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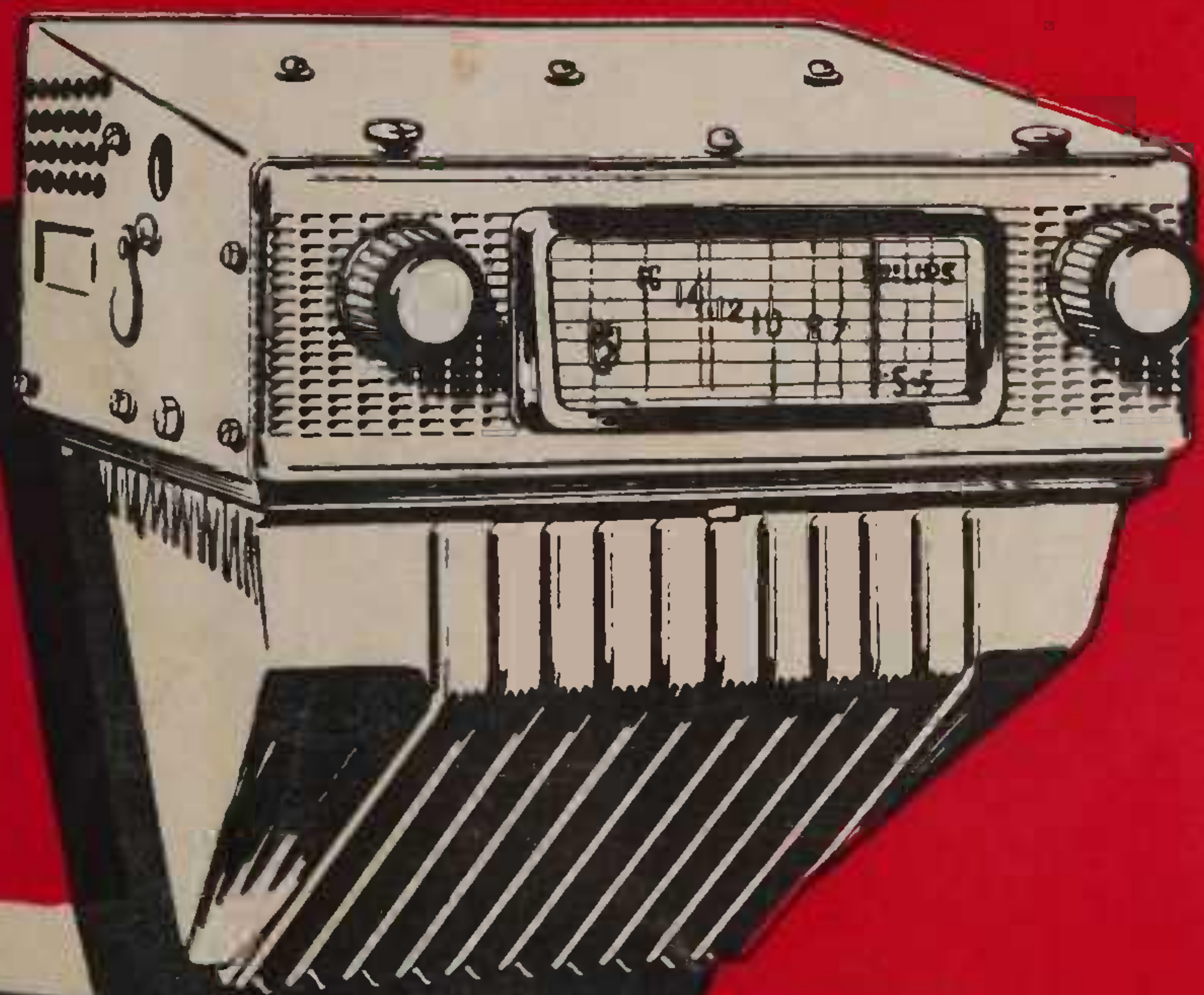
VOL. 13, No. 7

SEPTEMBER, 1958

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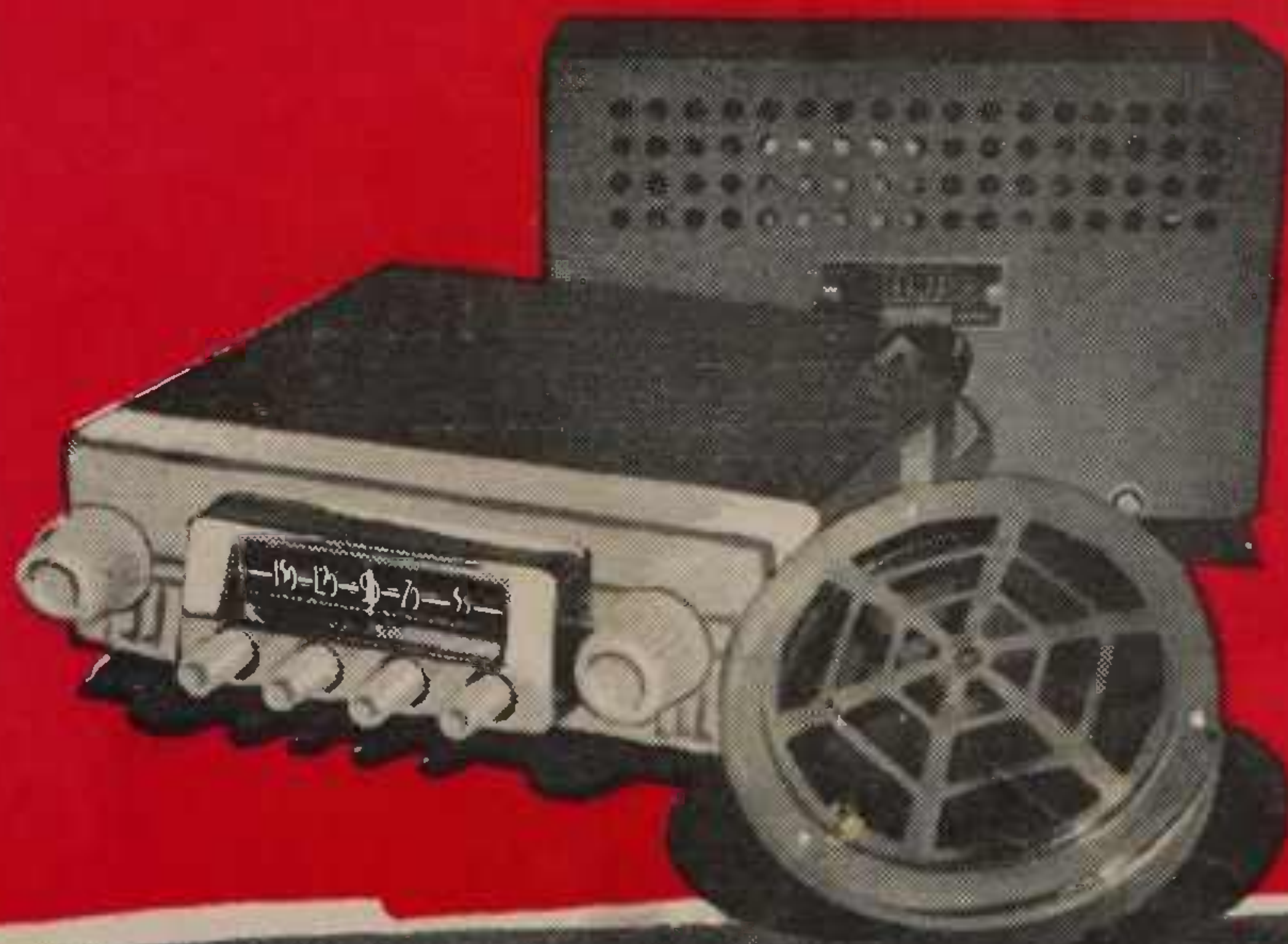
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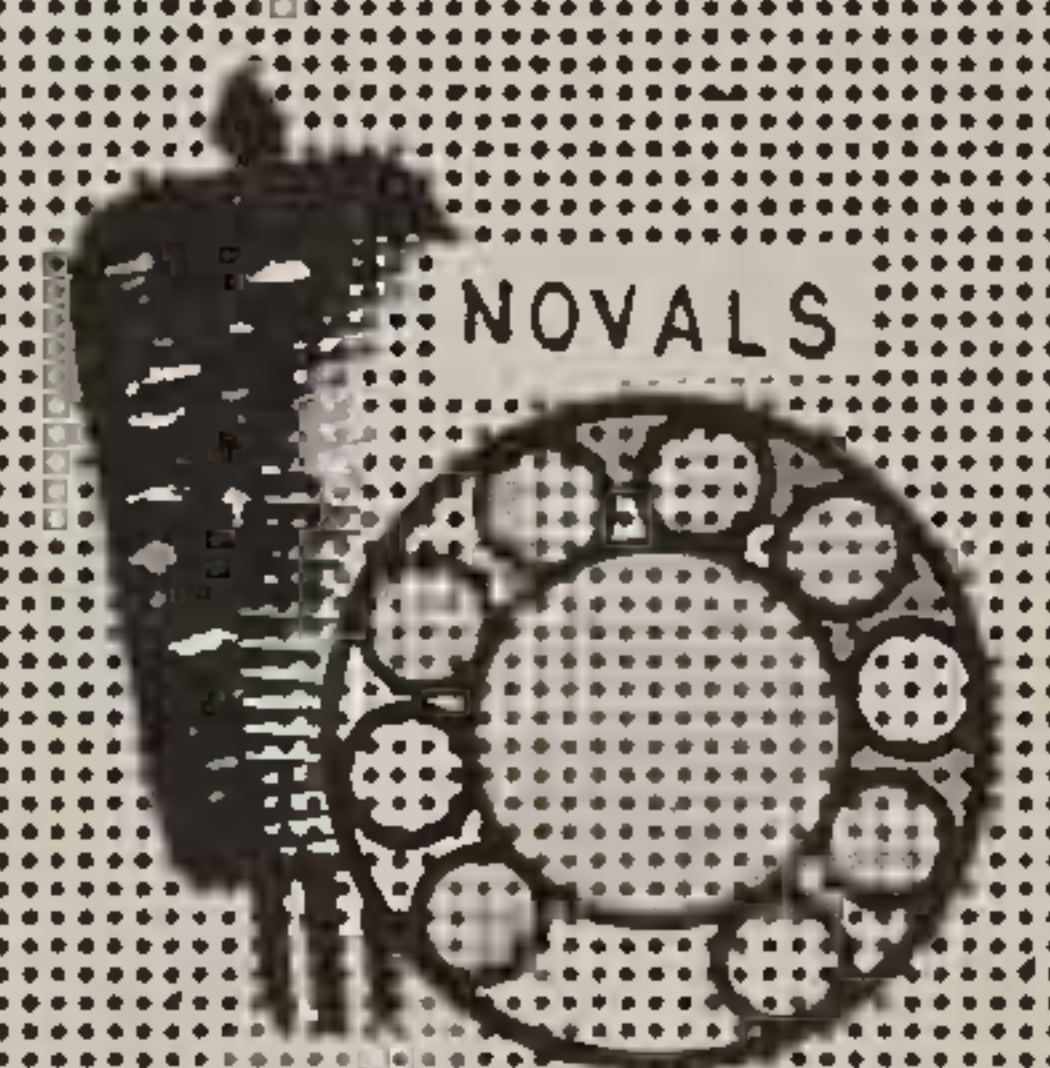
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Vol. 13, No. 7

SEPTEMBER, 1958

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A Note on Loud-Speaker Enclosures

We still find that many audio enthusiasts have an unaccountable aversion for bass reflex enclosures, or vented baffles, as they are sometimes called, seeming to prefer one or more of the more complex arrangements that are given a great boost from time to time in the popular technical press. One often hears reflex enclosures called by such unflattering names as "boom-boxes", the inference being that such baffles do not produce natural-sounding bass!

This journal is by no means alone in believing that the reflex enclosure is still the best type of baffle for any type of speaker unit, and there are numerous good technical reasons, quite apart from listening to actual results, to back up this opinion. About a year ago, we published an article by Alexis Badmaieff, research engineer to the Altec Lansing Corporation, in which this authority describes the performance of all possible types of baffle, from the flat baffle and the so-called infinite baffle, to reflex enclosures and the various types of front and back-loaded horn that have from time to time been proposed. To quote from Altec's findings, "It is possible to construct satisfactory enclosures of types other than the bass reflex, however the possibilities of obtaining excellent results from these other types are not good. The frequency response curves made in Altec's acoustic laboratory on many types of commercial enclosures on the market indicate clearly the difficulties often found in types other than bass reflex. Undoubtedly the lack of acoustic laboratory facilities to provide accurate measurements is the major contributor to the number of poor commercial enclosures now on the market."

"Speaker enclosures serve the twofold purpose of providing a good appearance, and producing good bass response. Unfortunately, in an effort to produce good bass response, many designers overlook the troubles that may be created by the enclosure in the mid frequencies. These mid frequencies are much more important than extreme low-frequency response. Altec Lansing maintains that no cabinet should be constructed in which good base response is obtained at the expense of good mid-frequency response."

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This is not the only authority which can be quoted in favour of reflex enclosures as against the many varieties of folded horn. H. F. Olson of R.C.A., one of the world's foremost authorities on acoustics generally, and on loud-speaker design in particular, holds similar views, and has chosen reflex enclosures for baffling the famous LC-1A speaker unit, which is probably the finest available today.

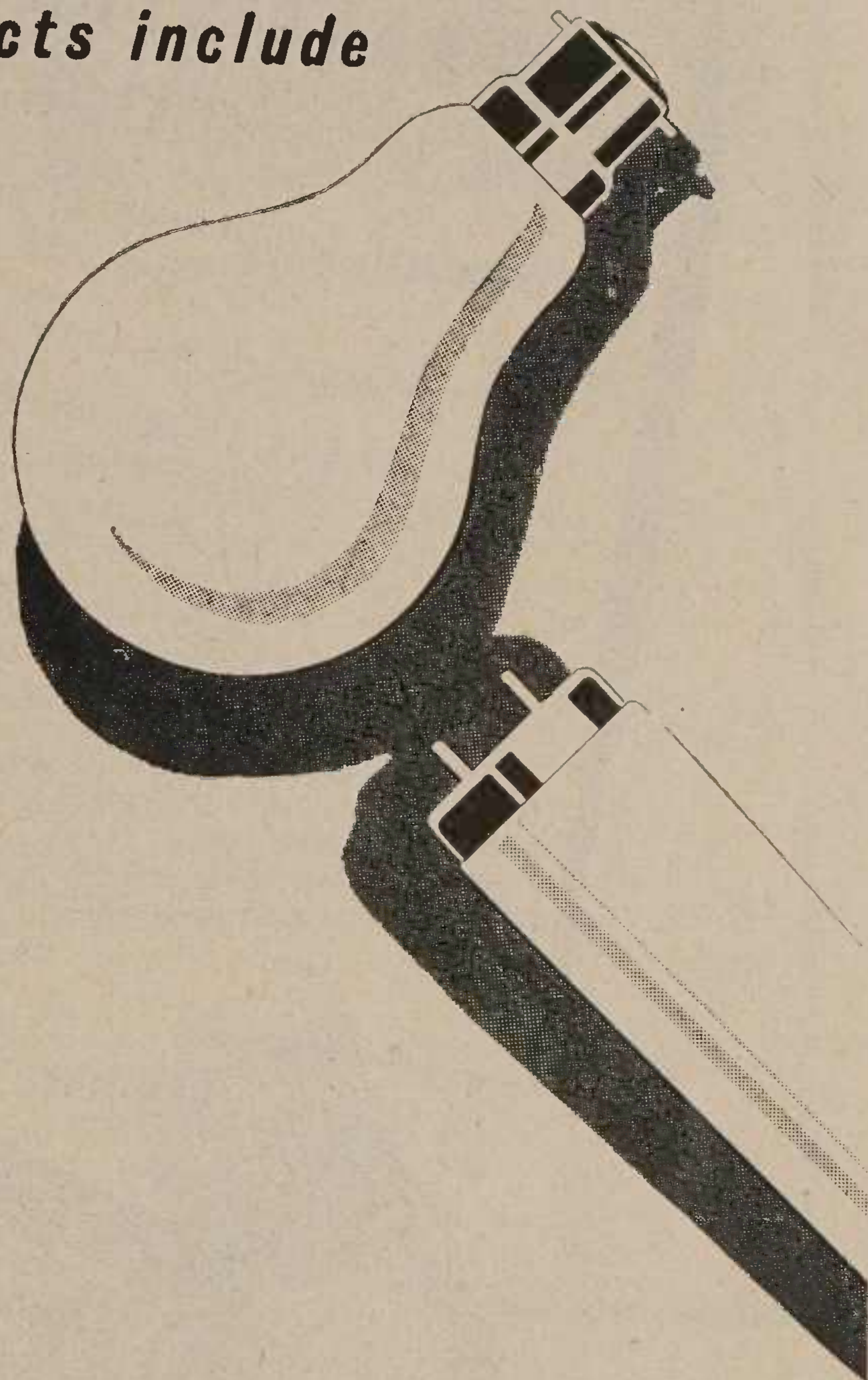
Needless to say, reflex baffles, like anything else need to be properly designed in relation to the driver unit with which they are to be used, and there is no guarantee that a particular baffle will give an acceptable result, just because it is of this type. Improper construction, too, can vitiate the results.

The fact remains, however, that unlike the fancier types of baffle, the bass reflex is eminently designable, which means that it can always, by proper design and construction, be made to give the best results of which the driver unit itself is capable. Moreover, its performance at the bass frequencies is obtained without prejudice to the performance at the middle and upper frequencies, and this is something that can rarely be said for any of its competitors.

