

RADIO *and* ELECTRICAL

TELEVISION COMMUNICATIONS - SERVICE - SOUND



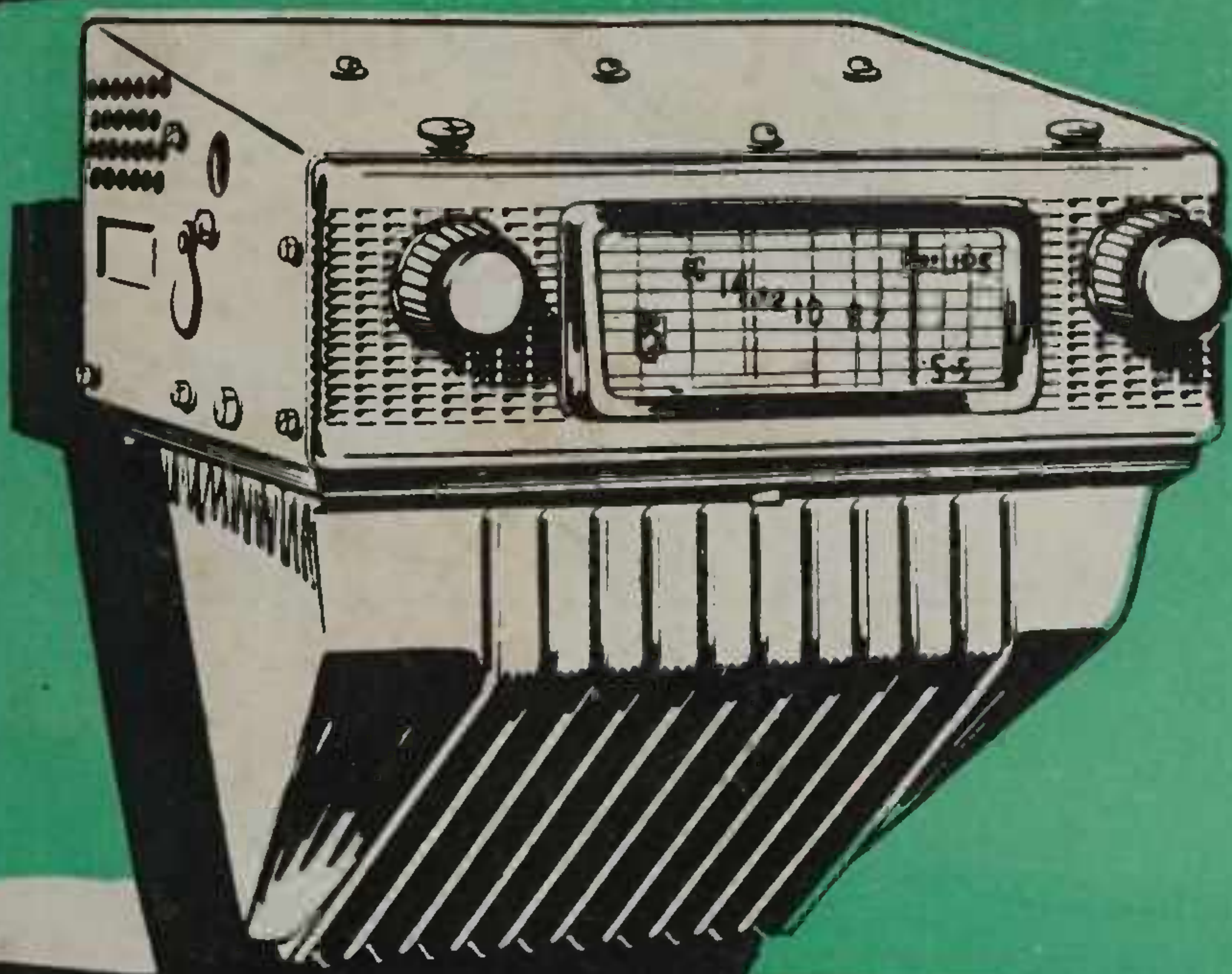
VOL. 12, No. 12

FEBRUARY, 1958

Incorporating "RADIO and ELECTRONICS"

'FIT IT YOURSELF' CAMPAIGN

puts more AUTO-MATES in more cars!



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Auto-mate
CAR RADIO



★ Your customers can fit Philips AUTO-MATE themselves, following simple step-by-step instructions and diagrams. This will mean more sales for you of this popular car radio.

★ "Living-room quality" of reproduction is a feature of both Philips Auto-mate illustrated at left and Philips Auto-master, below.

★ Scientific shielding and built-in suppression make them interference free.

Philips Auto-mate 26 gns. without aerial
Several aerial types available



*'living-room quality
is a true claim...*

Says G. W. of Wellington. "I have never heard any other car radio with such 'big radio' performance. Philips 'living-room quality' is a true claim backed by the wonderful reproduction of this amazing car radio".

PHILIPS

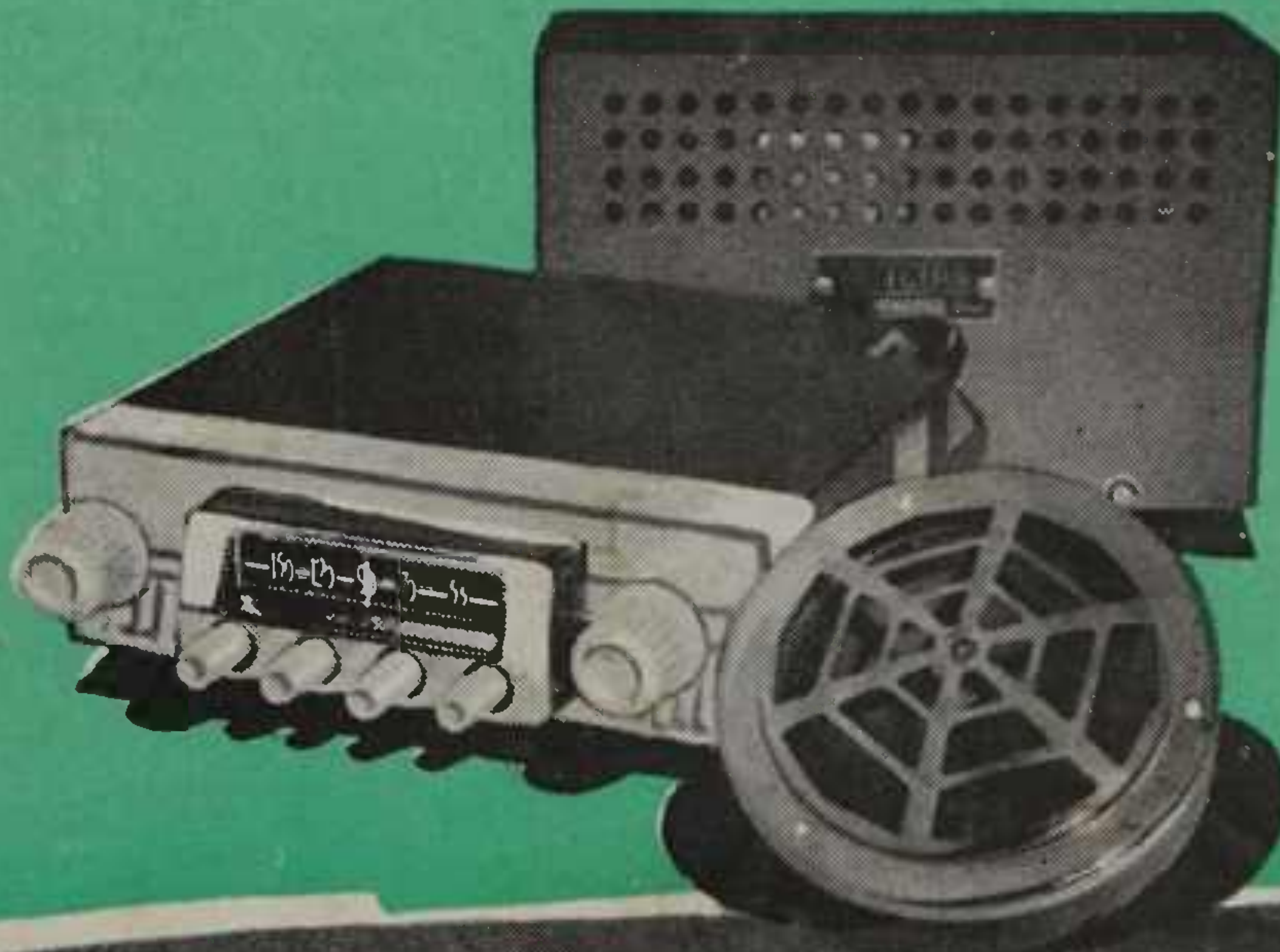
PUSH BUTTON

Auto-master

Only Philips supply custom-styled dash panels available for 34 models. Entirely suitable for every make of car. One finger push-button tuning.

39 gns. with aerial

No-one ever regretted buying quality



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	ON THE SEA		BRIMAR
	EVEN UNDER THE SEA		BRIMAR

BRIMAR

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for a guaranteed minimum life and utter reliability.*

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Your reputation is in safe hands when you specify Brimar Valves.

Now is the time to ****BRIMARIZE!***

**Remember, to Brimarize is to improvise,
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Radio and Electrical Review

VOL. 12, No. 12

FEBRUARY, 1958

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Sole New Zealand Distributors: Gordon & Gotch (N.Z.) Ltd., Wellington

Survey of New Zealand Radio Sets — 1958

From time to time we have been asked by retailers of our acquaintance whether there exists in a readily usable form any publication which sets out in a comprehensive and authoritative manner data on all the current radio set models on sale throughout the country. Up till now, the answer has been that such a survey does not exist; it appears, however, that there is a real need for it, and, accordingly, this journal proposes to publish one in the near future. At this moment, all manufacturers throughout New Zealand are being approached with a view to collating the necessary data, and a target date for publication has been set at 11th June, 1958.

The Survey, sub-titled "Set-buyers' Guide," will be published as a pocket-sized booklet which should be exceedingly useful for reference purposes by all retailers and their staffs, both sales and servicing, and which should also find ready acceptance by the purchasing public as an authoritative guide to exactly what is currently available.

Space will be available for an illustration of each model and for a special tabulation of each set's features—such information as model name and number, number of valves or transistors, frequency ranges covered, spread bands (if any), intermediate frequency, type of cabinet, colours available, power output, whether pick-up terminals are provided, make and type number of record changer used (where applicable), and so on. In this way, enough data will be available on each and every receiver to form a most useful reference for anyone concerned with domestic radio receivers, either as a salesman, technician, or as a potential buyer. The main body of the work will comprise these detailed descriptions, while a separate section will be devoted to classifying sets in different ways, with page references to the full descriptions. Also included will be brief explanations in layman's language of the purpose of many of the design features mentioned, so that members of the public using the book may know just what these features mean to them, the buyers of the sets. The book will therefore act as a genuine buyers' guide—factual and without bias of any kind.

The price, to bona fide retailers, will be only 2s., and a somewhat higher price, not yet decided, will be set for purchase by the public.

We would suggest that now is a suitable time for retailers to place orders for the quantities they will require, both for their own use and for re-sale to the public.

The "Survey of New Zealand Radio Sets, 1958," will be available only from Radio and Electronics (N.Z.) Ltd., P.O. Box 6361, Wellington.

In conclusion, we will be happy to consider any recommendations interested people may have as to the type of information they would like to see included in the Survey, but such suggestions should reach us at the earliest possible date if we are to be able to act upon them.

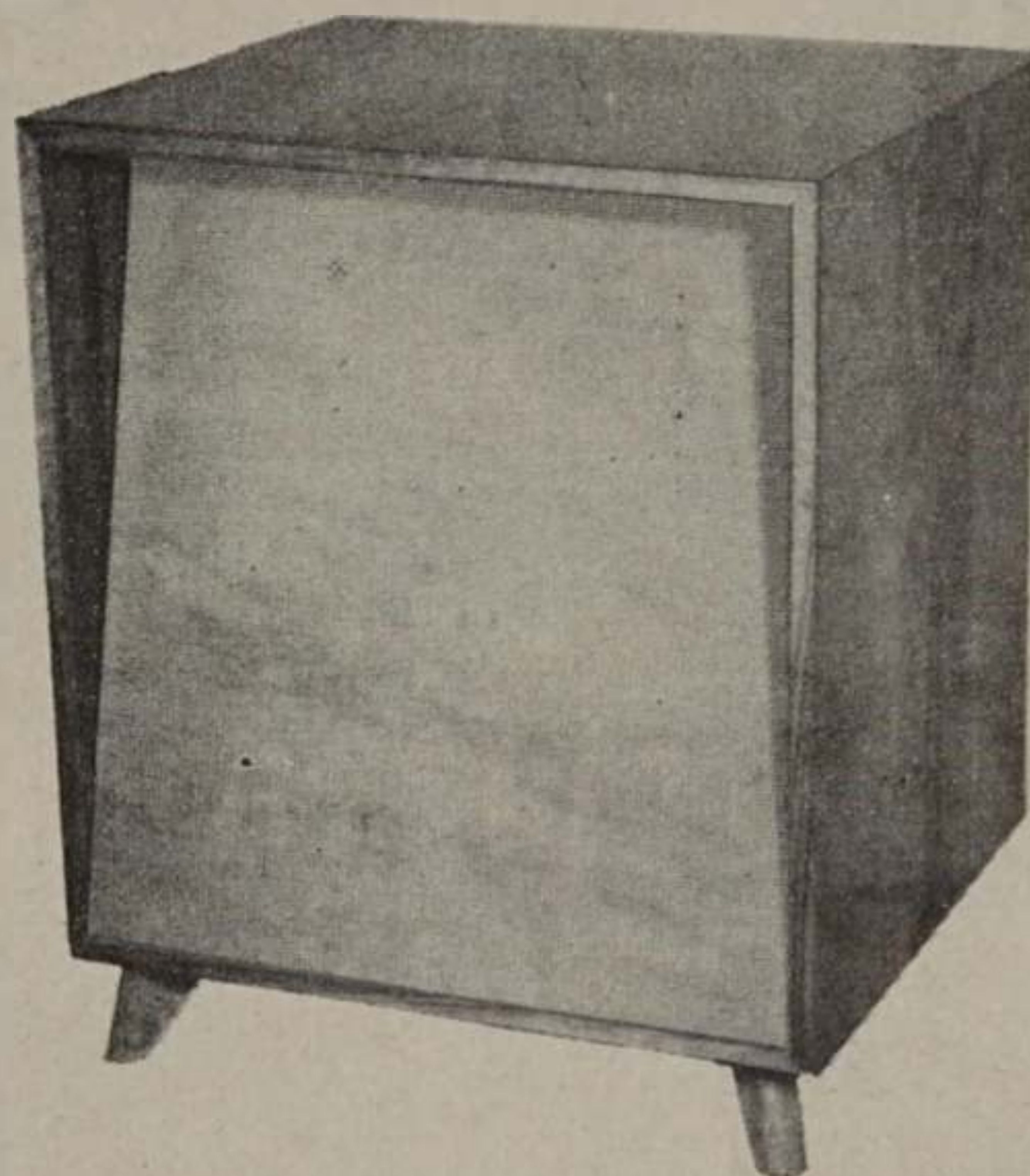
GOODMANS

HIGH FIDELITY LOUDSPEAKER SYSTEMS

The SHERWOOD ENCLOSURE

designed to contain either single or twin unit High Fidelity loudspeaker systems. As a single unit system the Axiom 150 Mk. II (15 watts) or the Axiom 22 Mark II (20 watts) is used. The choice depends upon power handling capacity required. Both are 12 in. twin cone units, with frequency coverage of 30-15,000 c/s. For a twin unit system the Trebax high frequency horn loaded pressure driver is added to the single unit system, together with crossover network XO/5000, the 12 in. loudspeaker being employed as a bass and mid-range reproducer, up to 5,000 c/s., the Trebax handling the remainder of the range up to 16,000 c/s. By this means the response is extended and distortion minimised.

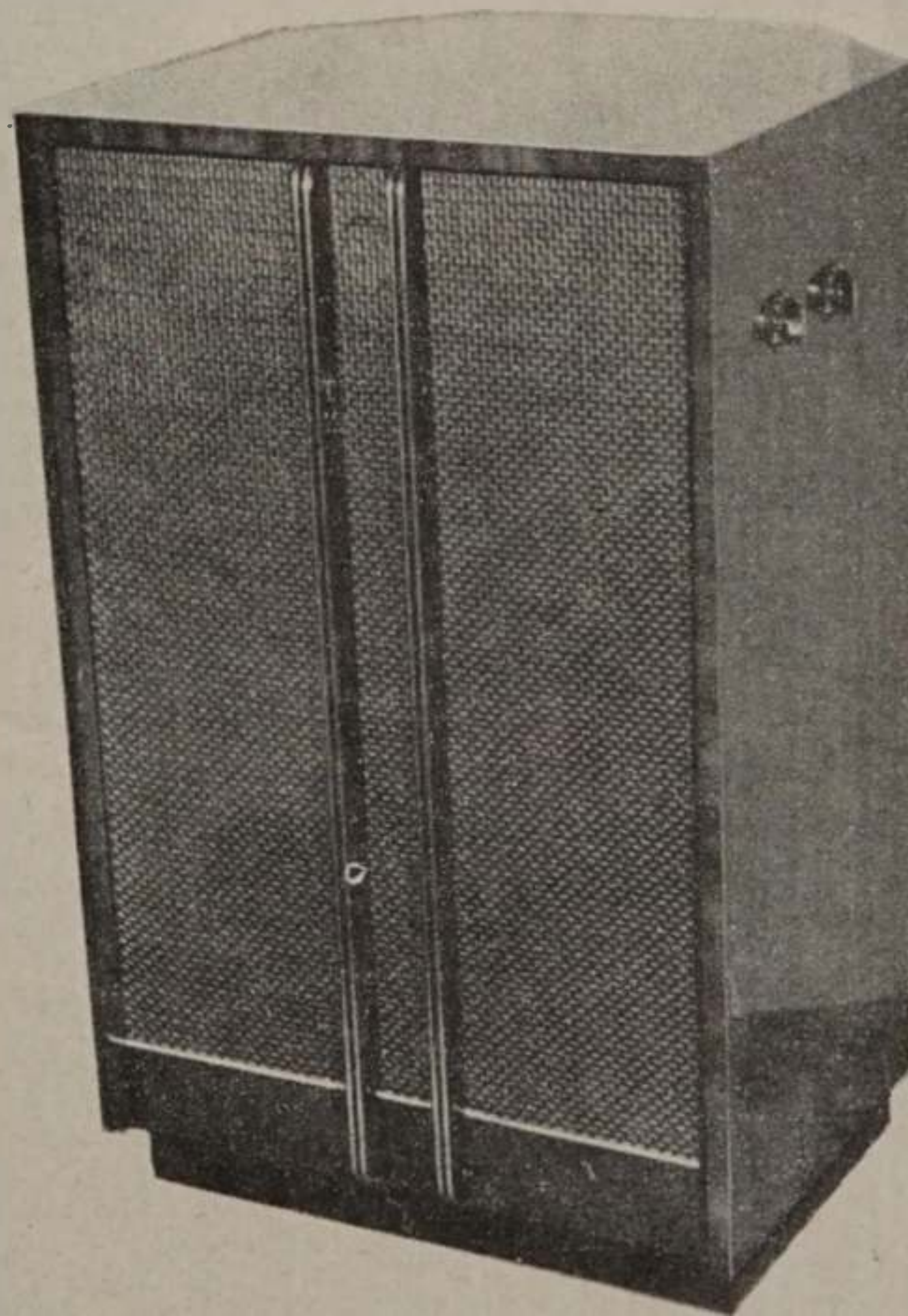
*Finished in choice mahogany veneers
with contrasting woven plastic fret.*



The "315" REPRODUCER

is a complete complex loudspeaker system. It contains three loudspeaker units; a 12 in. bass unit of the direct radiator type, operating from 30 c/s. to 750 c/s.; a mid-range unit, pressure type, horn loaded, operating from 750 c/s. to 5 Kc/s.; and a treble unit, pressure type, horn loaded, operating from 5 Kc/s. to 16 Kc/s. The three units are fed by a double divider network, the mid-range and treble units are provided with constant impedance variable attenuators, calibrated in 2 decibel steps, enabling easy and accurate variation from level response to suit individual listening conditions and special requirements. The complete system is housed in a thick walled enclosure of exceptional rigidity; the bass chamber is loaded by an Acoustical Resistance Unit.

*The "315" Reproducer is finished in distinctive
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Tape speeds $3\frac{3}{4}$ in./sec. and $1\frac{7}{8}$ in./sec. Max. playing time 180 minutes. Frequency range 60 to 11,000 c.p.s. ± 3 db at $3\frac{3}{4}$ in./sec. Fully automatic push-button control; Single-knob control for radio recording, microphone recording, and playback volume. Automatic stop at end of tape. Tape spot indicator.

the specifications tell the story

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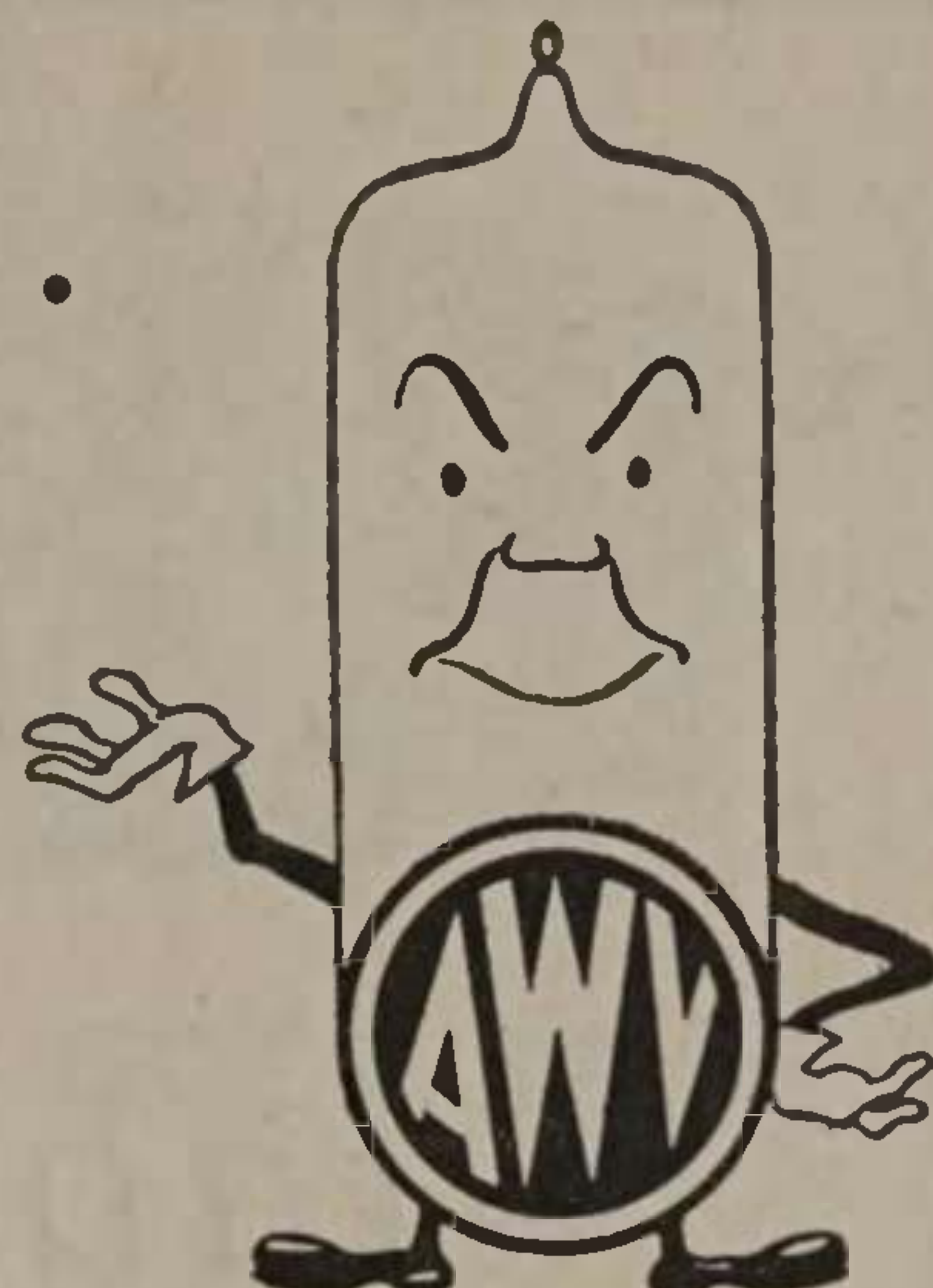
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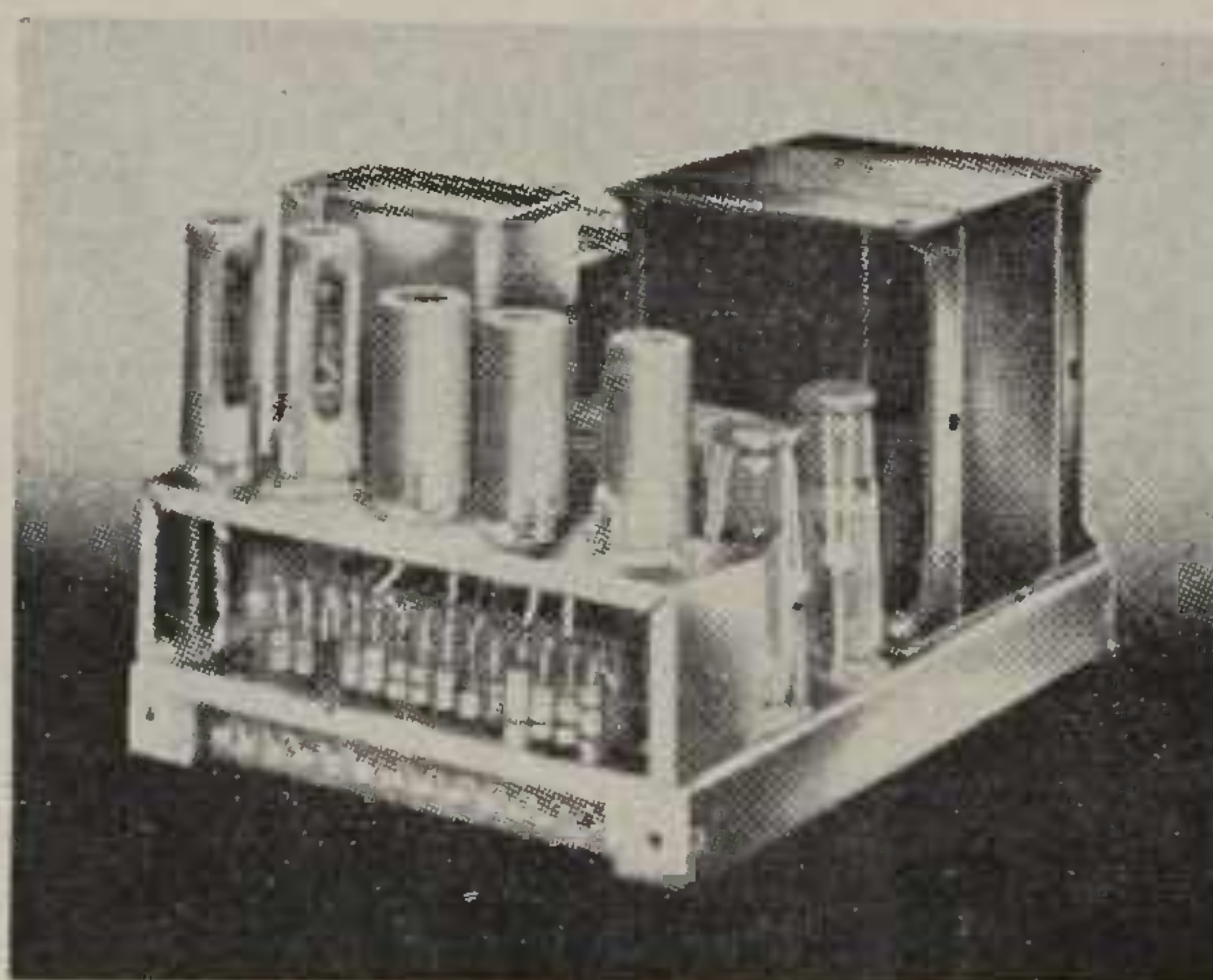
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Dr Frittertime, of course, likes to make everything himself, but not everyone can afford the Frittertime technique.

Solartron can make power supplies for you at a fraction of the real cost when you do it yourselves. We can give immediate

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the AS. 517



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Current		10/100 milliamps
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Source Impedance A.C. 40 cycles to 100 kilocycles		0.25 ohms
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Junction Transistors

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GET 3 • GET 4

These are medium frequency transistors for 6 and 12V operation and are suitable for use in amplifiers at 315 and 465 kc/s.

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Two watts of audio are available from a pair under class B push-pull conditions. This performance is obtainable combined with the high frequency performance typical of a small transistor.

GET 5—£2 5s. 0d.

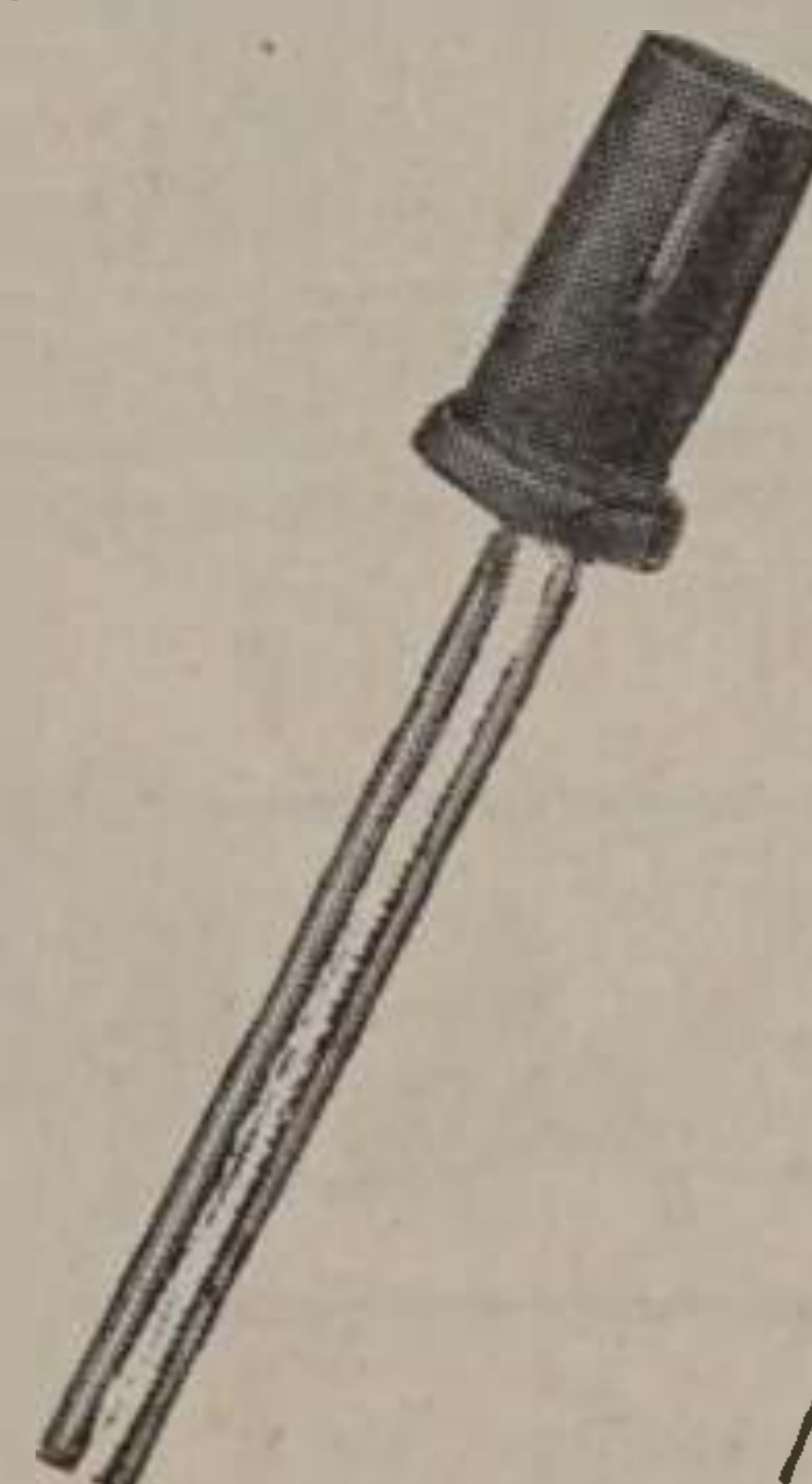
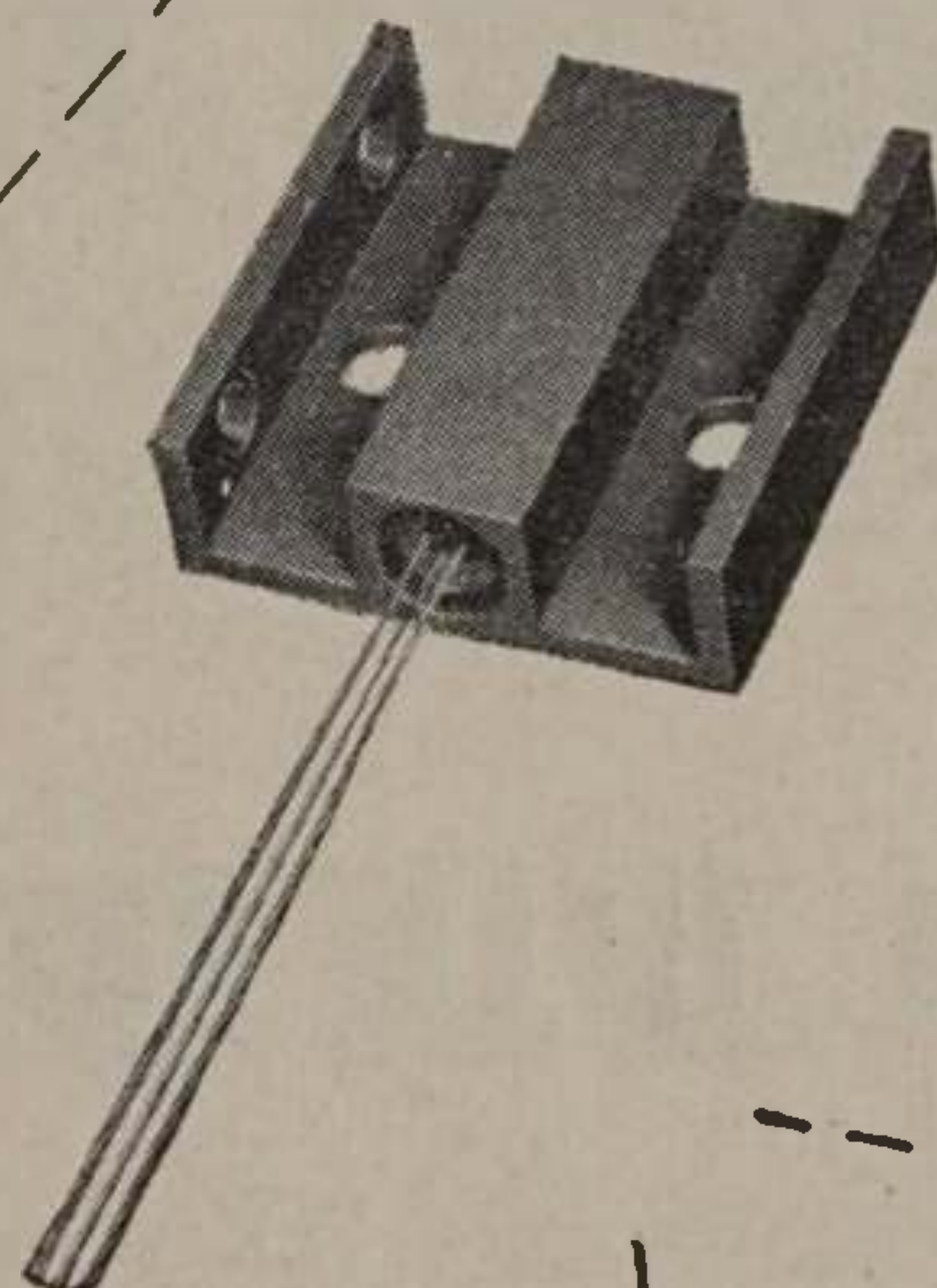
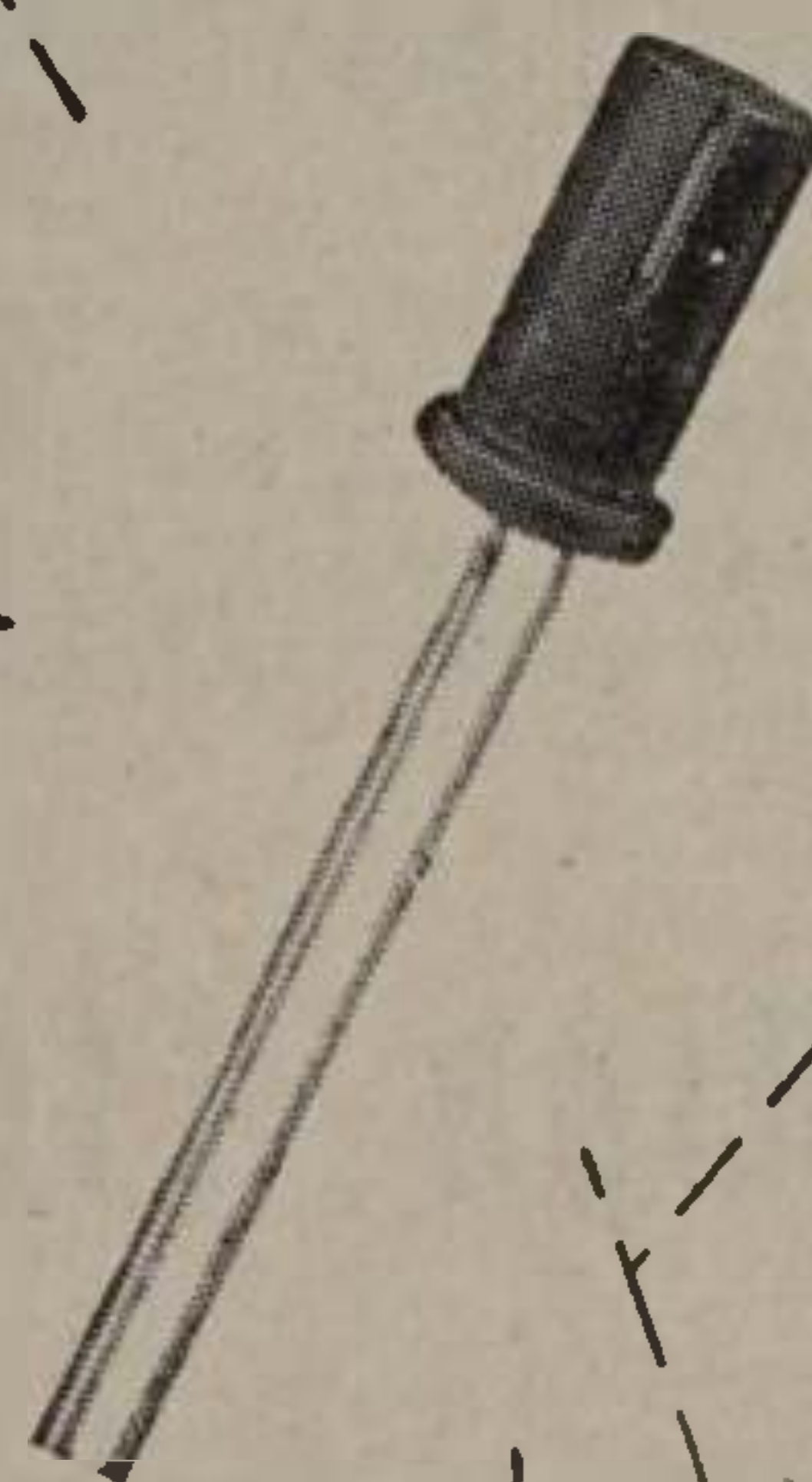
GET 6

This transistor features an extremely low noise level which has hitherto been unobtainable with transistors.

