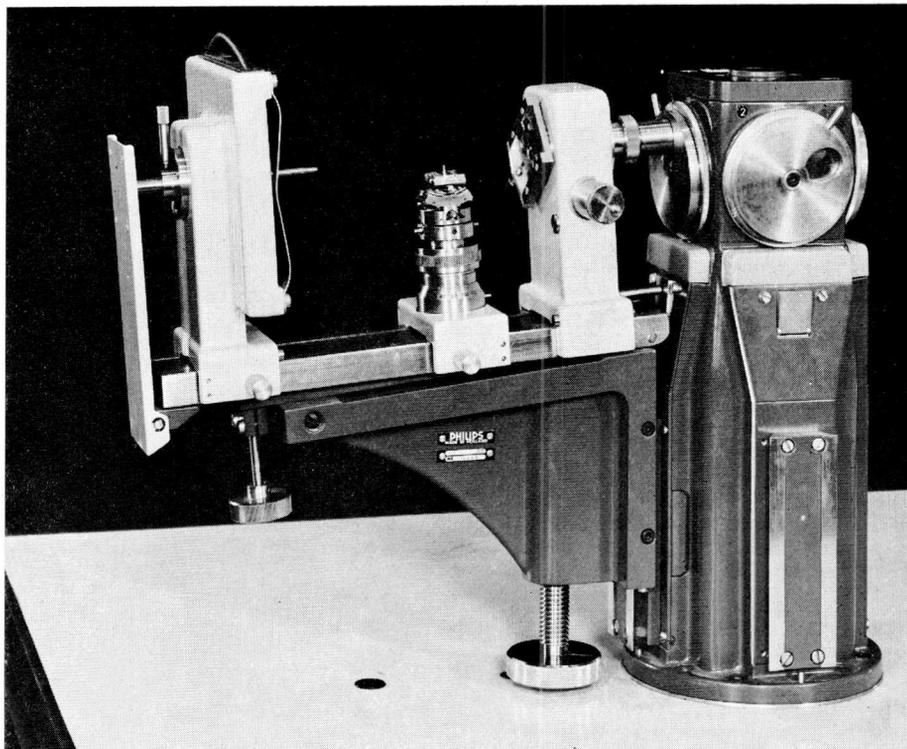
This attachment is used with the wide range goniometer for continuously recording the intensity of a particular reflection as a function of the orientation of the specimen.

- speed:  $2.5^\circ, 5^\circ, 10^\circ$  (per rotation of specimen)
- measuring time:  $2.5^\circ$  per 8 min
- $5^\circ$  per 8 min
- $5^\circ$  per 16 min
- $10^\circ$  per 16 min

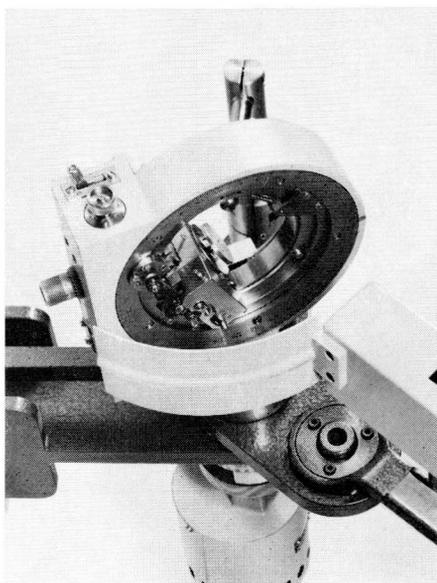
- reflection range:  $0^\circ-70^\circ$
- transmission range:  $70^\circ-90^\circ$ , in steps of  $2.5^\circ$
- specimen translation: 5, 9 or 15 mm
- specimen dimensions: reflection: 75 mm (largest diagonal)
- transmission:  $15\text{ mm} \times 30\text{ mm} \times 3\text{ mm}$
- degree marking: 4 indications per 8 min
- power requirements: 110—220 V; 50 or 60 c/s

**X-ray diffraction tubes**

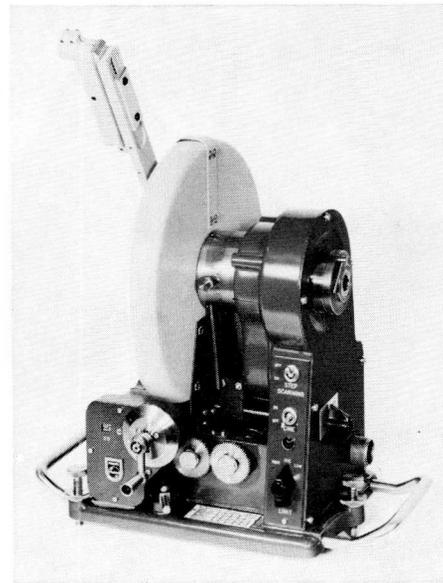
Both the 2 kW and 1 kW X-ray diffraction tubes are of the sealed-off, four window type. This window construction affords high efficiency in the use of light element target materials such as chromium. The 1 kW X-ray diffraction tubes are available with either a normal or fine focus.



Universal flat plate camera PW 1030 arranged for making Laue patterns.



Texture attachment, type PW 1078.



Wide range high and low angle goniometer, type PW 1050.

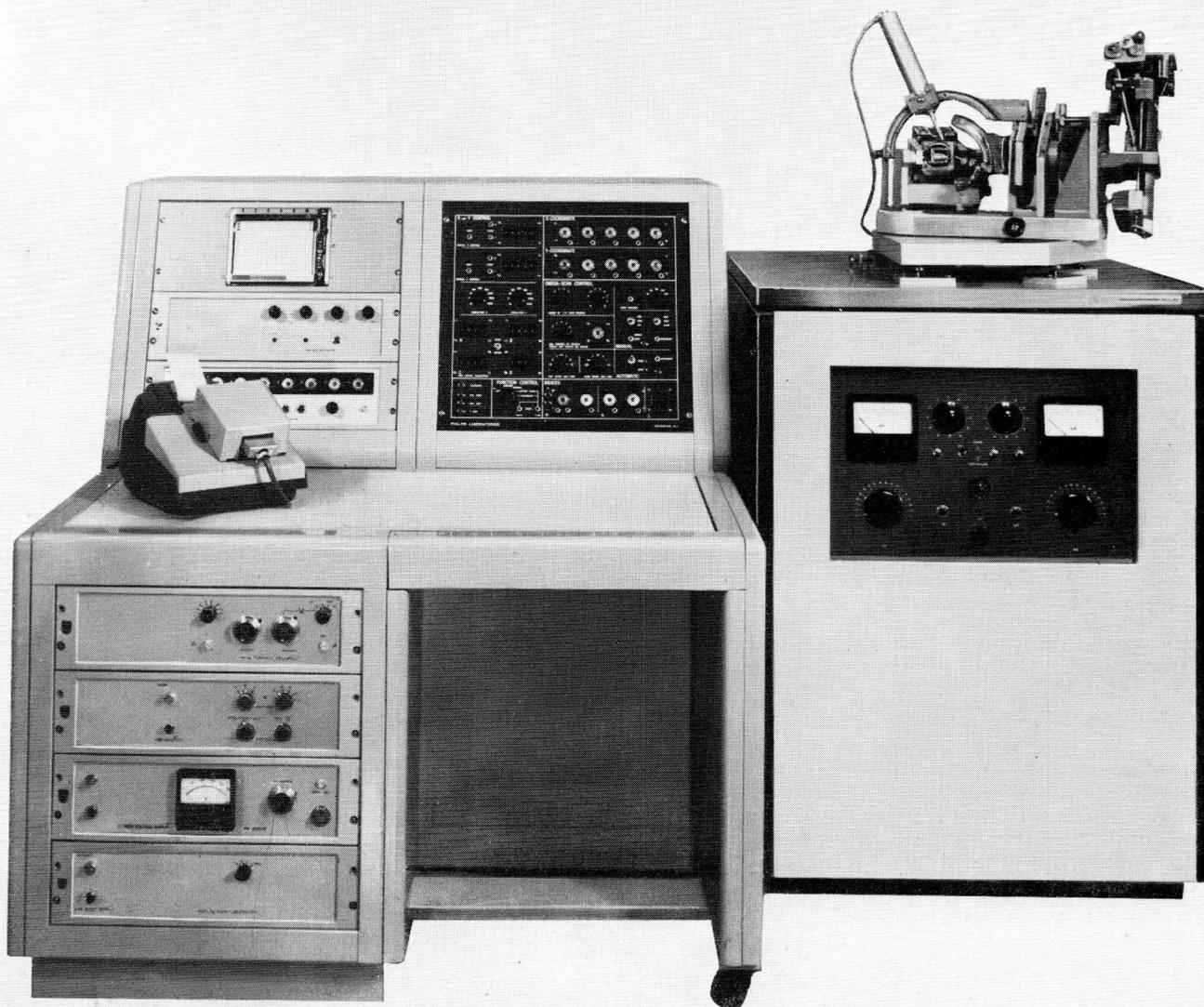
**X-ray diffraction tubes**

types	anode materials	window materials	focus mm <sup>2</sup>	load W
RD 60/2-PW 210/00	Cu-W-Mo Co-Fe-Cr	beryllium	2 × 12	2 000, 1 000 (for Cr 1600)
RD 50/1-2562/62	Cu-W-Mo Co-Fe-Cr	mica-beryllium	1 × 10	1 000, 350 (for Cr 300)
RDF 50/1-2563/62	Cu-Mo-Co	mica-beryllium	0.4 × 8	800 (for Co 300)

## Single-crystal diffractometer

The automatic single crystal diffractometer supplies the crystallographer with complete three-dimensional intensity data. The output (punched tape) can be fed directly into a computer. Alignment of the crystal, even when it is practically unknown, can be accomplished on and with the instrument in a very short time. Intricate calculations are not required. The flexibility of the instrument permits, apart from collecting three-dimensional intensity data, a large variety of other investigations such as: determination of lattice parameters, studies of symmetry and space groups by direct and reciprocal space methods, study of physical properties (by changing wavelengths) such as extinction, absorption and anomalous dispersion, measurement of line profiles to study thermal diffuse scattering, mistake structures, lattice distortions and phase changes. The instrument is designed for 24 hours per day operation making use of high quality components and materials.

Single-crystal diffractometer.



## X-RAY SPECTROMETRY

### Spectrometers

#### *Automatic X-ray spectrometer, type PW 1212*

This spectrometer is available for production and routine testing where maximum programming facilities together with short analysis times are required.

Interchangeable peg-boards permit complete analysing programmes to be changed rapidly. For a series of samples that are outside routine requirements the operating conditions can be set on a programming switch-board. For detailed investigations and research the spectrometer can be readily switched from automatic to manual operation.

In one cycle up to four samples can be analysed for elements from sodium upwards. Analytical data are presented in digital form. The automatic spectrometer performs all functions without supervision. The output can be fed directly to a data processor for automatic conversion of intensities into concentrations.

#### *Semi-automatic X-ray spectrometer, type PW 1220*

For the analysts engaged in large numbers of routine analysis of many types. It is based on the spectrometer-goniometer combination of the automatic spectrometer. Like the automatic instrument, the goniometer can be preset for any 24 elements. Counters, crystal, collimator and other conditions have to be set manually, but to ease operation these are motor driven into position.

#### *Universal vacuum spectrometer attachment, type PW 1540*

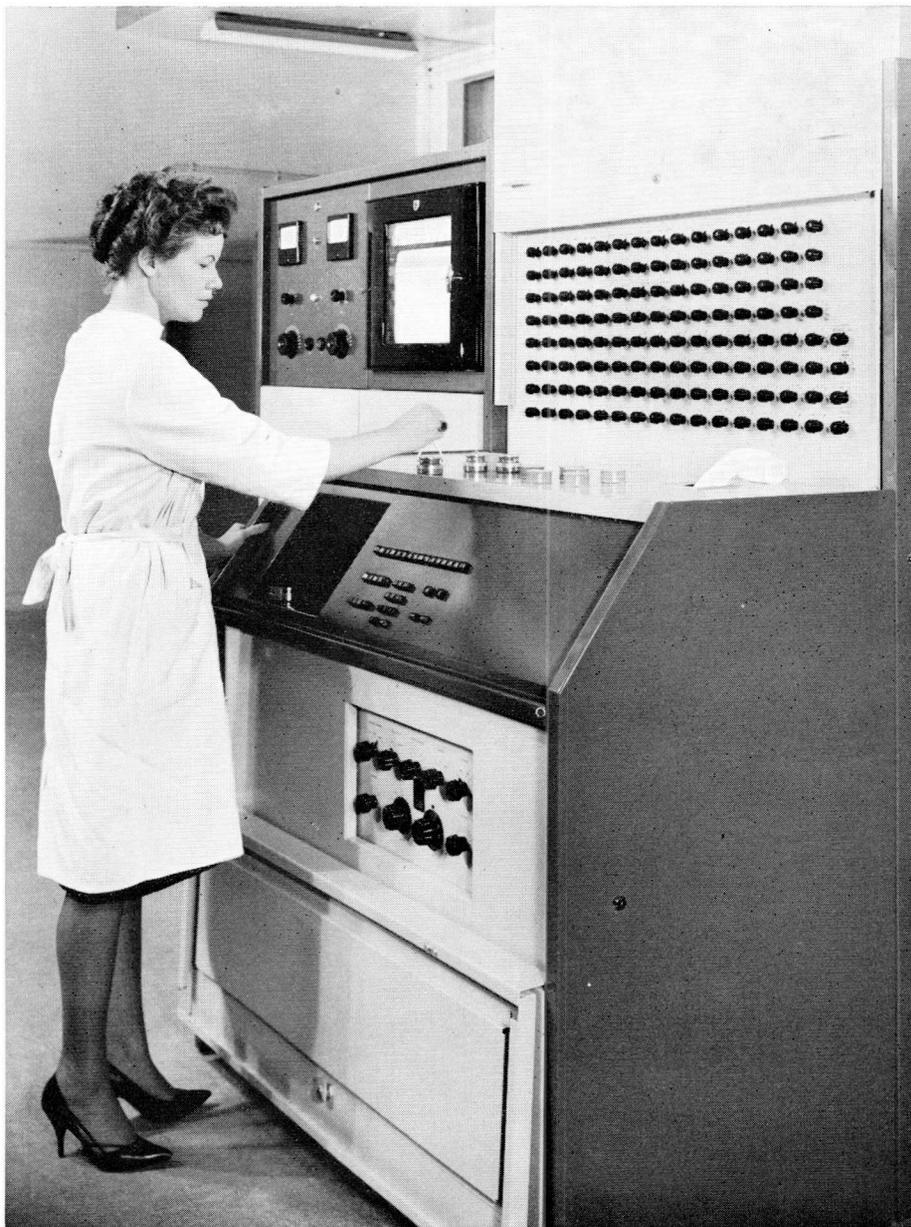
The universal vacuum X-ray spectrometer attachment PW 1540 analyses elements from sodium upwards. In the specimen chamber the four holders can be rotated to eliminate the effects of preferred orientation, thus favourable affecting the accuracy. In the instrumentation set-up the PW 1540 may be replaced by a standard X-ray spectrometer attachment PW 1250, which if required, can be equipped with bulk specimen chamber for the investigation of non-uniform or finished articles.

#### *Vacuum simultaneous X-ray spectrometer*

With vacuum simultaneous X-ray spectrometer one to six elements (from sodium upwards) can be determined simultaneously on a dynamic or static sample. The analytical system with flexibility of sample presentation is easily adapted by quality control and process control chemists and engineers, as well as all research personnel interested in controlling and evaluating their processes.

### X-ray spectrometer tubes

In X-ray spectrometry both the X-ray tube load and the geometric arrangement are important factors in the ultimate X-ray intensity originating from the specimen. A high tube load can be largely negated if the distance between tube and specimen surface is not very small. In the design of the 2 kW spectrometer tubes, all the advantages of the small tube head characteristics have been maintained. The sensitivity of our automatic X-ray spectrometer and of the semi-automatic X-ray spectrometer has thus been brought to a very high level. Maximum attention is given in the construction of the anodes to ensure that contamination is extremely low.



*Automatic spectrometer, type PW 1212.*



*Semi-automatic X-ray spectrometer, type PW 1220.*

type	anode materials	window materials	voltage kV	load W
FA 100/2	Au	beryllium	100	2 000
	W	beryllium	100	2 000
	Mo	beryllium	100	2 000
	Cr	beryllium	100	1 200
Fa 60/1	Au	beryllium	60	1 000
	W	beryllium	60	1 000
	Mo	beryllium	60	1 000
	Cr	beryllium	60	1 000

## EMISSION SPECTROMETRY

### "Spectrovide"\*

The "Spectrovide"\* is a vacuum optical emission spectrometer covering the spectral range from 1600 to 3500 Å. Combined with "Thyratronic major"\* excitation source and a "Metronic Major"\* measuring console the spectrometer is capable of analyzing up to 24 elements including C, P and S in less than two minutes. This versatile instrument has been designed for production control in the steel and metal working industries.

### Air emission spectrometer, type "SM 150"\*

In conjunction with the appropriate equipment the "SM 150"\* air optical emission spectrometer forms an automatic direct reading spectrochemical installation for the analysis of up to 30 elements within two minutes.

Combining an excellent dispersion and a wide spectral range (1900—7000 Å) with a large number of photomultipliers the spectrometer is an invaluable analytical tool for a wide range of applications in spectrochemical analysis.

### "Thyratronic Major"\*

The "Thyratronic Major"\* excitation source is a reliable and stable source unit for both direct reading and photographic work. In consequence of its excitation facilities (d.c. arc, condensed arc and h.v. spark at 50 c/s) the instrument has found ready applications in both research and routine work.

### "Thyratronic Minor"\*

This compact and stable source unit is specially designed for those applications requiring a condensed arc only.

### "Metronic Major"\*

The "Metronic Major" measuring console automatically records integrated intensities from optical spectrometers. Visual display can be automatically printed or punched out. The console provides for nine fully-automatic programmes for repetitive analysis, one semi-automatic and one manual programme and can measure the output of 20 photomultipliers (can be adapted for another 20). Owing to the large number of channels (60 or 120) the instrument can be calibrated in such a way that intensities are read out as percentage concentrations.

### "Metronic Minor"\*

This transistorized measuring console is designed for the measurement of luminous intensities of up to 20 spectral lines.

\* developed by M.B.L.E. (Manufacture Belge de Lampes et de Matériel Electronique S.A.) Brussels, Belgium.

\*\* development of Shandon Scientific Company Ltd., London.

## MICROANALYSIS

### Electron probe microanalyser

Techniques from electron microscopy and X-ray spectrometry have been combined in the Electron probe microanalyser.

With this instrument direct chemical analysis can be rapidly and accurately made of extremely minute parts of a specimen (1 square micrometre). All elements from boron onwards can be analyzed. The test is usually being non-destructive, the sample may be retained for further experimentation. The equipment may be profitable introduced in many laboratories but is of special interest to the metallurgist and geologist.

## GAS CHROMATOGRAPHY

### Research gas chromatograph, type FB 5D\*\*

This is a dual column flame ionization gas chromatograph. This instrument is equipped with a temperature programmer and is capable of analyzing most organic or biomedical samples. The two columns permit, apart from normal dual column operation the simultaneous analysis of two samples.

In addition to the standard flame ionization detector various other detectors are available allowing for dual channel operation.

The "Spectrovide" emission spectrometer combined with excitation source and measuring console to form a direct reading spectrochemical installation.



## 31. CRYOGENIC EQUIPMENT

In many industries and in laboratories the use of cryogenics is becoming more and more indispensable. There the demand is for efficient and reliable low temperature plants, simple to operate and with minimum space requirements. All these features, coupled with high thermal efficiency and high purity of the product are combined in our cryogenic equipment. The Philips cryogenerators are unique single stage refrigeration machines covering a temperature range from ambient down to 12°K. They can be combined to meet the various problems associated with present day applications of cold where "on the spot" refrigeration is desirable.

Applications are: air liquefaction, recovery of liquefied-gases, gas purification, air separation, gas separation, environmental chambers, cryopumping and high vacuum systems, metal treatment, preservation of sperm, blood and storage of sensitive biological specimens, pulverization by cold milling of heat sensitive materials, accurate machining of soft and elastic materials, shrink fitting and low temperature research.

### INSTALLATIONS FOR THE PRODUCTION OF LIQUID AIR

#### Air liquefier, type PLA 107

Intended for use in research centres and laboratories where continuous and independent supply of liquid air is required. Supplies a constant yield of approximately 7.5 litres of liquid air per hour. The unit is suitable for long term operation with a minimum of attention.

Operating cycle: start up — liquid production in 10 to 15 minutes.

Power consumption: 9 kW

Overall dimensions: 50 cm × 140 cm × 150 cm (b × h × d)

#### Air liquefier, type PLA 433

Due to its high output, particularly suitable to meet requirements for large quantities of liquid air. Ensures at least 100 hours continuous operation, which provides approximately 3000 litres of liquid air.

Operating cycle: start up — liquid production in 30 minutes

Power consumption: 36 kW

Overall dimensions: 75 cm × 180 cm × 350 cm (b × h × d)

### INSTALLATIONS FOR THE PRODUCTION OF LIQUID NITROGEN

#### Liquid nitrogen plant, type PLN 106

This installation supplies approximately 6.5 litres of high purity liquid nitrogen per hour. The plant is provided with all necessary safety devices and requires only the minimum of supervision.

Purity of the nitrogen: 99.5 %

Operating cycle: start up — liquid production in approx. 1 hour, 150 hours of continuous production before defrosting is required.

Power consumption: 9 kW

Overall dimensions: 60 cm × 210 cm × 210 cm (b × h × d)

#### Liquid nitrogen plant, type PLN 430

Particularly suited for use in industry. The equipment has an output of approximately 27 litres per hour or 4000 litres per week of high purity nitrogen. It can be operated continuously for periods of 1 to 2 weeks.

Purity of the nitrogen: 99.5 %

Operating cycle: start up — liquid operation in approx. 1.5 hours.

1 to 2 weeks of continuous production before defrosting is required.

Power consumption: 36 kW

Overall dimensions: 90 cm × 260 cm × 260 cm (b × h × d)

### CRYOGENERATORS FOR SYSTEM ENGINEERING

#### Cryogenerator with pressure head, type PPG 102

For continuous refrigeration in the temperature range from ambient down to -200°C. The cryogenerator incorporates a special head which withstands pressures of up to 30 atmospheres and is therefore suited for an extensive range of applications such as cooling of gases and liquids and liquefaction and recondensation of gases as well as for use in closed circuit systems.

Operating cycle: start up — cold production in approx. 10 minutes from a warm start 300 hours of continuous operation.

Power consumption: depending on the temperature of the condenser head.

Overall dimensions: 50 cm × 140 cm × 95 cm (b × h × d)

#### 4 cylinder cryogenerator with condensation pressure head, type PPG 400

Specially designed for application in low temperature systems for condensation or recondensation of gases. It can be operated at system pressures of up to 30 atmospheres. This unit is an ideal cold source for low-temperature systems in both the laboratory and in industry.

Operating cycle: cool down time less than 10 minutes from a warm start.

Power consumption: depending on the temperature of the condenser head.

Overall dimensions: 75 cm × 150 cm × 200 cm (b × h × d)

#### 4 cylinder cryogenerator with cooling pressure head, type PPS 401

For low temperature cooling of gases and liquids. This cryogenerator permits operations at atmospheric as well as at higher system pressures of up to 30 atmospheres. The unit offers the same reliability and long duty cycle as the single cylinder PPG 102 cryogenerator, with the additional advantage of larger capacity.

Operating cycle: cool down time approx. 10 minutes from a warm start.

Power consumption: depending on the temperature of the condenser head.

Overall dimensions: 75 cm × 150 cm × 200 cm (b × h × d)

### INSTALLATIONS FOR CLOSED CIRCUIT COOLING

For low temperature treatment, deep cooling, environmental testing, etc. we supply closed circuit cooling equipment comprising a single-cylinder cryogenerator and a cold box. Various standard types of cold boxes can be delivered. Additionally a range of instrumentation for temperature control is available upon request.

#### Cryogenerator with circulation head, type PGA 105

The unit enables temperatures to be maintained from ambient down to -190°C. When incorporated in a Philips built closed circuit cooling system, it can be preset to any temperature between +30 and -190°C. The use of pure dry air as the cooling medium ensures that the material being stored is not damaged. In addition the unit may be applied in custom built closed circuit cooling systems.

#### Cold boxes and cooling chambers

Various types of cold boxes with storage capacities of 100 and 380 litres are available for direct connection to the PGA 105 cryogenerator.

#### Cryogenerator for very low temperatures, type A 20

For optimum efficiency at 20°K and particularly suitable for ultra low temperature experiments as encountered in masr and laser applications, cryopumping, infrared detection, etc.

Technical data:

Temperature range: 300—12°K

Overall dimensions: 50 cm × 150 cm × 95 cm (b × h × d)

#### Cryogem

The first miniature cryogenerator on the world, achieving temperatures from ambient to below 30°K in a single stage. It opens new frontiers for many specific low temperature applications such as cooling infra-red detectors and a variety of electronic components and assemblies.

Operating cycle: cooldown time less than 10 minutes from a warm start, 250 hours of continuous operation.

Power consumption: 125 W at 80°K, 200 W at 30°K

Overall dimensions: 15 cm × 31 cm (diam. × h)

#### Industrial cryogenerator, type C

A universal cryogenerator which meets the demand of modern industry due to its large refrigeration output combined with high reliability over long periods of operation.

One of its most outstanding features is the extremely high Carnot efficiency which is 42% at minus 196°C. Refrigeration is provided from minus 50°C down to minus 200°C. The unit includes facilities for accurate refrigeration control.

Cooldown time 15 minutes from a warm start,  
duty cycle 4 000 hours of continuous operation  
Overall dimensions: 30 cm × 200 cm ×  
200 cm (b × h × d)

## ACCESSORIES

### Cryogenic transfer pumps, types PW 7210—7218

These pumps provide for the transportation of liquefied gases from the cryogenic installation into storage containers.

### Defrosters

For the removing and the drying of the units which are incorporated in the liquid nitrogen plants and liquid air installation for accumulating and freezing out impurities from the ambient air.

### Hoisting device PW 7157 and PW 7158

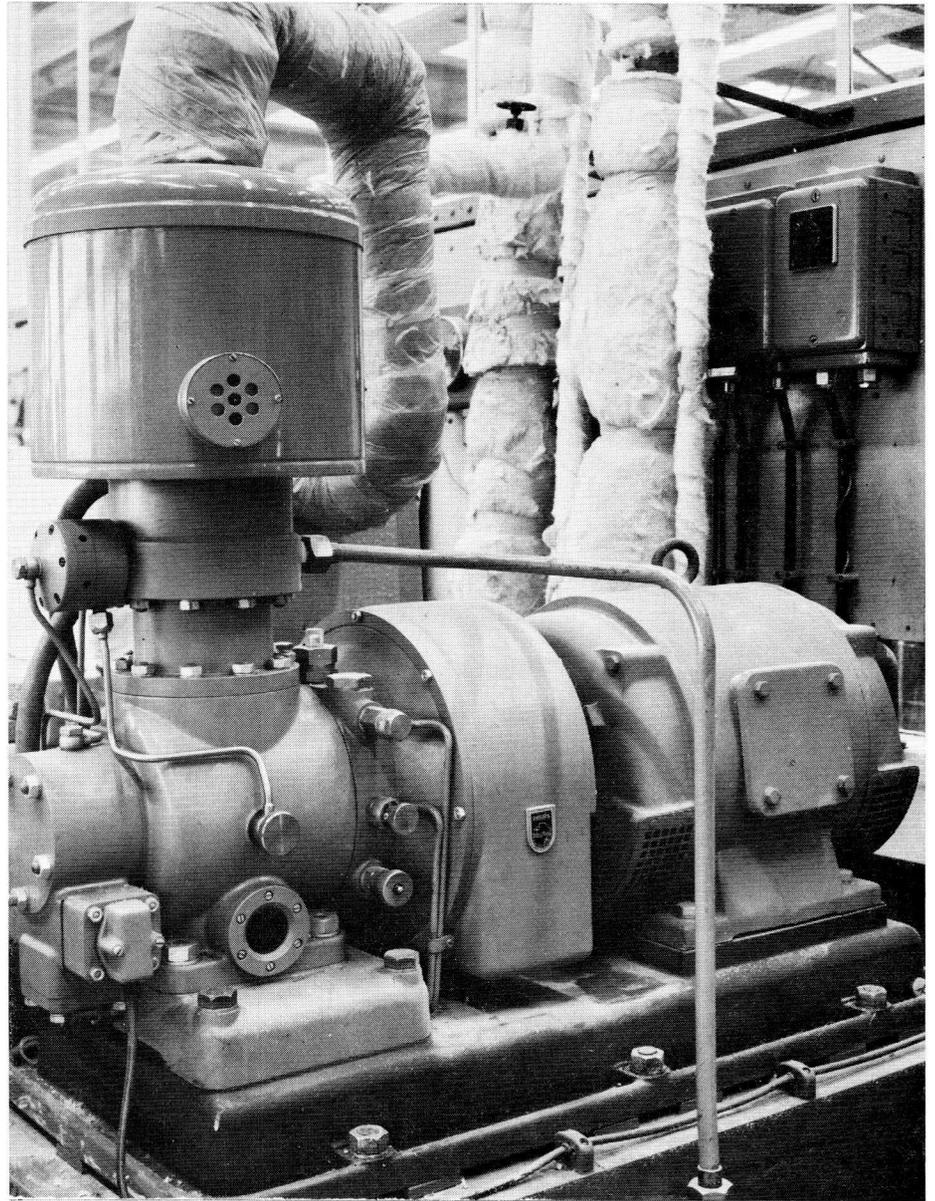
To facilitate mounting and dismantling of the condenser heads of the 4 cylinder cryogenic installations a hoisting device is available.

### Liquid nitrogen purity tester PW 7020

A simple device for the rapid measurement of the purity of liquid nitrogen.

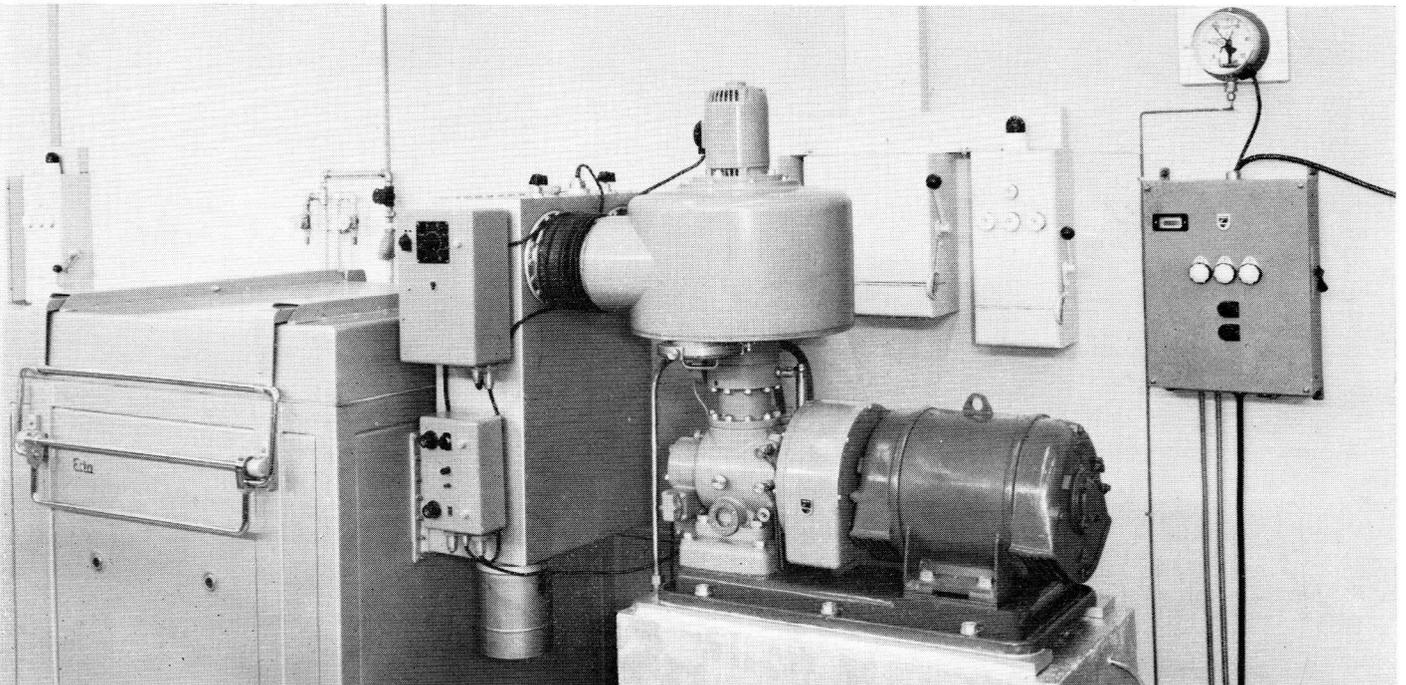
### Biological specimen freeze tunnel

For facilitating freezing, low-temperature storage and transportation of biologicals. It comprises a liquid nitrogen injection system. Any required temperature between 0 and  $-160^{\circ}\text{C}$  can be preset and maintained. Capacity is 300 ampullae.



Cryogenerator with pressure head, type PPG 102 in a closed circuit.

Cryogenerator, type PGA 105, connected to cold box.

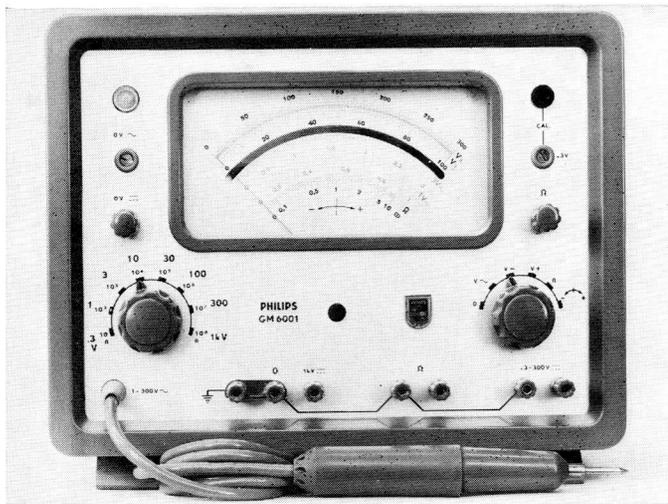


## 32. MEASURING APPARATUS, ELECTRONIC AND UNIVERSAL

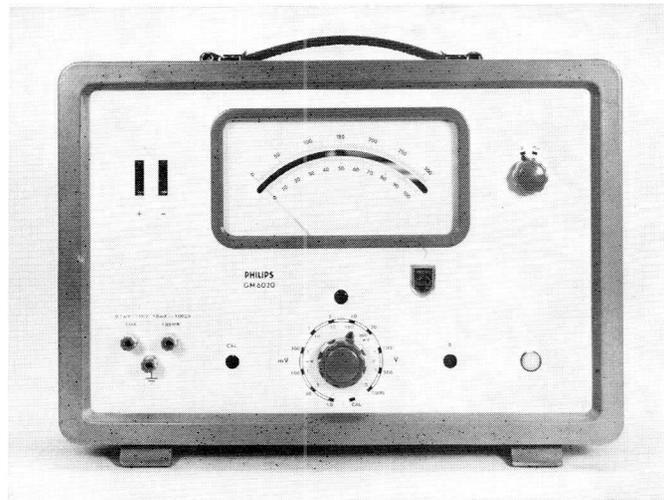
### VOLTMETERS AND VOLT-OHMMETERS

type	frequency range	measuring range f.s.d.	accuracy %	input impedance	special features
GM 6020	d.c.	100 $\mu$ V—1000 V 100 pA—10 $\mu$ A	3 3	1 M $\Omega$ //15—20 pF 100 M $\Omega$ //15—10 pF	automatic polarity indication recorder output
PM 2430	d.c.	1 mV—300 V	2	1 M $\Omega$ , 100 M $\Omega$	battery operated automatic polarity indication
GM 6012	2 c/s—1 Mc/s	1 mV—300 V	2.5, 5	4—10 M $\Omega$ //20—10 pF	amplifier output
GM 6014	1 kc/s—30 Mc/s	1 mV—30 V	3	50 k $\Omega$ —50 M $\Omega$ //2—7 pF	wide-band amplifier
GM 6025	0.1 Mc/s—800 Mc/s	10 mV—10 V	5, 15	35—65 k $\Omega$ //1 pF	calibration voltage for each measuring range
PM 2520	10 c/s—1 Mc/s	1 mV—300 V true r.m.s.	3.5, 5	4—20 M $\Omega$ //7.5—30 pF	crest factor 5, sym. and asym. input, amplifier and recorder output
PM 2405	20 c/s—1000 Mc/s d.c.	500 mV—300 V 500 mV—500 V 10 $\Omega$ —100 M $\Omega$	2.5 2.5 4, 5	3.5 pF 10 m $\Omega$ //2 pF	automatic range selection, automatic polarity indication
GM 6001	20 c/s—1000 Mc/s d.c.	1 V—300 V 300 mV—1000 V 1 M $\Omega$ —1000 M $\Omega$	3 2.5 10	3.5 pF 10—100 M $\Omega$	floating input centre-zero facility
GM 6000	20 c/s—100 Mc/s d.c.	1 V—300 V 1 V—1000 V 10 $\Omega$ —5 M $\Omega$	3 3 10	8 pF 10 M $\Omega$	floating input compact
GM 6023	10 c/s—1 Mc/s	10 mV—300 V	5, 8	1.5 M $\Omega$ //15—25 pF	compact, inexpensive
PM 2453	10 c/s—5 Mc/s	1 mV—300 V	5, 9	1 M $\Omega$ //15—35 pF	fully, transistorized, battery operated

All voltmeters have internal calibration voltages



Volt-ohmmeter, type GM 6001.



Voltmeter, type GM 6020.

### Accessories

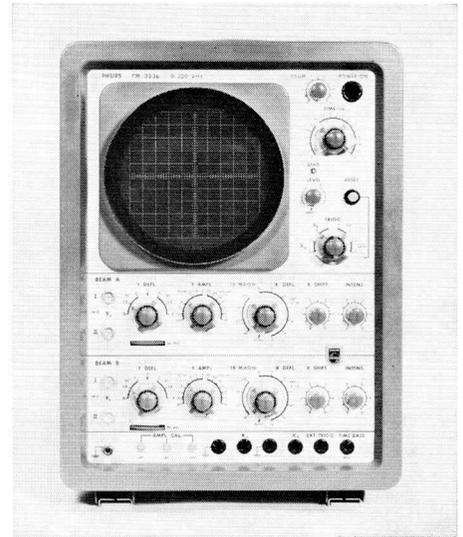
type	description	for use with	characteristics
PM 9000	battery charger	all transistorized instruments	for charging batteries up to 12 V, charging current 45 or 200 mA
PM 9200	v.h.f. diode probe	GM 6020, GM 6000	frequency range 0.1—700 Mc/s
PM 9250	coaxial T piece	GM 6020, PM 2405, GM 6001, GM 6000	frequency range 0.1—1000 Mc/s
GM 6070	EHT probe	PM 2405, GM 6000	attenuation 100 $\times$
GM 6071	EHT probe	GM 6001	attenuation 100 $\times$

## OSCILLOSCOPES

type	description	bandwidth from d.c. up to:	max. sensitivity	input impedance	signal delay	sweep speeds	magnifier ×	CRT diameter cm	accel. voltage kV
GM 5603	differential wideband	14 Mc/s	50 mV/cm	1 MΩ//22 pF	yes	0.2 μs/cm—1 s/cm	2, 5	13	10
GM 5602	wideband	14 Mc/s	50 mV/cm	1 MΩ//22 pF	yes	0.2 μs/cm—1 s/cm	2, 5	10	4
PM 3230	h.f. double beam	10 Mc/s	2 mV/div	1 MΩ//30 pF	no	0.5 μs/div—0.5 s/div	5	10	4
PM 3201	h.f.	5 Mc/s	10 mV/cm	1 MΩ//35 pF	no	0.5 μs/cm—0.2 s/cm	5	10	3
PM 3236	l.f. double beam	300 kc/s	500 μV/cm	1 MΩ//70 pF	no	10 μs/cm—5 s/cm	2, 5, 10	13	4
PM 3206	l.f.	300 kc/s	2 mV/cm	0.5 MΩ//20—50 pF	no	2 μs/cm—1 s/cm	5	10	3
GM 5639	XY	1 Mc/s	100 mV/cm	1 MΩ//15—40 pF	no	2 μs/cm—0.1 s/cm		10	2
GM 5600	compact h.f.	5 Mc/s	50 mV/cm	1 MΩ//40 pF	no	0.5 μs/cm—30 ms/cm		7	1.6
GM 5605	compact l.f.	200 kc/s	10 mV/div	0.5 MΩ//55 pF	no	20 μs/div—0.1 s/div		7	1.6

## Associated instruments and accessories

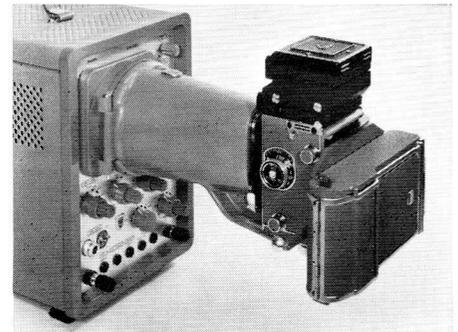
type	description	main characteristics
GM 4585	trigger delay unit	delay range 2.5 μs—100 ms with digital read-out
PP 1071	electronic switch	d.c. — 15 Mc/s, two channels
PM 6041	pre-amplifier	bandwidth 1 c/s—500 kc/s, amplification 1, 10 or 100 ×
PM 9301	projection lens	projection distance 53—240 cm, magnification 2.5 up to 15 ×



Oscilloscope, type PM 3236, double beam l.f.

## Oscilloscope cameras

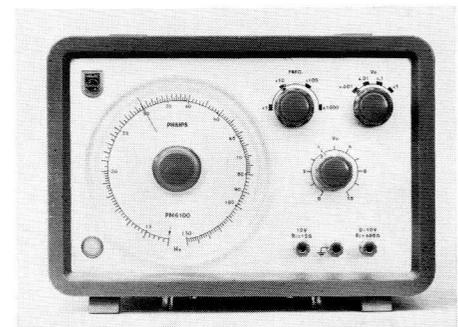
type	description	for screen diameters cm	mode of registration	film speeds
PP 1021	recording camera	7—16	single shots and continuous	0.004 cm/s—50 m/s
PP 1014	recording camera	10—16	single shots and continuous	1.02 cm/s—4.75 m/s
PM 9300	multi-purpose photographic equipment	10—16	single shots or normal or Polaroid film	



Multi-purpose photographic equipment, type PM 9300.

## L.F. GENERATORS

type	description	frequency range	accuracy %	ranges	max. distortion %	max. output V
GM 2308	beat frequency	30 cs—16 kc/s	1	1	0.75—3	25
PH 5121	l.f.	1 c/s—100 kc/s	2	5	0.5	10
PM 5120	l.f.	5 c/s—600 kc/s	2	5	0.5	10
PM 5100	l.f.	15 c/s—150 kc/s	5	4	0.5—1	10
PM 5140	l.f.	20 c/s—200 kc/s	1	4	0.3	10
PM 5101	l.f. battery operated	20 c/s—100 kc/s	5	4	0.5—1	2



L.F. generator, type PM 5100.