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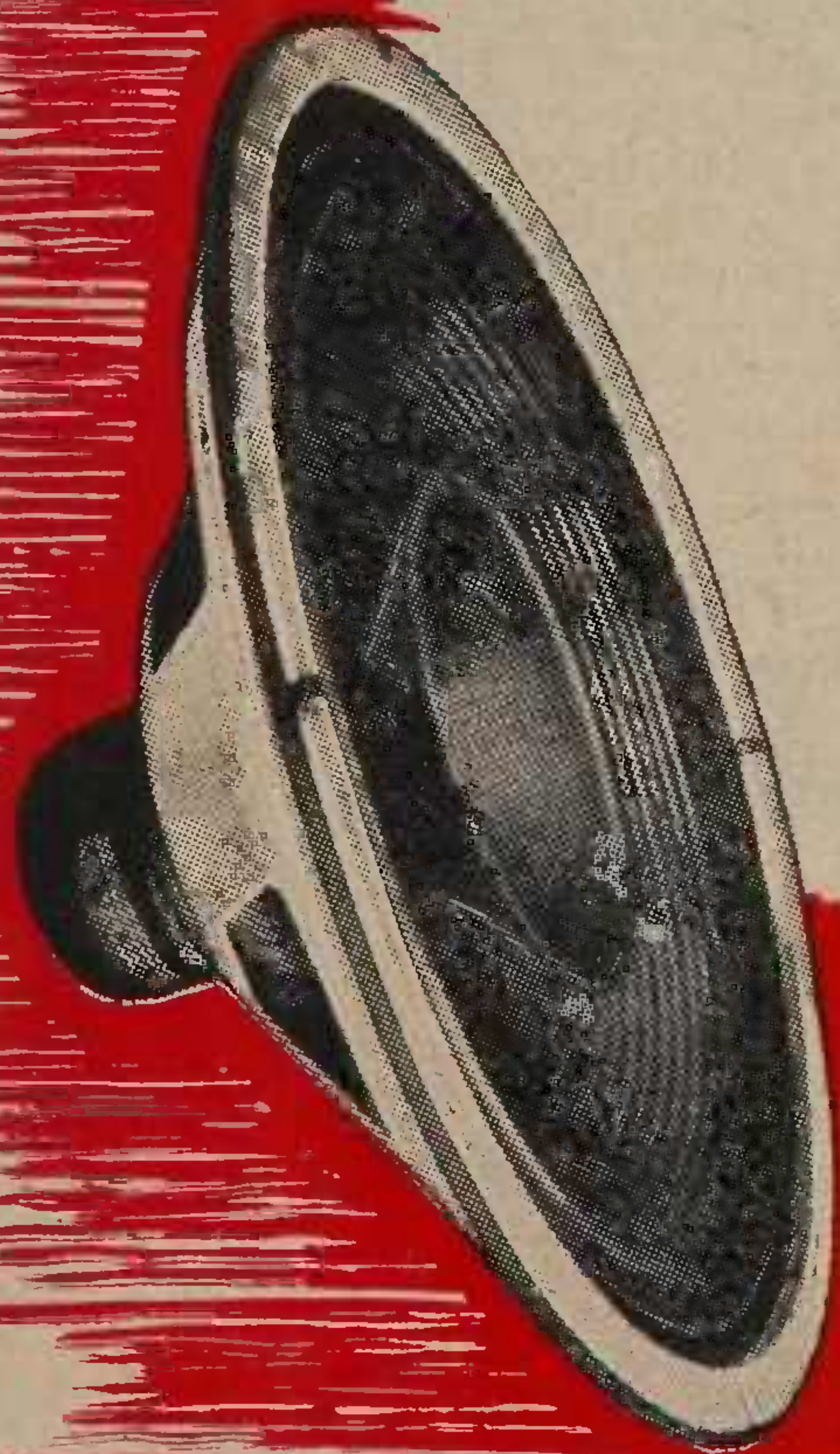


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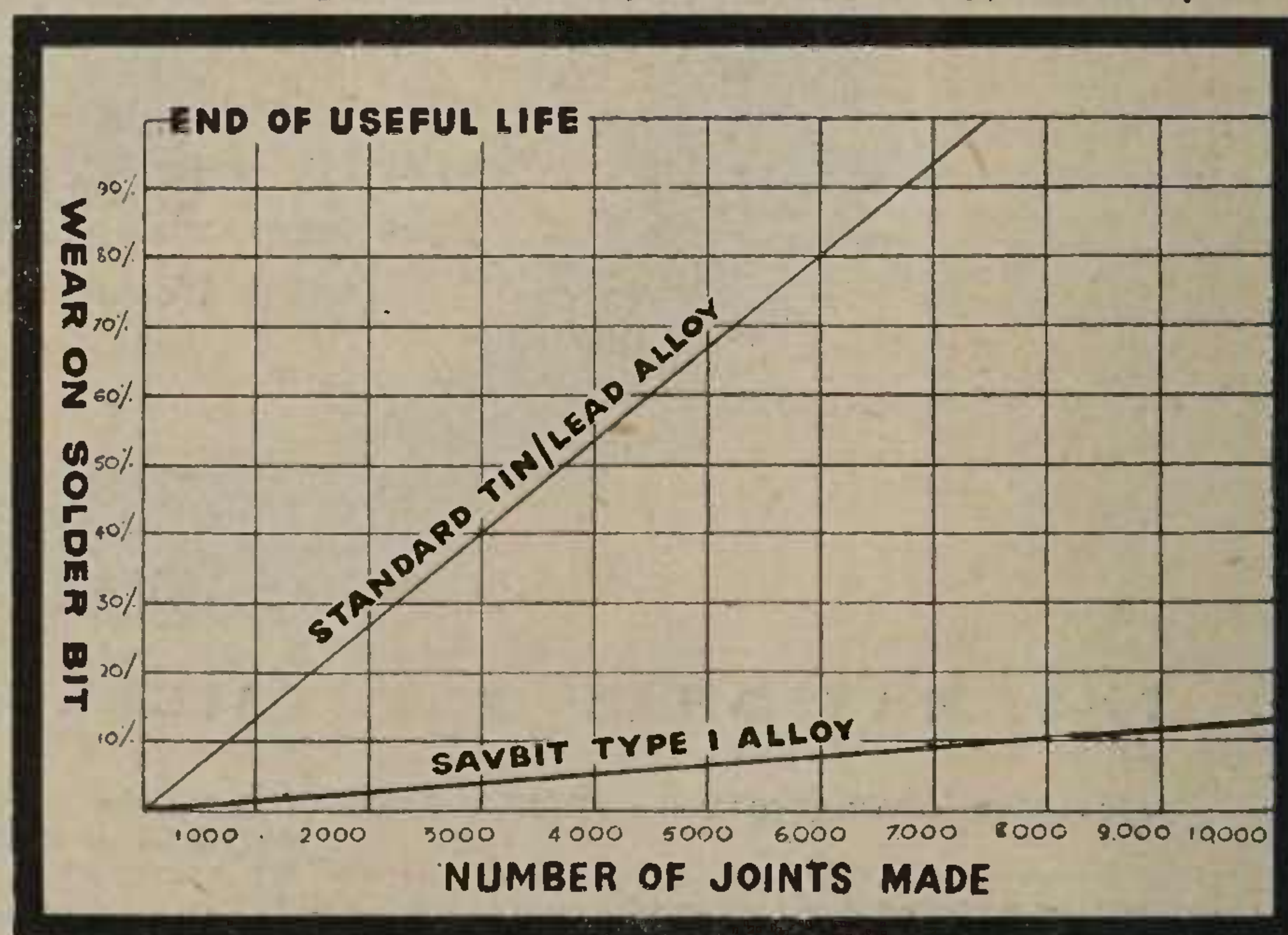
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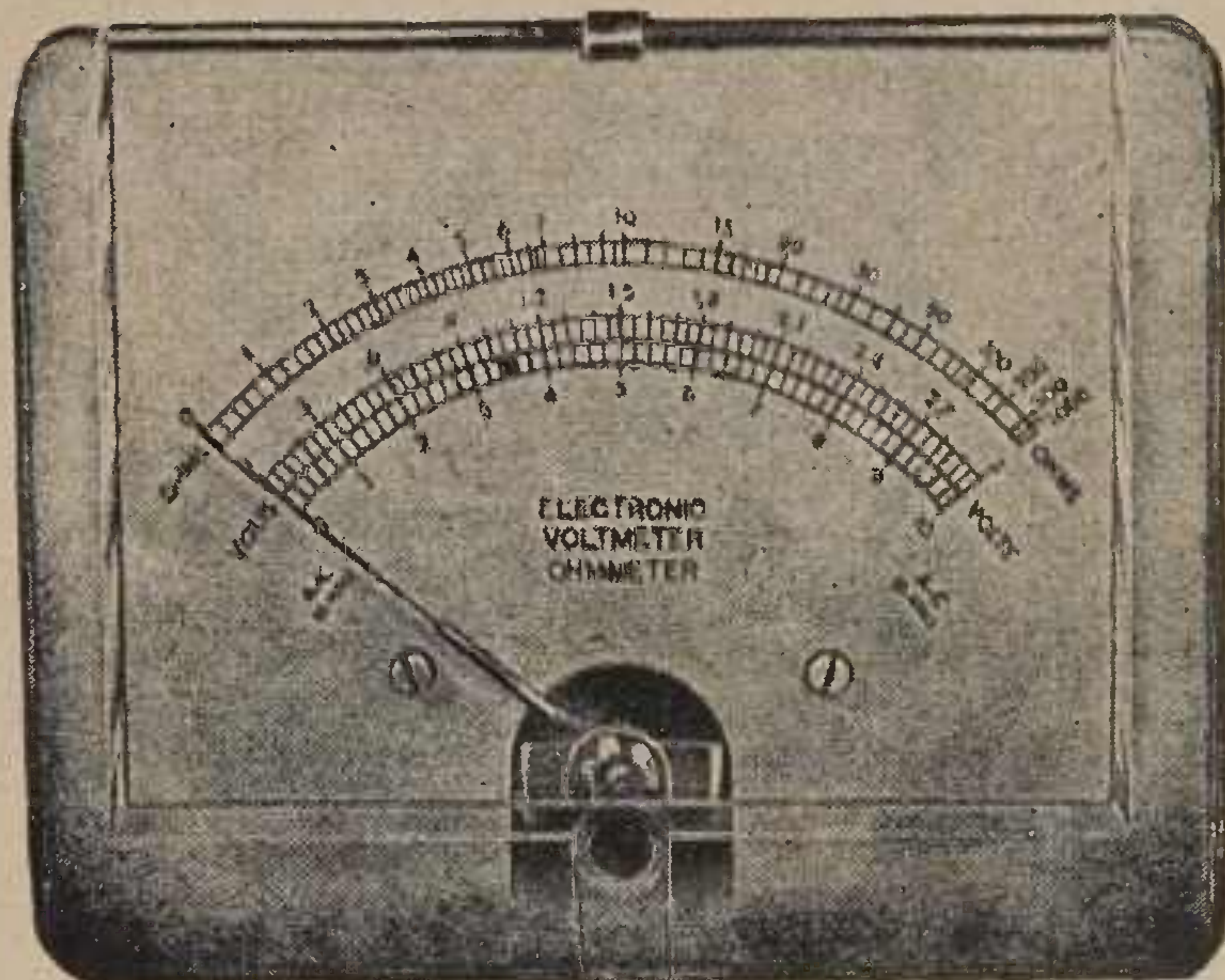
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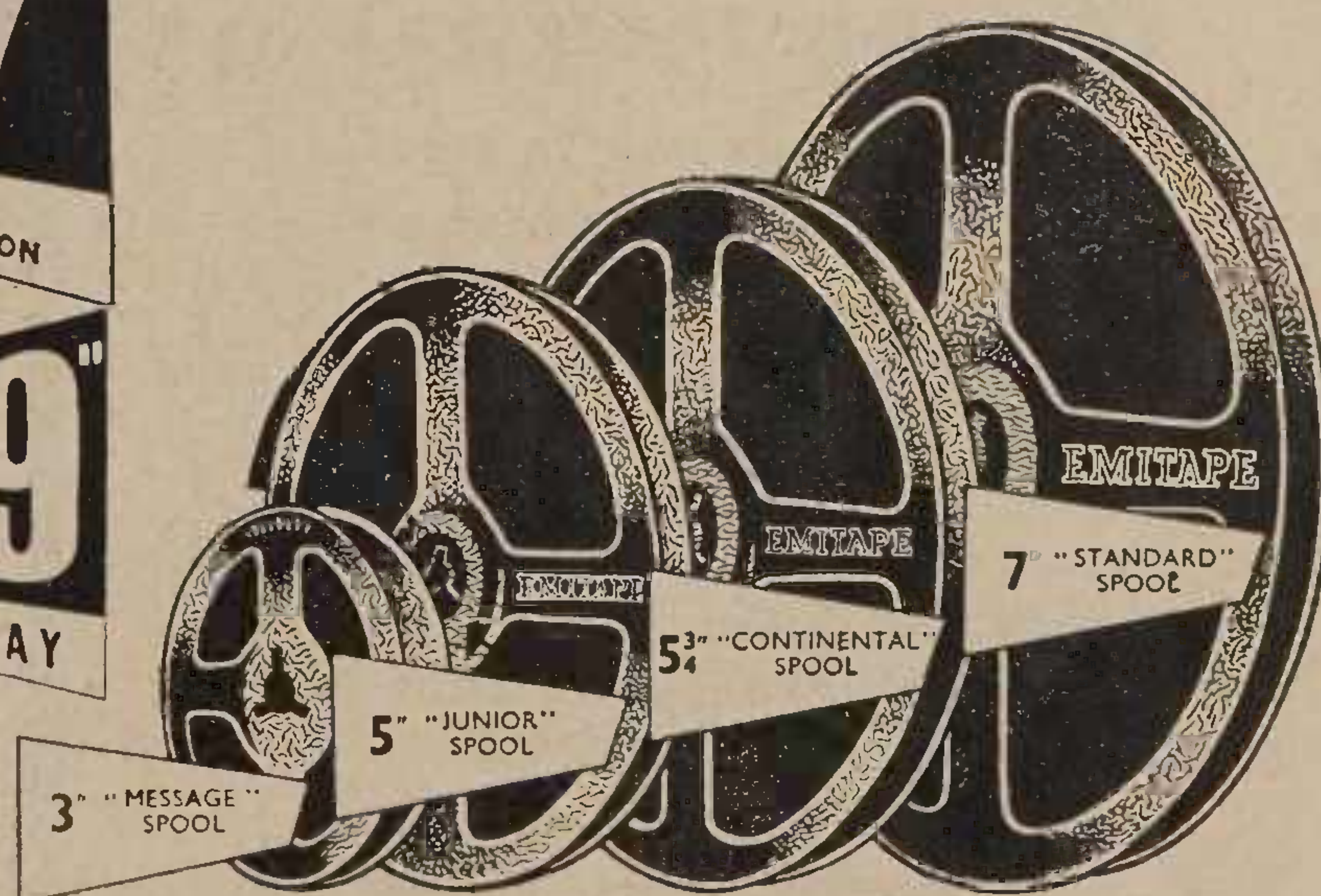
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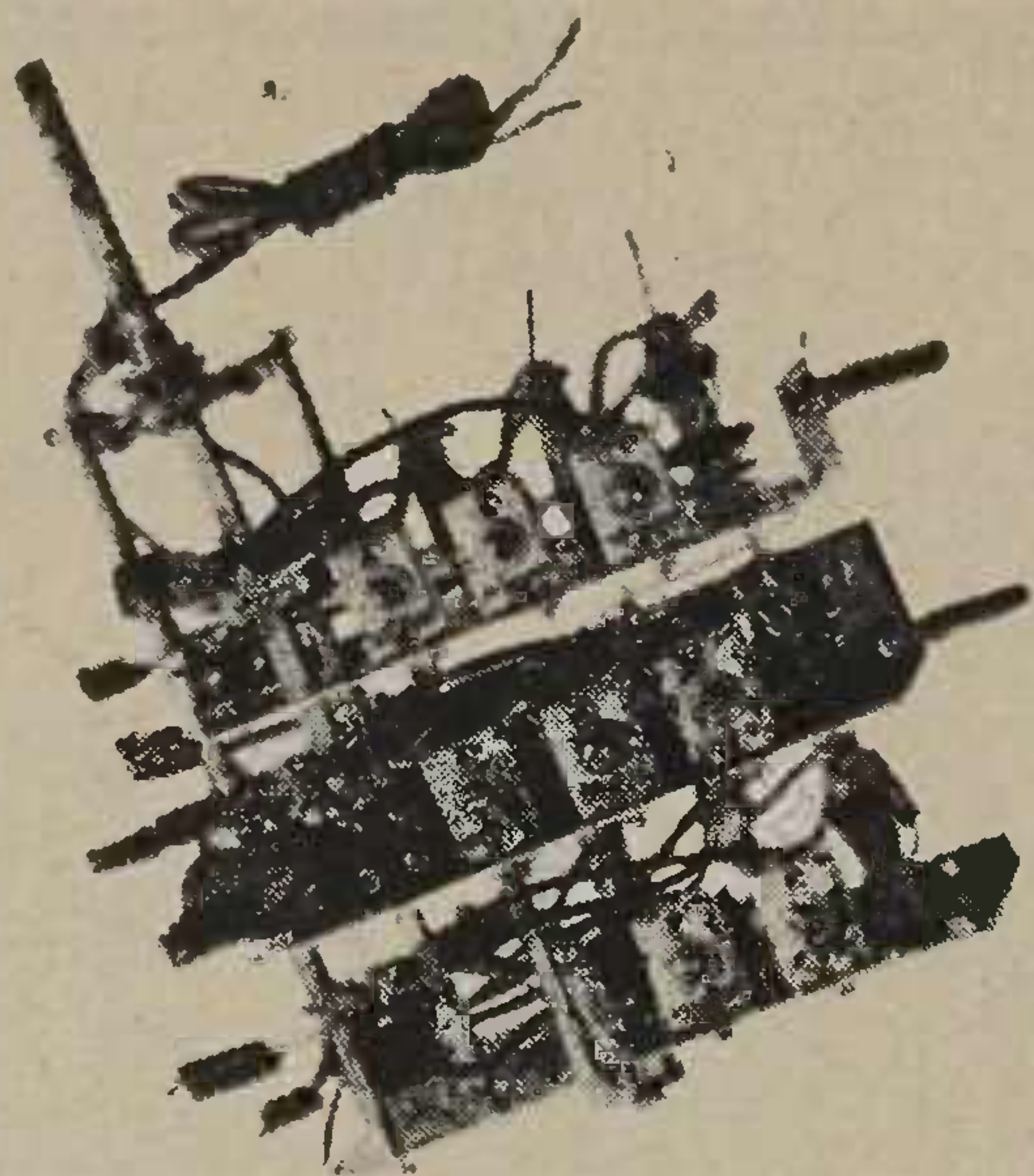