Noise factor
 $f = 1 \text{ kc/s}$
 $V_c = 2V$

6db
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 $I_e = 0.5 \text{ mA}$

GET 6—£2 5s. 0d.

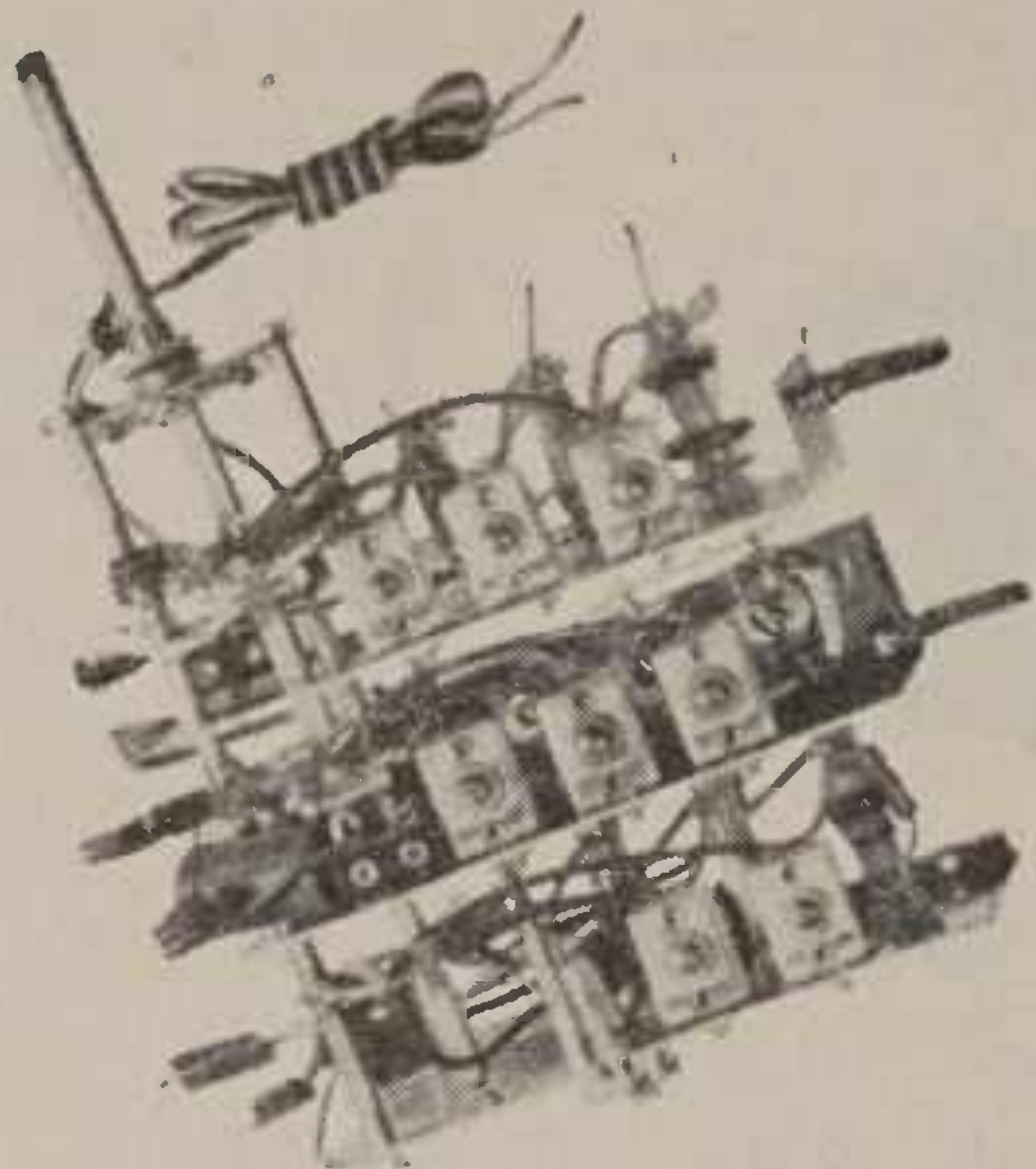


Full particulars of these devices can be obtained from G.E.C. Valve and Electronics Dept.

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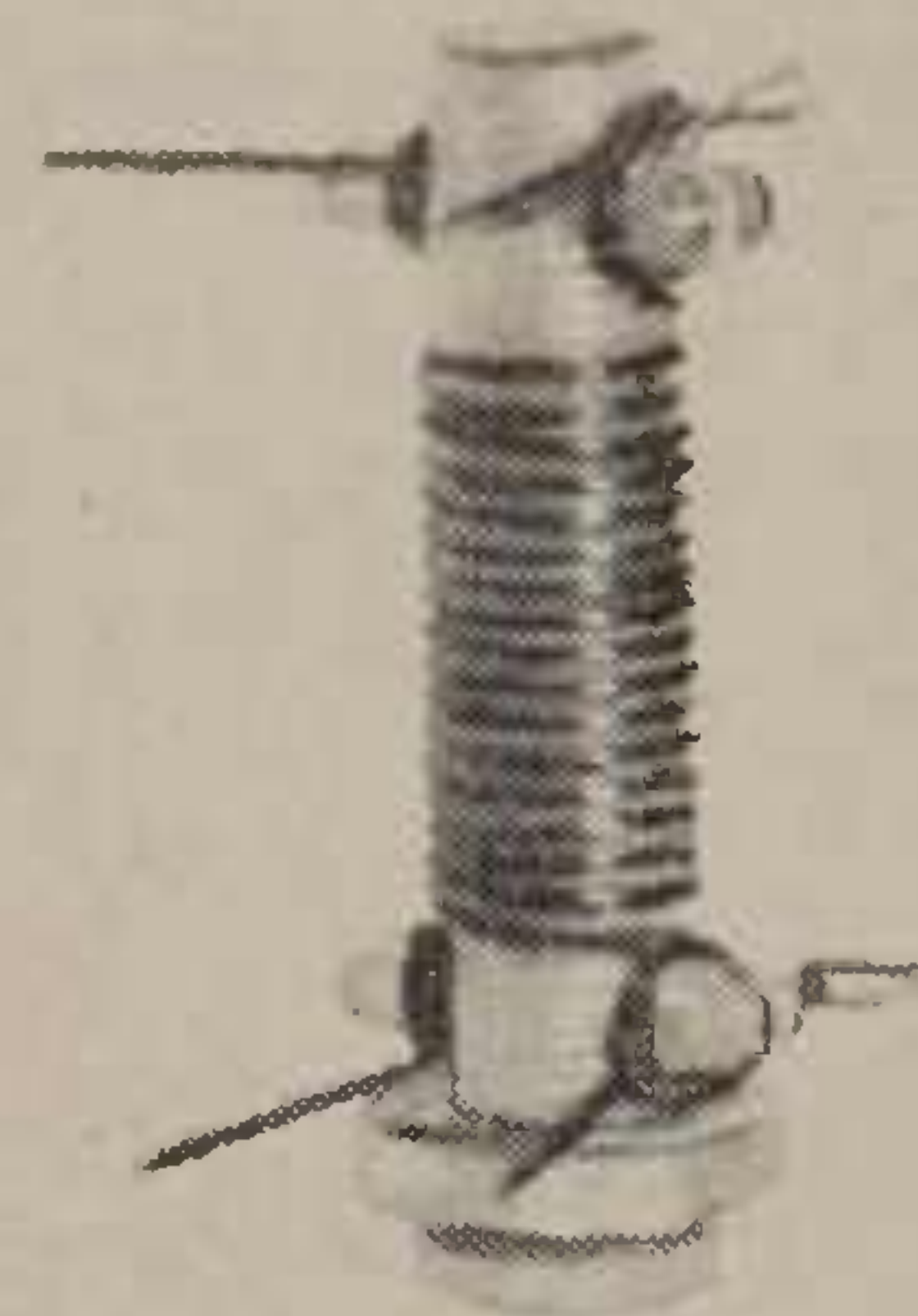
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Polystyrene low-loss coils throughout—adjustable iron-core slugs—fixed padders—oscillator plate tuned—temperature compensated on short-wave—A.V.C. time constant reduced on short-wave—converter ECH21/81—simply modified for ECH35—air tested and aligned—full instructions and circuit diagrams—easy to align—gang—dial—chassis to match.

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Spin-wheel ball-bearing 24—1 ratio drive—glass floodlit scale—accurate calibration and station positions—effortless tuning—escutcheon in Florentine bronze window 8 in. by 4½ in. also available—scale for D.W. SC/12, for A.W. SC/13.

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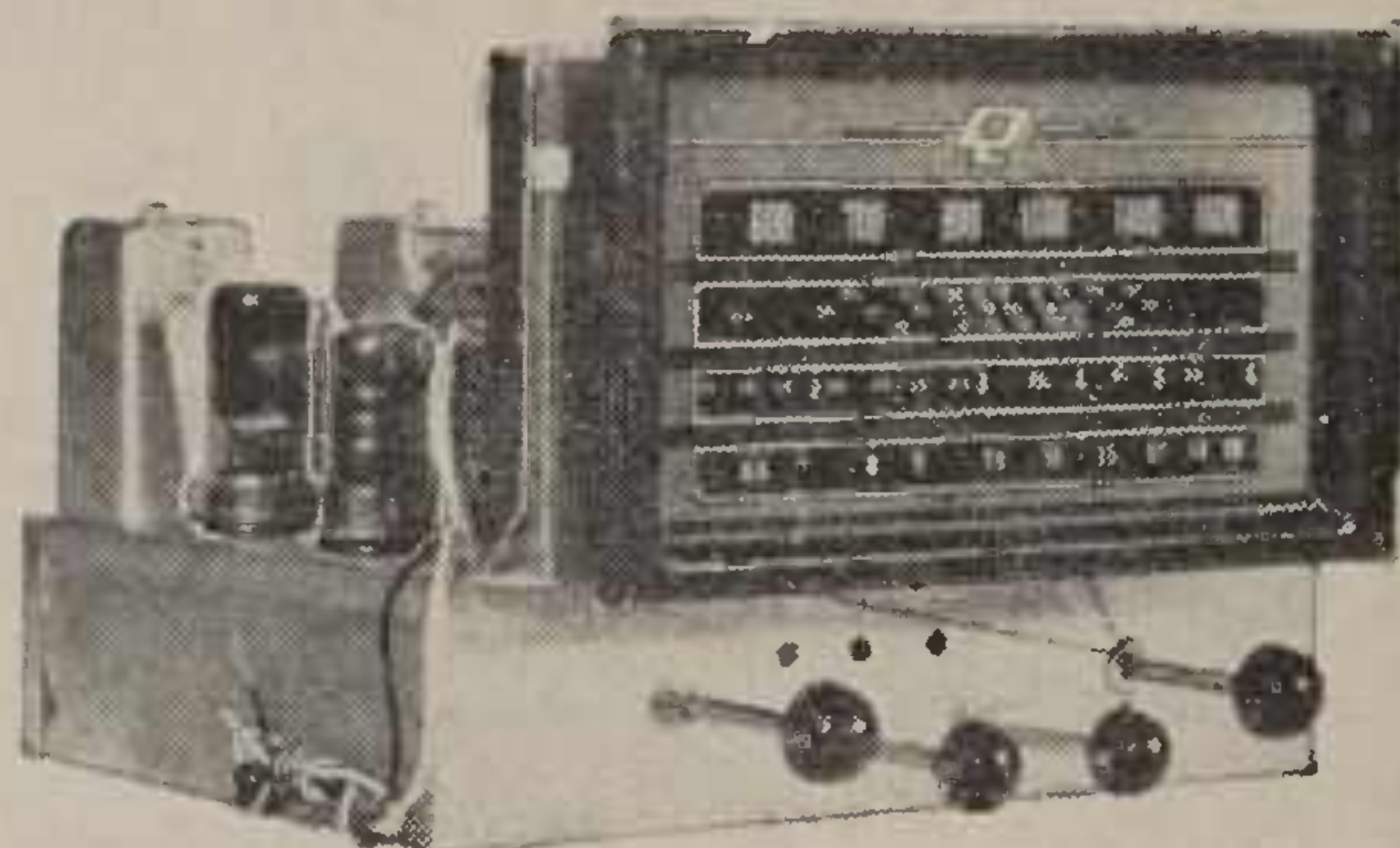
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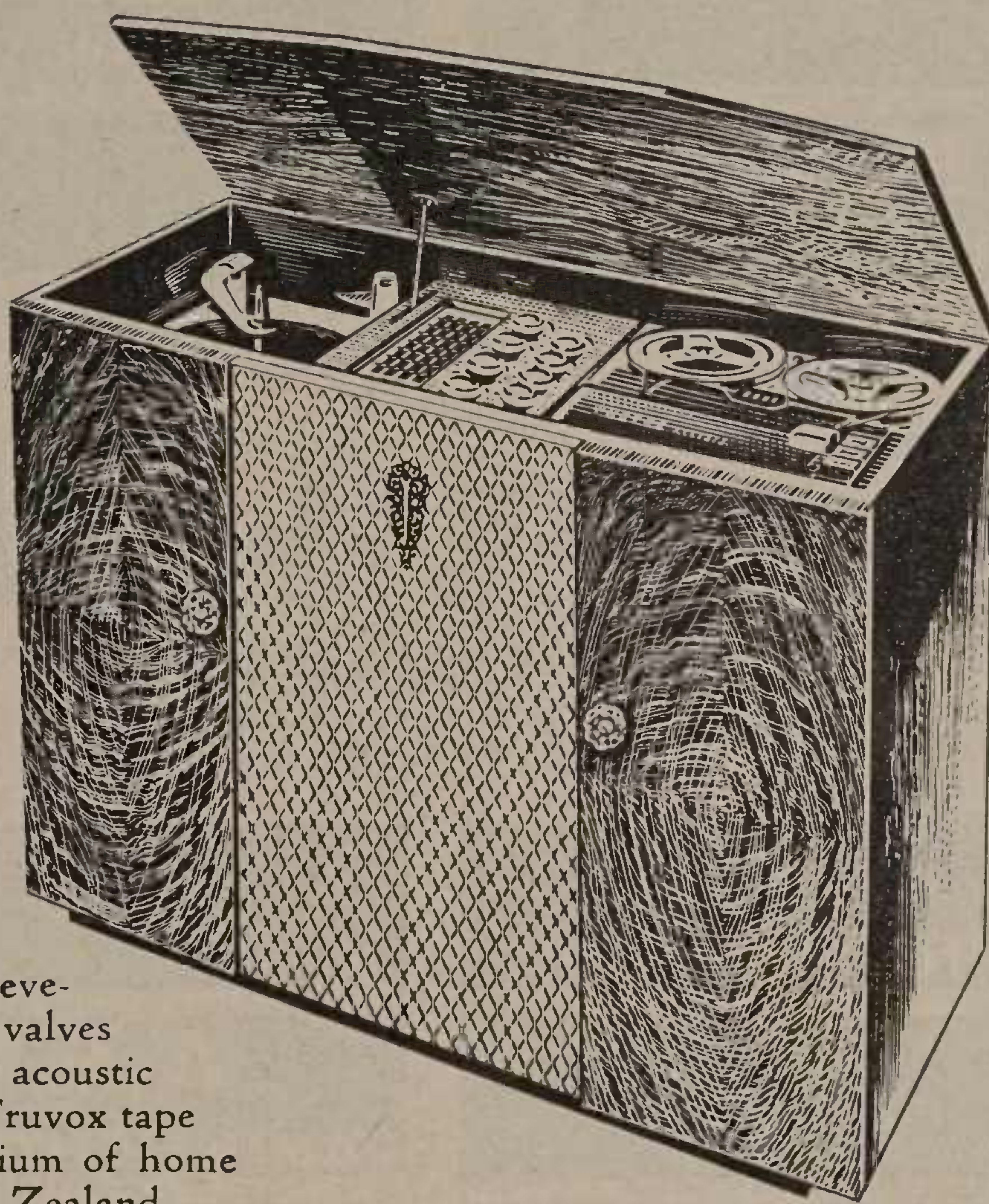
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introduces a New Era in
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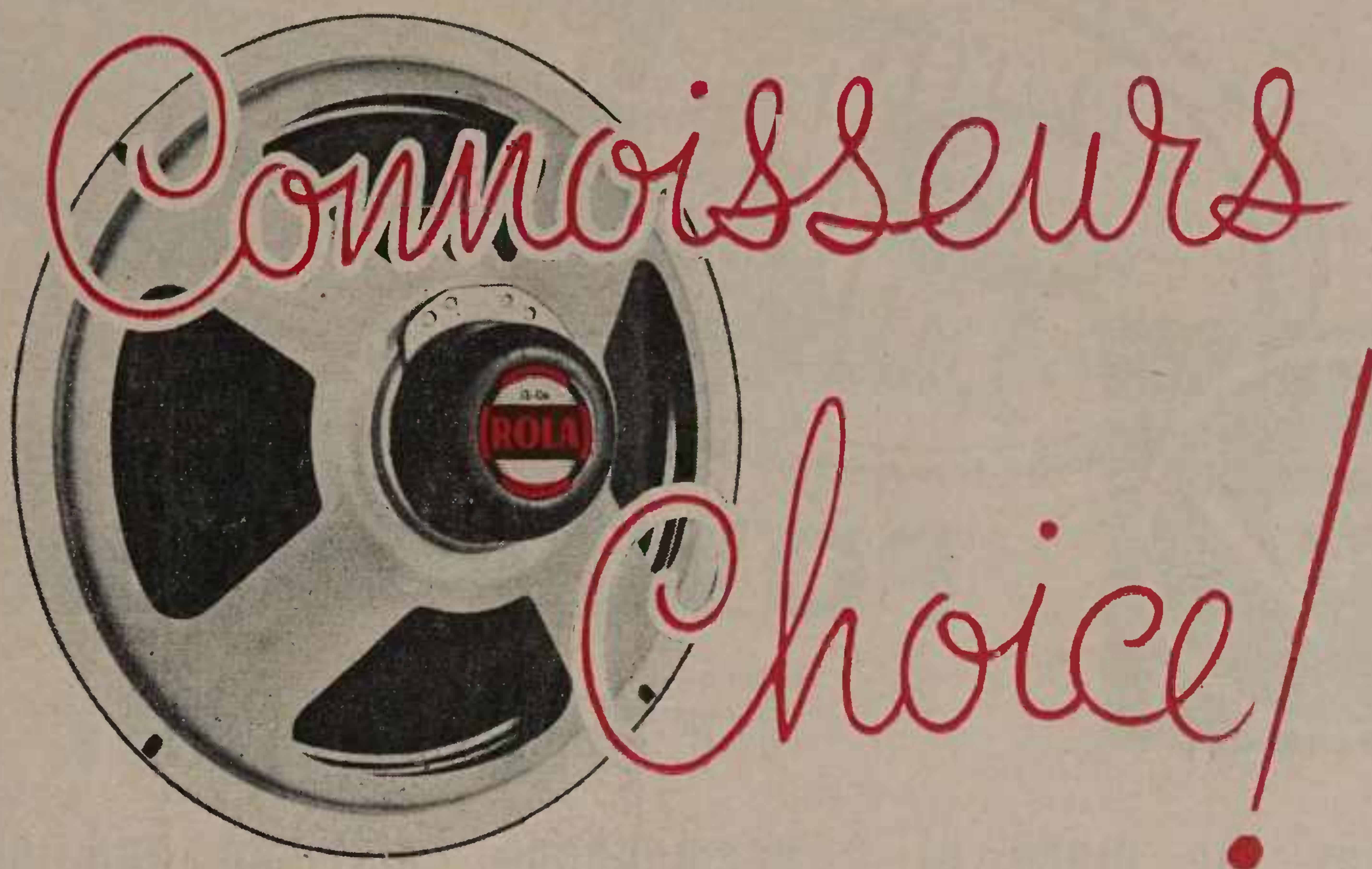
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"The Rola Model 12-Ox is the finest wide range speaker yet developed for home use."

The smoothness of its response throughout its whole range, its extremely low intermodulation distortion and its exceptional transient response combine to make the Rola 12-Ox a really *great* loudspeaker.

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LOUDSPEAKERS (N.Z.) LTD.

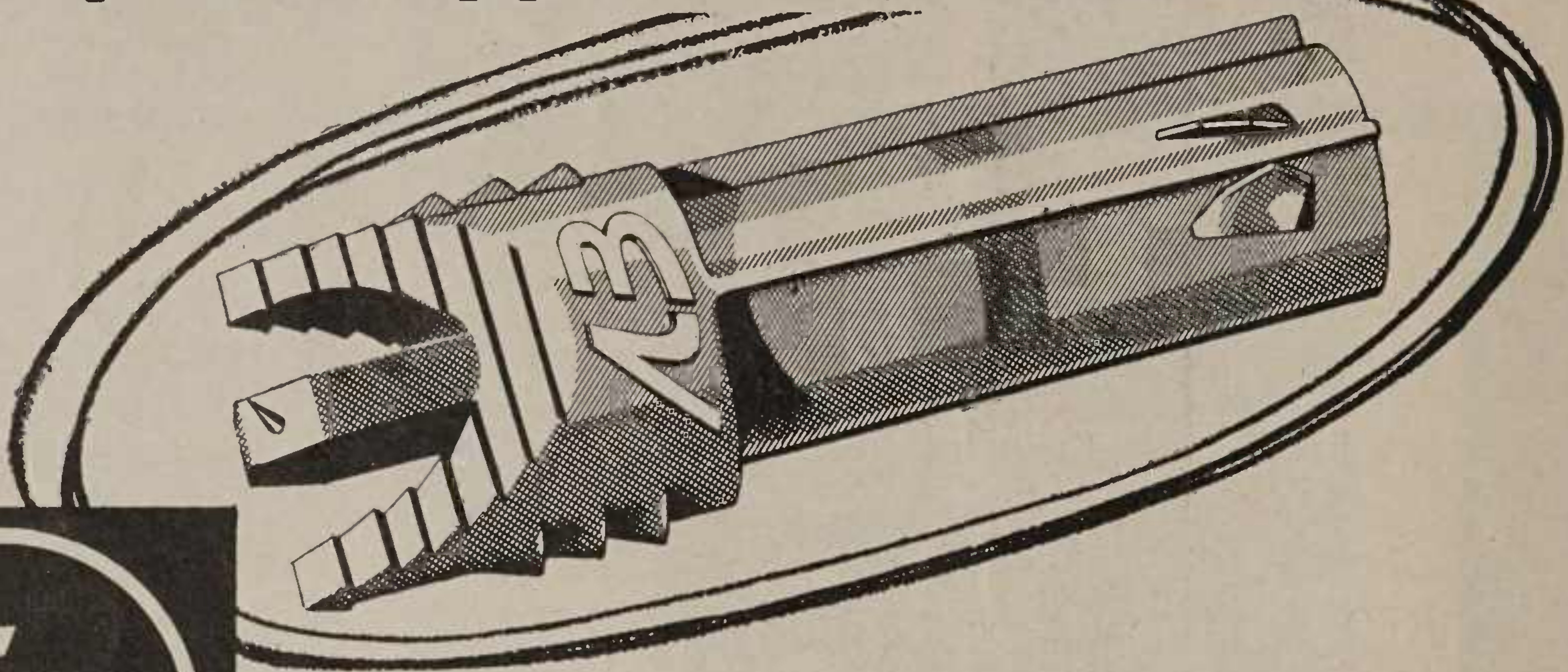
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POWER POINT Transducer

**Takes the place of a gramophone cartridge and needle
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MINIATURED CERAMIC GRAMOPHONE CARTRIDGE WITH TWO SAPPHIRE TIPS

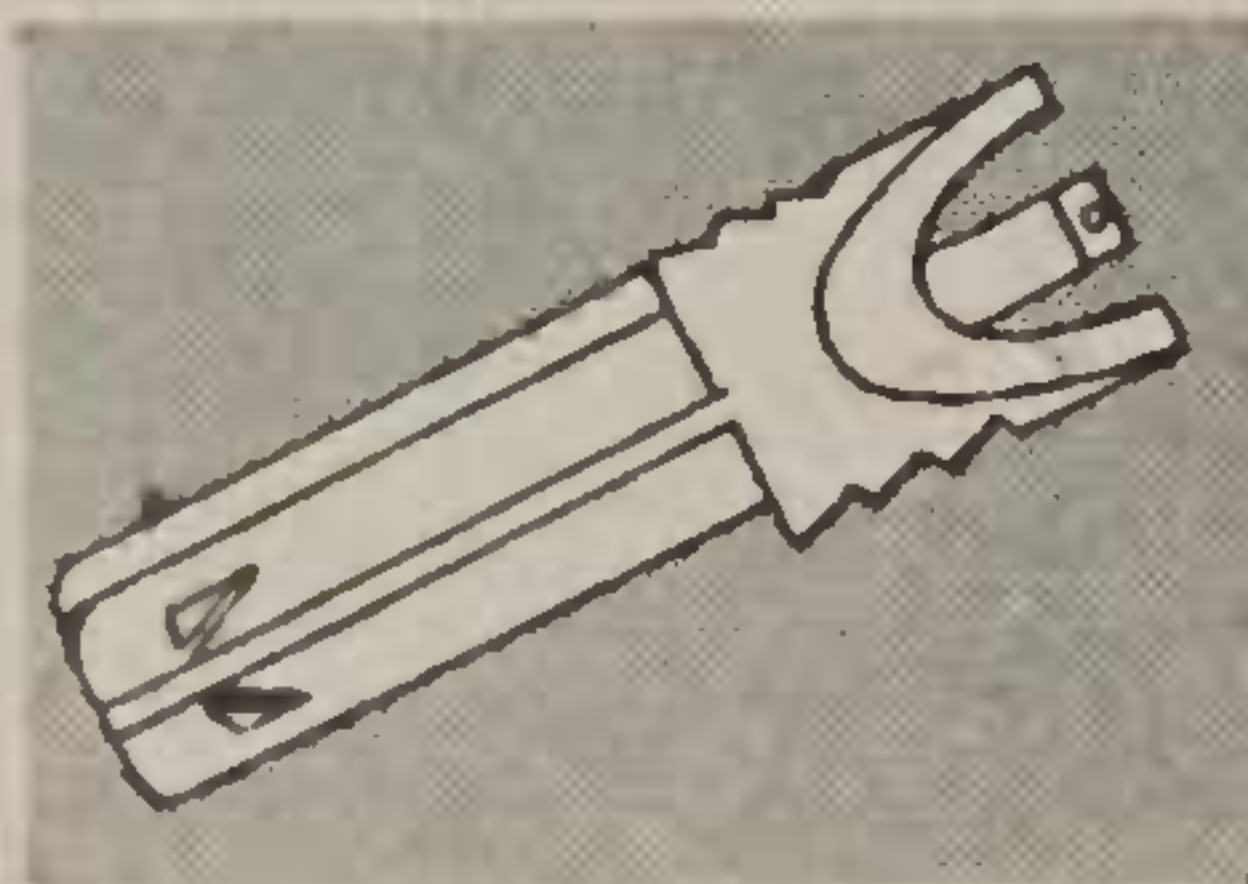
- Provides a fresh ceramic cartridge when you change needles.
- For use with most gramophones.
- Gives superior reproduction.
- Ensures longer record life.
- Slips in, slips out of special mount.
- Colour coded and keyed for easy use and identification.

POWER POINT is a revolutionary, high-quality gramophone cartridge the result of a new engineering concept making it possible to obtain wide range, low distortion, and minimum record wear. Costs less than a cartridge, less than a needle (remember, two needle tips are provided) and is superior to the now obsolete, old-fashioned cartridge-needle combination.

One basic POWER POINT transducer replaces virtually all cartridges, other than some "thumb-screw" types.

By eliminating the needle and using only the jewel point, bold design results in a tiny mechanism encased in nylon, less than $\frac{1}{4}$ -inch in diameter and $\frac{3}{4}$ -inch long. Resulting low inertia gives superior tracking ability and minimizes needle talk. Better than many expensive magnetic cartridges, it is accompanied by high compliance (1×10^{-6} cm/dyne). This ensures minimum record wear.

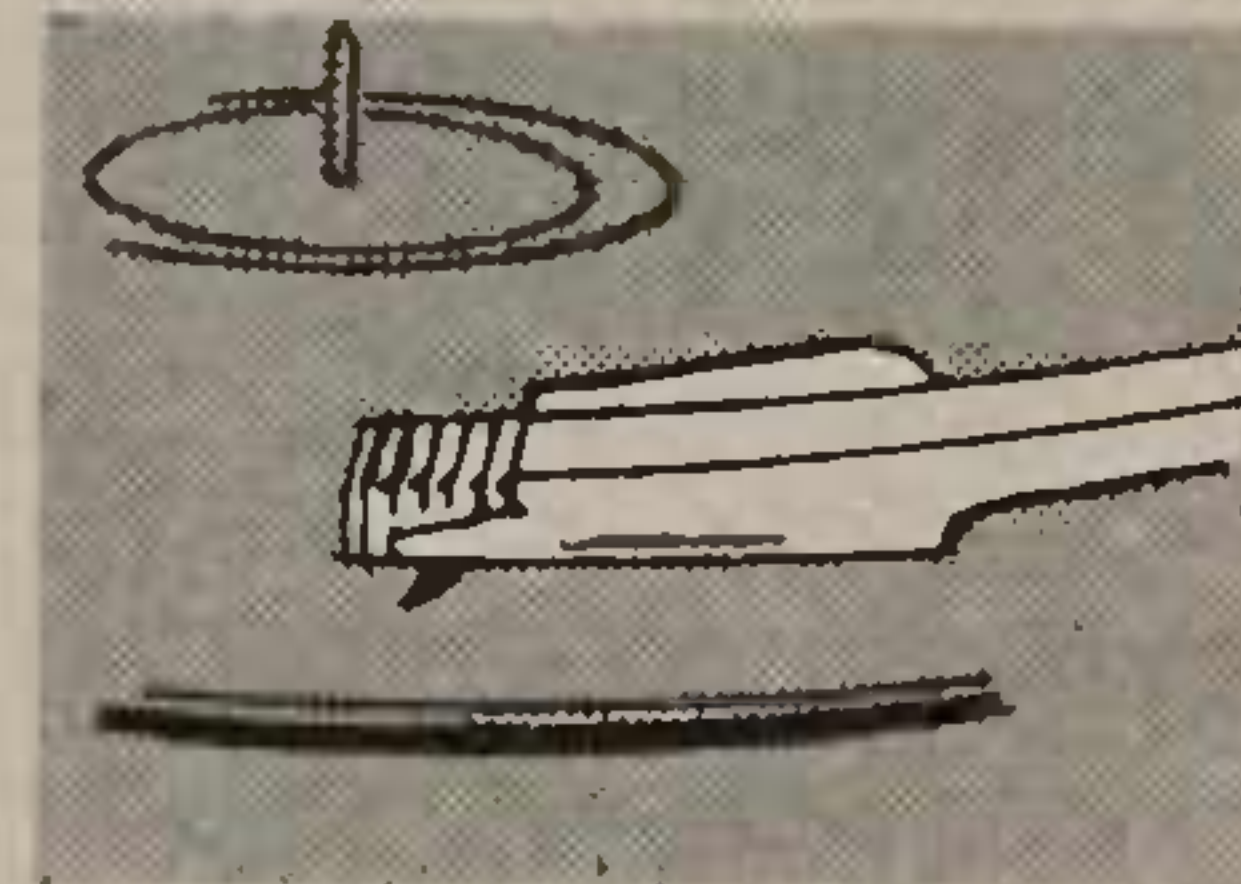
POWER POINTS are easy to use. After quick, easy installation of special mount with common screwdriver, replacement can be made by user with only two fingers in seconds; easier than changing a razor blade. When gramophone is equipped with POWER POINT, changing the unit requires no tools, simply remove and slip in.



PROVIDES A
FRESH
CERAMIC
CARTRIDGE



PROVIDES
TWO
SAPPHIRE
TIPS



SLIP-OUT,
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EXTREME NATURALNESS
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MINUS



UNDAMPED RESONANCES, WISKERS OR BOOM,
ADDED COLOURATION.

THERE IS NO MYSTERY ABOUT ALL THIS! IT IS
JUST WHAT YOU WILL GET FROM THE NEW
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ROUND.

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Make sure it's EMITAPE

The World's finest magnetic recording tape

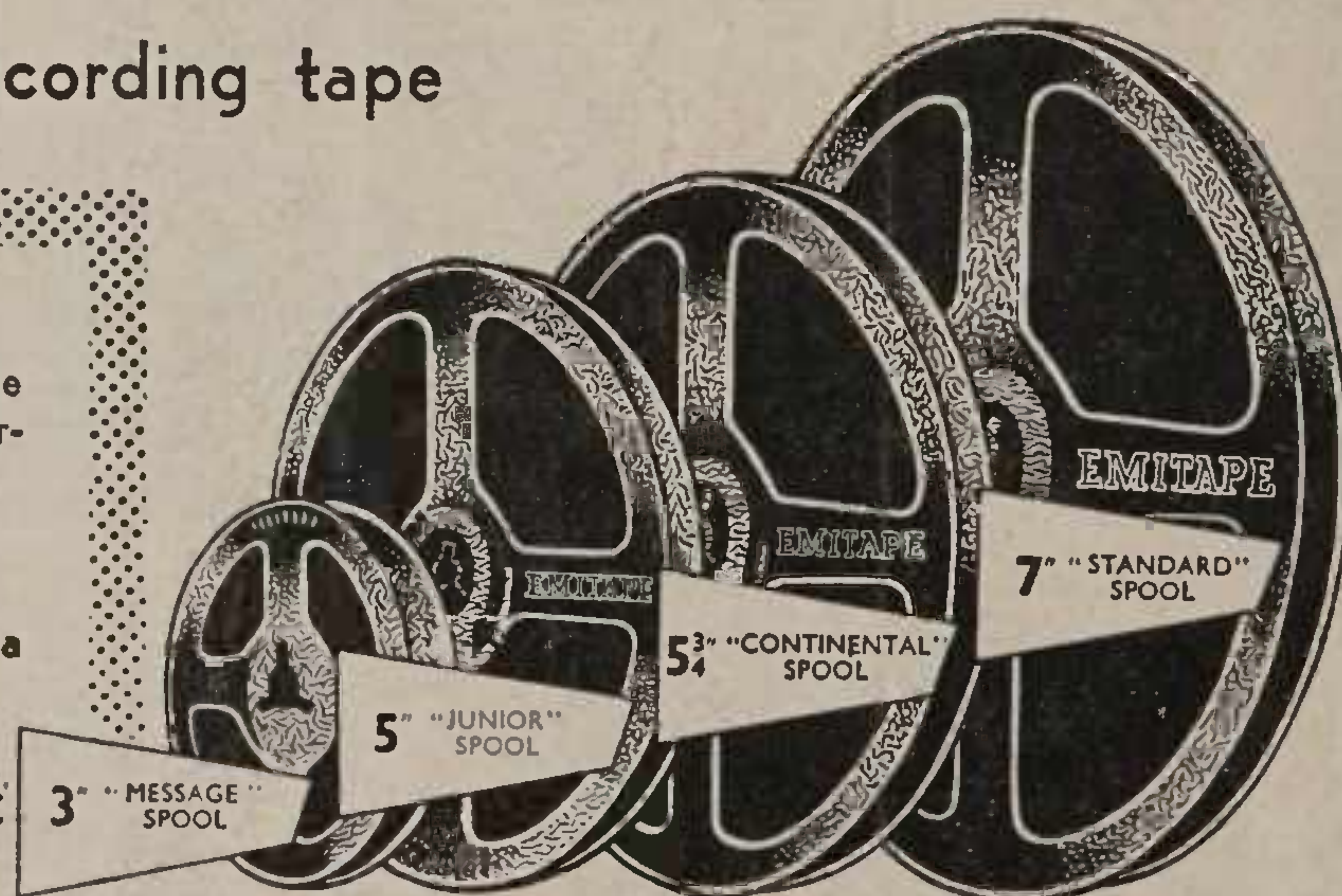
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HIS MASTER'S VOICE (N.Z.) LTD.