## H.F. GENERATORS

type	description	frequency range	accuracy %	ranges	max. output		
					a.m.	f.m.	
GM 2877	wobbulator	5—220 Mc/s 440—880 Mc/s		1 1	30 mV 15 mV	int.	int.
GM 2621	a.m., f.m.	4.5—300 Mc/s	1	7	1 V	int., ext.	int., ext.
PM 5320	a.m., f.m.	150 kc/s—50 Mc/s 87—108 Mc/s	1 1	7 1	50 mV 15 mV	int.	int.
PM 5300	a.m.	150 kc/s—55 Mc/s 87—108 Mc/s	1 1	7 1	30 mV 10 mV	int.	

type	description	input	modulator	output
PM 6450	stereo multiplex generator	30 c/s—15 kc/s  L and R sensitivity 77.5 mV	subcarrier 38 000 ± 3%  subcarrier suppression < -50 dB  cross-talk < 40 dB	MPX peak voltage 4.36 V  pilot 270 mV  r.f. 200 mV, 100 Mc/s

## TELEVISION SERVICE GENERATORS

### Pattern generators

type	t.v. system	bands	pattern	output
GM 2892	CCIR, FCC, OIR France, Belgium	I, III, IV, V	hor. and, or vert. bars	20 mV, 5 mV
PM 5500	CCIR, FCC, OIR	I, III	hor. and, or vert. bars	20 mV

### Service generators for professional t.v.

type	description	t.v. system	pattern, frequency	max. output
GM 2671	pattern	CCIR, British 625, FCC, French 819	chess-board	1 V
GM 2681	v.h.f.	CCIR, British 625, FCC and special versions	t.v. channels 2 to 11	100 mV
GM 2682	v.h.f.	any system with f.m. sound and neg. picture modulation	one of t.v. channels 2 to 11	1.5 V (modulated)

### Service generators for colour t.v.

type	description	main characteristics
PM 5550	colour test pattern	fully transistorized, supplies primary and complementary colour signals, auxiliary signals and black and white information; conforms NTSC standards
PM 5530	sync. and blanking	fully transistorized, supplies standardized sync. and blanking signals for PM 5550 or studio equipment

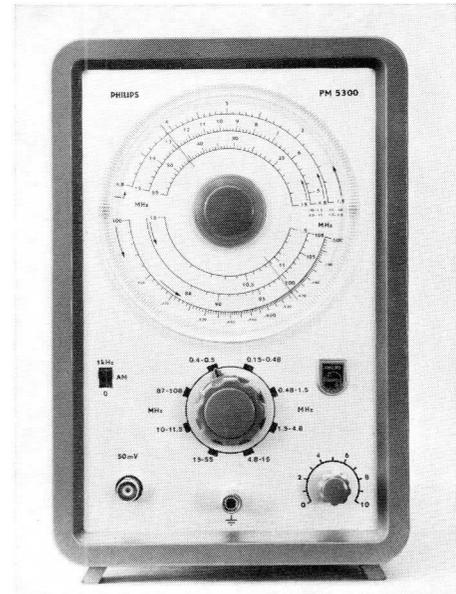
## PULSE AND SQUARE-WAVE GENERATORS

type	description	frequency range	max. output			
			pulses V	rissetime ns	square-wave V	rissetime ns
PP 1122	double pulse	10 c/s—1 Mc/s	10 and 100	20		
PM 5710	pulse	10 c/s—1 Mc/s	5 and 100	30		
GM 2314	pulse	15 c/s—200 kc/s	40	75	10	
GM 2324	square-wave	25 c/s—1 Mc/s			15	30

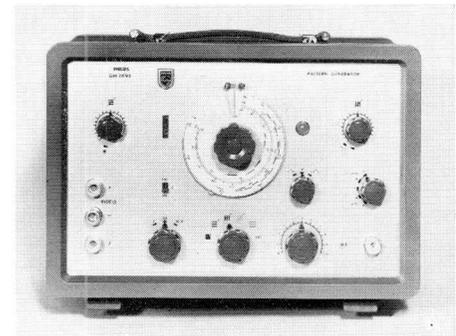
## MODULAR PULSE GENERATOR

An extremely flexible pulse generator system providing a variety of pulses on one or several channels.

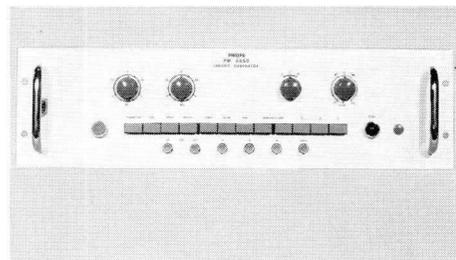
Systems can be programmed from the following units:



H.F. generator, type PM 5300.



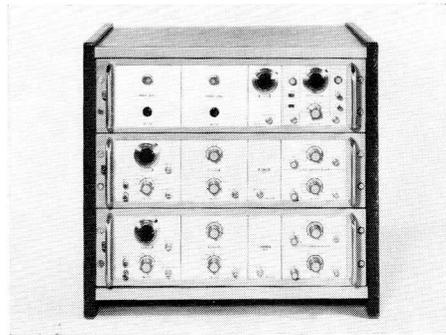
Television service generator, type GM 2892 (pattern generator).



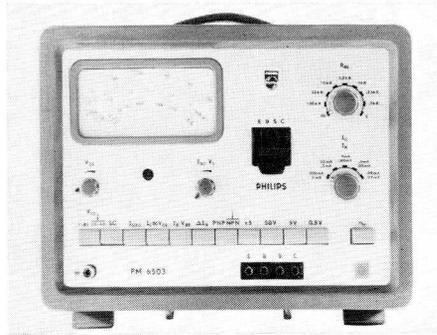
Colour television service generator, type PM 5550.

## Modular pulse generators

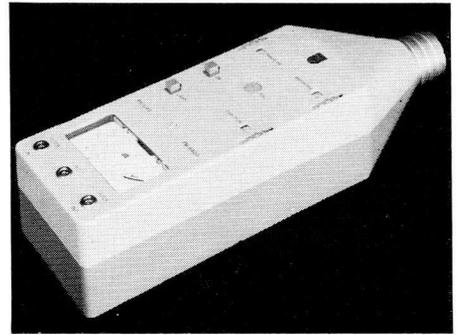
type	description	main characteristics
PM 5720	master generator	10 c/s—10 Mc/s, external d.c. — 15 Mc/s, single shot and remote control
PM 5722	short delay and width unit	range 10 ns—1 ms
PM 5723	long delay and width unit	range 1 $\mu$ s—1 s, external gate output, facilities for modulation of pulse delay and width
PM 5725	interpulse unit	for additional setting of pulse delay and width in connection with PM 5723, range 1 $\mu$ s—1 s
PM 5732	AND-OR gate	mixer and AND-gate for system needle pulses
PM 5727	output unit	output 5 mV—5 V across 50 $\Omega$ , rise and fall time < 10 ns, true positive and negative pulses simultaneously available
PM 5728	output unit	output 12 V across 50 $\Omega$ , rise and fall time from 10 ns—10 $\mu$ s
PM 5737	output unit	output 0.7 V across 50 $\Omega$ , rise time < 0.3 ns, fall time < 1.5 ns
PM 5740	power supply unit	110—245 V, 50—60 c/s



Modular pulse generator, type PM 5720—40.



Analyser, type PM 6503.



Sound level meter, type PM 6400.

## TRANSISTOR MEASURING EQUIPMENT

type	description	tests
PM 6505	analyser	short-circuit, $I_{CE0}$ , $I_{CB0}$ , $I_{EB0}$ , $I_C = f(I_B)$ , $I_C = f(V_{BE})$ , $V_{CEK}$ , $h_{ie}$ , $h_{fe}$ , CE — D, CB — D, EB — D
PM 5603	analyser	short-circuit, $I_{CE0}$ , $I_{CEK}$ , $I_C = f(I_B)$ , $I_C = f(V_{BE})$ , $I_D = f(V_D) = \alpha_{fe}$ , $\alpha_{fe}$
PM 6501	tester	short-circuit, $I_{CE0}$ , $\alpha_{fe}$

## SOUND MEASURING EQUIPMENT

type	description	main characteristics
PM 6400	sound level meter	measuring range 43—120 dB ( $\pm 2$ dB), frequency range 31.5 c/s—8 kc/s
PM 6410	octave filter set	frequency range 15 c/s—35 kc/s, max. input voltage peak to peak 25 V

## MICROWAVE MEASURING EQUIPMENT

### Frequency meters

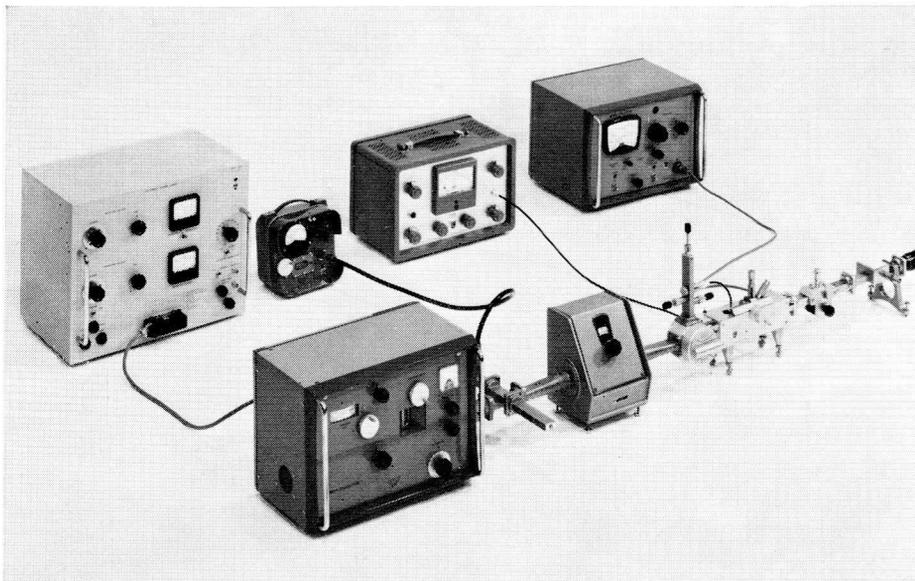
Direct-reading frequency meters are available in 10 bands. Each model operates over the full bandwidth with direct reading accuracy better than 0.1% for at least one of the coupling elements combinations. The cavities of the frequency meters have two coupling windows to which six basic elements can be connected.

### Waveguide switches

Philips and Siverts Lab waveguide switches enable quick and economical switching in both high and low power microwave systems. They combine low v.s.w.r. with high cross-talk attenuation. Manual as well as automatic types are available.

### Millimetre and sub-millimetre components

For the millimetre and sub-millimetre region is developed a complete range of components of outstanding quality and great reliability. The 2 and 4 mm components are provided with the Philips clawflange, which is internationally standardised by the IEC for frequencies from 50—120 Gc/s.



3 cm microwave bench.

## CONDUCTIVITY MEASURING EQUIPMENT

### Measuring instruments

type	measuring ranges	accuracy	internal bridge supply	power supply
PR 9500/01 conductivity measuring bridge	0.5 ... 10 m $\Omega$ and -20% ... +25% (6 ranges)	2.5% at f.s.d.	50 or 1000 c/s	all a.c. mains voltages 50 ... 60 c/s
PR 9501, direct reading conductivity meter (11 ranges)	0 ... 300 M $\Omega^{-1}$ cm $^{-1}$	1% at f.s.d.	80 or 1000 c/s	all a.c. mains voltages 50 ... 60 c/s
PR 9582 conductivity meter for industrial use	0 ... 15 000 $\mu\Omega^{-1}$ cm $^{-1}$ (20 ranges)	2% (at 20°C)	80 or 1000 c/s	all a.c. mains voltages 50 ... 60 c/s

### Conductivity relay, type PR 9601

Control range:  $(0.5 \dots 2) \times$  conductivity of the reference solution.

Accuracy: 2% of set point value.

Temperature compensation by means of reference cell.

It can be supplied to meet Buxton certificate standards.

PR 6000G stainless steel immersion cell, cell constant 0.70 $^{-1}$

PR 6002G stainless steel immersion cell, cell constant 0.0154 cm $^{-1}$

PR 9514/11/01 plastic "Penton" immersion cell, cell constant 1 cm $^{-1}$

PR 9515/11/01 plastic immersion cell, cell constant 0.02 cm $^{-1}$

### Conductivity cells

PR 9510 glass immersion cell, cell constant: 1.20 ... 2.00 cm $^{-1} \pm 1\%$

PR 9511 glass flow cell, cell constant: 1.20 ... 2.00 cm $^{-1} \pm 1\%$

PR 9512/00 glass micro cell, provided with thermometer inlet, volume of liquid 4 cm $^3$ , cell constant 1.20 ... 2.00 cm $^{-1} \pm 1\%$

PR 9512/01 glass micro cell to be used in a thermostat, volume of liquid 3 cm $^3$ , cell constant 1.20 ... 2.00 cm $^{-1} \pm 1\%$

PR 9513 glass micro cell to be used in a thermostat, volume of liquid 0.5 cm $^3$ , cell constant 0.70 cm $^{-1} \pm 1\%$

PR 9514/10 plastic "Penton" immersion cell, cell constant 1 cm $^{-1} \pm 2\%$

PR 9515/10 plastic "Penton" immersion cell, cell constant 0.02 cm $^{-1} \pm 2\%$

## pH MEASURING EQUIPMENT

These instruments are equipped for measurements with the aid of electrodes having the electrical zero-point at pH 7. Input impedance amounts to  $10^{12} \Omega$ .

Facilities are provided in all instruments for measurements in liquids at earth potential.

### Automatic pH controller, type PR 7202

Time proportioning controller, especially designed for pH control enabling proportional control action when using a simple solenoid "go — no go" valve. Particularly applied in effluent control for both batch and continuous processes. The instrument is for instance the essential part in the Philips industrial waste water purification equipment.

## AIR HUMIDITY AND GAS ANALYSIS EQUIPMENT

The measurement of air- and gas humidity is based on the determination of the dewpoint with a LiCl-cell, in combination with the appropriate indicating and recording instruments.

### LiCl-cell, type 6010H/01

Accuracy within  $\pm 1^\circ\text{C}$  dewpoint.  
Reproducibility better than  $0.2^\circ\text{C}$  dewpoint.  
Temperature range  $-30 \dots +100^\circ\text{C}$   
Humidity range  $-30 \dots +60^\circ\text{C}$  dewpoint.  
Pressure range from vacuum up to 4 atm.

### "Okometer" photo analyzer

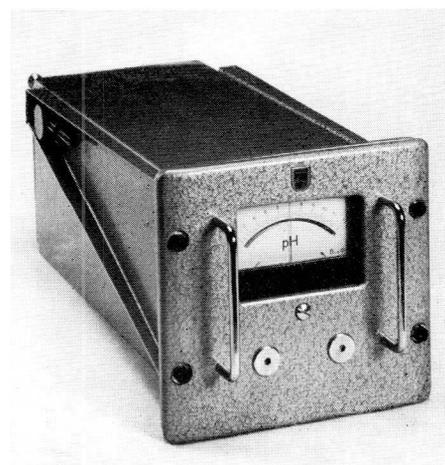
For the continuous measurement of the concentration of a large range of gases and liquids. It is a comparison analyser, working on the principle of the absorption of visible or ultra-violet light by the substance to be analysed. The optical system can be either of glass or of quartz, as required. The instrument is equipped with a built-in air circulation system for temperature stabilization.

Output current enables driving up to three moving coil instruments (0—50  $\mu\text{A}$  at max. load 100  $\Omega$  ... 10 k $\Omega$ ).

Accuracy:  $\pm 2\%$  of measuring range.  
Zero drift and sensitivity drift: 2% of measuring range per week.

Measuring and comparison cells: length 1—100 mm.

Power supply: 220 V  $\pm 1\%$ , 50 c/s, (voltage stabilizer).



pH-meter for industrial use, type PR 9402.

## MISCELLANEOUS MEASURING EQUIPMENT

type	description	range
PM 6700	precision decade capacitor	100—1100 pF continuously, 1 kpF—1 $\mu$ F in 30 steps, accuracy 0.1%
GM 4351	variable capacitor	35—135 pF, accuracy 1%
GM 4353	variable capacitor	100—1100 pF, accuracy 1%
PM 6301	universal measuring bridge	1 $\Omega$ —100 M $\Omega$ , 10 pF—100 $\mu$ F, 10 $\mu$ H—100 H; separate percentage scale
GM 4144	universal measuring bridge	0.5—10 M $\Omega$ , 10 pF—100 $\mu$ F; separate percentage scale
P 817.00	universal measuring instrument	d.c. 60 mV—1200 V (7 steps), a.c. 3—1200 V (6 steps), d.c. 30 $\mu$ A—3A (7 steps), a.c. 600 $\mu$ A—3A (5 steps), frequency 30—10 000 c/s, resistance 1 k $\Omega$ —10 M $\Omega$ (3 steps)
GM 7600	signal tracer	d.c. voltages, mod. r.f. voltages and l.f. voltages
GM 3121	wavemeter	2.5—260 Mc/s (7 ranges), accuracy 2%

## INDUSTRIAL MEASUREMENT OF MECHANICAL QUANTITIES

Static or dynamic mechanical phenomena such as strain, vibration pressure, load, etc., can be measured with electronic equipment with the aid of pick-ups or transducers, which relate the phenomenon in question to an electrical signal. The special pick-ups or transducers, which are available for this purpose, may be divided into two main classes, active and passive transducers.

Passive transducers normally need to be fed by a supply voltage before a measuring signal can be obtained. Into this class fall, for example, strain gauges, potentiometers and differential transformers.

Active transducers supply an electrical signal which can be used directly. Into this class fall, for instance, piezo-dynamic and thermo-electric transducers.

Selection of the correct transducer principle is based on such criteria as range, temperature, linearity, accuracy, dimensions, reliability. For both types of transducers amplification of the signal obtained is usually required. When passive transducers are used certain auxiliary equipment as supply units, oscillators, etc., is also needed.

Often the possibility of direct reading is incorporated in the auxiliary equipment as is the case with strain gauge bridges. In other cases, separate devices are used, such as recorders, magnetic tape recorders, digital displays, etc. Also it is possible to build a number of units together to form a complete measuring system, to form a data logger.

### Strain

#### Strain gauges and transducers

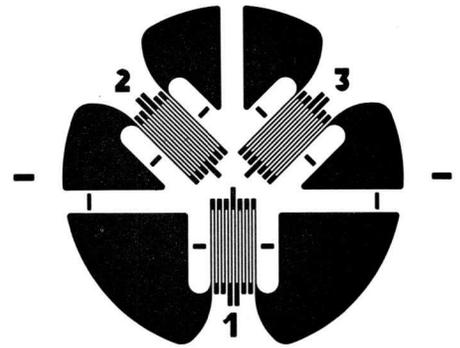
A complete range of strain gauges is available: 8 different kinds and a total of 40 types with the following features: measuring linear up to 4000 microstrain<sup>1</sup> (measurements possible up to 10 000 microstrain); no detectable hysteresis; fatigue life more than 10<sup>7</sup> cycles of  $\pm$  1000 microstrain; negligible creep (diagrams are available); fitted with flat electrodes, giving excellent performance under dynamic load conditions; wide temperature range: generally from -150 to +200°C (measurements are possible up to 300°C); low humidity sensitivity.

<sup>1</sup> The word microstrain is not a unit conform ISO; its use, however, is wide spread and its meaning is nothing else as a strain equal to one millionth (10<sup>-6</sup>). A strain, being the ratio of an elongation to the original length has no physical dimensions. A strain of 4000 microstrain = 4000 · 10<sup>-6</sup> = 0.004 = 0.4%.

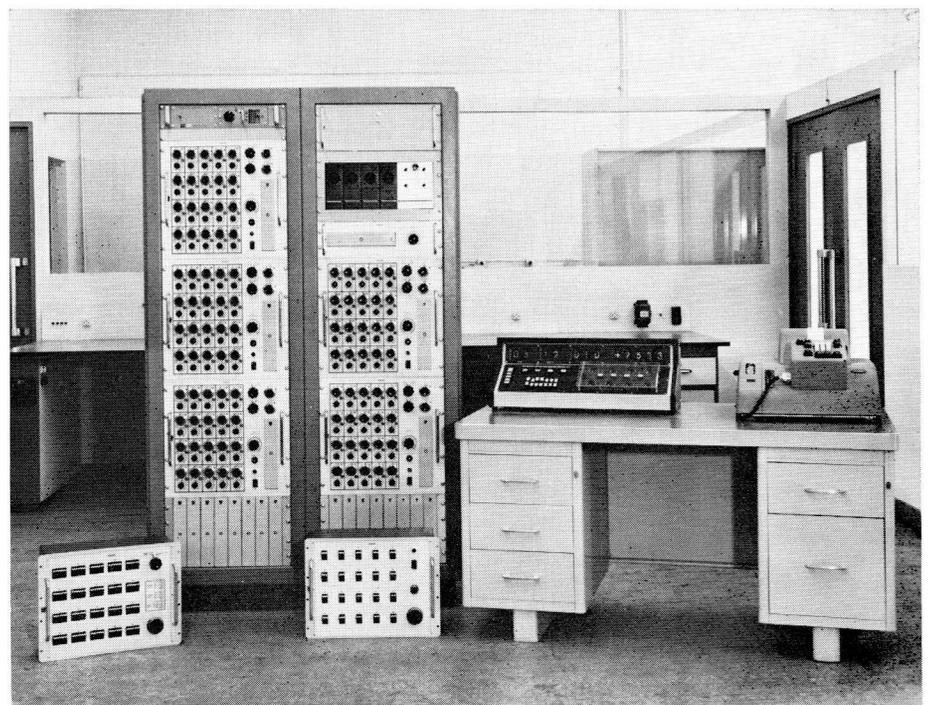
Available types:  
 paper backed wire gauges  
 cresol wire gauges  
 cresol wire rosette gauges  
 foil gauges (with or without electrodes)  
 foil rosette gauges  
 semi-conductor gauges  
 temperature compensated gauges  
 concrete deformation gauges  
 heat conducting gauges  
 Accessories such as sets of cement, water, repellors, etc. are available.

For those cases, where a quick strain indication is required, an inductive strain pick-up can be used.

On places, where, due to overdimensioning of the construction very low strains occur, such as with rolling mills, use can be made of the industrial strain transformer.



Etched foil rosette strain gauge, type PR 9845.



Data logger for strain gauge and temperature measurement.

## Strain measuring bridges

Strain measuring bridges incorporate an oscillator for the supply of the measuring current and a carrier wave amplifier with outputs for static or dynamic measurements. Inductive transducers based on the differential transformer or halfbridge induction principle can also be connected. Four different types of measuring bridges are available:

1. a portable manual compensated strain gauge bridge
2. a simple direct-reading strain bridge for half bridge inputs
3. a universal direct-reading strain gauge bridge
4. a high quality strain compensator

The first bridge is for static measurements only, the others for both static and dynamic measurements with frequencies up to approx. 1500 c/s. All these instruments have outputs for oscilloscopes and recorders.

For industrial application use can be made of automatic indicating or recording strain gauge compensators.

To connect more than one measuring point to a strain gauge bridge, an automatic switchbox can be delivered with a capacity up to 100 channels in steps of 10 channels. For each channel, wide zero and capacitance adjustment ranges are incorporated. Also, an identical system, without calibration facilities, is available.

## Displacement

### Transducers and measuring instruments

Linear pick-ups and measuring instruments enable accurate measurement of displacement from 0.05  $\mu\text{m}$  up to 200 mm and with potentiometer types to 200 mm for contact and contactless measurement. In addition, angular displacement pick-ups enable measurement from parts of a second to 360°. These types are available for industrial use and for laboratories while frequencies of up to 1000 c/s are covered.

## Vibration measuring and excitation equipment

For vibration measurements the vibration pick-ups can be connected directly to a direct reading vibration meter, an oscilloscope or a high speed recorder. A portable vibration meter allows quick investigation of vibration amplitudes.

As a special feature a so-called frequency corrector is available. In combination with this unit, a normal seismic vibration pick-up, with a natural frequency of approx. 10 c/s, enables accurate vibration measurement down to about 1.6 c/s to be made. In fact the small seismic pick-up is given an artificial natural frequency of about 0.5 c/s.

Special equipment has been developed for application on turbines. With this equipment, continuous supervision of expansion, eccentricity and vibration is possible.

Inductive linear velocity pick-ups are available as:

suspended cage type (relative measurement)  
seismic pick-ups (absolute velocity vibration measurement)

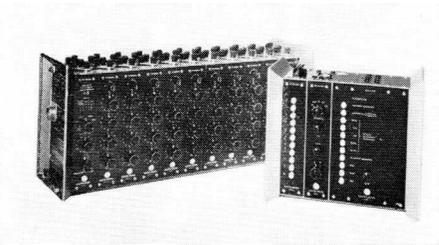
contactless types (relative measurement)

Velocity variations can be measured to max. acceleration of approx. 100 g with a frequency range up to about 1 000 c/s and at amplitudes from parts of a micron to several millimeters. Special heavy-duty types cater for application under adverse conditions, such as with turbines and engines.

Finally, a range of equipment for vibration excitation as exciters, generators and power amplifiers completes the range of vibration equipment.

## Rotational speed

For the measurement of rotational or circumferential speeds a series of electromagnetic, photoelectric and oscillator pick-ups is available for use in either laboratories or under adverse industrial conditions. Contactless measurements without mechanical loading can be made, with provision for indication of sense of rotation ("ahead" and "astern"). Accessories such as trigger for shaft mounting can also be supplied.

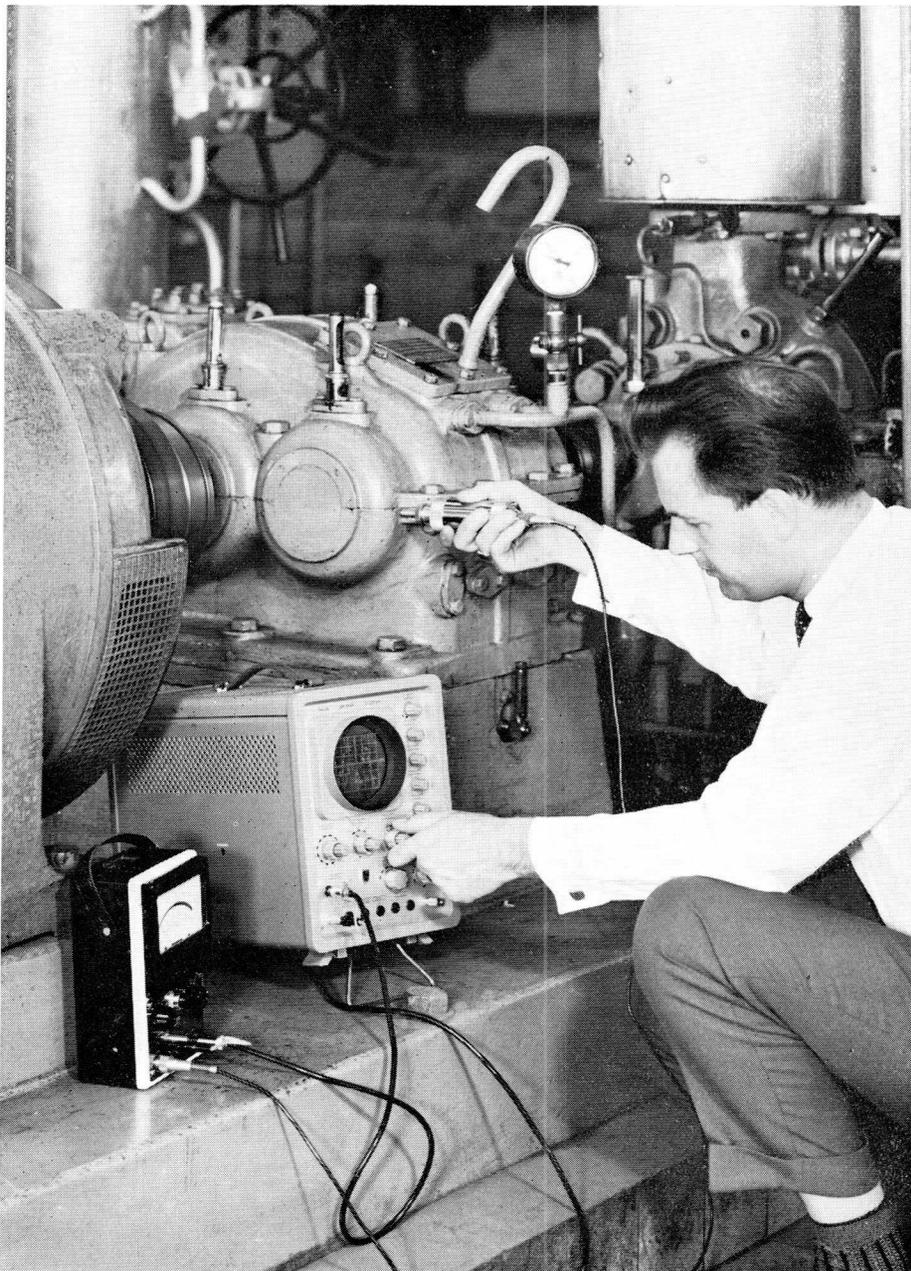


Zero adjustment switching equipment, type PT 1210/29.



Portable strain measuring bridge, type PR 9205.

Vibration measurement with transducer, direct reading vibration meter and oscilloscope.



## Electronic tachometer equipment

The measurements can be effected by a series of electronic tachometers. The working principle of this equipment is based on the frequency to voltage conversion. Pulses supplied by the pick-up are converted into a signal for indication or recording. Furthermore, a portable tachometer which also enables slip measurements to be made as well as a number of industrial tachometers are in the program, including a single channel version with direction sensitive output, a two channel version also providing difference and percentage difference measurements, and a very economically priced single channel version. This equipment fulfils "interservice specifications" and withstands heavy mechanical vibrations. Explosion safe equipment and digital systems are supplied to order. The equipment mentioned above can be used in combination with all transducers delivering a pulse-frequency proportional to the measuring value.

## Acceleration

The strain gauge acceleration pick-ups and measuring equipment cover measuring ranges of approx. 5 to 200 g with accuracy better than 0.1 % and frequency ranges to approx. 1000 c/s. For special purposes, miniature pick-ups are available, based on semi-conductor strain gauge techniques.

## Torque

Torque measurements on rotating shafts can be performed either by cementing strain gauges to the shaft, employing a slipping system for the connection to measuring instruments, or by means of a calibrated intermediate shaft with strain gauges, a so called torque pick-up. Torque pick-ups can be delivered in ranges up to 100 mkg. Three forms of slipping systems are offered: a heavy duty slipping for shaft mountings (diameters 25—65 mm) for permanent use and stick-on slipping for short term measurements.

## Pressure

For gas and liquid pressures a series of unbonded strain gauges, potentiometric transducers and measuring equipment are available, covering an extensive range of pressures and differential pressures and also a wide application field.

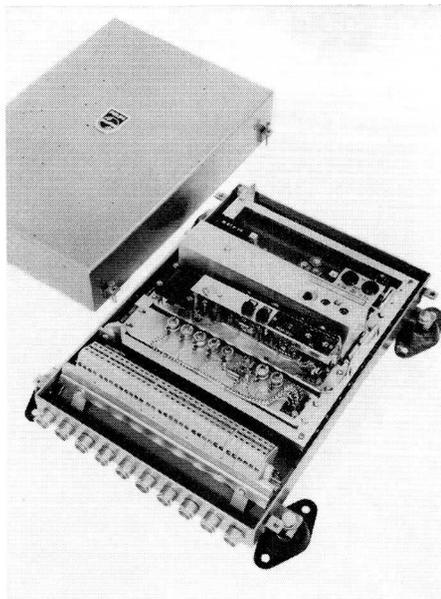
Pressure ranges from 0—200 mm water gauge to 0—2000 kg/cm<sup>2</sup>. Differential pressure ranges from  $\pm 250$  mm water gauge to  $\pm 50$  kg/cm<sup>2</sup>. Temperature compensated pick-ups and special types suitable for direct contact with the combustion flame in engines are available.

## Force

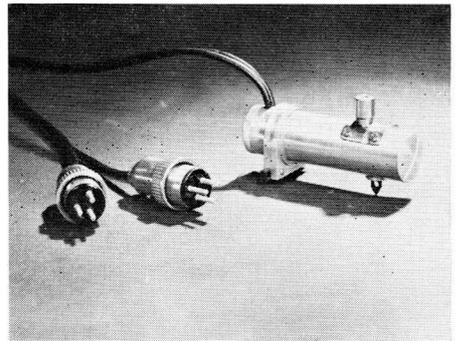
Strain gauge load cells, load beams and dynamometers enable force measurements between a few grams and 100 tons with an accuracy of 0.1%. See chapter 37. *Electronic weighing.*

## Engine monitoring equipment

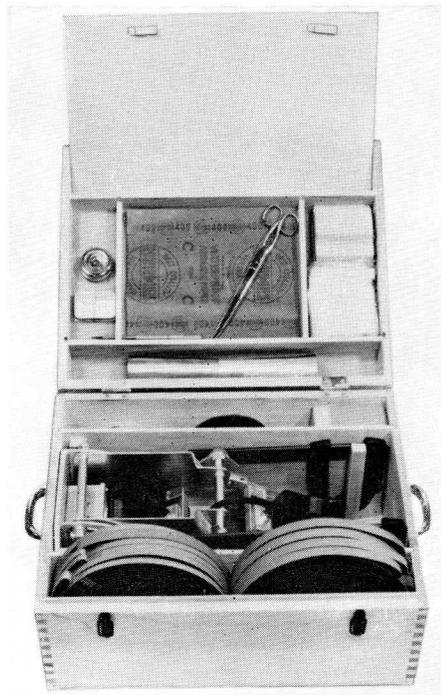
The combination measurement of torque and rotational speed enables direct indication of shaft power. Special heavy duty equipment has been developed for use on board of ships. Extension of this equipment can result in systems for automatic and continuous measurement of fuel consumption, specific fuel consumption, shaft thrust and propellor efficiency.



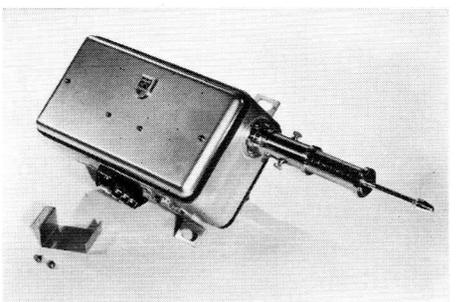
Transistorized torsion, rotational speed and power meter, type PR 9905.



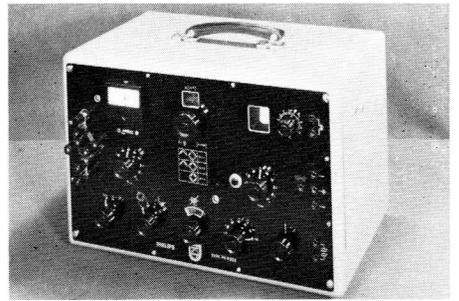
Extensometer, type PR 9312 for the rapid measurement of strain.



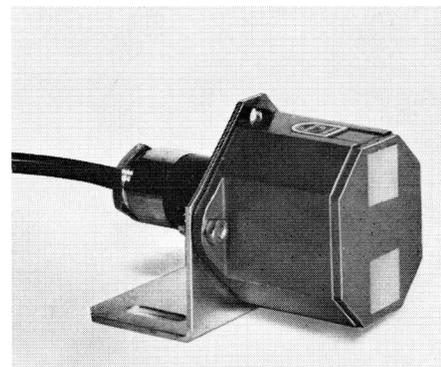
Transportable slipping unit PT 1464 for short time measurements.



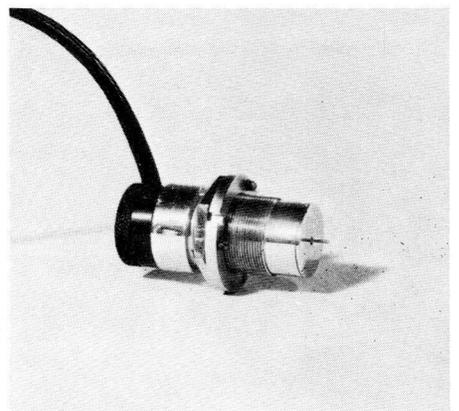
Transducer, type PR 6402 for the measurement of absolute expansion.



strain measuring bridge, type PR 9302.



Two direction rotational pick-up PT 1418/05.



Inductive displacement transducer, type PR 9310.

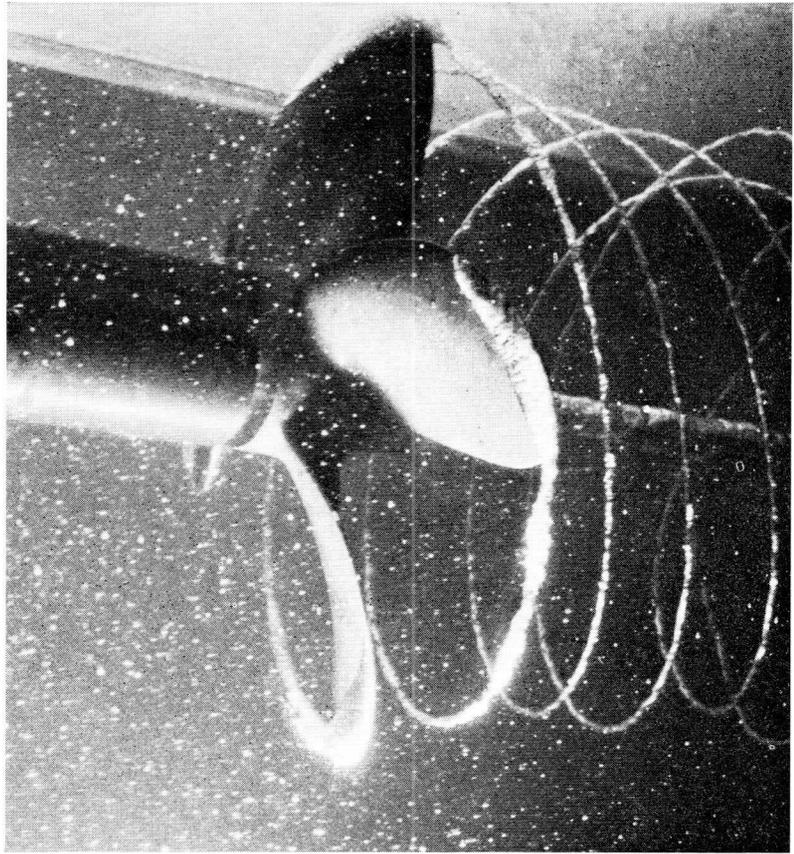
### 33. STROBOSCOPES

Stroboscopes are nowadays widely used in practice, such as for "on the spot" observation and measurement of rotating or vibrating machinery parts or other dynamic phenomena or for motion analysis, without physical contact with the object being necessary.

The range of stroboscopes comprises:

1. a portable battery operated compact stroboscope for outdoor use,
2. a small versatile stroboscope for laboratory use,
3. a high quality stroboscope with  $24.10^6$  lux peak intensity; flashes to a frequency of 500 c/s and features like synchronisation for cameras, built-in phase shifter and programmer for flash-series and two different reflectors for broad and narrow light beam.

Accessories for synchronizing the stroboscope with the vibrating or rotating object are available in the form of a series of trigger pick-ups.

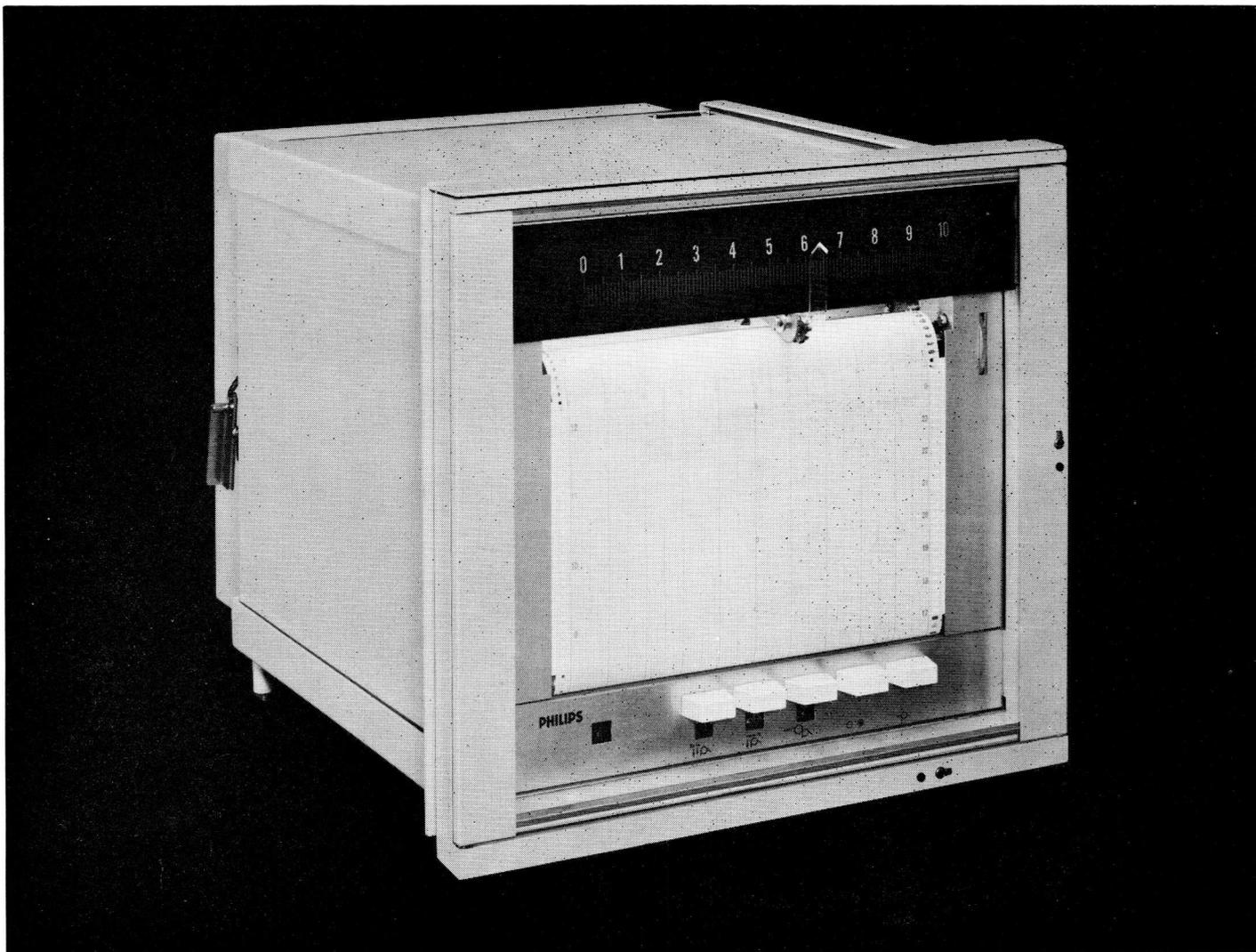


*Cavitation at a ship's screw being photographed with the aid of a stroboscope.*

Universal 40 W stroboscope, type 9107.



## 34. RECORDERS



Potentiometric multi-point recorder, PR 3500 series.

### Potentiometric recorders, PR 2500 and PR 3500 series

Virtually any phenomenon which may be converted into a d.c. mV signal can be recorded with this equipment.

These strip chart recorders represent two extensive ranges of high performance instruments for single line and multi point recording with a series of adaptors. As a result of applying a universal unit construction they are custom engineered. During production each instrument is assembled according to individual specifications. The user can order the specific type of instrument he needs, knowing that no expense need to be incurred for unwanted refinements or extras.

Modifications at a later date, can be easily made on site. In most cases conversion and recalibration are merely restricted to the exchange of plug-in units, which is so simple that it can be performed by the user's personnel with little time and cost.

#### Characteristics:

250 mm calibrated chart width with extra space for margin marker.

Zero balance d.c. potentiometer and transistorized amplifier.

Accuracy far better than for a 0.25 class instrument reproducibility better than 0.1% of span.

Accommodates thermocouple, small d.c. voltage and resistance variation inputs.

Range units to comply with any specification. Multi-range units with 5 ranges and 5 zero-positions.

Automatic cold junction compensation for thermocouples.

Choice of 50 chart speeds (single line) or 12 speeds (multi point).

Multipoint recording with either 4, 6, 8, 12, 24 records.

### Miniature recorder, type PR 2400A

The apparatus requires a panel opening of only 138 mm x 138 mm. The time for full

scale deflection is 1 second with the same sensitivity as the large size units.

### Galvanometer strip-chart recorder

Single and six channel types (two or three channel version to special order). With moving coil galvanometer for d.c. input (e.g. thermocouples). Can be provided with bridge circuit for use with resistance thermometer or transmitter. It is built up from interchangeable units and is available with 1, 2, 3 or 6 colour marking for use with a corresponding number of transducers. It can be fitted with signalling controls.

### "Transokomp" potentiometric strip-chart recorder

Single channel and six channel six colour types for small voltage and current and for resistance variation inputs. Built up from interchangeable units. Fully transistorized printed wiring circuits. Insensitive to vibration. A slave potentiometer can be fitted.

**Universal optical recorder, type PR 9070**

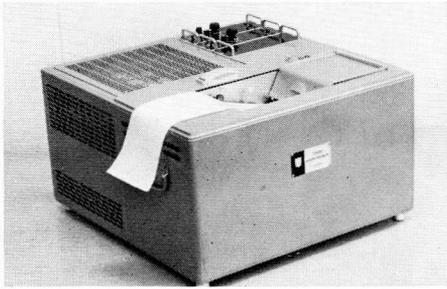
Ultra-violet galvanometer recorder for dynamic measurement and recording of high frequency measuring phenomena, such as stress, vibration, load and pressure. A frequency range from d.c. to 5000 c/s with recording amplitude up to 120 mm ensures rapid and accurate analysis of the quantity to be measured. Max. 12 channels can be recorded simultaneously while the sensitivity of the recorder enables pre-amplification being necessary.