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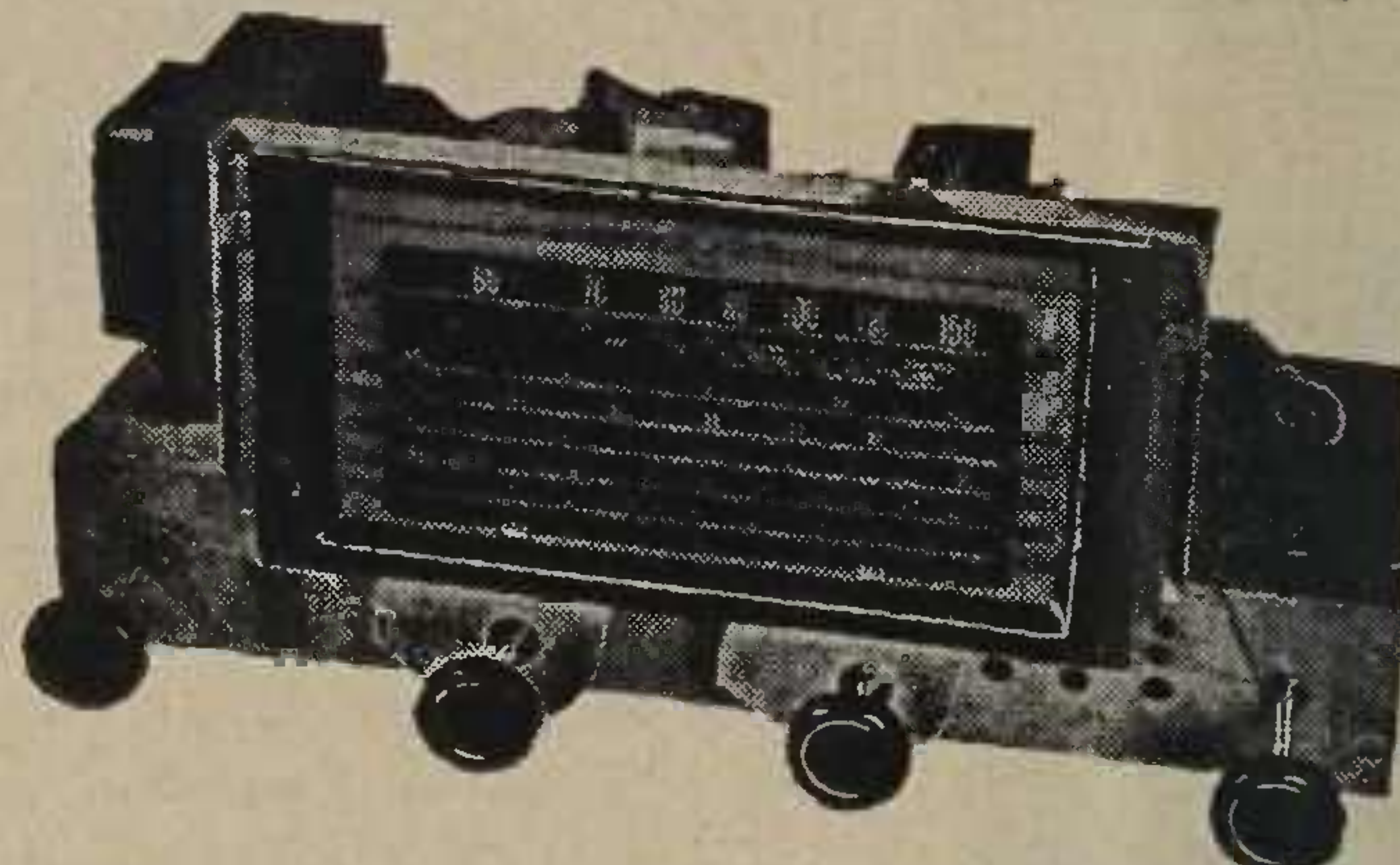
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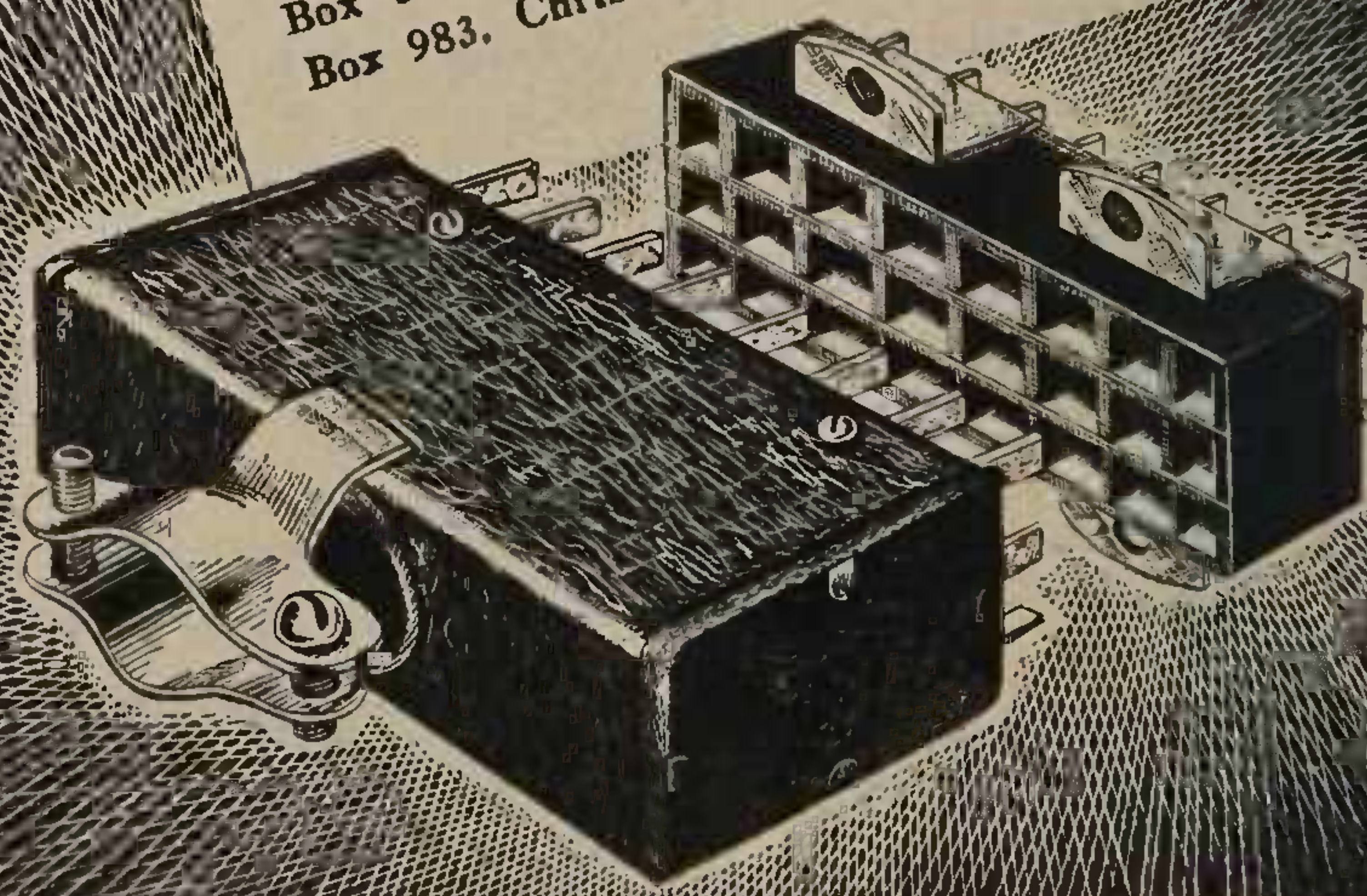
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INSTRUMENTS

A DYNAMIC TRANSISTOR TESTER

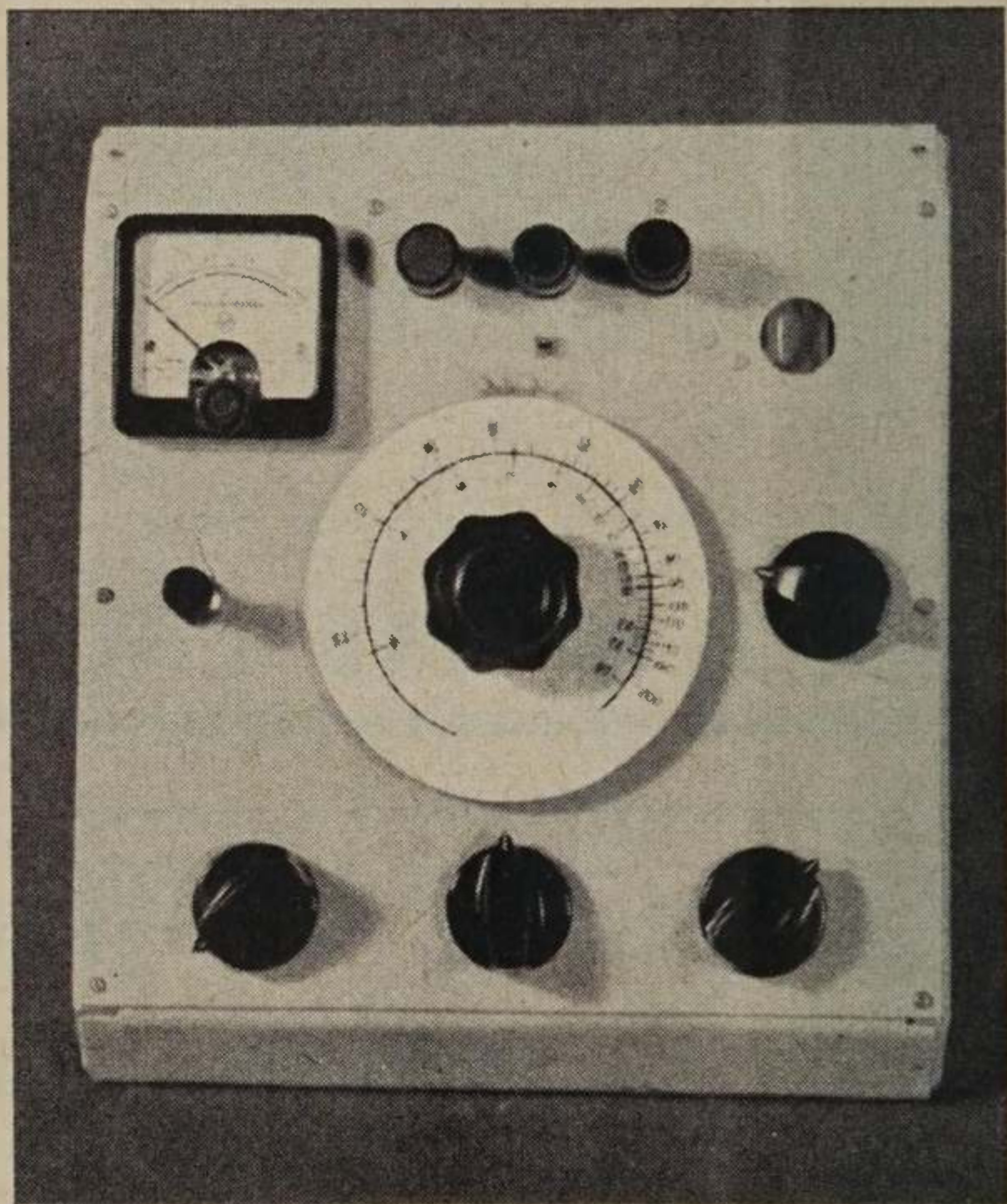
So much domestic equipment containing transistors has come on the market in the last twelve months, that radio service workshops now have a real need for a device which will test transistors satisfactorily. There have been available in small quantities, Japanese testers which are inexpensive, and very good, up to a point. The instrument to be described in this article, however, is rather better than these, since it has been designed to measure the actual current amplification of the transistor in addition to providing a measurement of leakage current.

Introduction

By now, many radio servicemen will have come up against the somewhat new problems associated with the repair of transistor devices. Transistor amplifiers and radio receivers are quite commonplace now, and in spite of their excellent serviceability, they can and do go wrong. Servicing them will clearly pose several problems up against which few of us have come, as yet, and a major one is the question of whether a particular transistor is in good condition or not. Endless time can be wasted if one assumes wrongly that the transistors in a set are not at fault, when all the time, one of them is not working properly, or even at all. The problem is only made more difficult by the fact that many manufacturers do not employ sockets for their transistors, but solder them directly in place by their leads. This at once discourages the serviceman from taking them out and performing a substitution test, which, though not a very scientific method, is frequently used as a quick check in valve-operated gear that the trouble is not due to a defunct valve. Also, if one does suspect a transistor, and removes it from the circuit, it is far better to be able to carry out at least simple tests on it, rather than simply to substitute a good one in the circuit.

If it is agreed that a transistor tester is a desirable piece of equipment, then it is essential to decide just what aspect of a transistor's performance it must be designed to test. As with valve testers, it is possible to have two basic kinds—static, and dynamic. The former measures, or even merely indicates on a relative basis, the transistor's closeness to or departure from the *direct current* performance of one having the nominal characteristics of its type. Such a tester might, for example, measure the D.C. collector current under a specified set of conditions, so that the value obtained can be compared with the value for a "bogey" transistor of the same type. Such a test certainly tells us something about the transistor, but not much. It is equivalent to testing a valve merely by measuring its plate current under fixed conditions of plate and grid voltage.

The better class of valve tester does a good deal more than this. They measure the mutual conductance,



The completed instrument. It is built with a sloping panel to facilitate operation when on the bench. Working drawings and interior photographs are shown later in the article.

either numerically, or on a "go-no go" basis. This is a far better test of a valve's capabilities, because it is a measure of the actual amplification of which it is capable. And if the measurement is made with an actual signal the conditions of the test are really quite close to those under which the valve has to work in real life. Such a test is called a dynamic test, because it is made under dynamic, or working conditions.

The Same for Transistors

Exactly the same considerations apply to the testing of transistors. A dynamic test, measuring the actual amplification of the transistor is worth many times the value of a static test, which after all need not

necessarily tell us whether the transistor is able to amplify at all.

Some readers may already have decided that to do a test of the kind mentioned will be too difficult and complicated, but such is not the case at all. Admittedly, making a "home-brew" valve tester is quite a contract, but this is mostly because of the need to provide a multitude of socket types, and an imposing array of switches, in order that any valve may be tested. In this respect, transistors are a good deal easier to cope with. Only triode types are available at present (it seems that multi-electrode transistors are still in the future as far as ordinary equipment is concerned) so that it is only necessary to provide three terminals, to which the transistor's leads can be connected. Thus, it can be seen that whatever the actual testing arrangements used, the builder will be faced only with a relatively simple circuit, devoid of most of the complication that besets the valve tester.

What to Test for

What, then is the best thing to use, and measure, as a yardstick of a transistor's performance? Since a transistor is fundamentally a current amplifying device, the best answer is obviously to test the actual current amplification of the specimen. If this is done with the transistor actually amplifying an A.C. signal, then we will have a dynamic test, of the kind we want. The question then arises, "What frequency should be used for the test signal?" It is easiest, of course, to use a low audio frequency, but will this be satisfactory for testing transistors that are supposed to work at a reasonably high radio frequency? Undoubtedly, R.F. transistors would be better tested at R.F., for obvious reasons, but to do so would require an instrument rather in the research laboratory class, and so we will have to put up with an A.F. test for all transistors. After all, testing at A.F. will show whether an R.F. transistor is capable of amplifying at any frequency, which is the most important thing to know about it, because if it will not amplify at 1,000, or at 50 cycles per second, it will clearly be little use in the broadcast band. Comparative tests of R.F. transistors at 50 cycles may not mean very much as far as their R.F. performance is concerned, but they can still yield useful information, particularly when correlated with one's own experience.

Then again, because most transistors are used in the grounded-emitter connection, it will be best to connect them this way for testing. Fortunately, this also makes the test much easier to design and carry out, for in grounded emitter, the current amplification factor is able to have any value from about 5 to about 200. Transistors connected in grounded-base would have amplification factors ranging from 0.8 to 0.995, and devising a suitable method of measurement would be rather difficult; interpretation of the results would be difficult, too, so that the measurement of the grounded-emitter current amplification factor,

or a' , as it is often written, has been chosen for this instrument.

In addition to a' (which is always quoted in the transistor data sheets, making a comparison with measured figures easy) it is useful also to be able to measure the leakage current of the transistor.

Leakage Current

One way in which transistors are the direct opposites of valves is that the latter have to be biased *back*, while transistors have to be biased *forwards*. That is to say, a valve with zero bias, as everyone knows, draws the maximum current of which it is capable, but a transistor with zero bias draws, in theory, zero current. In practice, there is always a certain minimum collector current, even when no forward bias is applied to the base, and this is what is called the leakage current. Some transistors are quite normal in all respects, and will amplify strongly, but differ from others of their own type in that their leakage current is much higher than normal. For some purposes, this may not matter at all, but in other circuits, high leakage current may well prevent the device from working properly. This is why a leakage current test is desirable. Fortunately, it is a very simple test to arrange for, and adds nothing to the expense or complexity of the tester.

Matching of Transistors

A majority of transistor audio amplifiers use Class B circuits, which depend largely for their success on the matching of the characteristics of the pair used in the Class B stage. This is of course why power transistors such as the OC72 and OC16 can be obtained from the makers in matched pairs. In working with transistor amplifiers, therefore, some means is essential of checking whether the transistors in a Class B pair are in fact matched. The tester described here has provision for carrying out this test, and once more the facility to do so is inherent in the circuit arrangement, and needs no specially provided circuitry.

How it is Done

In the published data on transistors, there is always to be found a line which quotes the current gain a' , for a given collector voltage or current. In addition, it is usually stated that the figure given refers to an arrangement in which the collector circuit is short-circuited for alternating signals. In other words, in addition to carrying out the test under the stated conditions of collector voltage and/or current, there should be no load impedance in series with the collector circuit. The reason for specifying this somewhat unrealistic condition is that the current amplification of the transistor actually depends on the collector load, so that the only way to make the test independent of the external circuit is to specify no-load conditions for the test. This has the unfortunate effect of making

the test procedure more difficult to devise, but the design of the tester has taken this into account.

In finding the current amplification, therefore, we can proceed, in theory at least, by applying a known input current to the transistor circuit, and measuring the output current. The required answer would then be the ratio of these two currents. Unfortunately, such a procedure would be exceedingly difficult to do directly, because the current in the collector circuit would be exceedingly small, and would require a very sensitive A.C. meter, which would be likely to have quite a high resistance, and thus destroy the condition that there must be no impedance in the collector circuit during the test.