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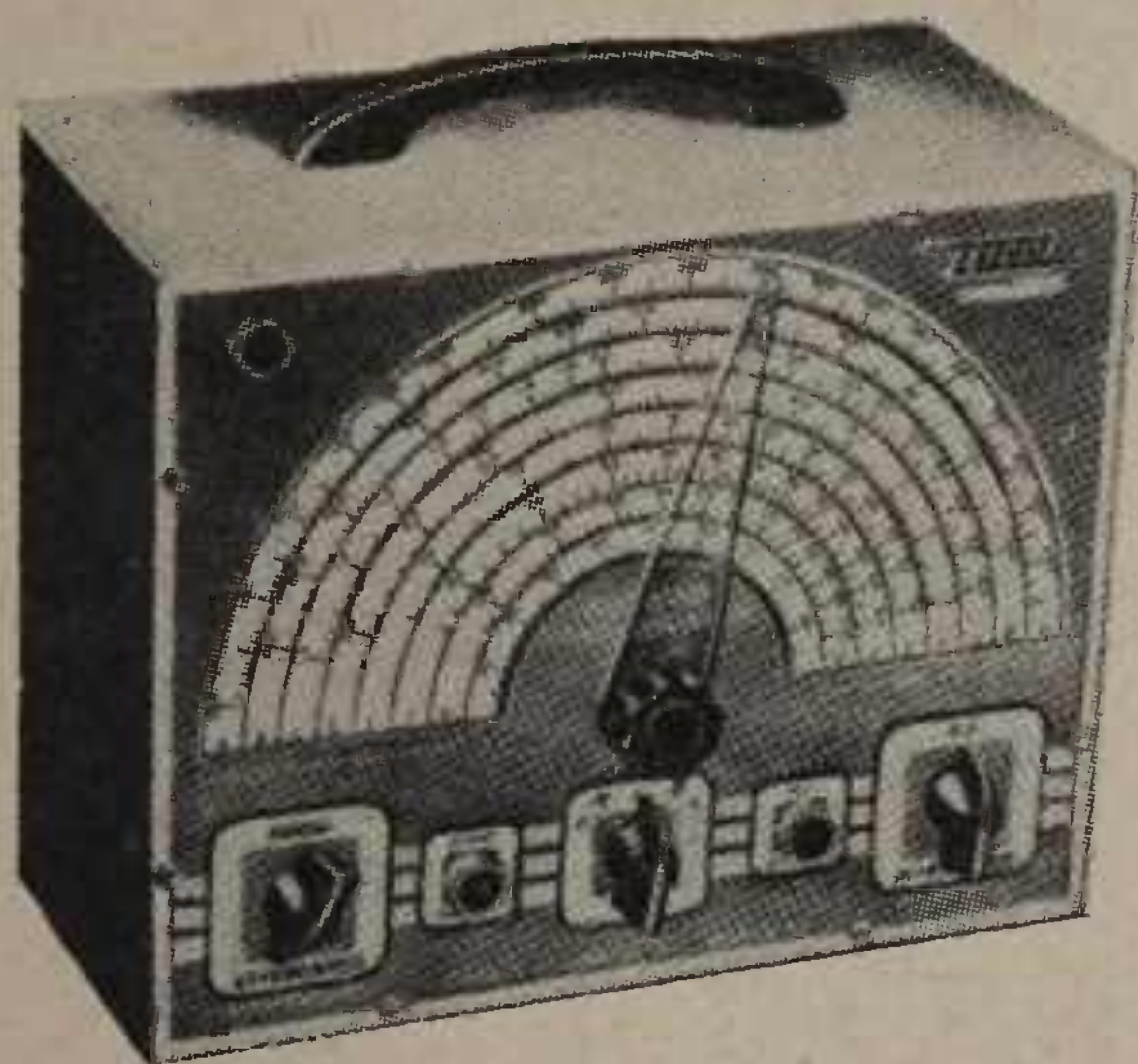
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230V.

Price: £15 9s.

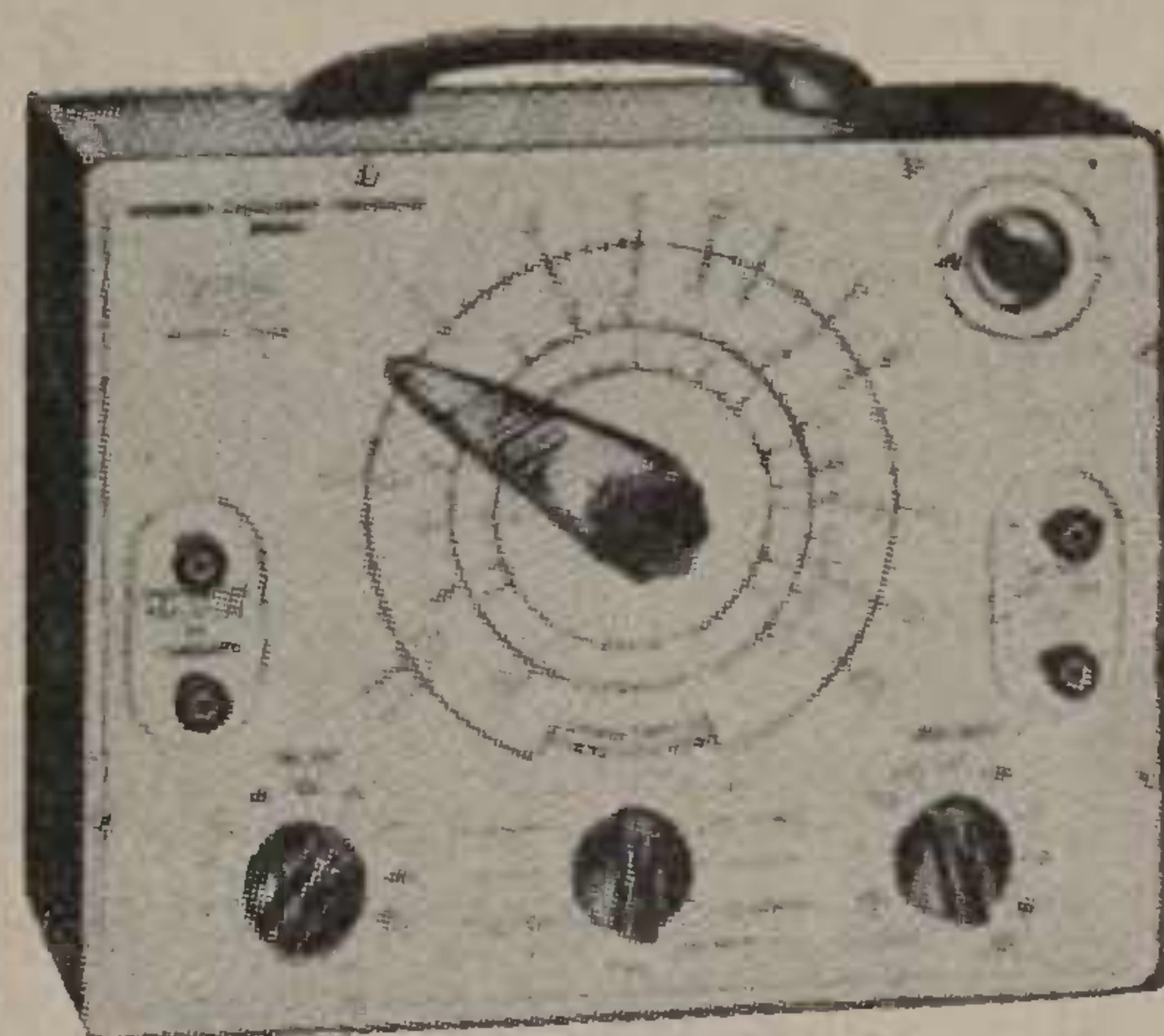


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221 KX**

The popular, reliable performance-proven VTVM—over 50,000 in use! Large $4\frac{1}{2}$ in. meter can't-burn-out circuit. Zero centre for TV/FM discriminator alignment. AC/DC Volts: 0-5, 10, 100, 500, 1000 (up to 30,000 c. with HVP probe up to 250 mc. with PRF probe). Ohms: 0.2 ohms to 1000 megohms. D.B.: -20 to +55. Input R: 25 megohms. 1% precision multipliers. Stable, accurate, double-triode bridge circuit. 3-colour etched panel; steel case.

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950BKX**

Latest bridge-type instrument directly reads 0.5 ohms—500 megohms resistance (4 range), 10 mmfd.—500 mfd. capacitance (4 ranges), and power factor. (Kit includes precision calibrating resistor.) Unique comparator range for R, C, and L comparison measurement against external standard. Leakage testing of all capacitors at rated dc working voltage with internal 0-500 vdc source. Electron-ray tubes as both bridge balance and capacitor leakage indicator.

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*Electronic Devices—No. 1***THE FLUXGATE**

This is the first of a series of articles describing devices that find application in many fields (a) because electronic circuitry makes their practical application possible, or (b) because they themselves make possible the application of electronic techniques to a particular set of problems. The fluxgate comes into both these categories at once, and is a device of considerable interest to the electronics engineer and technician.

Introduction

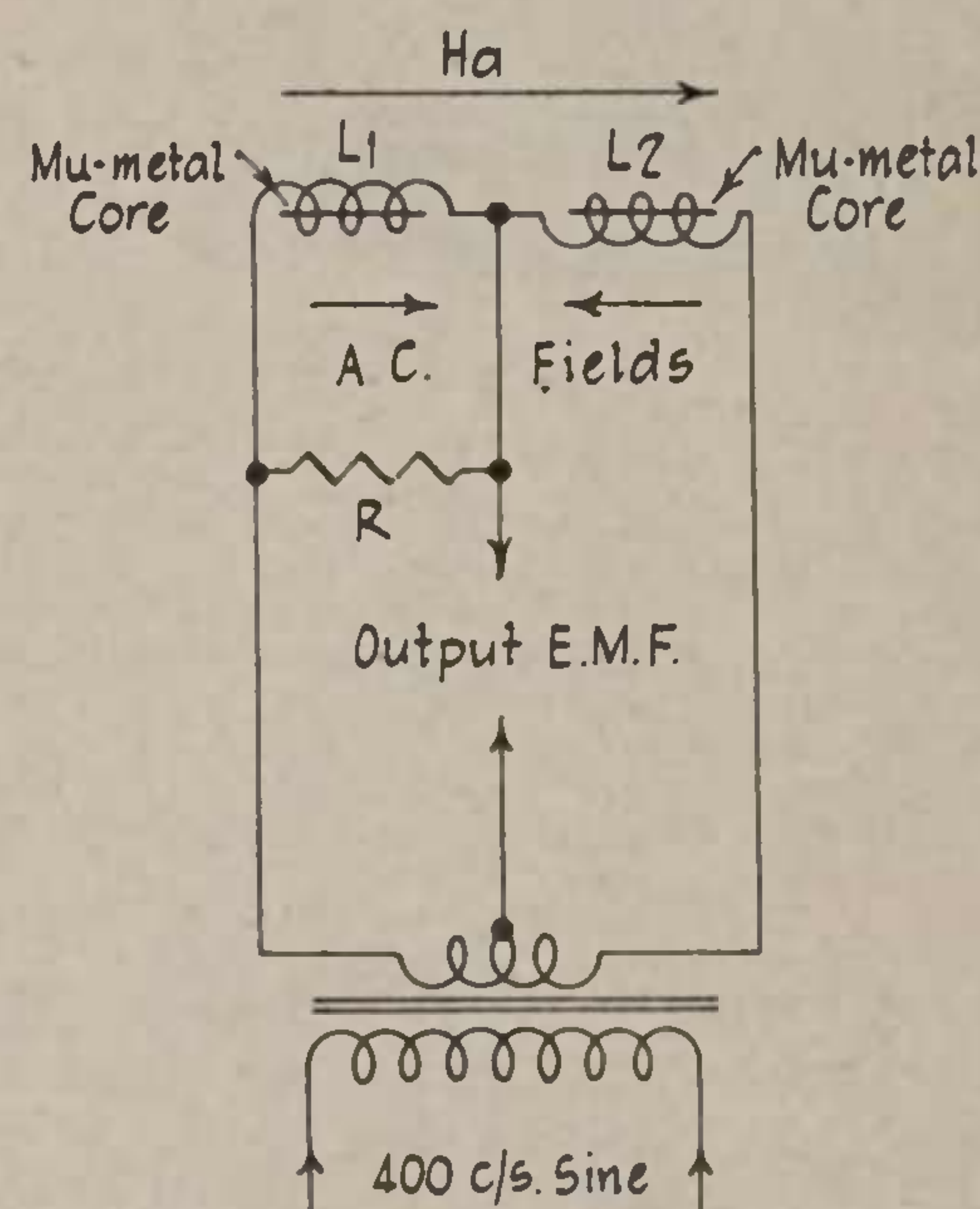
The fluxgate is a first-class example of the application of the relatively elementary theory of electricity and magnetism enabling an instrument of remarkable versatility and sensitivity to be designed. With the aid of electronic circuits, the fluxgate enables old jobs to be done better, and new ones to be tackled that were impracticable before it was invented. Although it has distinct affinities with what is universally known as the magnetic amplifier, it is not, properly speaking, one of these. On the other hand, it lends itself well to the use of magnetic amplifiers in the associated equipment that it must have with it if it is to do a practical job. At the same time, valve techniques can just as readily be applied to its realization as a practical instrument, and indeed, are very often so used. Thus, the fluxgate readily comes within the scope of the general heading to the series of articles of which this is the first.

What Does the Fluxgate Do?

Fundamentally, the fluxgate is a device which is extremely sensitive to the presence of magnetic fields, and it can be used for a wide variety of applications in which this basic property is useful. Its special property is its extreme sensitivity, which is almost unbelievable. For example, it has been stated that it is capable of detecting a magnetic flux of 10^{-6} oersted, which is equivalent to the field produced at the centre of a solenoid of 25 turns per inch, when a current of less than a tenth of a microampere flows in it! Of course, it cannot perform such feats without auxiliary equipment, such as amplifiers of some sort, but the fact that it can do them at all stems from the simple magnetic nature of the fluxgate itself, and not from the sensitivity of the associated equipment. For many purposes, amplifiers of any desired sensitivity can be used, but their useful sensitivity depends on the stability of the original sensing device, and no amount of amplification can render useful something that is subject to drifting of its characteristics.

What Does it Consist of?

This question is answered in Fig. 1, in which the fluxgate proper consists of two magnetic cores of high permeability, on which two identical coils are wound.

**Fig. 1**

Circuit of the fluxgate and its energizing A.C. supply.

The cores are placed in a straight line, with the coils connected in series opposing, so that when an alternating E.M.F. is applied to them, the alternating magnetic fields are in opposition, as illustrated by the arrows. It should be pointed out that the cores of the coils are separate, and that the windings are not opposing windings on a single core. If the latter were the case, the nett magnetic flux in the core would be zero, and the action to be described could not take place.

The coils are supplied from the secondary winding of a transformer with such a voltage (at some medium audio frequency such as 400 c/sec.) that over a large part of each half cycle, the cores are saturated. Thus, the flux density in each core, if plotted against time, has an almost square waveform. This is illustrated in Fig. 2 (b), simultaneously for both cores, while in Fig. 2 (a) the magnetic mechanism is illustrated. In this figure, the magnetizing force, H , which is proportional to the current through the coils, is shown in relation to the B - H curve, or hysteresis loop of the magnetic material of the cores. The curves of Fig. 2 (b) are easily obtained by reading off values of flux density, B , for each instantaneous value of magnetizing force H , much as the alternating plate current of a valve may be found graphically when the shape of the

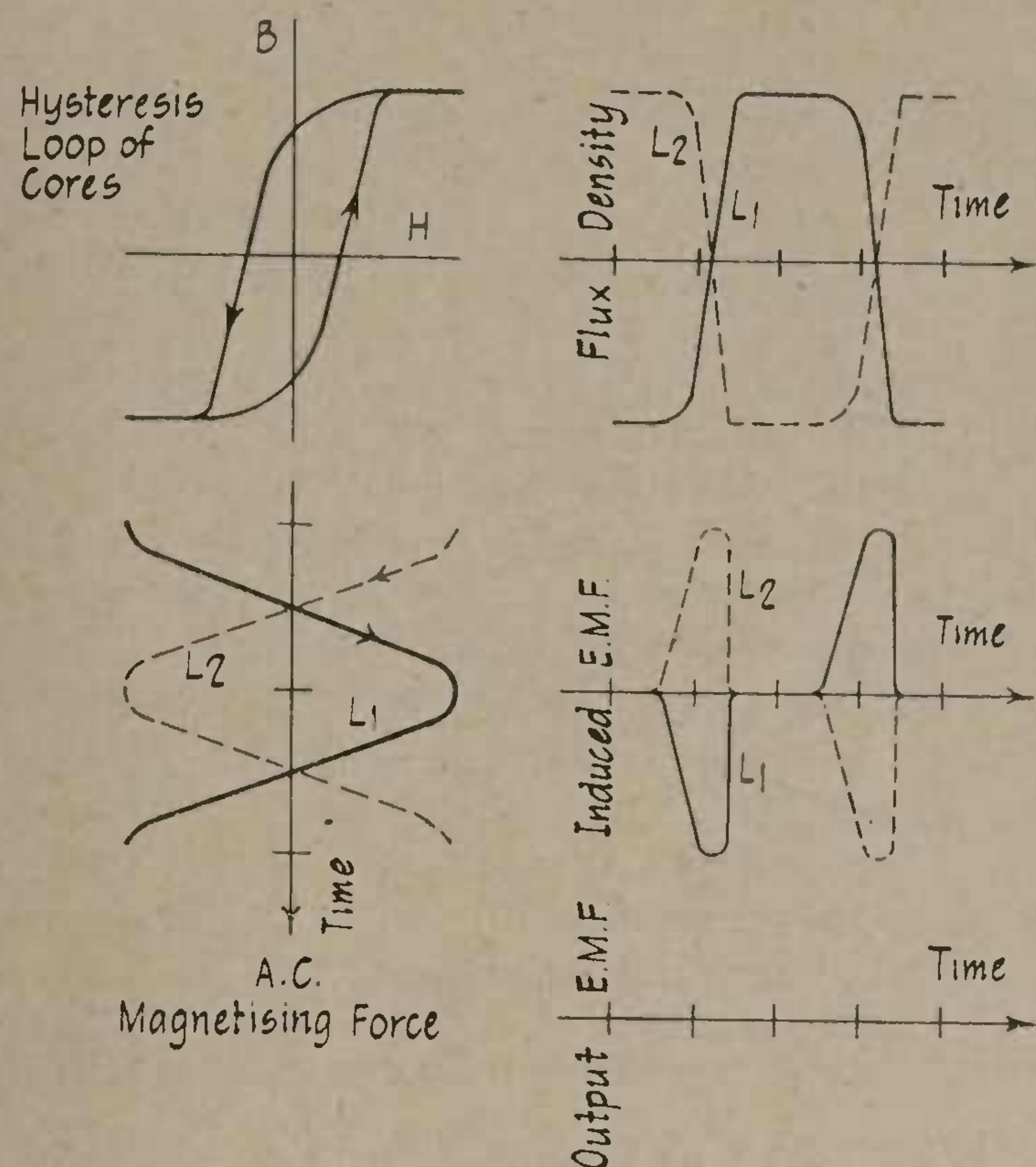


Fig. 2

Waveforms when the circuit of Fig. 1 is accurately balanced, i.e., without R in position. No direct external field.

valve's I_p - E_g curve is known, and a sine-wave of known amplitude is applied to it.

Now, these sudden changes in magnetic flux in each coil will produce corresponding changes of voltage across them, and these have been drawn in Fig. 2 (b) directly below the flux-density curves, to show the time relationship between them. The coils possess inductance, and as we all know who have had anything to do with elementary A.C. theory, the voltage across an inductance is proportional to the rate of change of the current through it. This is the same thing as saying that if we have the wave-shape of the current through the coil, this is also the wave-shape of the change of flux density in the core, so that the E.M.F. appearing across the coil will have a shape that can be obtained by differentiating the current (or flux-density) curve.

In the curves labelled "induced E.M.F.s", we have the shapes of the E.M.F.s across each coil. It can be seen that since the coils are identical, these shapes are also identical, but they are also exactly out of phase with each other.

Now, if we have a centre-tap on the transformer, and take off an output connection between this and the junction of the two inductors, the voltage that we obtain will be the sum of all the E.M.F.s in the circuit. The output at the original 400 cycles will be zero, because the outputs on either side of the centre-tap are equal in magnitude and opposite in phase, and because the inductors are identical. The arrangement is clearly a bridge circuit, which is balanced for the 400-cycle input. There remain, therefore, the E.M.F.s induced in L_1 and L_2 by the variations in flux density. These

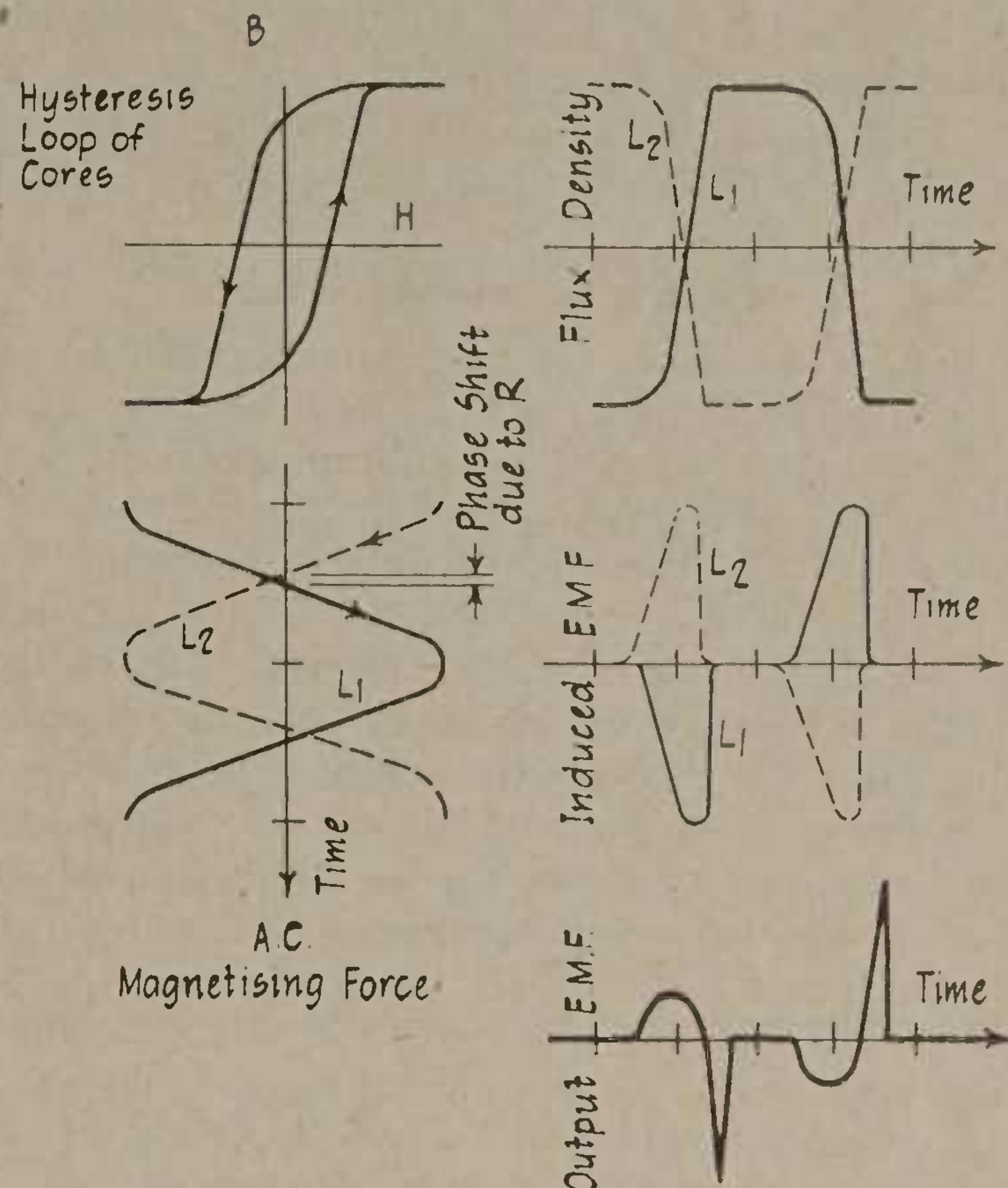


Fig. 3

Waveforms when R is in position, and adjusted to produce a very small phase shift. Still no external field through fluxgate cores. Note that output pips are equal and opposite in polarity.

two E.M.F.s are illustrated in Fig. 2., and it can be seen that their shapes are exactly complementary. Thus, if, as in Fig. 2, the outputs from L_1 and L_2 are exactly synchronized in time, they will cancel exactly, and the output will be zero.

If, now the alternating exciting currents are not exactly out of phase with each other in L_1 and L_2 respectively, the residual output of the circuit will no longer be zero, and the type of output that will be obtained will be similar to that shown in Fig. 3. Here, the exciting currents are shown with a slight phase shift, which is easily obtained in practice by shunting either inductor with a resistor. This is shown in Fig. 1 as R , and in order that the phase shift it produces may be small, its value must be large compared with the reactance of L_1 and L_2 at the operating frequency. In the absence of R , the applied voltages to L_1 and L_2 being 180° out of phase, the currents in L_1 and L_2 , and consequently the magnetizing fluxes in their cores, would also be exactly 180° out of phase. But R causes the current in the L_1 to lag the applied voltage by very slightly less than 90° , so that as indicated in Fig. 3, the magnetizing flux in L_1 leads the exactly out-of-phase position by a few degrees.

This phase lead therefore holds with respect to all the remaining waveforms. The induced E.M.F. in L_1 thus leads that in L_2 , so that the sum of these E.M.F.s is no longer zero, but gives a resultant output which can be obtained by taking the difference between their respective curves. This gives the answer shown

at the bottom of Fig. 3, where it can be seen that the output consists of two narrow pips, in opposite directions, but equal in amplitude. This is the normal method in which the fluxgate is operated.

Adding a Steady Flux

In Fig. 3, the flux is purely an alternating one, set up by the currents in L_1 and L_2 , and we have assumed that there is no other flux linking their cores. This statement is really implicit in Fig. 3, where the datum line of the A.C. magnetizing flux is vertically in line with the zero of the H axis on the hysteresis curve of the cores. If a small steady magnetic flux is superimposed on the A.C. fluxes, this can be represented on the diagrams by shifting the datum line for the A.C. flux sideways by an amount equal in magnitude and direction to the value of the steady flux, on the H scale. This has been done in Fig. 4. The effect of this on the output is shown in the remaining curves of Fig. 4, where we see that the first pair of "pips" on the induced E.M.F. curve are brought more nearly into co-incidence, while the second pair move farther apart. The final result of this is that the negative-going output pip decreases in amplitude, while the positive-going one increases. This increase and decrease represent the magnetic action caused by the presence of the small steady field in the cores of L_1 and L_2 .

Further, had the steady field been of the opposite direction, the result would have been to increase the negative pip in the output, and to decrease the positive one. Thus, we see that the fluxgate can distinguish between fields in either direction through the cores, and can also respond to varying amplitudes of this field.

Associated Circuits

By itself, of course, the fluxgate cannot deliver a useful output that will give a readable indication, as, for example, by deflecting a meter. For it to do this, associated electronic circuits are needed, but all the necessary "information" is contained in the output E.M.F. of the fluxgate itself, and this E.M.F. needs only suitable processing to make it suitable for bringing it to the notice of our senses, so that we may measure it. It is not the purpose of this article to describe such circuits, but we should perhaps indicate their nature. Anyone interested in using a fluxgate should be able to either find in the literature, or design for himself, circuits that will perform the needed functions.

One method is by direct operation on the output waveform. For example, if two rectifiers are arranged, one of which measures the amplitude of the negative peaks, and the other the positive peaks, it is clear that the outputs of these rectifiers will be equal when there is no steady flux through the cores of the fluxgate. If the rectifier outputs are added together, the result will be zero. When a steady flux is present, the combined output of the rectifiers will be either positive or negative in polarity, depending on the direction of the

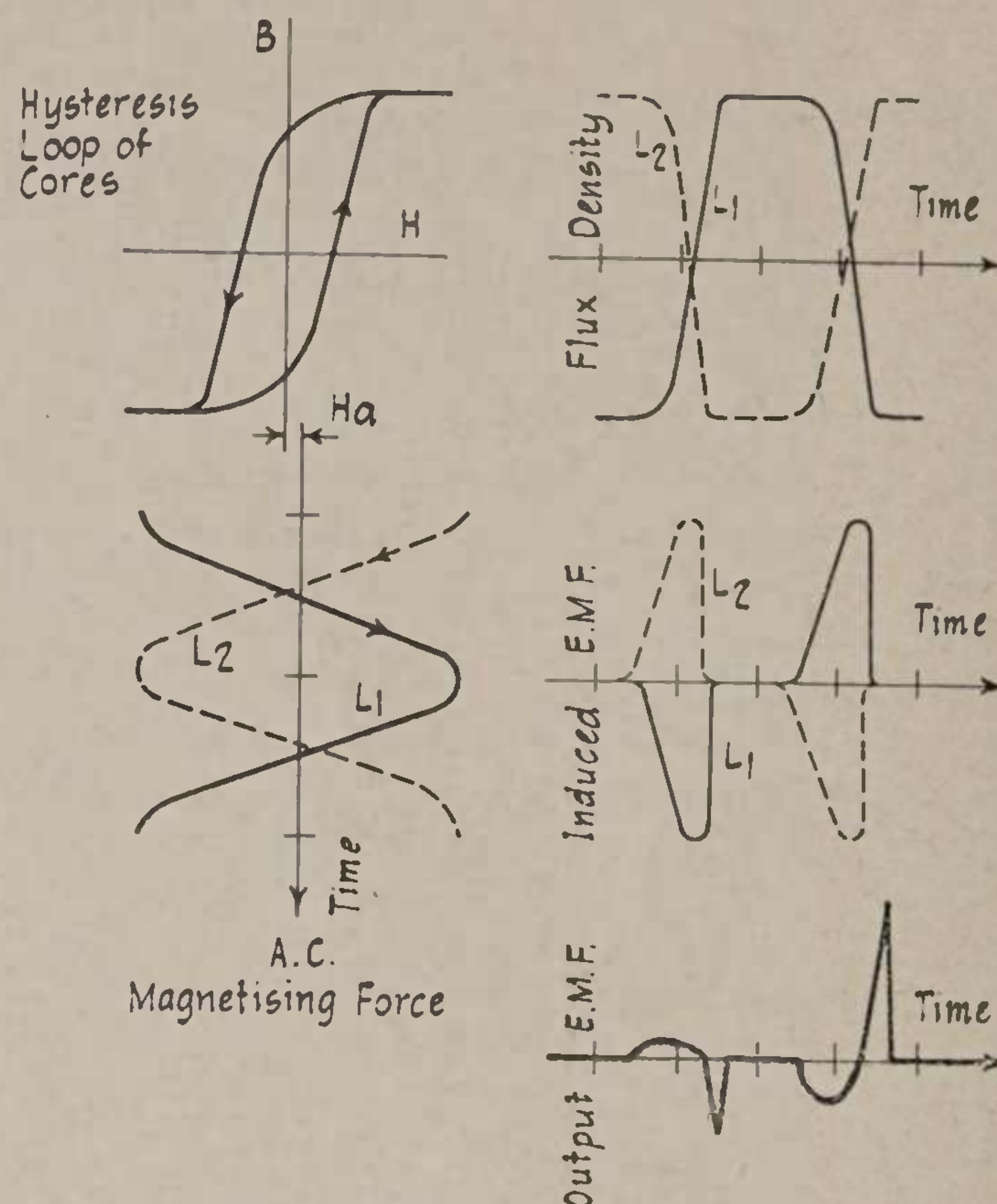


Fig. 4

Waveforms as in Fig. 3, but with a steady field H_a through the fluxgate cores. Note that the positive pip is larger and the negative one smaller than H_a is zero.

measured field, and its amplitude will be a measure of the field's amplitude. Thus, if the output of the rectifier system is applied to a suitable D.C. amplifier, which operates a meter with a central zero, the meter readings can be calibrated in terms of the magnetic field in the fluxgate.

Another method depends on the fact that when the positive and negative pips in the output are equal in amplitude, the waveform contains only the fundamental 400-cycle frequency, and odd harmonics. But when the waveform becomes unsymmetrical, a component at the second harmonic makes its appearance, and is greater, the greater the difference between the two sets of pips. Thus, if the output waveform of the fluxgate is passed to a selective amplifier, tuned to 700 cycles per second, the output will be zero for zero steady field through the fluxgate, and will rise whenever a steady field appears in the cores. Moreover, the phase of the 800-cycle voltage will change by 180 degrees if the measured field changes direction. In this way, the amplitude and phase of the 800-cycle output gives an indication of the strength and direction of the measured field.

Which form of output indication is used in a given application of the fluxgate depends largely on the application itself, and on the most convenient form of output for that purpose. For example, for giving a meter presentation, whether for visual reading or for operating a recording meter, the first type of auxiliary circuit is often used. Often, however, it is necessary to make the fluxgate output drive an electric motor, which,

through gearing, keeps the fluxgate either in alignment with, or at right-angles to the field being observed. For applications of this sort, the second harmonic amplifier type is more convenient. An A.C. motor is used, designed to work from 800 c/sec., and of the two-phase induction type. One field winding is supplied with constant current at 800 c/sec., the phase of which is arranged to be either zero or 180° , compared with the output of the fluxgate amplifier, while the output of the latter feeds the second field coil. In this way, the motor is made to turn whenever there is output from the fluxgate amplifier, and because of the phase reversal in the output of the fluxgate when the field changes direction in its cores, the rotation of the motor reverses when the fluxgate field reverses. Also, the speed of the motor increases, the farther the fluxgate is from the position of zero field in its cores. It thus becomes possible to make the electric motor align the fluxgate cores at right-angles to the steady field with

as much precision as we please. It can be seen that whatever the orientation of the object containing this system, the fluxgate will remain always at right-angles to the magnetic field through its cores. If this magnetic field is that of the earth, the whole system becomes an accurate magnetic compass, known as the fluxgate compass.

There are still other methods of utilizing the output of a fluxgate, but the examples already given serve to show its principle, and to indicate some of the things that can be done with it. Its sensitivity and stability are such that it can be used to measure small variations in the strength of the earth's magnetic field, in which case it becomes the basis of an ultra-sensitive magnetometer. In addition, there must be many purposes for which its sensitivity need not be nearly as high, and in which its application would be correspondingly easier to implement.

RADIO TO THE RESCUE

V.H.F. System to Prevent Cattle Stealing in Uganda

Karamoja is a wild and virtually uncivilized part of Uganda, inhabited by pastoral but war-like tribes similar in some ways to the Masai of Kenya. They are a fine upstanding race, clad in their birthday suits and accustomed to carrying spears not merely for ornament or decoration. The country itself consists of dry scrub-covered plains interspersed with bold rocky mountains rising in some cases to a height of over 10,000 ft. To the Karaamajong their herds of cattle are everything and a young brave naturally likes to blood his spears or to raise the price of a bride in cattle by carrying out raids into the neighbouring districts which are populated by less war-like and more modernized Africans.

In recent years these neighbouring districts have been expanding and moving up to the borders of Karamoja and where previously there existed an uninhabited No Man's Land, into which during the dry weather grazing season the Karamajong could expand at will, there is now no such vacant space and in consequence Karamajong raids into neighbouring districts have increased both in terms of murders and cattle thefts.

Karamajong cattle raiders can and do drive a stolen herd of cattle 40 miles in a night and it is no easy task to pursue and recover the stolen cattle which are speedily dispersed amongst their own herds.

To their neighbours the Karamajong are naturally a continual nuisance and menace, but it is noticeable that those Government Officers who work among them soon tend to regard them as naughty but in their own way pleasantly virile people.

The high incidence of cattle stealing in the Karamoja

district of Uganda has led the police authorities to install a V.H.F. radio network as a means of forestalling the sporadic raids of local tribes on the herds of neighbouring villages. The system, which will be under the control of the native-recruited Uganda Police uses Marconi equipment throughout. The network links up fourteen local police posts with a headquarters post. Any suspicious activities observed by local constables are reported to the H.Q. post and a patrol is sent to investigate in radio-equipped vehicles.

All the local constabularies have been equipped with Marconi Type HX86A/HR86A fixed-station transmitter/receivers working into the headquarters post at Nabilatuk via a repeater station built on a conveniently situated high point within range of all the fixed stations. Both the headquarters and repeater stations are equipped with a duplicate installation of the Type HX86A/HR86A transmitter/receiver, and duplicated power supply equipment. The repeater station is designed to operate unmanned, but should a fault arise in the radio equipment or generating plant a warning bell is rung in the guard hut nearby and the switch-over to standby equipment is carried out manually.

The Uganda police authorities say:

"The radio repeater station which forms the backbone of this scheme has been sited at a point about 7,000 ft. on the northern slopes of Mount Elgon, from which there is a quite magnificent view across the plains to the ranges of mountains as much as 60 to 100 miles north. The radio scheme is now in full operation and is working with exceptionally good and clear efficiency up to the optimum range at the curve of the horizon."