**High-speed recorder "Oscilloscript", PT 2002—2112 series**

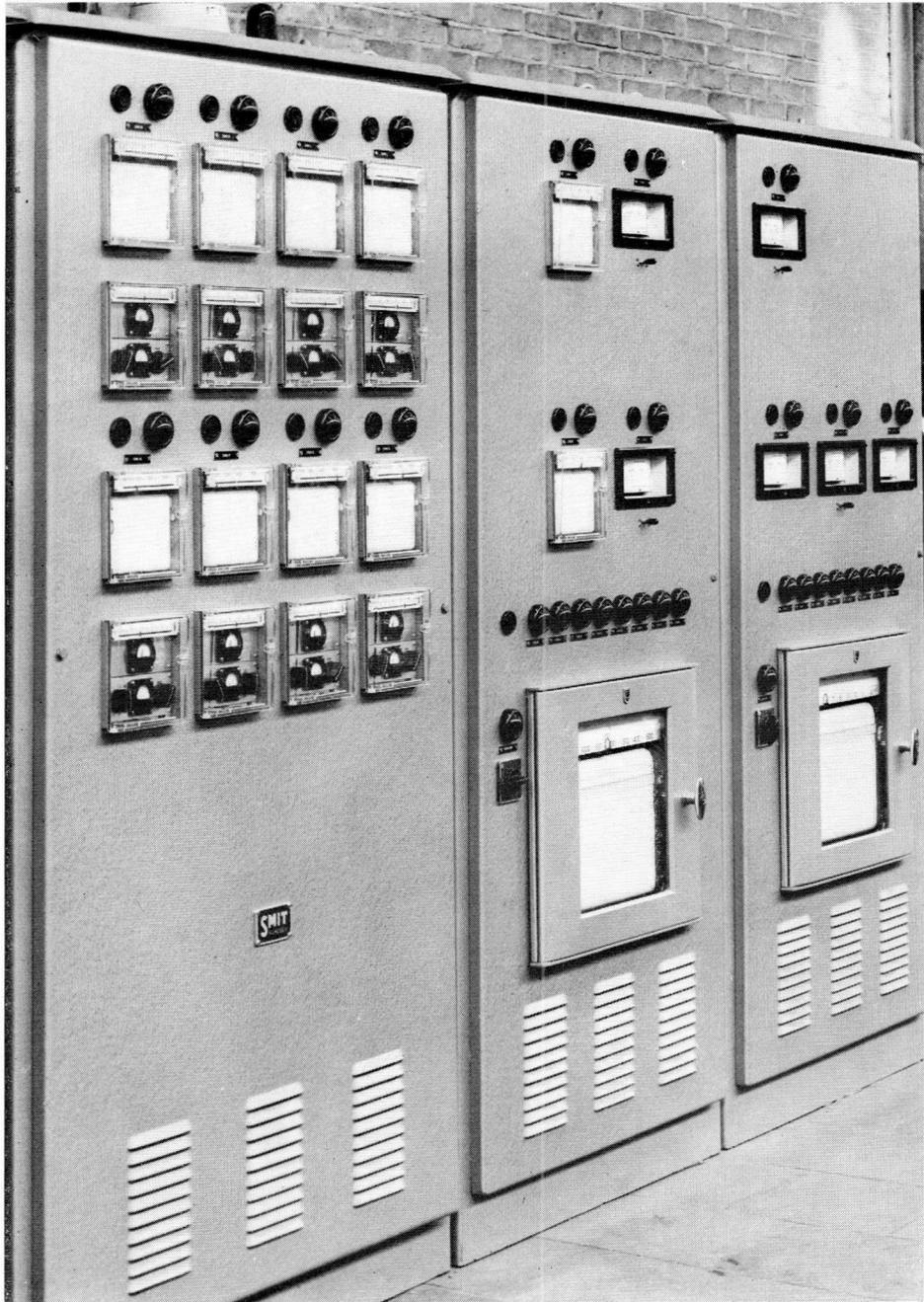
Versatile analogue direct-recording system, with built-in d.c. amplifier units, for static and dynamic phenomena, such as strain, vibration, etc.

The "Oscilloscript" can be supplied with either a high frequency recording system (H-type) or with a wide-script system (B-type). Several types are available, for recording of 2 up to max. 12 channels.

Recordings are made in Cartesian coordinates on normal paper.



High-speed recorder "Oscilloscript".



Miniature recorders, type PR 2400A, and P.I.D. controllers, type PR 7201 in ceramics factory.

## 35. CONTROL EQUIPMENT

### **"Getrosist" indicating galvanometer controller, PT 4000 series**

With inductive sensing system. Controller can be fitted with max. or min. value set point, and the set point arm with one or two sensing heads. Available for small power and current and for resistance variation input.

Three types are available: PT 4000 for on-off control, PT 4003 for time-proportioning control, and PT 4004 for time-proportioning control with integral action.

### **"Getronik" non-indicating temperature controller**

Specially designed for temperature control of machinery used in plastics, to be mounted directly on the machine. With the temperature detector located near the bore of the machine cylinder, straight line control is achieved by means of delayed electronic feedback. The equipment consists of a resistance thermometer, a plug-in type controller with time proportioning characteristics to give anticipatory control, and a set point unit.

### **"Getroplan" program controller**

Indicating galvanometer controller whose set point arm is automatically positioned according to a predetermined program. Available for small power and current and for resistance variation inputs. Fitted with metal program chart, which is easily cut to the required shape with a pair of scissors, and requires no machining. It employs a photoelectric sensing system; auxiliary switches can be fitted.

### **"Getrodukt" stepless proportional controller**

For very close proportional control action. Fitted with moving coil galvanometer. It is available for small voltage and current (e.g. thermocouples) and for resistance variation input and employs a transistorized inductive sensing system.

### **P.I.D. controller, type PR 7201**

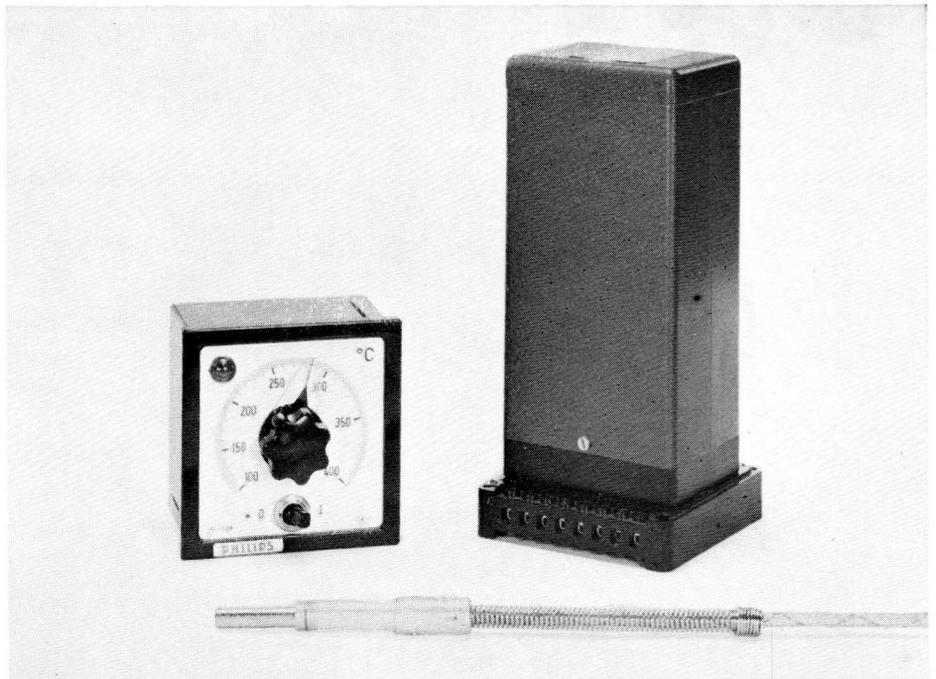
Three-term controller, with modular construction, enabling almost any control condition to be met (Proportional, Integration, Differentiation).

P-action: 3—3000 %, continuously adjustable  
I-action: 2—1800 s in 20 log steps with provision for infinite reset time

D-action: 2—600 s in 11 log steps with provision for zero rate time.

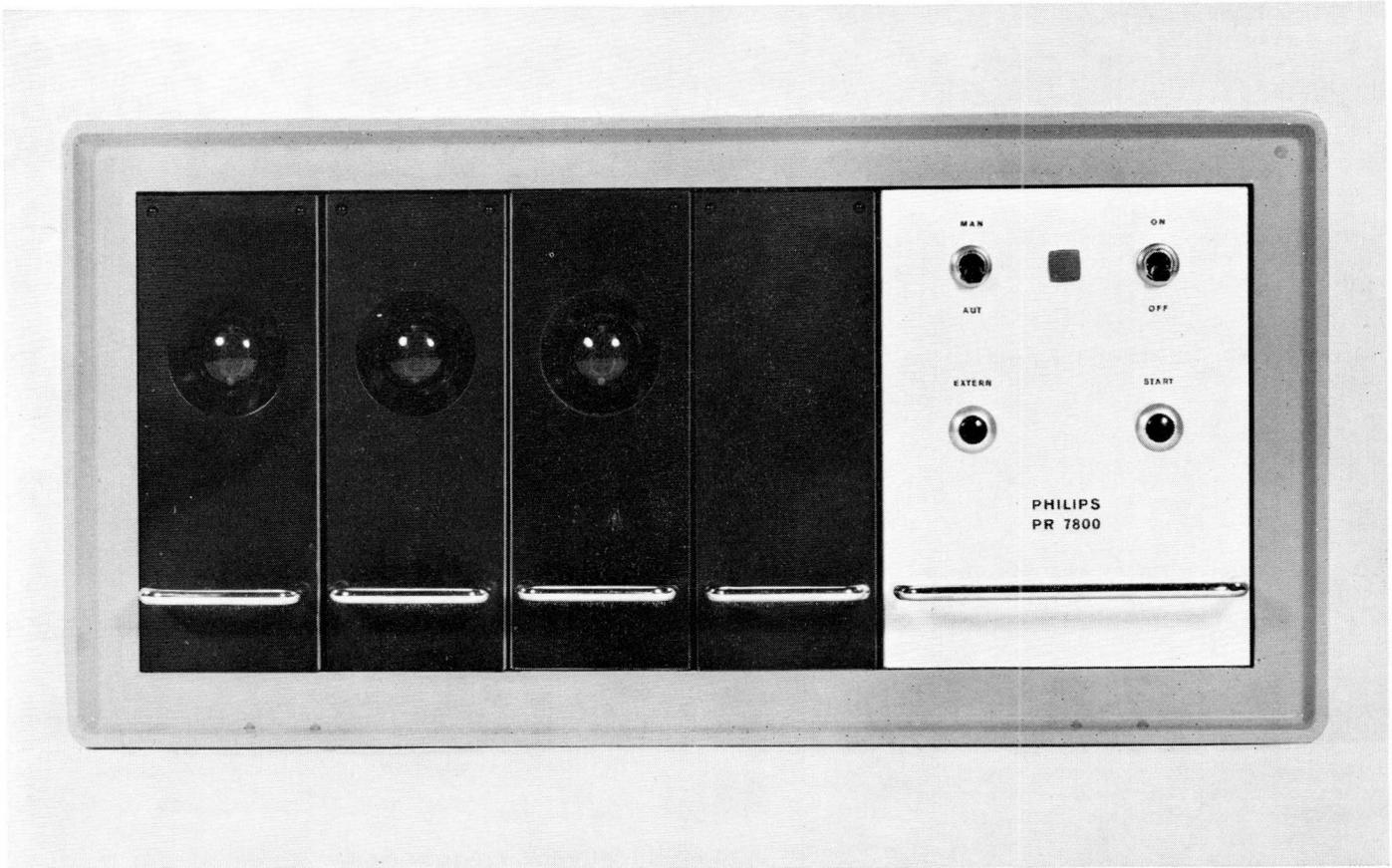
### **Program transmitter, type PR 7211**

In this program transmitter the desired value of a variable process may be set in advance as a function of time in such a way that the process proceeds according to a pre-selected program.



*"Getronik" non-indicating temperature controller.*

## 36. ANALOGUE-TO-DIGITAL CONVERTERS



*Analogue-to-digital converter, type PR 7800.*

### **Analogue-to-digital converter, type PR 7800**

For translating the analogue indication of an automatic self-balancing potentiometric instrument, or alternatively the d.c. output voltage of an electronic device, into a digital code, provided in the form of a numerical display. The information is also available for direct printout or for further processing of data.

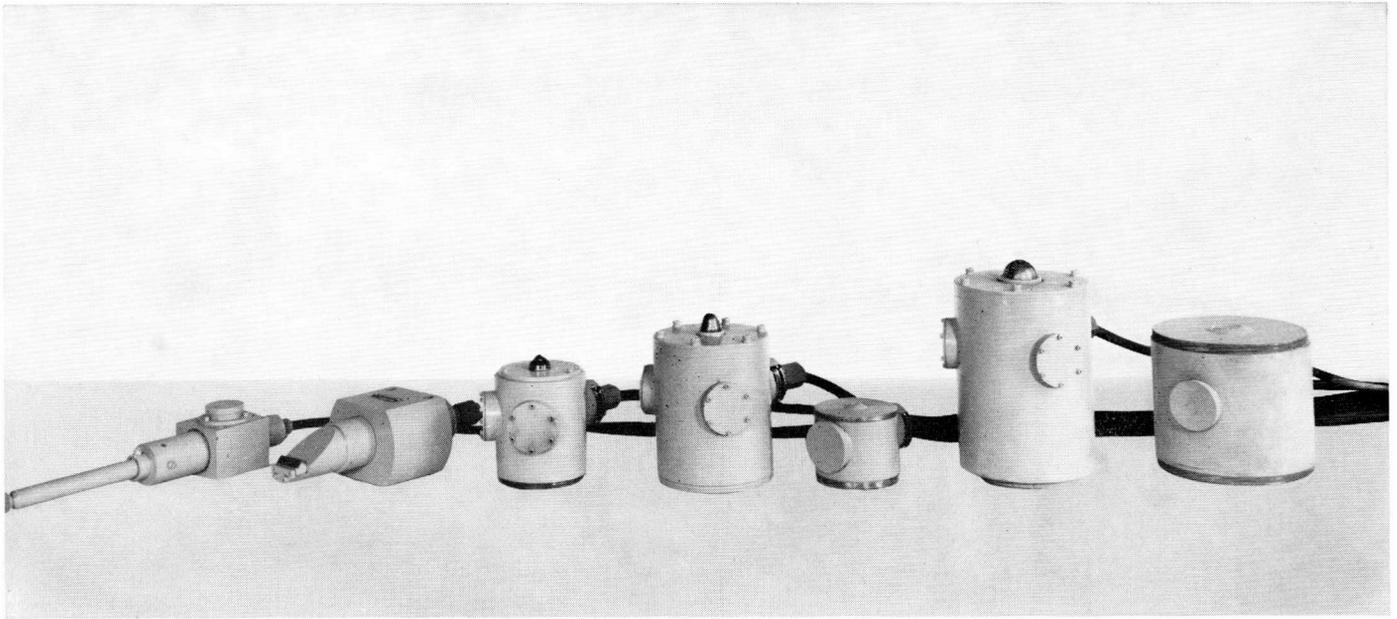
### **Analogue-to-digital converter, type PT 3000**

For use in applications requiring high speed measurements:  
a. where large numbers of readings must be made in short time periods or in short time cycling intervals,  
b. where readings must be made at definite points in time.  
With facilities for digital, serial, parallel and steady state output.

### **Automatic measuring systems**

We supply complete automatic systems for digital strain and temperature measurements. Such a system consists of input units with calibration scanner, amplifier, analogue-to-digital converter and digital display unit. Facilities for flexible programming and connection of typewriter, tape puncher or magnetic tape recorder are incorporated.

## 37. ELECTRONIC WEIGHING



Load beams and load cells for 20 and 500 kg, 1, 5, 10, 20 and 100 tons

Basically an electronic weighing installation comprises: a load cell, the measuring instrument and accessories. The heart of the load cell is a steel billet to which strain gauges, arranged in a complete bridge circuit, are cemented. The deformation of the billet, causing a resistance variation proportional to the deformation, is a measure for the load imposed, which is indicated recorded on the direct reading or recording instrument.

Typical applications are:

*Weighing of permanently installed objects* such as tanks, silos, bunkers, melting furnaces, platforms.

*Weighing of movable objects* as bulk goods and all kinds of vehicles, as lorries, railway waggons, by means of electronic weigh bridges.

*Conveyor belt weighing* with integration unit, equipped with or without belt speed transducer for elimination of belt speed variation. Easily incorporated in existing conveyors.

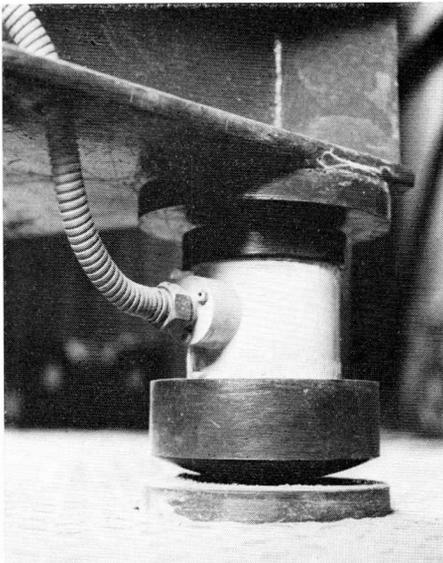
*Weighing and measuring on cranes* for determination of weights and load moments.

*Automatic batch-weighing.* Preset automatic batching of powdered, granulated or liquid components, as well as the automatic control or other operations within the batching cycle, as transport of the components, temperature control, switching of mixing equipment, etc.

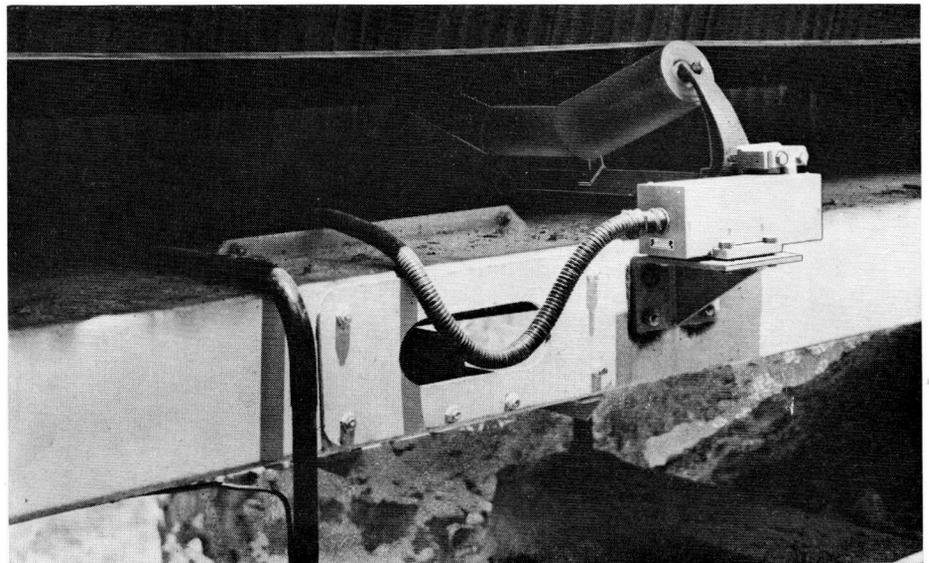
*Automatic feed control* of material transported on conveyor belts, e.g. for mixing of products in continuous processes.

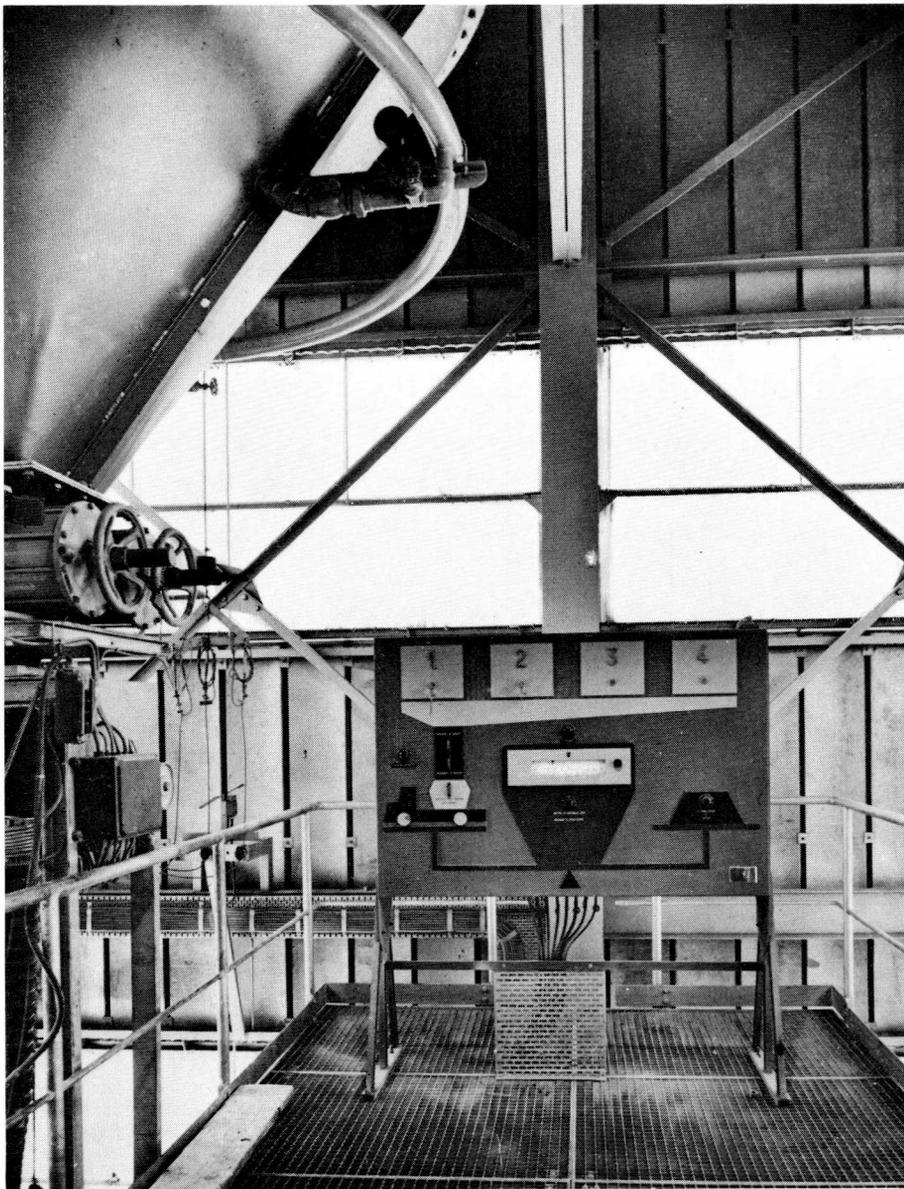
*Check-weighing,* checking of the weight of products in continuous production, providing either an alarm signal or an installation for the automatic removal of rejects.

A PR 9226 series load cell applied in tank weighing.

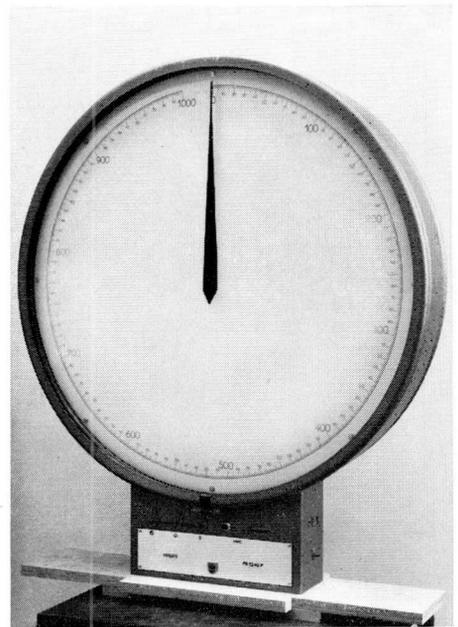


Load beam PR 9228 in special housing, mounted on a conveyor belt in mining.

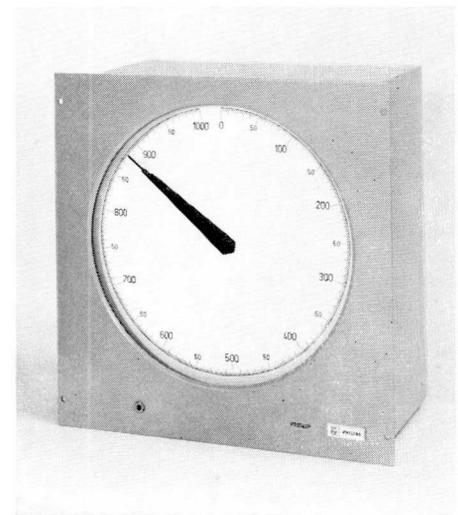




*In France: self-service supply centre or cement controlled by electronic batching.*



*High precision weighing indicator PR 1240 P series.*



*PR 1220 P standard circular scale indicator.*

*In Austria: A DEMAG overhead travelling crane in a paper factory capable of handling loads up to 7 tons. Two girders with 4 dynamometers are suspended from the traversing track of the crane. The measuring cable is coiled on a sprung cable drum without sliding contact. The indicator is moved along with the crane.*

## Measuring instruments

The load cells can be used in combination with measuring instruments such as:

PR 100 P, PR 1210 P, straight scale indicators, scale length 250 mm

PR 1220 P, circular scale indicator, scale length 760 mm

PR 2210 P, 1 channel strip chart recorder, scale length 250 mm

PR 3210 P, 6 channel strip chart recorder, scale length 250 mm

PR 1520 P, high precision indicator with 1 m circular scale length

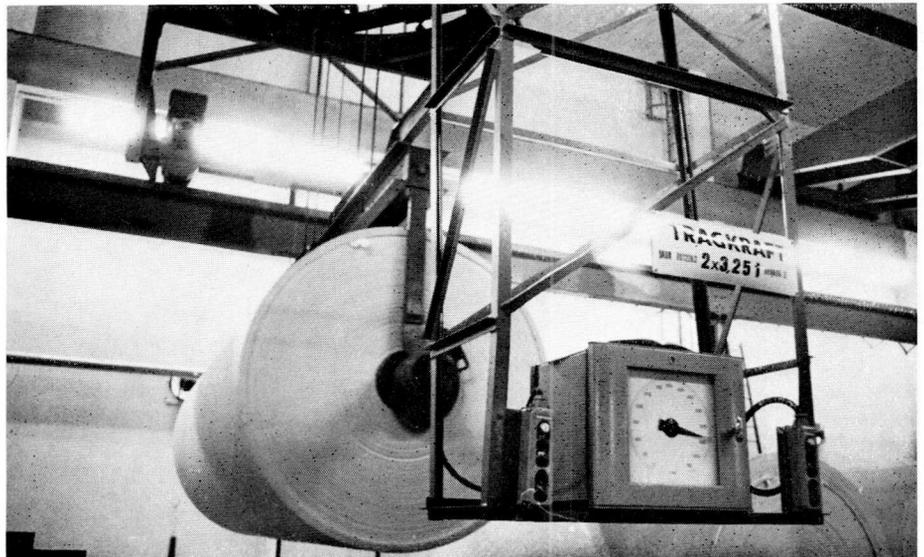
PR 1521 P, universal circular scale indicator with 1 meter scale length

For installations in which stringent demands are made on the accuracy of the measurement, special load cells and measuring instruments are available, such as:

PR 6101, PR 6110, PR 6120 and PR 9228.

For measuring forces from 4 to 8000 kg:

PR 2240 P round scale indicator, scale length 2000 mm.



## 38. "THERMOCOAX" MINERAL INSULATED THERMOCOUPLES AND HEATING ELEMENTS

'Thermocoax' represents a range of mineral insulated thermocouples and heating elements. Originally designed for use in heavy-duty applications in nuclear reactors, having excellent properties to withstand adverse electrical, mechanical or physical conditions (such as extreme temperatures and pressures), it now covers a wide range of applications in science and industry.

### Thermocouples standard series

Available with overall diameters from 0.25 up to 2 mm, as bulk material or with ready-made, sealed, hot junction.

Thermocouple elements: Chromel/Alumel (registered trademark of Hoskins Mfg. Co., U.S.A.) or Pt (10%)/Rh-Pt (for temp. up to 1400°C). Insulant: magnesium oxide; sheath: SS 304 or Inconel.

In addition, non-standard types with alternative materials can be supplied upon specification.

The main characteristics of some Chromel/Alumel types (fully in agreement with ISA and DIN standards) are given below.

### Thermocouples

types in general demand	2 AB Ac 10	2 AB Ac 05	2 AB I 10
type of sheathing	18/1 stainless steel	18/8 stainless steel	Inconel
thermocouple wires	Chromel/Alumel	Chromel/Alumel	Chromel/Alumel
overall diameter	1 mm	0.5 mm	1 mm
approximate diameter of the thermocouple wires	0.2 mm	0.1 mm	0.2 mm
thickness of the sheathing	0.12 mm	0.06 mm	0.12 mm
resistance between core and sheathing	several megohms per meter	id.	id.
resistance per meter (approx.) (Chromel + Alumel)	up to 20°C: 35 Ω up to 650°C: 48 Ω	up to 20°C: 140 Ω up to 650°C: 190 Ω	up to 20°C: 35 Ω up to 650°C: 48 Ω
temperature range	0–900°C	0–900°C	0–1000°C
max. permissible temperature	1100°C	1100°C	1200°C
min. diameter of bends	2 mm	1 mm	2 mm
standard length (approx.)	35 to 45 m	150 m	35 to 45 mm

### Heating elements

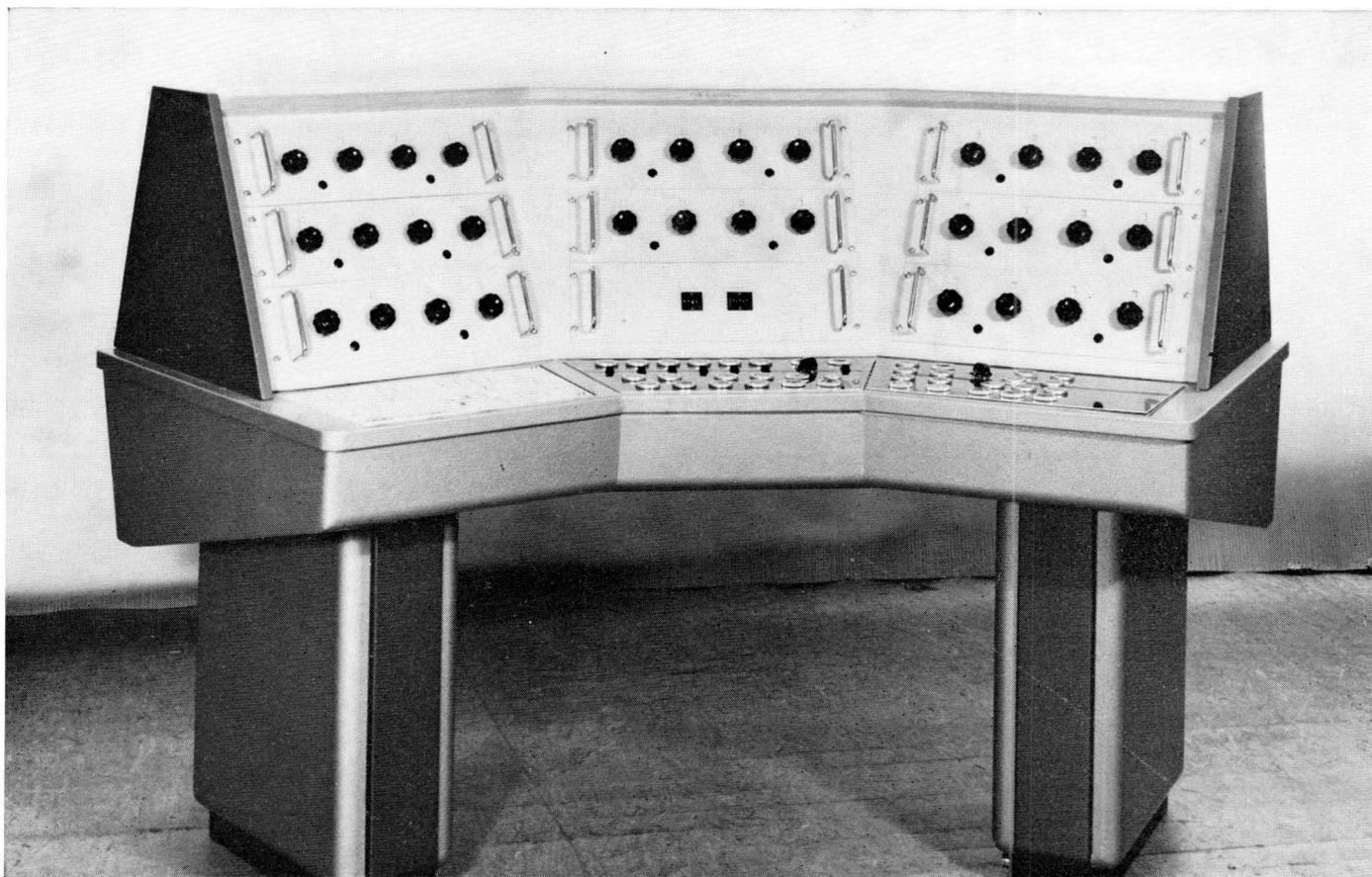
The main characteristics of the available types are given in the adjacent table.

Separately available: identical heating elements with two wires in one common sheath (to promote the construction of fully closed elements which are supplied from one side).

### Heating elements

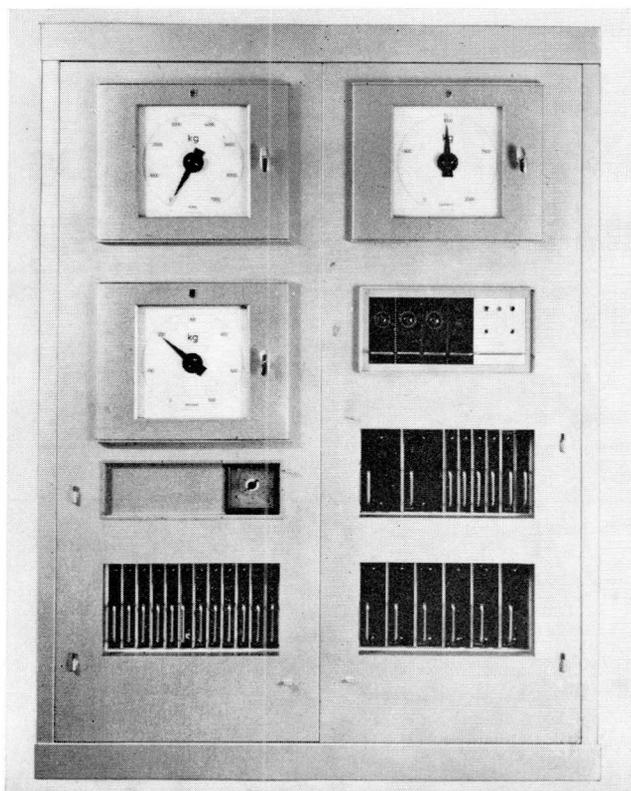
type	1 Nc I 10	1 Nc I 12	1 Nc I 15	1 Nc I 18	1 Nc I 20
overall diameter (mm) (in)	1.0 0.0393	1.2 0.0473	1.5 0.059	1.8 0.071	2.0 0.079
resistance (Ω/m) (Ω/ft)	13 4.0	8.5 2.6	5.9 1.8	3.7 1.1	2.9 0.88
maximum permissible current (A)	8	10	17	26	32
current (A) for sheath temperature of 1 000°C	5.1	7.5	12	16.5	19.5
standard length of wire on reels (m)	80–90 40–45	55–65 28–32	35–40 18–20	25–28	20–23
standard length of wire on reels (ft)	250–280 125–140	170–200 85–100	110–125 55–65	80–92	65–75

## 39. PROCESS PROGRAMMING SYSTEMS



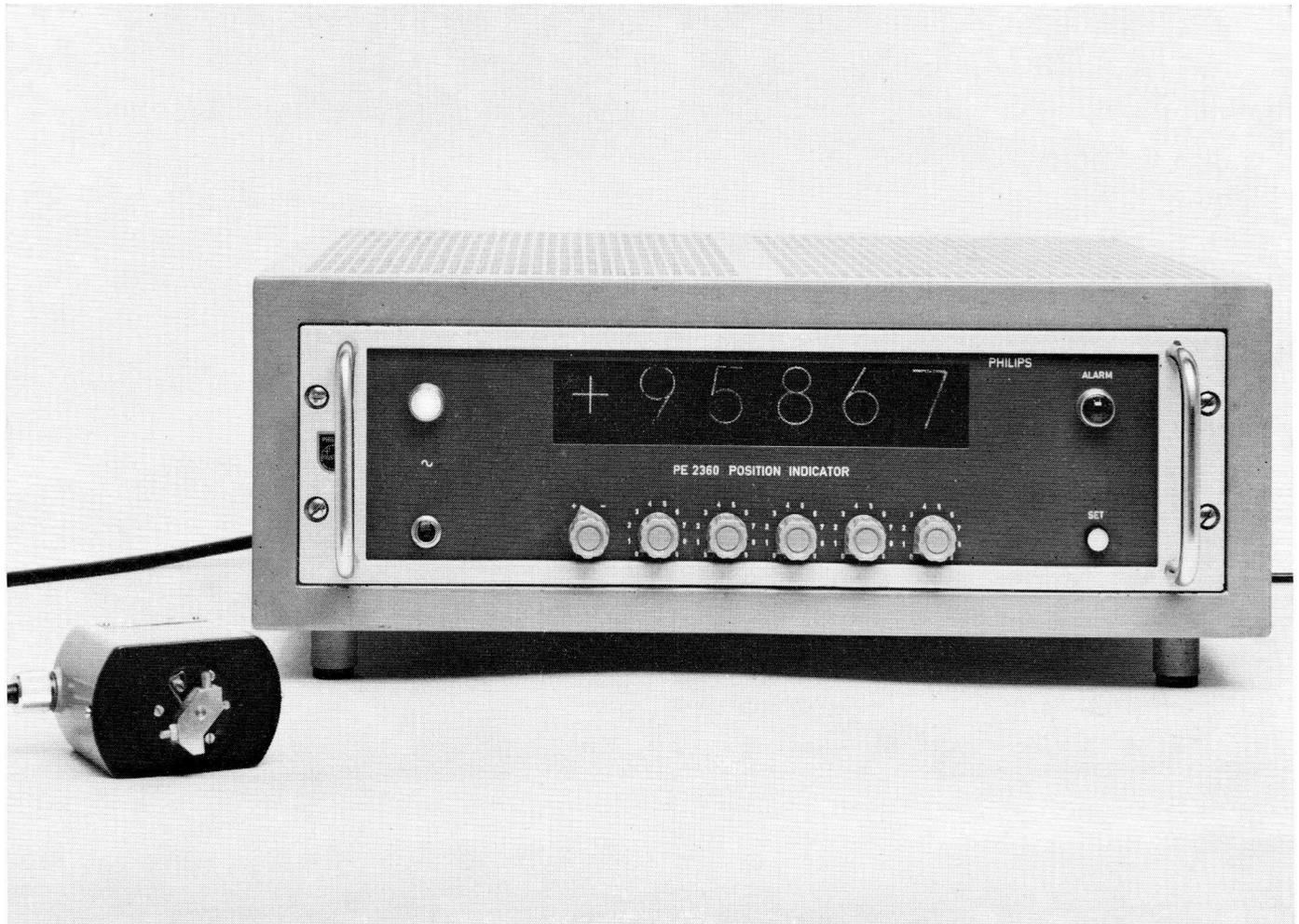
*Control panel for automatic batching installation.*

The data of a process, cast in the form of a program, are punched in a tape or a card. After the process has been started, all operations are automatically carried out, controlled by the equipment. This may include the recording of required components and their weight.



*Control and measuring panel for automatic batching installation.*

## 40. NUMERICAL INDICATING AND CONTROL SYSTEMS FOR MACHINE TOOLS



Numerical position indicator, type PE 2360/00.

### ROTARY TRANSDUCER, TYPE PE 2270

The rotary transducer PE 2270 serves as a pick-up with Philips numerical indicators and numerical control systems for machine tools. It can be attached to working or measuring spindles. The greatest accuracy is naturally obtained with separate measuring spindles, in almost all cases recirculating ball spindles. Due to the pitch of the spindle and the smallest measuring unit required, a very great range of number of pulses per revolution of the measuring pick-up is needed. While the normal version of the pick-up has a resolution of 1000 pulses per revolution practically all pick-ups with between 320 and 2500 pulses can be supplied (the condition being that the value must be divisible by 4).

Its method of working is based on the photoelectric scanning of a rotating disc provided with radial slits. The photoelectric cells supply two trapezoidal signals that exhibit a mutual phase shift of 90°, which permits counting in two directions.

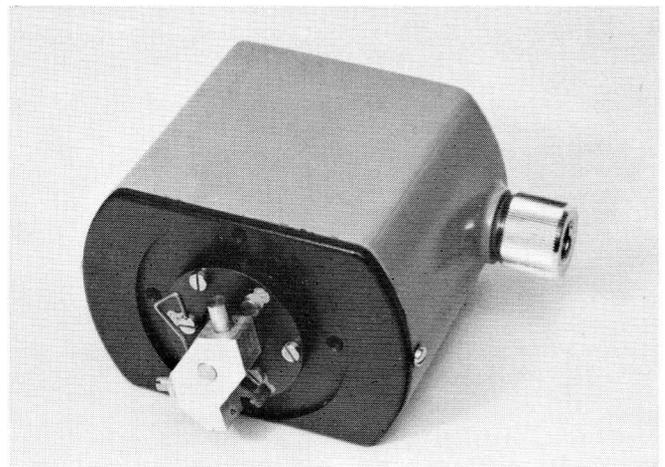
Technical data:

Output signal: two trapezoidal signals with a mutual phase shift of 90°, at a level of 12 V and with an amplitude of 8 V.

Resolution: 1000 pulses per revolution. Transducer with a minimum of 320 and a maximum of 2500 pulses per revolution can be supplied.

Mains supply: lamp current 1 A at 2.4 V, logic voltages 0 and 16 V, both voltages are supplied by the power supply PE 2260/14.

Dimensions: 144 mm × 60 mm × 81 mm (b × h × d).



Rotary transducer, type PE 2270.

## NUMERICAL POSITION INDICATOR, TYPE PE 2360/00

The indicator is a bi-directional counter with digital display in 5 decades for simplifying the reading off from machine tools. Due to the possibility of selecting the reference-point freely by adjusting each decade separately between 0 and 9 in steps of 1 the indicator gives each moment the true measurements of the workpiece being machined. The counter comprises a 1-0-1 circuitry to avoid complementary counting as f.i. 03-02-01-00-99-98, but counts +03, +02, +01, +00, -01, -02, etc. The mathematical sign + or - is automatically switched over when zero point is being passed. As pick up serves the rotary transducer, type PE 2270. The indicator has a built-in error control circuitry; in case a pulse should be missed, the counting process is stopped after having counted a full decade and a pilot lamp lights up. Before starting the counting process, the functions of the indicator can be checked.

Technical data:

Input: 2 signals having a mutual phaseshift of 90°.

Counting capacity: 0...15 kc/s.

Mains supply: 110 or 220 V  $\pm$  10 %, 50 c/s.

Construction: housed in 19 in cabinet, tropicproof.

Dimensions: 530 mm  $\times$  210 mm  $\times$  367 mm (*b*  $\times$  *h*  $\times$  *d*).

## INCREMENTAL POSITIONING SYSTEMS

In an incremental system the positional information put in refers to the previous position and not to a fixed point. The information decisive for programming is the difference in distance between the present position and the desired consequent position.

This principle simplifies the assembly of the control system and thus reduces the number of the requisite building units. The numerical positioning systems, designed in accordance with the building block principle and fully transistorized, can be supplied in four standard versions:

type I 22 DT: 2 coordinates, simultaneously settable, with manual and punched tape input;

type I 21 DT: 2 coordinates, sequentially settable, with manual and punched tape input;

type I 22 D: 2 coordinates, simultaneously settable, with manual input;

type I 21 D: 2 coordinates, sequentially settable, with manual input. All versions are designed for five or six decades and can in addition be equipped with an auxiliary-function register, a programme-step display and an increment display.

### Information input

Manual with decade switches or with punched tapes; the standard version of models I 21 DT and I 22 DT are suitable for the eight-channel punched tape. The application of the code transformer PE 2354 also permits of using a five-channel punched tape. With punched tape control, in addition to positioning two further functions can also be programmed, e.g. boring and tool changing.

### Mechanical construction

The control system is built up from standardized building units and can be accommodated in a 19 in sheet metal housing. The units can be easily exchanged. All connections are made with multiple plugs and flexible cables in the housing.

For easy control and exchangeability the electronic units are mounted on hinge-out frames.

Technical data:

Measuring system: rotary transducer PE 2270; resolving power 0.01 mm.

Coordinates: 2.

Amount of traverse: with a resolving power of 0.01 mm over five decades 0.9 m, over six decades 9.0 m.

Punched tape coding: eight-channels in accordance with E.I.A. or V.D.I. (code 8B). Five-channel coding optional.

Maximum fast travel: 6 m/min with a resolving power of 0.01 mm.

Speeds: Maximum 3. The change-over points can be adjusted: first switching over between 1000 and 100 measuring units, in steps of 100;

second switching over between 100 and 10 measuring units in steps of 10 before the set point is reached.