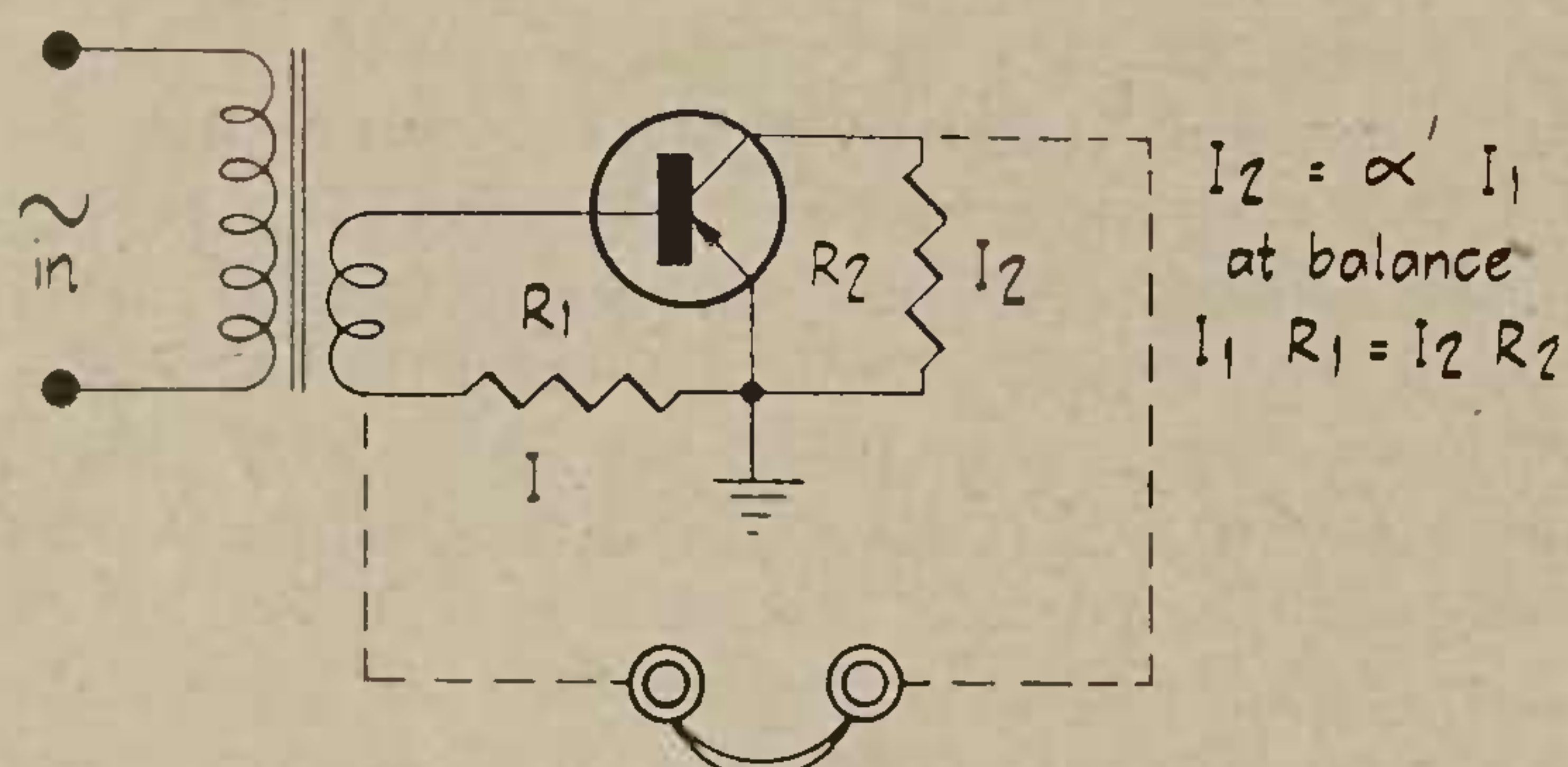


FIG. 1

In point of fact, it is impossible to carry out the test without connecting some impedance in the collector circuit, so that all we can do is to see that this is as small as we can possibly make it. In the present case, the collector load resistance is quite low, varying between 10 and 110 ohms. These figures are low enough to have a negligible effect on the accuracy of the measurement.

In Fig. 1 we have drawn a simplified diagram of a transistor in grounded-emitter connection. The battery supplies have been left out in order to simplify the circuit, and because it is the A.C. circuit that is of importance. We see that a signal, at any convenient frequency, is applied between base and emitter from the secondary of a transformer, in series with which is a resistor. In the collector circuit there is also a resistor, R_2 , and we will assume that its value is low enough not to affect the measurement. Now we can regard the input current as flowing through the base-emitter junction, the resistor, and the transformer secondary, and we can call this current I_1 . There will thus be a potential drop across the resistor equal to $I_1 R_1$.

Now, if the current amplification factor of the transistor is a' , there will be an amplified current in the collector circuit, of $a' I_1$, and there will be a voltage across the collector resistor R_2 , equal to $a' I_1 R_2$. Also, because the output current is out of phase with the input current, the voltages across R_1 and R_2 will be out of phase. Then, if we place a pair of headphones across R_1 and R_2 , as indicated, it is possible to adjust either R_1 or R_2 until the two voltages are not only out of phase, but also equal in magnitude. Under

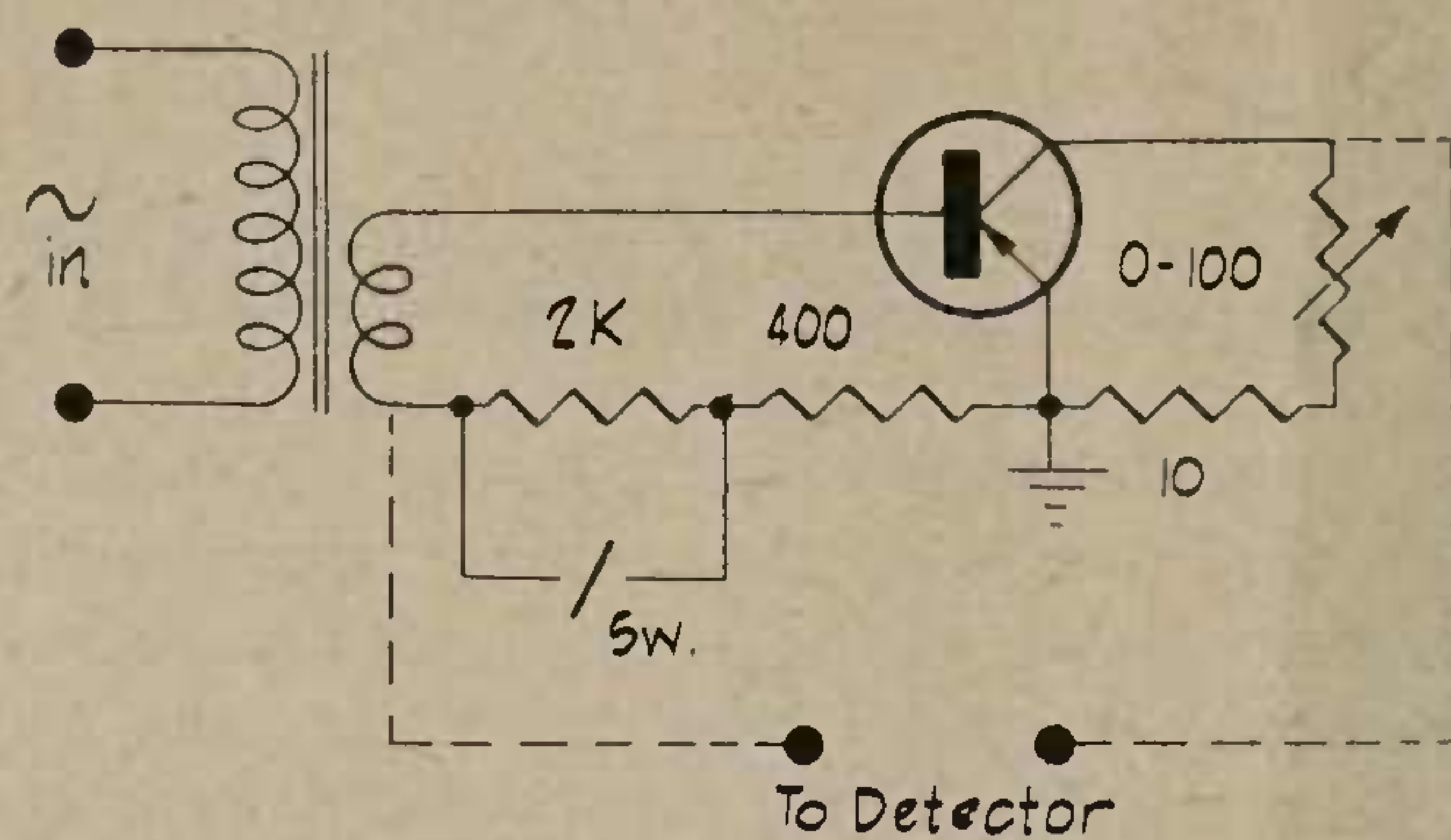


FIG. 2

these conditions, there will be no output in the headphones. Also, since the two voltages are equal, we can write:

$$I_1 R_1 = a' I_1 R_2$$

from which, by re-arranging, we get

$$a' = \frac{R_1}{R_2}$$

This, then, is the basis of the instrument. In practice, R_1 is made fixed, and R_2 is made variable. It is possible, then to calibrate R_2 directly in readings of a' . It is equally easy to switch in a different value of R_1 , thus providing ourselves with a different measuring range. For example, in the completed instrument, the arrangement is as in Fig. 2. This still gives only the A.C. circuit, but shows exactly how the two measuring ranges come about, and what their extreme readings must be. R_1 consists of two resistors, of 2,000 and 400 ohms in series. For the low-reading range, the former is short-circuited, leaving only the 400 ohms in circuit. R_2 consists of 10 ohms, fixed, in series with a 100 ohm variable resistor.

Now, applying the above formula, it is obvious that on the low range, measurements may be made of values between $400/110 = 3.63$ and $400/10 = 40$. On the high-reading range, R_1 is multiplied by six, so that these figures also will be multiplied by six, and the measuring range will be from 21.8 to 240. This arrangement gives a generous overlap in the region from 21.8 to 40, and this has been provided because of the rather awkward nature of the scale.

At this point we might answer in advance a fairly obvious question that will probably occur to readers. It is this. Since $a' = R_1/R_2$, why do we not fix R_2 and make R_1 variable instead. If this were done, we would get a linear scale, and calibration would be rather easier.

The reason for not doing it this way is not immediately obvious. It is because varying R_1 in this way would vary the input current as the control was moved, and this would make a balance very difficult to achieve. In addition, although the reciprocal scale of the actual instrument is in some ways a nuisance, it does have the advantage of giving a good open

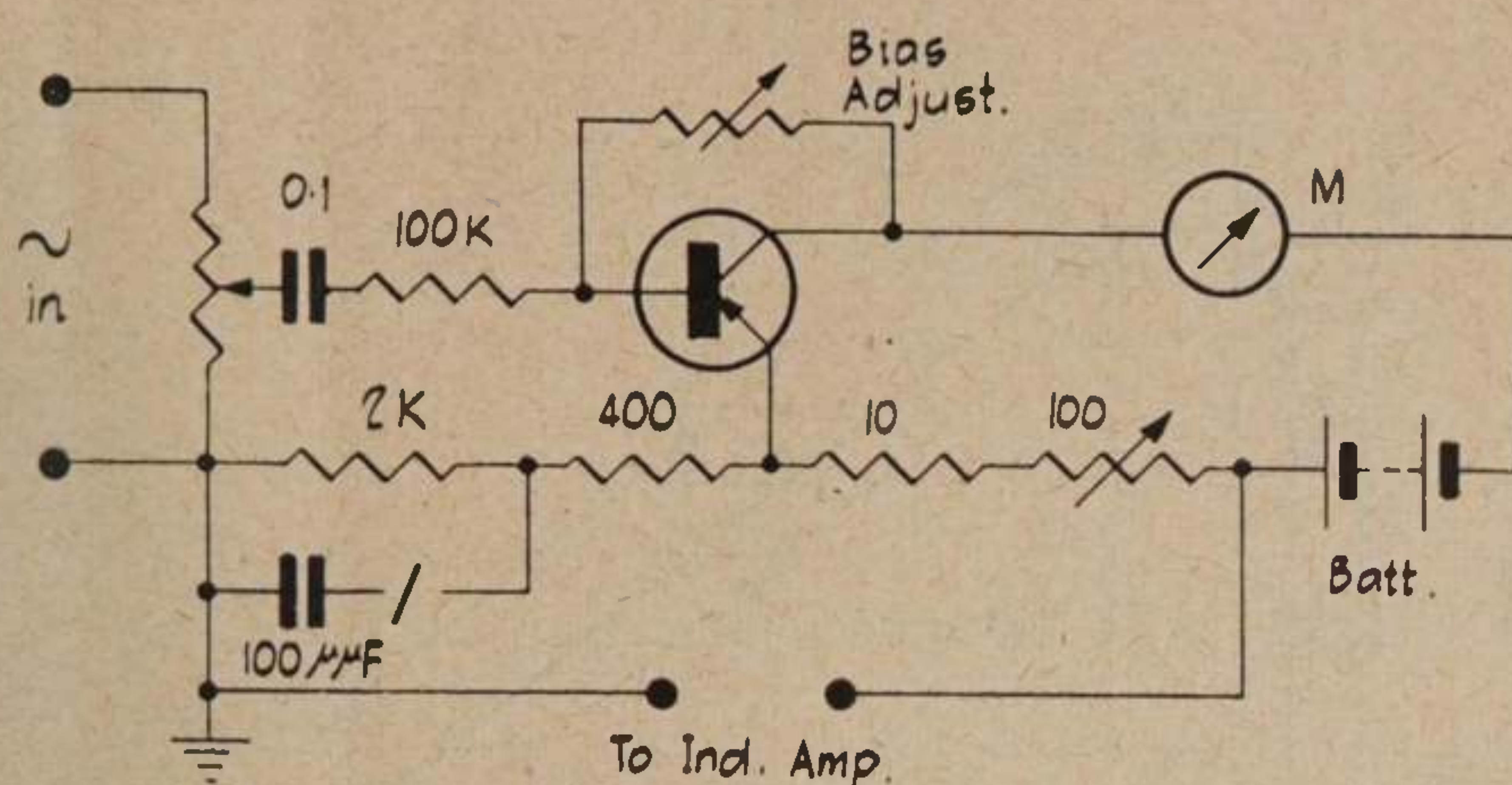


FIG. 3

scale in one portion of the variable resistor's travel, so that by carefully choosing the ranges, this can be made to co-incide with the most-used values. Also, this kind of scale enables values up to 240 to be readily seen and read, with only two ranges. To get the same case of reading from linear scales would require many more than two of them, and would thus add to the complication.

Practical Arrangement

Figs 1 and 2 do not give much idea of how a practical test circuit can be arranged embodying the principle just described, and so we have drawn Fig. 3, which is a simplified version of the actual instrument. It is very similar to Fig. 2, with the addition of the battery which operates the transistor, and with a few other changes which are made purely for practical reasons, and do not affect the principle of operation at all. Forward bias is provided by means of a variable resistor from the negative battery terminal to the base of the transistor, and a meter is included in the collector circuit so that the operating collector current can be adjusted to the required value.

The input has been provided with an adjustable control so that the transistor can be operated below the overload point, and a 0.1μfd. condenser isolates the base from the input transformer and the control potentiometer. The 100k resistor in the base circuit limits the input current so that the potentiometer can give a suitable type of control, and also swamps out the effect of the change in the resistance of the base circuit when the range switch is operated.

To change ranges, the 2k. resistor is shorted out not directly, but through a 100μfd. condenser. This is done so that shorting the resistor to signal current does not affect the D.C. conditions, and thus has no effect on the D.C. collector current. It is then unnecessary to re-adjust the latter when the range switch is operated.

Another difference between Figs 2 and 3 is that in the practical arrangement, the earth point for the circuit has been altered from the emitter end of the resistors in the base-emitter circuit, to the other end. This has been done to enable the balance indicator to have one side earthed, as in Fig. 3. Otherwise, it

would have been necessary to use an input transformer, with a floating primary, to feed the indicator amplifier. At first sight it may appear that shifting the earth point has altered the basic arrangement so that the transistor no longer operates in the grounded-emitter connection, but such is not the case at all. The circuit operates in exactly the same manner as before.

Another point about the practical arrangement is that the battery and meter have been placed on the collector side of the measuring resistor. This is done because otherwise, the resistance of the meter, and any internal resistance the battery might have would be included in the measuring resistance, and would result in a variable measuring error as the battery ages.

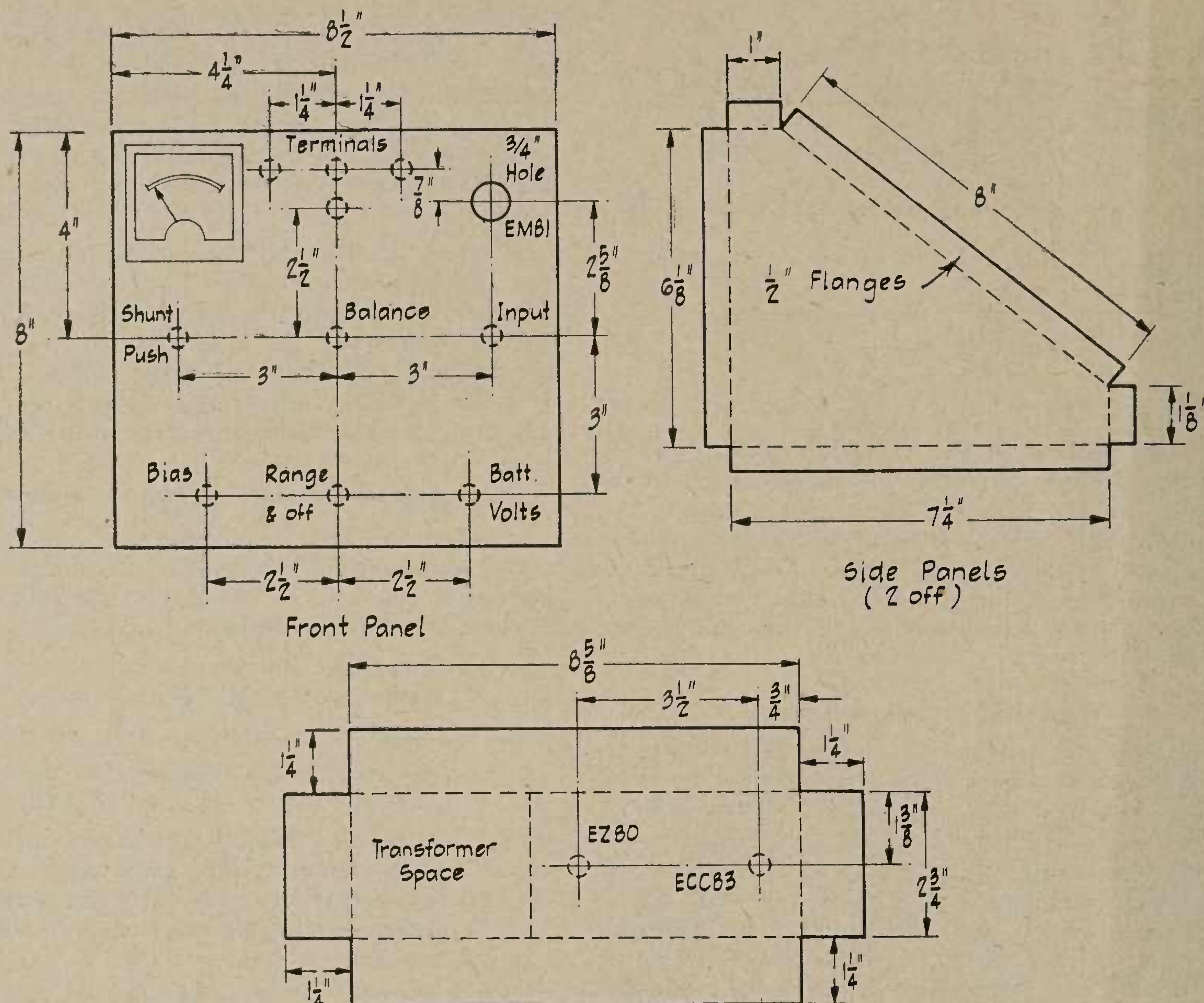
Actual Circuit of the Instrument

It is but a short step from the circuit of Fig. 3 to the actual circuit used in the completed instrument. The latter contains, as well as the measuring arrangement of Fig. 3, the following additional gear.