Receivers

WHAT MAKES A COMMUNICATIONS? RECEIVER—Part 4

This month's article on communications receiver practice describes image interference and its importance, and shows what design features are incorporated in practical receivers in order to eliminate it and its undesirable effects.

What is Image Interference?

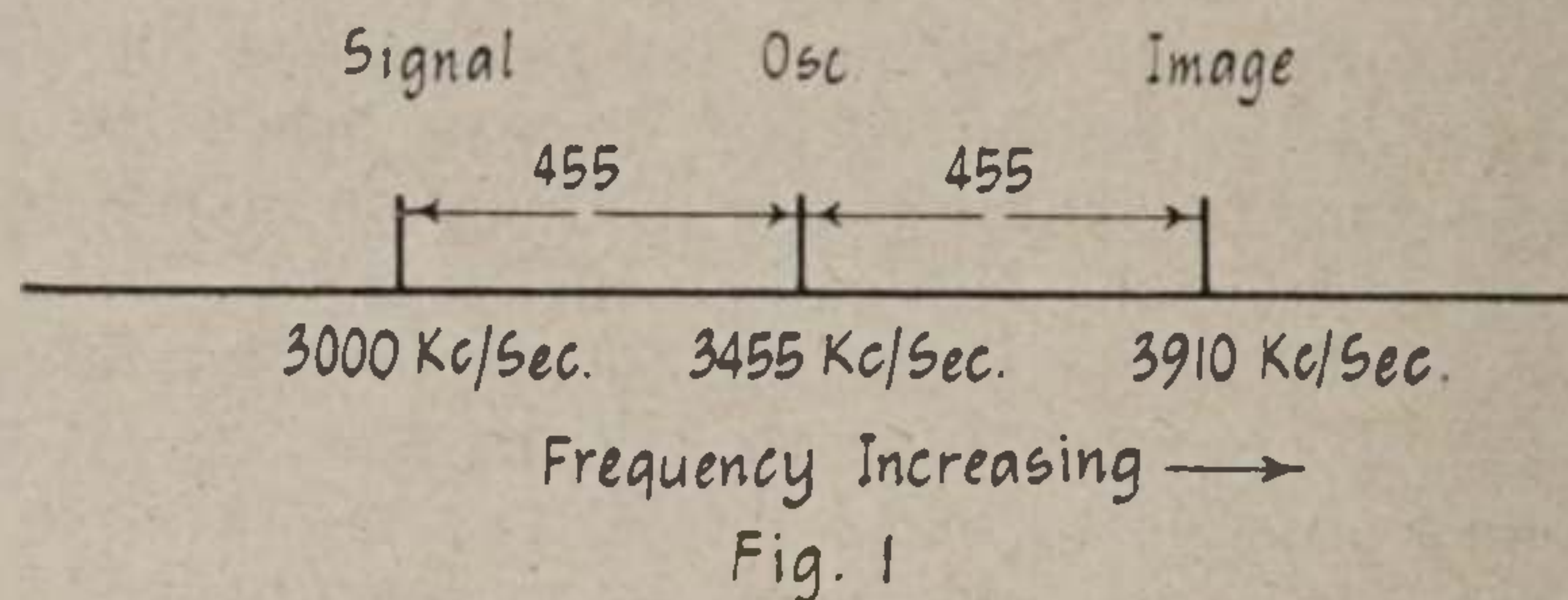
Although practically any article or text-book that purports to give information on communications receivers, makes some mention of image interference and its effects, this seems to remain a subject upon which there is a good deal of misunderstanding. In some ways, this is understandable, because some of its aspects are tricky, to say the least, but its importance—or rather the importance of eliminating it in any receiver that makes itself out to be of communications quality—is quite frequently underestimated. Its main effect, when present, is to produce heterodyne whistles with signals it is hoped to receive, thus making them difficult or even impossible to copy. This is obviously a very bad fault, for there is more than enough difficulty of this sort due to circumstances outside the receiver's control, without going out of our way to manufacture more, through imperfect receiver design!

For this reason alone, it is important to eliminate it, but it is not always realized that there is at least one major disadvantage in a receiver having appreciable image response, even when there is no actual heterodyne present because of its existence. We will enlarge upon it later; at the moment it will suffice to say that it results in a worsening of the receiver's signal-to-noise ratio.

First of all, however, what are image response, and image interference—two terms we have already used without defining them?

First of all, it should be made clear that both of them are phenomena peculiar to the superheterodyne type of receiver, and that in any other type they cannot occur; further, since the distinguishing feature of a superheterodyne receiver is the oscillator-mixer, whereby every signal, whatever its frequency, is for purposes of reception converted to a single, fixed frequency known as the Intermediate Frequency, or I.F., it is not illogical to suspect that image response is due entirely to the presence of the oscillator-mixer.

This supposition is quite correct, and the mechanics of the business is really very simple. Let us see, then, what the mechanism is. As everyone knows, the mixer stage in a superhet accepts the desired signal and also the signal from the local oscillator. In the circuit, new frequencies are produced, which are numerically equal to the sum and difference of the frequencies of the oscillator and the signal. Other frequencies are produced too, but these two are the most important ones. In the plate circuit of the mixer is a circuit, tuned to



one or other of these frequencies—usually the difference frequency—so that the remaining one, as well as the others we have not specified, is rejected, while the one to which the plate circuit is tuned is emphasized, and is passed on to the I.F. amplifier, the whole of which is tuned to this same frequency. For example, if the signal is at 3,000 kc/sec., and the oscillator is at 3,455 kc/sec., the mixer plate, and the I.F. amplifier are tuned to $3,455 - 3,000 = 455$ kc/sec., which is the I.F. of the receiver. The sum frequency, of 6,455 kc/sec. is so far removed from 455 kc/sec., that none of it appears in the mixer plate circuit, while the remaining tuned circuits in the I.F. amplifier each discriminate still further against it, and it is to all intents and purposes non-existent.

Now let us consider the signal-input circuit of the mixer stage for a moment. In any practical receiver it is tuned to the frequency of the signal it is desired to receive, and it is well known that a major problem in the design of a superhet receiver is to ensure that as the local oscillator and the signal circuits are simultaneously varied in frequency, to enable the receivers to "tune in" different signals, on different frequencies, the difference between their frequencies must remain the same, and equal to the intermediate frequency. This is known as the *tracking* of the circuits of the superhet. Now, if the receiver we are considering is a simple one, without a stage of tuned R.F. amplification, there will usually be only one tuned circuit, at signal frequency, between the aerial and the grid of the mixer tube. As everyone knows who has built a simple crystal set containing only one tuned circuit, the selectivity of a single tuned circuit is not very high. This is true on the broadcast band, and it is even more so at higher frequencies, say above 2 mc/sec., at which our communications receiver has to work. This means that if a number of signals are present in the aerial circuit at one time (and this is always the case) many of them are certain to be presented to the mixer grid simultaneously, because the tuned circuit in this grid is not selective enough to ensure otherwise. This being

the case, all of them will beat with the local oscillator, and each will produce its own beat frequency in the plate circuit of the mixer. Not all of them will be heard at one time, however, because the I.F. amplifier is very much more selective than the tuned R.F. circuit, and it is this selectivity at the I.F. that makes the whole set so selective insofar as picking out one signal from a number of adjacent ones is concerned. From this it can be seen that if we are concerned about adjacent-channel selectivity, as it is called, all we have to do is to increase the selectivity of the I.F. amplifier. And because this entails little difficulty, an extremely selective set is not difficult to produce, if all we are worried about is signals spaced by only a few kilocycles from the desired one of the moment.

It might be thought that this would be the beginning and end of the selectivity problem, but unfortunately it is not. Suppose, for instance, that the selectivity of the aerial circuit is very poor. In this event, signals far removed from the point to which the mixer grid circuit is tuned would be presented to the mixer circuit with little or no reduction in strength. It then becomes possible for the receiver to respond not only to the desired frequency, as determined by the difference between the oscillator and signal frequencies, but also to another frequency which is also related to these two important ones. To illustrate this, we have drawn a simple diagram, Fig. 1, in which frequency is measured horizontally along a straight scale. In this diagram we have marked the frequency of the desired signal, and that of the local oscillator, when the receiver is correctly tuned so as to receive this signal. The difference between these two frequencies is obviously equal numerically to the I.F. of the receiver.

Now sums and/or differences are a two-edged weapon. There are, in fact *two* frequencies which will beat with the oscillator in a mixer circuit, to produce a difference frequency equal to the I.F. This is illustrated in Fig. 1, by the frequency that has been labelled "image". It will be noticed that in the example shown, the oscillator is 455 kc/sec. higher in frequency than the desired signal, so that if this signal is present, an I.F. of 455 kc/sec. will be produced, and will pass through the I.F. amplifier and be detected. But if a signal is present at the mixer input, having a frequency 455 kc/sec. higher than the oscillator frequency, this too will beat with the oscillator to produce an output of 455 kc/sec.

If this "image" signal, as it is called, should happen to be present at the same time as the desired signal, both will produce their own I.F. signals at 455 kc/sec., and the I.F. amplifier will have no means of separating them. Consequently, the signal in the image frequency will interfere with the desired signal, *in spite of the fact* that they are on very different frequencies, and *because* of the fact that their frequency difference happens to be exactly twice the I.F. It might be supposed that this exact relationship would very seldom occur—so seldom, perhaps, as to make image interference a very unlikely happening—but this is far

from being the case. In actual fact, the whole of the radio frequency spectrum is so crowded with signals, that to find them spaced by any frequency difference we like to think of is the rule rather than the exception. It is thus obvious that the only cure for image interference is *to ensure as far as possible that signal on the image frequency do not manage to reach the grid of the mixer stage.*

How is Image Interference Reduced?

From the description thus far, it should be possible to deduce without much difficulty that the answer is simply to provide selectivity at the frequency of the wanted signal. It is as simple as that, at least in theory. For example, if we increase the selectivity at the signal frequency, what we are doing is merely to reduce the response of the pre-mixer portion of the set to all frequencies other than the signal frequency. It might be argued that this should be pretty easy to do, because after all, the image frequency is always twice the I.F. away from the desired signal, and this is a fairly long way. In the case of a set with the usual 455 kc/sec. I.F., it is actually 910 kc/sec., and when the signal is on the broadcast band, 910 kc/sec. is quite a long way, in terms of percentage frequency difference. Thus, at broadcast frequencies, even a single tuned circuit ahead of the mixer is able to provide quite good rejection at the image frequency. But when the signal frequency is much higher, as it is in communications receivers, the spacing of 910 kc/sec. between signal and image frequencies becomes only a very small proportion of the signal frequency, so that the selectivity of a single tuned circuit is not great enough to give a reasonable amount of image rejection.

We are now in a position to see that there are two courses of action possible if we wish to improve a set's image rejection, at least while it is in the planning stage. We can obtain the same effect as far as image performance is concerned either by improving the selectivity ahead of the mixer circuit, or by increasing the spacing between the signal and image frequencies. The only way to do this is to increase the intermediate frequency, because, as we found out earlier, *the frequency difference between signal and image is always equal to twice the I.F.*

Those readers who remember the days when superhets were the latest thing in radio, will remember that at that time, intermediate frequencies were very much lower than they are today. The reason for this was that valves were not so highly developed, and stage gains were low, so that in order to obtain a reasonable sensitivity without employing too many valves, a low I.F. was used, enabling greater gain per stage to be achieved. A major disadvantage of this was the poor image rejection, even on the broadcast band, when no R.F. amplifier was used, to give good signal selectivity, and when I.F.s of the order of 100 kc/sec. were in vogue. Consequently, as valves' performance was improved, intermediate frequencies crept higher and higher, thus improving the sets' image performance.

It is worth noting that this trend stopped at 455 kc/sec. because this frequency is not very far removed from 550 kc/sec., the low end of the broadcast band, and if the I.F. were higher still, there would be trouble with instability at this end of the band.

Some sets have been built with higher I.F.s, but these never include the broadcast band in their coverage. If we make the I.F. higher than 455 kc/sec., we are then forced to jump straight away to 1,600 kc/sec., thus dodging intermediate frequencies inside the broadcast band. This has to be done in order to prevent one or more broadcast stations from being picked up directly by the I.F. amplifier. If the I.F. is higher than the broadcast band in frequency, it is an almost impossible job to obtain proper tracking between signal and oscillator circuits, and besides, a single I.F. stage at this frequency no longer has enough selectivity to give the set adequate adjacent-channel separation.

From this, we can see just what factors influence the choice of the intermediate frequency for a communications receiver.

Choice of the Intermediate Frequency

If the I.F. is low, each I.F. stage has high gain, and one, or at most two, are all that are required, simply for giving the set sufficient overall gain. A further advantage of a low I.F. is that a given number of tuned circuits than give more adjacent-channel selectivity than they would do if tuned to a higher frequency. We can see, therefore, that the question of image interference, though an important one, is not the only consideration when the I.F. is being chosen.

If the I.F. is high, the stage gain is reduced, and so is the adjacent-channel selectivity, but the image rejection is improved, without the necessity for increasing the pre-mixer selectivity.

There are good reasons, then, for having an I.F. that is it at once high, for good image rejection, and low, for good selectivity and stage gain. Unfortunately, the I.F. cannot be both at the same time, so that the designer's life is a difficult one! Nor can he choose the I.F. from the above considerations alone. He must consider the set's signal-to-noise ratio, for example, and how his steps to obtain a good noise figure affect the choice of the I.F. For instance, is he to use one R.F. stage, two stages, or none at all? If he decides on two, he will have at least three tuned circuits at signal frequency, giving good R.F. selectivity, and considerable gain. This being so, he need not have so much I.F. gain, and so there would not be any necessity to use two I.F. stages, especially if a fairly low I.F. is used. Usually, however, he will use two I.F. stages in the interests of adequate adjacent-channel selectivity, so that many high-quality communications sets have two R.F. stages, an I.F. of 455 kc/sec., and two I.F. stages at this frequency. Unfortunately, such a set is difficult and costly to build, if maximum advantage is to be taken of the basic tube line-up, so that many not-so-expensive sets make do with one R.F.

stage, and two 455 kc/sec. I.F. stages, putting up with somewhat poorer image performance. Fortunately, however, the performance of such a set need be very little inferior to that of the more ambitious one at the lower frequencies, since the poorer image performance will hardly be noticeable below about 20 mc/sec. It is the range between 20 and 30 mc/sec. that causes the greatest difficulty to the designer, and where the performance falls off markedly unless he has done his stuff remarkably well.

Other Approaches

The tube line-ups that we have described above are by no means the only ones to give a satisfactory performance, although it is true that the bulk of communications receivers conform to one or other of them.

For example, it is possible to have in one set, and at the same time, the advantages of both a high and a low intermediate frequency. This is done by the simple expedient of having *two* frequency conversions between the signal frequency and that at which the detector works. Such a set is usually known as a double-conversion, or double-shift superhet, and it has many advantages. Relatively few commercial receivers use the scheme, yet it is worthy of note that one of the finest of them all is to be numbered among them. Also, one should not forget that by far the commonest type of receiver among amateurs who operate the V.H.F. bands is the double conversion set. All the problems attaching to a communications receiver for the H.F. range of 3 to 30 mc/sec. are greatly intensified when it comes to obtaining good performance on the V.H.F. bands, so that it pays handsomely to use double conversion there. True, the set is usually a two-unit affair, comprising a regular H.F. receiver to provide the second I.F., with its sensitivity and adjacent-channel selectivity, and a separate converter containing any signal-frequency amplification that may be used, together with the first mixer and if any, some amplification at the first I.F. Then, the main receiver is tuned to this first I.F., so that its signal-frequency amplifiers become the first I.F. amplifier. There are a number of variations on the basic scheme, but fundamentally all of them boil down to the system illustrated in block-diagram form in Fig. 2.

First of all, there is the R.F. amplifier, as usual, there primarily to provide a good signal-to-noise ratio. This is followed by the first mixer, which converts the signals to a high I.F. The fact that this is high enables the set to have an excellent image rejection, and the high first I.F. is included solely for this purpose. Next comes a second mixer, converting the output of the first I.F. amplifier to a second, usually very low I.F., 100 kc/sec., or lower. The second I.F. amplifier easily provides excellent adjacent-channel selectivity, and is chosen low for that very purpose. Thus, it is not difficult to see that such a line-up obtains in a very simple manner, all the advantages of both high- and low-frequency I.F.s.

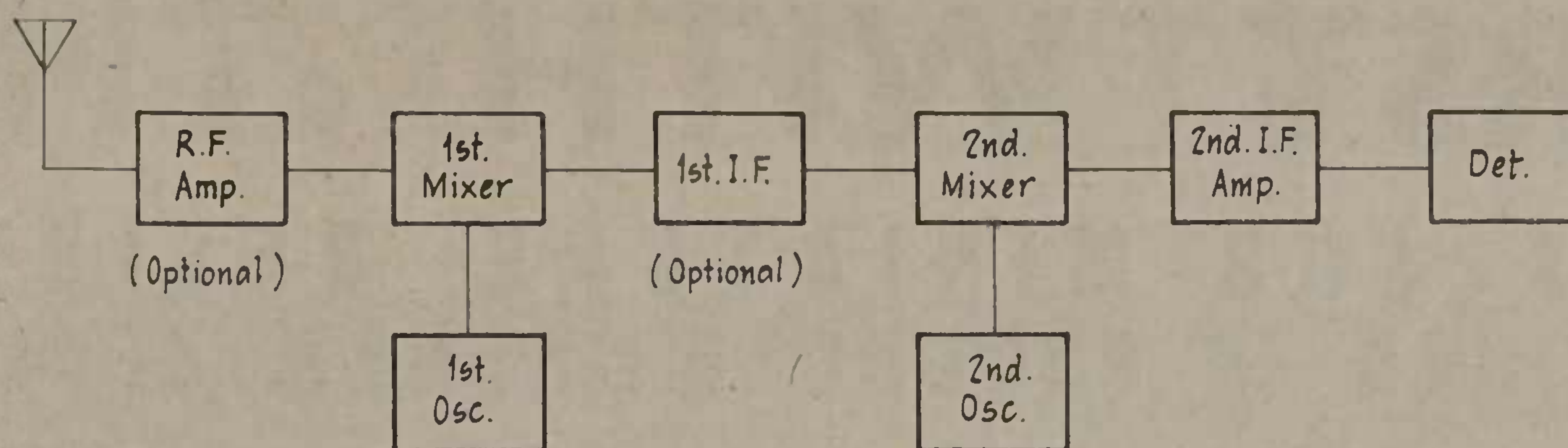


Fig. 2

Other Advantages of Double Conversion

Although Fig. 2 illustrates the principle of double conversion accurately, there are many variations in detail that can be applied to the general scheme. For instance, when it is used as a V.H.F. receiver, with the H.F. communications receiver fulfilling all functions except those of the R.F. and first mixer circuits, it is possible to fix the tuning of the latter, and use the signal circuits of the main receiver as a tunable first I.F. amplifier. This makes the converter for the particular V.H.F. band very easy to build, provided the band is not so wide that the circuits cannot handle it properly without re-tuning. Alternatively, the "front end" can be tunable in the ordinary way, while both I.F.s are fixed, the dial of the main receiver being left at the frequency of the first I.F.

However, it is mainly with the advantages of double conversion, as applied to an H.F. communications receiver, that we are concerned here.

Suppose that we have a single stage of R.F. amplification. This will be followed by the first mixer, whose output may go straight to the second mixer, which is followed by a stage of I.F. amplification. Both mixers produce appreciable gain, each considerably less than that of an I.F. stage, but taken together, their combined gain is much greater than that of a single stage of I.F., which might replace them in a conventional single-conversion set. Thus, even if there is no separate amplifier stage at the first I.F., the overall gain of the set will be greater than that of a set with one R.F. stage and two I.F. stages on 455 kc/sec. Furthermore, this high level of amplification is obtained very easily, with complete stability, because *no two valves in the line-up have their plate circuits working at the same frequency*. Everyone who has built, or attempted to build, a set with two I.F. and/or two R.F. stages knows that if it is to work stably, extreme precautions must be taken with the lay-out of the circuit, and with the de-coupling of the various valves that are working on the same frequency. Indeed, it is just this difficulty of obtaining stable operation that deters many amateurs from trying at all to build their own receiver. Thus, for the amateur, the double-conversion set is a god-send, in that unless it is very scruffily put together, there is little chance of its producing undesirable oscillations, or of being unstable in any way.

This very great advantage is quite incidental to the fact that in many other respects, the performance of the double-conversion set can easily be made equal to the very best of commercial receivers' performance. Then, too, it will be remembered that in our article on bandspreading systems, we pointed out that double conversion presents considerable possibilities for the introduction of special bandspreading schemes. For instance, by giving the second oscillator a slight tuning range, controllable from a knob on the front panel, it is possible to have extremely fine bandspread, covering a fixed number of kilocycles, irrespective of where the signal circuits are tuned to. Moreover, this bandspread is obtained with excellent frequency stability.

Alternatively, by making the first I.F. tunable over a small range—say 500 kc/sec., its tuning control can act as a bandspread dial, giving this amount of spread, also irrespective of the setting of the signal circuits. It thus becomes possible to have general-coverage, and spread bands, simply by including one extra position on the main wave-change switch for each spread band desired, and in these positions using pre-set tuning of the R.F. end. This is a scheme that to the best of our knowledge has not yet been applied to a commercial receiver, but there is no reason why it should not be made the basis of an excellent home-built communications receiver that has complete general S.W. coverage, together with specially spread amateur or S.W. broadcast bands.

Measuring Image Ratio

To get back to our original subject, that of image interference, we should not finish without pointing out how image response is measured, and why appreciable response at the image frequency can degrade the signal-to-noise ratio of a set, if only slightly.

First of all, measuring the image performances of a receiver is very simple, requiring only a signal generator and the usual output meter. First of all, the signal generator is set to the frequency for which the test is to be carried out, and the signal is tuned in on the receiver. Next, the signal generator is shifted to the image frequency, that is the signal frequency plus twice the I.F., and the generator is accurately tuned for maximum signal on the image frequency. The

(Concluded on page 45.)

FIRST WITH THE S

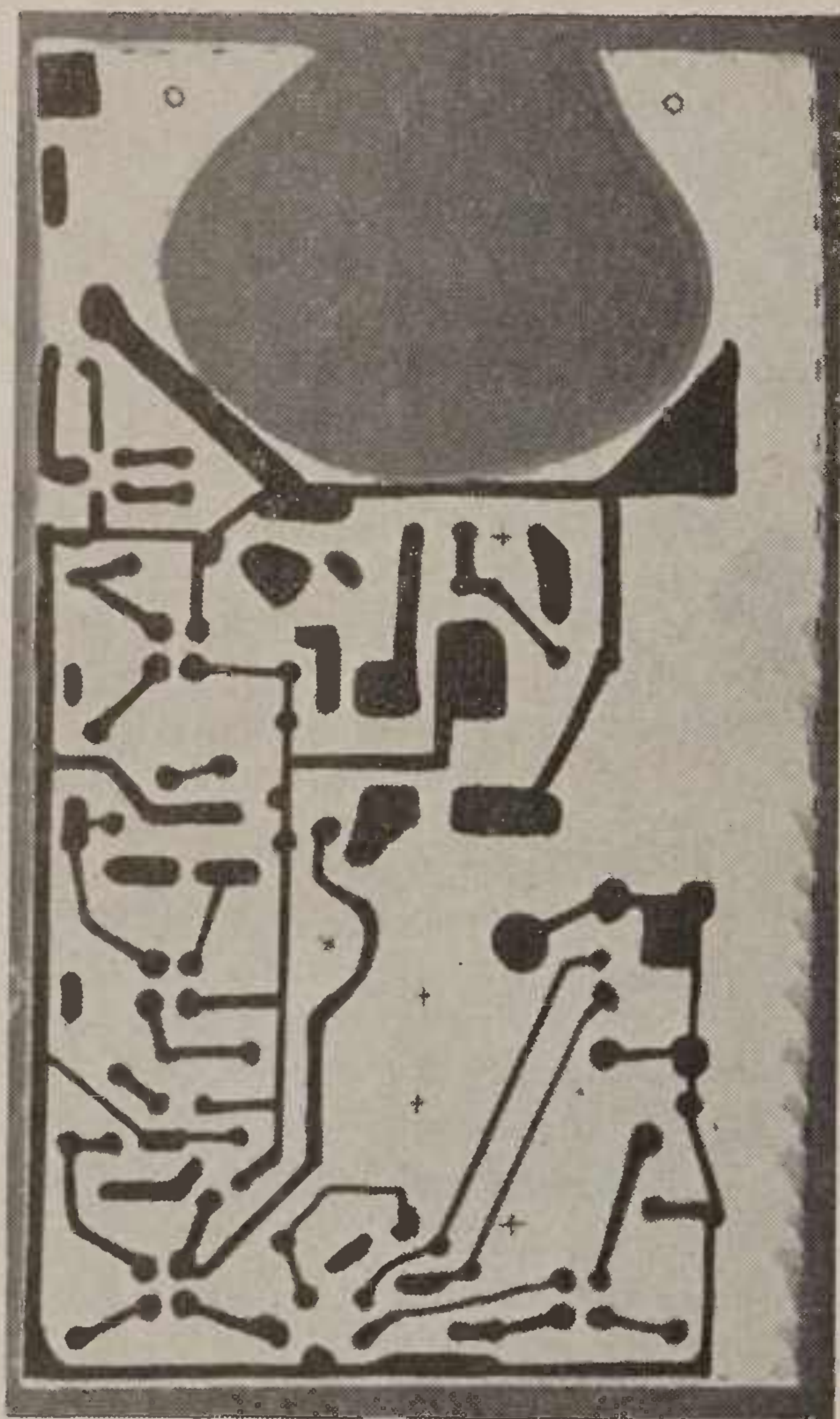
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LEFT: The printed circuit board, made of copper-clad laminated plastic. By an etching process, unwanted copper is removed, leaving a pattern which forms the wiring.



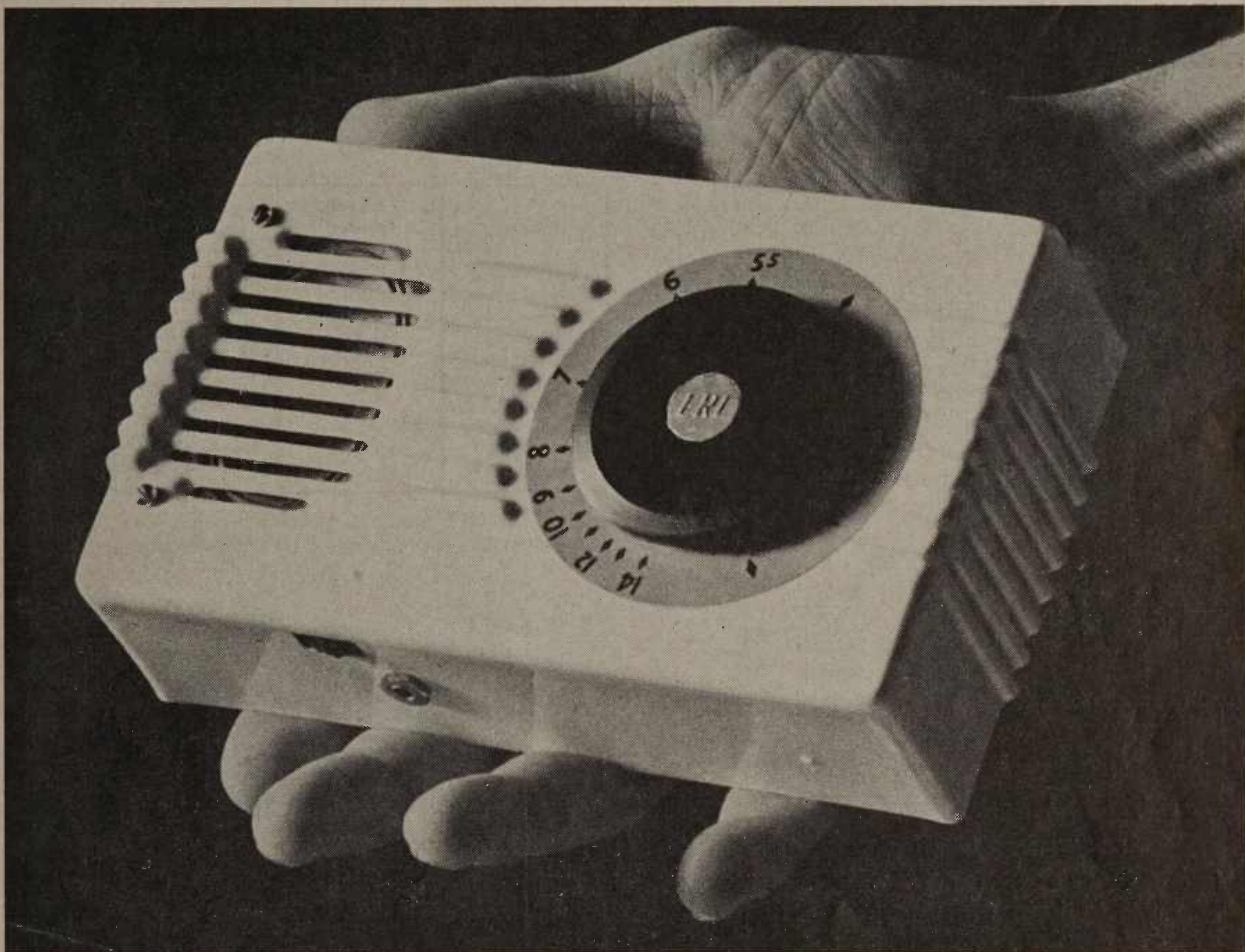
ABOVE: Here are the four pen-cells that run the set, with the minute but efficient speaker, and the Ferroxcube aerial rod.

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Transistors

TRANSISTOR AUDIO AMPLIFIERS—Part 2

Part 1 of this article appeared in our December, 1957 issue, and was concerned mainly with illustrating some of the simple similarities and differences between ordinary valve amplifier stages, and similar stages using a transistor. This month we continue the story with a description of some practical transistor amplifier stages.

Recapitulation

In Part 1 of this article, we spent a good deal of time and space in showing in a simple fashion, the similarity, and some of the differences between simple resistance-loaded valve and transistor stages. We saw, for example, how the "ordinary" valve connection, with input applied between grid and cathode, is very similar in some important respects to the "grounded-emitter" transistor circuit, in which the input is applied between the base and the emitter, which correspond roughly to the grid and cathode respectively, of the valve. Also illustrated was the correspondence between the cathode-follower and the grounded-collector transistor circuit. To refresh readers' memories, Figs 2 and 4 have re-printed here, together with a new diagram, Fig. 5, which shows the third basic manner of connecting both valves and transistors. The valve circuit is usually known as the grounded-grid stage, and it corresponds to the grounded-base transistor circuit, which is illustrated in Fig. 5 (b).

Features of the Three Transistor Arrangements

Before going on with the story, it would be best to list the features of the three types of transistor circuit, with, for comparison purposes, the similar features of the corresponding valve circuits. This has been done in tabular form, for easy reference.

It will be noticed that we have not yet discussed the last two rows in this table, namely those dealing with the input and output impedances of transistor circuits. This is a matter about which we must talk later in the article, and they have been included in Table 1 for the sake of completeness. The figures given are only approximate, since they vary considerably with the type of transistor, and its conditions of use, but these figures do serve to show the differences between transistors and valves, as far as actual values are concerned, and also the relative dif-

TABLE 1.

Property	Grounded emitter	Grounded collector	Grounded base
Phase Reversal	Yes	None	None
Power amplification	Highest	High	High
Voltage amplification	High	1	High
Input impedance	Low (about 1000)	High (abt. 20-50 k.)	Very low (about 50)
Output impedance	Medium (about 25 k.)	Low (about 100)	Very high (abt. 1 meg)

Figs 2 and 4 below. Grounded cathode, and cathode follower valve arrangements, with the corresponding transistor circuits.

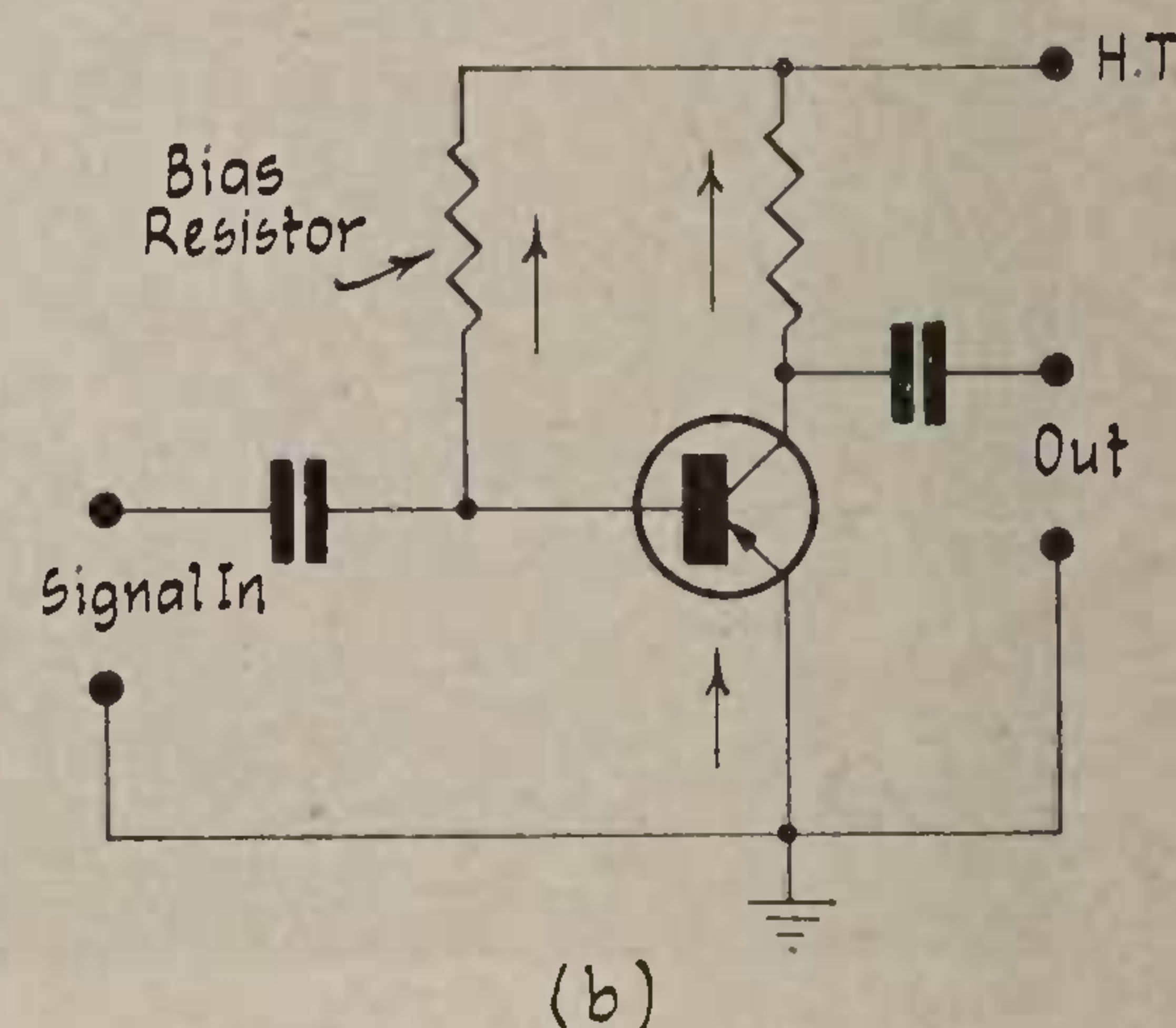
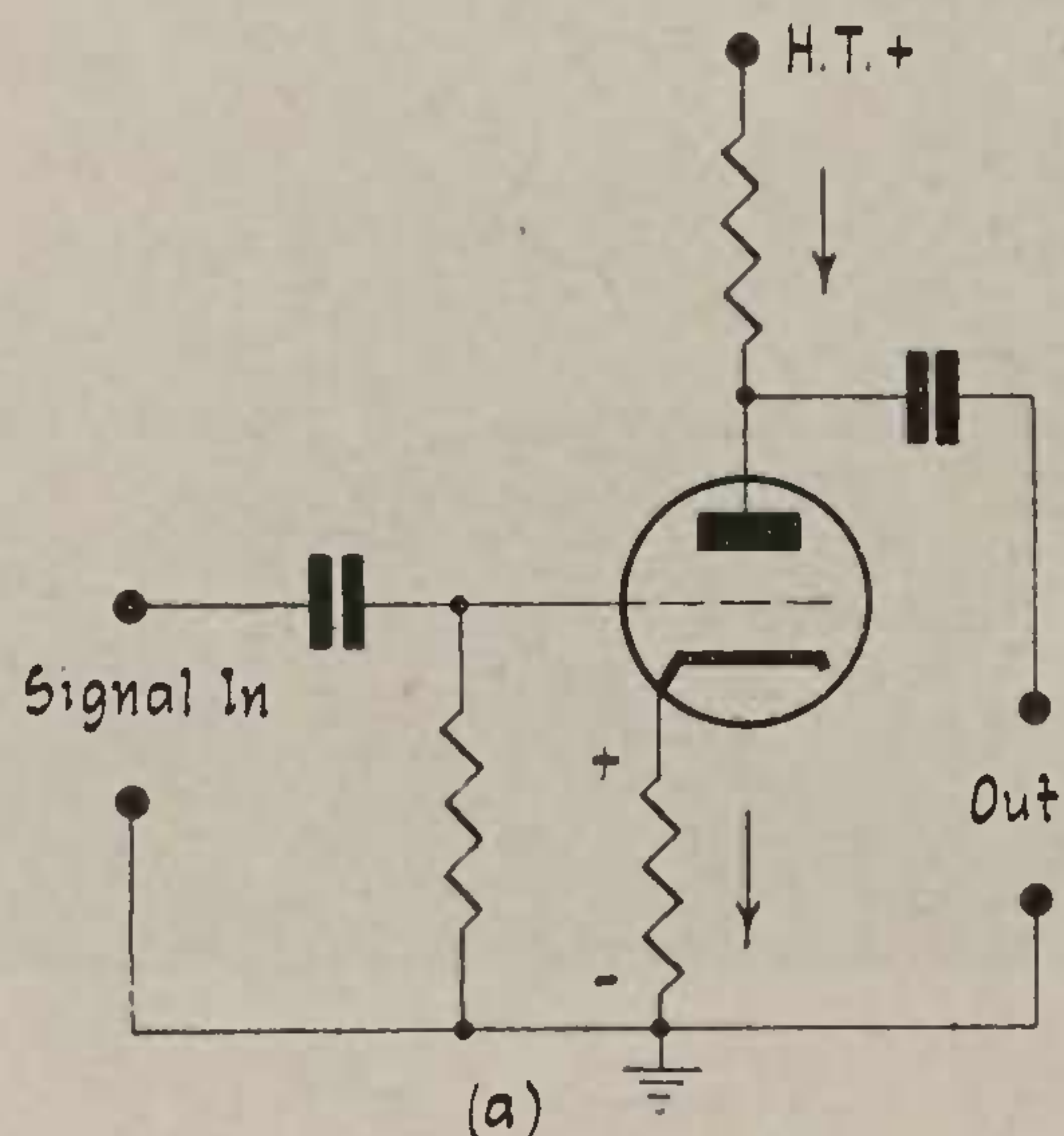