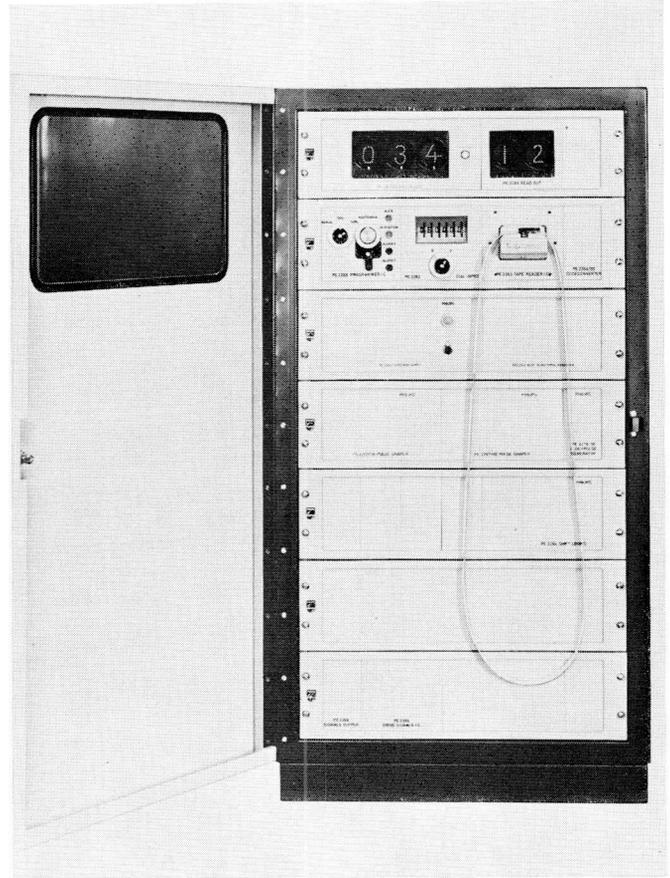
Approach of the position: always from one and the same direction. Self-checking: automatic correction of overrun, transducer signals supervised for faulty and spurious pulses.

Mains supply: 110, 220 V, 50 c/s.

Dimensions: 1060 mm  $\times$  552 mm  $\times$  557 mm (*h*  $\times$  *b*  $\times$  *l*).

Optionally supplied: programme-step indicator (three decades), type PE 2291.

Register for auxiliary functions (two decades), type PE 2294.  
Auxiliary-function indicator (two decades), type PE 2289.  
Increment indicator for five or seven decades, type PE 2282.



Incremental positioning system.

## NUMERICAL 2-COORDINATE CONTROL, S-NOR SYSTEMS

The numerical 2-coordinate control, S/NOR system, is a positioning control for small and medium sized machine tools. With its flexible design and the above-mentioned facilities this control can comply with all requirements of positioning and processing 2 axes of motion. It excels in addition by its extraordinary reliability in service, achieved by the use of semiconductor units throughout as well as by a sturdy mechanical construction in a dustproof and splashproof cabinet and ready accessibility for servicing.

### Function of the switching logic

The control receives via its inputs 2 different data, namely the set value of the tape recorded programme and the actual value provided by the transducers. Both these values are continually compared with each other. Any differences revealed in this comparison are passed as commands to the drive motors for the X and the Y axis. Kind and magnitude of the signals determine direction and speed of positioning. If the set value coincides with the actual one, the difference becomes zero and the position that had to be approached has been reached. On the control panel the In-Position lamp lights up.

The switching logic, built up entirely of NOR circuit elements, has no direct store. The data providing the set value and the actual value are processed continually and shifted in the circuit at the rate of 225 kc/s or 4  $\mu$ s per position.

### Error detection

For greater reliability in service the control is equipped with an automatic error detection which indicates by means of a warning lamp any errors occurring during positioning and interrupts the positioning process. This detection circuit reacts to reading-in errors resulting from wrong coding of the punched tape, from asynchronous shifting of information or from switching errors, as well as from errors due to wrong transducer signals.

## Components of the control

	Dimensions		
	length	height	breadth
A complete control embraces:			
control unit PE 2371 with power pack	640	1400	200
punched tape reader PE 2365 or PE 2366	300	200	95
dial input PE 2369	300	100	80 (approx.)
operating panel PE 2364 with programme switch	300	100	80 (approx.)
digital display PE 2362 of the position in 2 coordinates	300	200	80 (approx.)
indicator unit PE 2363 to show sequence number and auxiliary function	558	264	270
the measuring system and the drive motors	558	264	270

## NUMERICAL POINT-TO-POINT AND STRAIGHT-CUT CONTROL SYSTEMS

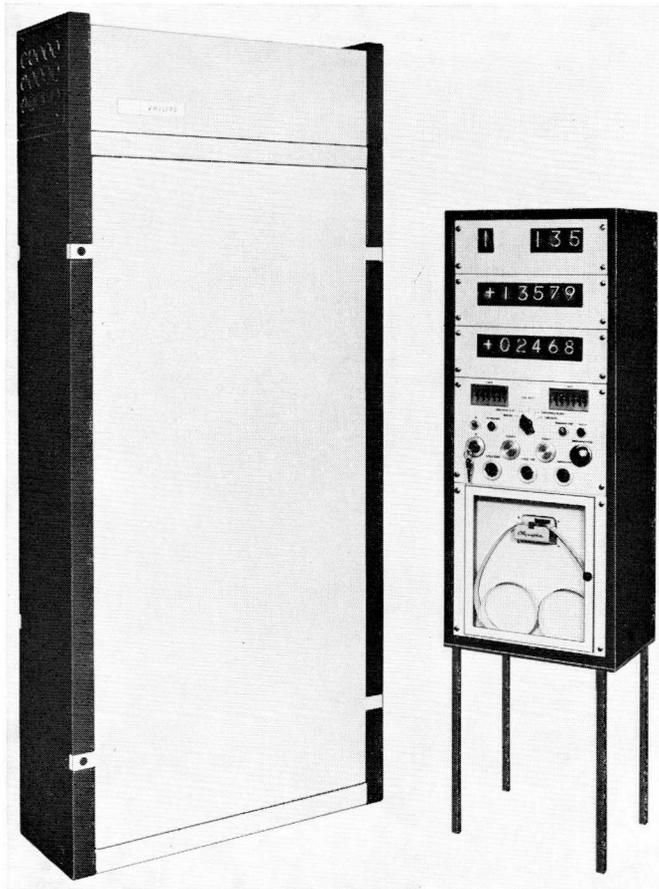
Philips machine tool controls with input of absolute dimensions are point-to-point and straight-cut control systems for the controlling of the travel or the machining distance in 1, 2, 3, 4, or 5 axes of motion. By supplementing the building-block engineered installations with the corresponding standard units it is possible to include in the control or the programmes a large number of auxiliary functions, so that the installation offers practically unlimited possibilities in respect of adaptation to the demands of the customer. The standard versions are equipped with dial or punched tape input, 5, 6, or 7 digit display of the actual value, zero shift, and mirror image switches. With a number of complementary building blocks any system can be adapted to the special requirements of the customer. The controls in respect of extreme reliability in operation and simplest servicing facilities comply with all demands of machine construction.

### Basic components of a control system

All controls are built up of building blocks which are more or less the same for each coordinate.

### Punched tape input

The information is read in by a Friden or a Tally punched tape reader.



Numerical 2-coordinate control, S-NOR system.

The punched tape used is the 8-track tape (E.I.A. Code) with a width of 1 in (25.4 mm). This tape is able to accommodate as data: sequence number in 3 decades, preparatory functions in 2 decades, X, Y, Z, Z<sub>1</sub>, and  $\Phi$  coordinates in up to 7 decades at the most, as well as milling feed, spindle feed, spindle speed, tool number and miscellaneous functions. The coding of the punched tape accords with E.I.A. standard instructions R 227 or RS 224. The read-in data are stored in the control until a new information is put in. It is therefore not necessary, when changing only a part of the whole data block, to repeat also the unchanged part.

### Dial input

These are decade switches (7 decades at the most, separate for each axis of motion) by means of which the information is read into the control.

### Mirror image switches

These permit of programming in one of the four quadrants. Throwing of the relevant switch allows of using the programme tape also for the opposite quadrant. Since in the application of this unit any point of symmetry can serve as the zero point, programming is considerably simplified.

### Zero shift

This permits of shifting the zero point over the whole range either by the punched tape or by the dial input.

### Operating controls

Mains switch, zero shift by dial input, switch for changing over from punched tape to dial input, read-in switch, start and stop commands for drive motors, switch for remote control of information read-in, as well as start and stop switches, emergency switch for cutting the installation off completely from the mains.

### Electronic building blocks

Read-in or programming unit for the control of various electronic functions such as reading of the tape, logic operations, blocking of output leads, adder for comparing set and actual values, as well as various units for the generating of pulses, supply units, etc.

### Positioning cycle and traversing distance

The cycle embraces the operations of read-in, computation, positioning, computation.

Read-in: the information is passed by means of decade switches or punched tape to the relevant register.

Computation: this process embraces the determination of the increment and further arithmetic work.

Positioning: the slide moves with an ever smaller driving velocity towards the desired point. When the position is attained, the indication "in position" is given, and this may simultaneously be the command to start the machining proper.

After the slide has come to rest the position reached is instantaneously calculated and displayed.

The starting of a positioning or machining cycle may take place by dial input or automatically.

	Traversing distance in one direction with		
	5 decades	6 decades	7 decades
	mm	m	m
resolving power	0.1	5	50
	0.01	0.5	5.0
	0.001	—	0.5
			5.0

### Control of machine and auxiliary functions

Numerical controls are essentially pure point-to-point controls. In order to achieve fully automatic control of the process the positioning controls must be supplemented with a few building blocks so as to make straight-cut control systems of them which permit of the control of functions beyond the field of pure positioning.

The functions to be considered are: feeds, speeds of revolution, tool indication and tool changing, various auxiliary functions, preparatory functions.

These machine and auxiliary functions are put on the punched tape in coded form and read into the control. For the processing of these values the control must be equipped with additional storage capacity, which can accept the code number on the tape and put it out again in accordance with the programme as an output signal.

The output signal of this auxiliary-function register then switches a relay in the power circuit of the machine to control the programmed auxiliary function. Philips controls can be equipped with one or several auxiliary-function registers, type PE 2294; this is a standard building block containing a 2-decade register with output stage. The register can take from the tape 99 coded auxiliary functions and store them. By means of this register different or similar routines occurring sequentially can be controlled, i.e. approach of the table in the Z-direction and approach of the spindle. But it is not possible to control spindle speed and feed by means of a common register; for this two registers are required. The indication of each register is digital with a 2-decade flood-lit numerical display.

#### Signal supervision at the measuring input

The measuring inputs are continually supervised in respect of missing or spurious pulses. In case that such a wrong pulse occurs, which might lead to wrong positioning, the control process is interrupted and the machines stops. Only after read-in of the new reference point is it possible to continue working.

#### Mechanical construction

All Philips controls for machine tools are built up of standard units that can be accommodated in 19 in cabinets. Since the individual units are accommodated in drawers provided with handles, they are readily accessible for maintenance. The individual units are connected to each other by flexible cables and multiple plug-in connections. In the units themselves the switching circuits are largely standardised. Since they are built up on hinged frames they can be exchanged quickly and easily.

#### Cabinet dimensions $l \times h \times b$ (mm)

2 coordinate control  $1900 \times 640 \times 660$

3 coordinate control  $1680 \times 1220 \times 660$

Operating cabinet for 3 coordinates  $880 \times 535 \times 390$

#### Supplementary building units for extending the basic models

Flood-lit display unit for digital display of position with up to 7 decades.

Flood-lit display for indicating the sequence number in 3 decades. Auxiliary function register, consisting of 2 decades with which 99 auxiliary functions, such as feed, speed, tool changing and the so-called preparatory functions can be controlled.

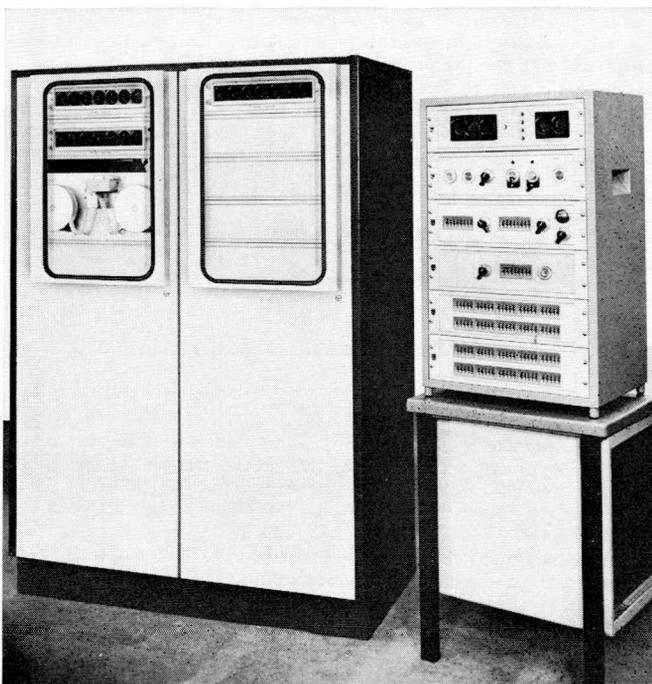
Flood-lit display unit for indicating the auxiliary function or the preparatory functions in 2 decades, generally used to indicate the tool number.

Plus/Minus programming unit for extending the field of application of a control that can only process positive values to a control with which both positive and negative values can be programmed (4-quadrant programming).

Compensation of tool length to take into account the length of the tool by means of switches, for 10 tools (optionally also for up to 30 tools).

Milling diameter correction.

Decoding unit for the recoding of a 5-track punched tape.



Numerical point-to-point and straight-cut control system.

## 41. H. F. HEATING

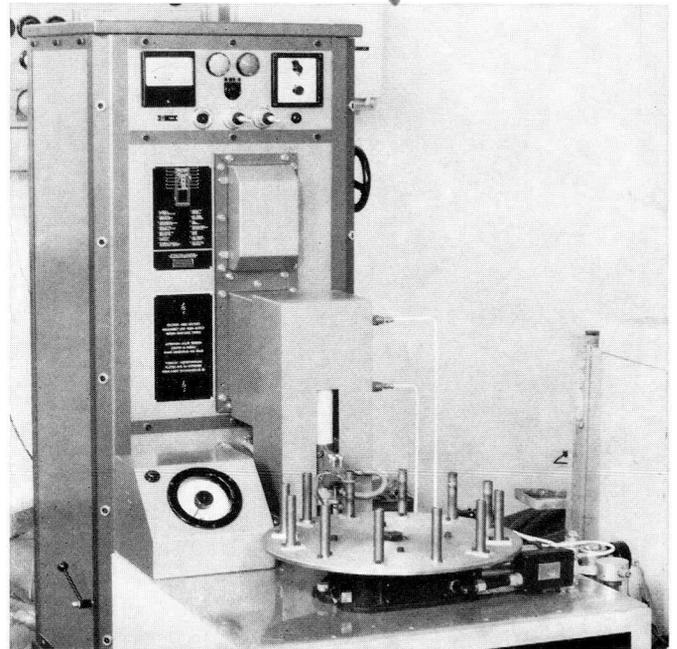


*Brazing with a 12 kW h.f. generator.*

### HIGH FREQUENCY INDUCTION HEATING GENERATORS

With h.f. induction heating it is possible to achieve a high heat concentration selectively, that is to say, to raise a well-defined region of an object to a high temperature. It is further possible, using this method, to carry out certain heating processes with a very high degree of reproducibility. Induction heating, then, is eminently suitable for the heat-treatment of metals in quantity production; its applications include surface hardening, quenching, soldering, brazing, tempering, annealing and also the fusing of metals or special alloys in vacuo or in an enclosed gas atmosphere. In other applications, such as zone refining, h.f. induction heating is the only method that produces the desired results.

The heat sources, the h.f. generators, are equipped with a variable output adjustment. In the medium power range (4–12 kW) high impedance and low impedance output terminals ensure freedom in coil design and optimum power delivery to the load. The generators are provided with overload and other safety protections to prevent damage when the generators run with open or short-circuited terminals; they are switched off if the cooling-water flow drops below a present minimum and if the inside cabinet temperature rises above a maximum value. A forced air or water cooling system is built-in. The requirements of the most stringent international standards with respect of radio and t.v. interference are fully met.



*6 kW h.f. generator with turntable.*

type	PH 1001	PH 1004	PH 1006	PH 1012	PH 1025	PH 1050
max. h.f. output (continuously adjustable)	1 kW	4 kW	6 kW	12 kW	25 kW	50 kW
working frequencies Mc/s	1.7—2.7	1	1 or 5	1 or 5	1	0.6
mains supply 50 c/s	190, 220, 240 V single phase	220, 380 V three phase	220, 380 V three phase	208—420 V three phase	220, 380 V three phase	220, 380 V three phase
output terminals impedance	low and high	low and high	low, low and high	low, low and high	low, high	low
cooling system	air	water	water	water	water	water

**SPECIAL H.F. INDUCTION HEATING EQUIPMENT**

**Melting furnace and 500 W h.f. generator** for the melting of minute quantities, specially for steel samples and C and S analysis. The interchangeable crucibles can be heated up to 2 000 °C within a few seconds. The h.f. output is 500 W or 1000 W in a 25 % duty cycle, the frequency 10 Mc/s.

**Universal h.f. heating furnace**, heat treatment takes place in interchangeable molybdenum or tungsten tubes, diameter 30 mm, length 150 mm.

**Automatic zone refining installation** for simultaneous zone refining of 8 bars of approx. 1.5—1.8 kg each. Number of passes 1—15, pulling speed 2—10 mm/min.

**Automatic floating zone refining equipment** capable of handling 300 mm rods of silicon up to a diameter of 27 mm. Typical processes are purification, doping and single crystal growing.

**Equipment for pulling single crystals** of silicon or germanium up to 400 mm length, or a max. diameter of 40 mm.

**Silicon reprocessing equipment** an installation for zone refining of silicon scrap material.

**High vacuum heat treatment equipment** for metals, alloys, oxides and carbides, in operations as melting, casting, welding, sintering, refining and hardening.

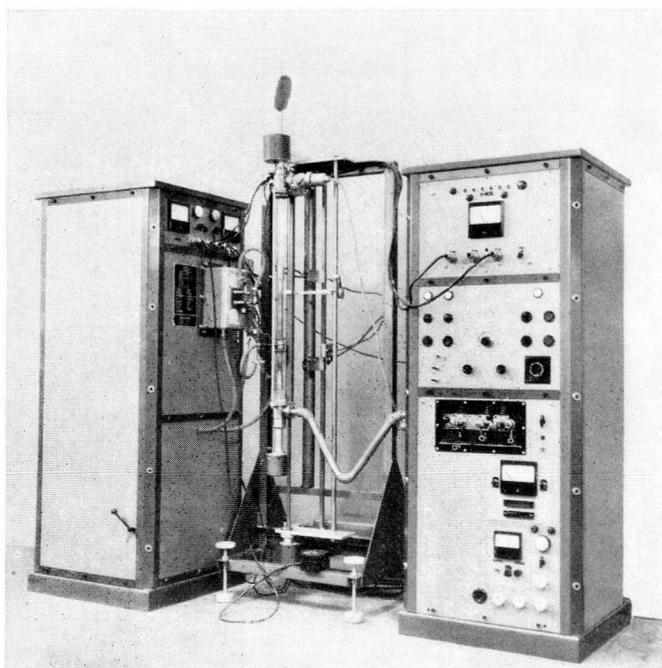
**Induction plasma burner**, a universal burner for plasma temperatures up to 20 000 °K. Suitable heat sources are 6—12 kW generators.

**DIELECTRIC HIGH FREQUENCY GENERATORS**

For the thermal treatment of non-conducting materials, such as wood, glue, synthetic resins, textiles, rubber and sand cores.

*dielectric high frequency generators*

type	PH 1201	PH 1204	PH 1206
adjustable h.f. output	1 kW	4 kW	6 kW
mains supply 50 c/s	190, 220, 240 V single phase	220, 380 V three phase	220, 380 V three phase
output	one	one, two	one, two
cooling system	air	air	air



*Automatic floating zone refining equipment.*

## 42. ULTRASONIC CLEANING EQUIPMENT



*Ultrasonic cleaning equipment in a hospital.*

The principle of ultrasonic cleaning is the conversion of electrical energy into high-frequency mechanical vibrations, propagated into a cleaning solution. Those vibrations, caused by immersed or built-in transducers, result in a very thorough cleaning. This method is of special interest for the handling of intricately shaped objects.

### Transducer

Type PH 2152/00 submersible transducer in stainless steel housing. For operation with generators PH 2002/00, PH 2003/00 and PH 20212/00.

### Cleaning tanks

Type PH 2100/10 cleaning beaker with 1 litre stainless steel inner vessel and built-in transducer.

Type PH 2101/00 cleaning tank with 3 litre stainless steel bath and built-in transducers inside.

Type PH 2102/00 cleaning tank with 12 litre stainless steel bath fitted to transducer inside.

### Generators

type	output power (continuously) W	power consumption (full load) W	operating frequency kc/s
PH 2000/01	35	125	21
PH 2002/00	200	390	20.5
PH 2003/00	as type 2002/00 but in chassis form for building-in purposes		
PH 20212/00	as type PH 2002/00 but for building block systems to active more power		

## 43. D. C. POWER SUPPLIES

The d.c. power supplies are intended for the supply of d.c. power to apparatus requiring a highly constant operating voltage, e.g. for transistor circuits, in the development of measuring amplifiers, for regulating amplifiers and pulse amplifiers, for measuring circuits in chemical and medical laboratories and as power sources in the fields of photometry, cardiography and optical pyrometry.

### D.C. REGULATED POWER SUPPLIES

All units are suitable for single phase a.c. mains from 110 up to 245 V; 50 . . . 60 c/s and for continuous operation under ambient temperature of 35 °C at full load. Frequency variations and input voltage distortion do not deteriorate the electrical characteristics. The units are designed for bench use or mounting into 19 in racks, while several of these units are available for mounting in customer's own prototype equipment. Cabinets are optionally available.

### D.C. FIXED OUTPUT POWER SUPPLIES

Except types PE 4860 and PE 4861 all units are delivered as chassis model or for rack mounting. Coarse adjustment of voltage in steps of 6 V in low voltage range of power supplies and in steps of 50 V in the medium range.

At lower load adjustable to any value between specified limits Cabinets for 19 in types available on request.

#### D.C. regulated power supplies

type	d.c. output		voltage ranges	variations of output voltage		internal resistance Ω	hum r.m.s. voltage mV	measuring instrument current I voltage V	dimensions b × h × d mm
	voltage V	current A		at ± 10 % mains voltage %	from 0–100 % load mV				
PE 4801*	0–30	0–0.3	1	0.1	30	0.1	4	V	250 × 170 × 170
PE 4802*	0–15	0–6	3	0.1	30	0.005	1	I and V	482 × 265 × 230
PE 4803*	0–15	0–4	3	0.1	20	0.005	1	I and V	482 × 266 × 220
PE 4804*	0.5–35	0–2	7	0.15	40	0.02	1.5	I or V	482 × 266 × 305
	0.5–35	0–2	7	0.15	40	0.02	1.5	I or V	
PE 4805*	0–35	0–1	5	0.1	20	0.02	1	I and V	482 × 88 × 310
PE 4806*	0–35	0–3	5	0.1	20	0.007	1	I and V	482 × 133 × 310
PE 4807*	0–35	0–10	5	0.1	20	0.002	1	I and V	482 × 222 × 370
PE 4808*	0–35	0–20	5	0.1	20	0.001	1	I and V	482 × 266 × 520
PE 4811*	0–75	0–1	1	0.03	40	0.04	1	I and V	482 × 133 × 310
PE 4818*	0.7–35	0–150 mA	1	0.3	45	0.3	1.5	V	68 × 120 × 190
PE 4820	150–330	0–150 mA	1	0.1	300	2	5	I or V	482 × 133 × 245
PE 4821	150–330	0–300 mA	1	0.1	300	1	5	I or V	482 × 133 × 310
PE 4822*	150–330	0–600 mA	1	0.1	300	0.5	5	I or V	482 × 177 × 370
PE 4826	0–330	0–150 mA	2	0.1	300	2	5	I or V	225 × 320 × 250
	0–85	0–1 mA	1	0.1		85 kΩ	1		
PE 4828	300	0–50 mA		0.05	150	3	1	I	169 × 245 × 245
	0–250	0–0.5 mA	1	0.05		500 kΩ	1	V	
PE 4830	0–500	0–150 mA	4	0.015	75	0.5	1	I and V	482 × 222 × 310
	0–85	1 mA	1	0.015		85 kΩ	0.5		
	150	5 mA		0.1		30 kΩ	0.5		
PE 4831	0–500	0–300 mA	4	0.015	75	0.25	1	I and V	482 × 222 × 370
	0–85	1 mA	1	0.015		85 kΩ	0.5		
	150	5 mA		0.1		30 kΩ	0.5		
PE 4832*	0–500	0–600 mA	4	0.015	75	0.125	1	I and V	482 × 266 × 370
	0–85	1 mA	1	0.015		85 kΩ	0.5		
	150	5 mA		0.1		30 kΩ	0.5		
PE 4839*	200–2000	0–10 mA		0.015		10 Ω/100 V	10	I and V	482 × 133 × 370

\* Provided with automatic overload and short circuit protection.

#### D.C. fixed output power supplies

type	d.c. output		variations of output voltage		internal resistance Ω	hum r.m.s. voltage mV	measuring instrument current I	dimensions b × h × d mm
	voltage V	current A	at ± 10 % mains voltage %	from 0–100 % load mV				
PE 4860*	5.9–6.5	0–6	0.02	6	0.001	1	I	220 × 130 × 340
PE 4861*	11.9–12.8	0–4	0.02	4	0.001	1	I	220 × 130 × 340
PE 4862	1/30	0–1	0.1	10	0.01	1		101 × 98 × 255
PE 4863	1/30	0–3	0.1	10	0.006	1		101 × 138 × 320
PE 4880	250	0–40 mA	0.05	120	3	1		81 × 115 × 283
PE 4881	150/250	0–40 mA	0.2	1.4 V	35	10		81 × 115 × 258
PE 4882	150/250	30–130 mA	0.1	1.2 V	12	5		101 × 140 × 322
PE 4883	150/300	0–200 mA	0.1	200	1	3		210 × 140 × 320
PE 4884	150/300	0–500 mA	0.1	200	0.4	3		210 × 140 × 320

\* Provided with automatic overload and short circuits protection.

## 44. A. C. VOLTAGE STABILIZERS

A.C. voltage stabilizers supply a highly constant voltage to electrical and electronic equipment or systems in laboratories and industrial installations. They meet all requirements with respect to variable input voltage, short response time, overload protection and high reliability.

type	power rating kVA	input voltage V	output voltage fluctuations %	power factor lag-lead	response time at 5% mains voltage variations ms	distortion %	technical details
PE 1033	0–0.25	187–242	$< \pm 1$	0.75 ... 1	40	$< 3.5$	magnetic, 220 V, 50 c/s, 330 mm × 188 mm × 200 mm output voltage adjustable from 220–240 V
PE 4222	0–1	187–242	$< \pm 0.1$	0.75 ... 0.95	$< 80$	$< 3$	electronic magnetic: 440 mm × 310 mm × 380 mm
7776	0–2	187–242	$< \pm 0.1$	0.75 ... 0.95	$< 80$	$< 3$	electronic magnetic: 445 mm × 300 mm × 605 mm
PE 4225	0–5	187–242	$< \pm 0.1$	0.75 ... 0.95	$< 80$	$< 3$	electronic magnetic: 366 mm × 366 mm × 1450 mm
PE 4210	0–10	187–242	$< \pm 0.1$	0.75 ... 0.95	$< 60$	$< 3$	electronic magnetic: 528 mm × 528 mm × 1715 mm All four types: output voltage adjustable $\pm 5\%$ of nominal value; mains connections single phase 110, 127, 220 V; 50–60 c/s; coupling units for three phase or parallel operation optional.
PE 4250	0–50	380 V threephase with neutral $< \pm 15\%$	$< \pm 1$	0.1 ... 0.1	8 V/s		servo-controlled; 390 mm × 670 mm × 1670 mm; 380 V; threephase with neutral; 50 or 60 c/s; output voltage adjustable $\pm 5\%$ of nominal value

### Coupling transformers and junction boxes

Coupling transformers are used to connect two a.c. stabilizers in parallel, thus doubling the power of one stabilizer.

The junction box enables star connection of three a.c. stabilizers, thus giving three times the power delivered by one stabilizer, while at the same time the effective value of the phase and coupled voltages are kept constant.

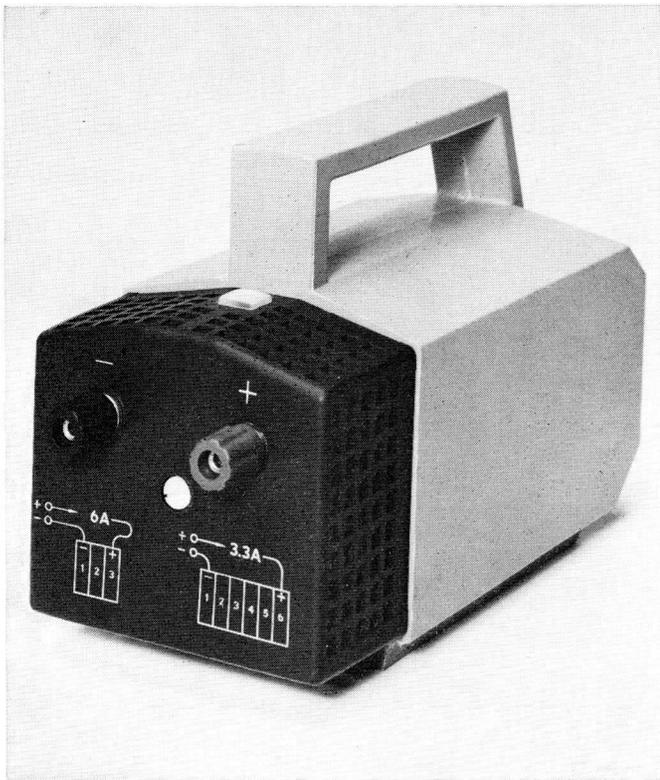
#### For parallel connection

type	220 V	output power	127, 110 V	output power	dimensions b × h × d mm
PE 4292/00	2 × PE 4210	20 kVA	2 × PE 4225	10 kVA	210 × 150 × 210
PE 4298/00	2 × 7776	4 kVA	2 × PE 4222	2 kVA	203 × 132 × 144
PE 4298/01			2 × 7776	4 kVA	203 × 132 × 144
PE 4299/00	2 × PE 4225	10 kVA			203 × 132 × 144

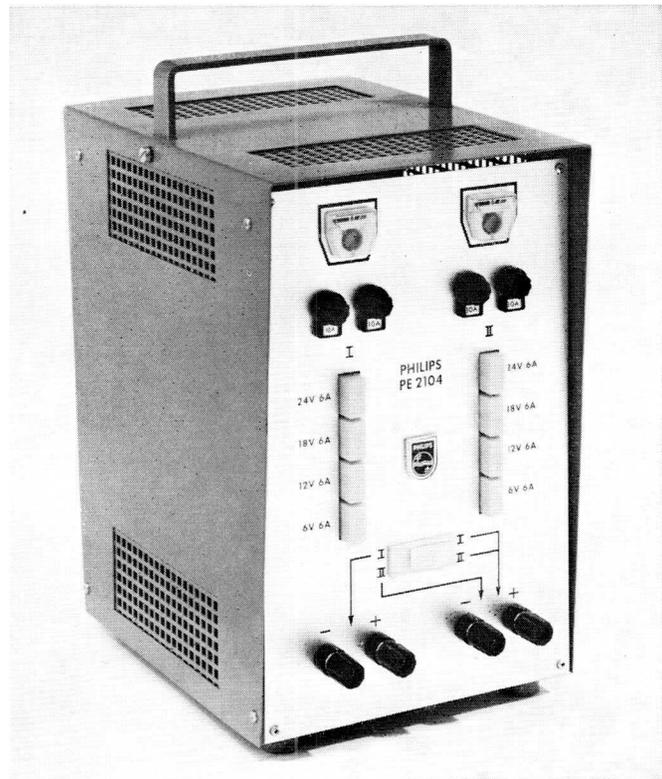
#### For star connection

type	output power	dimensions b × h × d mm
PE 4293/00	30 kVA	366 × 1400 × 366
PE 4295/00	3 kVA	195 × 485 × 285
PE 4296/00	6 kVA	445 × 605 × 300
PE 4297/00	15 kVA	366 × 1400 × 366

## 45. BATTERY CHARGERS



Battery charger, type 2102.



Battery charger, type 2104.

type	charging voltage and current	mains voltages V	mains frequency c/s	dimensions (mm) b × h × d
1347	6 V, 3 A 6 V, 1.5 A 2 × 6 V or 12 V, 2 A 2 × 6 V or 12 V, 1 A	110, 115, 125, 145, 155, 200, 210, 220, 230, 250	40 ... 60	165 × 260 × 120
2102	2 V, 7 A 6 V, 6 A (or 3 × 2 V) 12 V, 4 A (or 2 × 6 V) 18 V, 1 A (or 3 × 6 V)	110, 125, 220, 235	50 ... 60	106 × 146 × 230
1377	6, 12, 18, 24 V 6 and 12 A	111, 118, 127, 225, 240	40 ... 100	290 × 435 × 200
1389	6, 12, 18, 24 V charging current each circuit: 6 A; both circuits in parallel: 12 A	110, 125, 145, 155, 200, 210, 220, 240, 250	50 ... 100	280 × 500 × 200
2100	charging capacity: battery groups with a reserve voltage of 6–72 V, in series or parallel connection. charging current: between 3 and 15 A	this rectifier can be adapted to normal main voltages between 110 and 240 V	50	420 × 565 × 390
2104	6, 12, 18, 24 V charging current each circuit: 6 A; both circuits in parallel: 12 A	110, 125, 220, 235	50 ... 100	190 × 355 × 270

## 46. FILTRATION

### MAGNETIC FILTERS AND MAGNETIC AND MECHANICAL FILTERS FOR LUBRICATION OIL SYSTEMS

The main purpose of the magnetic filters and the magnetic and mechanical filters is the separation of minuscule ferrous particles, which become detached from sliding and bearing surfaces and are taken up by the lubricating fluid.

For removing ferrous and non-magnetic contamination as well, combinations of mesh strainers and magnetic assemblies are made. The design is such that the majority of the particles removed are trapped out of the line of the flow. Contamination of the filter therefore does not reduce the rate of the flow. Twin filters, fitted with separate change-over cocks or plate valves are available in order to allow cleaning during full operation.

If during periodical cleaning, a filter is found to have collected an abnormal amount of ferrous material, then this is clear proof that somewhere some part is subject to serious wear and abrasion. There is no means of signalling such wear other than filtration.

capacity l/h	single magnetic mechanical	twin magnetic mechanical	twin magnetic	bore in
450	E 7040			1
1 100	E 7042			1
550	E 7028/01	E 7088/01	7088/02	1
1 300	E 7029/01	E 7089/01	7089/02	1
2 500	E 7030/01	E 7090/01	7090/02	1
5 500	E 7031/01	E 7091/01	7091/02	1 1/2
10 000	E 7032/01	E 7092/01	7092/02	2
15 000	E 7033/01			2 1/2
20 000	E 7034/01	E 7093/01	7093/02	3
28 000	E 7035/01			3 1/2
36 000	E 7036/01	E 7094/01	7094/02	4
55 000	E 7037/01	E 7095/01		5
36 000	E 7713 C/01			4
72 000	E 7713 C/02			6
110 000	E 7713 C/03			7
145 000	E 7713 C/04			8
180 000	E 7713 C/05			9
220 000	E 7713 C/06			10
260 000	E 7713 C/07			11
290 000	E 7713 C/08			12
330 000	E 7713 C/09			12
360 000	E 7713 C/10			13
400 000	E 7713 C/11			14
435 000	E 7713 C/12			14

### Magnetic filters for pipeline installations

capacity l/h	type	bore in
600 and 1 200	KS 7715	5/8 and 3/4
2 500	E 7718	1 and 1 1/2
	E 7729	1 1/2 and 1 3/4
3 000	E 7725	1 1/2
7 000	E 7717	1 1/2 and 2
	E 7731	1 3/4
18 000	E 7722	2 1/2
	E 7730	2 1/2 and 3

### Filtricator type 7070

A small and adaptable magnetic mechanical filter for machine tools with a large part of the outer case in the form of a domed glass, enabling machine operator to see at once when the filter should be cleaned.

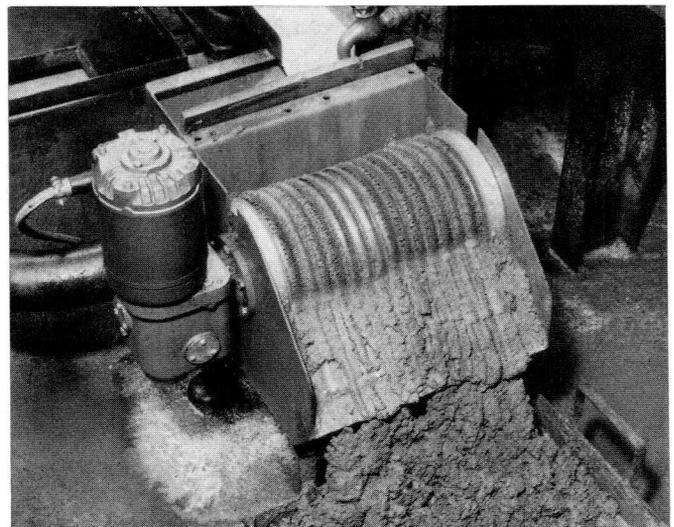
### Magnetic plugs for gearboxes

Magnetic assemblies usually mounted on a screwed plug to replace the drain plug of gearboxes for machine tools, marine and aircraft engines, tractors and road vehicles.

### COOLANT FILTRATION

For the separation of grinding swarf and particles of abrasives from coolants in which industrial processes as grinding and honing take place, an extensive range of equipment with varied principles of operation, magnetic as well as mechanical, is available.

equipment	capacity l/h	type
<b>"Magna-Drum" magnetic coolant clarifiers</b>	1 400	E 7760
for the separation of ferrous contamination by means of a drum of a ceramic-magnetic material	2 900	E 7761
	5 500	E 7762
	7 000	E 7763
	9 000	E 7764
	11 000	E 7765
	13 500	E 7766
	16 500	E 7767
	18 000	E 7768
	20 000	E 7769
	22 000	E 7770
	27 000	E 7772
	33 000	E 7775
<b>Universal coolant clarifiers</b>	900	E 7744/24
for the removal of magnetic and non-magnetic contamination by means of special filtering material carried on an endless wire mesh-conveyor	1 800	E 7744/25
	4 500	E 7744/22
	8 000	E 7744/23
	11 000	E 7744/30
	13 500	E 7744/27
	18 000	E 7744/28
	23 000	E 7744/29
<b>"Magna-Fabrix" magnetic and mechanical clarifier</b>	2 000	E 7725/25
a combination of the magnetic and universal clarifier and their advantages, for two-stages filtration	4 000	E 7755/22
	6 500	E 7755/23
	9 000	E 7755/30
	12 000	E 7755/27
	18 000	E 7755/28
	25 000	E 7755/29
<b>Pressurised coolant clarifier</b>	4 000	E 7778
the contaminated coolant is mechanically filtered under pressure	5 500	E 7779A
	8 000	E 7780A
	5 500	E 7781
	16 000	E 7782B



"Magna-Drum" magnetic coolant clarifier.

### Centrifugal separator

The swarf is rapidly extracted by centrifugal force and formed into hard cakes which are easy to remove. For straight and soluble oils. Capacity up to 4 000 l/h straight oil and 5 300 l/h soluble oil.

### Magnetic skimmer

The Magnetic skimmer, type KS 7721 is intended for removing ferrous sludge from the scum floating on top of coolants in settling tanks and other places where such contamination collects.

### Settling tank filters

Settling tank filters, types E 7719 and E 7720 are normally installed in the last of the settling tanks, or pump chamber in order to remove those ferrous particles which are not trapped by the settling tanks.

### MAGNETIC TRAMP IRON TRAP

For extracting tramp iron and other ferrous contamination from powdered material in pneumatic pipelines.

### FUNNEL FILTERS

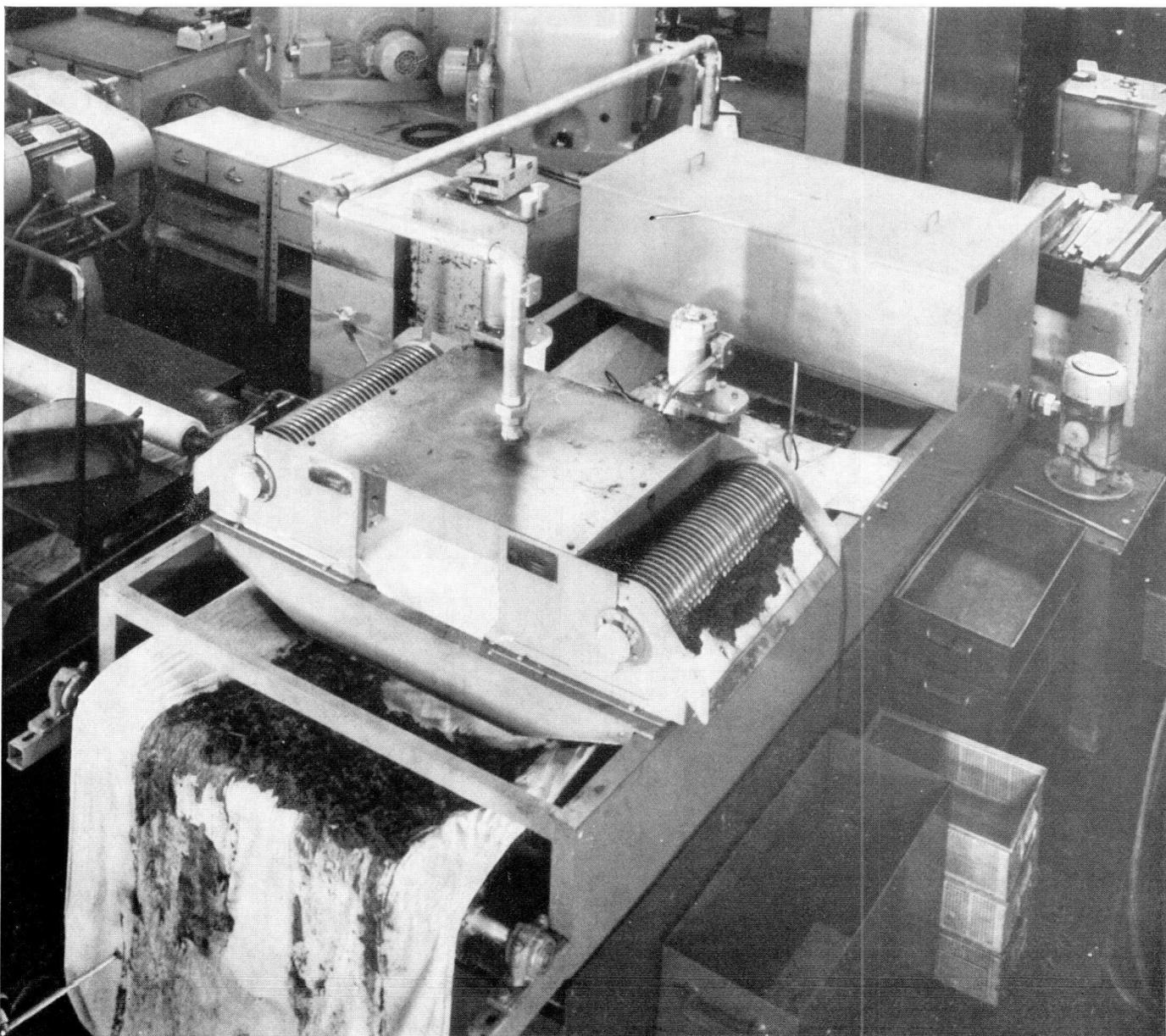
The Funnel filters, types KS 7711/00R, KS 7711/03R and KS 7711/04R are particularly used in the paint and pottery industry for the magnetical extraction of ferrous particles from slip and paint ingredients.

### MAGNETIC DRY SEPARATORS

Magnetic dry separators, types KS 7780 and KS 7781 are used for picking iron parts or particles out of dry materials by means of a rotating drum on which the materials are spread out by a vibrating chute.

### ELECTROSTATIC LIQUID FILTER

The Electrostatic liquid filter, type PE 7102, serves to clean non conductive liquid from all kinds of decontaminations both solid parts and waterspores. Dielectric strength increases to 50 kV/mm and higher. The filter is charged by a generator up to 25 kV. Capacity: 360 l/h for oil with viscosity 4° Engler.



*"Magna-Fabrix" magnetic and mechanical clarifier.*

## 47. ELECTRIC WELDING



This huge truck is built by Messrs. Benne Marrel, of Saint-Etienne, France. For the welding work Philips low-hydrogen electrodes and rutile electrodes were used.

In the field of electric welding we have available arc welding transformers, automatic and semi-automatic welding machines using protection of  $\text{CO}_2$  gas, various types of electrodes, installations for pipe welding and stud welding and electronic control equipment for resistance welding machines.