- (1) A two-stage indicator amplifier, and an EM81 magic eye as the balance indicator.
- (2) A small mains power supply for the above.
- (3) A selector switch enabling the transistor to be worked from a selection of battery voltages.
- (4) A normally-closed push-button switch, and a meter shunt, giving two ranges on the collector current meter, with the sensitive range automatically disconnected until the button is pressed.
- (5) A switch, S_4 , in series with the bias adjusting resistor, so that the forward bias can be removed altogether.
- (6) An "off" position on the range selector switch, S_1 , so that the battery voltage can be removed while a transistor is being connected into the test circuit.
- (7) A switch on the transistor signal input potentiometer, to switch the A.C. to the power supply.
- (8) Three large terminals for connection of the transistor under test, and, if desired, a transistor socket wired in parallel with these.

The Full Circuit Diagram

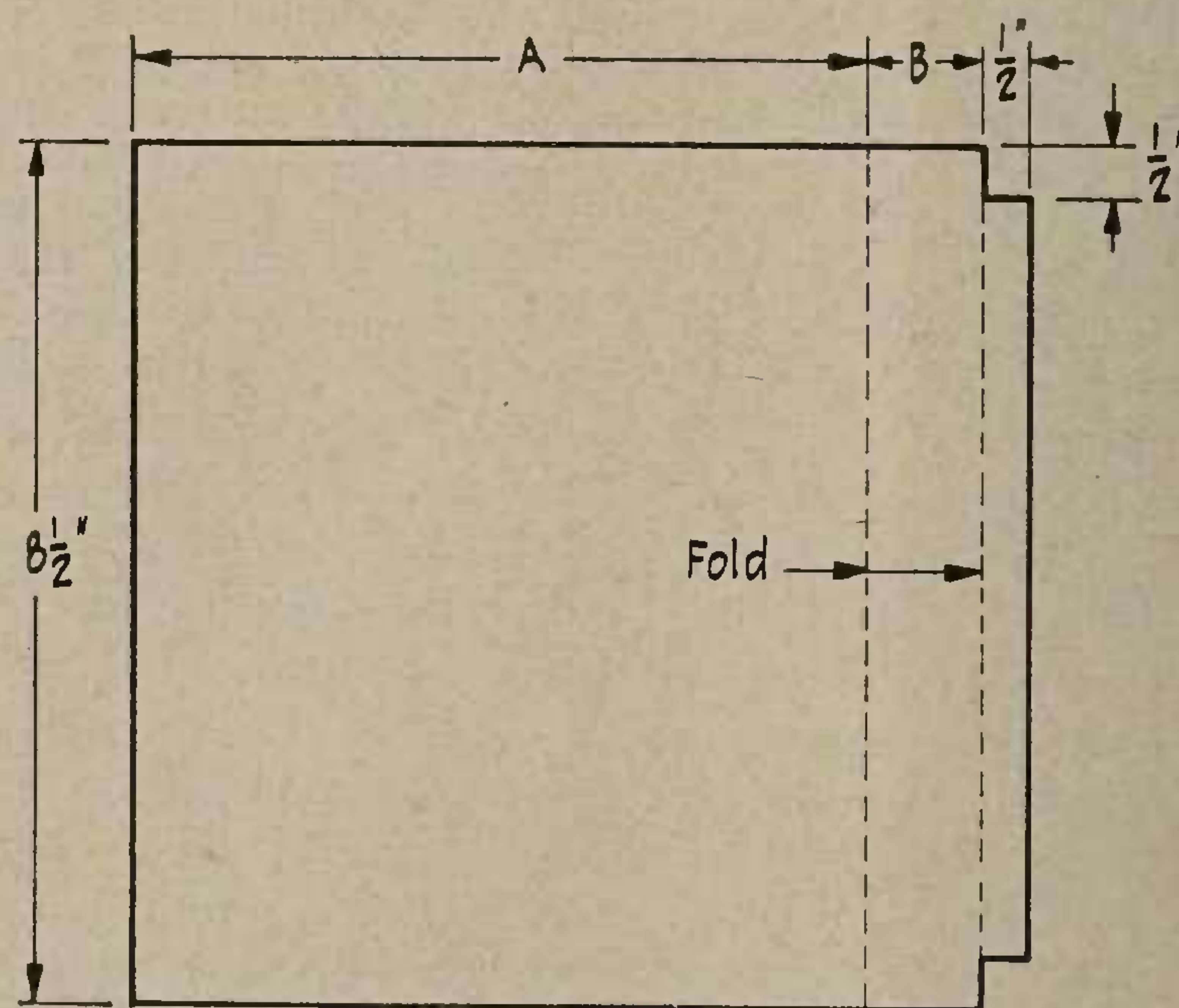
The only portions of the complete circuit that have not been shown on Fig. 3 have been detailed above, and can readily be recognized when referring to the main diagram. The power supply is made from a small Beacon instrument transformer with a 220-volt secondary, a single 6.3-volt heater winding, and no centre-tap on the former. An EZ80 is used as a half-wave rectifier, as this tube has enough heater-cathode insulation to enable us to feed its heater from the same earthed heater winding that supplies the remainder of the valves in the circuit. Incidentally, before we go any further, it should be pointed out that a slight error has



been made in the circuit diagram. The end of the 220-volt secondary which is shown earthed, should join on to one side of the heater winding, and not jump over it, as the diagram shows. The heater winding is used as the source of signal for the measuring circuit, and so must have one side earthed, quite apart from the question of hum in the high-gain indicator amplifier.

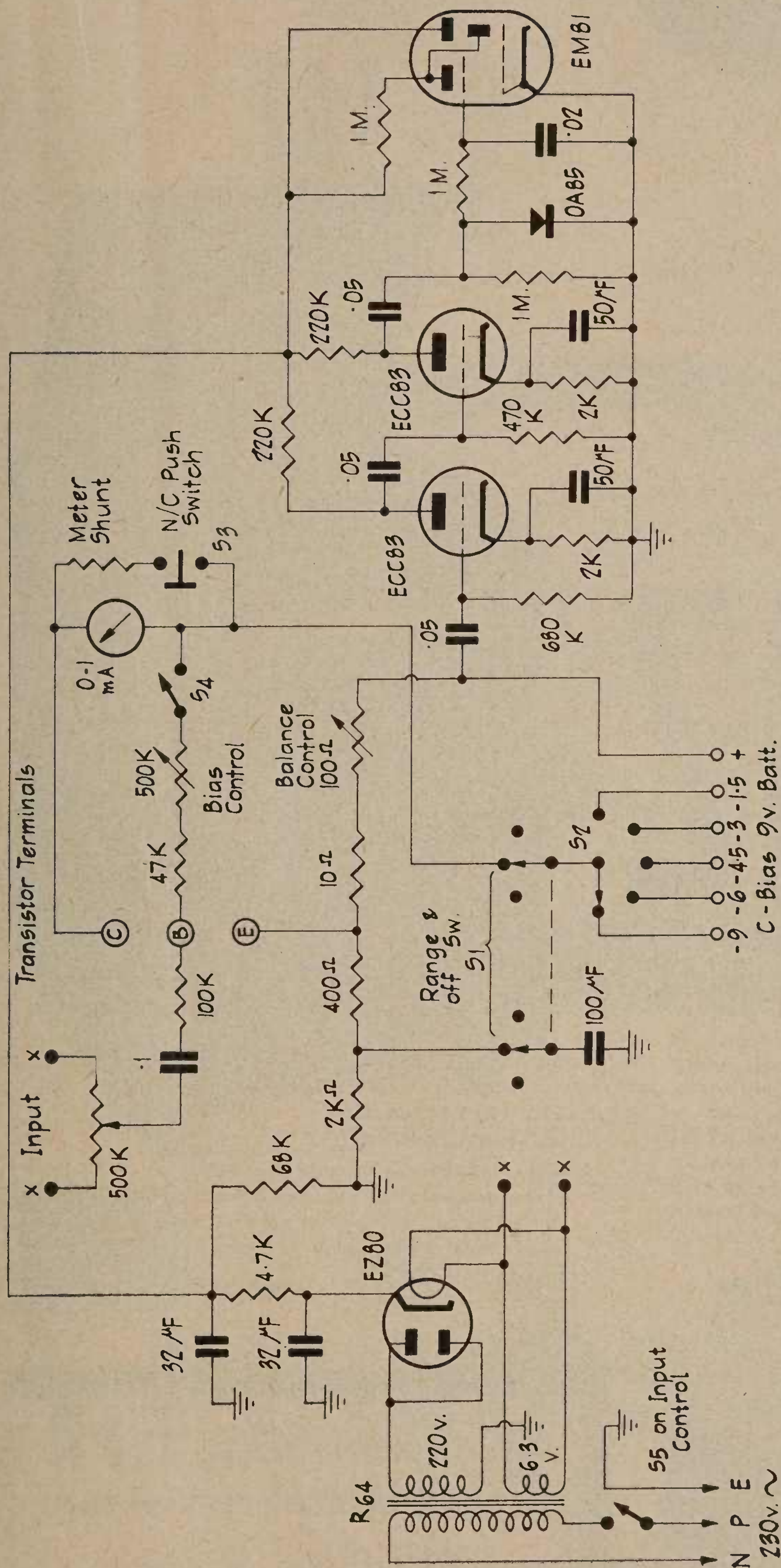
The circuit of the latter requires little comment as it is a conventional two-stage resistance-capacity coupled amplifier, feeding an OA85 crystal diode rectifier. The output of the latter is smoothed by the filter comprising a 1 Meg. resistor and a $0.02\mu\text{fd.}$ condenser, the purpose of which is to remove most of the 50-cycle signal from the rectifier output and so give an almost pure D.C. control signal to the control grid of the EM81 magic eye indicator. In this way, it is ensured that the eye shadow is sharp at all times, and this makes the null point easier to find than when the fuzzy-edged shadow is used that one gets when the A.C. output of the amplifier is applied directly to the magic eye without rectification or smoothing.

No specification has been given for the meter shunt, because its resistance will in any case depend on the meter used. The movement used in the prototype was a 0-1ma., and this should be adhered to in any that are



For Bottom Panel $A = 7\frac{1}{4}"$, $B = 1\frac{1}{8}"$
 For Back Panel $A = 6\frac{1}{8}"$, $B = 1"$

Working drawings for the metal-work. Layout is not important, however, and the builder may use any other convenient form provided that the bridge circuit is on the panel, and the chassis, with the amplifier and power supply, is separately constructed.



built. The shunt was arranged to give a full-scale deflection of 10ma., so that the meter is protected by the normally-closed push-button when the battery supply to the transistor is switched on. This precaution is needed because a defective transistor might pass a high current, even when no forward bias is applied.

The switch S_1 is a two-bank, three position one, and its function has already been described. The right-hand bank should have one of the contacts shown as unconnected, paralleled with the centre one. As drawn, the transistor would have no supply voltage on the high measuring range. It is shown in the low range, with the 2k. resistor shorted by the 100μfd. condenser.

S_2 selects the desired battery supply voltage for the transistor.

S_3 is the normally closed push-button switch for the meter shunt.

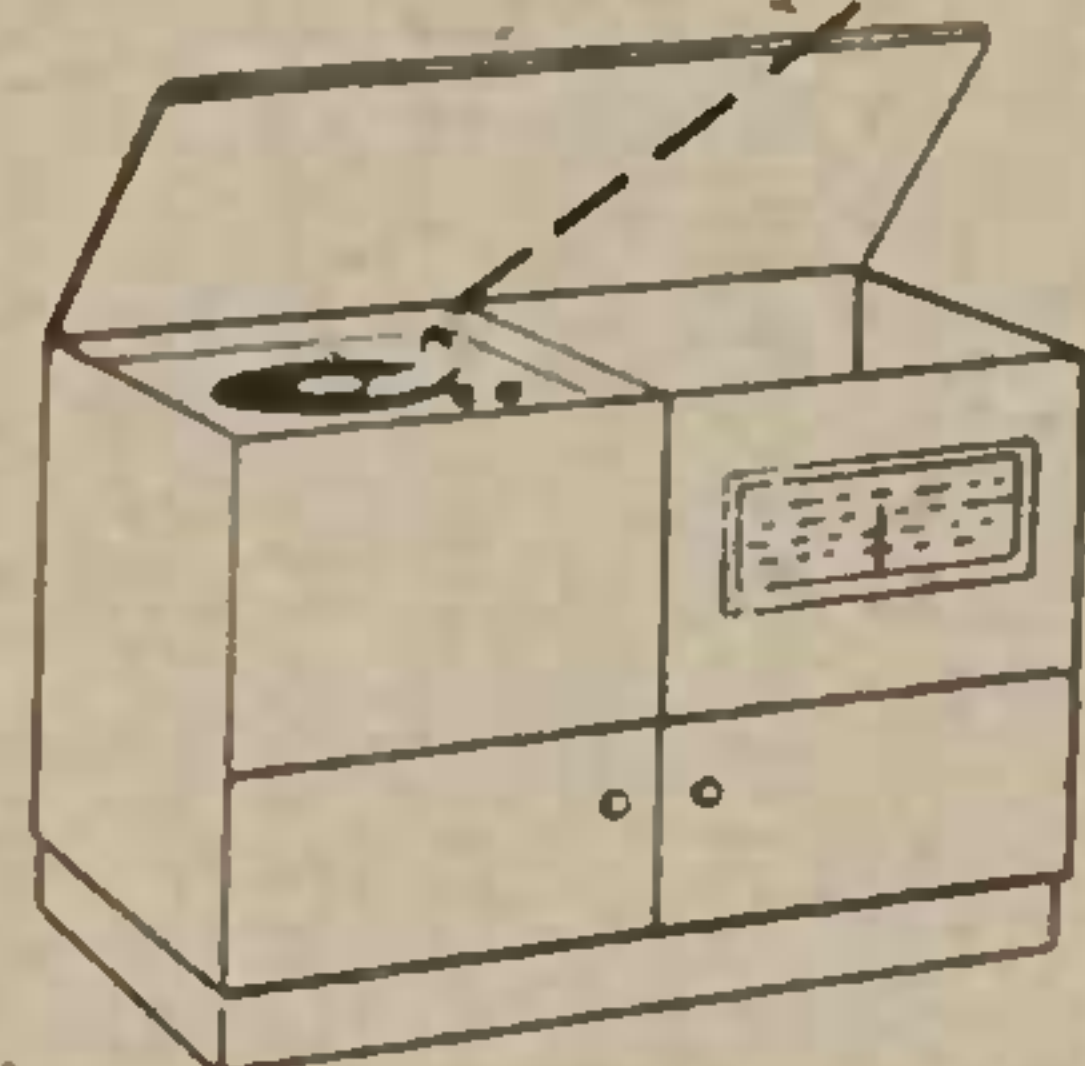
S_4 is on the 500k. bias control potentiometer, and opens the bias circuit so that the leakage current can be read.

S_5 is on the 500k. signal input control, and switches off the A.C. to the power supply.

Construction of the Instrument

Full working drawings are given for the construction of the tester. It has been built with a sloping panel in order to make operation on the bench easier. The panel holds all potentiometers and switches, and in fact has the whole circuit wired on it, except for the power supply and the indicator amplifier. These are on a small chassis which is arranged to fit neatly between the sides of the case, and to act as a spacer.

(Continued on page 22.)