Fig 2

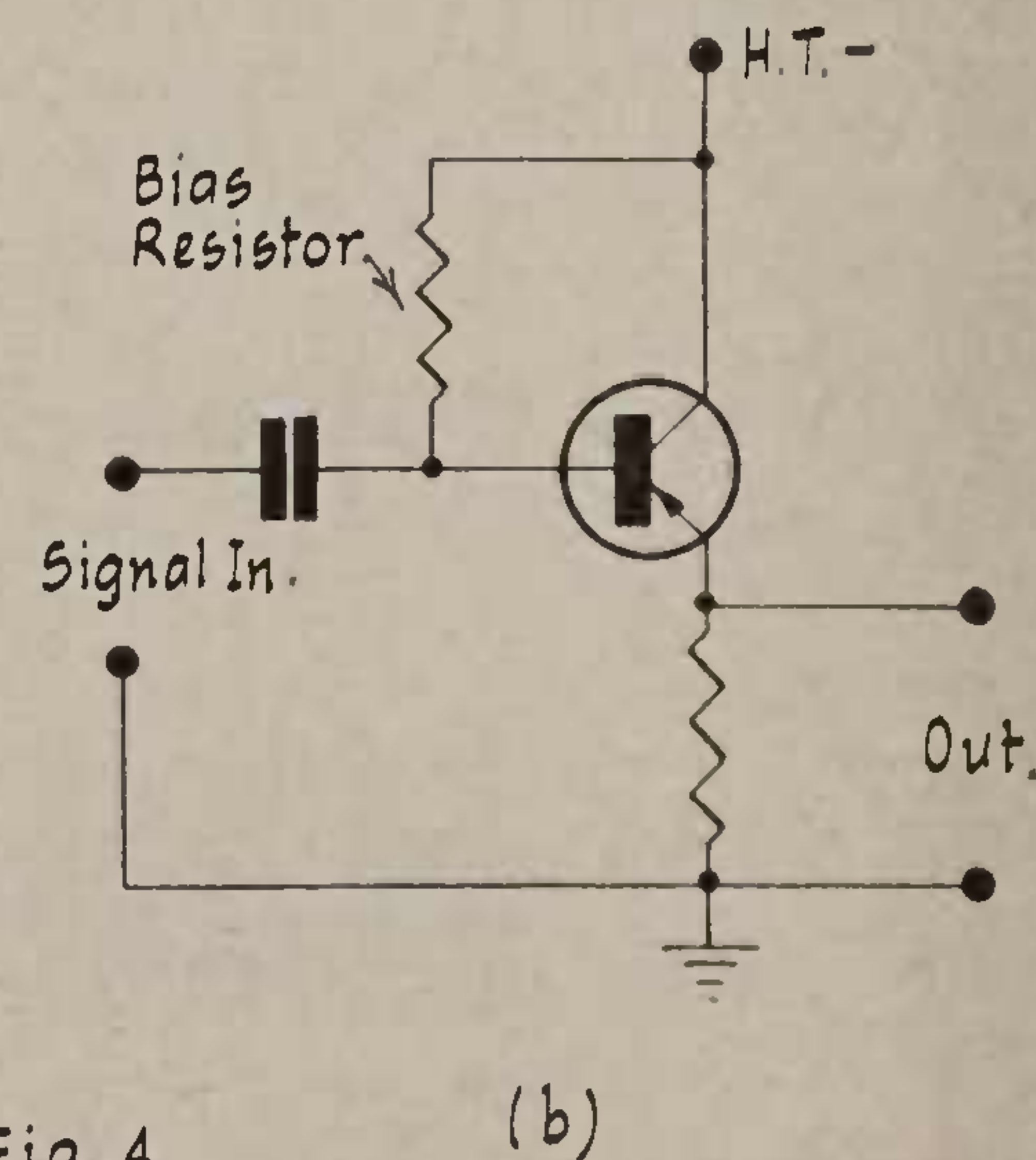
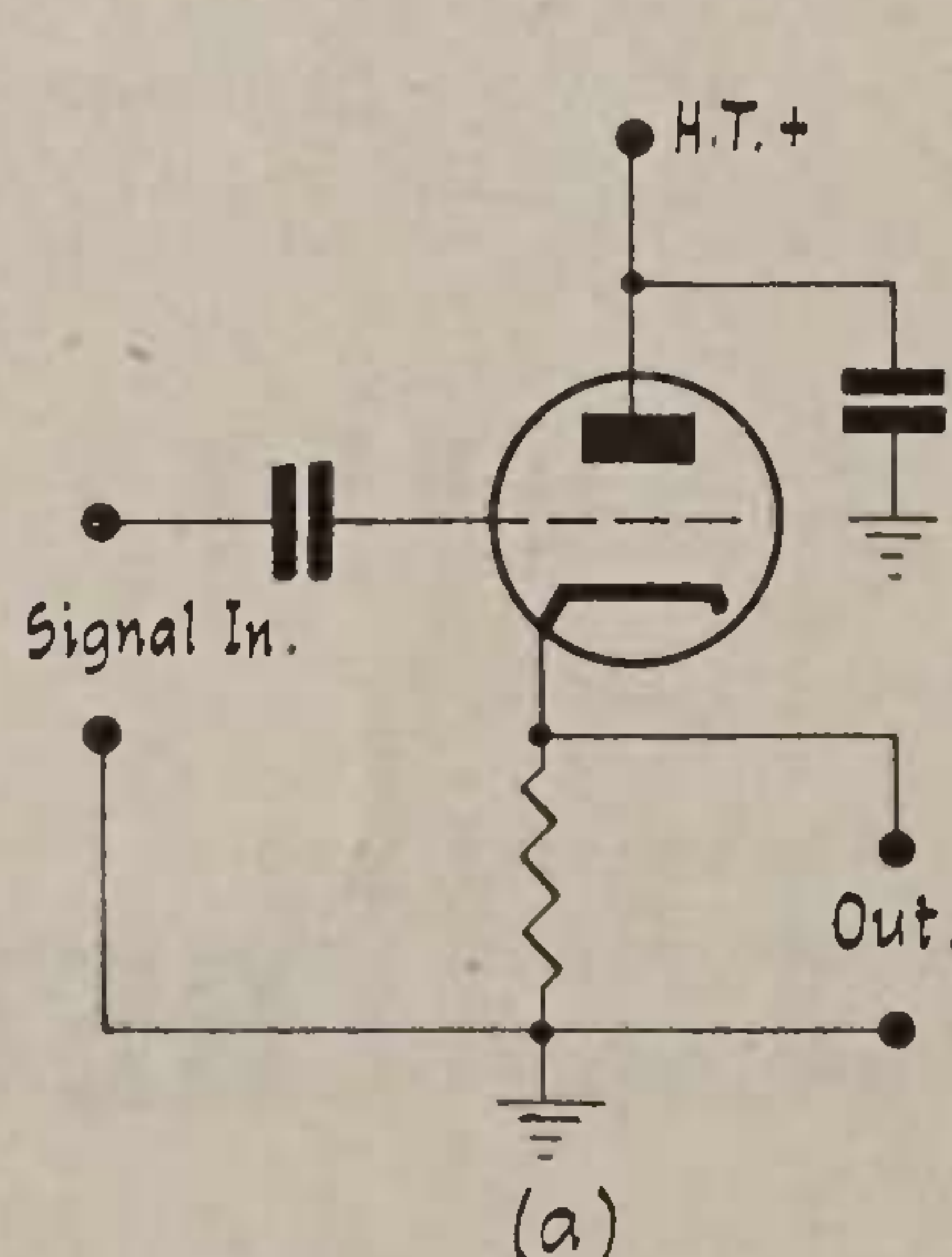


Fig. 4

ferences between the various kinds of transistor connection.

Impedances in Transistor Circuits

While our discussion thus far has served to bring out some of the main differences between transistor and valve circuits, in a very simple and fundamental way, it is necessary to become a little more technical if we are to understand such things as, for example, the very great differences to be found in the values of corresponding components in otherwise very similar circuits. To illustrate what we mean, let us take a look at two circuits, one using valves, and the other transistors, and both designed for the same purpose. The latter is a simple enough application, namely a pre-amplifier for a moving-voil microphone, using two stages in each case. In order to confine the discussion more closely to familiar arrangements, we will assume that both arrangements use resistance-capacity coupling. In order to emphasize the differences between the two circuits, key component values have been inserted. But before we get on to the description, it should be pointed out that though the transistor circuit would

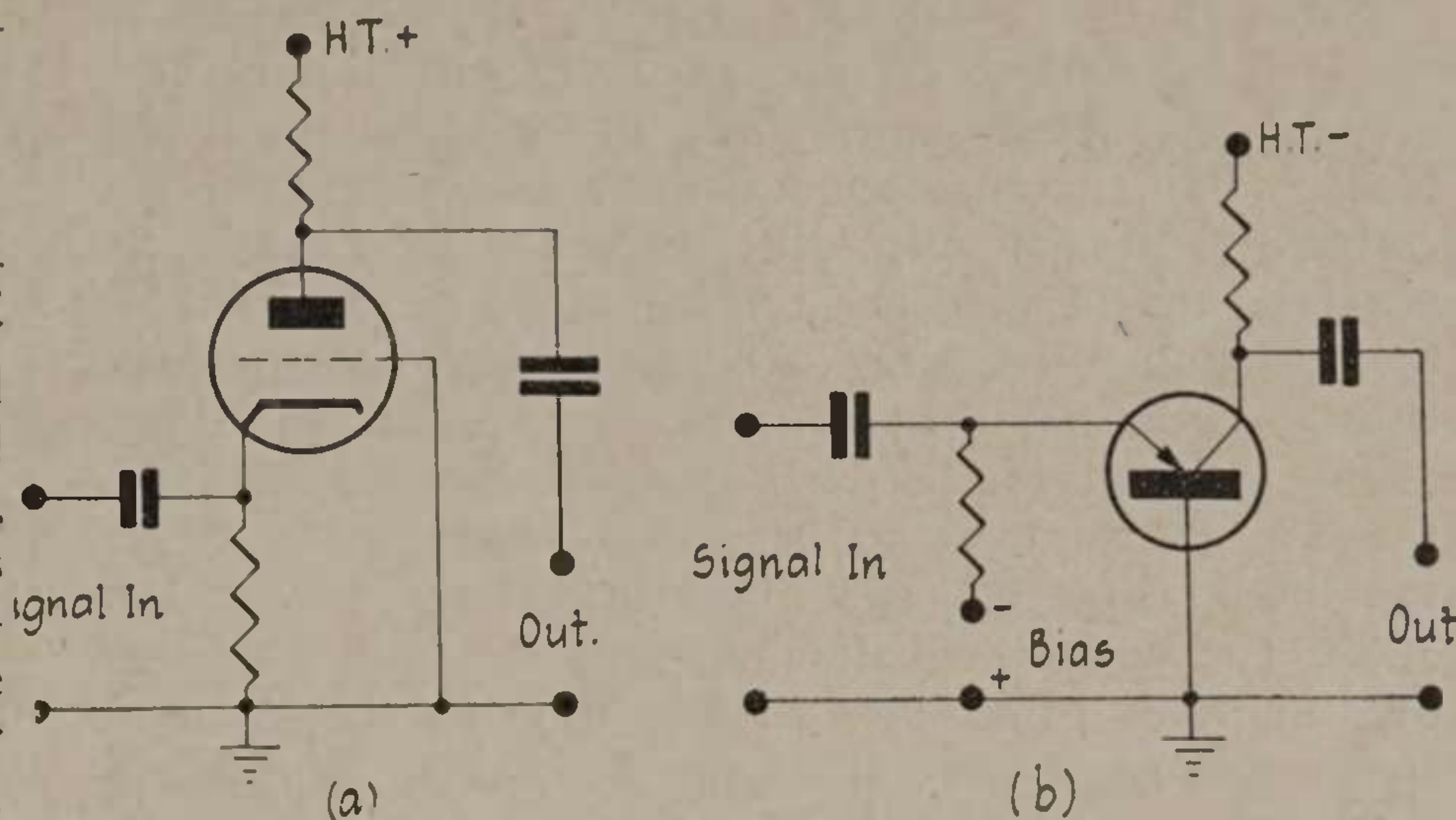


Fig. 5

Grounded-grid valve circuit, with its corresponding transistor arrangement, grounded-base.

This circuit is so ordinary that most of us have forgotten the reasons which underlie the choice of component values, or if we have not forgotten them, they are so ingrained in our consciousness that we do not have to stop to think about them. Let us look first at the grid circuits. We all know that the valves'

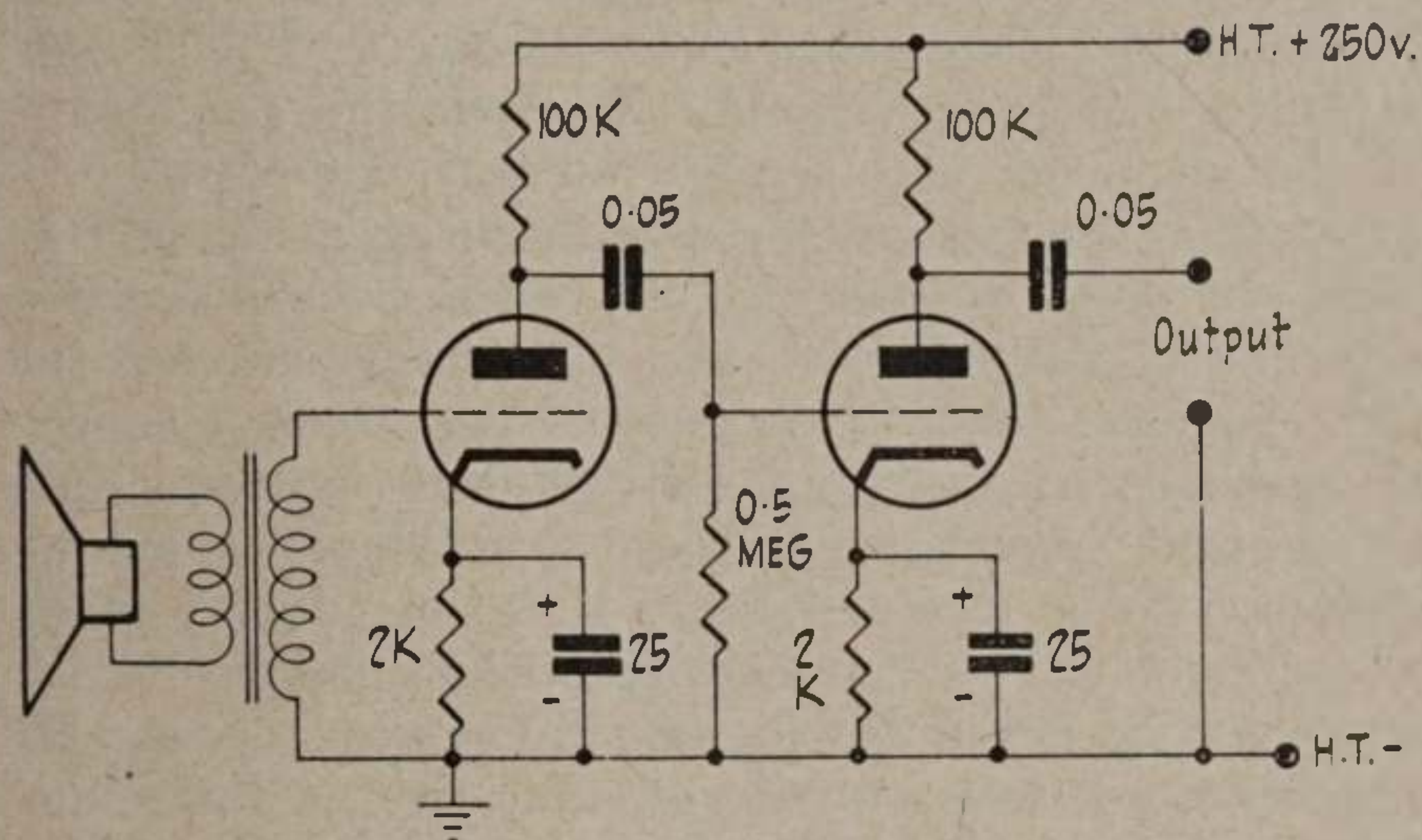


Fig. 6

in practice work quite well, a circuit for serious application would be rather more complex. No different amplifying principles would be involved, however, but only arrangements inserted in order to prevent the undesirable effects of temperature variations, to which transistors are much more susceptible than valves.

Taking the valve circuit first, we see that the microphone, which is a low-impedance type, is connected to a step-up transformer, which may have quite a high turns ratio, and which increases the signal voltage applied to the grid of the first tube by a factor equal to this ratio. Since there is a D.C. path to earth from the grid through the secondary of the transformer, there is no necessity for a grid leak. Grid bias for each valve is obtained by means of the usual cathode bias resistor, which is bypassed by a 25μfd. condenser in order to avoid negative current feedback, and consequent loss of stage gain. Plate load resistors of 100k. are used, and the inter-stage coupling consists of a condenser of 0.05μfd. from plate to grid, together with a 500k. grid leak for the second tube.

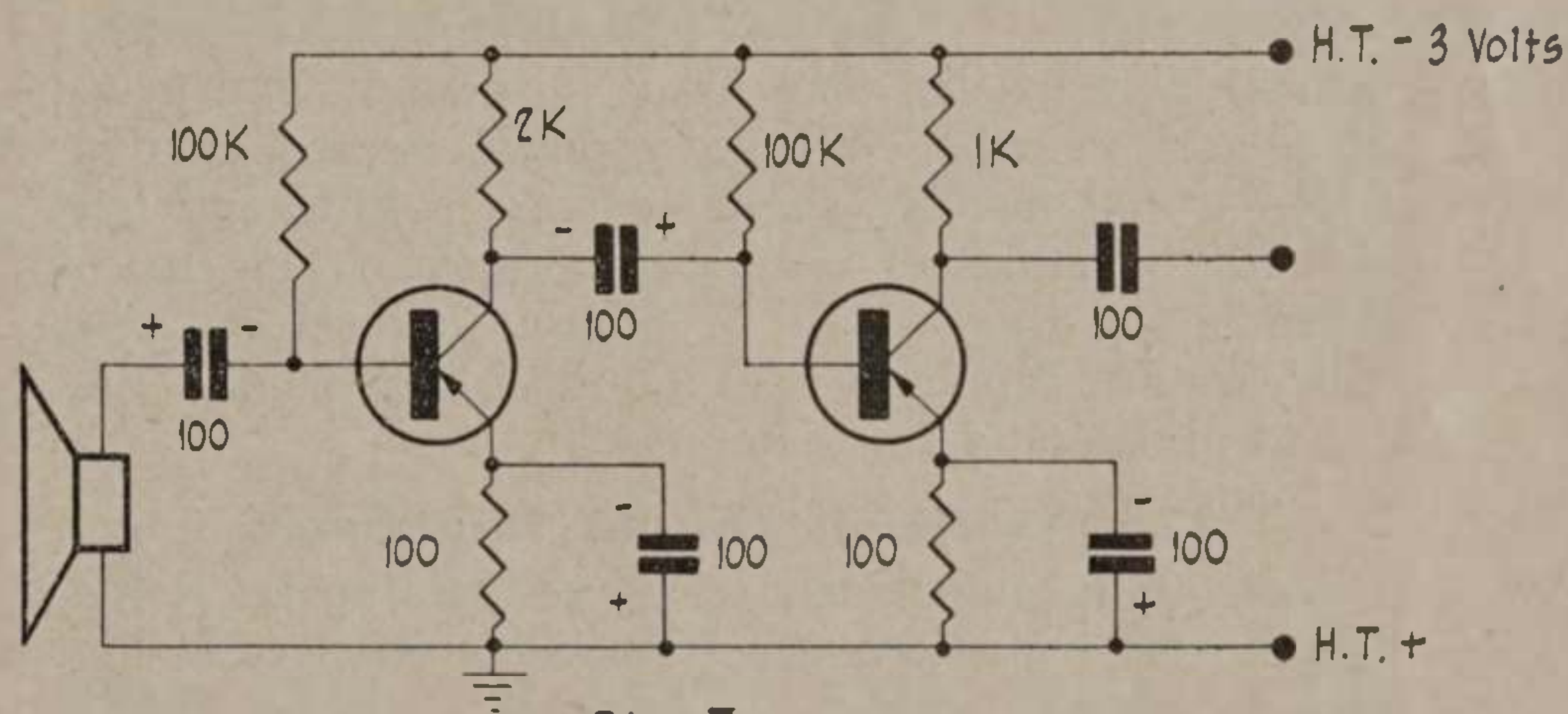


Fig. 7

input impedances are high, but just what exactly do we mean by this statement? It means that if a given voltage is applied to the input terminals, the ratio of the voltage itself to the current that flows between the terminals, is very large. This is nothing more than an exercise in Ohm's Law, which states that $Z = E/I$. Now, since the current flowing between the input terminals is very small, and since this current must come from the source of the signal (be it microphone, pick-up, or another valve), this means that the power delivered by that source is also very small.

The high value of input impedance can be expressed in another way, by saying that the connecting of the grid circuit of the valve across the output terminals of the signal source places a negligible load on that source. It is, in fact, equivalent to shunting across the source a very high impedance, which therefore has a negligible effect on the voltage produced by the source. If we connect a much lower impedance across the source, the latter's output voltage no longer remains the same, so that the device whose input we are feeding no longer receives the same signal voltage that it would if its input impedance were much higher.

Now, in the usual valve circuit, the impedance of the grid is almost infinite, because grid and cathode are in a vacuum, and, since the grid is negatively biased, the current that can flow between grid and cathode is almost zero. But, in order to stabilize the potential of the grid, it is essential that a (relatively) low resistance, of, say, 500k. to 1 Meg. be connected between grid and earth. Thus, the input impedance of the grid circuit becomes equal to the value of this resistor. If we were to be strictly accurate, however, we should say that the input impedance is equal to 500k. (or whatever value the grid leak has) shunted by the input impedance of the tube itself. At audio frequencies, this impedance can amount to as much as a million megohms, shunted by a few micro-microfarads, so that for all practical purposes we can regard the valve's own input impedance as being infinitely great. Thus, there is no error of any consequence in stating that the *circuit's* input impedance is equal to the value of the grid leak.

If now we transfer our attention to the source of the signal, namely the transformer in the case of the first stage, or the first valve when we are considering the input to the second stage, we must consider its *output* impedance. Now this is a slightly more difficult conception to master than input impedance, and many people are somewhat confused about it. Because of this, it is essential that we should digress a little and talk about the meaning of output impedance. If its nature is not understood, even in relation to valves, with which we are supposed to be familiar, how shall we be able to understand transistor circuits?

The Nature of Output Impedance

The output impedance is an essential part of the make-up of any device which provides an electric current or voltage.

This last sentence is really incorrect, in a sense, because when a source of voltage is applied to some external device, some current, however small, must flow. Thus, the sentence should have read "... which provides an electric current and voltage." Or, better still, voltage and current, because we can't have a current unless there is an E.M.F. to cause it.

When we say that a source of voltage has an output impedance, what we really mean is that it has an *internal* impedance. For instance, no battery ever built has ever had zero internal resistance. The fact is, that there is no such thing as a zero-impedance source of voltage. Some things come fairly close to this ideal, such as a large storage battery, which may have so small an internal resistance that when its terminals are short-circuited, the current reaches a value of hundreds, and even thousands of amperes.

Dry batteries are not nearly so good in this respect, having much larger internal resistances, while valves, transistors, and other devices can have even higher internal resistances. What we are interested in now is the effect that the internal resistance (or impedance, as it must be called when we are dealing with alternat-

ing currents) has, both on the generator itself, and on the circuit to which the generator is connected.

To do this, we have drawn a simple diagram, Fig. 8, in which the source is represented by a generator, which we pretend is a perfect one, with no internal impedance at all, in series with an impedance, which represents that of the actual source of E.M.F. At (a) we have drawn this arrangement with its output terminals connected to nothing at all, so that there can obviously be no current drawn from it. In this event, the voltage which appears at the terminals of the generator must be equal to the output voltage, because with no current flowing, there can be no volts dropped in the generator's impedance, Z .

At (b), we have connected a *load*, which for simplicity we have indicated as a pure resistance, R . This time, since the circuit is complete, an output current flows, and its size is determined not only by the value of R , but also by the value of Z . Indeed, it is determined by the impedance of R in series with Z . There must therefore be some voltage dropped across Z , so that not all the E.M.F. produced by the source is able to appear across the load. For example, if the internal impedance Z has the same value as the load resistance R , exactly half the open-circuit E.M.F. of the source will appear across R , while the remainder will be dropped across the internal impedance Z . Since in a practical case, we cannot get inside the source, in order to measure the volts dropped across Z , the only effect we are able to observe directly is that when the load is connected, the voltage across the terminals of the source drops. It is obvious that the internal impedance Z forms a simple potential divider with the load resistance R , so that if we know the value of Z , we can calculate what proportion of the voltage generated will actually appear across R . This being so, it is equally obvious that if the value of R is very much higher than that of Z , almost the whole of E will appear across R , and this is almost always the case when we are dealing with valves. In transistor circuits, on the other hand, we often find that R is comparable in value to Z , or even less than it in value. It follows from this that it is no longer possible to connect or disconnect the load resistance R from the source of signal without affecting the latter. This is yet another of the main differences between transistor and valve circuits, and it calls for special treatment in the design of transistor amplifiers—treatment specially tailored to the transistor's characteristics. Before we turn to the transistor circuit of Fig. 7, we will go back to the corresponding valve circuit, Fig. 6, and re-examine it in the light of the last few paragraphs.

Impedances in Valve Circuits

In the first stage of our amplifier, the very low impedance of the moving coil microphone (say 50 ohms) is stepped up to, say 500 ohms by the input transformer. This means that if we look backwards into the secondary winding of this transformer, we will

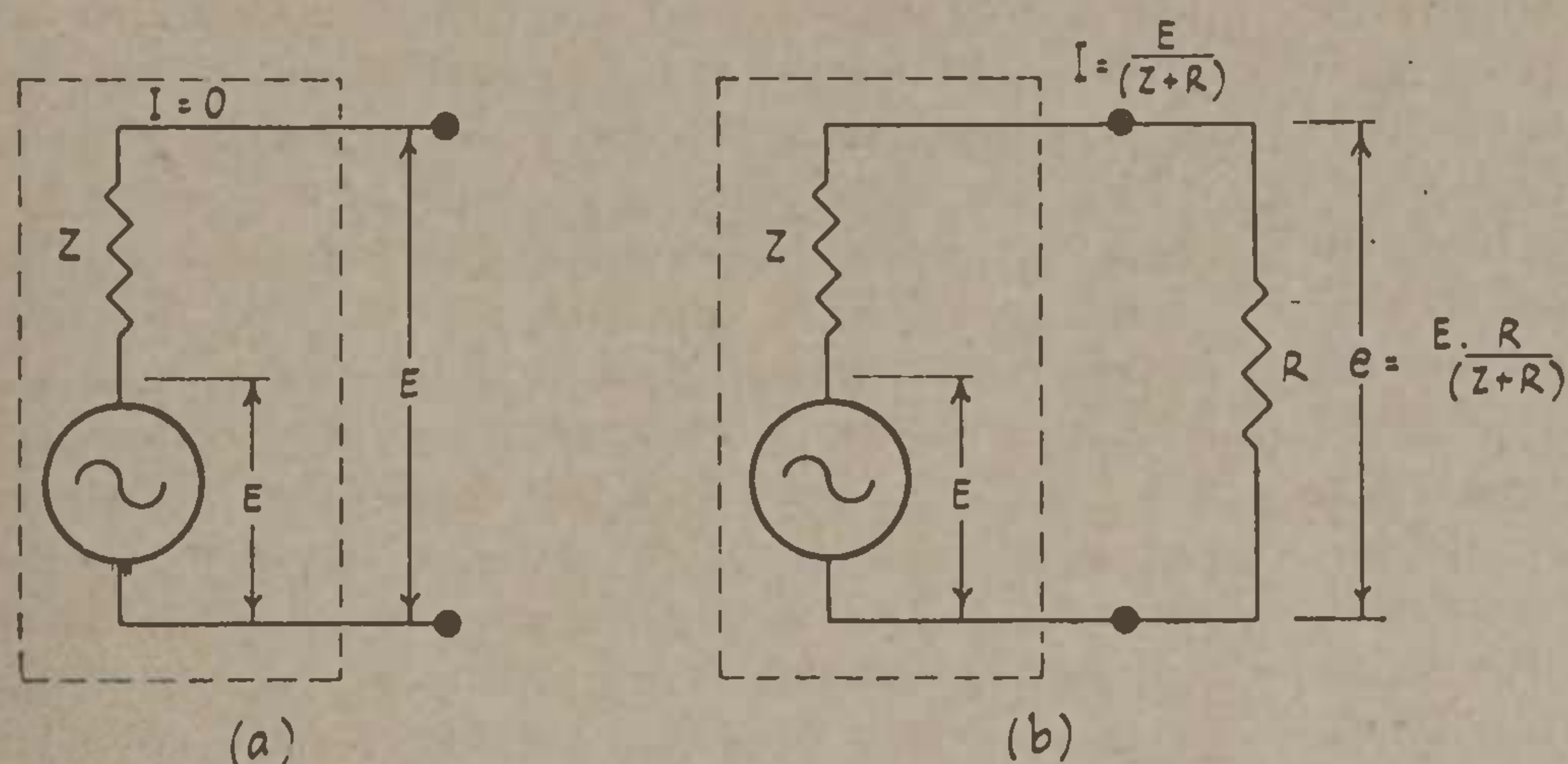


Fig. 8

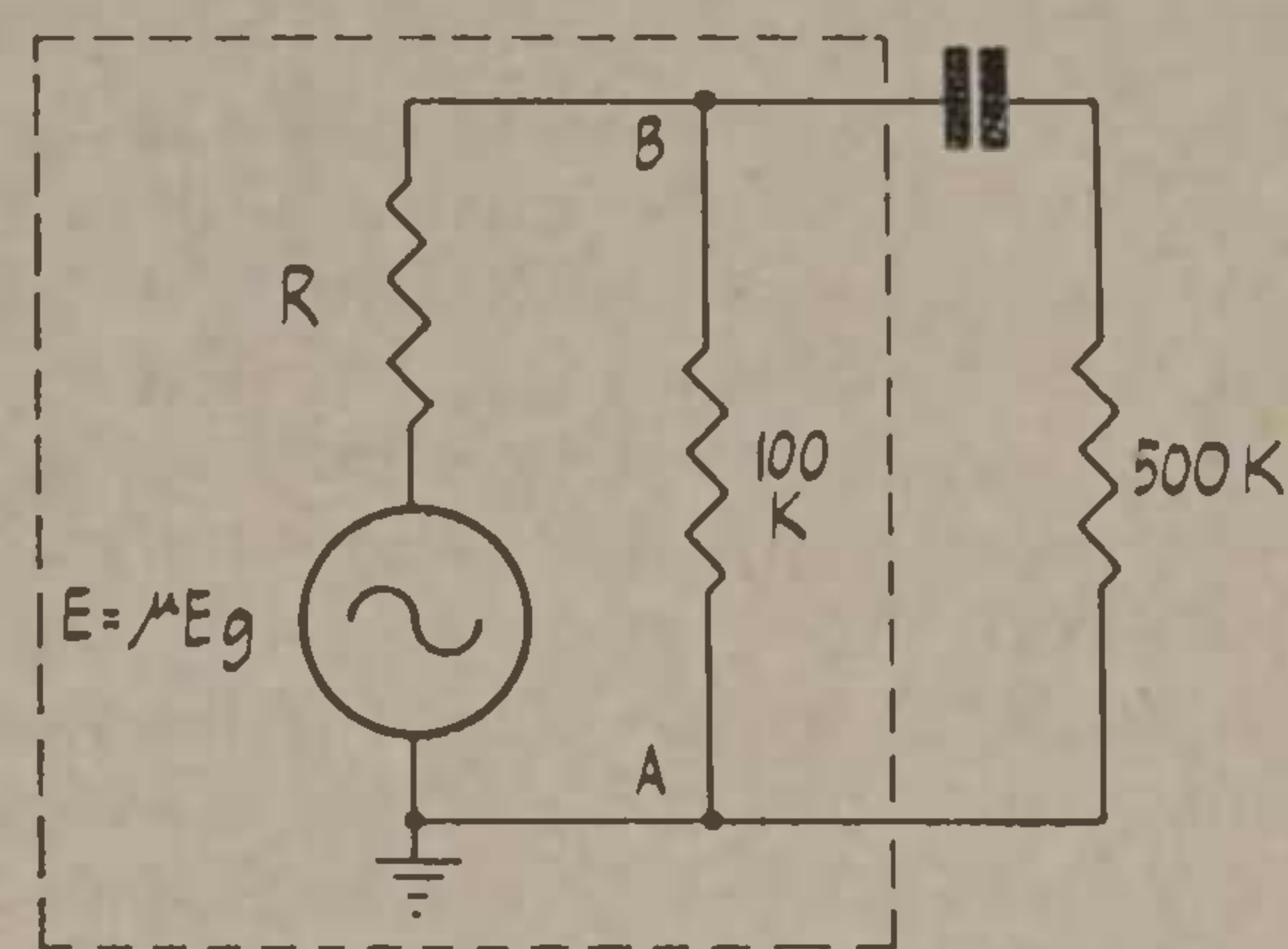


Fig. 9

see a generator of signal voltage, which effectively has an internal impedance of 500 ohms. Now this winding is connected in the grid circuit of the first valve, and this is biased negatively. This tells us that the grid circuit's impedance is as high as several hundreds of megohms, perhaps, from which we know that in connecting this as a "load" across the transformer secondary, we will be affecting the generator so little that for all practical purposes, the signal voltage delivered to the grid of the valve will be equal to the generator voltage of the transformer.

The next point of interest is the plate circuit of the first valve, and what happens when the grid circuit of the following valve is connected to it. Since the valve is a triode, its *plate impedance*, which is only another term for the internal impedance when the generator happens to be a valve, is of the order of 10,000 ohms. Its other characteristics are such that the signal voltage appearing at the plate is about 20 times that at its grid. Now the plate of the first valve is connected to the grid of the second by a coupling condenser, which for signal frequencies we can regard as a short-circuit. This places the grid circuit of the second valve, and its grid-leak resistor directly in shunt with the plate circuit of the first valve. From what has gone before, we can see that we will be sufficiently accurate if we take this load as equal to the value of the grid leak resistor, namely 500k. Knowing that the internal impedance of the valve is 10k., we are now in a position to assign actual values to the circuit of Fig. 8, whereby Z becomes 10k., and R becomes 500k. Thus, the fraction of the E.M.F. generated by the valve that is applied to the grid of the next is clearly 500k./510k. Virtually all the valve's output is delivered to the grid of the next one and there are no difficulties of any kind. But supposing, for some reason outside our control, that we had to give the second valve a grid leak not of 500k., but of 10k., what now? Obviously, under these conditions, only half the open-circuit output voltage of the valve would be delivered to the next grid. In addition, other effects would occur which would reduce the output from the first valve that could actually be used, to below even this figure, but

we had better not cloud the issue by discussing these as well.

This illustration is a useful one, though, because it illustrates exactly what happens when we attempt to connect transistors one to another by resistance-capacity coupling. We see, then, that although Fig. 7 looks quite similar to Fig. 6, except for the use of transistors instead of valves, there is rather more in the arrangement than meets the eye. It is this unfortunate fact that has caused us to become involved as we have been, in discussions about internal impedance and so on, and before we are out of the transistorized wood, we will have occasion to talk about this a little more. So if you have not already fallen by the wayside, and can still bear with us a little, here goes.