### ARC WELDING TRANSFORMERS

type	PZ 2018/00	PZ 2019/00	PZ 2020/00
welding current:	a.c. 50—300 A	50—400 A, divided over 2 regulating ranges: 50—235 A in the low range, 170—400 A in the high range	60—550 A, divided over 2 regulating ranges: 60—315 A in the low range, 200—550 A in the high range
welding capacity:	heavy-coated electrodes from 2—6 mm diam. (14—4 s.w.g.)	heavy-coated electrodes from 2—6 mm diam. (14—4 s.w.g.)	heavy-coated electrodes from 2.5—8 mm diam. (12—0 s.w.g.)
no-load voltage:	71—76 V	the no-load voltage depends on the welding- current setting and is: 76—82 V in the low range, 78—80 V in the high range	the no-load voltage depends on the welding- current setting and is: 76—82 V in the low range, 76—80 V in the high range
current setting:	the current scale has been calibrated to formula $E = 20 + I/25$  In this formula E is the arc voltage and I the current setting of the apparatus	the current scale has been calibrated to formula $E = 20 + I/25$	the current scale has been calibrated to formula $E = 20 + I/25$
power consumption:	24 kVA at full load	30 kVA at full load	45 kVA at full load
power factor:	$\cos \varphi = 0.5$ at full load	$\cos \varphi = 0.7$ at full load	$\cos \varphi = 0.7$ at full load; therefore it need not to be improved
mains connection:	by means of a normal three-core cable between two of the phases of a three phase mains of 220, 380, 440 or 500 V; 50 c/s. The third core serves to earth the apparatus	by means of a normal three-core cable between two of the phases of a three phase mains of 220, 380, 440 or 500 V; 50 c/s. The third core serves to earth the apparatus	by means of a normal three-core cable between two of the phases of a three phase mains of 220, 380, 440 or 500 V; 50 c/s. The third core serves to earth the apparatus
improvement of power factor:	the power factor can be improved from 0.5—0.7 at full load by connecting 6 Philips capacitors (C125 JB/A25M) of $6 \times 1.13$ kVA in parallel to the primary winding		
cooling:	air cooled	fan-cooled	fan-cooled
dimensions $l \times b \times h$ (cm)	$96 \times 46 \times 70$	$96 \times 46 \times 87$	$96 \times 46 \times 87$
weight (kg)	130	140	155

## WELDING UNDER PROTECTION OF CO<sub>2</sub> GAS

Automatic and semi-automatic welding under the protection of CO<sub>2</sub> gas can undoubtedly be considered as one of the principal developments in welding engineering. In but a few years the process has undergone an almost explosive revolution, and is now employed in many branches of industry.

Two factors responsible for the rapid absorption of this welding process by industry may be indicated; in the first place the high welding-speed that can be attained with the process, which applies both to the deposition rate and to the actual rate of travel and secondly the universal application possibilities of the process and the equipment. Philips, as one of the first to launch this process, have closely followed its applications and further development and have used this experience when designing the equipment.

Some characteristic properties of CO<sub>2</sub> welding are:

- high energy efficiency,
- high deposition rate,
- deep penetration,
- high duty cycle,
- good reproducibility,
- absence of slag,
- visible arc,
- good mechanical properties of the weld,
- excellent X-ray quality of the weld.

### Automatic CO<sub>2</sub> welding machine, type PZ 5000/94A

This type of automatic welding machine was in principle designed for welding large numbers of identical workpieces.

In most cases, therefore, the automatic machine will as such be incorporated in a fully automatic welding plant.

The complete automatic welding machine consists of the following components:

- the pneumatically controlled wire-feeding mechanism,
- the welding head,
- the control box,
- the gas valve,
- the shunt,
- the wire-reel suspension,
- standard accessories.

### Automatic CO<sub>2</sub> welding machine, type PZ 5001/00

The machine rests on a mounting plate and, hence, is suitable for stationary mounting and also for mounting on a column with swivelling arm or on a carriage. The first two methods can be employed for automatic welding of parts which are rotated under or moved along the welding head.

For the third model of mounting use can be made of carriage type PZ 9000/00. This version is eminently suitable for welding butt joints and fillet welds, in which case the carriage with the automatic welding machine moves on a rail along the groove.

### Automatic CO<sub>2</sub> welding machine, type PZ 5050/00

The PZ 5050 automatic CO<sub>2</sub> welding machine is intended for welding of chassis beams. The machine is mounted on a carriage which runs on a track alongside the workpiece. The welding head can be moved in horizontal as well as in vertical direction, following the workpiece by means of guide wheels.

### Semi-automatic CO<sub>2</sub> welding machine, type PZ 5505/00

For quick and easy performance of the most varied kinds of welding-jobs. The compact size makes this machine handy and pleasant to work with.

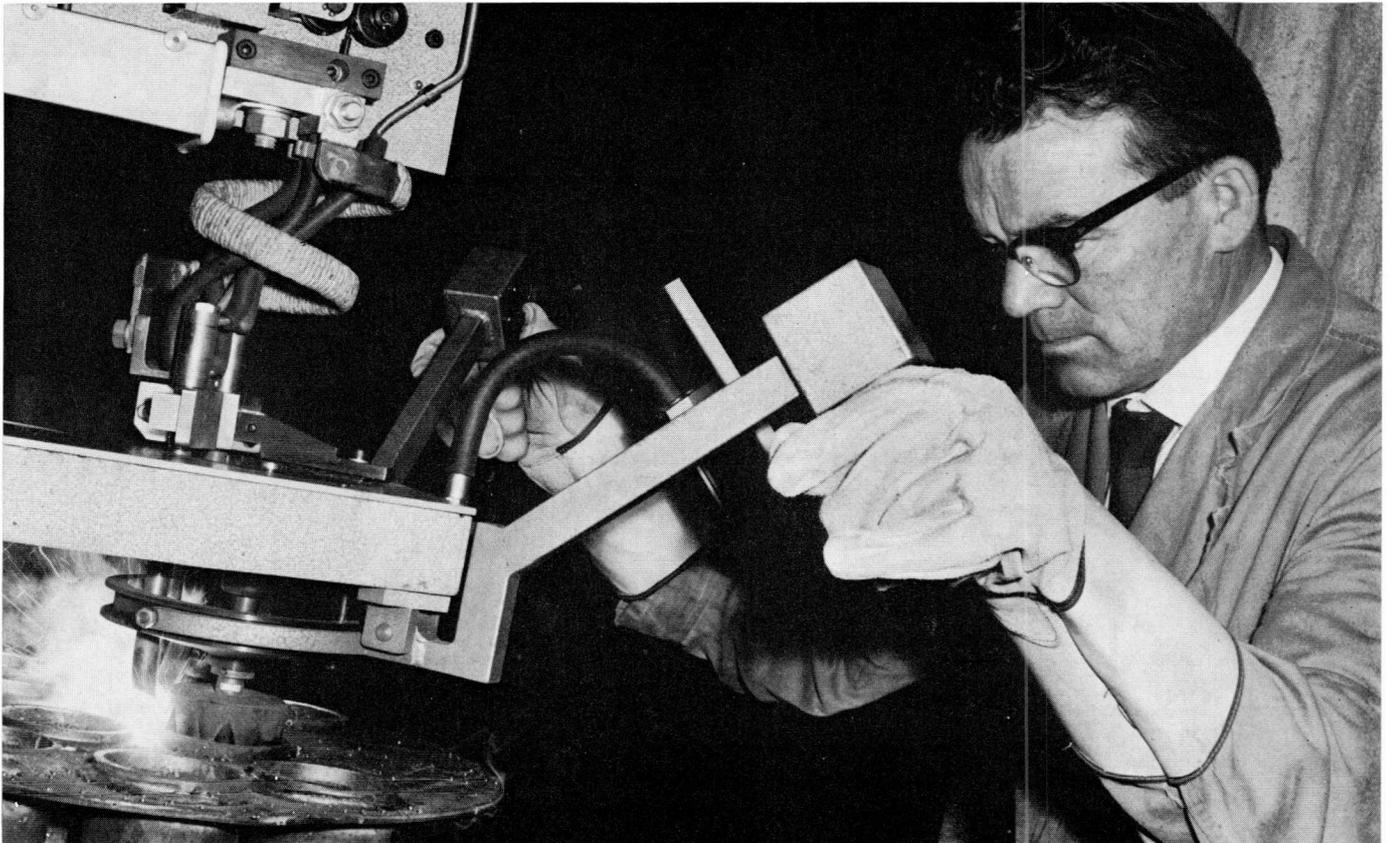
The PZ 5505/00 is built on a carriage-type chassis, which has a handle and two aluminium rollers. The chassis is also fitted with a lifting-lug. The wire-reel suspension can carry wire reels of 20 kg (44 lb) weight. The drive unit contains all the components, both electrical and mechanical, necessary for supplying wire and gas to the welding-gun and for controlling their supply.

Several types of gun, either air- or water-cooled, can be employed. Cables of 3.5 m (12 ft) are supplied with the guns.

### Enclosed-welding machine, type PZ 5015/00

This equipment is the solution for welding vertical grooves at a higher rate and at lower cost. It has been designed for welding square ending plates, the thickness of which may vary from 14 to 45 mm.

The features of CO<sub>2</sub> enclosed welding are: inexpensive groove-preparation; proportionally little deposit required due to the small gap of 14 mm between the plates; high deposition rate: 0.30—0.50 g/Amin; 100 % duty cycle, resulting in a high linear welding speed without deformation of the assembly; single-run welding.



Automatic pipe-welding machine, type PZ 5031.

## Automatic pipe-welding machine, type PZ 5031

The PZ 5031 is a special-purpose machine and is accordingly intended for one field of application, viz. the production of circular fillet welds for joining vertical pipes into horizontal plates. This application is frequently encountered in the manufacture of boilers for central heating, of heaters and cooling machines, for example. The minimum and maximum diameters of the pipes that can be welded with this machine are 15 and 92 mm respectively. In industry this automatic welding machine showed that it can easily replace 4 to 5 highly skilled welders and that its joints are as good as — or even better than — those produced manually.

## CO<sub>2</sub> welding wire

The welding wires are available solid and composited.

## STUD WELDING

Stud welding is an arc-welding process in which coalescence is produced by heating with an electric arc drawn between the metal stud and the workpiece. The equipment is simple and handy and consists of a stud welding gun, a switch box and cartridges. The features of this method are: low initial outlay on equipment; normal studs, anchor bolts, split pins can be welded without preparatory work; excellent welds are obtained, even by unskilled welders; quick and easy installation of the equipment; quick welding action; the equipment can be connected to any source of alternating or direct welding-current. This method is very attractive when many bolts or studs have to be welded as in the case of bridge-building and other constructional work, where for the steel/concrete joints thousands of anchor bolts are used. Welded studs are also employed for the connection between wood and steel, for fixing insulating materials to steel tanks or steel plates and for securing corrugated plates to steel tubes or girders.

## Stud welding gun

Type PZ 3003/00, with holders for studs having British linear dimensions (3/16, 1/4, 5/16, 3/8, 1/2 and 5/8 in), or type PZ 3003/10 with holders for studs having metric dimensions (5, 6, 8, 10, 12, 14 and 16 mm).

## Switchbox, type PZ 3015/00

Must be incorporated in the secondary circuit.

Max. current intensity: 900 A

Weight: approx. 40 kg (approx. 80 lb)

Dimensions: width 485 mm (approx. 19 in)

height 365 mm (approx. 14½ in)

depth 480 mm (approx. 19 in)

With this equipment studs of up to 16 mm (5/8 in) diameter can be welded.

## Stud welding cartridges

Cartridges are available for studs with a diameter of 3/16, 1/4, 5/16, 3/18, 1/2, 5/8 in, 5, 6, 8, 10, 12, 14, 16, 18 mm.

## ELECTRODES FOR THE WELDING OF JOINTS

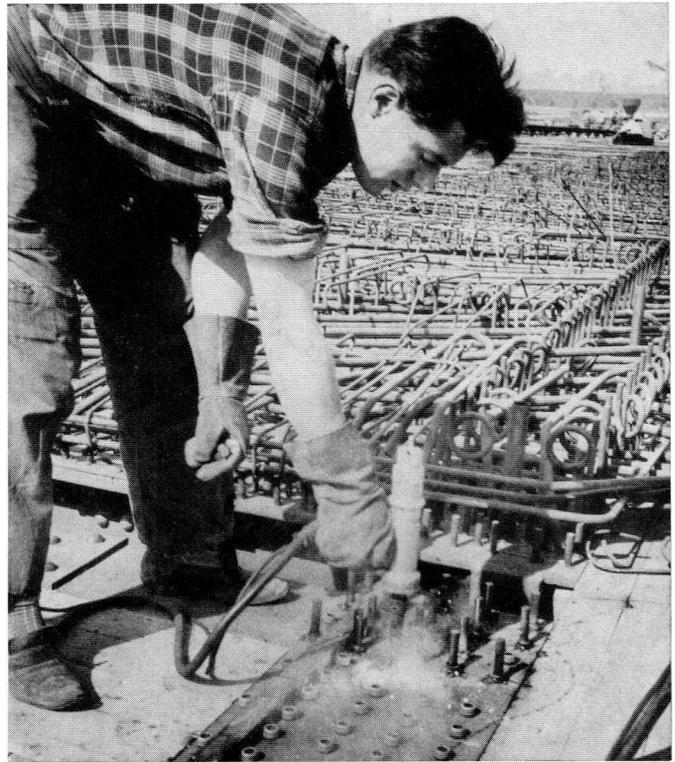
### Acid electrodes (ferricoated)

Most suitable for flat-position welding and for standing-fillet welds in one or more layers. Suitable for welding with a.c. and d.c. The acid coated electrodes are susceptible to sulphur in the workpiece material.

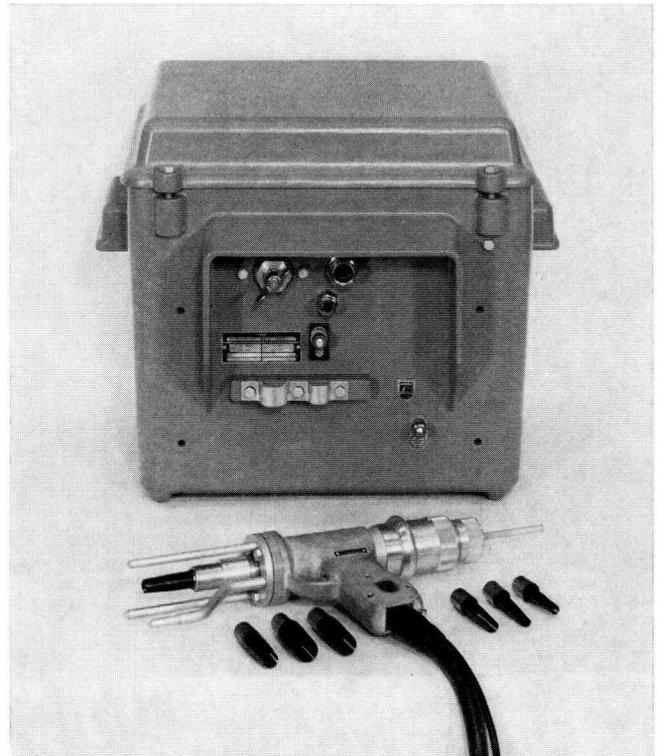
### Rutile electrodes

#### Quick setting

This is the so-called organic-coated electrode. Typical properties of these electrodes are that with the same welding current welding can be done in all positions and the suitability for welding of rusty and painted plate.



Philips stud welding process employed for welding studs and curled anchor bolts onto the steel girders of a bridge.



Switchbox type PZ 3015/00 and the studwelding gun type PZ 3003/00 with studholders.

#### Moderately quick-setting

This type fulfils the task of a universal electrode, suitable for welding in all positions, usually with the exception of downward in the vertical position. It is very suitable for welding of thin plate, especially where pipe constructions are concerned.

#### Slow setting

The easily controlled slag and calm weld pool have given this electrode a very large part of the market. Many undertakings are working almost exclusively with this type and the low-hydrogen electrodes.

## Low-hydrogen electrodes

The deposited metal has a high resistance to hot and cold cracking; accordingly these electrodes are particularly suitable for the welding of heavy workpieces and of very rigid mild steel constructions. They are also recommended for welding low-alloy steel and steel of which the carbon and sulphur contents are higher than those of easily weldable mild-steel.

## Contact electrodes

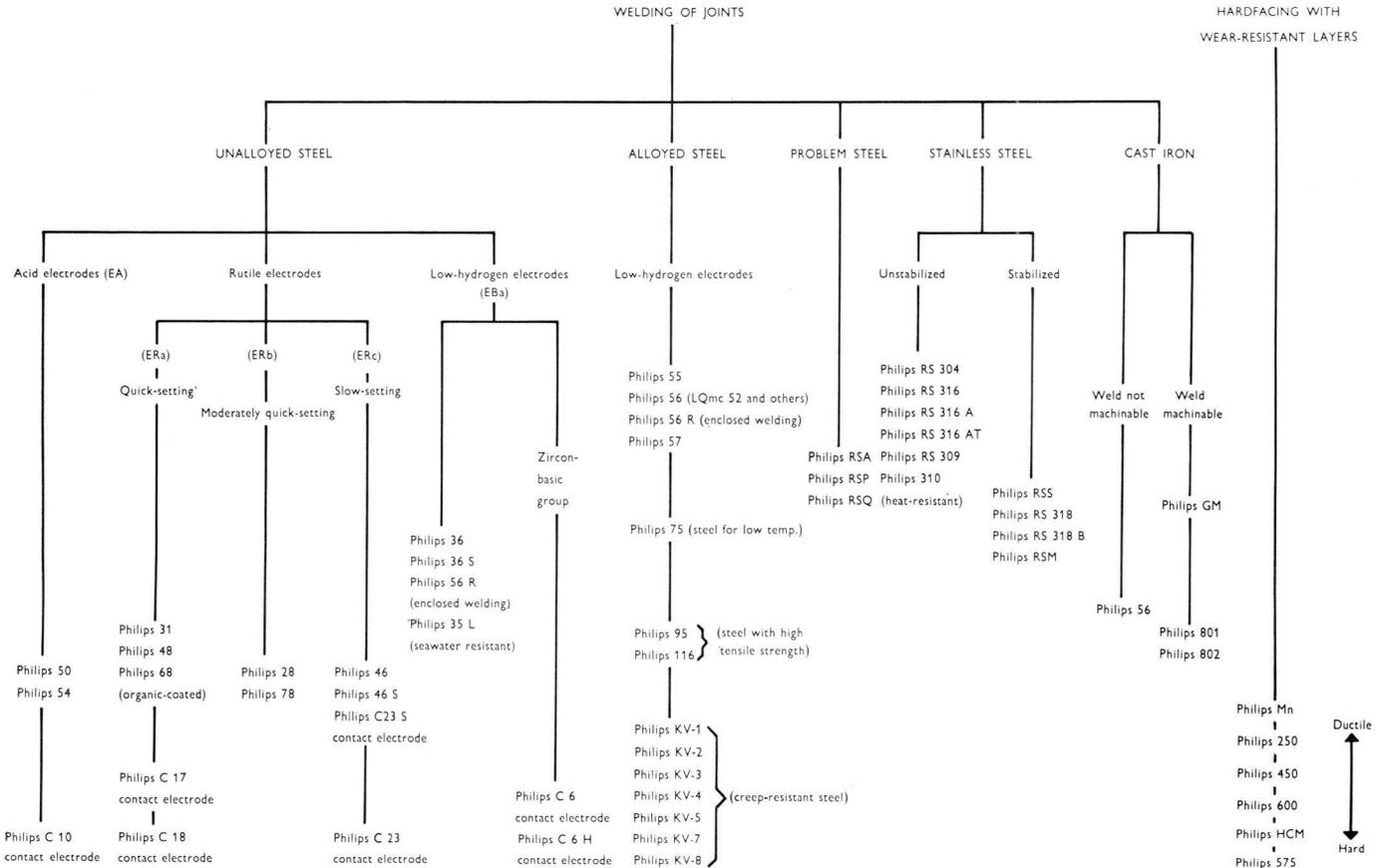
The main advantages of the contact electrode are the large deposition rate and the gain in time that can be achieved.

## Electrodes with same composition as the workpiece material

Special electrodes with the same composition as the workpiece material are available for the welding of joints in alloy steel, stainless steel, problem steel and cast iron.

## ELECTRODES FOR HARD FACING

Here the field of application and the composition of the workpiece metal determine the type of electrode that should be employed. The use of the wear-resistant layer plays the most important part; differences in composition are offset by the use of intermediate layers.



Field of application of Philips welding electrodes.

## 'TEMPOMAT' ELECTRONIC CONTROL EQUIPMENT FOR RESISTANCE WELDING MACHINES

"Tempomat" is the name of our system for fully automatic control of resistance welding machines. "Tempomat" welding controllers are designed to govern a complete welding cycle in accordance with a preset programme, thus involving: the closing and opening of the electrodes; the switching and timing of the welding current, as appropriate to the particular welding cycle; the repetition of the cycle. "Tempomat" comprises in general:

1. the control unit for setting the welding cycle
2. the firing and heating control unit with the thyristors for switching the ignitrons, this unit also serves for the mechanical and electrical connection between control unit and ignitron contactor unit.
3. the ignitron contactor unit with two ignitrons for switching the primary current of the welding transformer.

The range of "Tempomat" welding controllers available for switching capacities of up to 1200 kVA permits of: single and multi spot welding; press welding; seam welding; pulsation welding. If required, the welding equipment may be extended to allow control of more complicated welding processes.



"Tempomat" with ignitron contactor unit PE 5108, with firing and timing control unit PE 5171 for repeat and non-repeat spot welding.

## 48. LIGHT AND LIGHTING



Application of "Argenta" lamps in a hotel's lobby.

### INCANDESCENT LAMPS

#### "Argenta" lamps

"Argenta" lamps excel because of several special light characteristics, among which we may mention: pleasant, warm light, soft shadow effect, perfect diffusion of light and complete absence of glare. They are, therefore, particularly suitable for home, office and shop lighting.

W	V	filling	filament	diam.	max. length with base	
					E 27	B 22
40	110	gas-filled	coiled coil	60	109	107.5
60	115			60	109	107.5
75	120			60	109	107.5
100	125/130			60	109	107.5
150	240			80	148.5	144
200	250		80	178	173.5 <sup>1)</sup>	

<sup>1)</sup> on special request only.

#### "Argenta" super lux lamps

With these lamps, the favourable combination of a partially "Argenta" and partially satin-frosted bulb has resulted in a higher luminous intensity (up to 30 %) in the direction of the working plane, while the other favourable characteristics of the "Argenta" lamps, such as soft shadows and a perfect diffusion of light in the other directions, are retained. This construction makes the Super Lux lamp specially suitable for all applications where higher local illumination levels are required.

W	V	filling	filament	diam.	max. length with base	
					E 27	B 22
40	110	gas-filled	coiled coil	50	91.5	90
	115				91.5	90
	120				104.5	103
	125/130				104.5	103
	220/230				104.5	103
150	240			75	128.5	124
	250					

## Inside frosted and clear lamps

The clear version which was originally in general use, has, in the course of time, been almost entirely superseded by the inside-frosted type, which owing to its freedom from glare is suitable for a wide variety of purposes. Nevertheless, the clear lamp is still fairly widely applied in the field of indirect lighting, in closed fittings and in those cases where brilliance and sparkle are more important than the avoidance of glare.

finish	W	V	filling	filament	diam.	max. length with base		
						E 27	B 22	E 40
inside frosted or clear	15	25	vacuum	single coil	60	109	107.5	—
					60	109	107.5	—
	25	40	gas-filled	coiled coil	60	109	107.5	—
					60	109	107.5	—
	60	110			60	109	107.5	—
					60	109	107.5	—
					60	109	107.5	—
					60	109	107.5	—
					80	148.5	144	—
					80	178	173.5 <sup>1)</sup>	—
	150	125/130			80	148.5	144	—
					80	178	173.5 <sup>1)</sup>	—
200	220/230			80	178	173.5 <sup>1)</sup>	—	
				90	183	—	188	
clear	300	250	gas-filled	single coil	90	183	—	188
					110	248 <sup>2)</sup>	—	239
					150	—	—	308
					170	—	—	343
					200	—	—	358

<sup>1)</sup> on special request only.

<sup>2)</sup> non-standard.

## Bowl reflector lamps

Fundamentally these are normal, inside-frosted incandescent lamps, the bulb being provided with a silvered bowl, the glaring filament thus being completely shielded from view. This characteristic makes the lamp extremely popular for efficient indirect lighting in homes, shops, offices, etc.

W	V	filling	filament	diam.	max. length with base	
					E 27	B 22
60	110/115	gas-filled	coiled coil	60	109	107.5
				70	128.5	124
100	125/130 220/230 240/250			60	109	107.5
				70	128.5	124
150	220/230		single coil	80	148.5	—
				90	178	—

## Lustre and candle lamps

Intended for use in all kinds of ornamental fittings, to create a cosy atmosphere in the home.

## K Lamps

Owing to their special bulb shape of smaller dimensions, these lamps can be used in places and fittings where the available room would not allow the application of an ordinary lamp. Supplied with "Argenta" finish.

W	V	filling	filament	diam.	max. length with base	
					E 27	B 22
25	110	gas-filled	coiled coil	50	91.5	90
40	115			50	91.5	90
60	120			50	91.5	90
75	125/130			60	104.5	103
100	220/230			60	104.5	103
150	240			75	128.5	124
200	250			80	151.5	147 <sup>1)</sup>

<sup>1)</sup> on special request only.

## "Anti-insect" lamps

A lamp whose yellow light has less attraction for most insects than light of other colours. These lamps are thus the ideal light sources for garden parties, camps, road stands, service stations, etc. Available in 60 and 100 W.

## Reinforced-construction lamps

The particularly strong filament of these lamps, for which a special filament wire is used, makes them extremely suitable for use in places where shocks, bumps and vibrations frequently occur. They are available with an inside-frosted finish.

W	V	diam.	max. length with base	
			E 27	B 22
25	110	60	109	107.5
			109	107.5
			109	107.5
			120.5	116
			128.5	124
			178	173.5 <sup>1)</sup>
			178	173.5 <sup>1)</sup>
			178	173.5 <sup>1)</sup>
			178	173.5 <sup>1)</sup>
			178	173.5 <sup>1)</sup>

<sup>1)</sup> on special request only.

## Low-voltage lamps

In places where power must be supplied by accumulators or other private house-lighting plants, such as in rural areas or in isolated districts, special low-voltage lamps are required. We manufacture these lamps in a range from 6–42 V, with an inside-frosted finish.

W	V	diam.	max. length with base	
			E 27	B 22
15	6, 12, 24, 32	60	109	107.5
25	6, 12, 24, 32, 42	60	109	107.5
40	12, 24, 32, 42	60	109	107.5
60	12, 24, 32, 42	60	109	107.5
100	24, 32, 42	70	128.5	124

## Daylight-blue lamps

The natural-coloured glass bulb filters the excess of red light, peculiar to conventional incandescent lamps. The light colour of these lamps thus approaches that of daylight, as a result of which they are extremely helpful for colour discrimination. Available in 60, 100 and 200 W.

## Oven lamps

These lamps are primarily designed for use in places where the ambient temperature is high, such as in ovens, rotisseries, etc. Manufactured with special heat-resistant solder and lamp-base cement, they ensure satisfactory operation in lampholders at temperatures up to 280 °C. Available in 10, 40 and 60 W.

## Tubular lamps

Tubular lamps find wide application in homes and industry, e.g. in refrigerators, vacuum cleaners, sewing machines and other domestic apparatus, for piano and cupboard lighting, for signalling purposes in switch boards, telephone exchanges, etc.

catalogue number	W	V	finish	diam.	max. length with base				
					E 12	E 14	B 15	E 27	B 22
7248	6	110/115 120 125/130	clear	18	47	48	47	—	—
					47	48	47	—	—
7248	10	220/230 240/250		18	47	48	47	—	—
7697	15		inside	18	—	61	60	—	—
7692	15	110/115	frosted	25	—	81.5	80	—	76
7693	25	125/130		25	—	81.5	80	—	76
7696	25	220/230		20.5	—	117.5	—	—	—
7691	25	240/250		28	—	105.5	104	102.5	101
7690	40			28	—	105.5	104	102.5	101
7647 <sup>1)</sup>	25	110/115 125/130		25	—	86.5	80	—	76
7648 <sup>1)</sup>	25	220/230		22	—	63.5	57	—	—

<sup>1)</sup> Reinforced construction.

## Pilot lamps

These lamps are extensively used in places where space is restricted and little light is wanted; they find application in signs, running light advertisements, illuminated scoreboards, switchboards, refrigerators, cupboards, etc. Available in 5, 15 and 25 W.

## Show window lamps

Their slender shape, small diameter and high luminous intensity make these lamps very well suited for the illumination of show-windows, showcases, aquaria, pictures and mirrors. The filament, extending over the entire length of the lamp, gives a uniform, long strip of light. Available in 25, 40 and 60 W with clear, half mirrored or white finish.

## Three-light lamps

Three-light lamps contain two filaments, making it possible to obtain three different illumination levels. In fact, each filament is of a different wattage and can be lighted individually or in combination with the other, thus giving these lamps numerous application possibilities.

finish	W	V	base	diam.	overall length
"Argenta"	40/60/100	110/115 125/130	3cE26	70	124
	60/100/160	220/230 240/250		80	142

## "Colorenta" lamps

The graceful design of these lamps combined with their white, enamelled finish result in a charming candle-light effect, making these lamps outstandingly decorative elements in contemporary interiors. Available in 25, 40 and 60 W.

## "Philinea" lamps

A combination of slimness of line, white finish and concealed bases has made these lamps appealing to the eye. Moreover, filaments of adapted wattage ensure incandescent light of a strength sufficient for various types of utility lighting systems. An additional feature is that the lamp bases are not mounted at the lamp ends, so that "Philinea" lamps can be arranged to form continuous strips of light. All these features ensure that the lamps find wide application in banks, theatres hotels, shops and homes.

As "Philinea" lamps require special lampholders, Philips have holders in an ivory-coloured finish available for the lamps with S14s bases. In addition, mounting channels for the 300 and 500 mm lamps can be supplied.

catalogue number	W	V	finish	base	diam.	overall length
6275 X	35	110	inside	S14s	30	300
6276 X	60	115	white		30	500
6277 X	120	120 125/130 220/230			30	1000
6275 Z	35	235 240		S14d	30	300
6276 Z	60	250			30	500

## "Comptalux" lamps

"Comptalux" lamps are provided with a high-quality internal mirror which cannot be affected by external conditions such as dirt and dust. The lamps produce a wide beam of light and can be supplied in two versions: the pressed-glass and the blown-bulb version. Lamps of the former group, the so-called "Comptalux"-Flood lamps, have the widest field of application as they are made from pressed hard glass, which makes them ideal for outdoor use, e.g. for floodlighting, without further protection. Another feature of the pressed-glass version is that the lamps have a higher light intensity and a longer life than blown-bulb reflector lamps (2000 hours versus 1000 hours). The

blown-bulb "Comptalux" lamps are suitable for indoor lighting only, in places where the requirements imposed on the illumination level are not so stringent.

catalogue number	V	W	base	diam.	max. length
"Comptalux"					
13927	E/44	75	E 27	95	130
	B/44		B 22	95	125.5
13412	E/44	110, 115, 120, 125, 130 220/230, 240, 250	E 27	95	130
	B/44		B 22	95	125.5
13211	E/44	150	E 27	125	165
	B/44		B 22	125	160.5
13320	E/44	300	E 27	125	165
"Comptalux"-Flood					
13985	E/99	110, 115, 120, 125/130, 220/230, 240, 250	E 27	122	133
13012	E/99		150	E 27	122

## "Comptalux" flood color lamps

Pressed-glass reflector lamps are supplied with red, green, yellow or blue front as well, thus enabling a variety of coloured lighting effects to be easily obtained. The colours are heat and weather resistant and are therefore suitable for both indoor and outdoor use. Philips "Comptalux"-Flood Color lamps are ideal for all kinds of illumination purposes.

catalogue number	colour	V	W	base	diam.	max. length
		110	100	E 27	122	133
13985 E/476	red	115				
13985 E/470	blue	120				
13985 E/472	yellow	125/130				
13985 E/473	green	220/230 240 250				

## "Attralux" lamps

Apart from the narrow beam of light "Attralux" lamps produce, they have, for the rest, the same excellent qualities and are supplied in the same versions as "Comptalux" lamps, the pressed-glass version being sold under the trade name "Attralux"-Spot. "Attralux" lamps are applied for the illumination of smaller surfaces or for objects placed at greater distances. The 150 W type is also available for 24 V. This lamp has a still narrower beam and a candela value three times as great as that of the corresponding 220/230 V type, and is particularly suitable for all applications where, for reasons of safety, low voltage is preferred. The 24 V "Spot" version can furthermore be considered as a reinforced construction type, in view of its reinforced filament. When "Attralux" 24 V lamps are applied, an additional step-down transformer is required.

catalogue number	V	W	base	diam.	max. length	
"Attralux"						
13926	E/44	110, 115, 120, 125/130, 220/230, 240, 250	75	E 27	95	130
	B/44		B 22	95	125.5	
13411	E/44		100	E 27	95	130
	B/44		B 22	95	125.5	
13378	E/44	150		E 27	125	165
	B/44		B 22	125	160.5	
13321	E/44	300		E 27	125	165
	E/44		E 27	125	165	
13378	B/44	24	150	B 22	125	160.5
"Attralux"-Spot						
13987	E/99	110, 115, 120, 125, 130, 220/230, 240, 250	100	E 27	122	133
13011	E/99		150	E 27	122	133
13011	E/99		24	150	E 27	122

## Newsreel lamps

Newsreel lamps have been designed to display advertising texts, announcements, company names and other messages in bright and easy-to-read letters. The tracing effect, resulting from the lamps lighting up one after the other, is striking and has a high visual impact. The lighting system is composed of electronic light relays, consisting of a cadmium-sulphide cell and an incandescent lamp. Available in 2.5 W, 40 V and 0.05 A, 24 V.

## Telephone lamps

These lamps find wide application in telephone exchanges where they act as indicators to enable visual control of the number of lines in operation and the connections made. Moreover, the miniature lamp type with B7s cap is, owing to its compactness, ideal for mounting in push-buttons, apparatus for intercom facilities etc. — Telephone lamps can also be applied as resistors. When mounted in series with the circuit, they serve to keep a check on the proper functioning of the respective telephone lines.

type	V	mA	base	diam.	overall length
Bell	6—60	30—100	T 6.8	6	45
Bell Lilliput	6—60	20—50	T 5.7	4.8	31
Ericsson	6—60	20—75	T 5.8	5.3	43
Nawi	7—60	40—100	T 6.6	6	46
BSI	4—24	100—250	T 7	6.6	45
—	6—60	20—100	B 7s	6.6	23.7

## Miners' lamps

It is of vital importance that the miner can rely on the proper functioning of the lamps he must use when performing his task. For this reason the greatest care is bestowed on the production of these lamps. Available in 0.6—1.75 A and 2.4—4 V, with Krypton or Argon filling.

## Dial lamps

These lamps are used extensively throughout the radio industry for panel lighting and indication on radios, tape recorders, etc. Great care is given to precision mounting of the filament so as to avoid interference noise. They are also widely applied in elevators, signal panels, clocks, amplifiers, etc. Available in 0.1—0.25 A and 1.5—19 V.

## Flasher lamps

Flasher lamps have a built-in bi-metal strip which automatically closes and opens the current circuit, resulting in intermittent lighting and extinguishing of the lamp. An ideal self-contained flashing unit for a great variety of applications, e.g. as marker light in the event of a motorcar break-down, as warning light in case of road accidents or road repairs, as identification light on police belts, as flashing unit in festive illuminations, advertising media, etc. Available in 0.3—0.27 A and 1.25—14 V.

## Flashlight lamps, prefocus flashlight lamps, lens-end lamps

Flashlight lamps with round bulb are suitable for torches from which an even spread of light is required, or which have a focusing arrangement. By using prefocus lamps in conjunction with a parabolic reflector, a beam of high intensity may be obtained — Lens-end lamps are commonly used for pencil-type torches. They produce a concentrated spot of light. Available in 0.1—0.27 A and 1.2—6.15 V.

## Lenslite lamps

Lenslite lamps produce a sharply concentrated uniformly distributed beam of light of a high luminous intensity. This is achieved by means of the front of the bulb which consists of a lens focusing the light beam. The difference from the lens-end lamps described above lies in the fact that Lenslite lamps give a wider beam of light. Available in 0.2—0.3 A and 2.5—3.8 V.

## Bicycle lamps, lamps for bicycles with auxiliary motor

Philips can offer a wide range of bicycle and motorcycle lamps of high dependability, essential to ensure safety for the users of these vehicles during the hours of darkness. Available in 0.05—15 A and 4—10 V.

## Motorcar lamps

As the number of motorcars is constantly growing and speeds are increasing, efficient and reliable vehicle lighting is one of the major criteria in present-day road safety. Philips have always been in the van of progress as far as lamps and lighting, including lighting equipment for motor vehicles, are concerned and have available a full range of efficient and reliable motorcar lamps. We would draw attention to the latest developments in this field: the halogen lamp. The main ad-

vantages of motorcar lamps with halogen-filling are inter alia: smaller dimensions, a higher luminous intensity, no light depreciation during effective life as there is no bulb blackening. We can offer motorcar lamps for cars of continental, American and British make.

## Train lamps

To withstand the intense vibrations and shocks encountered on railway trains, lamps of a robust construction are required. For this special purpose we offer a range of lamps in 15—25 W.

## Lamps for optical signalling

Increasing speed and frequency in railway traffic require the perfecting of the signalling systems generally used hitherto. Optical signals are, therefore, gradually replacing manual or flag signs, which means a really important step forward in ensuring the safety of both passengers and railway material, as the human element is eliminated here as far as possible. Philips manufacture a range of high-precision lamps for this field of application as well. Available in 6, 30/30 and 15/15 W.

## Aircraft lamps

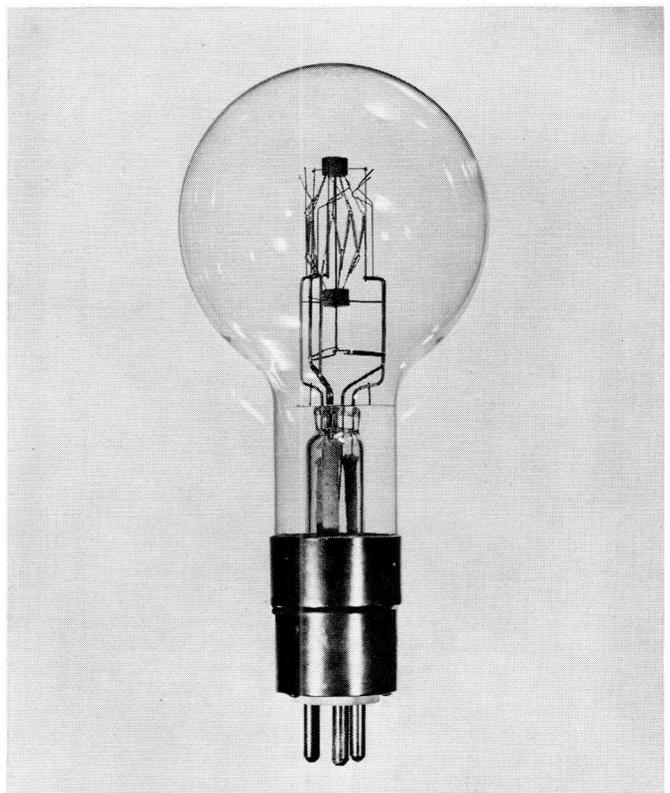
We have available an extensive range of lamps for general illumination of passenger cabins, galley and luggage compartments, as well as controlled-beam lamps for passengers' individual reading and for stewardess' and navigator's work-tables.

## Locomotive headlight lamps

For this purpose, we have developed a range of lamps which produce a strong beam of light and which effectively withstand the intense vibrations and shocks encountered on the railway trains. Available in 150—250 W and 24—32 V.

## Lighthouse and beacon lamps

Lighthouse and beacon lamps have to be high quality light sources as they must fulfil a task of major importance, i.e. to be a safe guide for the seafarer. As it is necessary that lighthouses and beacons be visible over long distances, Philips make a range of lamps for this application, which have a very high luminous efficiency and which excel in reliability. Available in 1500, 3000 and 4200 W. Other lamps for the same purpose are to be found in the table floodlighting lamps.



Lighthouse, beacon and aerodrome lamp.

## Aerodrome lamps

Good airfield lighting contributes highly to the safety of air traffic. With this thought in mind, a full range of lamps has been designed to fulfil the special requirements for the lighting of aerodromes; for instance, lamps for beacons to help pilots to identify individual airports, for approach lights to guide them safely to the runways during bad weather, for runway and taxiway lights for safe travel, for obstruction lights to mark possible obstacles etc. To keep pace with aircraft development, continuous research is being carried out in our laboratories, to make constant improvements in these lamps. Available in 30, 35, 45, 65, 100 and 200 W.

## Lamps for medical purposes

Lamps for medical, ophthalmological and dental applications have to fulfil special requirements. For this reason Philips bestow the utmost care on the manufacturing of these lamps so as to ensure optimum reliability. The lamps used in operating theatres are, for example, equipped with a double filament. The main filament is connected to the mains, the auxiliary filament to an accumulator battery. In the event of a breakdown in the electric mains during an operation, the auxiliary filament is switched on.

## Floodlighting lamps

These lamps are intended for floodlighting buildings, sports stadia, parks, statues, etc. They have concentrated, cylindrical filaments as a result of which a strong, accurately controlled beam of light is produced. They fit any of the commonly used projectors.

## Low voltage spot- and floodlighting lamps for theatres

For reasons of safety, low voltage is often applied on stages in theatres. We supply a range of lamps for this application, which have the additional advantage of highly concentrated filaments, so that light beams of a high luminous intensity can be obtained. Available for 12 and 24 V.

## Episcope lamps

Lamps for episcopes and for stage and studio lighting. They can be supplied with or without mirror. Available in 250—1000 W and 100—160 to 200—250 V.

## Projection lamps (horizontal)

Their sharp, concentrated beam makes these lamps eminently suitable for stage lighting. They are specially developed for burning in a horizontal position. Available in 100—300 W and 100—160 to 200—250 V.

## Linea lamps

Tubular shaped lamps, also intended for stage lighting, especially as footlights. Available in 500—1500 W and 100—160 to 200—250 V.

## Projection lamps (vertical)

These lamps have been developed for stage lighting as well, especially however, for burning in a vertical position. They are available without or with mirror. Available in 1000—3000 W and 32, 200—250 V.

## Tubular projection lamps

For use in dia-projectors and epidiascopes. The lamps of higher wattage are also suitable for projectors used in smaller cinemas and theatres. Available in 30 A, 500, 900 and 1000 W.

## Pin-base projector lamps

The tremendous advances in projector performance in recent years have caused a real revolution in projection-lamp design. To meet the wishes of projector designers to make still more compact projectors. We have developed a range of short lamps, which enable manufacturers to design projectors in accordance with contemporary conceptions. These lamps satisfy the highest standards of precision and craftsmanship. The keyed guide-pin and heavy duty contact pins of the base assure precise alignment and positioning of the filament, resulting in an excellent performance of the lamp. Available in 150, 300 and 500 W.

## Mirror condenser lamps

For narrow-gauge film projectors we can supply light sources with an internal ellipsoidal mirror, rendering a separate condenser lens, applied in conventional projection systems, superfluous. Though these lamps have only a low power consumption, they achieve a screen brilliance equal to that of most other conventional lamps of far higher wattages. In addition, the small size of these lamps enables the designer to meet in every respect the demands for modern projectors. Available in 50, 100 and 150 W.

## Projection lamps for photographers', film and television studios

Lamps which have to serve this purpose, are manufactured with highly concentrated filaments, in order to obtain maximum luminous intensity of the controlled beam. Great care is given to the exact centering of the filament with respect to the pins of lamps with bi-post base, so that the replacement can be made without any further adjustment. The lamps are suitable for both black-and-white and where a colour temperature of 3200 °K is required. Available in 500—20 000 W and 100—160 to 200—250 V.

## Lamps for narrow-gauge film and home cinema apparatus

As the lamp may be considered to be the heart of the optical system of a projector, the utmost care must be taken with the manufacture of lamps for picture projection. The range of lamps which Philips have designed for this purpose is second to none as regards, for instance, their luminous efficiency, small dimensions, concentrated filament with optimum luminous intensity and minimum manufacturing tolerances.

## Sound-film exciter, home-cinema and microprojection lamps

The quality of this category of lamps is determined by the filament Philips bestow, therefore, the utmost care on the manufacture of perfect filaments with small tolerances in their dimensions.

## Halogen projection lamps

The halogen lamp, one of the latest members of the family of incandescent lamps, has some great advantages over the usual incandescent lamps.

It may be assumed to be a well-known fact that, owing to the evaporation of the tungsten filament, the life of an incandescent lamp is limited, and that the luminous flux decreases steadily owing to blackening of the bulb wall. The temperature of the filament could be increased with the object of obtaining a higher luminous flux. This would mean, however, a faster evaporation of the coil, thus a further decrease in life and a more rapid blackening of the bulb. Moreover, this blackening is related to the dimensions of the bulb for, the smaller the bulb, the smaller the surface over which the blackening is then spread, so that a greater loss of light results.