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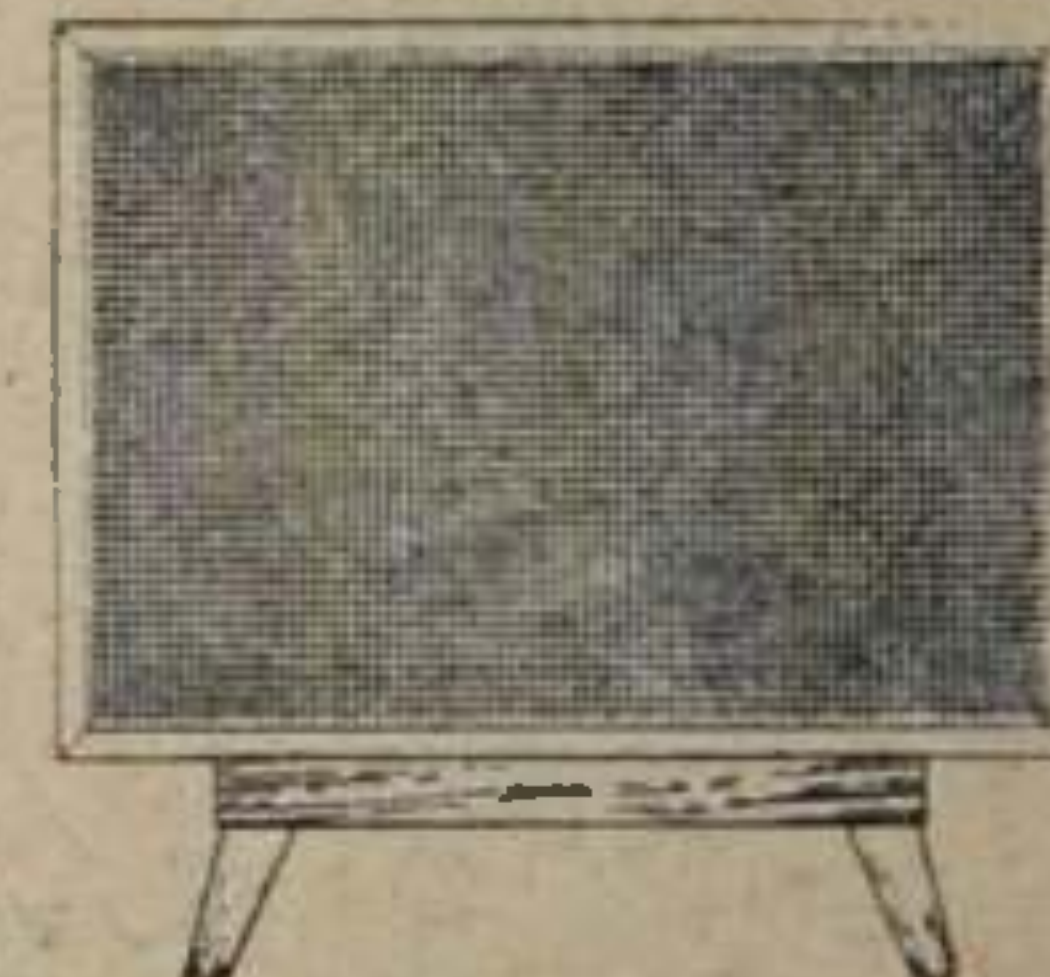
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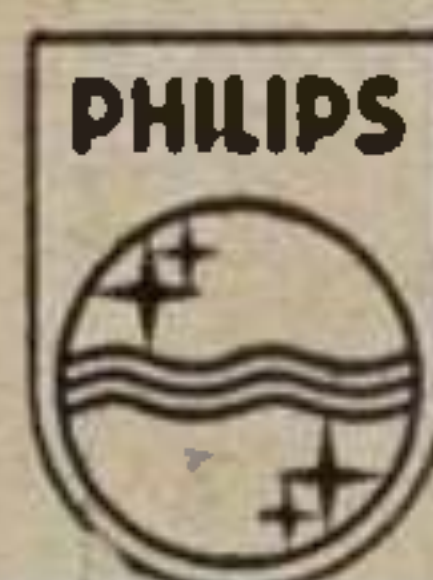
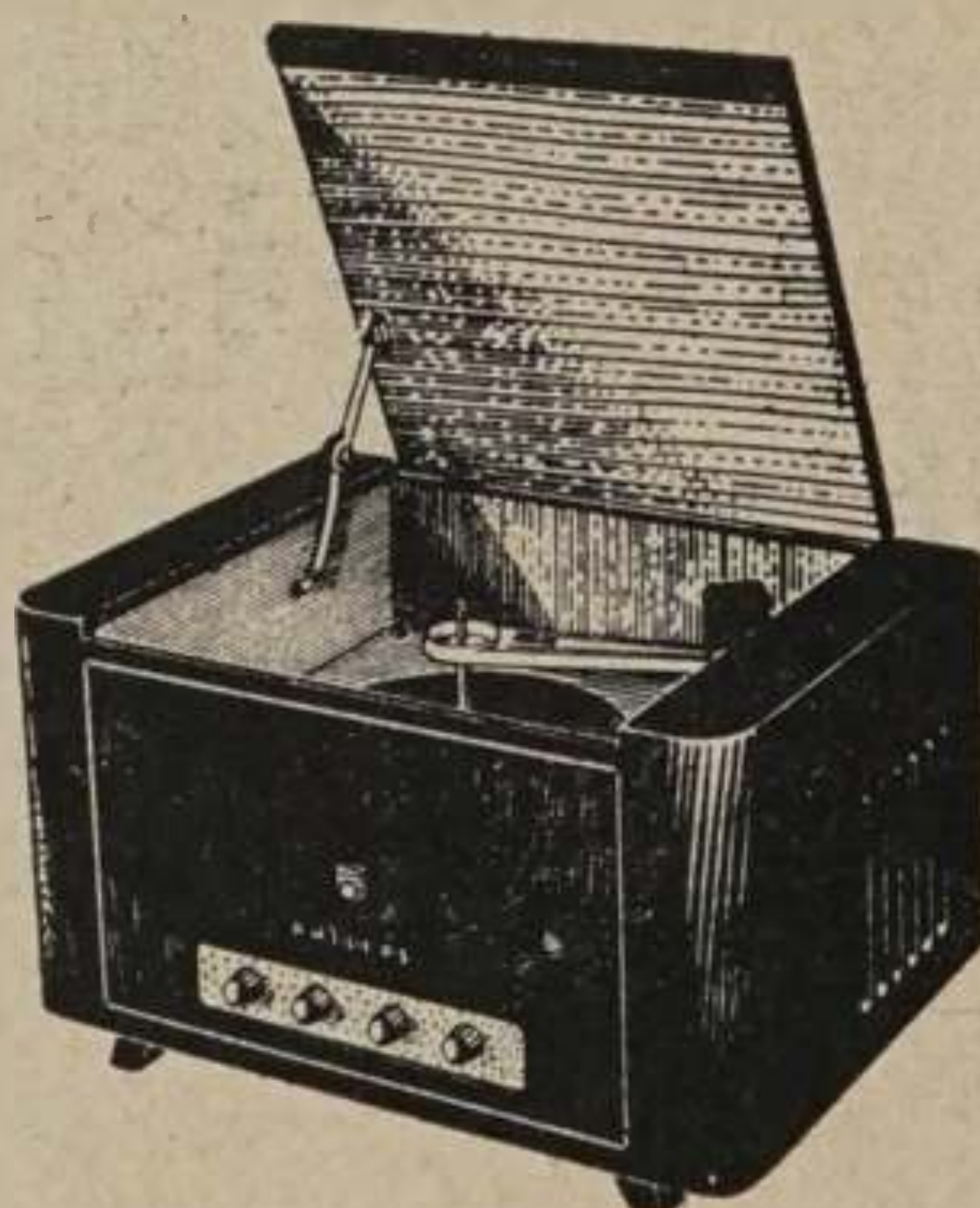
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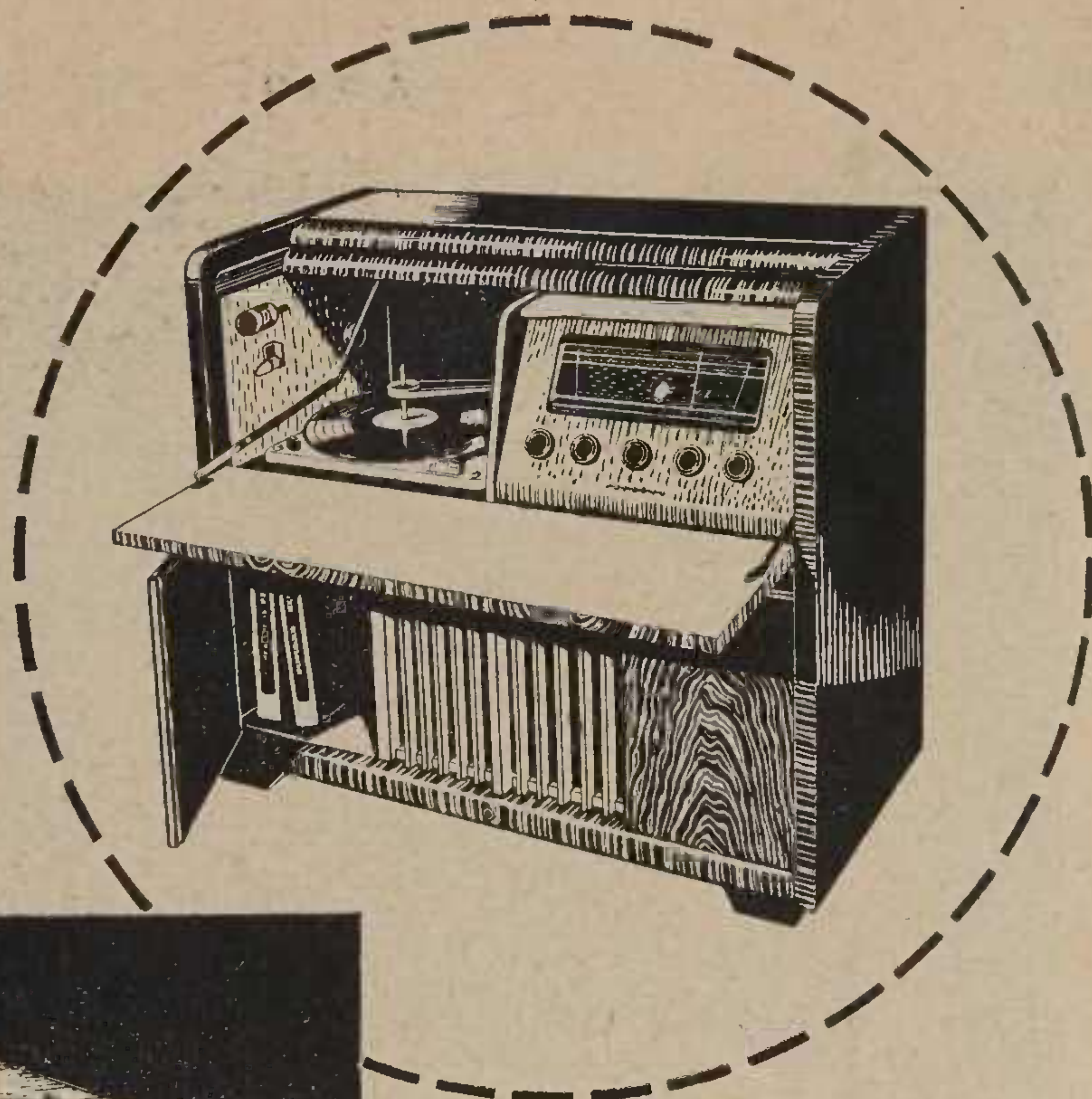
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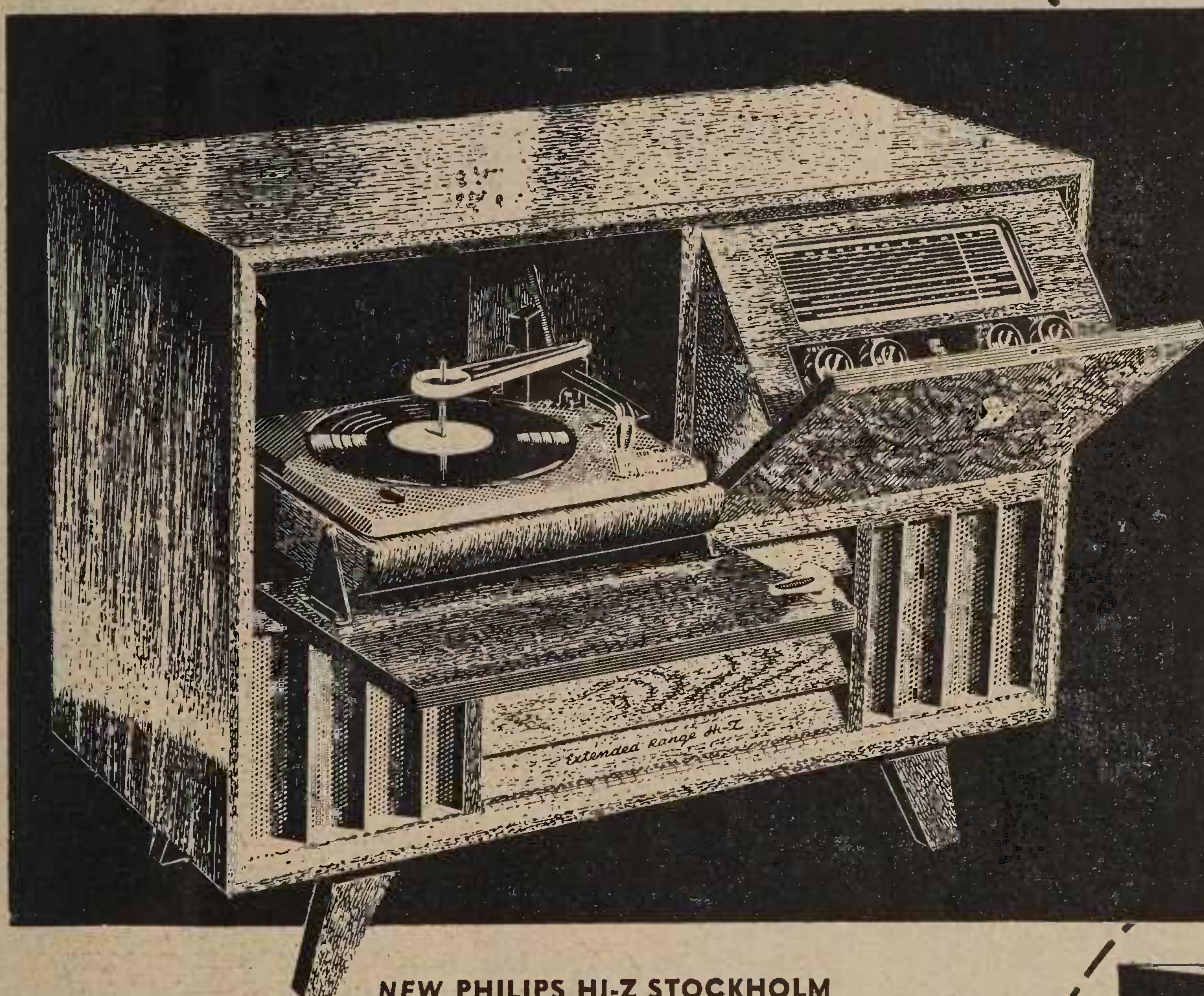
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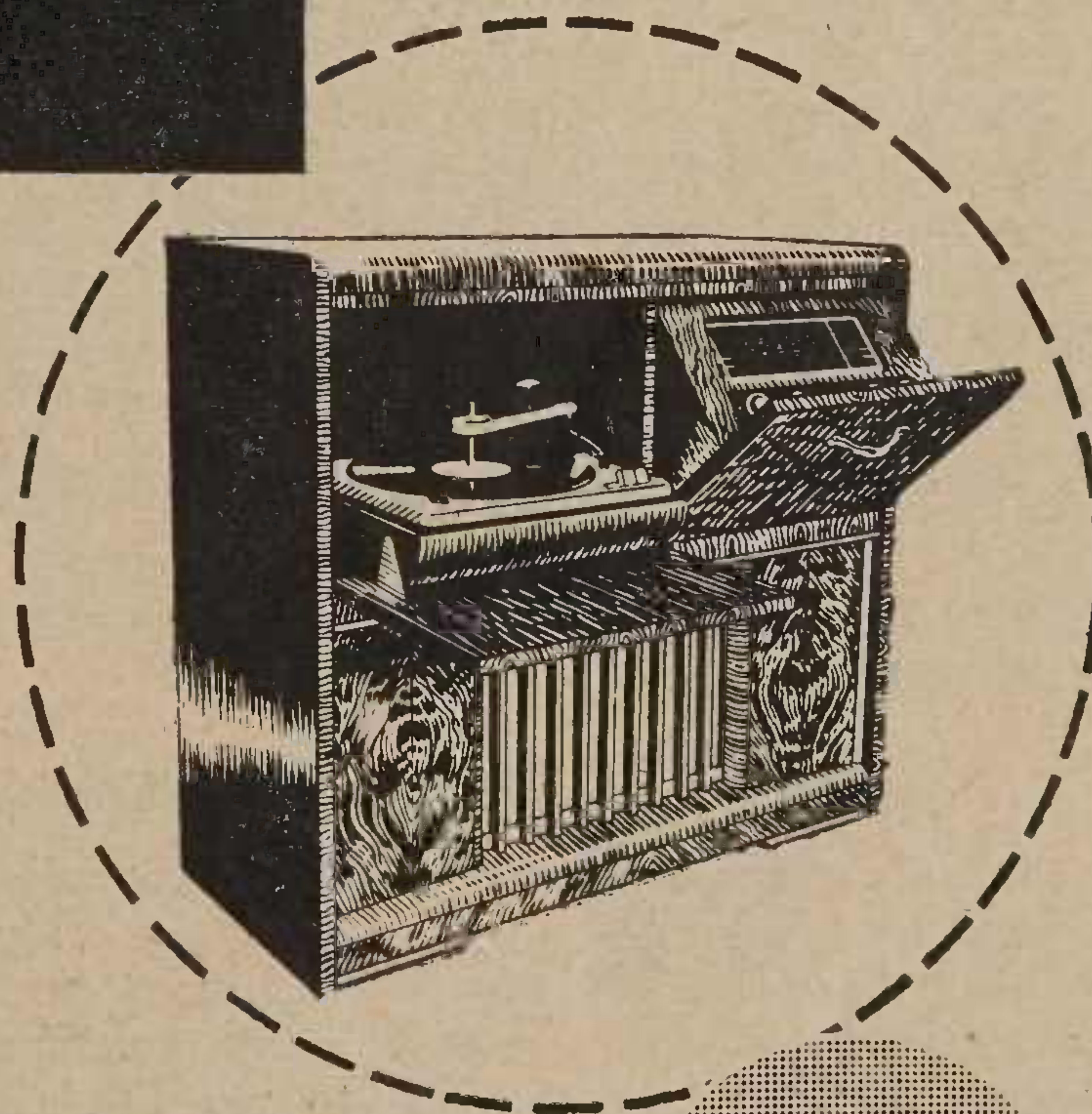
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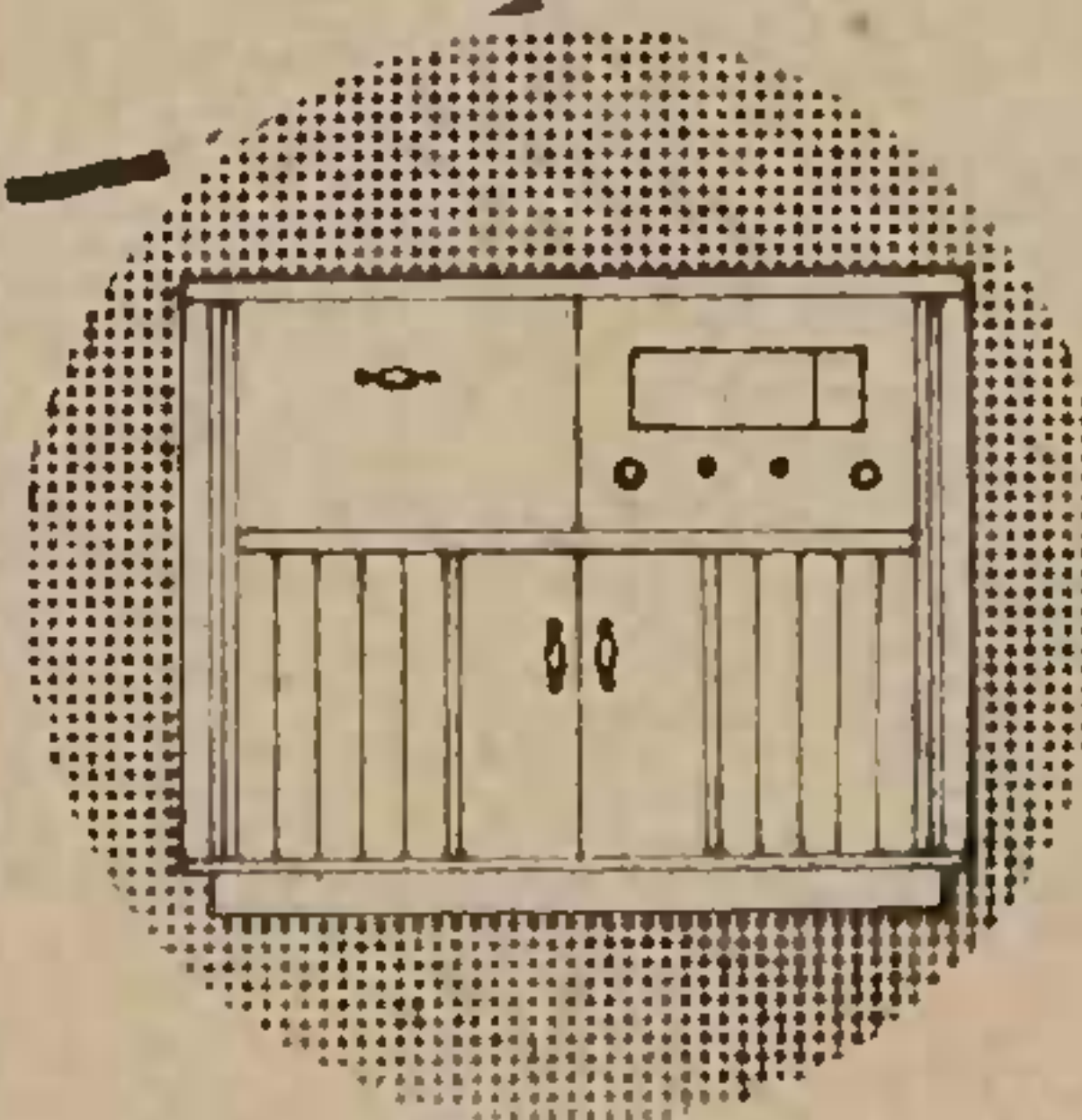