Some More Impedance Ideas

A little way back, we skated round a little problem that must now be cleared up before we can go any farther. We said, you will remember, that the internal impedance of the triode amplifier was about 10,000 ohms. Right. Now this is the figure that would be found in the data book under the heading of "Plate Resistance". The question now arises, where, if anywhere, does the 100k. plate load resistor come into the picture? The answer is that in making the statement we did, it was already taken into account. You see, the point of interest is the internal impedance, not of the valve itself, but of its *circuit*. The valve cannot function as a resistance-coupled amplifier unless we have a resistor in series with its plate circuit, across which the output voltage can be developed. Accordingly, our signal source becomes the portion of Fig. 9 that is inside the dotted box. In this representation, B is the plate end of the 100k. plate resistor, and A is the H.T. end. But in Fig. 9 we have shown an earth sign at A, which may appear confusing. It should not, because remember, we are purposely forgetting about the D.C. supply voltages in the circuit, and instead, remembering that to the signal, the H.T. line is at the same potential as the chassis.

Outside the dotted box representing the valve and its plate load resistor, we have added the coupling condenser and the 500k. grid leak of the following stage.

From the point of view of the valve circuit, this is the load that it has to feed, while from the point of view of the load, the part inside the box is the signal source. It is evident that the impedance of this source is equal to R_p in parallel with 100k., and since R_p is 10k., the value of the source impedance is slightly less than this.

The next step in the argument is to imagine that the valve is a pentode. In this case, its plate resistance will be very high—say 1 Meg.—so that the internal generator impedance of the circuit is now equal to 1 Meg. in parallel with 100k. This time, the plate resistor is much smaller than the internal resistance of the valve, so that the circuit's impedance is almost equal to the value of the plate resistor.

Now for the Transistor

At this point we can take another look at the transistor circuit, and in particular, the coupling between the first and second stages. The collector circuit of the first transistor is very similar to the plate circuit of a pentode, because the internal impedance of the collector is, say, 25,000 ohms, while the collector load resistor is much lower—only 2,000 ohms. Thus, the internal impedance of the transistor circuit is very slightly less than the value of the collector resistor, as nearly as makes no difference, 2,000 ohms.

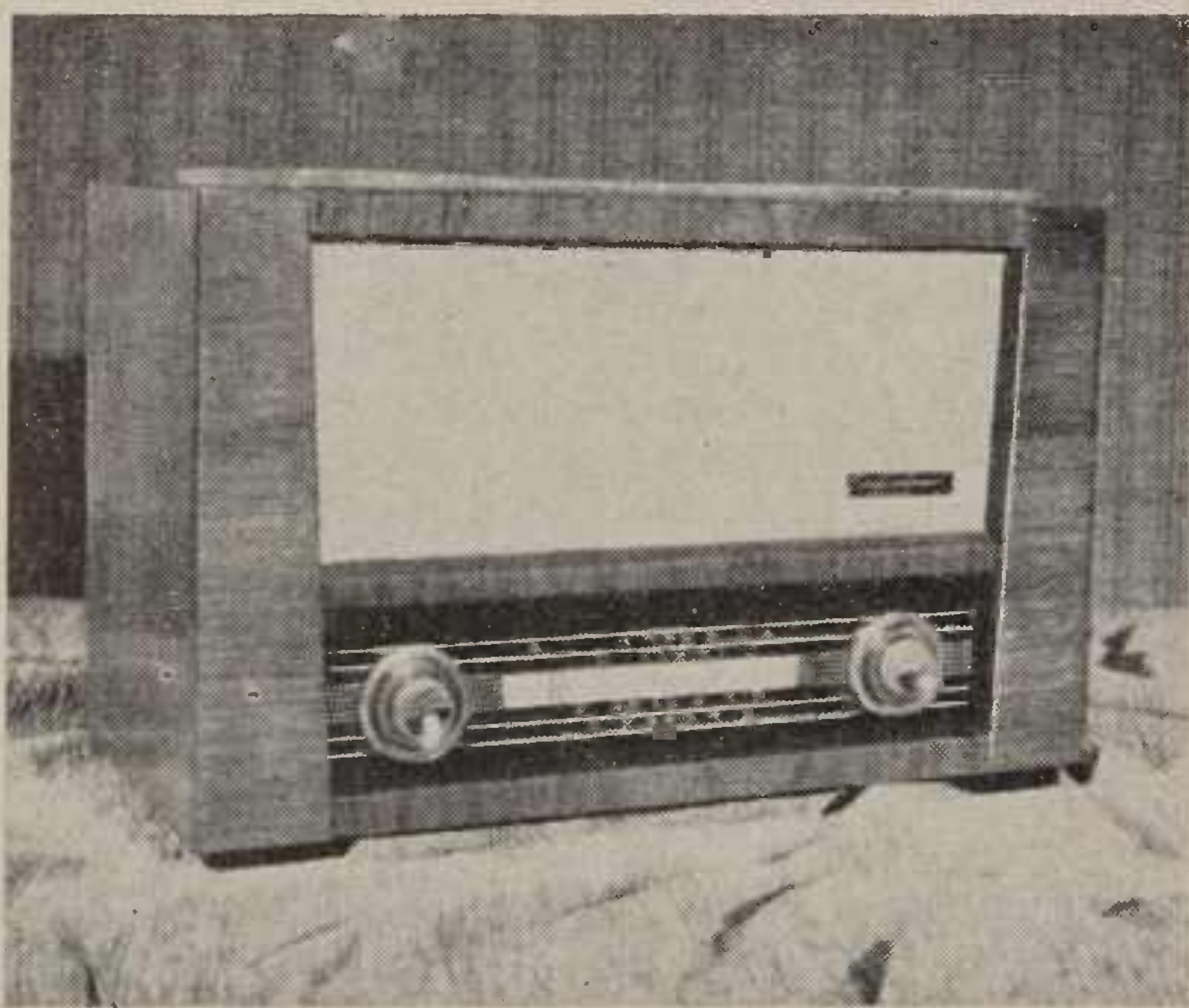
Now we come to the essential difference between the valve and transistor circuits, for the input im-

pedance of the second stage in the latter is not high, but low. In fact it is considerably lower than the value of the preceding circuit's impedance, whereas with valves, the following grid leak is a good deal higher than the internal impedance of the preceding stage, even when this is a pentode. From the practical point of view this makes quite a difference. The main effect is that when the next stage is actually connected to the first, both the gain and the maximum undistorted output of the first stage are considerably reduced—an effect that does not happen when one resistance-loaded valve is capacity-coupled to another. Fortunately, however, we are still able to obtain useful gain from the first stage, so that RC coupling with transistors is quite a practical proposition. The fact remains, however, that if we want maximum gain from the minimum number of stages, transistor amplifiers must use transformer coupling between stages, and further, the turns ratios must be carefully chosen on an impedance matching basis, which is a thing that never has to be done with valve voltage amplifiers, and indeed, is quite impracticable anyway.

In the next instalment of this story, we will discuss the somewhat knotty question of transformer-coupled transistor amplifiers, but in the meantime, it is felt that we have perhaps given readers something to digest!

(To be continued.)

An Eight-transistor Mantel Set by "Pacemaker"



To look at it, no one would guess that this is a transistor set, but it is. It has been designed by Messrs Collier and Beale Ltd., of Wellington, as an economical, self-contained battery-operated receiver, with a performance equal to that of any conventional receiver employing a stage of R.F. amplification. It is intended primarily for situations where A.C. mains are not available, and is even more economical to run than an equivalent A.C. set, as hundreds of hours of trouble-free operation can be expected from its built-in 9-volt dry battery. The set illustrated is actually a pre-production prototype.

LOOKING INSIDE A TV CAMERA

(Continued from page 33.)

stantaneous brightness of the scanned scene, can be applied to the picture-tube in such a way as to vary the brightness of its spot as it in turn scans the screen, then we have everything needed to produce on the latter a replica of the light pattern focused on the matrix on the camera tube.

Once again, we can see that in principle there is nothing about the whole system that is difficult to understand. In fact, a scientist named Campbell-Swinton succeeded in "thinking up" just such a system, many years before the means existed for putting it into practice! The marvel of television is that these means have been found, and that they have been sufficiently highly developed to enable excellent reproduction of images to be obtained—faithful enough to enable the resulting pictures to have real entertainment value, as many millions of TV viewers outside New Zealand are able to testify!

"R. & E" prototypes are frequently available for sale at attractive prices. If you are interested, please write to "Radio and Electrical Review," P.O. Box 6361, Wellington. Telephone 50-660.

SIGNALS ARE BOUNCED FROM METEOR TRAILS IN EXPERIMENTAL RCA FACSIMILE SYSTEM

High-Frequency Equipment Developed with Air Force Support Transmits Images over a Distance of 910 Miles in Preliminary Tests of New Technique

High-frequency radio signals, bounced from meteor trails 60 to 100 miles above the earth, have been used experimentally for the first time to transmit images of printed material over a distance of nearly 1,000 miles without relays, it was disclosed today by the Radio Corporation of America.

The disclosure came in a report by three R.C.A. laboratories scientists that special facsimile equipment has performed successfully in preliminary tests of meteor-path propagation between the transmitting station of the National Bureau of Standards at Havana, Illinois, and the R.C.A. laboratories radio research installation at Riverhead, Long Island. This is an air-line distance of 910 miles.

The novel system was developed for the Cambridge Research Centre of the Air Research and Development Command. Principals in the development were Warren H. Bliss, of the technical staff at R.C.A.'s David Sarnoff Research Centre in Princeton, N.J., and R. J. Wagner, Jr., and G. B. Wickizer, of the R.C.A. laboratories radio research staff at Riverhead.

Basic research in the field of meteor trails has been conducted in America, notably at Stanford University and the Bureau of Standards, much of it sponsored by the Department of Defence, as well as in Canada and the United Kingdom. In recent years more attention has been given to the effects of meteor reflection on communications. The Canadian Research Board developed a teletype system.

Because radio reflections from meteor trails were believed to be of importance to the air force, the propagation laboratory of The Cambridge Research Centre had initiated a meteor programme in 1953. As a result of this programme, Dr Philip Newman and Dr Joseph Casey of the Cambridge Centre came to the conclusion that it should be possible to make radio transmission of visual material via meteor trails. R.C.A., at the request of the air force, developed special equipment to investigate this possibility. The first trial of this equipment during early autumn met with instant success. However, the meteor trail phenomenon is a complicated one and considerable further research will be required to determine how best to exploit this new capability.

Meteor Trail Propagation Explained

When a meteor enters the thin upper atmosphere of the earth, the high velocity of its passage cause the air particles to break down into positive and negative ions. This trail of ionized air, which may persist

during a time interval ranging from one-tenth of a second up to several minutes after the passage of the meteor, acts as a reflector of radio signals which would otherwise radiate out into space. Along a transmission path of the type used in the experimental facsimile system, ionized meteor trails appear on an average of several times a minute to close the circuit between transmitter and receiver.

The research team pointed out that meteor path propagation promises ultimately to increase the versatility of all radio communications by providing a means of sending information at times and over distances for which other means may not be available. It also offers a valuable means of supplementing the overcrowded radio spectrum.

How the Air Force-RCA System Works

According to the report of the three scientists, the experimental system functions this way:

The material to be transmitted is recorded on 35 millimeter film, which is scanned to produce a signal in a manner similar to the techniques used in television film transmission. The resulting signal is sent out from the transmitter through a highly directive antenna aimed in the direction of the distant receiver. At the receiver, the signal is picked up by another directive antenna each time it is reflected during the brief life of an ionized meteor trail, and the information is fed to a cathode-ray tube for display on a viewing screen. In the experimental system, photographic techniques are used to record the image as it appears on the screen.

The research team reported that the scanner and transmitter are run continuously, sending copies of a picture over and over at the rate of two complete scans each second. The receiver is also on continuously with the recording unit in a "standby condition."

"When a passing meteor closes the transmission path, the incoming signal trips the recorder . . . to permit reproduction on the phosphor screen," they said. "The circuit then resets for the next burst."

The report stated that the experimental transmitter produces 20 kilowatts of power at a frequency of 40 megacycles, which is in the very-high-frequency range somewhat below the portion of the frequency spectrum used for commercial V.H.F. television service. It added that the "encouraging results" so far have been achieved during preliminary tests of the new equipment prior to the start of a planned research programme.

LATEST OVERSEAS DEVELOPMENTS

A Decade Counting Unit with Remote Pre-set Selection

Announcement has just been made by Computer Measurements Corp. of their newest instrument—the Model 101AR Remote Preset Decade. In many applications of preset counters and controlling equipment it is desirable that selected numbers be preset from a remote location. The Model 101AR Remote Preset Decade Counting Unit was developed for this application. The control of the Model 101AR is accomplished through the use of a five-wire cable brought out the back of the decade terminating in a small five-pin plug.

The cable may be extended to any reasonable distance and a sample switch at the extremity is then used to select any digit from 0 to 9. The actuating voltage can be from 6 to 24 volts DC. The small size of the switch lends itself to installation in a simple housing.

The direct reading Model 101AR is designed to provide an output pulse at a selected number of rates in excess of 40,000 counts per second. If reset is not required, they are capable of counting at a 100,000 cps. rate. These units are readily connected in cascade in order to emit a pulse at any desired count. Among the typical applications are batching, sorting, packaging, automatic counting and controlling, frequency division, generation of precise delays, etc. The Model 101AR is of the coincident type with an 11-pin base, pulse output at 0 reset.

Outstanding specifications include: input requirements—negative pulse, 75 to 100 volts peak; rise time—1 microsecond maximum; duration—at least 2 microseconds; input impedance—100 $\mu\mu\text{f.}$ in series with 16,000 ohms; preset coincidence output—positive pulse, approximately 50 volts peak; reset to 0—instantaneous by opening grid circuits or by application of 70-volt pulse at least 15 microseconds wide.

Many possibilities for this remote preset decade are evident after the specifications are inspected. One example would be to terminate the 5-wire cable into a printed circuit type of socket rather than a switch. Several printed circuit-type cards could then be produced to give different operation. The Model 101AR utilizes self-latching relays so that once the preset number is introduced the switch or card may be disconnected without loss of the selected number. By the use of a stepping switch a single preset selector switch may be moved from decade, thus setting up the preset number for a bank of 101AR's.

Any inquiries concerning this instrument should be directed to Ad. Auriema, Inc.

MISSING AND STOLEN RADIOS

Auckland:

Ultimate 5-valve broadcast mantel model R.C.P. radio. Blue plastic case, 11 in. x 7 in. x 6 in. Two white plastic tuning knobs at base and towards left of radio with possibly the word "Ultimate" printed in gold lettering between the two knobs. Oblong shaped dial directly above tuning knobs. Serial No. 177516.

Columbus 1949 portable model, 5 valve. Dark stained wooden cabinet and lemon coloured plastic front. Leather handle. One-inch diameter hole in front left corner. Serial number not known. Value £20.

Aerial car radio, coloured black, licence number 9,000, stolen from a wrecked car while in transit.

Christchurch:

Philips "New Yorker" mantel radio, Model No. 267. Radio is in a dark coloured plastic case, 12 in. x 9 in. x 8 in. with a horizontal bar-type dial and two dual-purpose tuning knobs. The speaker is installed behind clear perspex. Chassis number 189996. Serial No. 11495. Value £18 15s.

Autocrat 8-valve car radio. Serial number 32834. The set is in three units—speaker unit, control box, and tuning control. The tuning unit has an oblong glass dial under which are five push buttons with a tuning knob each side of the buttons. The metal parts of the units are in a grey crackle finish. Value £40 15s.

Philips car radio. Metal case with speaker attached and measure 8 in. x 3 in. It has two tuning knobs and a selector dial 4 in. x 1 in. with a needle pointer. Can be used on 6-volt or 12-volt circuits. New condition. Serial No. 17012. Value £28.

Columbus mantel radio in cream coloured plastic case 16 in. x 10 in. x 10 in., square dial on right-hand side of front. One black and one blue earth and aerial wires on rear. Model No. 504. Serial No. 53936. Value £14 14s.

Greymouth:

Autocrat car radio, speaker fitted into radio, knob controls. Serial No. 35722.

Hamilton:

Pye make car radio, grey colour. Six-valve model no loudspeaker attached. Serial No. 103835.

Te Kuiti:

Pacemaker 5-valve radio, portable. White plastic cabinet. Fitted for battery and electricity. Serial No. S/N 56603. New condition. Value £33.

Waihi:

Bell Champ 3-valve, white bakelite case about 14 in. x 8 in. x 8 in. Serial No. 51955. Value £12 12s.

Wellington:

Bell mantel model radio, white plastic case, 4 valve with name "McAndrew" in red crayon at end. Serial No. 3019.

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ELECTRICAL AND TRADE SECTION**LOOKING INSIDE A TV CAMERA**

This short article describes in non-technical terms how a television camera works. It is presented here for the benefit for non-technical readers of this journal, and is the first of a series of such articles, designed for (we hope) the edification and enlightenment of those readers of "R. & E." whose bent is commercial rather than technical.

Most of us who are interested in television will have read at one time or another a description of how the cathode-ray tube works, on the face of which a television picture appears for viewing. Fundamentally it is nothing more than a large glass envelope, of a shape enabling one end of it to be enlarged into a large flat surface, called the "screen". At the other end of the tube, which is only a little more than an inch in diameter, there is an "electron gun", whose name describes its function exactly. It is a source of electrons—those minute, almost weightless particles which are produced and used inside every radio valve. The "gun" not only produces the electrons, from a thing called the *cathode*, but bunches them into an intense beam or *ray* so that this particular type of electron tube is called a cathode-ray tube. The beam of electrons is then focused, in much the same way as a beam of light can be, into a narrow, conical shape, such that the apex of the cone impinges on the front face, or screen, of the tube. The inside surface of the tube screen has been coated with a special material whose outstanding property is that when struck by a beam of electrons, it emits light. This is the light that we "process" in such a way that a picture is formed on the screen, which we view through the transparent glass of the end of the tube. In order to make this single spot of light give us the impression of a picture, two things must be done to it. First of all, the spot is caused to travel very rapidly across and down the screen, so that it traces out a series of parallel lines, covering the whole of the area on which the picture is to appear. Because of the rapidity of this motion, the eye is not able to see the spot as such, but, when at the proper viewing distance, only as a bright area of illumination.

If, as the spot travels over the screen in its regular *scanning* pattern, as it is called, its brightness is varied in a particular way, then a pattern of light and darker areas is formed, which is the picture, instead of an evenly illuminated area. Just how these things are done is a matter for the engineers to know about, but the principle involved in producing a picture on the screen, is no more complicated than this description.

Camera Action

Now the television camera is not so very different in some important ways from the picture-tube we have just described, and operates as follows:

A plate, in the form of an electrical conductor, on the surface of which is deposited many thousands of minute light-sensitive blobs, is called a matrix. This is installed inside a cathode-ray tube in such a way that the electron beam (exactly similar to the one in the picture-tube) can perform its rapidly-scanned pattern of lines over the surface of the matrix.

The tube is so constructed that it is possible to focus upon the sensitive surface of the matrix a light image of the scene to be televised. This image is exactly similar to the one formed on the sensitive film of an ordinary camera when taking snapshots. When the light falls on the microscopic blobs of sensitive material that make up the matrix, electric charges are accumulated by these cells, as they can be called, and the strength of the charges depends directly on the strength of the light. Thus, when the light on the matrix is in the form of a focused light image, there will be found on the matrix a pattern of electric charges, corresponding exactly in geometrical arrangement and in strength, to the optical image.

If now these charged cells are discharged, electric impulses corresponding in strength to the original charges, and thus to the original light intensities, can be drawn off by means of a wire connected to the matrix. Now it is the electron beam, sweeping over the matrix in a regular manner that actually discharges the minute cells, each cell being discharged at the instant when the beam passes over it.

It was mentioned earlier that the scanning motion of the electron beam in the picture-tube is made identical in kind with the scanning of the similar beam in the camera tube. Moreover, the two beams are kept exactly in step, so that at any instant, they are in exactly corresponding positions on their respective pictures areas. If we can imagine that the impulses coming from the matrix, and representing by their strength the in-

(Concluded on page 30.)

"R. & E." CONTRIBUTES TO THE I.G.Y.



This photograph of the personnel of the Awarua I.G.Y. station was sent to "R. & E." by Alex Ayton, well known as our laboratory assistant for a number of years. It was, in fact, the station's Christmas card, and shows each member in a manner related (?) to his particular job. Seated, not in the clouds, but in the midst of an aurora, is Bob Unwin, in charge of the station, and many of our readers will recognise Alex immediately below him, hurrying up the hill for scheduled (or possibly unscheduled) maintenance on the radar station. With someone sitting on the aerial, we aren't surprised.

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*New Developments***AN ALL-TRANSISTOR AUTO-PORTABLE RADIO**

This article describes a novel combination of a transistor portable receiver, with a high-powered transistor amplifier which is a permanent fixture in the car. The two units in combination make a car-set, while the portable can be removed to make a self-contained set for use outside the vehicle.

The idea of adapting a portable radio receiver to use in automobiles is by no means new. A number of interested individuals and manufacturers have considered the idea, and some have done experimental work along this line. In 1940, one of National Carbon's engineers designed a portable radio receiver using 1.4-volt tubes that could be coupled to a whip antenna in a car. The radio receiver had adequate sensitivity for this application, and the whip antenna eliminated the directional effect of the receiver's loop antenna, but the audio output was quite inadequate for comfortable listening, particularly at medium to high speeds.

New Approach

The availability of all-transistor portable receivers and audio frequency type power transistors in 1955 revived the interest of National Carbon Company engineers in auto-portable radio receivers. They decided to adapt a late model all-transistor portable radio to use in automobiles in such a way that its use as a portable receiver would not be impaired. Figure 1 shows how a Raytheon transistor portable receiver was fitted into a rectangular receptacle in the glove compartment of a 1955 Chevrolet sedan.

The portable receiver operates at all times on its own self-contained 6-volt dry battery. It was felt that this mode of operation would be entirely satisfactory, since the receiver operates for approximately 500 hours on its own battery at a very nominal cost, and the arrangement simplifies connections to the automobile's electrical system. The problem of keeping ignition interference out of the radio receiver was also simplified.

The tuning and volume controls on the portable receiver are located in a convenient position with the receiver on its side as shown in Fig. 1. A whip antenna is coupled to the receiver input when the receiver is pushed into place.

Audio Amplifier

To provide ample audio power output for comfortable listening in the presence of engine, road, and wind noise, a supplementary all-transistor power amplifier is connected to the radio output circuit when the set is used in the car. The audio amplifier is located immediately below the radio receiver, as shown in

Fig. 2. It uses three Sylvania 2N95 transistors, and it is connected to the car's 12-volt storage battery. One of the power transistors serves as a driver and the other two operate in a Class B circuit to operate a

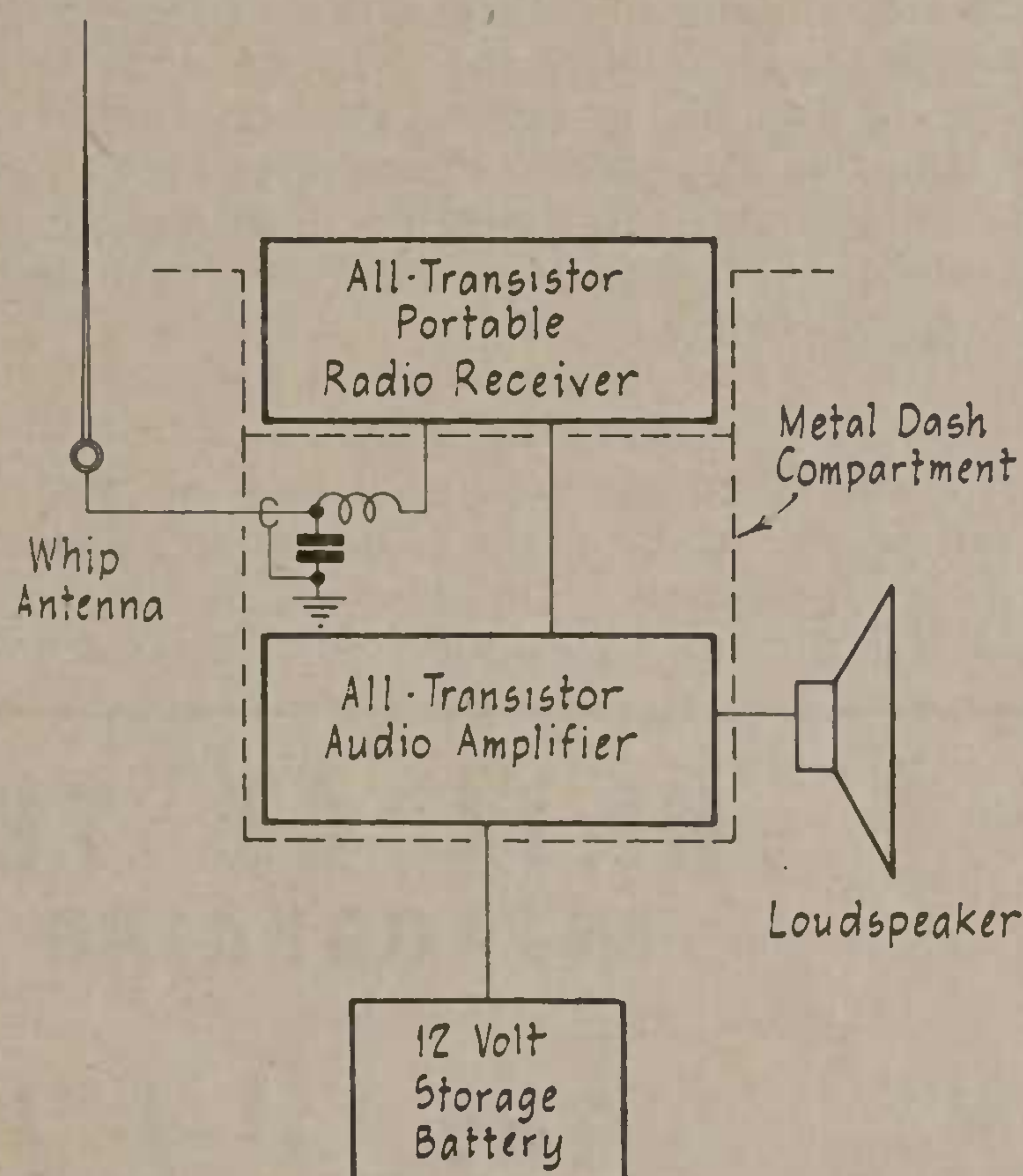


FIG. 3.—This block diagram shows how the portable receiver plugs into the car, and then works with the built-in amplifier and the car aerial. Figs 1 and 2, referred to in the text, were unfortunately unsuitable for reproduction.

permanent magnet dynamic loudspeaker of the size which is widely used with auto radios. Up to 3 watts of audio power are available with minor harmonic distortion.

The D.C. power to the supplementary amplifier is controlled by the on-off switch on the portable receiver's volume control, so it is not necessary to operate a second switch for this purpose. Furthermore, the amplifier's power supply is automatically cut off when the receiver is removed from its receptacle; hence it is not possible to leave the amplifier energized when the receiver is being used as a regular portable, outside of the car.

The drain imposed on the storage battery by the supplementary amplifier varies with the sound level, but in general ranges between 100 and 250 milliamperes. This low drain, which is about one-twentieth of that required by auto receivers using tubes, makes it possible to operate the radio in the car for extended periods without discharging the battery to a point where it would interfere with starting the engine.

Block Diagram

Figure 3 shows how the elements of the experimental auto-portable radio are connected for operation in the car. A conventional whip antenna is coupled to the loop stick in the radio receiver through a coaxial connector in the bottom of the receiver compartment. A conventional low-pass filter is included in the antenna input circuit to reduce pickup of ignition interference.

As explained earlier, the radio receiver operates on its own self-contained 6-volt battery to reduce ignition noise pickup and simplify the wiring and changeover from car to portable operation. The audio output circuit and the on-off switch in the receiver are connected to the amplifier chassis through a four-contact Jones. Conventional filtering is used in the line from the car's battery to the amplifier.

Performance

In preliminary trials the installation operated in a very satisfactory manner. The audio output was greater than actually necessary, and it was entirely free of ignition interference. This was somewhat surprising,

since no preventive measures, such as capacitor bypassing, spark noise suppressors, or bonding were used in the ignition system. The whip antenna eliminated any directional effect normally present in portable receivers.

Recommendations

If a system as described were to be put into regular production, it is suggested that several improvements be incorporated. The sensitivity of the receiver should be improved. The portable set that was used in the experiment was of conventional design, with a sensitivity quite adequate for the intended use of the set. The automatic volume control could be improved, although that of the Raytheon set was surprisingly good, considering the wide changes in signal level that are available to the receiver as the car operates in various environments.

Two mechanical changes are suggested. First, a radio receiver designed specifically as an auto-portable might be equipped with push-button tuning. This would make tuning less hazardous. Second, with design as it stands, a theft problem exists. Perhaps the receiver could be designed to lock into place to reduce the theft hazard.

It was not the purpose of this work to spell out all of the design details of an auto-portable radio of optimum performance. It was rather to see if adequate performance might be obtained using currently-available components with a minimum of modification. This has been demonstrated to a satisfactory degree.

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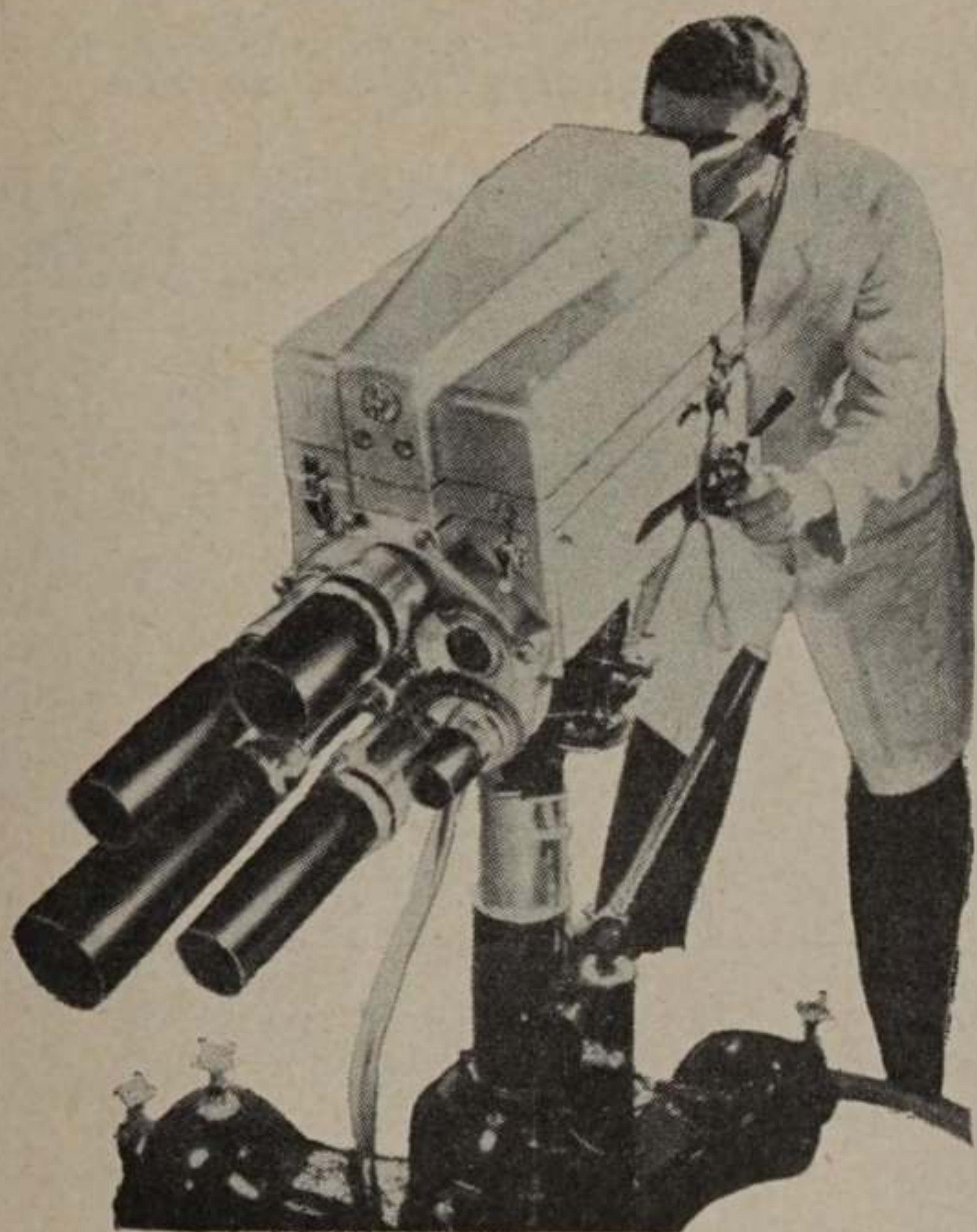
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Round-Europe TV Programme on New Year's Eve

From "Philips TV News-Flashes" we learn that on New Year's Eve the Eurovision network carried an exchange programme in which eleven countries participated. Such exchanges are now almost commonplace, and emphasize the advanced state of development of television in Europe. To bring about such a programme, 250 television transmitters were involved, counting low-powered booster stations, and a hundred microwave relay stations were in operation. It is estimated that in the area covered by such broadcasts, there are 12 million household receivers, out of a total possible number of some 55 million. When it is realized that apart from Great Britain, European countries have possessed TV services for a total period of only five years or so (and some countries much less than this), the tremendous development rate of public TV services can be guessed at. Such, then, is the public service that New Zealand is as yet unable to possess, solely because of the negative attitude of politicians towards it.

Television in Canada

Yet another country in which television is making great strides is Canada. There, no service existed until 1951, but many places were of course able to receive programmes from stations in the U.S.A. At that time, the receiver market was restricted to such areas, and the cost of Canadian-built receivers was naturally high. The average consumer cost of a TV set under these conditions in Canada was \$523. Today, the average price has dropped to \$300—a reduction of more than 40%.

T. V. ROUND THE GLOBE

The actual reduction, however, is much greater than this, because for some time, TV sets have carried a 15% excise tax, and a 10% sales tax as well. In addition, as in most other countries, costs of materials, labour, and freight have also increased, so that had these remained at the 1951 figure, the reduction in costs would be staggering.

Causes of this spectacular advance are said to be the application of research, advances in the techniques of mass-production, and the rapid increase in the size of the market as TV stations have opened up throughout the country.

Colour TV in Cuba

Further news has come to hand of the inauguration of colour television in Cuba, to which goes the distinction of being the first country outside the U.S.A. to possess a colour service to the public. Initially, colour programmes are to be on a 16-hour-a-day basis, using film material exclusively. There will be a basic two-hour colour film programme, repeated several times a day, with fresh news and film items interspersed as they become available. Filmed news and other features are being flown daily to Havana from New York, Miami, Mexico City, and Madrid.

In order to publicise colour TV a thousand sets have been installed in clubs, homes, and public places; it is estimated that ten thousand colour sets can be sold in Cuba in the first year, and that when the total reaches 20,000, it will be economically feasible to introduce live colour programmes. Oddly enough, there is said to have been a demand for colour receivers even before the colour transmissions started.

Set Sales Still Rising in U.K.

In spite of the advanced state of TV coverage that has existed in Great Britain for some years, the sales of TV receivers continues to rise. In 1957, according to the British "Wireless & Electrical Trader", 1957, sales were ten per cent up on those in 1956, the figures quoted covering the first nine months of both years. A little over 50% of these sales were made by hire-purchase, or other credit arrangements.

Two TV Programmes on One Channel

The Blonder-Tongue Laboratories, in the U.S.A., have developed a system by means of which it is possible to transmit two separate television signals at the same time, using only one radio frequency channel. Should the new system prove operationally successful, it could be the technical answer to a number of problems. It could halve the number of channels in use in a given locality, without decreasing the number of programmes available, or it could double the number of available programmes without any increase in the number of R.F. channels in use. Particularly in

(Concluded on page 40.)

TRADE WINDS

"English Electric" Develops in New Zealand

The English Electric Company Limited announce the formation of a subsidiary company. The English Electric Company of New Zealand Limited, which, in collaboration with Messrs Cory-Wright and Salmon, will in future handle the business of the parent company in New Zealand.

To head up this new company, English Electric have appointed as managing director Mr H. Nuttall, A.M.C.E., M.I.E.E., A.M.I.Mech.E., A.M.A.I.E.E., who has just arrived in Wellington to take up his new appointment.

Born near Manchester, England, Mr Nuttall studied electrical and mechanical engineering at the Manchester College of Technology. His early practical training was with Metropolitan-Vickers as student apprentice and switchgear engineer, and with the North Eastern Electric Supply Co. Called up in 1939 from the Army Officer's Emergency Reserve as a Lieutenant, Ordnance Mechanical Engineer, with the R.A.O.C. he transferred to the Indian Army in 1941 and saw service as a Major, I.E.M.E., in India, Ceylon, Burma, and Netherland East Indies.

Mr Nuttall's association with the English Electric Company began following his demobilisation in the United Kingdom in 1946, when he joined their agents in South India, Messrs Binny and Co. (Madras) Ltd., as assistant engineering manager, becoming chief engineer in 1950. In 1952 he returned to the United Kingdom to the London office of the English Electric Company, where he has been eastern area export manager.

Through Messrs Cory-Wright and Salmon Limited as their agents, the English Electric Company has played a large part in the development of New Zealand over many years. Notable contributions to transport have been the electric locomotives and passenger units for the railway electrifications at Wellington, Arthurs Pass, and Lyttelton, and over 60 of the main-line diesel electric locomotives operated by New Zealand Railways. In the sphere of electric power supply, the company has in large measure harnessed the water in New Zealand's mountains to its factories and homes, bringing better living to the country. Its products figure prominently in nine of the main generating stations

Philips "Town and Country" Goes to Sea



Photographed at Auckland before leaving for Lord Howe Island on the first lap of a world tour are crew members of the ketch Kiwi with Philips attractive Town and Country Transworld portable. In the centre, not going on the trip, although we daresay he would like to, is Bill Anderson, Philips Auckland branch manager. With its long-range reception and highly efficient marine band the transistorized Town and Country should be the ideal long-voyage companion. Mr T. Sharples, skipper of the Kiwi, seems to think so anyway.