With the addition of a small amount of halogen to the filling gas, it has been possible to restore part of the evaporated tungsten to the filament, by means of a chemical reaction, which effects a so-called "regenerative cycle". As a result of this, the following main advantages could be obtained: no blackening of the bulb, therefore no light depreciation during effective life; smaller bulbs; the possibility of increasing the temperature of the filament without decreasing the life. These developments enabled us to manufacture a range of lamps of small dimensions and a high luminous intensity, eminently suitable for floodlighting, for the lighting of film studios, for 8 mm cine photography, for narrow-gauge film projection, and for use in motorcar headlights.

## Lamps for general photographic and cine lighting

A substantial part of the progress in the art of photography has been contributed by the development of special lamps for this application.

### "Photolita"

These lamps are available in the inside-frosted finish and with internal reflector. Both kinds of lamp have an extremely high luminous intensity. Though the life of "Photolita" lamps seems to be short, a great many pictures can be made, as the exposure per picture requires a few seconds only.

### "Argaphoto"

"Argaphoto" lamps give a more diffused lighting and have a longer life than the "Photolita" series. They are available in two versions as

well; the inside-frosted type is to be used in a reflector, the other version has an internal mirror. The lamps are intended for infra-red photography, and for general photographic lighting for still and cine work.

*“Photocrescenta”*

Enlarger lamps with a white diffusing bulb. These light sources have a high luminous intensity and give an even distribution of the light, as is required for enlarging apparatus. Philips “Photocrescenta” lamps are, therefore a valuable asset to the professional as well as to the amateur photographer.

*Darkroom lamps*

In the processing of cine and photographic materials, the different characteristics of negative an positive materials impose special requirements which are fully taken into account with the range of darkroom lamps. Available in the colours yellow-green, yellow, green and red.

*“Photoflux” flashbulbs*

The modern camera-owner is making an ever-increasing use of flashbulbs. The “Photoflux” bulbs we can offer him, are ideal light sources for exposures of fast-moving subjects or for candid shots. They are indispensable for photographs indoors as well as outdoors when daylight is insufficient or absent, or, in case of bright weather, to decrease the sharp contrast between sun-lit areas and dark shadows. “Photoflux” bulbs make every camera-user independent of time, place and weather. With this never failing aid he can be sure of a successful snap every time.

**Infra-red heat lamps**

*Reflector infra-red heat lamps for rearing of animals*

Infra-red heat lamps make a considerable contribution to the healthy rearing of chicks, ducklings, goslings, turkeys, pigs, calves, foals, etc. The advantages of infra-red heating are: more rapid growth, decreased mortality, increased power of resistance and hygienic premises. Available in 150 and 250 W.

*Reflector infra-red heat lamps for industrial purposes*

Reflector infra-red heat lamps have proved to be for most industries the proper solution to their drying problems, as these lamps possess some very characteristic properties, making them extremely suitable for industrial drying processes. These lamps also make it possible to construct, at low initial cost, efficient ovens of simple construction, of light weight, easily transportable and of great adaptability to varying conditions.

Some outstanding features are: high power with small dimensions, high efficiency and long service life, any burning position permissible and easily interchangeable. Available in 250 and 375 W.

*Quartz infra-red heat lamps for industrial purposes*

The application of higher-power IRK lamps in heaters used in industrial processes is increasing rapidly because a higher infrared energy output is provided than is the case with the reflector bulb lamps. Moreover, quartz heaters are much more sturdy. The most outstanding feature of quartz infra-red lamps is, however, the possibility of building very compact heating systems, simple and light in weight. Moreover, the lamps reach the optimum working temperature immediately and cool down very rapidly. Finally, temperature control is possible within very narrow limits, which is an essential factor in treating all kinds of modern material. Available in 500, 1000, 2000 and 3000 W.

*Quartz infra-red lamps for copying purposes*

Tubular, quartz infra-red copying lamps are efficient, compact size, high-intensity radiant heat sources for dry reproduction systems. These are high colour-temperature lamps with exact filament and dimensional tolerances, offering accurate focussing in properly designed reflectors. Available in: 1350 and 2360 W.

*Quartz heaters for comfort heating*

The quartz heater IRQ has been designed for application in the space-heating field. Quartz heaters possess various characteristics which make them eminently suitable for this purpose: they radiate heat immediately, reach high radiating temperatures, have a good optical effect, can resist sudden temperature changes and are resistant to acids. Available in 1000 W.

**Festoon lighting sets**

There is an ever-growing demand for festoon lighting sets suitable for outdoor use, e.g. for the illumination of large trees in parks and gardens, near petrol service stations, in playgrounds, on balconies, for decorative lighting of façades and streets, etc. The “Philite” lampholders of the set shown opposite, are provided with rubber sealing rings and interconnected with heavy rubber cord. Another set designed for outdoor use as well. The green lampholders with saucers made of “Philite” are also provided with a rubber sealing ring, to prevent water from entering into the lampholder. Both the sets described here, are attached to trees or other objects by means of a strong crocodile clip with ball-and-socket joint. Also available: Christmas-tree illumination sets.

**Coloured lamps**

The colour coatings of these lamps being flushed inside, they cannot chip, scratch or fade, nor can they be affected by weathering. This feature makes the lamps ideal for outside decorative use in illumination signs, Christmas and other decorations, for garden parties, carnivals, fairs, etc. Of course, there are also numerous applications for special effects in homes, theatres, public buildings, restaurants, etc. Philips coloured lamps are supplied in two shapes: the “normal” and the drop shape, and are destined for parallel mounting. In addition to the coloured lamps for parallel burning described above, we manufacture various kinds of lamps for festive illumination and ornamental lighting for series burning as well.

**FLUORESCENT LAMPS**

In the Philips fluorescent lamp programme there is a type available for almost every application in the general lighting field. In the survey below the fluorescent lamps are grouped according to the methods of starting and operation. Each method requires a particular combination of lamp and auxiliary equipment.

The complete range of our fluorescent lamps is composed of the following types:

The fluorescent lamps of the “TL” standard range operate with starter switches and ballasts. In this group are also incorporated “TL” miniature, “TL”D small diameter, “TL”E circular, “TL”W and “TL” coloured fluorescent lamps.

The reflector-type lamp “TL”F has an internal reflecting powder layer. It is also normally starter-operated.

The rapid-start fluorescent lamps “TL”M/RS operate without starters on special ballasts. Rapid-start fluorescent lamps are also supplied in a circular version, type “TL”EM/RS and with internal reflector, type “TL”MF/RS.

The “TL”/RS rapid-start lamps operate without starter on special ballasts. They can also be operated with starter on normal ballasts. “TL”/RS and “TL”M/RS “Double-Flux” lamps operate without starter on special ballasts. These lamps too, can be supplied with internal reflector.

For Great Britain, we manufacture a series of universal “TL”A fluorescent lamps, suitable for either switch or instant start ballasts. Again, these lamps are also made with internal reflector, type “TL” AF.

The fluorescent lamps “TL”C have been designed for d.c. operation in trains, trams, buses, aircraft and ships. They operate on stabilizing tubes.

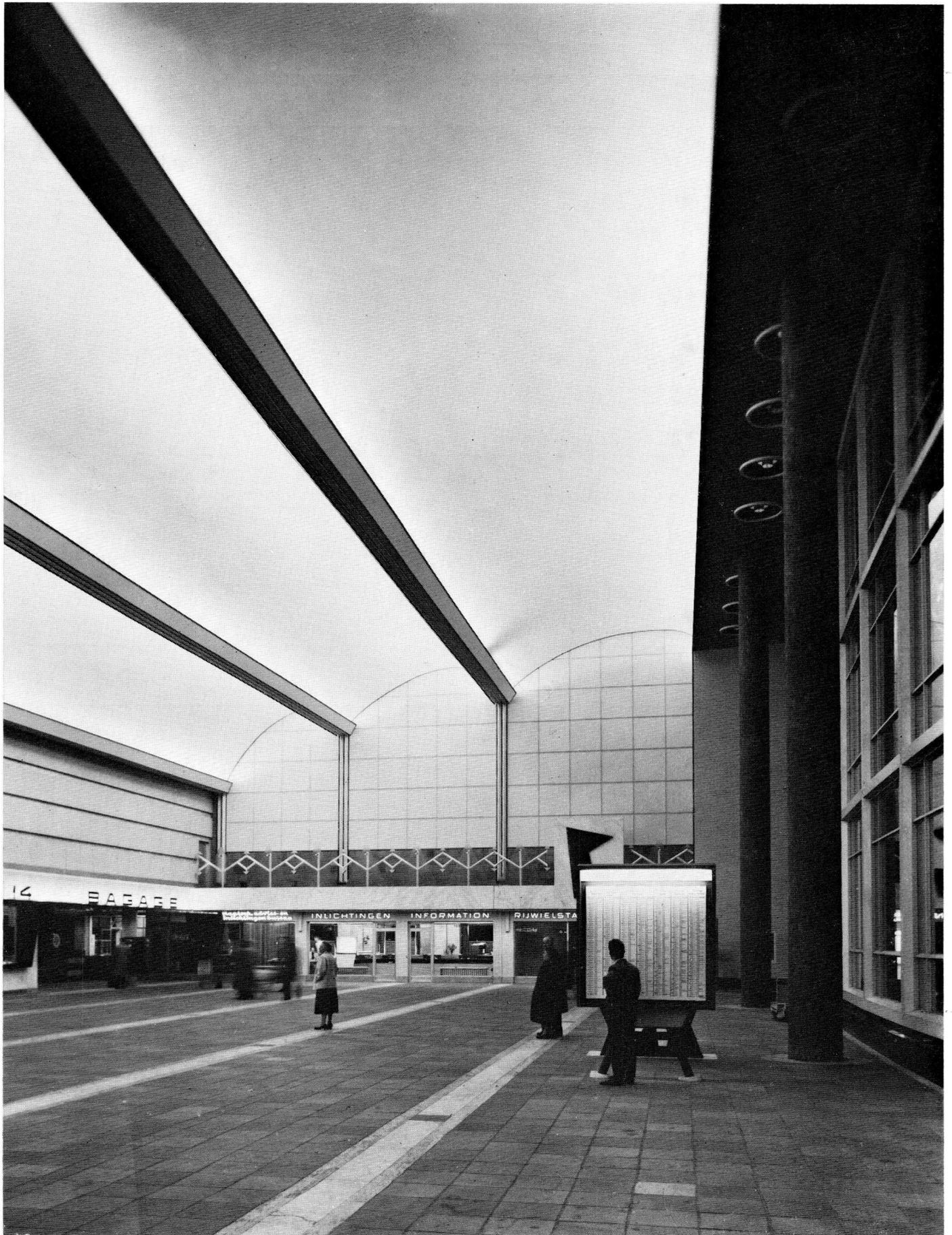
The “TL”R lamps are for d.c. operation. They need auxiliary equipment, such as stabilizing lamps and magnetic relays.

Fluorescent-lamp type “TL”S with inside ignition strip can be operated with stabilizing lamps as well as with a ballast. No starter is required.

For housing in flameproof fittings the “TL”X type is available, which operates without starter on the same ballasts as for “TL”S lamps. Finally, the Slimline lamps are instant-start, hot-cathode fluorescent lamps. They operate without starter and have a single-pin base.

It is not only the right choice of lamp types and the correct use of fittings on which good lighting is based, the colour of the light also has a part to play. In addition to types with high luminous efficiency, there are also available those developed for maximum colour rendition. As can be seen from the table hereunder, colours 32, 34, 55 and 57 ensure perfect rendition of all colours, thanks to their well-balanced spectrum. The colours 29, 33 and 54 give maximum efficiency.

maximum efficiency	col. temp.	maximum colour rendition	col. temp.
warm white /29	3 000 °K	warm white deluxe /32	3 000 °K
white /33	4 200 °K	white deluxe /34	3 800 °K
cool daylight /54	6 500 °K	daylight /55 (or colour matching)	6 500 °K
		daylight /57	7 400 °K



*Indirect lighting of "TL" lamps in the hall of a railway station.*

## Standard range of "TL"-lamps

colour type	luminous flux (lumen)							dimensions l × diam. (mm)	base
	29 warm-white	32 warm-white de luxe	33 white	34 white de luxe	54 cool daylight	55 daylight	57 daylight 7 400 °K		
<b>miniature</b>									
"TL" 4 W	110	—	100	70	—	—	—	150 × 16	miniature bipin
"TL" 6 W	240	—	240	170	—	170	—	230 × 16	
"TL" 8 W	400	—	390	270	—	270	—	300 × 16	
"TL" 13 W	760	—	760	540	—	540	—	330 × 16	
<b>slender</b>									
"TL" D 15 W	880	570	860	580	700	580	—	460 × 26	standard bipin
"TL" D 30 W	2080	1350	2050	1400	1700	1400	—	920 × 26	
<b>standard</b>									
"TL" 14 W	610	—	610	410	500	410	—	380 × 38	standard bipin
"TL" 15 W	800	530	800	550	660	550	—	460 × 38	
"TL" 20 W	1150	750	1100	750	900	750	—	610 × 38	
"TL" 25 W	1700	1130	1700	1150	1400	1150	—	1000 × 38	
"TL" 40 W	3000	1950	3000	2000	2400	2000	1700	1220 × 38	
"TL" 65 W	4900	3200	4850	3300	—	3300	—	1520 × 38	
"TL" 80 W	5300	3450	5200	3500	—	3500	—	1520 × 38	
<b>circular</b>									
"TL" E 22 W	1100	—	1100	750	900	750	—	215 <sup>1</sup> × 28	four pin
"TL" E 32 W	1850	1250	1850	1300	1530	1300	—	310 <sup>1</sup> × 32	
"TL" E 40 W	2640	1800	2640	1850	2170	1850	—	410 <sup>1</sup> × 32	
<b>W-shaped</b>									
"TL" W 25 W	—	—	—	1150	—	—	—	27 diam.	standard bipin

<sup>1</sup> Outer diameter of circle.

## coloured

	luminous flux (lumen)				dimensions l × diam.	base
	red	yellow	green	blue		
"TL" D 15 W	—	—	1000	—	460 × 26	standard bipin
"TL" 20 W	60	800	1300	250	610 × 38	
"TL" 40 W	160	2000	3300	650	1220 × 38	

## "TL" F reflector fluorescent lamps

The "TL" F fluorescent lamp is provided with a reflecting powder coating. This coating covers about 2/3 of the circumference and is found between the layer of fluorescent powder and the glass wall. The reflector layer reflects light that would normally be emitted upwards. In this way the majority of the luminous flux passes through the single-coated portion of the lamp. Consequently, in the direction of this part the luminous intensity is considerably higher than that of a normal "TL" lamp, whereas in the direction of the coating the intensity is considerably reduced. The luminous intensity in the downward direction is approximately 70 % greater than that of non-reflector lamps. Thus, the presence of dust on a reflector fluorescent lamp so mounted that the light rays are mainly directed downwards, causes practically no trouble. For practical use this means that the illumination level obtained with "TL" F lamps will remain considerably higher than that obtained with normal "TL" lamps. The "TL" F lamp is the ideal light source for dusty rooms, such as workshops, and it has advantages in offices also.

Available in 20, 40, 65 and 80 W. Colour range: 29, 33, 34, 55.

## "TL" M/RS rapid-start and "TL" MF/RS rapid-start reflector fluorescent lamps

"TL" M/RS rapid-start fluorescent lamps are provided with an external ignition strip, connected to one of the electrodes via a high-ohmic resistor, which enables starterless operation. To ensure prompt ignition also in damp surroundings, the lamp is provided with a silicon coating.

When used with the corresponding ballast, the "TL" M/RS lamp offers the following important advantages: almost instant starting, no limiting installation requirements, such as an earthed metal frame near the lamp, and finally: ignition independent of atmospheric conditions. The "TL" MF/RS reflector fluorescent lamps combine the electrical

properties of the "TL" M/RS lamp with the lighting properties of the "TL" F lamp. Available in 20, 40 and 65 W. Colour range: 29, 32, 33, 34, 55, 57.

## "TL" (M)/RS "double-flux" and "TL" (M)F/RS "double-flux" reflector lamps

Normally the luminous flux of fluorescent lamps can only be raised by increasing the wattage, which can only be done if the lamp is made longer accordingly. A normal 4 ft "TL" 40 W/33 lamp, for instance, produces 3000 lm, i.e. 750 lm/ft. Now, based on the length of the next type of lamp, viz. the 5 ft 65 W, we developed a lamp of much higher wattage, viz. 120 W, which has a luminous flux of 7300 lm in colour /33, or 1460 lm/ft. This means that the luminous flux per unit of length is twice as much as was previously possible, hence the name "Double-Flux". Besides this 5 ft 120 W type, an 8 ft 810 W lamp is available.

The "TL" (M)/RS "Double-Flux" lamps are also available with a reflecting powder layer, as described with the "TL" F lamps. Available in 120 and 180 W. Colour range: 33, 55.

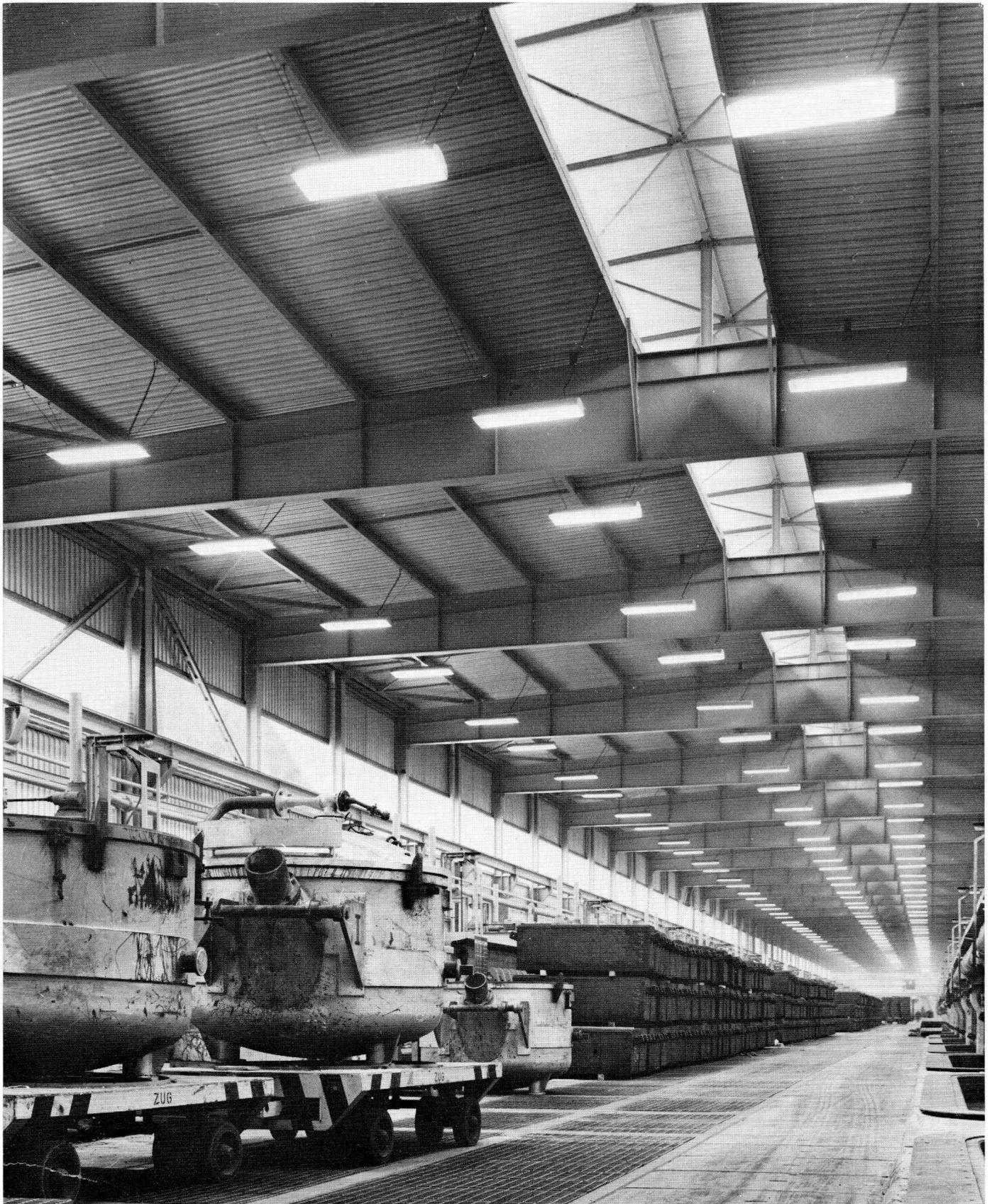
## "TL" /RS rapid start lamps

The fluorescent lamps of the "TL" /RS type are operated on rapid start ballasts of various design. The lamps up to 65 W (shorter types) can also be used on circuits with starter switch.

The tubes are silicon-coated in order to eliminate any adverse influence of humidity on the striking voltage of the lamps.

The 105 W type of the "TL" /RS lamps is also available with internal reflecting layer.

Available in 20, 40, 65, 85 and 105 W. Colour range: 29, 32, 33, 34, 55.



*Lighting of hall in a plant of the Rheinische Aluminium A.G. at Cologne.*

## Slimline lamps

Slimline fluorescent lamps are instant-start lamps with non-preheated cathodes. When used in combination with the right ballast, the lamp ignites immediately after switching on without flicker. Slimline lamps have single-pin caps and are available in a wide choice of sizes, wattages and colours.

The most important characteristics are: coating with high-efficiency fluorescent powder for top luminous performance, reliable ignition down to 0 °F (−18 °C), long life and dependable service, invisible water-repellent coating for reliable operation under humid conditions.

## BALLASTS FOR FLUORESCENT LAMPS

In each fluorescent lighting installation the ballasts form an invisible but essential part, being a decisive factor in the correct operation of the lamps.

The three most important functions a fluorescent lamp ballast must fulfil, are:

1. Preheating the lamp electrodes so as to start electron emission.
2. Providing a sufficiently high voltage to start the arc between the electrodes.
3. Stabilizing the lamp current and power to the values set for each type of lamp.

Apart from these fundamental requirements, a quality ballast should also comply with a number of demands which ensure smooth operation. Firstly the design of the ballast must be such as to keep its power loss as low as possible, resulting in a long operating-life. Furthermore, the dimensions and weight should be confined to the minimum, so as to promote economic fitting design. It is by no means easy to comply with these requirements, the more so as they interfere with each other. The Philips range of totally enclosed ballasts entirely fulfil the above conditions. The ballasts are filled with a specially compounded and processed polyester, which is a thermosetting material, i.e. it remains hard and thus cannot flow out. This material guarantees so high a dissipation of heat, that the dimensions of the ballast could be considerably reduced, whereas the temperature rise is kept well within the limits of the I.E.C./C.E.E. specifications. As the coil is now practically hermetically sealed, it is no longer exposed to atmospheric influences and ballast hum is virtually absent. Thus, these polyester ballasts not only amply meet the requirements the materials and technique of manufacture endow, for practical purposes, unlimited life.

Features:

Small dimensions.

Correct power supplied to the lamp, hence full lumen output.

Correct preheating conditions during starting, together with minimum distortion of lamp-current wave-form during operation, thus ensuring long lamp life.

Low working temperature due to cooling of polyester resin between coil and sheet-steel canister.

Freedom from leakage: polyester cannot melt.

High reliability, combined with very long life; no maintenance

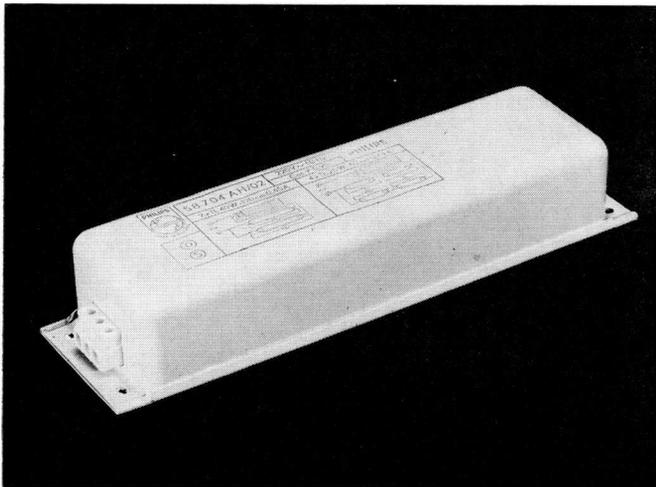
Easy to mount: terminals, no loose wire ends.

Noiseless.

Reduced weight.

Compliance with all supply authority requirements; made in accordance with international specifications.

Wiring diagram clearly marked.



Ballast for 2 "TL" lamps 40 W or 4 "TL" lamps 20 W.

## Ballasts for "TL" M(F)/RS lamps

"TL" M(F)/RS lamps are employed in starterless circuits. For this purpose special ballasts are needed. In conjunction with the lamp and its starting aids, reliable and rapid ignition is ensured, even at lower temperatures and under less favourable voltage conditions, independent of the humidity of the surrounding atmosphere.

## Step-up transformer

If 110/125 V ballasts are not available or the use of a separate step-up transformer is advantageous, this 100 VA step-up transformer should be used in conjunction with 220 V ballasts. It can operate two "TL" 40 W lamps in duo-circuit or 2 "TL" M 40 W/RS lamps on HPF single-lamp ballasts. The transformer is cooled by means of a polyester filling of the box.

## Transistor ballasts

Fluorescent lamps are being employed more and more in vehicle lighting, as for this application also they have various significant advantages over incandescent lamps: very long life, high luminous output, yet low consumption, resistance to vibration, uniform illumination, no glare, slim shape, cool operation, low sensitivity to voltage fluctuations.

To convert the vehicle low voltage d.c. supply to the a.c. current required by fluorescent lamps, special ballasts are required. Philips transistor ballasts serve this purpose, without moving-parts and without the need for servicing. They are already widely applied in railway carriages and in road transport vehicles. Most conventional fluorescent lighting can be adapted to take transistor ballasts, or alternatively, lamps and ballasts may be installed separately at convenient points.

Applications:

motor buses, both for interior lighting and for advertising signs railway carriages,

aircraft,

loading space of lorries and vans,

caravans and tents,

fishing boats and other small vessels,

houses and farms in which low voltage d.c. supplies are available,

emergency lighting,

mobile workshops,

travelling shops.

## STARTERS

The function of the starter in the fluorescent lamp circuit is to start the lamp automatically.

Philips starters are carefully constructed for long and reliable operation, and are designed to ensure starting characteristics that will promote full lamp life. Hence, they help to cut down maintenance cost and are a really important link in the economic operation of fluorescent lamps.

## ELECTRONIC APPARATUS FOR REGULATING THE LUMINOUS FLUX OF "TL" M/RS LAMPS

With incandescent lamps the lamp current can be regulated by varying the voltage applied to the lamp. This simple method cannot, however, be used with gas-discharge lamps, as the lamp must be ignited anew in each half-cycle. A certain ignition voltage is necessary for this. As ignition can no longer take place if this voltage is reduced, the lamp cannot remain burning either.

Several systems are known for the regulating — dimming as it is called — of "TL" M/RS fluorescent lamps, for instance with the aid of thyratrons. With these systems the voltage is kept fairly constant, but the moment of ignition and thus the current through the "TL" M/RS fluorescent lamps is controlled.

Owing to recent developments in the field of semiconductors, silicon-controlled rectifiers have become available which, in principle, have the same function as the thyratrons used hitherto. Two silicon-controlled rectifiers are connected anti-parallel and this combination is included in series with the "TL" M/RS fluorescent lamps in one circuit.

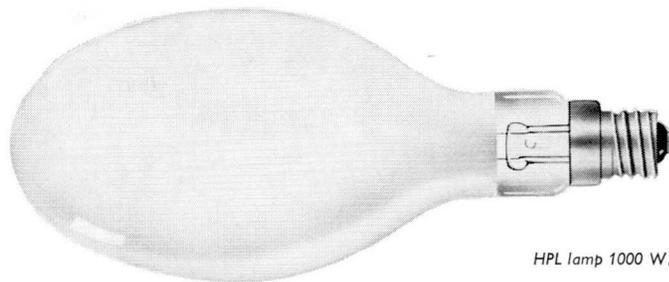
To avoid interference with radio reception, a filter is connected in series with the silicon-controlled rectifiers. In order to ensure good preheating of the electrodes of the "TL" M/RS fluorescent lamps, specially developed ballasts are applied.

The ballast contains a preheat transformer for which two secondary windings and one series impedance are provided in the ballast. The lamp is connected, in series with the series impedance, to the dimming apparatus.

During each half-cycle the controlled rectifiers will, in turn, allow the current to pass provided that a suitable signal ensures that they become conductive. A phase-changing network postpones the moment at which the signal is given so that the average current is regulated. A circuit which ensures that the luminous flux is constant in each set position, independent of mains voltage fluctuations, is included in the apparatus.

The dimming ballasts for the "TL" M/RS fluorescent lamps are housed in mounting channels or fittings.

In the dimming apparatus, if necessary together with a control box, all other components are accommodated to enable the luminous flux of the "TL" M/RS fluorescent lamps to be regulated. In addition, a potentiometer is necessary for operating the dimming apparatus, either direct or via the control box.



HPL lamp 1000 W.

## GAS-DISCHARGE LAMPS

### HPL mercury fluorescent lamps

The comprehensive range of these efficient light sources ensures the most economical solution for the lighting problems in numerous industrial and public-lighting installations. The range comprises lamps with a wattage of 50 W to 2000 W and with a luminous flux of 1700 lm to 125 000 lm!

The high-efficiency discharge, in balanced combination with the fluorescent coating, provides a crisp white light with excellent colour properties. HPL lamps thus combine fine colour quality with high luminous output and long service life. See table below.

### HPLR mercury fluorescent reflector lamps

The new-shape internal-reflector mercury fluorescent lamps are ideally suited for high-bay mounting, where maintenance is a problem. This highly economical lamp, HPLR, gives good colour rendering and is available in a wide range of wattages.

The most important innovations are the optimum bulb shape and the titanium dioxide reflector surface inside the lamp, making it impervious to atmospheric pollution in dirty surroundings, so that the high efficiency is maintained throughout its long, reliable life. HPLR lamps may be used indoors as well as outdoors in permanent or temporary fittings, there being no need for expensive optical control fittings. The application possibilities are legion, just a few examples being: factory lighting, quarries, paper mills, iron foundries and advertisement floodlighting. See table below.

### HP/T mercury lamps

HP/T lamps are non-colour-corrected high-pressure mercury-vapour lamps, consisting of a quartz discharge-tube, contained in a tubular glass outer-bulb. These lamps have a high luminous flux and ensure excellent visual acuity and are thus suitable for installations where colour rendition is of minor importance.

Special applications of these lamps are: photography, photochemical processes, egg testing, microscopic examinations, etc. Available in 250, 400 and 1000 W.

### MLL blended-light lamps

MLL lamps consist of a quartz mercury discharge-tube connected in series with a tungsten filament. This filament functions as an incandescent light source and at the same time it operates as a ballast for the mercury discharge-tube, by limiting the lamp current. Hence, MLL lamps can be connected direct to the mains (200—250 V, 40—60 c/s), without the use of ballasts.

The outer bulb of MLL lamps is internally coated with a corrective layer, to improve the colour rendition. This coating ensures a proper blending of the light of both sources, resulting in diffused and clear white light, with the attendant feature of reduced glare. A few minutes after an MLL lamp is switched on, the performance of the two light sources reaches its optimum efficiency. MLL lamps meet the present demands for longer life, better luminous efficiency and economical light depreciation.

They are an excellent means to improve the lighting of streets, factories, stores, garages and in many other fields of application. Existing lighting installations with incandescent lamps can easily be modernized without any extra cost for control gear, wiring or new fittings. See table page 124.

### HPL mercury fluorescent lamps

lamp type <sup>1</sup>	catalogue number			V	A	lum. flux <sup>2</sup>		max. length with base		
	E27-base	B22-base	E40-base			lm	diam.	E27	B22	E40
HPL 50 W	57224 E/25	57224 B/25	—	95	0.6	1 700	55	129	125	—
HPL 80 W	57235 E/25	57235 B/25	—	115	0.8	3 100	70	156	152	—
HPL 125 W	57236 E/97	57236 B/97	57236 G/97	125	1.15	5 400	75	177	172	186
HPL 250 W	—	—	57220 G/97	135	2.1	11 500	90	—	—	227
HPL 400 W	—	—	57221 G/97	140	3.2	20 500	120	—	—	290
HPL 700 W	—	—	57226 G/97	140	5.4	37 000	140	—	—	330
HPL 1000 W	—	—	57222 G/97	145	7.5	52 000	165	—	—	410
HPL 2000 W	—	—	57229 G/97	270	8.0	125 000	185	—	—	445

### HPLR mercury fluorescent lamps

lamp type <sup>1</sup>	catalogue number		V	A	lum flux <sup>2</sup>	diam.	max. length with base	
	E27-base	E40-base					E27	E40
HPLR 125 W	57238 E/93	57238 G/93	125	1.15	4 900	125	190	199
HPLR 250 W	—	57239 G/93	135	2.00	10 800	165	—	264
HPLR 400 W	—	57240 G/93	140	3.20	19 000	180	—	304
HPLR 700 W	—	57231 G/93	140	5.25	33 500	200	—	328
HPLR 1 000 W	—	57241 G/93	145	7.50	50 000	220	—	380

<sup>1</sup> For ballasts, see page 125.

<sup>2</sup> After 100 burning hours.



Hall lighted with HPLR 400 W lamps.

### MLL blended-light lamps

lamp type	catalogue number <sup>1</sup>	nominal voltage V	minimum mains voltage <sup>2</sup> V	lamp current A	nominal luminous flux <sup>3</sup> lm	diam.	max. length with base		
							E27	B22	E40
MLL 160 W <sup>4</sup>	57503 E/B/56	200—210	180	0.83	2 900	88	183	178.5	—
	57504 E/B/56	210—220	180	0.79					
	57500 E/B/56	220—230	180	0.75					
	57501 E/B/56	230—240	190	0.72					
	57502 E/B/56	240—250	200	0.69					
MLL 250 W	57508 E/G/25	200—210	190	1.32	5 200	110	245	—	239
	57509 E/G/25	210—220	190	1.26					
	57505 E/G/25	220—230	190	1.20					
	57506 E/G/25	230—240	195	1.15					
	57507 E/G/25	240—250	205	1.10					
MLL 500 W	57513 G/97	200—210	180	2.60	12 500	130	—	—	274
	57514 G/97	210—220	180	2.50					
	57510 G/97	220—230	180	2.40					
	57511 G/97	230—240	190	2.30					
	57512 G/97	240—250	200	2.20					

<sup>1</sup> E stands for E27-base, B for B22-base, G for E40-base.

<sup>2</sup> For vertical burning position, for other burning positions, values are slightly higher.

<sup>3</sup> After 100 burning hours.

<sup>4</sup> On special request the MLL 160 W lamp can also be supplied with hard glass outer bulb. In this case the catalogue number reads ..... /96



Building site lighted with HP/T lamps.

### Tin-oxide sodium lamps SOX

The outstanding features of these SOX lamps are as follows: super-high efficiency (up to 150 lm/W), optimum lumen maintenance throughout life (95 %), long and reliable life, interchangeability with existing types, as they are identical as regards mechanical and electrical characteristics. In view of the rapidly increasing traffic density, the range of new sodium SOX lamps is definitely the most efficient and economic solution for public lighting.

lamp type	catalogue number	V	A	lum. flux <sup>1</sup> lm	diam. mm	overall length
SOX 40 W	57021B/00	75	0.60	4 400	51	310
SOX 60 W	57022B/00	115	0.60	7 400	51	424
SOX 100 W	57023B/00	120	0.90	12 500	64.5	525
SOX 150 W	57024B/00	180	0.90	20 500	64.5	775
SOX 200 W	57025B/00	265	0.90	30 000	64.5	1120

<sup>1</sup> After 100 burning hours.

### XOP lamps

XOP lamps are low-pressure xenon-filled discharge lamps specially developed for reproduction and copying in the printing industry. One of the most important features of these lamps is that their spectrum largely approximates average daylight, making them the answer to the problems of copy-board lighting, particularly in regard to colour exposures. They are advantageously applied for copy-board lighting, in stop-and-repeat copying machines and as light source in photo and film studios.

### BALLASTS FOR MERCURY AND SODIUM LAMPS

Mercury and sodium lamps, like all other gas-discharge lamps, need control gear to limit the current flowing through the circuit, and the ballast characteristics must conform to the lamp requirements. These ballasts incorporate in their dripproof, canned polyester-filled units the newest electrical designs ensuring very low operating temperatures and low losses combined with the most rugged mechanical and electrical constructions.



Railway yard lighted with discharge lamps.

## LIGHT-PRINTING LAMPS

### HOGK and HOQ light-printing lamps

HOGK and HOQ lamps are geometrically and electrically identical; they only differ in the kind of quartz used for their envelopes.

For HOQ lamps a special quartz is used, which does not give rise to ozone formation and their application does not call for measures to prevent ozone formation or to have it exhausted.

Moreover, the output of HOQ lamps in the long-wave ultra-violet and adjacent visible region (to which most phototype papers are sensitive) is slightly better than that of HOGK lamps. This difference is even larger when HOGK lamps are operated in a jacket to keep the ozone within bounds, because this jacket will absorb some radiation.

Available in 700, 2000 and 2500 W.

### HOKI light-printing lamps

HOKI lamps consist of a quartz burner and an integral jacket made of a glass having a high transparency for long-wave ultra-violet radiation. This jacket prevents ozone formation outside the lamp and protects the burner from the airstream flowing between the lamp and the printing cylinder.

HOKI lamps have a higher wattage per unit length and their surface temperature is accordingly higher than that of HOGK or HOQ lamps. Electrically they are identical with their predecessors, the HOK lamps (without jacket). The latter used to be mounted in separate jackets, made available by the sequent maker. Geometrically and also with regard to the bases there are some differences, which may require some mounting modifications. Available in 850, 1200, 2000, 3000 and 5000 W.

### Ballasts

Most HOGK, HOQ and HOKI lamps are operated from a.c. mains in conjunction with ballasts of the constant-wattage type (with high power-factor). A constant-wattage ballast consists of a leak-transformer and a suitable capacitor, which is connected to the secondary side in series with the lamp. Mains fluctuations of  $\pm 10\%$  cause less than  $2\%$  variation in lamp wattage.

### Super actinic "TL" lamps

Super actinic "TL" lamps are second to none as regards efficiency of long-wave U.V. radiation, needed for various photochemical processes, such as light (dialo) printing, copying and reproduction. They are tubular, low-pressure mercury lamps, coated on the inside with a fluorescent layer that transforms the short-wave ultra-violet radiation of the arc into useful actinic radiation with a peak at approximately 3700 Å.

Super actinic "TL" lamps are operated from a.c. mains. As lamp powers are low, several lamps are often used together per machine when a larger light-printing speed is required. Heat production is relatively small and therefore the lamps may be placed quite near to the printing materials and no complicated cooling systems are required.

Available in 6, 15, 20, 25, 30, 40, 65, 80 and 120 W.

### Ballasts

The dimensions and electrical characteristics of super actinic "TL" lamps being identical with those of standard "TL" lamps of the same rating, the ballasts and other accessories of the latter can be used.

### HPR lamps

Owing to the bluish-white light with strong actinic radiation, the HPR 125 W mercury-vapour lamp with internal reflector is particularly suitable for black-and-white reproduction and copying processes. It is also widely used as a floodlight lamp and — when a separate Wood's glass filter is applied — as a "black light" lamp, the reflector ensuring a homogeneous beam of radiation.

Available in 125 W.

### Sunlamps MLU

The sunlamp MLU 300 W is a tungsten mercury lamp, built on the principle of the blended-light lamps MLL.

Besides visible light, strong ultra-violet radiation is also emitted as well as infra-red radiation. The bulb is made of hard glass which filters out radiation below 2800 Å. The internal reflector ensures a homogeneous beam of radiant energy. These characteristics make the lamp eminently suitable as a sunlamp for home use.

Besides, the MLU 300 W lamp also finds application in the preheating and drying processes of plastics.  
Available in 300 W.

### Black light blue lamps

Black light blue fluorescent lamps are tubular low-pressure mercury-vapour lamps. The bulb consists of dark blue glass, transparent for ultra-violet and opaque for visible radiation. The ultra-violet radiation is emitted by a fluorescent powder layer on the inside of the tube, which converts the arc's energy into long-wave ultra-violet with a maximum emission at 3500 Å.

Black light blue lamps are applied for the excitation of the "luminescence" phenomenon. A minimum of visible light is produced by the lamp as this would interfere with the luminescent colour.

The lamps are operated from a.c. mains, in series with a ballast and with a suitable starter in circuit. These accessories are identical with those used for standard fluorescent lamps of the same rating.

Available in 20 and 40 W.

### HPW 125 W lamps

The HPW 125 W black light lamp is a super-high-pressure mercury-vapour lamp, consisting of a quartz discharge tube in an outer envelope of blackWood's glass. It constitutes a source of invisible radiation for the excitation of the phenomenon "luminescence". Because of easy mounting and simplicity of operation, this lamp is used for the most varied purposes, e.g. for analysis and detection in chemical, sugar and textile industries, in food production, philately, mineralogy, banking, criminology and medicine.

### TUV 6 W lamp

The TUV 6 W germicidal lamp works on the principle of a glow discharge. It operates on 220/230 V mains voltage without the use of a ballast. The absence of ballasts is an additional advantage, facilitating the application of this lamp in spaces of reduced dimensions.

Owing to its small size, the TUV 6 W germicidal lamp constitutes an inexpensive and handy source of ultra-violet radiation, used in analysis by means of the phenomenon "luminescence", in refrigerators and in vending machines for liquids.

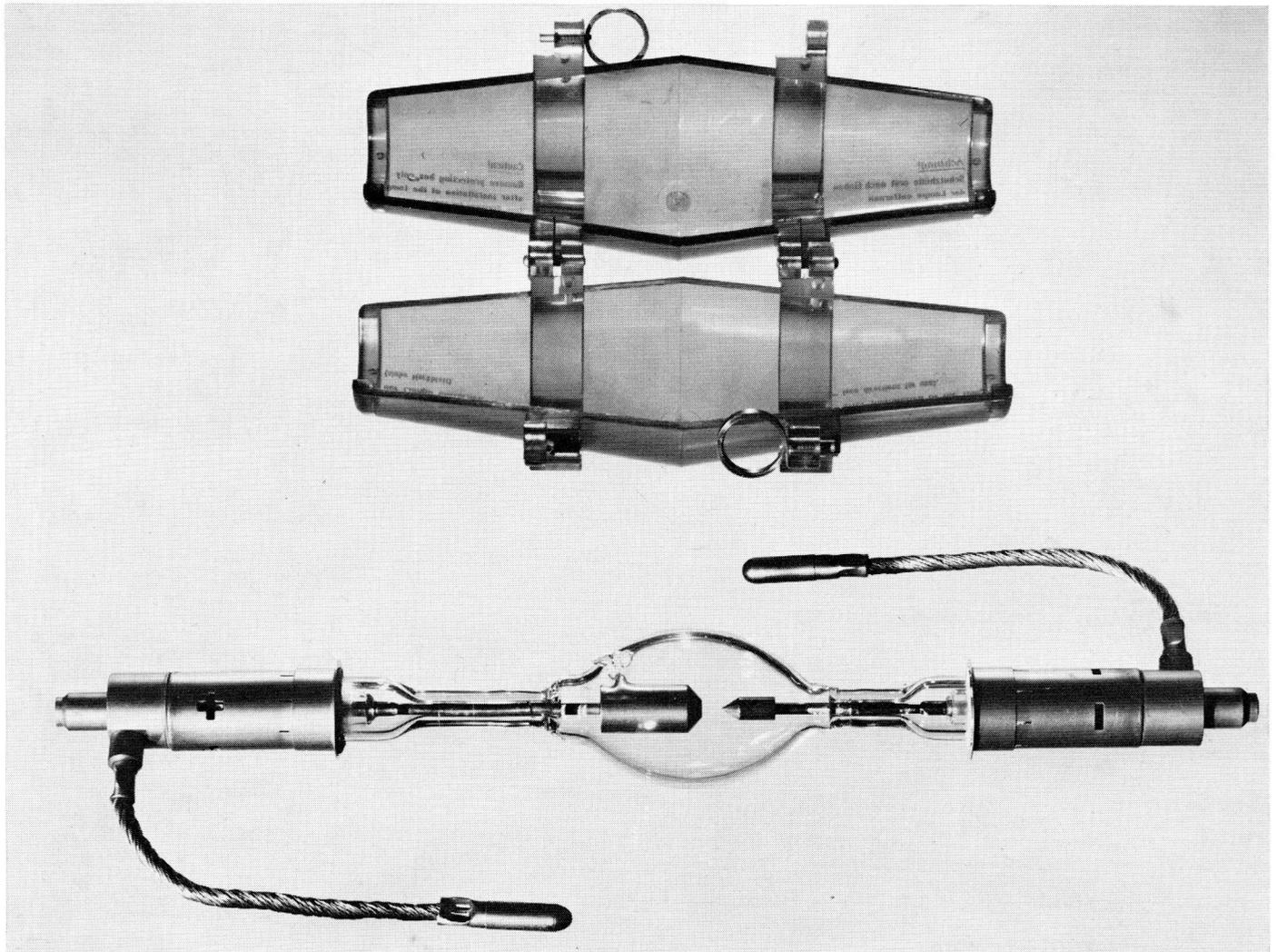
### TUV germicidal lamps

Essentially, TUV germicidal lamps are low-pressure mercury-vapour lamps, just as fluorescent lamps, however without a phosphor coating and using a glass which transmits efficiently the short-wave ultra-violet. TUV lamps radiate most of their energy at the 2537 Å-line, which is very near the wavelength most effective in destroying bacteria and moulds. They are widely used in hospitals, cold-storage rooms, cheese warehouses, pharmaceutical industries, dairies, breweries, bacteriological research institutes, etc.