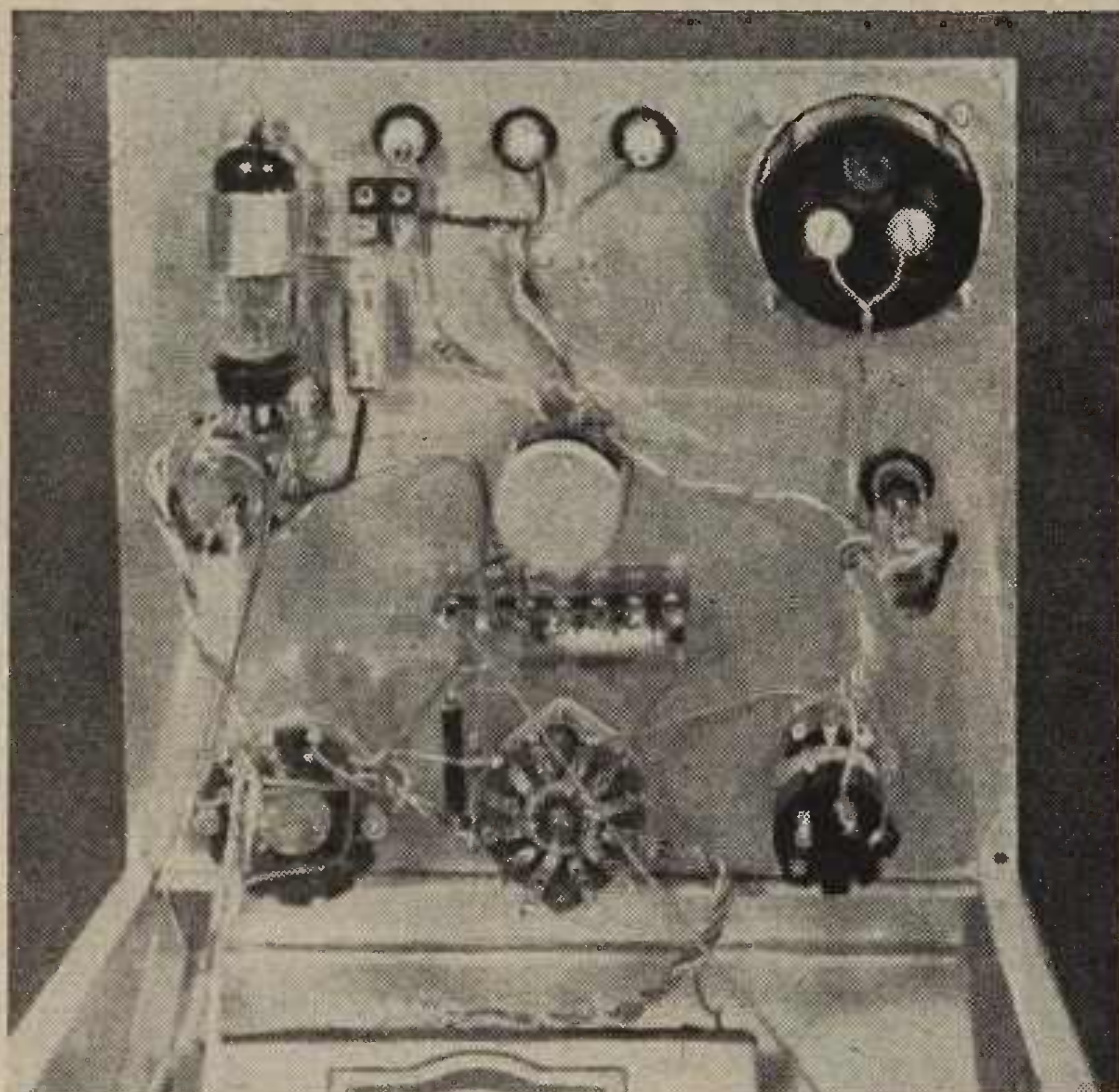
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In this view, we are looking down on the instrument from above, and the front panel has been tilted forward to show the bridge circuit, built on it.

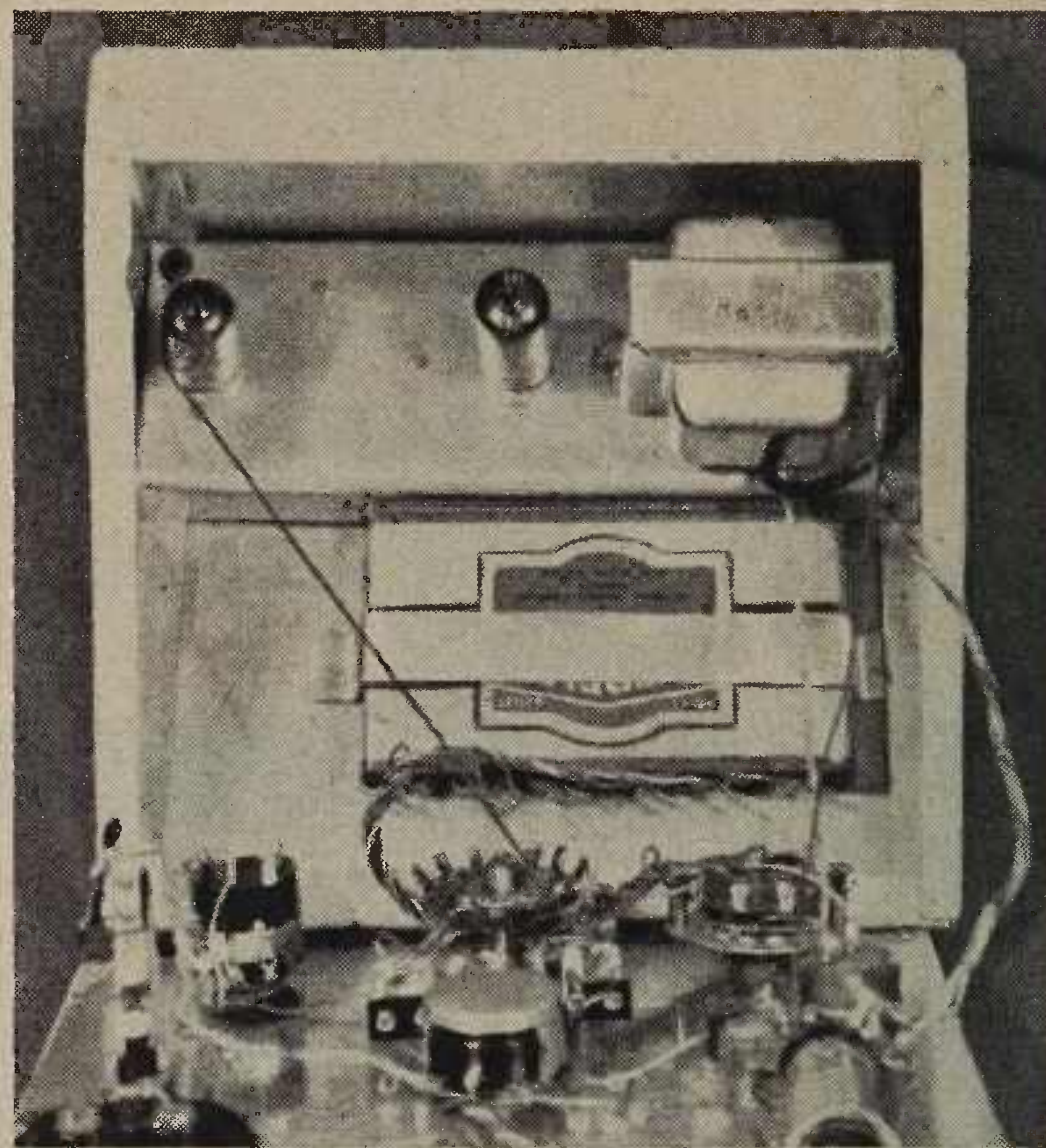
holding them the correct distance apart at their lower rear corners.

The magic eye tube is mounted behind a hole in the panel by making a small right-angle bracket which supports the socket as close to the panel as possible.

The arrangement of controls on the panel is as follows. The left-hand knob in the bottom row is the bias control, with S_4 on it; the bottom centre one is the range switch, S_1 ; the right-hand bottom is the battery selector switch, S_2 ; the one to the right of the main dial is the input control with S_5 ; the meter push-button is directly under the meter, and the main dial is, of course, the 100-ohm balance control. The three Belling-Lee terminals at the top are the transistor terminals, with the collector at the left, base in the middle, the emitter at the right. Also, there is a minute three-pin transistor socket directly under the base terminal, with its connections wired in parallel with the terminals. The collector terminal has a red top to indicate that it is the collector one, since most transistors have a red spot next to the collector lead. The eye can be seen at the right-hand top corner of the panel.

Special Components and Calibration

The only components that need to be specially chosen for accuracy are those in the measuring bridge; that is to say the 400, 2,000, and 10 ohm resistors. If these are accurately chosen as one per cent. tolerance components, it should be possible to use the same dial calibration as was made for the original instrument. Of course it is better to make one's own dial calibration, if the facilities are available. This is somewhat tedious, but not at all difficult to do, especially if one has access to an accurate bridge. It is very simple to



Here we are looking into the space normally occupied by the front panel, and see the battery fixed to the floor, and the chassis, at the back.

calculate the actual resistance that should be in circuit in the variable bridge arm, for a given reading, as this can be done from the formula, already given, that $a' = R_1/R_2$. Thus, if the 2,000 and 400 ohm resistors are one percenters, we can assume that the high and low scales will bear an accurate six to one ratio to each other. This will enable a good many of the calibration points to be made only once. For example, since the top scale is exactly six times the lower one, 24 on the former will correspond exactly in position with 4 on the latter. 30 with 5, 36 with 6, and so on.

To perform the calibration, it is first necessary to make a list of the resistances in the variable arm of the bridge against the scale readings they will give. For instance, for a reading of 4 (the first calibration point in the low scale) we know that $R_2 = R_1/4$, $= 400/4$ or 100 ohms. Similarly, for 5 on the scale, $R_2 = 400/5 = 80$ ohms, and so on. Armed with this list, worked out for every calibration point, and with a resistance bridge, one proceeds as follows.

First of all, gum a piece of blank paper to the metal dial plate, and by holding the pencil still, and turning the dial, inscribe an accurate circle on it. Next, install a temporary pointer so that its sharp tip is exactly on this circle.

To the bridge being used for calibration, take two wires from the emitter terminal and the battery positive terminal respectively. This ensures that the 10 ohm fixed resistor is included in the portion measured by the bridge, and saves further calculation, because the figures worked out as above include *all* the resistance

(Concluded on page 28.)

RCA

TRANSISTOR

DATA



TYPE	CLASS OF SERVICE	BASING OR LEAD ARRANGEMENT	MAXIMUM CASE DIMENSIONS—Inches		CHARACTERISTICS							
			LENGTH	DIAMETER	DC Collector Volts	DC Emitter Ma	Current Transfer Ratio at 1 Kc	Alpha Cutoff Frequency Mc	Power Gain db	Noise Factor db	Frequency For Unity Power Amplification Mc	Power Output Watts
2N77	Class A AF Amplifier	3 Flexible Leads	.405	.24	—4	—0.7	55	0.7	44.1	6.5	1.7	---
2N104	Class A AF Amplifier	3-Pin Base	.495	.26	—6	—1	44	0.7	41	6.5	1.6	---
2N105	Class A AF Amplifier	3 Flexible Leads	.255	.135	—4	—0.7	55	0.75	42	7.5	2.6	---
2N109	Large-Signal AF Amplifier	3-Pin Base	.495	.26	—9*	—2	75 [■]	---	33 [§]	---	---	0.16 [§]
2N139	Class A 455-Kc Amplifier	3-Pin Base	.495	.26	—9	—1	48	6.8	38.8 [□]	4.5	14	---
2N140	540-1640 Kc Converter	3-Pin Base	.495	.26	—9	—0.6	75	10	32	---	16.5	---
2N175	Class A AF Amplifier	3-Pin Base	.495	.26	—4	—0.5	65	0.85	43	6	2.06	---
2N206	Class A AF Amplifier	3 Flexible Leads	.405	.24	—5	—1	47	0.78	46	9	1.6	---
2N215	Class A AF Amplifier	3 Flexible Leads	.405	.24	—6	—1	44	0.7	41	6.5	1.6	---
2N217	Large-Signal AF Amplifier	3 Flexible Leads	.405	.24	—9*	—2	75 [■]	---	33 [§]	---	---	0.16 [§]
2N218	Class A 455-Kc Amplifier	3 Flexible Leads	.405	.24	—9	—1	48	6.8	38.8 [□]	4.5	14	---
2N219	540-1640 Kc Converter	3 Flexible Leads	.405	.24	—9	—0.6	75	10	32	---	16.5	---
2N220	Class A AF Amplifier	3 Flexible Leads	.405	.24	—4	—0.5	65	0.85	43	6	2.06	---
2N247	Class A RF Amplifier	4 Flexible Leads [•]	.375	.36	—9	—1	60	30	45 [□]	8	132	---
2N269	Low-Level Switch	3 Flexible Leads	.405	.24	—6	—1	35	12	For "on-off" control applications			
2N270	Large-Signal AF Amplifier	3 Flexible Leads	.375	.36	—12*	—2	70	---	32 [§]	---	---	0.5 [§]
2N274	Class A RF Amplifier	4 Flexible Leads [•]	.405	.24	—9	—1	60	30	45 [□]	8	132	---
2N301	AF Power Amplifier	2-Pin Base with	.475	.87	—14.4	—50	75 [■]	---	32.5	---	---	12 [§]
2N301-A	AF Power Amplifier	Mounting Flange	.475	.87	—14.4	—50	75 [■]	---	32.5	---	---	12 [§]
2N370	Class A RF Amplifier	4 Flexible Leads [•]	.375	.36	—12	—1	60	30	50.5 [□]	---	132	---
2N371	RF Oscillator	4 Flexible Leads [•]	.375	.36	—12	—1	60	30	---	---	132	---
2N372	RF Mixer	4 Flexible Leads [•]	.375	.36	—12	—1	60	30	50.5 [□]	---	132	---
2N384	VHF Amplifier	4 Flexible Leads [•]	.405	.24	—12	—1.5	60	100	34	---	250	---
2N398	High-Voltage Switch	3 Flexible Leads	.250	.36	—0.35	—5	60 [■]	—105-Volt Collector Breakdown Voltage Rating				
2N404	Low-Level Switch	3 Flexible Leads	.250	.36	Max. DC Collector-to-Emitter Saturation Voltage = —0.15 Volt							
2N405	Class A AF Driver Amplifier	3-Pin Base	.495	.26	—6	—1	35	---	43	---	---	---
2N406	Class A AF Driver Amplifier	3 Flexible Leads	.405	.24	—6	—1	35	---	43	---	---	---
2N407	Large-Signal AF Amplifier	3-Pin Base	.495	.26	—1	—50	65 [■]	---	33 [§]	---	---	0.16 [§]
2N408	Large-Signal AF Amplifier	3 Flexible Leads	.405	.24	—1	—50	65 [■]	---	33 [§]	---	---	0.16 [§]
2N409	Class A 455-Kc Amplifier	3-Pin Base	.495	.26	—9	—1	48	6.8	38.8 [□]	4.5	14	---
2N410	Class A 455-Kc Amplifier	3 Flexible Leads	.405	.24	—9	—1	48	6.8	38.8 [□]	4.5	14	---
2N411	540-1640 Kc Converter	3-Pin Base	.495	.26	—9	—0.6	75	10	32	---	16.5	---
2N412	540-1640 Kc Converter	3 Flexible Leads	.405	.24	—9	—0.6	75	10	32	---	16.5	---

■Large-signal dc current transfer ratio. *Supply voltage. •One lead, connected internally to case, acts as a shield to minimize interlead capacitance and coupling to adjacent circuit components.
§Two transistors. □Measured in a single-tuned unilateralized circuit matched to the generator and load impedances for maximum transfer of power (transformer insertion losses not included).