Mr H. Nuttall

(such as Highbank, Lake Coleridge, Tekapo, Cobb, Atiamuri, and Mercer), at distribution substations, in major and minor industries, and in domestic appliances in the homes.

In the sphere of defence, English Electric-built Canberra jet bombers will shortly go into service with the R.N.Z.A.F.

With such recent developments as the supersonic P1 jet fighter, the world's largest atomic power station, guided missiles, gas turbines, the revolutionary Napier Deltic diesel engine, television equipment, radio navigational aids, electronic computers, etc., the English Electric Company and its subsidiaries and associates are contributing markedly to scientific and industrial development on a world-wide scale. At the same time, it has demonstrated a progressive policy in calling on the countries of the Commonwealth to assist in their own industrial development. Subsidiary companies with their own factories have already been established in Australia, Canada, and South Africa.

RADIO PRODUCTION STATISTICS BY QUARTERS

The following statistics cover radio set production in New Zealand, and have been supplied by the New Zealand Radio and Television Manufacturers' Federation

		1956					1957				
		Jan.- March	April- June	July- Sept.	Oct.- Dec.	Total 12 mths.	Jan.- March	April- June	July- Sept.	Total 9 mths.	
Royalty	Streams	No. 85722	125500	142648	141614	495484	111597	131535	150606	393738	
Table	Sets	No. 5547	10044	12673	9831	38095	9106	8588	11539	29233	
Radiograms		No. 3562	5340	6350	5791	21043	5484	7332	8905	21721	
Car	Radios	No. 4919	4658	3682	5145	18404	3138	6146	4897	14181	
Portables		No. 1275	1236	1716	4035	8262	2239	615	2403	4257	
Others		No. 95	2	280	401	778	89	313	611	1013	
Retail Value		(£) 631396	789288	929749	980223	3330656	815003	949783	1185296	2919622	
Other Production		(£) 71427	108692	107328	104027	391474	77213	97925	126965	302103	

Transatlantic Television Cable to Boost Trade with Canada?

"By far the best thing a British government could do to promote exports to Canada would be to put in hand a transatlantic television cable at the earliest possible date."

Mr C. O. Stanley, chairman and managing director of the Pye group of companies, made this suggestion when he announced contracts which Pye Telecommunications Limited had received recently from Canada.

The occasion was a private electronics exhibition, which was held in London for members of the Canadian trade delegation.

In his announcement, Mr Stanley said that the company had received an order for over 100,000 dollars worth of radio telephone equipment for the Veterans' Taxi Cab Company of Montreal, in the face of fierce American competition.

"Our company," Mr Stanley said, "is the only one in the world, outside North America, to have radio telephone equipment fully approved by the Canadian Government."

Continuing his suggestion for a transatlantic television cable, Mr Stanley said, "Reception of American television programmes has probably done more to swing Canadian trade away from Britain and towards America, than any other single factor. I am convinced that a television cable from Britain could go a long way towards altering the situation in our favour."

"A good television outlet from Britain to Canada might easily double exports of British consumer goods in the space of only a few years."

"I feel that the development of submarine transistor amplifiers should make this project possible at a cost

comparable with the recently-laid transatlantic telephone cable, the cost of which was £15 million."

Mr Stanley said that although his company had no interest in the submarine cable industry, he was certain that other British companies had the necessary know-how to accomplish the project. "We are, however, pioneers in transistor manufacture and would be very willing to co-operate in the research necessary to make transistors available."

"The cable could be made to pay its own way by the sale of live programmes and by carrying hundreds of telephone circuits during non-TV hours."

"The foundations for good trade relations," Mr Stanley concluded, "depend upon getting to know other people's ways of life. Putting a television cable between the two countries is the most effective single thing that can be done to this end."

Later, in a television broadcast made at the invitation of the B.B.C., Mr Stanley elaborated on his earlier story, commenting on the fact that submerged amplifiers would need to be only 15 miles apart in a TV cable against 37 miles in a telephone cable. He stressed that if we could only get some of the drive we had during the war years, to complete this project in 4 years was not impossible.

When the new transatlantic telephone cable had been operating for only six months, the Canadian Overseas Telecommunications Corporation reports an improved net profit of over 400,000 dollars. The cable was the main factor in this rise, for cross-atlantic telephone traffic had increased by 300 per cent.

The moon may be used as a relay station for radio communications, for United States Naval researchers have discovered that the moon reflects radio waves. Experiments with a transmitter and a large parabola-shaped aerial set into the earth showed that high

frequency pulses can be sent to the moon and back. In February last year a 3,000 Mc/s signal was bounced off the moon, the round trip of 500,000 miles taking $2\frac{1}{2}$ seconds.

A special type of transistor has been developed by American radio engineers for incorporation into the U.S. earth-satellite's transmitter. The transmitter using the transistors is a carefully packed $10\frac{1}{2}$ lb. unit enclosed in a magnesium-sheathed sphere 20 inches in diameter. When shot to an altitude of 300 miles the satellite can send back data on pressure, densities and temperature of matter in outer space, the strength of the earth's magnetic field and cosmic radiation.

* * *

TV ROUND THE GLOBE

(Continued from page 37.)

America, where the U.H.F. bands have had to be used in order to accommodate the demand for channels, this could mean a very big step forward.

There would, of course, be a "snag", in that special equipment would need to be fitted to existing receivers to enable them to cope with their double transmissions, but new sets could have the additional facility already built into them.

RADIO DEALERS

WATCH FOR NEWS IN THESE PAGES
OF THE "R. & E." SET-BUYER'S GUIDE

This comprehensive survey of the complete New Zealand radio receiver production for 1958 will be published in approximately mid-June of this year.

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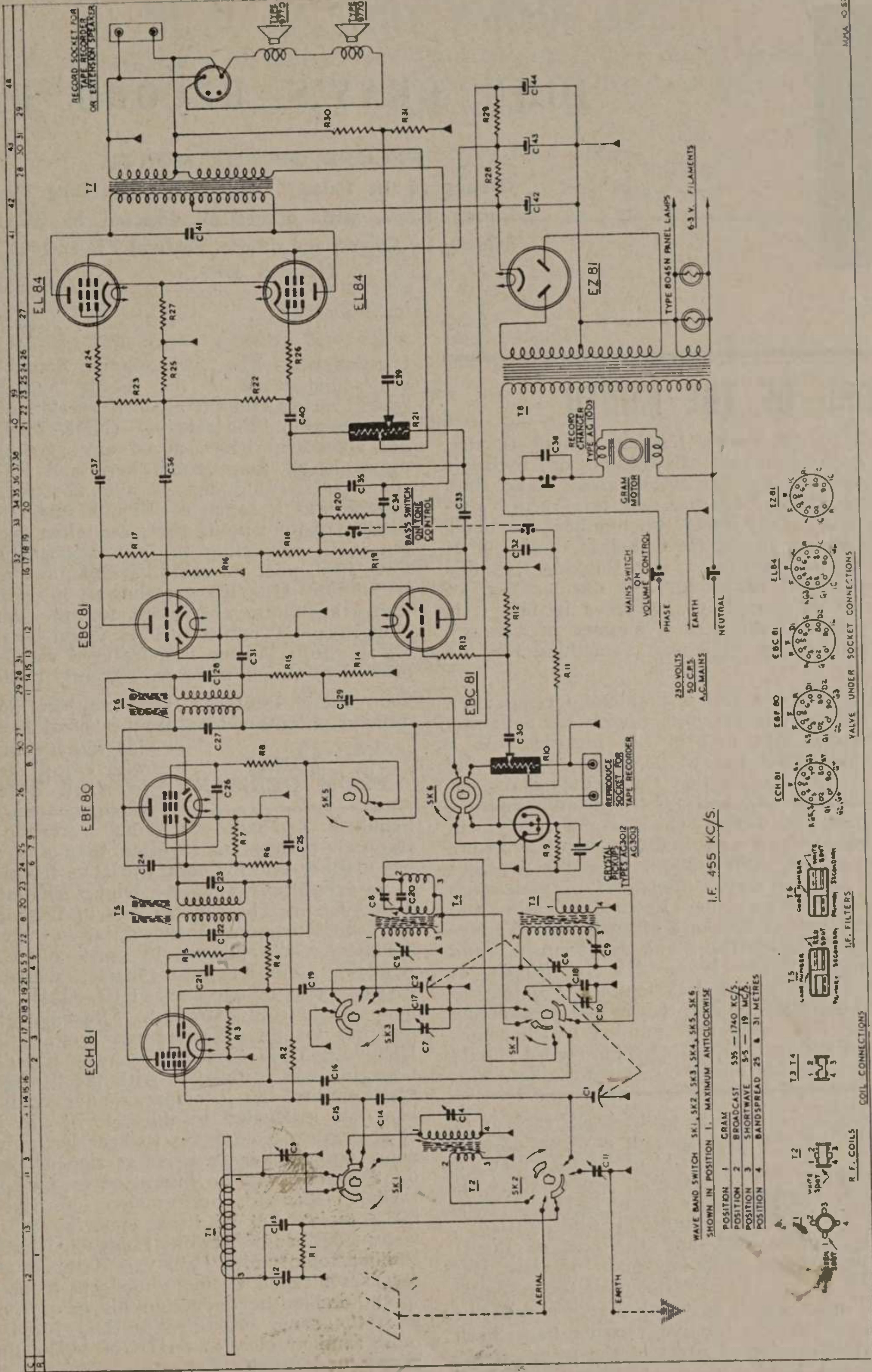
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- C14 233 mmfd +/- 1% ceramic
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- C35 0.01 mfd 600v paper
- C36 0.01 mfd 600v paper
- C37 0.01 mfd 600v paper
- C38 0.01 mfd 750v ceramic
- C39 5000 mmfd 400v paper
- C40 0.01 mfd 600v paper
- C41 2000 mmfd 750v paper
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- C43 40 mfd 350v |
- C44 20 mfd 350v |
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- R3 47k 1w. carbon
- R4 33k 1w. carbon
- R5 27k 1w. carbon
- R6 1M 1w. carbon
- R7 1M 1w. carbon
- R8 100k 1w. carbon
- R9 470k 1w. carbon
- R10 M4 + 1M6 carbon potentiometer
- R11 56k 1w. carbon
- R12 47M 1w. carbon
- R13 56k 1w. carbon
- R14 330k 1w. carbon
- R15 100k 1w. carbon
- R16 4.7M 1w. carbon
- R17 220k 1w. carbon
- R18 100k 1w. carbon
- R19 100k 1w. carbon
- R20 4.7M 1w. carbon
- R21 1M + 1M carbon potentiometer
- R22 220k 1w. carbon
- R23 220k 1w. carbon
- R24 1000 ohms 1w carbon
- R25 220k 1w. carbon
- R26 1000 ohms 1w. carbon
- R27 82 ohms 1w carbon
- R28 1000 ohms 4w. wire wound
- R29 1000 ohms 4w. wire wound
- R 30 100 ohms 1w. carbon
- R31 390 ohms 1w carbon
- T1 Ferrocube rod aerial coil
- T2 SW aerial coil
- T3 BC oscillator coil
- T4 SW oscillator coil
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- T6 Micro '12' I.F. bandpass filter
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- T8 Power transformer
- T9 Gram motor
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R19	100k 1w. carbon	R23	220k 1w. carbon	R27	82 ohms 1w carbon	R31	390 ohms 1w carbon	T3	BC oscillator coil	VK 471 50	T6	Micro '12' I.F. bandpass filter	A3 126 84
R20	4.7M 1w. carbon	R24	1000 ohms 1w carbon	R28	1000 ohms 4w. wire wound	T1	Ferroxcube rod aerial coil	T4	SW oscillator coil	VK 471 37	T7	Output transformer	VK 671 12
R21	1M + 1M carbon potentiometer	R25	220k 1w. carbon	R29	1000 ohms 4w. wire wound	T2	SW aerial coil	T5	Micro '12' I.F. bandpass filter	VK 469 73	T8	Power transformer	VK 631 0-
R22	220k 1w carbon	R26	1000 ohms 1w. carbon	R 30	100 ohms 1w carbon			T6		VK 469 80			



John Gray

JOHN GRAY'S RECORD PAGE

RECORD OF THE MONTH

"Danny at the Palace". Favourite songs sung by Danny Kaye, with orchestras directed by Vic Schoen, Sy Oliver, and others. Festival FR 12-1501 (12-inch LP).

RECORD OF THE MONTH

The "Palace" is New York's leading variety theatre, comparable, say, to London's Palladium or Sydney's Tivoli. Danny Kaye is only one of the many stage stars who have trod its historic boards, and this record presumably gathers into handy form the numbers he made famous while appearing there. Nevertheless, the title of the record could mislead the buyer into thinking that this is an actual "on stage" recording, like one or two of Judy Garland's and Johnnie Ray's, whereas in fact it is simply a convenient packaging of a number of Danny's most famous records dating back over something like the last ten years.

What makes a great comedian is first and foremost the degree in which he establishes contact with his audience, and Kaye undoubtedly has that in full measure. On a record, however, the effect has to be obtained by voice alone, and it is in that respect that this artist scores decisively for his manner is both pleasant and incisive, allied to an excellence of diction which would surely win him a place in any Gilbert and Sullivan company, were his singing voice of the right calibre. The disc eschews items taken from Danny Kaye's films, all of which are already well represented on other Festival releases, and concentrates instead on his versions of such old standbys as "Ballin' the Jack", "Mad Dogs and Englishmen", and even the rip-roaring "I've Got a Lovely Bunch of Cooanuts". There is also Will Fyffe's famous "I Belong to Glasgow", and the most up-to-date item in the programme is the brilliant "Not Since Nineveh" number which comes from the spectacular musical, "Kismet". This record should make even more friends for an excellent entertainer.

We have been inundated with film sound-track records of late. I have said before that the issue of a whole 12-inch LP of background music from what is

FROM THE STEREOPHONIC SCREEN

essentially a non-musical film ("Giant", "Picnic", "Friendly Persuasion", and the rest of them) seems a dubious proposition from any point of view. But in the case of a film in which music is one of the essential ingredients, like "Funny Face" or the Rodgers and Hammerstein series, some very attractive records have been compiled from carefully selected parts of the sound track. The Eddie Fisher and Debbie Reynolds "Bundle of Joy" issue (RCA L10271) for example, makes extremely pleasant listening, and of course there is a whole group of records from the most obvious source—the M.G.M. label. Fred Astaire is well to the fore in the Cole Porter musical "Silk Stockings" (MGM C-760), which has recently appeared. There are some new Porter tunes, some with in-

triguing titles like "Stereophonic Sound". Then Nixa have the sound track of the recent "Oh Rosalinda" picture which was a fanciful modern version of Johann Strauss's very durable "Fledermaus" (NPL 18001). The film does not appear to have caused any great sensation, but the music is all that counts here and it is presented with some smartening up of the libretto, which has been turned into a satire of Vienna under the Four Powers. Several of the singing parts are taken over by professionals, but it is interesting to hear Michael Redgrave bursting forth in a quiet tolerable baritone, and a further attraction is Anthony Quayle's growling of his particular song. Also from the films, and more for the dance fans, is Ray Anthony's LP entitled "This Could be the Night" (MGM C-761). Julie Wilson is a featured vocalist in a generously filled disc which traverses several Anthony favourites.

The latest Deutsche Grammophon announcements are drawing attention to a number of attractive extended play

MUSIC FROM GERMANY

45s which should appeal to those who enjoy their classical music in small doses. There is, for example, a rather delightful Schubert Serenade—not "the" serenade which has been recorded perhaps more often than any other single song, but another one for contralto solo, female choir and piano. It is delightfully sung by Diana Eustrati with the Berlin Motet Choir. The reverse side of this disc is occupied by the short one-movement string quartet known as the "Quartettsatz", played by one of Germany's leading ensembles, the Koeckert Quartet, whom we welcomed in person a year or two back (EPL 30241). The great trio and final duet from Strauss's "Rosenkavalier" make ideal material for an extended play release, and are sung on EPL 30141 by Tiana Lemnitz, Elfride Trotschel, and Georgine von Milinkovic with the Stuttgart State Orchestra. Lemnitz, the incomparable Octavian of pre-war days, has now graduated to the role of the Marshallin and it is a pleasure once again to hear her velvety tones. Those appreciating an inexpensive version of Beethoven's "Moonlight" sonata will be interested in EPL 30072, which has Wilhelm Kempff's performance, effectively detached from his complete set of these enduring works. On LP is a well-made disc of Brahms Hungarian Dances by the Berlin Philharmonic under Paul van Kempen (DG 17068), while for ears attuned to more modern dance rhythms there is Paul Hindemith conducting his own "Symphonic Dances" with the same orchestra on DG 16094. Back we go to more familiar classics on DGM 18036, the Bamberg Symphony under Fritz Lehmann offering Tchaikovsky's everlasting "Romeo and Juliet". By way of a change, its companion here is Bruch's equally well liked violin concerto in G minor, the soloist being the Viennese artist, Wolfgang Schneiderhan. The latter's wife, Irmgard Seefried, sings a collection of German Christmas songs by Cornelius on DG 16077, with some Brahms folksong settings occupying well satisfied.

"R. & E.'s" HIT PARADE LIST

We are indebted to the publishers of "Musical Express" for the lists below, which we hope will be of considerable assistance to dealers as a guide for their "pop" record buying.—Ed.

WEEK ENDED 25th JANUARY, 1958

Title	Artist	Position last week	Record Make
1 Jailhouse Rock	Elvis Presley	1	R.C.A.
2 The Story of My Life	Michael Holliday	8	Columbia
3 All the Way	Frank Sinatra	2	Capitol
4 Ma, He's Making Eyes at Me—Johnny Otis Show	Marie Adams	2	Capitol
5 Oh, Boy	Crickets	5	Coral
6 Great Balls of Fire	Jerry Lee Lewis	4	London
7 My Special Angel	Malcolm Vaughan	6	H.M.V.
8 Peggy Sue	Buddy Holly	7	Coral
9 April Love	Pat Boone	11	London
10 Kisses Sweeter than Wine	Frankie Vaughan	12	Philips
11 Reet Petite	Jackie Wilson	10	Coral
12 Kisses Sweeter than Wine	Jimmie Rodgers	9	Columbia
13 At the Hop	Dannie and the Juniors	16	H.M.V.
14 I Love You, Baby	Paul Anka	13	Columbia
15 The Story of My Life	Gary Miller	18	Pye/Nixa
16 Wake Up, Little Susie	Everley Brothers	15	London
17 Bonie Moronie	Larry Williams	14	London
17 Love Me Forever	Marion Ryan	17	Pye/Nixa
19 If You are My Destiny	Paul Anka	—	Columbia
20 The Story of My Life	Dave King	19	Decca

William Clauson, the ballad singer who caused a great deal of interest during his recent tour of New Zealand, is the first visiting artist to leave a souvenir, on LP, of his performances. On HMV MCLP 6003 is a recording taken from Clauson's Wellington Town Hall concert, released with the sanction of the N.Z.B.S. and traversing the highlights of Clauson's repertoire. There is nothing much you can do with a folk song except sing it as simply and sincerely as possible and this Clauson does to admiration, but the items in which he calls for audience participation, though amusing "first time round", will probably bore on repetition. Already there has been a substantial sale of this disc among members of the audience who have been delighted to recognise themselves in the cover photograph, and all enthusiasts for this class of entertainment will be well satisfied.

More directly "home grown" is the Wellington Schola Cantorum's record, released on Argo RG 115. I have not been vouchsafed a glimpse of this potentially important release, though I am told that the cover has an eye-catching panorama of our fair capital city. The repertoire comprises some of the Schola's most notable achievements and is musically on the highest possible plane. Other releases from Argo include the Dylan Thomas "Under Milkwood" (RG 21-22), and the two much-sought-after discs by the choir of St. George's Chapel, Windsor—the Evensong on RG 99 and the seasonally appropriate Festival of Nine Lessons and Carols on RG 39. An interesting collection of Purcell's music, by the way, is also being put out under this label. This includes the complete keyboard suites and other works played on harpsichord and,

in some cases clavichord, by the renowned English performer and musicologist, Thurston Dart, and available on two discs, RG 82-83.

Another of Columbia's "popular concerts" has been released on 33MSX 1054. Seasoned record collectors may

ORCHESTRAL HIGHLIGHTS

sniff at the contents, which are those well-tried favourites, "Dance of the Hours", "Finlandia", "Danse Macabre", the "Samson and Delilah" ballet music and those evergreen overtures, "Merry Wives of Windsor" and "The Hebrides". The fact is that this is exactly what the doctor ordered and the record may well sell by the thousand—especially in these crack performances by the Philharmonia under George Weldon. It is indeed the issue for those who "know what they like and like what they know", and one has only to be in touch for a short time with the listening and buying public to realise what an immense audience there is for music of this type on record. The same release contains another disc of this variety, but its appeal may be less, simply because many of the pieces—all extracts from Italian operas—are scarcely known at all in this part of the world. Until this record came out I had never even heard Donizetti's overture to "Linda di Chamounix", and knew of the intermezzo to Mascagni's "William Ratcliff" only because I happened to have heard it played in Italy. Other items on this disc by the Florence Maggio Musicale Orchestra under Gavazzeni are the overtures to Verdi's "Luisa Miller" and Bellini's "Norma"—there are also attractive pieces in the intermezzo style by Puccini and Catalani. This really is recommended to all who enjoy tuneful music in the Italian manner. The number is Decca LXT 5288. On LXT 5305, and in more sophisticated vein,

is a really outstanding recording of Bartok's Concerto for Orchestra by the Suisse Romande under Ernest Ansermet. This wonderful score can rarely have been expounded with such clarity, and the recording easily takes first place in sheer realism. The issue is indeed a worthy companion to the excellent Mercury version under Antal Dorati. The music, too, is the best possible introduction to Bartok's fascinating world of sound.

Robert Stolz, the veteran composer of "White Horse Inn" and other enduring stage successes, turns up as conductor

NEWS FROM CORONET AND PHILIPS

on a new 12-inch Philips release entitled "Waltzing in Vienna" (B 08100). This title has, of course, an all-too-familiar look, and there are indeed one or two over-familiar pieces like "A Thousand and One Nights" and "Music of the Spheres". Besides these, however, the orchestra (named after the conductor) also plays its way through Lehar's "Eva", Ivanovici's "Danube Waves", and several other toothsome morsels. There are a large number of them, thus they will all be rather abridged, but this appears to be an ideal disc for summer listening. Much in the same style is the latest from Percy Faith, called "Passport to Romance" (Coronet KLL 535).

In their "Favourite" series, announced as being at a popular price, which is in effect about three shillings less than that charged by other companies for a similar product, Philips have a performance of the Cesar Franck symphony by the Hague Philharmonic under Van Otterloo (S 04011), and a whole galaxy of Tchaikovsky in the packaging of "Romeo and Juliet", "1812", and "Capriccio Italien", as done by the Concertgebouw Orchestra under Paul Van Kempen on S 04027. Coronet, on the other hand, have a Spanish attraction in the shape of Falla's "Nights in the Gardens of Spain". Mitropoulos and the Philharmonic-Symphony Orchestra of New York are the protagonists here; the important piano part is played by Robert Casadesu, who should be ideal in this school of music, and the disc is rounded out by the popular excerpts from Falla's ballet "The Three Cornered Hat" and from his opera, "La Vida Breve". All this is on Coronet KLC 618. In very different vein is a performance of Shakespeare's "Othello", with Paul Robeson, turned from singer to tragic actor, in the name role, Jose Ferrer as Iago, and Uta Hagen as Desdemona. The recording, made some time ago by this cast who were then appearing in a stage production in New York, is complete on three records (KLC 601-3), and supplied in an album.

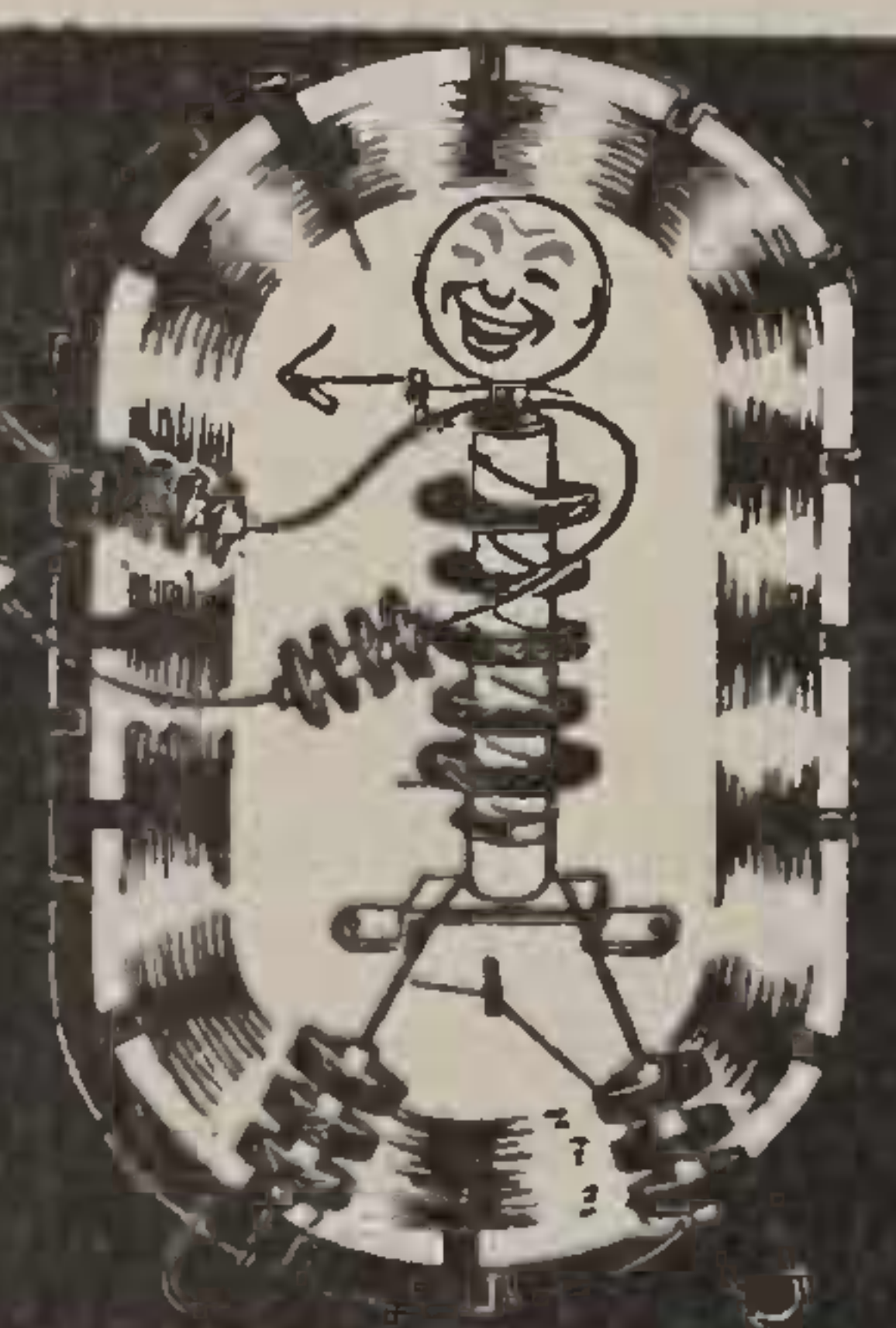
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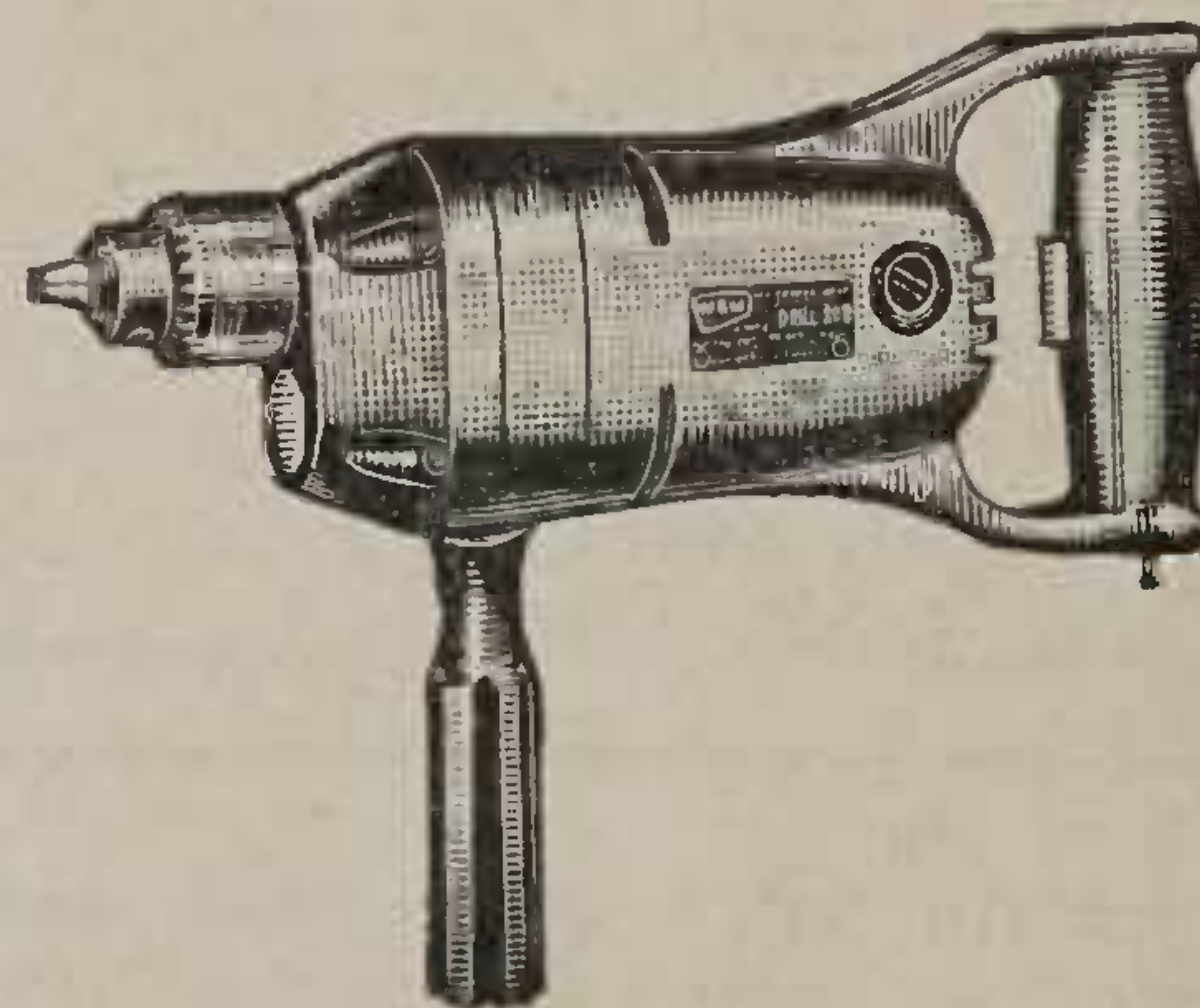
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IMAGE INTERFERENCE

(Continued from page 23.)

image ratio is then the ratio of the signal strengths required to give the same output from the set, at image and signal frequency. Since when image rejection is good, a very large signal is necessary at the image frequency, in order to produce appreciable output, it is usually best to take the first measurement at the image frequency, after which the signal has to be attenuated to enable the same output to be had at the proper signal frequency. The amount of attenuation that has to be introduced in this way is a measure of the image ratio, which is sometimes given as a number, and sometimes in Db.

Secondly, if a receiver has appreciable response at the image frequency, noise that is generated there will be able to pass through the I.F. amplifier, and is added to the noise picked up on the signal frequency. Obviously, then, a good image ratio is desirable for this reason too.

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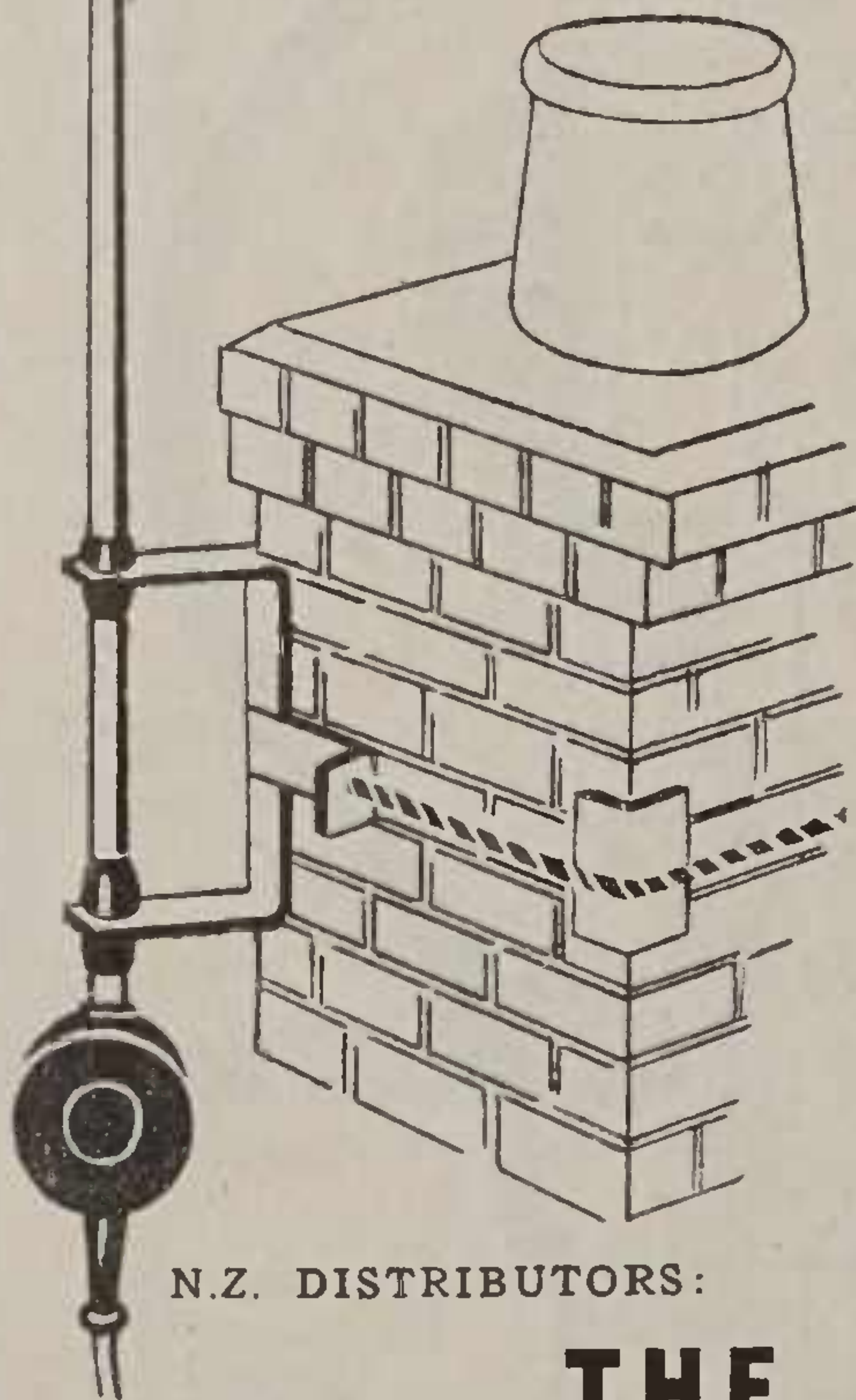
Twin screened Cable. 2/3 Yd. ASA 308

• "V.R.A." AERIALS

WALL MOUNTING, complete with Wall Bracket and 60 ft lead-in wire. £5 8s. 0d. VRA 501

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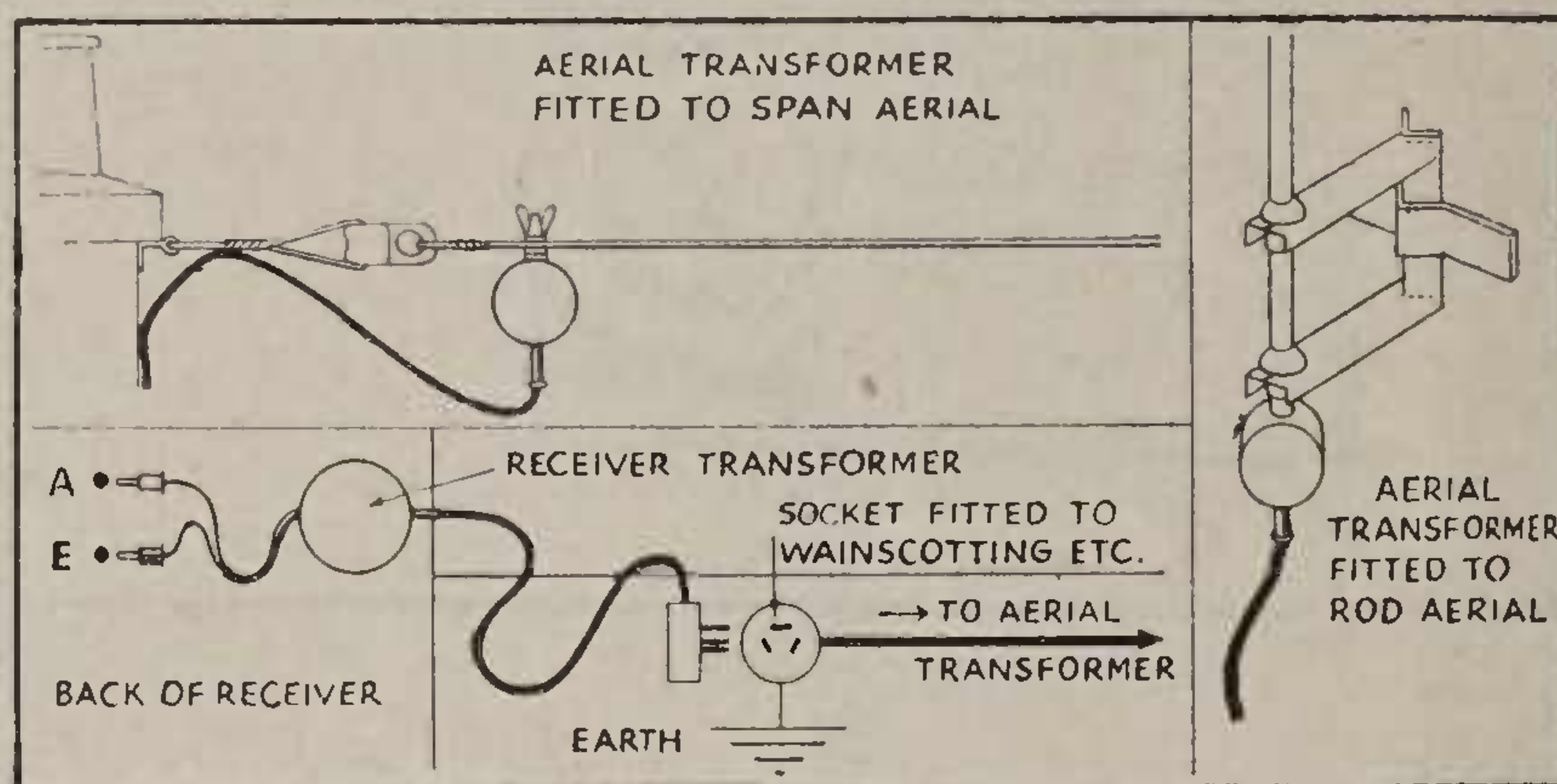
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THE "EXSTAT" PRINCIPLE