TUV lamps must be used with caution. Affected skin (erythema) and eyes (conjunctivitis) may be the result of long exposures.

### Ballasts

TUV lamps 15 W and 30 W have been designed along the same electrical lines as the normal fluorescent lamps of the same rating and they therefore need exactly the same type of ballasts and other accessories.



Xenon lamp, type CSX.

## **Compact source lamps CS and compact source xenon lamps CSX**

CS lamps are super-high-pressure mercury lamps. They are characterized by a very high energy concentration in the smallest possible dimensions. This results in a high brightness hitherto unknown for such an uncomplicated light source. Moreover, CS lamps give very high energy radiation in the middle and long wave ultra-violet.

Compact source mercury lamps are operated on a.c. or d.c. and have natural cooling. They consist of an elliptical quartz discharge tube with two diametrically placed electrodes. The 150 W size has a tubular outer bulb of hard glass, which transmits the visible and long wave ultra-violet.

They have some distinct advantages over many other types of lamps: they have a small concentrated point source, a high intrinsic brightness, a radiation of high actinic value and low heat content.

CSX lamps are super-high-pressure xenon lamps. They combine the very high brightness and maximum arc stability of the standard CS lamps with a colour rendition which closely resembles daylight.

## **Spectral lamps**

These lamps consist of a small discharge tube enclosed in a cylindrical outer bulb. The discharge tube is filled with a gas, a metallic vapour or a mixture of both and the electrodes permit a very high current density. In this way, a light source is obtained capable of emitting considerable energy in one single spectral line or in a few lines. These strongly monochromatic light sources are an important aid for physical and chemical experiments and for tests where visible or ultra-violet radiation plays a part. For most experiments it is necessary that the different sources be interchangeable both as regards electrical and geometrical characteristics. Hence, all Philips spectral lamps have identical outer dimensions as well as an identical light centre length, ensuring complete interchangeability.

Spectral lamps can be applied in all kinds of biological, chemical and physical experiments, such as interferometry, polarimetry, refractometry and spectroscopy.

## **Deuterium and mercury spectral lamps**

The deuterium lamp produces a continuous spectrum with, above 4 000 Å, the Balmer-lines and the strongest lines of the multi-line-spectrum of deuterium. The mercury lamp dissipates its energy in the well-known lines only.

## **Forced-cooled super-high-pressure mercury lamps SP**

Light from SP lamps is whiter than that produced by ordinary mercury lamps due to the internal pressure, which is very high. They constitute small light sources having a high level of brightness and a high efficiency. Additional features are, furthermore, that maximum luminous efficiency is reached at once and that the lamps re-ignite immediately.

In many instances SP lamps have proved to be an invaluable aid in obtaining a high degree of accuracy and in realizing large economies of labour and materials. They are used in the ship-building industry, in factories making railway carriages, large boilers and containers, and heavy machinery generally. SP lamps are also being applied in ceilometers, photography, photochemical processes, film and micro-projection, and in equipment which measures or checks by means of an optical system, e.g. for profile scanning in grinding and milling machines. Their use is also general for checking ball bearings, type-writer components, watch parts and in other precision industries. Available in 500, 900 and 1000 W.

## **Super-high-pressure pulsed mercury lamps SPP**

The SPP 800 W and 1000 W lamps are super-high-pressure mercury lamps, primarily developed for cinema projectors and for operation from a pulsator producing a pulse frequency of 60–120 pulses per second. For the 1000 W version, a correction filter can be applied if desired, in order to obtain a better colour balance.

## **Discharge flashlamps**

Xenon flashlamps are hard glass or quartz discharge lamps of different shapes, with xenon filling. An electrical discharge is passed through the tube to create an intensive light flash with a daylight spectrum (colour-temperature approx. 5000–6000 °K) of very short duration. These light sources, therefore, are eminently suitable for making sharply defined photographic negatives or for signalling installations. They are characterized by: high efficiency, optimum flash duration, reliable ignition, low tolerance in luminous flux, easy maintenance.

## **Xenon stroboscopic flashlamps**

Xenon stroboscopic flashlamps are xenon filled lamps, which give very short and intensive flashes with a high flash-frequency. With these lamps high-speed rotating, vibrating or reciprocating mechanisms can be observed clearly. They are applied in the nautical and aeronautical, in the electrical and electronic fields, in the textile and printing industries, in medicine and in photography.

## **Laser pumping flashlamps**

For solid-state lasers we have developed two special xenon flashlamps with which the rubies can be pumped above their threshold level.

The most efficient way in which the straight flashlamp, type 126159, can be used is to mount the lamp in one focus of an elliptical reflector and the laser rod (ruby) in the second focus of the same reflector. All the energy dissipated by the lamp is consequently concentrated in the ruby.

The helix flashlamp, type 126128, is a very high-power flashlamp which operates on a high voltage. By means of this flashlamp a very simple laser can be built, as the laser rod can be set up along the axis of the helix of the flashlamp. Hence, without the aid of adequate reflectors, the laser rod can be brought above its threshold level.

## **Airport-lighting equipment**

We can offer a full range of airport-lighting equipment which has been approved by several institutions in this particular field. The range includes: approach lights, runway lights, threshold lights, taxiway lights, obstruction lights, airport lamps, lamp transformers, constant-current regulators, control panels, apron floodlights.

For approach lighting, unidirectional as well as omnidirectional fittings are supplied. For the approach lighting systems of instrument-approach runways and precision-approach runways the unidirectional approach lights PS24 or PS28 are used, whereas for approach lighting systems of non-instrument runways the omnidirectional approach light PS22 is applied. This latter fitting is also used in combination with unidirectional approach lights to provide circling guidance.

Both elevated-type and flush-type fittings are supplied for runway and threshold lighting. The elevated types are the high-intensity bidirectional runway and threshold light PS16 and the medium-intensity bidirectional or low-intensity omnidirectional fitting PS22. The high-intensity runway light PS25 and the low-intensity runway light PS26 are flush-type fittings for recessed mounting in the concrete along the runway or threshold. For the lighting of taxiways either elevated taxiway lights PS22 or flush-type taxiway lights PS26 may be used. The elevated fitting PS22 can be supplied with a day-light marker cone.

For the lighting of obstructions the PS14 obstruction light is used. A double-light version can also be supplied. The fitting is manufactured for multiple or for series circuits.

Control panels are built to order in conformity with the requirements of our customers. They can be provided with the on/off switches, selector switches, indicator lamps, mimic diagram and all other controls required for the remote control of all the airport lighting circuits.

The constant-current regulators are of the static type, provided with contacts for positive back-indication and lightning arresters. If required, they can be provided with brightness control and circuit selectors.

Series isolating transformers can be supplied either completely enclosed in synthetic rubber or in a compound-filled cast-iron housing.

## INDOOR FITTINGS FOR FLUORESCENT LAMPS

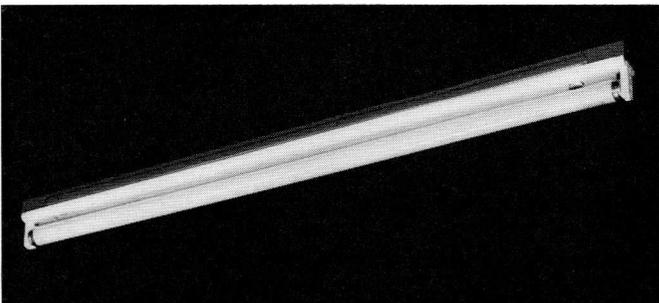
This is a very concise selection from the extensive program of Philips lighting fittings. The fittings for domestic use for instance, are completely omitted in this anthology. Therefore we draw your attention to the fact that Philips have a fitting for practically every lighting application. We are glad to receive your requests for complete and detailed catalogues or documentation.



Application of TF 11 fittings in a drawing-office.

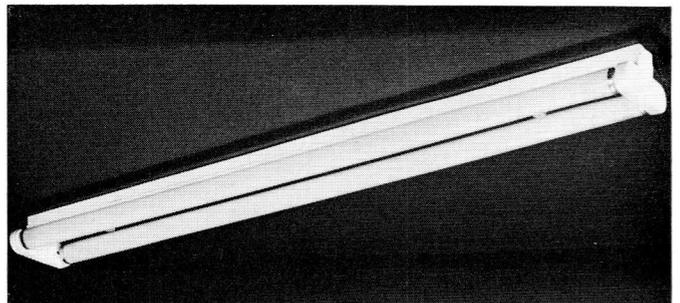
### Mounting channels for 1 or 2 fluorescent lamps, TMV

This small cross section type of batten fitting can be had with a ceiling rail of 50 mm width ("narrow") or one of 90 mm width ("wide"). Attractive attachments are available. Material: sheet steel. Finish: white stove-enamelled.



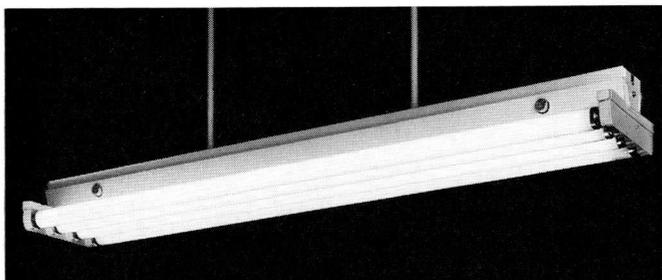
### Mounting channels for 1 or 2 fluorescent lamps, TMS

This small cross section type of batten fittings combines good mounting possibilities with attractive design and finish. Width: 50 mm. Material: sheet steel. Finish: channel grey stove — enamelled. Cover plate: white stove-enamelled.



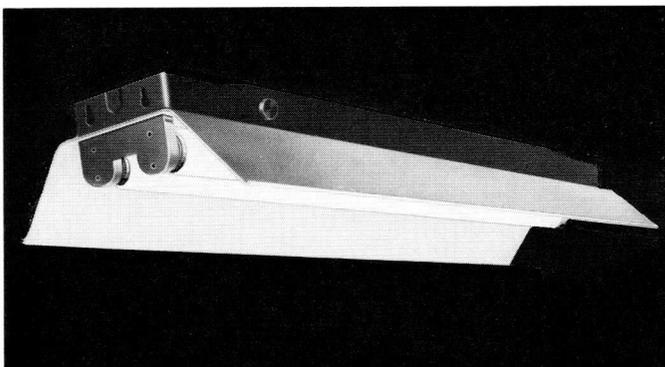
### Mounting channels for 1 to 4 fluorescent lamps, TM 10, MMA

These mounting channels are suitable both for pendant and surface mounting and may be used with or without attachments. Easy and quick mounting facilities together with superior electrical and mechanical features are the main advantages of these mounting channels. Material: sheet steel. Stove-enamelled finish.



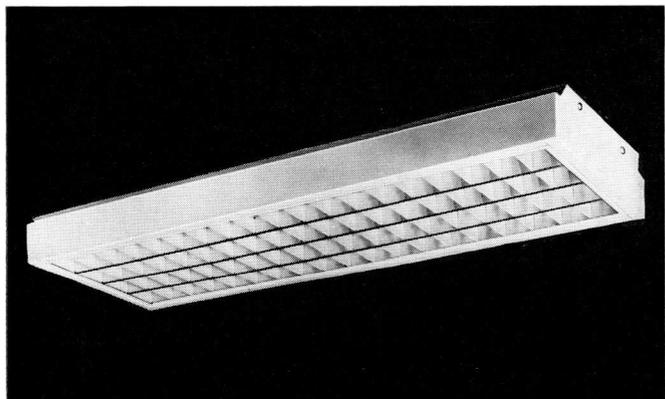
### Industrial trough fittings, TK

Suitable for 1, 2, 3 or 4 × 40 W; 1, 2 or 3 × 65 W and for 1 or 2 × 80 W fluorescent lamps. The reflector can be supplied either in a closed version or with a slotted top in order to ensure that some of the light is reflected towards the ceiling. Suitable for ceiling mounting as well as for pendant mounting from chains, steelwire cable or rods.



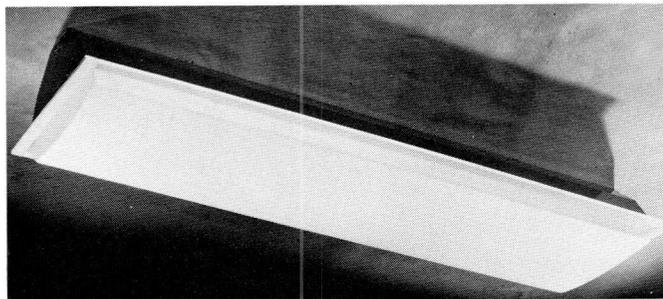
### Fittings for recessed mounting, TF 10 and TF 11

These metal fittings contain a plastified mirror-reflector system named TZR, which result in an extremely high level of illumination on the working plane with a low fitting brightness. Available in twin, four, and five lamp versions for "TL"(F) 40 W and 65 W.



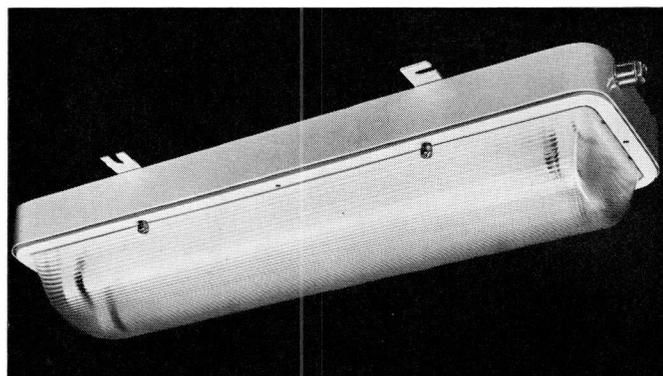
### Fittings for recessed mounting, TFC and MFC

Suitable for 2, 3 or 4 "TL"(F) 40 W lamps. The fittings are composed of a sheet steel housing containing a diffusing panel of reeded plastic or a plastic louvre. The latter is available in two different designs.

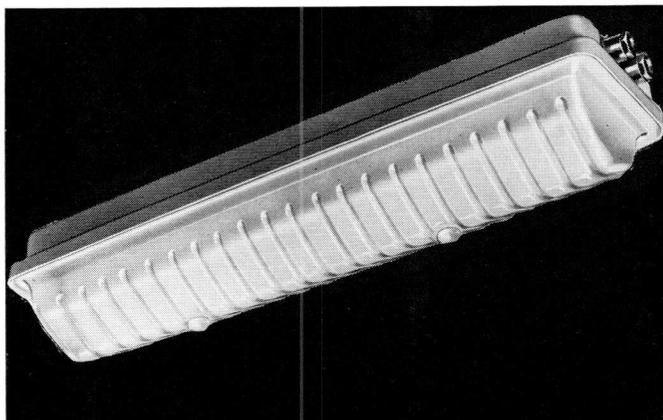


### Enclosed fittings for ceiling mounting, types TN 22, 24 and 25

Types TN 22 and 24 have a housing and reflector made of parkerized steel plate. They are available with cover of transparent opal plastic or transparent reeded plastic. Type TN 25 is a drip waterproof version. This fitting consists of a housing of reinforced polyester and a transparent cover of non-discolouring methacrylate. Suitable for 2 × 20 W "TL" lamps and available for various voltages both a.c. and d.c. The fittings comply with the requirements and specifications imposed by "Lloyds" on lighting and electrical apparatus on board ship.



Enclosed fitting TN 22.



Enclosed fitting TN 25.

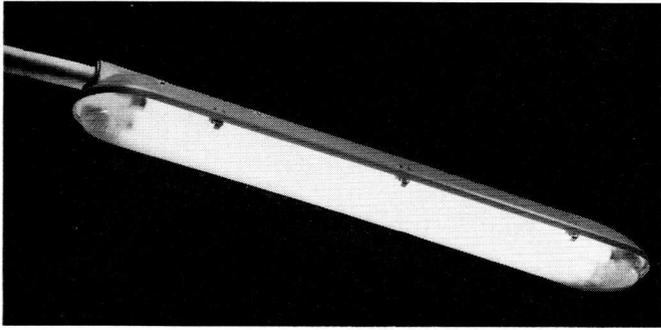
### STREETLIGHTING FITTINGS FOR FLUORESCENT LAMPS

#### Types TR 13 and MRD 13

Made from glass fibre reinforced grey polyester Corrosion-proof and dripwaterproof. Suitable for "TL"(F) 40 and 65 W or starterless "TL"(F)M 40 and 65 W RS lamps.

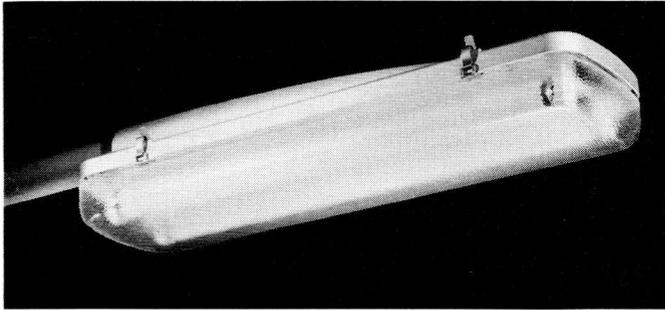
### Types TRD 11 and MRD 11

Made from glass fibre reinforced grey polyester. Corrosion-proof and dripwaterproof. Suitable for "TL"(F) 20, 40 and 65 W or starterless "TL"(F)M 40 and 65 W RS lamps.



### Types TRK, MRK, XRK 220

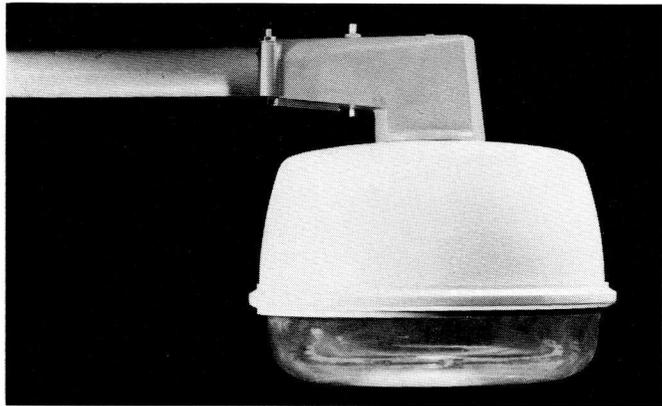
Housing made from a corrosion-resistant aluminium. Plastic cover. Designed on the medium-spread beam system, the fitting accommodates 20 W "TL" lamps (type TRK), two 20 W "TL" M (type MRK) or two 20 W "TL" S lamps (type XRK).



### STREETLIGHTING FITTINGS FOR MERCURY-VAPOUR AND INCANDESCENT LAMPS

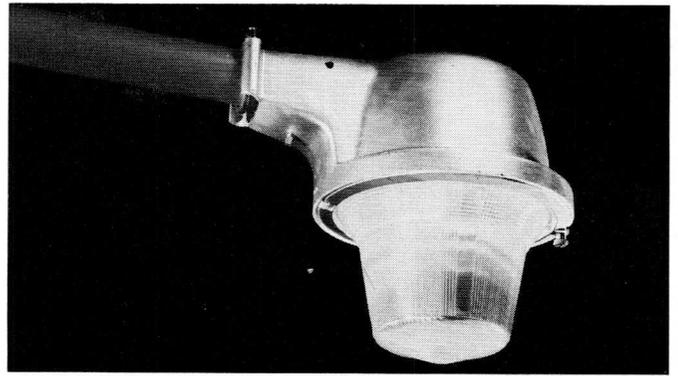
#### Types HCR 25—28

Fitted with adjustable spherical mirrors made of high grade aluminium in a high polish anodized finish. Suitable for colour corrected mercury vapour lamps HPL 80/125, 250, 250/400 and 700 W.



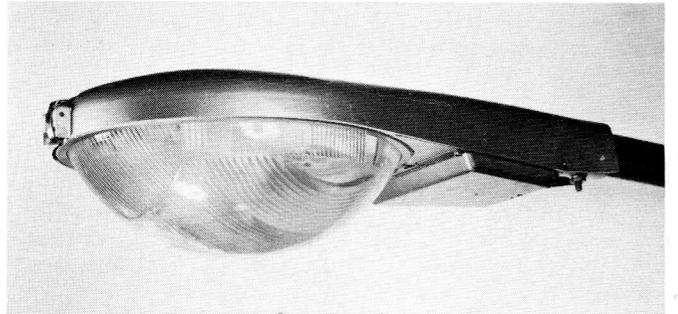
#### Types HRF 10/E and 10/H

Fitted with an asymmetrical cone-shaped or bowl-shaped refractor. Suitable for colour corrected mercury vapour lamps HPL 80 or 125 W, or a blended light lamp MLL 160 W or an incandescent lamp of 150 W.



#### Type HRL 11

Accommodates an HPL 80 or 125 W colour corrected mercury vapour lamp. Fitted with a glass refractor, semi-ellipsoidal in shape. Complete with gear compartment.



#### Type HRV 12/E and 12/H

Closed fittings of excellent performance accommodating HPL 80 or 125 W colour corrected mercury vapour lamps, and incandescent lamps 100, 200 W and ML 160 W lamp. Available with glass or clear Perspex refracting bowl.



### Type HRL 41

Accommodates an HPL 250 or 400 W colour corrected mercury vapour lamp. Provided with a compartment for mounting ballast and capacitor.



### Type HRG 10

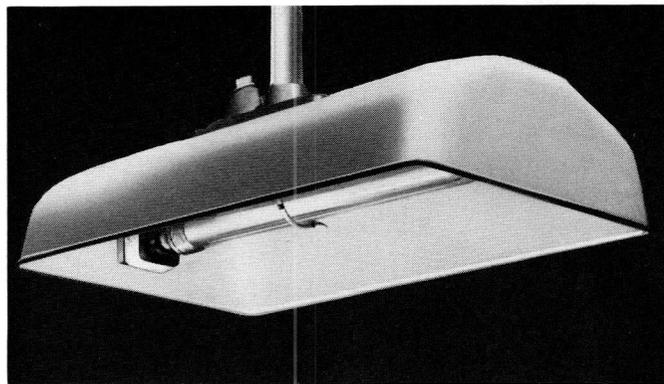
A post top lantern for those applications where a fitting of a decorative nature is desired. Suitable for 1 mercury vapour lamp HPL 50, 80 or 125 W or 1 incandescent lamp 200 W. Shade from opalescent plastic.



## STREETLIGHTING FITTINGS FOR SODIUM LAMPS

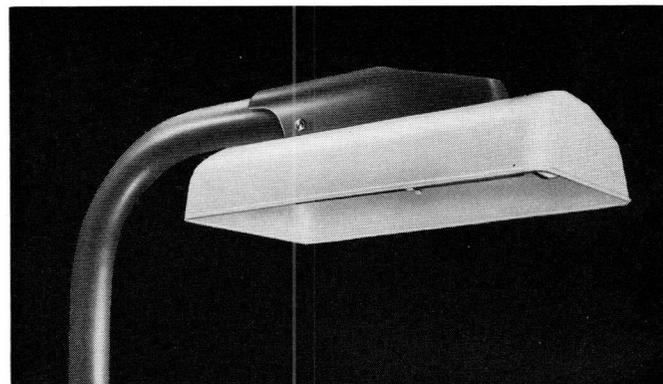
### Types SORA 108, 114 and 214

Reflector made of sheet steel. Provided with flange for lightmast mounting and adjustable lampholders. Suitable for sodium lamps SOI 60/85 and 140 W.



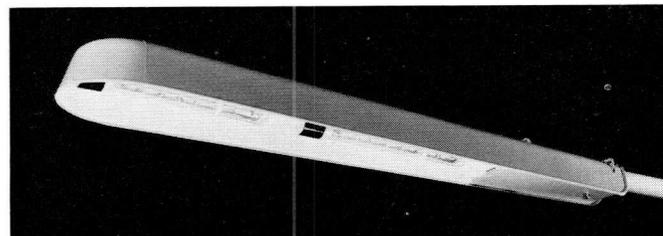
### Types SRA 104, 108, 114

Reflector made of a white opalescent plastic material. Can be used both for mounting on mast-arms and for central suspension. Suitable for sodium lamps SOI 45, 60 or 80, and 140 W.



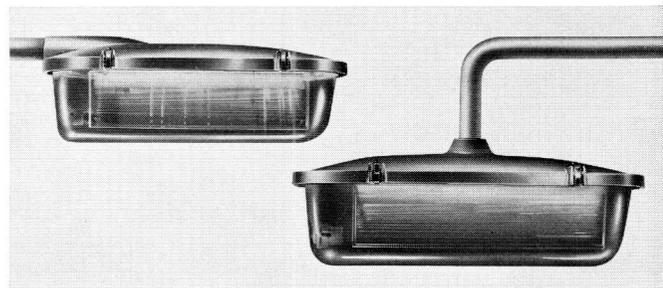
### Types SRD 208, 214

For the lighting of very wide streets. Made of specially processed aluminium. Accommodates two lamps SOI 85 or 140 W.



### Types SRL 108, 114

The housing is a one-piece corrosion resistant aluminium alloy die-casting of exceptional strength. Perspex diffusing bowl. Adjustable lampholders. SRL 108 for a SOI lamp of 85 W and SRL 114 for a SOI lamp of 104 W.

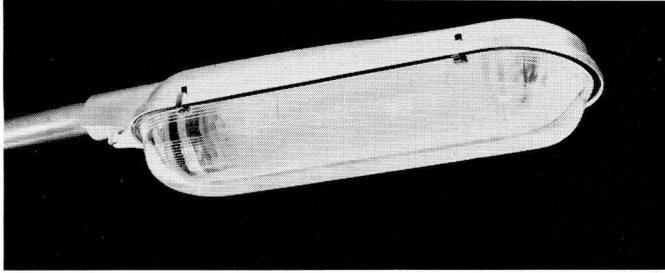


### Type SRL 120

The housing is a one-piece corrosion resistant aluminium alloy die-casting of exceptional strength. Perspex diffusing bowl. Adjustable lampholders. Accommodates a SOI 200 W sodium lamp.

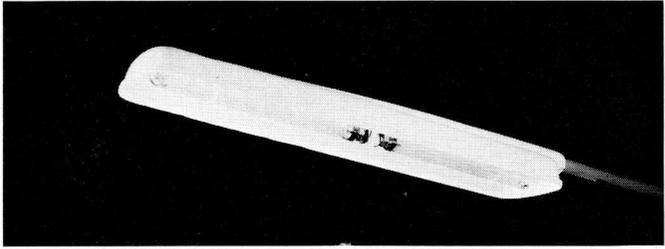
### Type SRM 120

Consists of a pressure-diecast aluminium housing of excellent finish. Suitable for a SOI lamp 200 or 140 W with remote gear or for a SOI lamp 85 W with built-in gear.



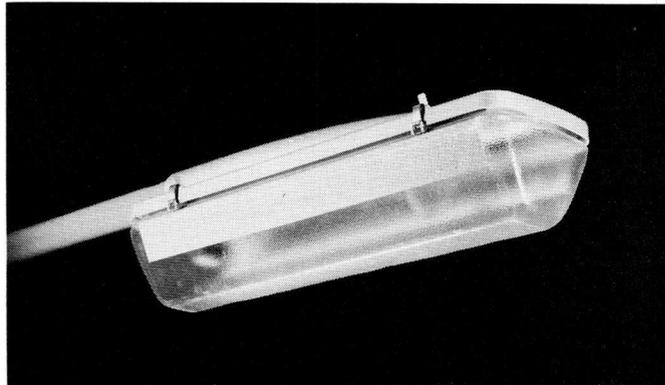
### Type SRS, SRT

For the lighting of a highway where at peak hours an extremely dense traffic has to be coped with. Type SRS is open, type SRT is closed by means of a clear plastic cover. They accommodate 2 SOI lamps 200 W of which one can be switched off during non-peak hours.



### Type SRX 114

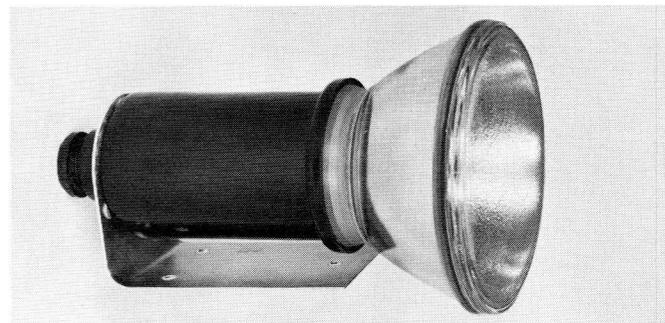
Lightweight fitting thanks to its pressure die-cast corrosion resistant aluminium housing. Suitable for one lamp SOI 85 W or one lamp SOI 140 W.



## FLOODLIGHT FITTINGS

### Floodlight fitting, type DV 13

A simple and inexpensive drip-proof lampholder unit for "Attralux" spot or "Comptalux" flood pressed glass lamps 100 or 150 W.



### Floodlight fitting, type DV

For the floodlighting of small statues and buildings, as well as for use in parks and gardens, with Philips mirrored lamps "Attralux", "Comptalux" or HPR.

### Floodlight fitting for SOI 140 W lamp, type SYA 140

Especially suitable for floodlighting high objects, such as office blocks, historic building, factories, as well as for security lighting of museums, banks, prisons, etc.



### Floodlight fitting for iodine incandescent lamp 100 W, type NV 50

A compact light-weight unit of precision die-cast aluminium which permits the use of light-weight and inexpensive polestructures.





*Floodlighting by 150 iodine lamps 1000 W of the new office of Philips Nederland n.v. at Eindhoven.  
In addition the building has windowlighting by "TL" fluorescent lamps.*

## 49. COMPONENTS FOR LAMPS (INCANDESCENT, FLUORESCENT AND NEON)

Filaments, lead-in wires, special wires. Rare gases, fluorescent powders. Capping-cement powders, insulation powder, getter and emitter emulsions, stamp inks.

## 50. TUNGSTEN AND MOLYBDENUM

Available are powders, bars, wires, sheets and processed parts for the electrical and electronic industries of tungsten and molybdenum. Thanks to their special properties, tungsten and molybdenum products have secured an important place in the manufacture of electrical and electronic equipment. The supplied tungsten and molybdenum wire and strip are uniform in structure, have a perfectly bright and smooth surface and are free from pores, cracks and internal faults. The bars, wires and sheets can be supplied in the following dimensions and tolerances:

### Wire

	tungsten	molybdenum
diameter tolerances	from 10 $\mu\text{m}$ to 20 mm $\pm 2\%$ of the wire weight (mg/200 mm)	from 25 $\mu\text{m}$ to 20 mm $\pm 3\%$ of the wire weight

### Sheet

	tungsten	molybdenum
thickness tolerances	0.2 to 4 mm $\pm 10\%$	0.1 to 2 mm $\pm 10\%$

### Tungsten welding electrodes

Tungsten welding electrodes are used in the argon and helium arc-welding processes for welding non-ferrous metals and stainless steel.

### Tungsten anode discs

As applied in X-ray tubes.

### Bimetals

The bimetal will provide the solution to many problems concerning thermal switching devices.  
Dimensions: width 3 to 120 mm; thickness 0.2 to 1.5 mm

### Tolerances:

nominal thickness in mm	<0.4	0.4	0.5 to 1.4	1.5
tolerance in mm on the thickness	$\pm 0.015$	$\pm 0.02$	$\pm 0.03$	$\pm 0.04$
on the width	$\pm 0.2$	$\pm 0.02$	$\pm 0.02$	$\pm 0.02$

### Special wires

Apart from tungsten and molybdenum a great number of wires of other metals are used in the electrical and electronic industries. As some of these wires are obtainable in good qualities everywhere in the world, we have specialized our production on those types of wire which have to conform specific requirements as to properties, diameters and tolerances. The most important item in this group of special wires is the *nickel-iron-copperclad wire*, to be used as a sealing wire for normal glass.

## 51. CHEMICALS

### RESINS

**Phenol-formaldehyde resins** form the basic product for the manufacturing of moulding powders.

**Cresol-formaldehyde resins** for the manufacturing of cresol-formaldehyde wire lacquer.

### MOULDING COMPOUNDS

**Philips moulding powders** are of the thermosetting type. They consist of phenol-formaldehyde resin, fillers and additives with various functions. They are suitable for the manufacture of a wide variety of articles. A number of normal standard grades, and specially granulated powders for automatic moulding, are available.

**Philips premixes** are also of the thermosetting type and consist of polyester resins mixed with fillers, e.g. glass fibre and inorganic materials. They give strong mouldings with good mechanical and good electrical properties.

### DERIVATIVES OF TUNGSTEN AND MOLYBDENUM

1. The disulphides of molybdenum and tungsten serve as catalysts in the petrochemical industry. Both substances are also used for lubricating purposes under extreme temperatures and pressure (30—40 % less wear).
2. Tungsten powders (doped and undoped), tungsten blue oxide, ammonium paratungstate and tungstic acid. Sodium tungstate for pigment industries.
3. Molybdenum powder, molybdenum dioxide, ammonium paramolybdate, zinc molybdate for pigment industries.

### FLUORESCENT AND LUMINESCENT POWDERS

### GASES

#### Rare gases

Argon, neon, helium, krypton and xenon. They are pure or mixed with rare or unrare gases.

#### Oxygen, nitrogen, hydrogen

These gases are supplied with a high degree or technical degree of purity.

#### Forming gases

These gases are mixtures of nitrogen and hydrogen, inflammable or unflammable.

## 52. GLASS

The glass supplied by our concern is a product of scientific research, highly developed industrial methods and fine workmanship.

A wide variety of glasses including lead glass, soda-lime glass, borosilicate glass and quartz glass is available for special purposes such as tungsten sealing, molybdenum sealing, fernico sealing, graded glass sealing and where special properties are required: high ultra violet transmissivity, low dielectric losses, high electrical resistivity, low electrical resistivity, high-temperature strength, high chemical stability. All these glasses are available in different forms such as tubes, rods and moulded and blown items.

Detailed information on chemical and physical properties, standard dimensions, etc. is available and will be supplied on request.

## 53. PLASTICS

### SAFETY HELMETS AND CAPS

Made from phenolic laminates on textile base (electrically insulated) or from glassfibre-reinforced polyester. The inner lining, made of leather, is held in position by a lace and it can be adjusted to fit sizes 52/58 and 58/62.

Weight (approx.) in phenolic laminates:

helmet (complete), size 52/58: 375 g, size 58/62: 385 g

cap (complete), size 52/58: 300 g, size 58/62: 310 g

Colour: for phenolic laminates: natural (from yellow to brown), for polyester: white.

(Other colours for bigger quantities, on request)

The safety helmets and caps meet the standards of the security instructions as formulated in the American Safety Code and other national security institutes.

### HOME FITTINGS AND SANITARY ARTICLES

The home fittings range comprises doorhandles, front-door knobs, letterbox plates, espagnolettes, closet seats, etc. All these articles are available in black and ivory.

### SYNTHETIC-RESIN-BONDED LAMINATES

#### a. Phenolic laminates on paper base

Dimensions: 1270 mm × 870 mm

Thickness: 0.2 to 45 mm

#### b. Copper-plated phenolic laminates on paper base

For dimensions see (a).

Thickness of copper foil: 35  $\mu$ m.

Basic material for the production of printed wiring.

Our "Hardpaper" booklet contains detailed information on the subjects of paragraphs (a) and (b).

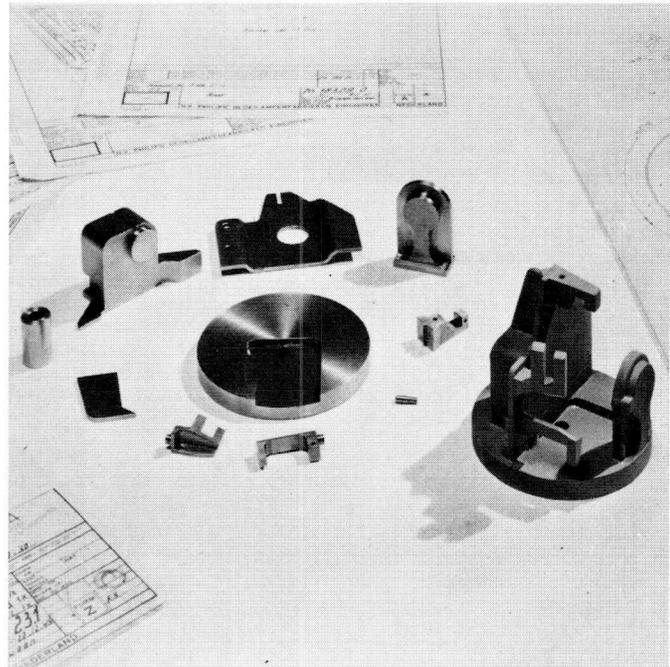
#### c. Phenolic laminates on textile base

Dimensions: 1270 mm × 870 mm

Thickness: 1 to 45 mm

## 54. PRECISION-CASTING PRODUCTS

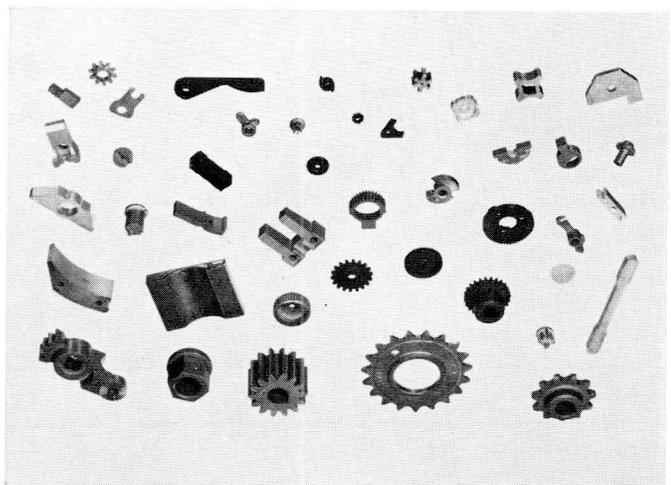
Thanks to the work done in our Physical Research Laboratory, the produced castings have a high degree of dimensional accuracy and a very smooth surface of practically all kinds of metals. Normally we manufacture castings not exceeding dimensions of 600 mm.



The component parts of a product made by conventional methods. To the right the complete product made by the lost-wax method of casting.

## 55. METAL-POWDER-SINTERED PARTS

The advantages of the powder metallurgy are being recognized more and more by engineers and designers. The process saves money and yields products with very narrow tolerances.



Some examples of sintered products.

## 56. DIAMOND WIRE-DRAWING DIES

Dies with diameters of 0.007—2500 mm (0.000275—0.0985 in) can be supplied for the drawing of all kinds of wire. The dies have diamonds of the highest quality, mounted in an inner casing of a special alloy, which reinforces the diamond; the whole is mounted in an outer casing of stainless steel.

### Die-hole tolerances

die-hole diameter		tolerance	
mm	in	mm	in
<0.025	<0.00099	0.0003	0.000012
0.026—0.050	0.001—0.00197	0.0004	0.000016
0.051—0.075	0.00198—0.00295	0.0006	0.000024
0.076—0.100	0.00296—0.00394	0.0008	0.000032
0.101—0.200	0.00395—0.00788	0.0016	0.000064
0.201—0.335	0.00789—0.01315	0.002	0.00008
>0.335	>0.01315	0.003	0.00012

Normally the dies are supplied with negative tolerances. Upon request the dies can be delivered with positive tolerances or with partly positive, partly negative tolerances.

### Tolerance on roundness:

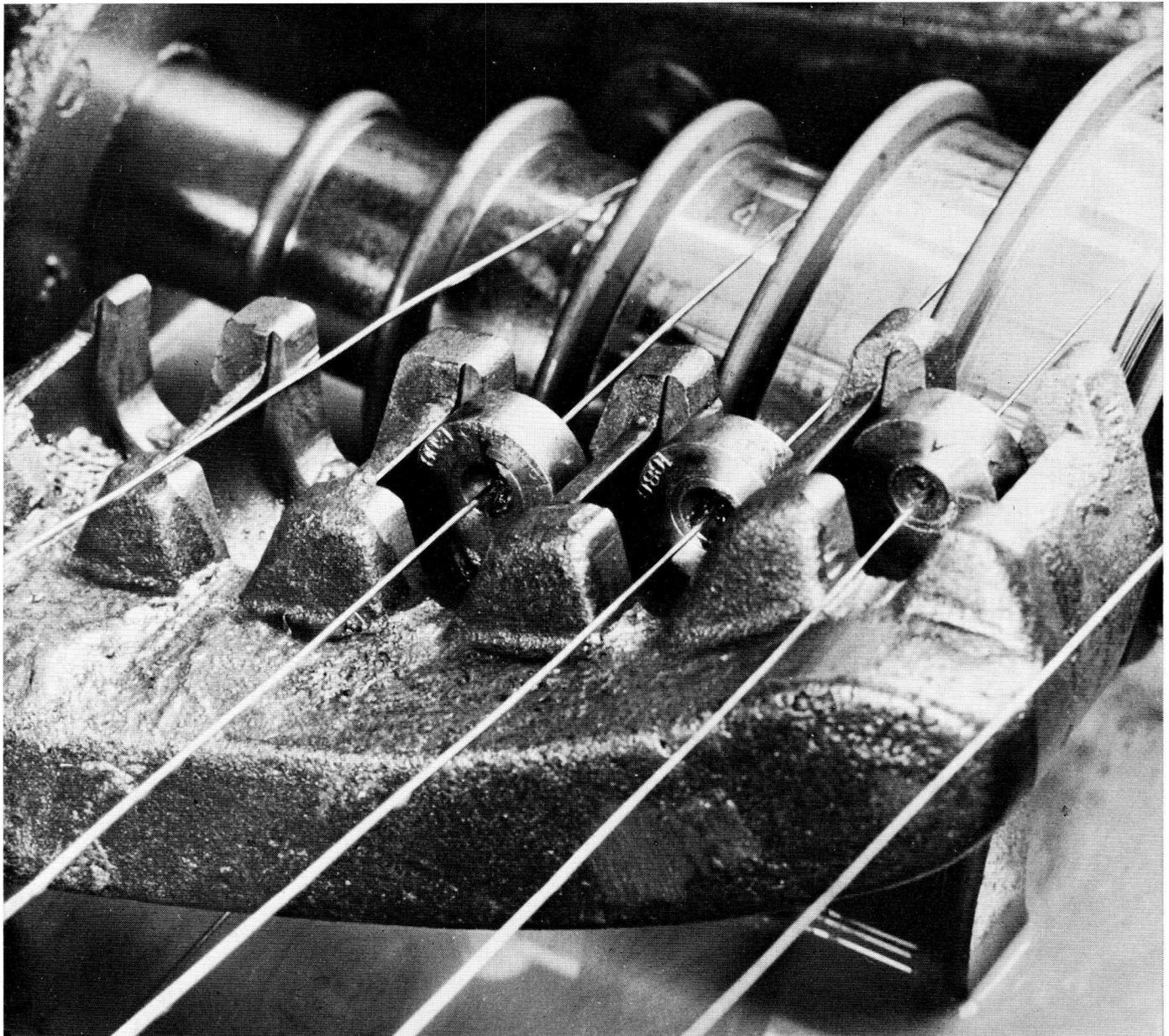
The tolerance on the roundness of the hole is 0.5 % of the rated diameters of up to 0.400 mm (0.01575 in), 0.002 mm (0.000078 in) for diameters up to 2.0 mm (0.0788 in) and 0.003 mm (0.00012 in) for larger diameters.

### Polishing equipment for reconditioning diamond dies

To obviate formalities and considerable expense involved in sending used dies for reconditioning to Eindhoven, it may be advisable for the customer to have his own department where diamond dies can be reconditioned. Repolishing tables with 5 or 10 machines can be supplied to our customers.

### Dimensions of mount

hole diameter		mount dimensions	
mm	in	mm	in
<0.100	<0.00394	25φ × 6	1φ × 0.24
0.101—0.500	0.00395—0.01968	25φ × 8	1φ × 0.31
0.501—1.000	0.01969—0.03936	25φ × 10	1φ × 0.39
>1.000	>0.03936	25φ × 12	1φ × 0.47



Wire-drawing with Philips diamond dies.



# SUBJECT INDEX

## A

Adaptation goggles  
 Adaptor  
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 (waveguide-to-coaxial)  
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 (dummy)  
 filter (variable)  
 for radio-relay links  
 (groundplane)  
 gutter  
 (helical television)  
 matching unit  
 (outdoor)  
 (single dipole outdoor)  
 (super-turnstile television)  
 (transmitting and receiving)  
 Air-gap trimmers  
 Airborne dust monitor  
 Aircraft lamps  
 Airground position device  
 Airport  
 lighting  
 television (closed circuit)  
 (transistorized radar for)  
 Alarm  
 monitor (gamma)  
 system (loudspeaker)  
 Altrilux floodlight fitting  
 Ambiophonic equipment  
 Ammonium paramolybdate  
 Ammonium paratungstate  
 Amplifier  
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 (distribution)  
 (excitation)  
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 (high fidelity stereophonic)  
 (high power)  
 (input)  
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 (line)  
 (linear)  
 (low-noise linear)  
 (measuring)  
 (monitoring)  
 (non-overloading)  
 (output)  
 (playback)  
 (pre-)  
 rack equipment  
 (recording)  
 (stereophonic)  
 system  
 (transistor)  
 (transistor mixer)  
 with time control  
 Amplitude  
 measuring apparatus  
 (pulse-) analyser  
 Analector projector  
 Analog  
 set point unit  
 to digital converter  
 Analyser  
 (anti-coincidence)  
 (pulse-amplitude)  
 (pulse-height)  
 (semi-automatic anti-coincidence)

(transistor)  
 (universal)  
 Angiography table  
 Anode  
 (cavitrax)  
 (single-) rectifying tubes  
 Antenna (slotted waveguide)  
 Anticoincidence  
 analyser  
 combination for low-level beta  
 counting  
 unit (universal)  
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 Aorto-arteriography table  
 Aprons (lead rubber)  
 Arc lamp  
 Argon  
 Arresters (surge)  
 Arteriography table (aorto)  
 Assembly  
 amplifier  
 (crystal holder sledge)  
 (head)  
 (liquid scintillation counting)  
 Attachment  
 (texture)  
 to mounting channels  
 (X-ray spectrograph)  
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 (fixed waveguide) X-band  
 (flap)  
 (logarithmic)  
 probes  
 (rotary vane)  
 (variable calibrated)  
 (variable flap)  
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 broadcasting  
 equipment  
 transformer  
 (transmitter) control equipment  
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 Ballast for fluorescent lamps  
 Ballistocardiography apparatus  
 Barium mixer  
 Battery  
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 radio  
 record player  
 shaver  
 Beacon (dual radio)  
 Beam (load)  
 Bench (loading) for use in the darkroom  
 Bench (measuring) accessories  
 Bends (waveguide)  
 Beta counting assembly (low level)  
 Bicycle lamps  
 Bimetals  
 Black light lamps  
 Blackboard (electronic)  
 Blankets (automatic)  
 Blended light lamps  
 Block  
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 (connecting)  
 (louvre)  
 (midget connecting)  
 (terminal)  
 Boat lamps  
 Bobbin resistors  
 Bolometer bridge  
 Bowl  
 reflector lamp  
 reflector lamp fittings

Box  
 (cold)  
 (control)  
 (loudspeaker)  
 (switch)  
 Brackets  
 (ceramic mounting)  
 (mounting)  
 (wall)  
 Branch exchange  
 (private automatic)  
 (private manual)  
 Bridge  
 (bolometer)  
 (conductivity measuring)  
 (direct reading measuring)  
 (direct reading strain measuring)  
 (strain gauge measuring)  
 (universal measuring)  
 Broadband  
 millivoltmeter  
 oscilloscope  
 power travelling wavetubes  
 Broadcast  
 aerials  
 (audio equipment for) and  
 television studios  
 (medium-wave) transmitter  
 (short wave) transmitter  
 studio audio equipment  
 transmitter  
 Bucky  
 diaphragm  
 stands  
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 table with transparent top  
**C**  
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 for drying of radiographs  
 Cable  
 (screened two-core)  
 transformer  
 Calibrated  
 phase shifter  
 variable impedances  
 Calibration standard  
 Call equipment (luminous)  
 Camera  
 chain (colour television)  
 chain (vidicon)  
 (compact t.v.)  
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 (high-speed mirror) for mass  
 photofluorography  
 (industrial t.v.)  
 (photographic recording)  
 (single-column stand for mirror)  
 (spot-film) for image intensifier  
 (standard industrial t.v.)  
 switching unit  
 (universal flat plate)  
 (vidicon television)  
 (weather-proof) housing  
 Capacitor  
 (anti-interference)  
 (ceramic)  
 (correcting)  
 (electrolytic)  
 (flat-foil)  
 (foil dielectric variable)  
 for starters of fluorescent lamps  
 (high tension)  
 (large general purpose electrolytic)

(long life midget electrolytic)  
 (mica)  
 (midget electrolytic) for photo-flash  
 (midget tubular ceramic)  
 (midget tubular polystyrene)  
 (miniature general purpose  
 electrolytic)  
 (moulded metallized polyester)  
 (paper)  
 (polyester)  
 (polystyrene)  
 (power factor)  
 (tantalum)  
 (transmitting)  
 (tuning)  
 (variable)  
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 Cardiograph  
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 Cardicphon  
 Cardioscope  
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 (piezo-electric crystal)  
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 for radiography  
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 Cast aluminium table stand  
 Catheterization table  
 Cathode follower probes  
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 (radar)  
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 (load)  
 (photoconductive)  
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 (mounting) for fluorescent lamps  
 (telegraph system)  
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 Chemical products  
 Cine radiography  
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 pulse unit  
 viewing table  
 Cinema  
 amplifier  
 broadcasting  
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 (home) apparatus lamps  
 loudspeakers  
 projector  
 rectifier  
 Circophone loudspeaker

- Circuit blocks  
Circuit continuity check system  
Circular fluorescent lamps  
(mounting units for)  
Circular scale indicator  
Clamping collet knob  
Clarifier  
(combined coolant)  
(magnetic coolant)  
(universal)  
Classifier (electronic)  
Cleaner  
(ultrasonic)  
(ultrasonic) with immersible transducer  
Clock (darkroom)  
Closed circuit television  
equipment  
for underwater use  
for use on airports  
transmission system  
CO<sub>2</sub> automatic pipe machine  
CO<sub>2</sub> welding plant (semi automatic)  
Coaxial switch  
Cobalt therapy equipment  
Coffemill  
Coils  
for tube-equipped radio-receivers  
/loading) and cases  
Cold  
box  
cathode indicating tubes  
cathode trigger tubes  
Collimators  
Colour t.v.  
camera chain  
flying-spot slide scanner  
monitor  
Colour lamps  
Column (sound)  
Communication  
receiver  
transmitter  
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(electromechanical)  
for lamps  
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Conductivity  
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control unit  
(direct reading) meter  
meter for industrial use  
Cone (clamping)  
Connecting blocks  
Connectors (printed wiring)  
Contact therapy equipment  
Control  
(aeronautical telecommunication)  
desk  
boxes  
equipment for welding  
knobs  
(light) regulator for fluorescent  
lamps  
(oil burner)  
panel  
(printer)  
(remote) equipment  
(resistance welding) "Tempomat"  
(television transmitter) desk  
(transmitter audio) equipment  
Converter  
(analogue to digital)  
(frequency voltage-)  
(radar/radio-relay and radio-relay/  
radar)  
(television)  
Cooling machine (single cylinder gas)  
Corner cutter (film)  
Count  
rate meter (linear)  
rate meter unit (linear)  
unit (preset)  
Counter  
(decade electronic)  
(electronic)  
(adjustable) mount  
(analyzing)  
controlled t.v. generator  
holder sledge assembly  
microphone  
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oscillator  
units  
(wide band) mount  
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regulator tubes  
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Data processor  
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Debye-Scherrer powder camera  
Decade  
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Decorative lamps  
Deep therapy equipment  
Deflection unit (master)  
Delay unit (trigger)  
Demodulator  
(diplex) equipment  
(nyquist)  
(tone)  
Dental radiograph  
Desk  
(aeronautical telecommunication)  
telephone set  
(television transmitter control)  
Detector  
(clinical stands for scintillation)  
(gas-flow)  
(high precision standing wave)  
(large area low-level beta)  
(low-intensity beta)  
(radiation)  
(scintillation)  
(scintillation) stand  
(standing wave)  
Diagnoscope  
Diagnostic  
stand  
(universal hand tilted X-ray) table  
X-ray installation  
X-ray monitor  
Dial lamps  
Diamond wire drawing dies  
Diaphragm  
(multiple-leaf light-beam)  
(new oscillating bucky)  
unit (automatic)  
Diathermy short-wave apparatus  
Dictation machines  
Dielectric loss heating generators  
(electronic preset time)  
(high-speed electronic)  
(high-speed electronic) for preset  
count measurements  
(high-speed preset-count preset-  
time)  
(high-speed preset-count preset-  
time) with ratemeter  
(high-speed) with preset count  
facilities  
(preset-count preset-time)  
(reversible digital)  
(single-channel)  
tubes (probes for Geiger-Müller)  
Counting assembly (low-level beta)  
Counting units  
Coupler  
(cross-guide directional)  
(directional)  
Cryogenerator  
Cryptoscope  
Crystal  
Discharge flash tubes for photography  
Discharge lamps  
Discriminator  
(linear amplifier/threshold)  
(single channel pulse height)  
Dishwasher (automatic)  
Dispersive type fittings  
Display unit  
(luminous)  
(radar)  
Diversity (dual) telegraph receiving  
equipment  
Dosimeter (universal)  
Double-band projector  
Double-beam oscilloscope  
Double pulse generator  
Dripproof  
fitting  
mounting channels  
Drive unit (teleprinter)  
Driver unit  
Drying  
cabinet for radiographs  
installation for X-ray films  
Dual current welding apparatus  
Dustproof  
and watertight mounting channel  
fitting for churchlighting  
Dynamometer  
**E**  
Earphones for portable radios  
Eidophor system (large screen)  
Electric suction apparatus  
Electro  
acoustic dual-cone loudspeaker  
acoustic equipment  
cardiograph  
dynamic vibration transducer  
encephalograph  
surgical unit  
Electrodes (welding)  
Electroluminescent panels  
Electromechanical components  
Electromedical X-ray apparatus  
Electron tubes  
Electrophone  
(automatic stereo)  
(battery)  
for monophonic reproduction  
(mains)  
(stationary)  
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Exchange  
(private automatic)  
(private automatic branch)  
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Expansion transducer  
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Fan heater  
"Fantasie" lamps  
Fernico strips  
Ferrite isolator  
Ferroxcube X-band  
Festive illumination lamps  
Field telephone set  
Filaments  
Film  
and slide projectors  
camera for image intensifier  
corner cutter  
filing cabinet  
filing equipment (X-ray)  
processing installation (self-  
contained X-ray)  
processing machine (automatic)  
projector  
size indicator  
viewer for remote observation of  
radiographs  
viewer (motordriven)  
viewing cabinet (motordriven)  
Filmclips  
Filmhangers  
Filter  
(harmonic)  
(magnetic)  
(magnetic) for cleaning the  
lubricating oils of diesel and  
turbine engines  
(magnetic-mechanical) for cleaning  
of lubricating oils panel  
(variable aerial)  
Filterplexer  
Fitting  
(discharge lamps)  
(fluorescent lamps)  
(incandescent lamps)  
(indoor lighting)  
(outdoor lighting)  
Fixed station receiver  
Flange  
adaptor  
(wall)  
Flap attenuators  
Flasher lamps  
Flashlight lamps  
Flashtubes (discharge) for photography  
Flexible shafts  
Floating zone refiner for H.M.P. metals  
Floodlight fitting  
Floor polisher  
Fluorescent lamp  
Fluorescent powders  
Fluoroscope  
(television)  
(transportable) with image  
intensifier  
(vertical)  
Focus-and iris ring adjuster  
Frame grid tubes for t.v.  
Freezer (refrigerator) combination  
Frequency  
meters  
modulation system  
multiplier  
Frying pan (electric)  
Furnace  
(melting) for induction heating  
generators  
(melting) for the analysis of  
contents in steel samples  
Fuse carriers for glass cartridge-fuses  
**G**  
Galvanometer point recorders  
Gamma spectrometer  
Gas  
density compensator  
noise source  
range (kerosene)  
rare  
Gauge  
film lamps  
(strain)

Gears (reduction) for small synchronous motors	road lanterns	(clamping-collet)	(spectral)
Geiger Müller counter tubes (probes for)	voltage indicator (neon)	(control)	(table)
Generator	voltage supply/pre-amplifier	(vernier control)	(telephone switchboard) with tungsten filament
(audio frequency)	Holder	Krypton	('TL' and 'TLW' fluorescent)
(crystal controlled t.v.)	for quartz-crystal units		(toy)
(double pulse)	(lamp)	<b>L</b>	(tubular quartz infra-red)
(encoder)	(specimen)	Lampholder	(ultra-violet rays)
(f.m. stereo multiplex)	(specimen) mask	Lamphouse	Language laboratory
for dielectric loss heating	Home	Lamps	Lanterns
for induction heating	cinema lamps	(aircraft)	(high road)
(high frequency)	lighting fittings	(airport)	(post-top)
(klystron)	Hoods (rubber viewing)	(arc)	(safelight)
(low frequency)	Horn	(ballast) on low voltage d.c. supply	(viewing)
(modular pulse)	(loudspeaker)	(bicycle)	<b>Large screen</b>
(noise)	(re-entrant)	(black light)	compatible colour t.v. projector
(photo-electric pulse)	Hoses (water)	(blended light)	projector "Eidophor"
(signal)	Hospital equipment	(boat)	t.v. projection
(single-channel) for t.v. bands	Housing	(bowl reflector)	<b>Lead</b>
(standard pattern)	(camera protective)	(Christmas tree illumination)	glass planes
(square wave)	(module) for electronic instrumentation	(cinema apparatus)	-in wires
(subcarrier)	Humidity	(circular fluorescent)	-ins (synthetic resin)
(synchronizing pulse)	cell	(coloured)	letters and figures
(television service pattern)	indicator (air)	(current indicator)	rubber aprons
(transistorized colour-bar)	Hybrid tees	(darkroom)	rubber arm cuffs
(ultrasonic)	Hydrogen thyratron	(decorative)	rubber gloves
(universal pulse)	<b>I</b>	(desk)	rubber panties
(X-ray)		(dial)	rubber protective shirt
(X-ray diffraction)	Ignition unit for thermionic tubes	(discharge)	rubber sheets
<b>Germicidal lamps</b>	Ignitron	("double-flux" fluorescent "TL")	shieldings (universal)
<b>Glass</b>	Image intensifier	(fantasie)	<b>Lens driving unit</b>
components for lamps	(cine control unit for)	(festive illumination)	Lenses for vidicon t.v. cameras
(borosilicate)	Image orthicons	(flasher)	Lenslite lamps
(lead)	Impedances (calibrated variable)	(flashlight)	Letters (lead)
(quartz)	Incandescent lamps	(floor)	Level meter (sound-)
(soda-lime)	Indicator	(fluorescent)	<b>Light beam</b>
to metal seals	(circular scale)	(fluorescent sun-) for the equipment of solaria	centring device
<b>Gloves (lead-rubber)</b>	(electronic temperature) for thermocouples	for narrow gauge film and home cinema apparatus	diaphragm (multiple-leaf)
<b>Goggles (adaptation)</b>	(film-size)	(forced cooled super-high pressure mercury)	<b>Limiter</b>
<b>Gonad</b>	lamps (current)	(gauge film)	Link equipment (studio transmitter)
apron	(neon voltage)	(germicidal)	Linking unit for manual telephone switchboard
shield	(potentiometric) and recorders for electronic weighing	(glow) for residential use	<b>Links</b>
<b>Goniometer</b>	(round-scale weighing)	(halogen incandescent)	(aerials for radio-relay)
accessories	Indoor lighting fittings	(high-efficiency integral sodium)	(telephone multiplexing equipment for radio)
(wide range)	Induction heating generators	(high-intensity arc)	Liquifier (single-cylinder gas)
<b>Gradated intensifying screens</b>	Inductive	(high output fluorescent "TL")	Liquid nitrogen plant
<b>Gramophone (radio)</b>	loop interpreting installation	(home cinema)	<b>Listen set</b>
<b>Granulated glass powder</b>	paging system	(illumination)	<b>Load</b>
<b>Graticules for oscilloscope</b>	transducer	(incandescent)	beam
<b>Grenz ray therapy equipment</b>	transmission system	(indicator)	cell
<b>Grill</b>	Infra-red heat lamps	(infra-red)	(dummy)
<b>Groundplane aerials</b>	Input	(infra-red reflector heat)	(low power matched) band
<b>Gutter aerial</b>	amplifier	(infra-red tubular quartz)	potentiometers
	equipment (audio)	(lens-end)	resistors
<b>H</b>	transformer	(lenslite)	<b>Loading</b>
Hair dryer	Instantuners	(light control regulator for fluorescent)	bench for use in the darkroom
Hair trimmer	(multiturn)	(mercury)	coil
Halogen incandescent lamps	(single-turn)	(microprojection)	coil cases
Hanger drainage rack	Intensifier	(miniature)	<b>Loads (matched)</b>
Harmonic filter	(cine control unit for image)	(miniature) for bicycles and bicycles with auxiliary motor	Logarithmic attenuator
Head	(image)	(miniature "TL" fluorescent)	Logger (strain gauge and temperature data)
assembly	Intensifying screens (gradated)	(motorcar)	<b>Loop transformer</b>
(pan and tilt)	Intercom exchange	(motorcar) for American, British and European cars	<b>Loudspeaker</b>
phones	Intercommunication systems	(narrow gauge)	alarm system
Hearing aid	Intermediate therapy equipment	(neon signal)	box
Heart examinations (X-ray kymo cassette for)	Interpreting installations	(normal incandescent)	(cinema)
Heart sound microphone	Invertor	(photo)	(circophone)
Heart sound microphone stand	Iron	(Pisella)	columns
Heart sound pre-amplifier	(electric)	(prefocus flashlight)	(double-cone)
Heat lamps (reflector infra-red)	(electric steam or dry)	(projection)	(dual cone)
Heater	Isolator	(projector)	grille
(fan)	(ferrite)	(pulsed discharged)	(high fidelity)
(immersion)	(ferrite) X-band	(quartz infra-red)	horn
<b>Heating</b>	Isotopes (radioactive)	(rapid start fluorescent "TL")	in cabinet
(high intensity radiant) generators	<b>K</b>	(reflector)	transformers
Helical television aerials	Kerosene gas range	(reflector fluorescent)	with earshell
Helicontraster	Klystron	(reflector infra-red heat)	(wall)
Helium	generator	(signal)	<b>Louvre blocks</b>
Helmets	mount X-band	(slimline)	<b>Louvre system for recessed lighting</b>
(safety-)	reflex	(sodium)	<b>Low</b>
(mining-)	Knife sharpener	(soundfilm exciter)	level beta counting (anti-coincidence combinations for)
<b>High</b>	Knob		level beta counting assembly
frequency heating equipment			level beta counting probe

- noise linear pre-amplifier  
voltage rectifying tubes  
Luminescent powders  
Luminous  
call equipment  
display unit
- M**
- Magnetic  
bands for recorders  
filters  
memory cores  
recording installation  
recording/playback installation  
tape store
- Magneto-dynamic stereo pick-up  
Magnetron  
Mains transformer  
Manual  
branch exchange (private)  
player  
player on base  
taring unit
- Maritime radio telephone  
Mask (specimen holder)  
Master deflection unit  
Matched  
expansion glass-to-metal seals  
loads
- Matching  
sockets  
unit (aerial)
- Matrix planes  
Measure (stainless steel)  
Measuring  
amplifier  
bridge  
instrument (electronic universal)  
for voltages and currents  
set (transmission)
- Mechanism (pan and tilt)  
Medical  
colour television system  
measuring equipment  
television chain  
X-ray television
- Medio X-ray apparatus with semi-conductor rectifiers  
Medium-wave  
broadcast transmitter  
transmitter
- Melting furnaces for induction heating  
generators
- Mercury lamps  
(enclosed fittings for streetlighting for)  
(fluorescent)  
(forced cooled super-high pressure)  
(vapour) for light printing  
processes
- Message switching system (automatic)  
Metal fittings  
for fluorescent lamps  
for outdoor lighting
- Metal-powder-sintered parts  
Meters (subscriber)  
Micro-projection lamps  
Microphone  
accessories  
(cardioid condensor)  
(condensor)  
(crystal)  
(floor) system  
(heart sound)  
(heart sound) stand  
(hypercardioid moving-coil)  
(moving-coil)  
(moving-coil cardioid)  
(moving-coil hand)  
(omni directional electrodynamic)  
(omni directional moving coil)  
transformers  
(universal moving-coil)  
(vehicle)
- Microradiograph  
Microscope (electron)
- Microvoltmeter  
Microwave  
instruments  
link equipment  
triodes
- Midget  
electrolytic capacitors for photo-flash  
electrolytic capacitors (long life)  
tubular ceramic capacitors  
tubular polystyrene capacitors
- Millimetre microwave instruments  
Millivoltmeter (broadband)  
Miniature  
lamps  
lamps for bicycles and bicycles with auxiliary motor  
lamps ("TL" fluorescent)  
receiver for inductive sound  
transmission  
resistors
- Mirror  
camera for mass photofluorography (high speed)  
camera (single-column stand for) (fitting with) for outdoor lighting
- Mixer  
(barium)  
(food)  
(three-speed)  
(transistor)  
(video)
- Mobile single and double-column stand for scintillation detectors  
Mobile ward unit  
Mobilophone  
(hermetically sealed)  
(transistor)
- Modulating equipment  
(programme)  
(television)
- Modulation  
equipment  
system (frequency)  
system (phase)
- Modulator  
(diplex)  
(tone)
- Module housing for electronic instrumentation  
Molybdenum  
dioxide  
powder
- Monitor  
(airborne dust)  
(colour t.v.)  
(diagnostic X-ray)  
(gamma alarm)  
(industrial video)  
(personnel)  
(portable transistorized radiation)  
(television)  
(transistorized pocket radiation)  
(video)  
(wave-form)  
(X-ray)
- Monitoring amplifier  
Motor  
driven film viewing cabinet  
driven stand for layer radiography  
(small synchronous)
- Motorcar lamps  
Moulding powders  
Mounting brackets  
Mounting channel  
(drip proof) for fluorescent lamps  
(dust proof and watertight)  
for fluorescent lamps  
(watertight) for fluorescent lamps
- Mounting plates  
Mounting units  
for circular fluorescent lamps  
with shade for circular fluorescent lamps
- Moving-coil microphone  
Moving-coil cardioid microphone  
Multi-
- channel electrocardiograph  
layer radiography (cassettes for)  
purpose film projector
- Multihole directional coupler  
Multiplexing equipment (telephone)  
Multiplier (frequency)  
Multipurpose photographic equipment for oscillograms  
Multiturn instantuners  
Musical instruments (electronic)  
Muting device
- N**
- Negistor equipment  
Neon  
filled noise diode  
signal lamps  
voltage indicators
- Nuclear medical measuring equipment for all applications (radio-active isotopes)
- Numerator  
Nuvistors  
Nyquist demodulators
- O**
- Oil burner control  
On-off voltage indicator tube for visual computer indication  
Organ (electronic)  
Orthicons (image)  
Oscillating bucky diaphragm  
Oscillator  
(crystal)  
(klystron)  
(modulated)  
(standard)  
(test bench)  
(variable frequency)
- Oscilloscope  
(broadband)  
(direct current)  
(double beam)  
(high frequency)  
(high frequency double beam)  
(high frequency) with differential input  
(low frequency)  
(one channel)  
(radar)  
(small)  
(small h.f.)
- Outdoor  
aerial  
aerial (single dipole)  
lighting fittings
- Output transformer  
Ovaries shield  
Oven (electronic)  
(microwave)
- Overload protection unit  
Overfader (automatic music-speech)
- P**
- Paging system  
(inductive)  
(wireless)
- Palpation spoon  
Pan and tilt head  
(indoor)  
(outdoor)
- Panel  
(control)  
(electroluminescent)  
(filter)  
(power supply)  
(speech)  
(universal transistorized electronic circuit)
- Panties (lead-rubber)  
Paper capacitors  
Parelleling cabinets for t.v. transmitters  
Peak transformers  
Pedestal bucky
- Pendant mounting (enclosed fitting for)  
Pendants (single)  
Pendulum therapy equipment  
Pentascopie viewer  
Pentode  
(dual frame-grid)  
(line output)  
(output)
- Personnel monitor  
pH-controller (automatic)  
pH-meter  
(direct reading)  
(direct-reading) with battery supply for industrial use  
(portable)
- Pharmaceutical  
chemical products  
Phase modulation system  
Phase shifter X-band (calibrated)  
Phase shifters  
Phonocardiography apparatus  
Photoconductive cells  
Photofluorographic stand with motor-driven platform  
Photofluorography (high speed mirror camera for mass)
- Photographic equipment  
(multi-purpose) for oscillograms  
(traffic)
- Photolamps  
Photomultiplier tubes  
Photomultipliers for scintillation counting
- Pick-up  
(concrete deformation)  
(electrodynamic) for relative vibrations  
heads (stereophonic and monophonic)  
heads (stereophonic ceramic)  
(inductive)  
(magneto-dynamic stereo)  
(universal inductive trigger)
- Pilot lamp holders (telephone)  
Pin (resilient)  
Pisello lamps  
Plastic fittings  
for fluorescent lamps  
for outdoor lighting with sodium lamps
- Plates (mounting)  
Playback  
amplifier  
installations
- Player  
(automatic)  
(battery record)  
(manual)
- Plethysmogram receptor  
Plethysmography apparatus  
Plotter (reflection)
- Plug  
(adaptor)  
(female)  
in transformer  
(screened)  
(single-pole)
- Plunger (calibrated)  
Pneumoscope, X-ray stand  
Polisher (floor)  
Polyester fittings for sodium lamps  
(enclosed)  
(open type)
- Portable  
apparatus for short-wave therapy  
pH meter  
radio  
stereophone  
tape recorder
- Portophone (transistor)  
Post-top lanterns  
Potentiometer  
(carbon)  
(load)  
(recorder)  
(wire-wound)
- Potentiometric displacement pick-up

Potentiometric measuring instruments	<b>Q</b>	amplifier	Scanning unit (automatic)
Powders	Quartz-crystal units	(magnetic) installation	Scatter equipment for television
(capping cement)		(magnetic) playback installation	Scintillation
(fluorescent)		Rectified Rotalix tube unit	counting (photomultipliers for)
(granulated glass)	<b>R</b>	Rectifier	detector
(luminescent)	Radar	(battery charging)	detector (mobile single and double
(molybdenum)	cathode ray tube	(cinema)	column stand for)
(moulding)	display unit	(X-ray apparatus with semi-	probe
(tungsten)	equipment tubes	conductor)	Scintiscanner
Power control unit	oscilloscope	Rectifying tubes	Screened
Power supply	radio-relay converter	Reduction valve	plugs
(compatible) package	radio-relay supervisor	Refining apparatus (floating zone)	sockets
(d.c.)	test equipment	Refining installation (automatic	two core cables
(high tension d.c.)	test set band	germanium zone-)	Screens
panels	(transistorized) for airports	Reflection plotter	(gradated intensifying)
(regulated d.c.)	(transistorized river)	Reflectometer	(intensifying)
(stabilized)	(transmitter receiver)	Reflector	(mobile protective)
(stabilized klystron)		(adjustable) for mounting channels	Seal
(stabilized) unit	Radiation	(fluorescent lamps)	(matched-expansion glass-to-metal)
unit	counter tubes	(infrared heat lamps)	(vacuum)
(voltage stabilized)	therapy (equipment for)	(lamp)	Seat
Pre-amplifier	Radio	(trough) for mounting channels	(mobile protective)
(equalizing)	(a.c., d.c.) receiver	Refrigerating machine	(X-ray protective)
(high voltage supply)	(all transistor)	Refrigerator	Secretary circuits
(linear)	(a.m./f.m.) receiver	Refrigerator-freezer combination	Sections (waveguide)
(video)	beacon (dual)	Regulated d.c. power-supply	Selective calling common talking system
Pre-set-count	(car)	Regulator	Selective calling system
preset-time counter	code paging receiver	(light control) for fluorescent lamps	Selector
unit	console wall radiogram	tubes	(programme)
Pre-modulator	(earphones for portable)	Relay	(video)
(telegraph)	(f.m. stereo) receiver	(electronic)	Semaphones
Pressure transformer	grammophone	(high-speed)	Semi-conductor
Printer	links	unit	Separating transformer
control	(portable)	Remote control	Separator (magnetic dry)
(high speed digital)	relay equipment	equipment	Servo-system
switch	really equipment for telephony	unit	Setpoint box
Probe	relay equipment for telephony and	Reproducer	Sharpener (knife)
(diode)	t.v.	(piezo-electric ceramic)	Shaver
for Geiger Müller counter tubes	relay links	(piezo-electric crystal)	(battery)
(low-level beta counting)	(stereo) receiver	Resins	(dry)
(scintillation)	telephone	(phenol-formaldehyde)	(electric)
Processing	telephone (direct dialling party-	(polyester)	Shieldings (universal lead)
and drying installation for X-ray	line)	Resistance welding controls	Shifter (phase)
films (automatic)	telephone for remote locations	Resistors	Short-wave
machine for film (automatic)	telephone switchboard	(adjustable type)	broadcast transmitter
(rapid) unit for use in the operating	telephone systems	(bobbin)	transmitter
theatre	telephone terminal	(carbon)	Shunt tee
(semi-automatic) unit	(transistor portable)	(disc.)	Signal
(small type) sets at choice in	Radioactive isotopes	(linear)	(neon) lamps
stainless steel or plastic	Radiograph (drying cabinet for)	(load)	tracer
unit with separate cooler	Radiography	(miniature)	Signalling (ring down) equipment
Processor (data)	(cassettes for)	(non-adjustable type)	Silicon reprocessing equipment
Programme selector	(motor-driven stand for layer)	(non linear)	Simultaneous interpreting system
Projection lamps	Radiological accessories	(rod)	Single
Projector	Rate meter	(voltage dependent)	anode rectifying tube
(analector)	(linear count)	(wire-wound)	channel counter
(cinema)	(logarithmic count)	Reversible digital counter	column stand for mirror cameras
(double band)	Re-entrant horn	Ring	dipole outdoor aerial
(film)	Receiver	-down signalling equipment	turn instantuners
lamps	(communication)	(driving)	Skirt (lead-rubber protective)
(slide)	(miniature) for inductive sound	stand	Slide projector
(sound film)	transmission	(trigger)	Sliding screw tuner X-band
(spectro analysing)	(radar transmitter)	Ringing unit	Slimline lamps
(t.v. large screen and colour)	(radio code paging)	River rader (transistorized)	Slotted waveguide antenna
with pulsed discharge lamp	(special quality)	Road lanterns	Sockets
Protective	(transmitter)	Rod resistors	for tubes
(camera) housing	Receiving	Rods (stirring)	for units
lead impregnated rubbersheets	adapter (twinplex-diplex telegraph)	Rotary vane attenuator	(matching)
screens (X-ray)	aerials	Rotational therapy equipment	(screened)
seat (X-ray)	and transmitting unit (combined)	Rubber	(transistor)
Public address system	(dual diversity telegraph)	aprons (lead)	(tube)
Pulse	equipment	arm cuffs	(wall)
amplitude analyser	equipment	glass planes	Sodium lamps
generator (double)	Receptor (pulse)	gloves (lead)	Sodium molybdate
height analyser	Recessed mounting (fitting for)	panties	Soliscopes viewer
height discriminator (single	Record player	protective skirt	Sound
channel)	(automatic) for cars	sheet	column
receptor	(battery)	viewing hoods	column transformer
unit (cine) for pulse technique in	Records	<b>S</b>	delay machine
cineradiography	Recorder	Safelight lanterns	equipment
Pulsoscillograph	(automatic multi-channel)	Sample changer (automatic)	film equipment
Pump	(automatic potentiometer)	Scanner	film projector
(cryogenic transfer)	(galvanometer point)	(automatic)	head
unit (high vacuum)	(tape-)	(colour t.v. flying spot slide)	installations
Punch control	(transportable tape)	(universal scintillation)	level meter
Purity tester (liquid nitrogen)	Recording		systems
			tracks (magnetic and optical)

- Soundfilm exciter lamps  
Source (gas noise)  
Specimen holder  
    (flat rotating)  
    (mask)  
Specimen stage for electron microscope  
Spectral lamps  
Spectrograph  
    (universal vacuum X-ray)  
    (X-ray) attachment  
Spectrography (X-ray) accessories  
Spectrometer  
    (automatic single-channel gamma)  
    (automatic X-ray)  
    (digital)  
    (preset-count preset-time)  
    (semi-automatic X-ray)  
Spectrometry tubes (X-ray)  
Speech  
    compandor equipment  
    duplex telegraph systems  
    listen set  
    panel  
Speedmeter (electronic road)  
Spoon (palpation)  
Spot-film camera for image intensifier  
Spotlight  
Spotlight fitting  
    for bowl reflector lamps  
    for pressed glass reflector lamps  
Square wave generator  
Stabilized power supply  
Stabilizer  
    (a.c. voltage)  
    for high voltages  
    (voltage) for a.c. supplies  
Stand  
    (bucky)  
    (cast aluminium table)  
    (clinical) for scintillation detector  
    (floor)  
    (mobile single and double-column)  
    for scintillation detectors  
    (motor-driven) for layer radiography  
    (photo-fluorographic) with motor-driven platform for patient  
    (pneumoscope X-ray) for examining standing patients  
    (ring)  
    (self-contained, mobile, universal)  
    (single-column) for mirror cameras  
    (surgical radiology apparatus)  
    (telescopic floor)  
    (therapy X-ray)  
    (universal X-ray therapy)  
    (vertical fluoroscope, self contained)  
    (vertical diagnostic X-ray)  
    (waveguide)  
Standard  
    (calibration)  
    capacitor (variable)  
    oscillator  
Standing wave detector X-band  
Stereo tuner  
Stereophone  
    (automatic)  
    (portable)  
Stereophonic  
    amplifier  
    amplifier (high fidelity)  
    and monophonic ceramic pick-up head  
    and monophonic pick-up heads equipment  
Stethoscope (electrical)  
Strain  
    and temperature data logger  
    gauge  
    indicator (portable)  
    measurement (adjusting and switching apparatus)  
    measuring bridge  
Streetlighting  
    (enclosed) fitting  
    (enclosed) fitting for mercury lamps  
    (enclosed) fitting for sodium lamps  
Stroboscope  
Stud welding process  
Studio  
    (broadcast) audio equipment  
    (television) audio equipment  
    (television) equipment  
    transmitter link equipment  
    (video and audio t.v.) equipment  
Suction apparatus (electric)  
Super-turnstile t.v. aerials  
Suppressor  
Surge arresters  
Surgery apparatus (electro-)  
Surgical  
    (electro-) unit  
    radiology apparatus  
    radiology apparatus stand  
Suspension  
    (ceiling) of X-ray tube  
    systems for fluorescent lamp fitting  
Switch  
    box  
    (electronic)  
    (motordriven coaxial)  
    (printer)  
Switchboard  
    (radio-telephone)  
    (telephone) lamps with tungsten filament  
    (trunk)  
Switching  
    apparatus for strain measurements  
    equipment for low level measuring signals  
    system (automatic message)  
    unit (camera)  
Synchronizing pulse generator  
Synchronous motors  
Synthetic resin lead-ins  
Syphon (automatic)  
**T**  
Table  
    and wall support for use with the compact television camera  
    (aorto-arteriography)  
    (bucky) with perspex top  
    (bucky) with transparent top  
    (catheterization)  
    (cine viewing)  
    (examination)  
    stand  
    (tilting bucky)  
    (universal hand-tilted X-ray diagnostic)  
    (universal two-tube tilting)  
    automatic serial changer  
    (universal X-ray treatment)  
Tachometer  
Tangential therapy equipment  
Tanks (through the wall and cascade washing)  
Tape  
    deck (studio)  
    recorder connection  
    recorder (transportable)  
    recorders  
    store (magnetic)  
Tare unit (automatic)  
Taring unit (manual)  
Tee  
    (hybrid) band  
    (series and shunt)  
Telecontrol and teleindication equipment  
    system  
Telegraph  
    premodulator  
    receiving adapter (twinplex diplex)  
    receiving equipment (dual diversity)  
    system  
    system channel  
    telephone transmitter  
    transmitters  
Teleindication  
    equipment (telecontrol and) systems (telecontrol and)  
Telemetering equipment  
Telephone  
    (carrier) equipment  
    (carrier) system  
    (desk) set  
    (direct dialling party-line radio) equipment  
    (field) set  
    (maritime radio)  
    multiplexing equipment for radio links  
    pilot lamp holders  
    (private) exchange  
    (public) exchange  
    (radio) for remote locations  
    (radio) systems  
    set  
    switchboard lamps with tungsten filament  
    transmission equipment  
Telephony  
    (radio relay equipment for)  
    (radio relay equipment for t.v. and)  
Teleprinter drive unit  
Teleprinting on radio  
Telescopic floor stand  
Television  
    aerials (helical)  
    aid (closed circuit)  
    camera  
    camera (vidicon)  
    chain (medical)  
    (closed-circuit)  
    (closed-circuit) for underwater use  
    (closed-circuit) for use on airports  
    (colour) at surgical clinic  
    (colour) camera chain  
    (colour) flying spot slide scanner  
    (colour) monitor  
    (colour) spotlight  
    (compact) camera  
    console receiver  
    consolette receiver  
    document viewer  
    fluoroscope  
    generator (crystal controlled)  
    (industrial) camera  
    large screen projector  
    (medical colour)  
    (medical X-ray)  
    modulating equipment  
    monitor  
    pattern  
    (portable)  
    projector  
    (radio-relay equipment for)  
    (scatter equipment for)  
    signal transmitting radio relay equipment  
    studio-audio equipment  
    studio equipment  
    (super-turnstile) aerials  
    system  
    table receiver  
    transmitter  
    transmitter control desk  
    (video and audio) studio equipment  
    (vidicon) camera  
Temperature controller (solid state blind)  
Terminal  
    block with connection cord  
    (radio telephone)  
Terminating equipment  
Test equipment  
    rack (video)  
    (radar)  
Tester  
    (liquid nitrogen purity)  
    (transistor)  
Therapy  
    (apparatus for short-wave) and electrosurgery  
    (cavity) equipment  
    (cobalt) equipment  
    (contact) equipment  
    (conventional deep) equipment  
    (deep) equipment  
    dental radiograph  
    equipment for radiation  
    equipment (fully automatic X-ray)  
    (grenz ray) equipment  
    (intermediate) equipment  
    (pendulum) equipment  
    (portable apparatus for shortwave) with facilities for minor electro-surgery  
    (radiation) equipment  
    (rotation) equipment  
    (rotational deep) equipment  
    (stationary field) equipment  
    (superficial) equipment  
    (tangential) equipment  
    (X-ray) equipment  
    (X-ray) stand  
Thermistor mount band  
Thermocouples  
    (high-vacuum)  
    (stick-on)  
Thermometer (tank)  
Through the wall and cascade washing tanks  
Thyratrons  
    (hydrogen)  
Tilt  
    heads  
    mechanism  
Tilting bucky table  
Time counter  
    (electronic preset)  
    (preset-count preset-)  
Timer  
    (electronic)  
    without display  
Titrator (automatic)  
"TL" lamps  
    (circular fluorescent)  
    (double flux fluorescent)  
    (fluorescent)  
    (fluorescent sun-)  
    (high output fluorescent)  
    (miniature fluorescent)  
    (rapid start fluorescent)  
    (reflector fluorescent)  
Tomograph  
Tone  
    demodulator  
    modulator  
Toy lamps  
Tracer (signal)  
Transceiver (data)  
Transducer  
    (direction sensitive)  
    (electro-dynamic vibration)  
    (electro-magnetic vibration)  
    (expansion)  
    (immersion)  
    (inductive)  
    (torsion and rotational speed)  
    (vibration)  
Transfer cabinet for X-ray cassettes  
Transformer  
    (arc-welding)  
    (audio)  
    (cable)  
    (industrial strain)  
    (input)  
    (l.f.)  
    (loop)  
    (mains)  
    (microphone)  
    (output)  
    (peak)  
    (plug-in)  
    (pressure)  
    (separating)  
    (sound column)  
    (super arc welding)  
    (triple arc-welding)  
    (variable)

(volume-control)	(broadband power travelling wave)	exciter	indicator
(wideband matching)	(ceiling suspended) column	meter (direct reading)	installation
Transistor	(cold cathode indicating)	(RC generator for) exciters	Welding
amplifier	(cold cathode trigger)	transducer	apparatus (dual current)
analyser	components	Video	electrodes
ballasts for "TL" fluorescent lamps	(current regulator)	and audio broadcasting	plant (semi-automatic SO <sub>2</sub> )
for television	(decade counter)	and audio t.v. studio equipment	(semi-automatic) machine
mixer	(electron)	mixer	(stud) process
mobilophone	for radar equipment	monitor	transformer (arc)
portophone	(frame grid) for t.v.	pre-amplifier	Wide-range goniometer
socket	head (powerful portable X-ray)	selector	Wideband matching transformer
tester	(instrument cathode-ray) for	studio-equipment	Wire drawing dies (diamond)
Transistorized	measuring equipment	test-rack	Wire trimmers
carrier	(low voltage rectifier)	(transmitter) equipment	Wire-wound
colour-bar generator	(on-off voltage indicator)	Vidicon television camera	potentiometers
decoder	(photomultiplier)	Viewer	resistors
radar for airports	(radiation counter)	(pentascope)	Wireless paging system
river radar	(rectifying)	(television document)	Wires
Transmission	(single-anode rectifying)	Viewing	(lead-in)
measuring set	sockets	lanterns	(special)
system for closed circuit t.v.	(special quality)	table (cine)	Wobbulator (service)
systems	stand	Volt-ohm meter	
Transmitters	(transmitting)	Voltage	<b>X</b>
audio control equipment	(T.V. picture)	dependent resistors	X-ray apparatus
(broadcast)	(voltage reference and stabilizing)	indicator (neon)	(electromedical)
(communication)	(X-ray diffraction)	on-off indicator tube for visual	(four-valve)
(medium-wave)	(X-ray) head	computer indication	(self rectified)
(medium-wave broadcast)	(X-ray spectrometry)	reference and stabilizing tubes	(standard four-valve)
(paralleling cabinets for t.v.)	Tubular quartz infrared lamps	stabilized power supply	with semi-conductor rectifiers
(prefix)	Tunable crystal mounts millimetre range	stabilizers (a.c.)	X-ray cassettes
(radar) receiver	Tuner	stabilizers for high voltages	X-ray diagnostic table
receiver	(sliding screw) band	Volume control transformer	X-ray film
(short-wave)	(stereo)	<b>W</b>	corner cutter
(short-wave broadcast)	Tungsten	Wall	filing cabinet
(special quality)	anode discs	brackets	filing equipment
(studio) link equipment	blue oxide	flange	hanger drainage rack
(telegraph)	powder	(light)	kymo cassette for heart
(telegraph-telephone)	welding electrode	mounting fitting	examinations
(television)	Tungstic acid	socket	processing installation
(universal programme)	Twinplex-diplex telegraph receiving	support for use with the Compact	X-ray generator
video and audio input equipment	adapter	television camera	(diffraction)
Transmitting	Twist (waveguide)	Ward (mobile) unit	X-ray monitor
and receiving aerials	<b>U</b>	Washing machine	X-ray protective seat
and receiving unit (combined)	Ultra-violet ray lamps	(automatic)	X-ray spectrograph
triode	Ultramicrotome	(semi-automatic)	X-ray spectrography accessories
tube	Ultrasonic cleaner with	Washing tanks	X-ray spectrometer
unit	immersible transducer	Water hoses	X-ray stand
Transportable fluoroscope with image	separate cleaning bath	Watertight mounting channel	(pneumoscope)
intensifier	Ultrasonic generator	(dustproof and)	(vertical fluoroscope, self-contained
Trigger	Unidirectional waveguide	for fluorescent lamps	vertical diagnostic)
delay unit	X-band	Waterway supervision radar systems	X-ray therapy
pick-up (universal inductive)	Uniselector	Wave-vorm monitor	equipment
ring	<b>V</b>	Waveguide	stand
Trimmer	Vacuum	antenna (slotted)	X-ray television (medical)
(air-gap)	cleaners	bends and twist	X-ray treatment table (universal)
(ceramic)	seal	stand	X-ray tube head
(hair)	Valve	switches	X-ray tubes
(wire)	(reduction)	-to-coaxial adaptor	X-ray units
Triode	see: tube	(unidirectional)	(pedestal bucky for use with)
(disc seal)	Variable	Wavemeter	(therapy)
(microwave)	aerial filter	(broad-band) X-band	Xenon
(transmitting)	frequency oscillator	(direct-reading) X-band	<b>Z</b>
Tripod	standard capacitor	8 mm band	Zeiss recording camera
dolly	transformer	(search)	Zero adjustment
for use with compact t.v. camera	Vertical fluoroscope	Weather-proof camera housing	Zone refiner (floating) for H.M.P.
Trough	Vibration	Weather reports dissemination	metals
(industrial) fittings		equipment	Zone-refining installation
reflector for mounting channel		Weighing	
Trunk switchboards			
Tube			





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