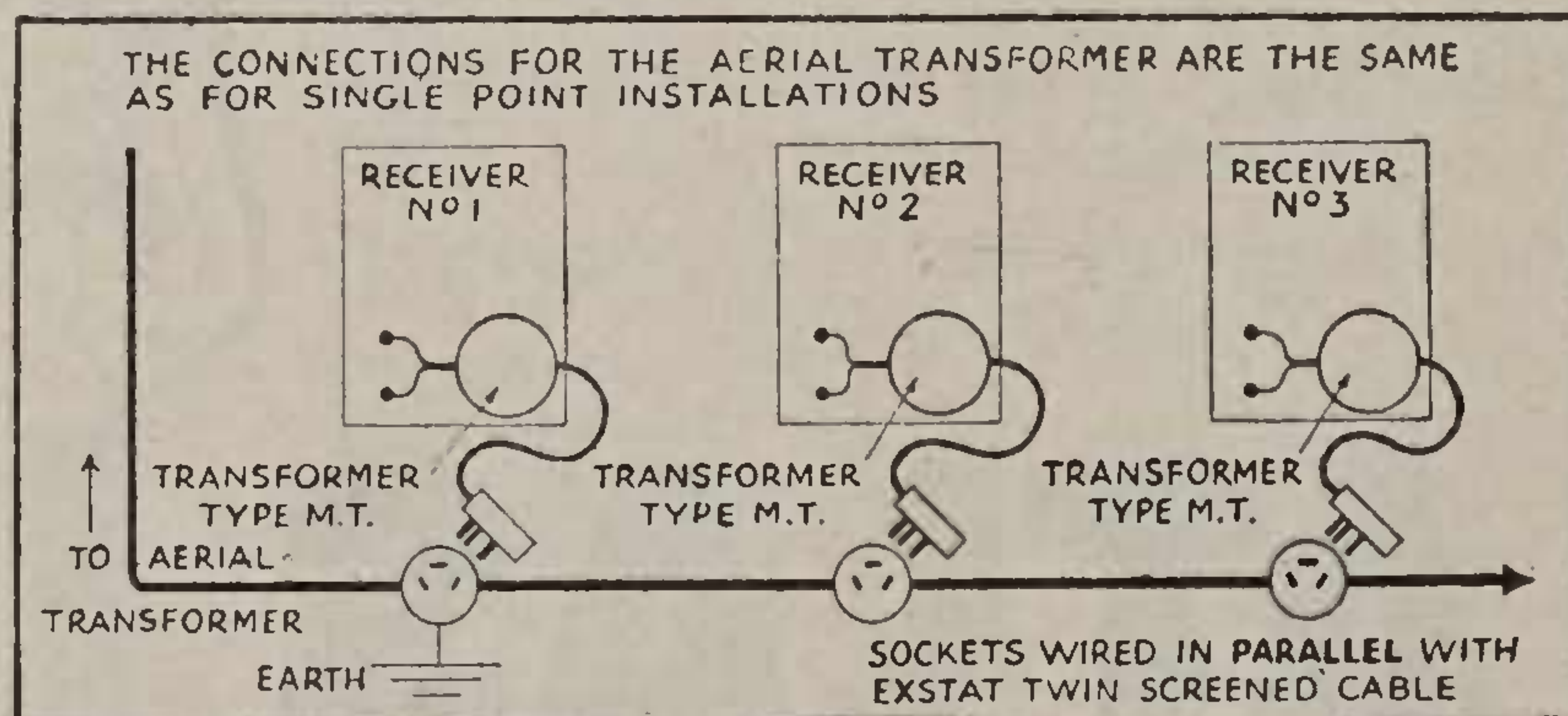
Most interference on normal aerials is picked up on the down lead via the housing wiring and metal piping etc. The "Exstat" system provides complete screening and eliminates all such pick-up. The aerial proper is mounted above the interference zone. The "pure" signals from the aerial are conveyed to the receiver without loss and are completely free from interference. The "Exstat" transformers, which embody the latest technique, ensure maximum signal strength over a range of 150 Kc/s to 30 Mc/s.

SINGLE POINT INSTALLATIONS



An "Exstat" Aerial Transformer Type A.T. is fitted to the Rod or Span Aerial and connected with twin screened cable to the Transformer Type R.T. via the three-pin plug and socket.

MULTIPOINT INSTALLATIONS



Depending on local reception conditions, up to six receivers may be operated from one "Exstat" Aerial by the use of Transformers Type M.T. at each point, as shown above.

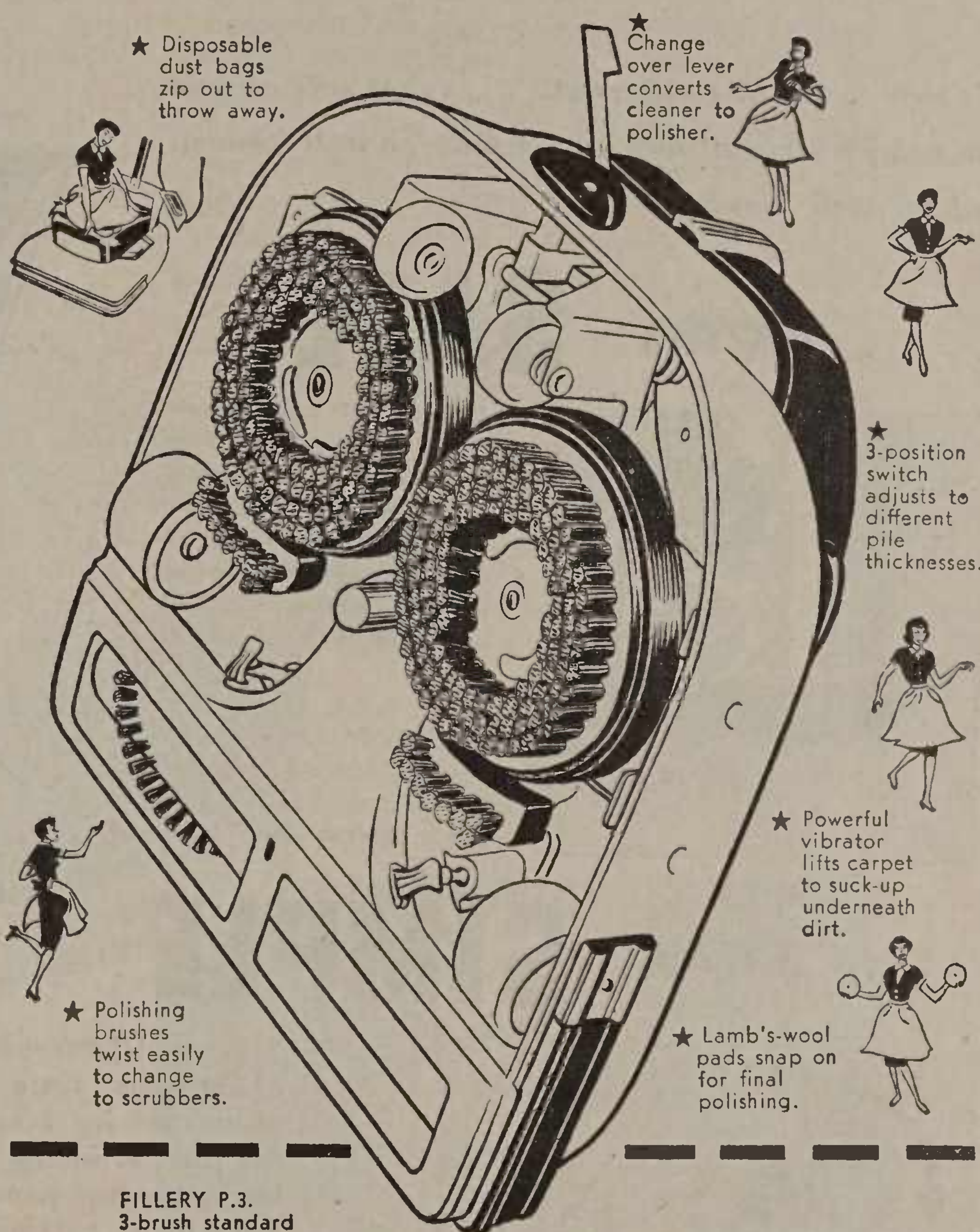
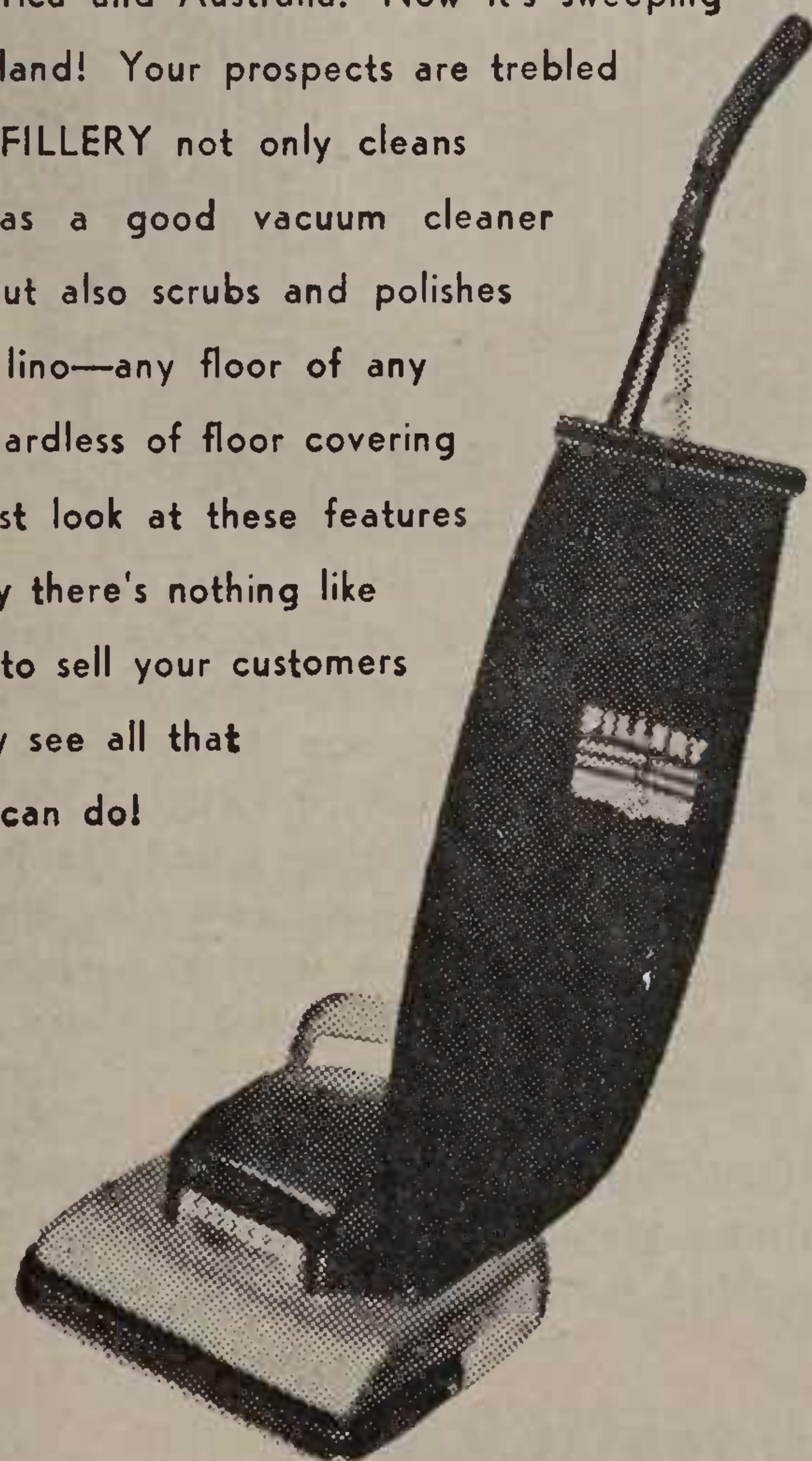


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The world's No. 1 CLEANER - POLISHER - SCRUBBER

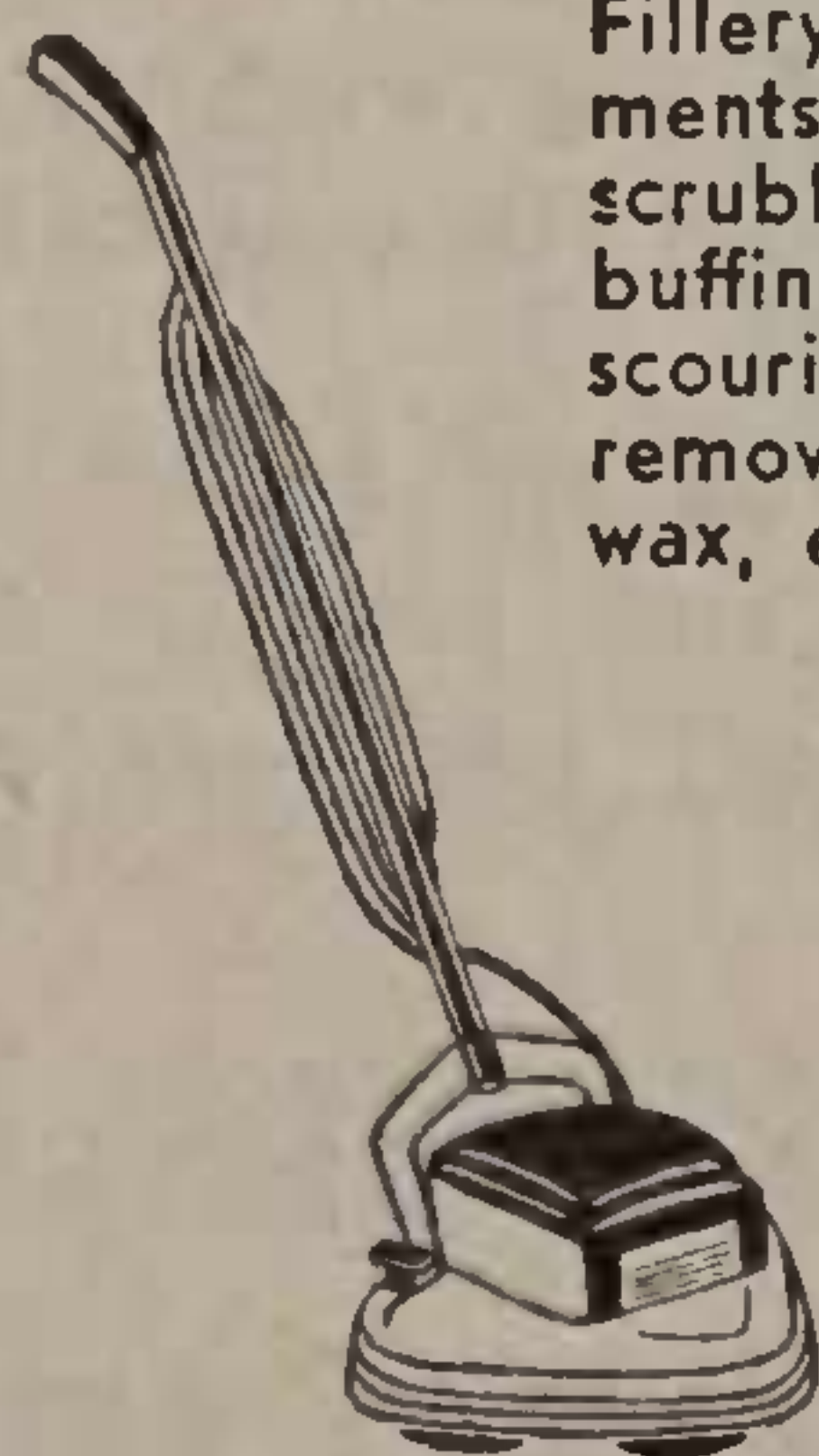
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It has already changed the outlook on heavy housework in America, Britain, the Continent, Canada, South Africa and Australia. Now it's sweeping New Zealand! Your prospects are trebled because FILLERY not only cleans carpets as a good vacuum cleaner should, but also scrubs and polishes parquet, lino—any floor of any home regardless of floor covering used. Just look at these features—see why there's nothing like FILLERY to sell your customers once they see all that FILLERY can do!



FILLERY P.3.
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model easily
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**These other fine FILLERY products
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cleaning.



All Fillery products are available from
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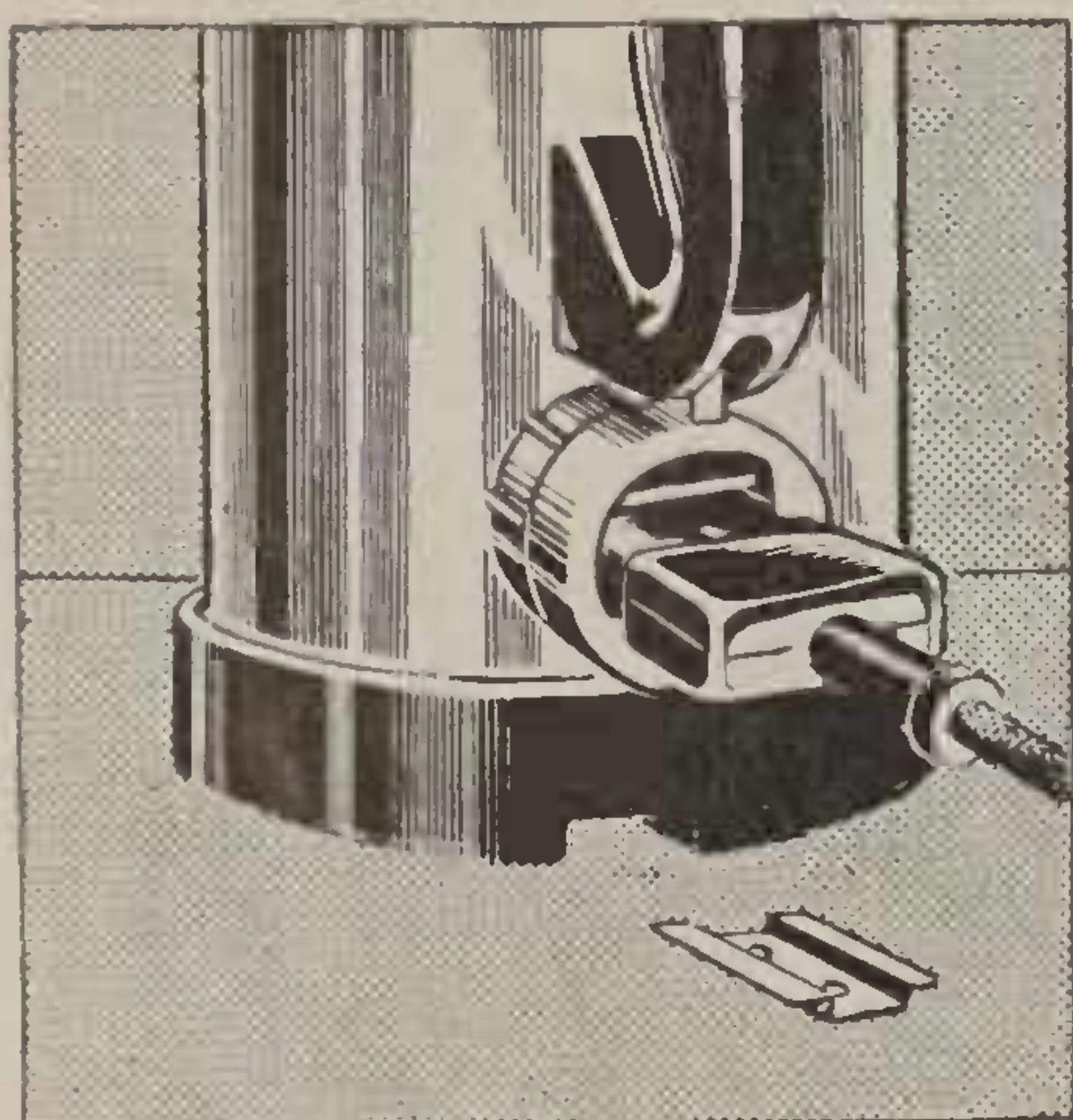
G.9363

THE NEW *Ultimate* *SUPER SAFETY JUG*

It's new . . . it's different! . . . yet still retains the superb streamlined appearance so well known, and so well received!

EXTRA

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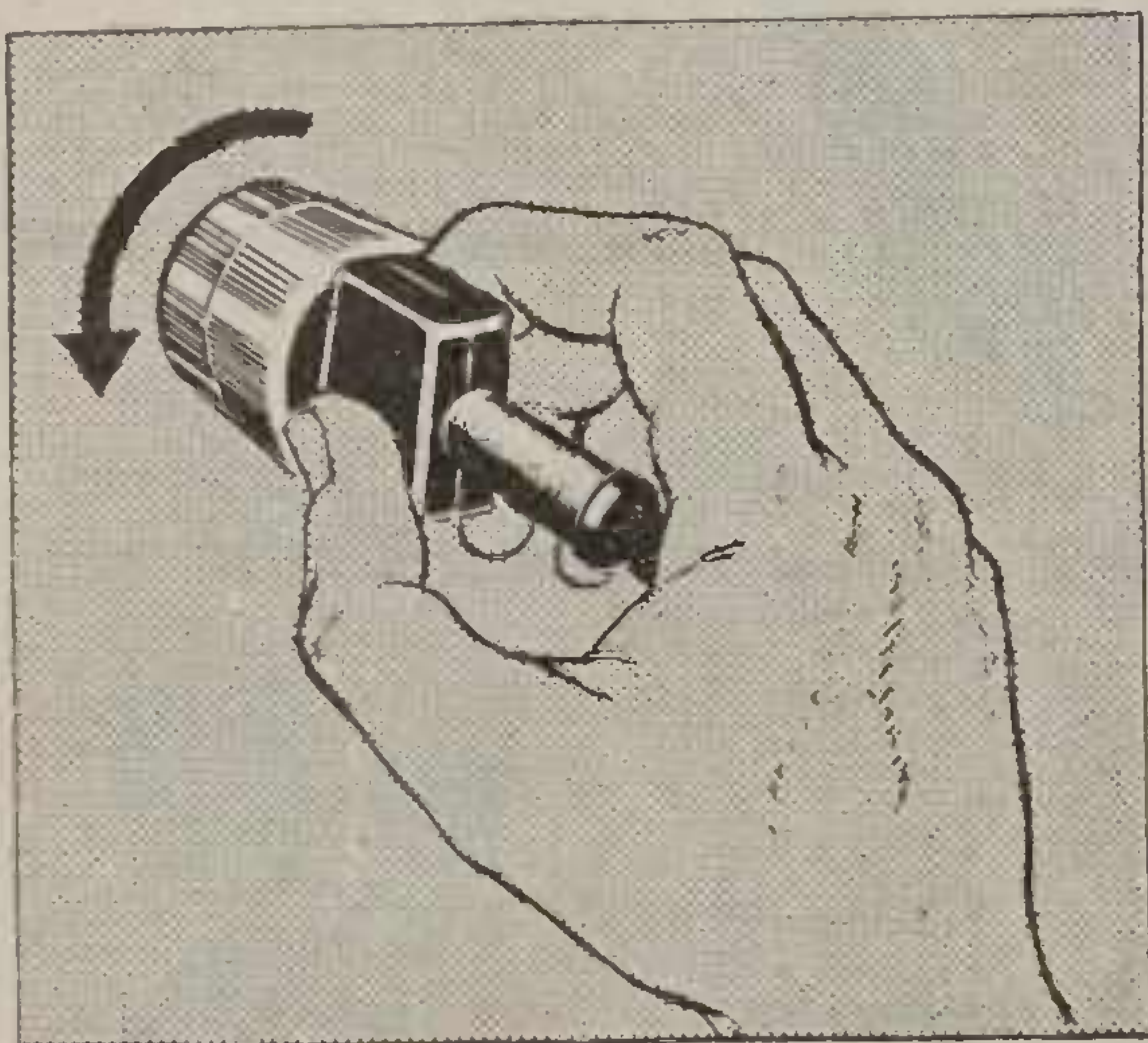


An improved anti-turbulence screen has been incorporated in the pouring spout, reducing boil-overs to a minimum. The moulded base still retains the anti-pull-over patent so widely acclaimed by leading Child Welfare Authorities.

AND NOW the element has been redesigned to prevent burnouts with a simple but highly effective safety device.

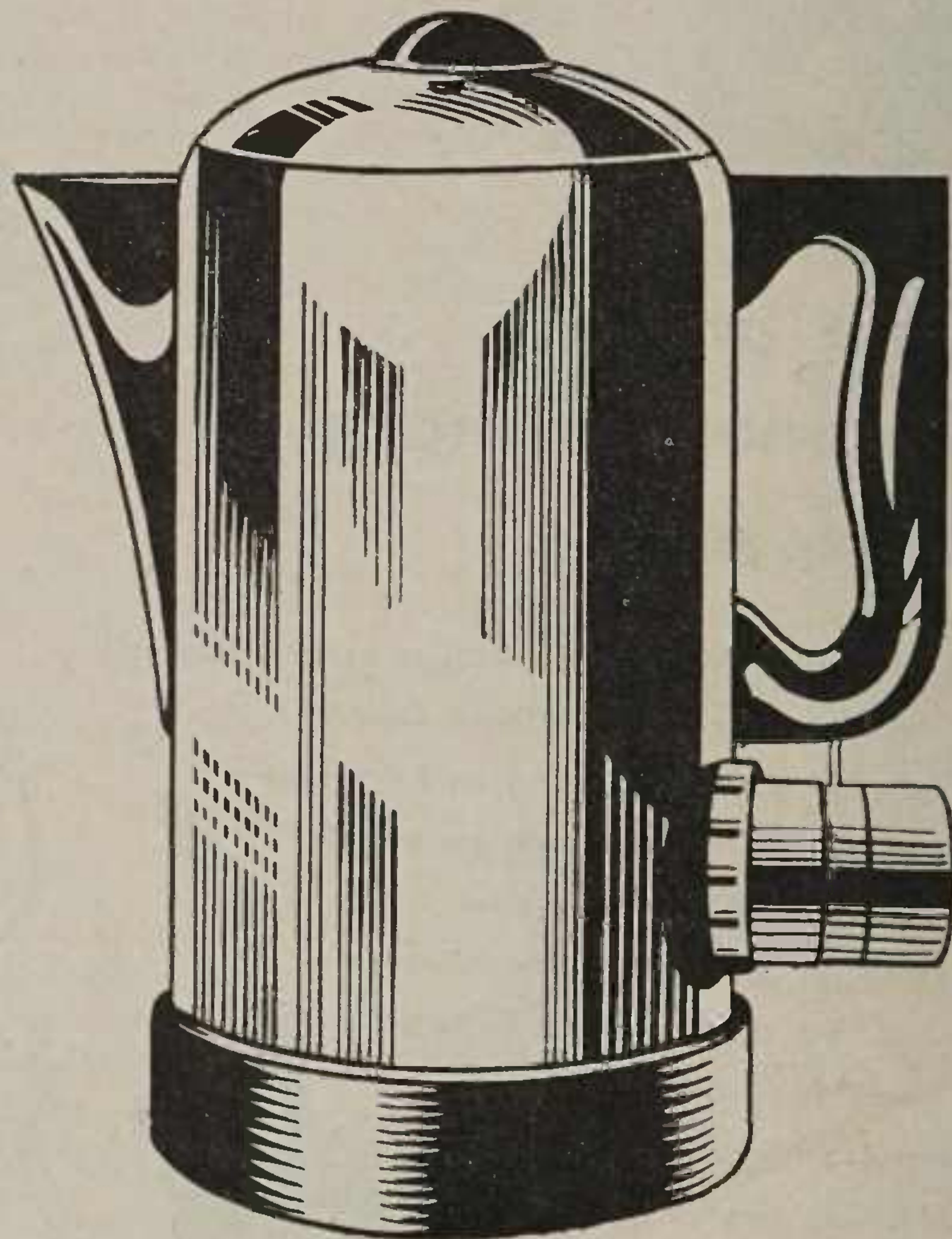
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The new Ultimate SUPER-SAFETY electric jug eliminates the worry of burnouts, spare elements or safety cartridges. No longer is the unattended jug a source of worry. Burnt out elements are a thing of the past. A simple but highly efficient device switches off the power before damage is done and a simple resetting action restores the element to its former efficiency. Boiling dry or switching on an empty jug merely turns the appliance plug into a vertical position . . . just refill the jug with water and rotate the plug anticlockwise through 90 degrees to its original position.

The Ultimate 3-pint SUPER-SAFETY jug is constructed from spun copper and heavily chrome plated to retain its fine finish. The handle, knob, and base are moulded from durable, heat resistant phenolic plastic.



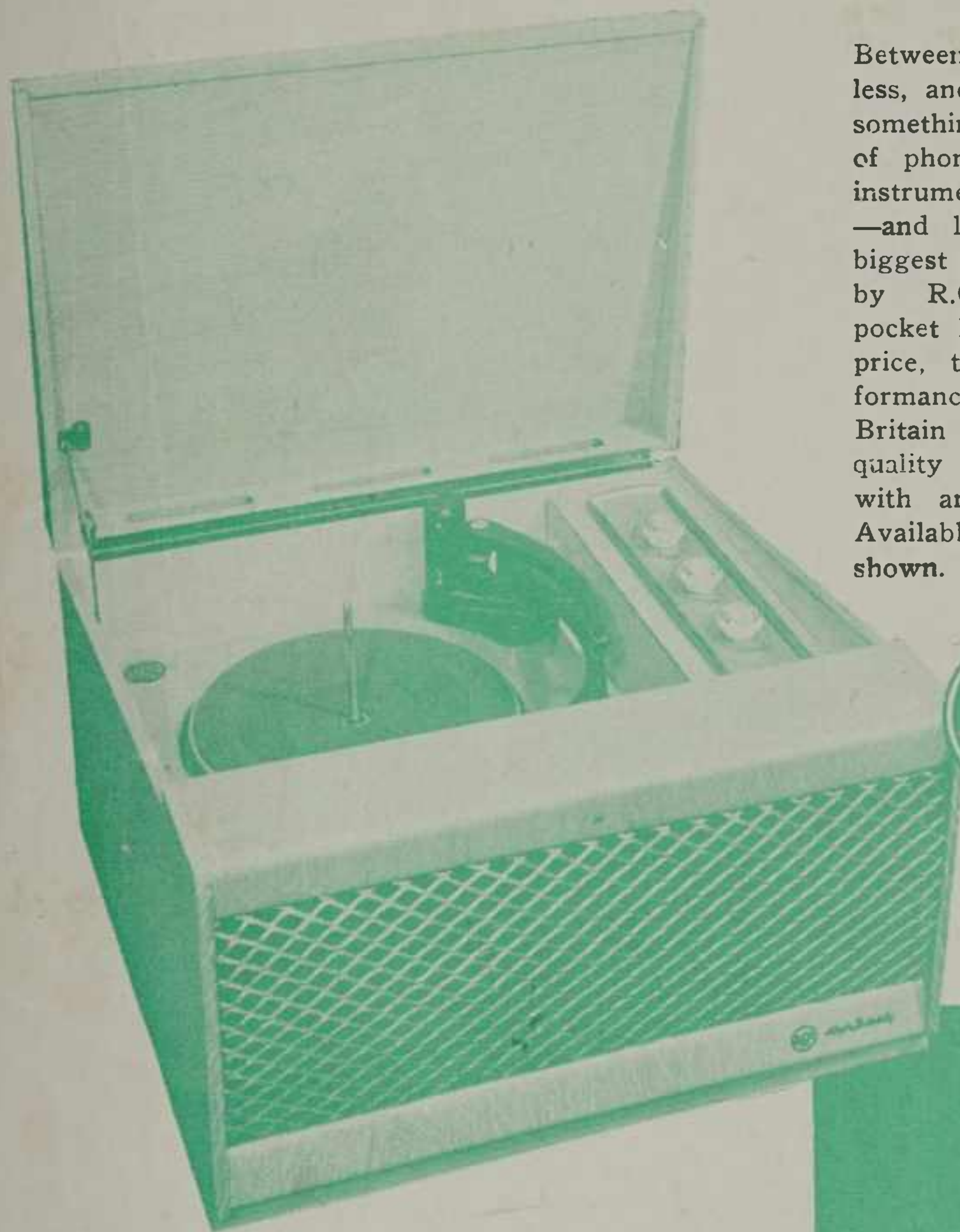
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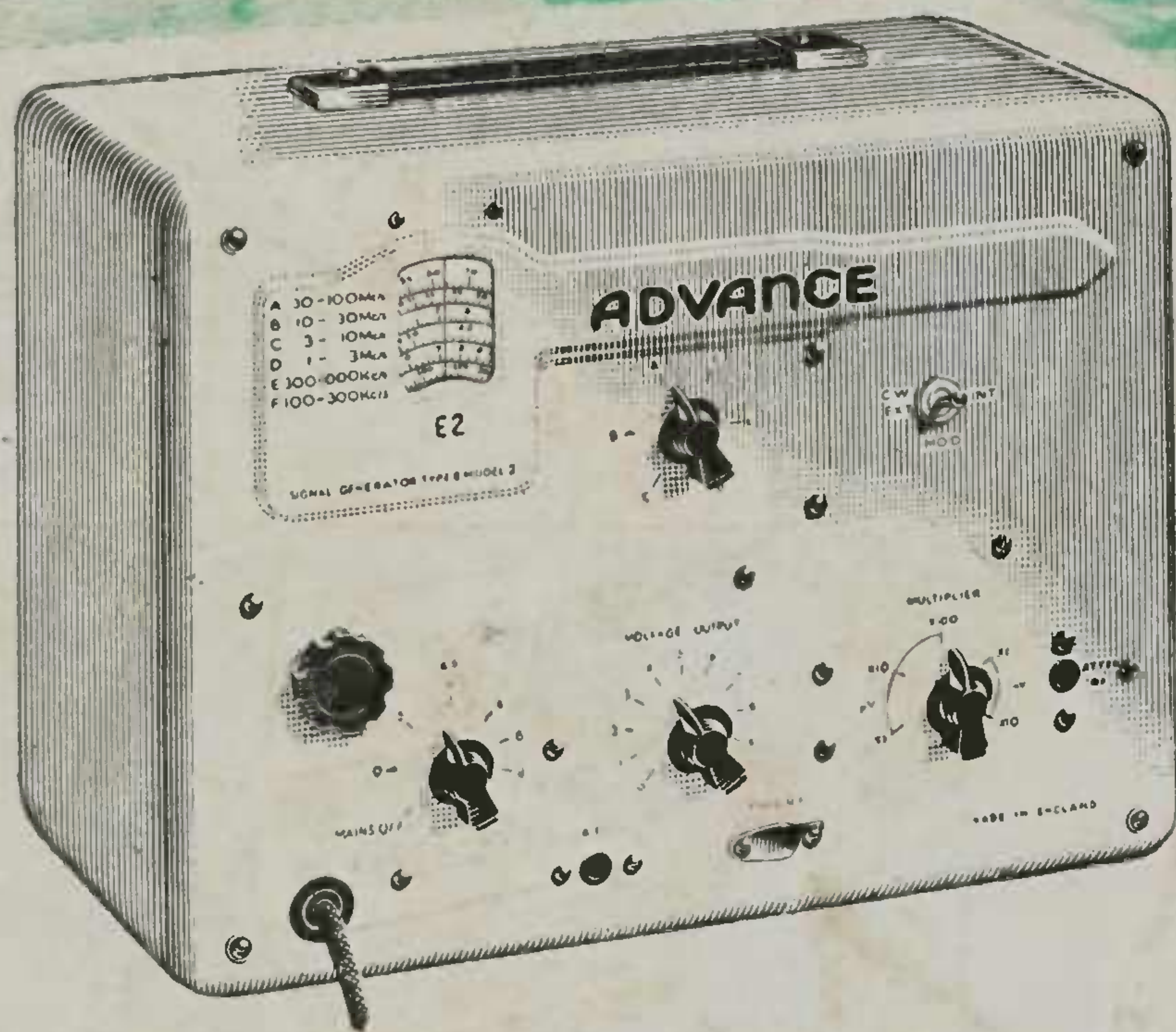
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