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LOUDSPEAKERS

VENTED ENCLOSURES WITH "TUNNELS"

Previous design charts published in this journal have given details of the size and construction of vented enclosures (or reflex baffles) without tunnels in the vent. The family of curves given below gives the sizes of enclosures for 12 in. speakers of various resonant frequencies, together with the required length of the vent tunnel. The use of a tunnelled vent enables the size of the enclosure to be reduced somewhat compared with the enclosure without tunnel.

Types of Vented Enclosure

For the purposes of this article, vented enclosures, or reflex baffles, as they are sometimes called, can be divided into two classes—those without tunnels in the vent, and those with. Those without tunnels are by far the commonest, and these are the ones which have a simple hole in the front panel acting as the vent. The tunnelled vent is one where the outlet is furnished with a tube, or tunnel, leading back into the cabinet.

The advantage of the tunnel is that it enables a smaller enclosure to be used, for a given resonance frequency. This is a matter of some importance when a bass speaker is used which has a very low resonant frequency—say, below 45 c/sec.—for such a speaker requires a large baffle in any case.

Thus, for these speaker units, the best type of enclosure is the corner-shaped one, because for a given enclosed volume, this kind takes up the least amount of useful room space. This having been decided upon, the size of the baffle may actually be reduced by using a tunnel in the vent. The accompanying set of curves contains all the information required in order to design a baffle of this kind for any speaker whose resonant frequency is known, provided that it is a twelve-inch unit. The curves for this speaker size have been printed because by far the greater number of bass speakers in use are twelve-inch ones. The curves were originally drawn up by the firm of Goodmans, noted for their speakers, and were published by Langford-Smith in the Radiotron Designers' Handbook.

How to Use the Curves

The scale for the volume of the baffle is given in cubic inches, not cubic feet, and runs vertically at the left of the diagram. Along the bottom runs a scale indicating the length of the tunnel, while there is one curve for each speaker resonant frequency. Thus, if the latter is known, we know that every combination of baffle volume and tunnel length can be found by running down the curve for that frequency. Thus, it can be seen that there are an infinite number of ar-

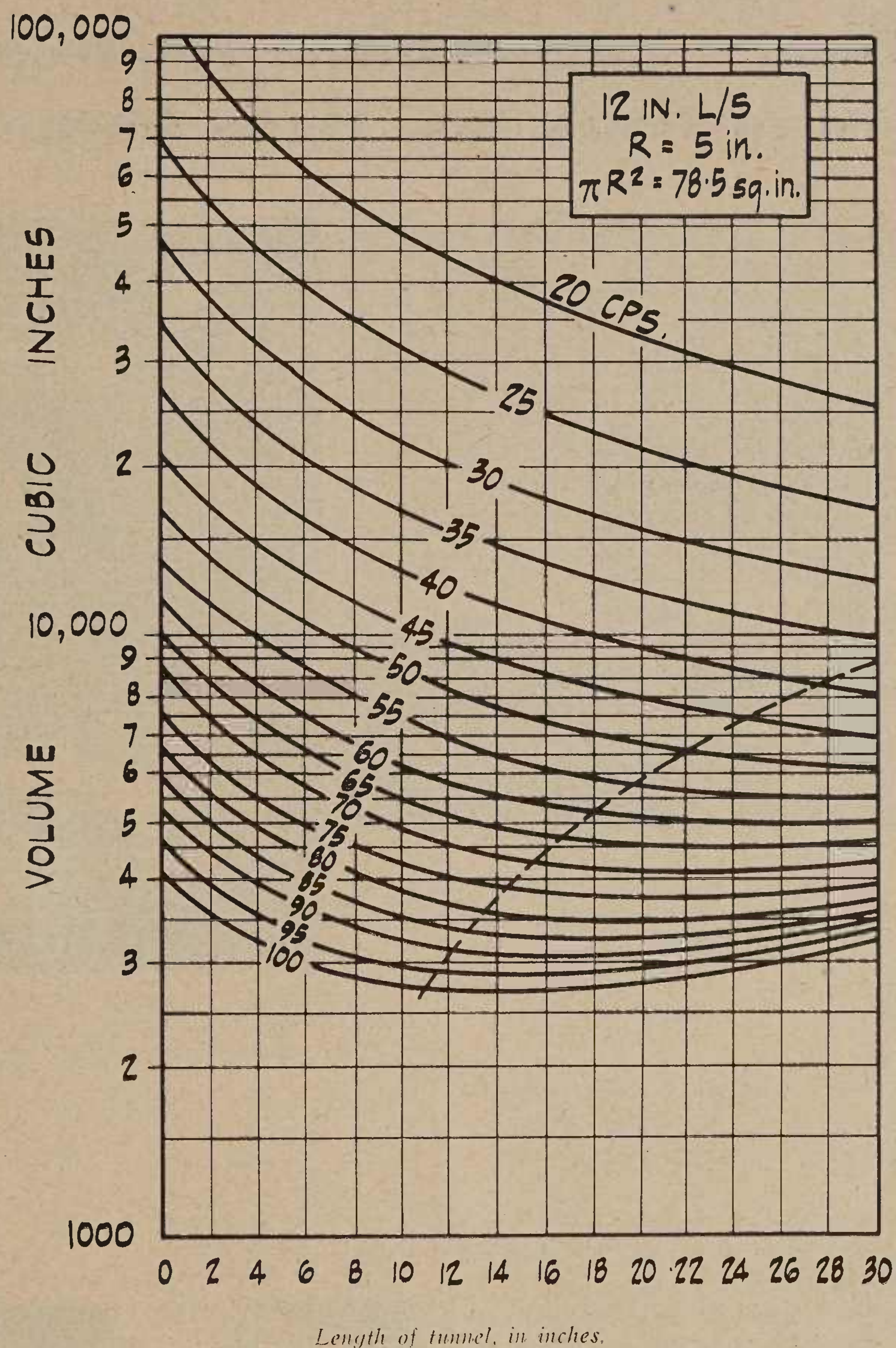
rangements that in theory will provide the right answer. For example, if we look at the curve for a 40-cycle resonant frequency, we find that for a tunnel length of zero (no tunnel at all) the baffle should have a volume of about 27,000 cubic inches, or approximately 15.6 cubic feet. This is really large, even when made in corner form, and so we seek some means of making it smaller. Running down the 40-cycle curve, we find that it crosses the line representing a volume of 15,000 cubic inches at a certain point. At this point, we travel vertically to the bottom scale of tunnel length, where we read off a length of 7 inches. This tells us, therefore, that if we use a vent tunnel of this length, the enclosure need have a volume of only 15,000 cubic inches, or about 8.7 cubic feet. This is a very different proposition, since a corner cabinet of 10 cubic feet is by no means over-large.

It is important to note that these curves are based on a vent size equal to 78.5 square inches. Other vent sizes would each require an entirely different set of curves, one for each size, but this is quite unnecessary, because the best results are known to be obtained when, as here, the vent size is about the same in area as the speaker opening.

Perhaps one of the most useful applications of these curves is in deciding whether a given cabinet can be modified to take a new speaker. For instance, if the existing cabinet has no tunnel, and we want to lower its resonant frequency to suit a different speaker, the curves will tell us whether this can be done or not. Naturally enough, the tunnel should not be taken too far back towards the rear wall of the cabinet, and the working rule is that the space between the back wall and the rear end of the tunnel should not be less than 5 inches for a twelve-inch speaker unit.

Use with Discretion!

The above rule will prevent tunnel lengths from getting out of hand, but builders should know that devices like tunnels, or making the vent very small, while certainly lowering the baffle's resonant frequency



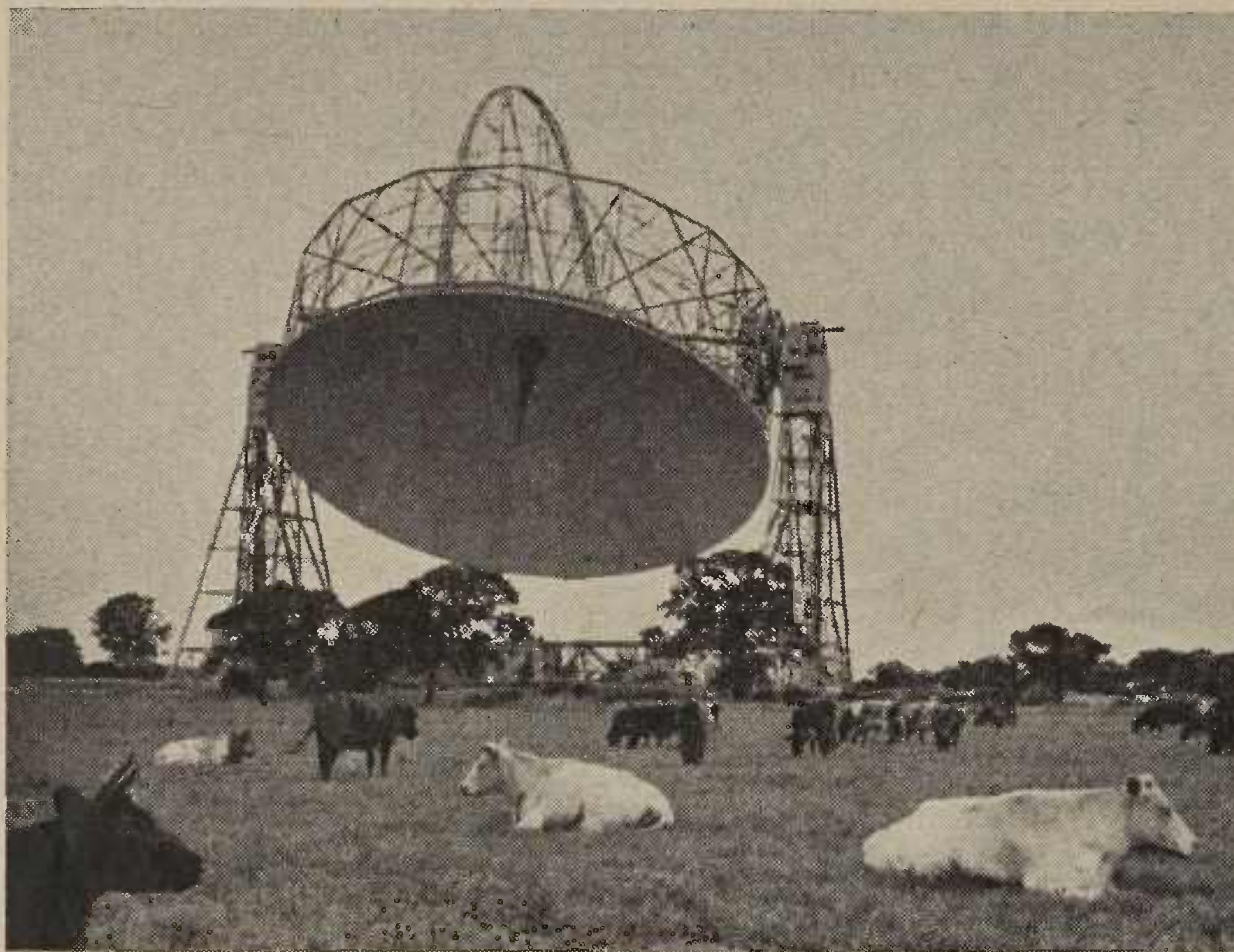
without making it any larger, do have disadvantages. The main one is that the Q of the enclosure is higher with the vent than without it. Thus, if the extra room can be afforded, it is always better practice to use an enclosure with a shorter tunnel than one with a longer one. In other words, the proper procedure is to make the enclosure as large as possible, and then use the tunnel in the vent to bring it to the right resonant frequency for the speaker it is proposed to use.

FOR SALE

TWO only ZCI mkI RADIO TELEPHONES. As new and in original condition. £20 each.

SMITH'S MOBILE RADIO SERVICE,
NEW PLYMOUTH.

World's Largest Radio Telescope Used to Track U.S. Moon Rockets



Britain's radio-telescope at Jodrell Bank, Cheshire, now being geared for its most vital mission to date—tracking the progress of the American moon rocket. In this picture the giant telescope—the world's largest fully steerable radio-telescope—is seen returning to its normal position after the aerial had been changed. The new aerial was installed to enable scientists to follow the progress of the moon rocket.

British and American scientists are working together at the station on the equipment which will be used to pick up the faint signals emitted by the rocket's transmitter.

The Jodrell Bank radio-telescope is one of the very few instruments in the world sensitive enough to pick up weak signals at great distances.

The radio-telescope will supply data on the position of the rocket and this will be sent to an American van stationed at Jodrell Bank which in turn will transmit it to the United States for computer calculation as to the rocket's exact location.

The Director of Jodrell Bank, Dr A. C. B. Lovell, said recently that the moon rocket project represented "another enormous step forward into the investigation of space by satellite vehicles and eventually, we hope, by manned vehicles."

The British radio-telescope is the world's largest fully steerable radio-telescope and is one of the few instruments in the world sensitive enough to pick up weak signals at great distances.



In this picture Mr J. V. Evans of the British team is seen working alongside Mr John Tabor, leader of the American team (standing), and Mr T. Guerin (right).

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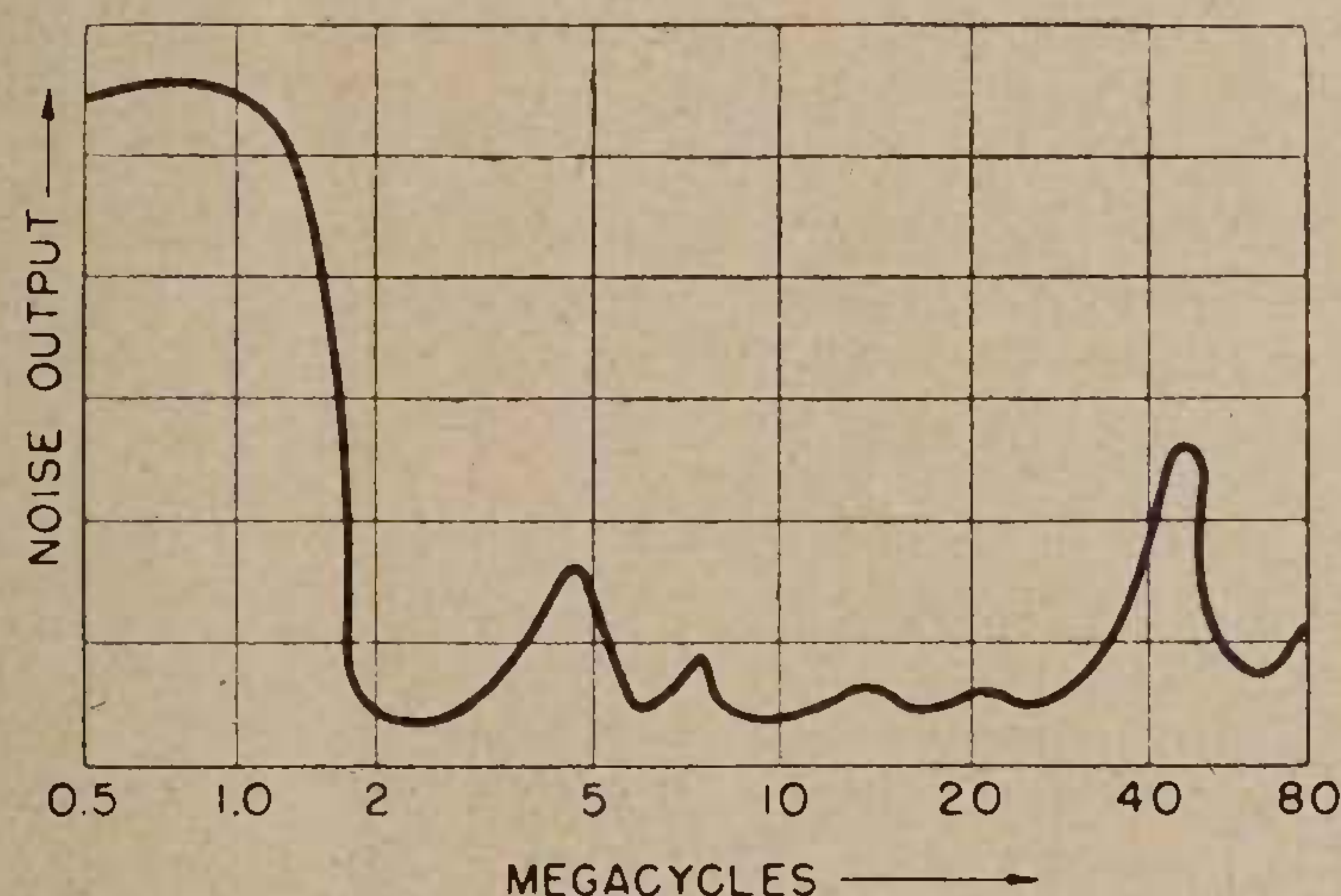
REDUCING FLUORESCENT LAMP QRM

Do nearby fluorescent lamps cause plenty of QRM in the broadcast receivers around your house? Or perhaps even on the amateur bands in your station receiver? That form of interference can be greatly reduced or eliminated if you will observe a few precautions when installing these lamps. The same remedies apply equally to fluorescent lamp fixtures that already are in use.

Well, why does a fluorescent lamp create this interference? Simply because it is essentially a mercury-arc discharge device that is automatically turned on and off 120 times each second when operated on 60-cycle A.C. power. The mercury arc within the glass tube causes a sputtering or sparking action at the lamp electrodes, thus setting up a series of radio waves. This RF energy is radiated in one or more of the following ways:

- (1) Direct radiation from the mercury arc.
- (2) Radiation from the power line near the lamp.
- (3) Feedback through the power line to the radio.

The intensity of noise generated varies considerably among identical lamps, as well as those of different wattage ratings. In most cases, the total amount of noise produced by a multiple-lamp installation will be very little more than that of the single lamp of the group that produces the most noise. The broadcast frequencies from 0.55 to 1.6 megacycles are most affected by this noise, as the graph below indicates.



Graph showing the distribution of noise over the radio spectrum from 500kc/sec. to 80mc/sec.

This particular curve represents the noise spectrum of a typical 40 watt fluorescent lamp. Lamps having different wattage ratings usually will have peaks of noise output at other frequencies.

Direct Radiation

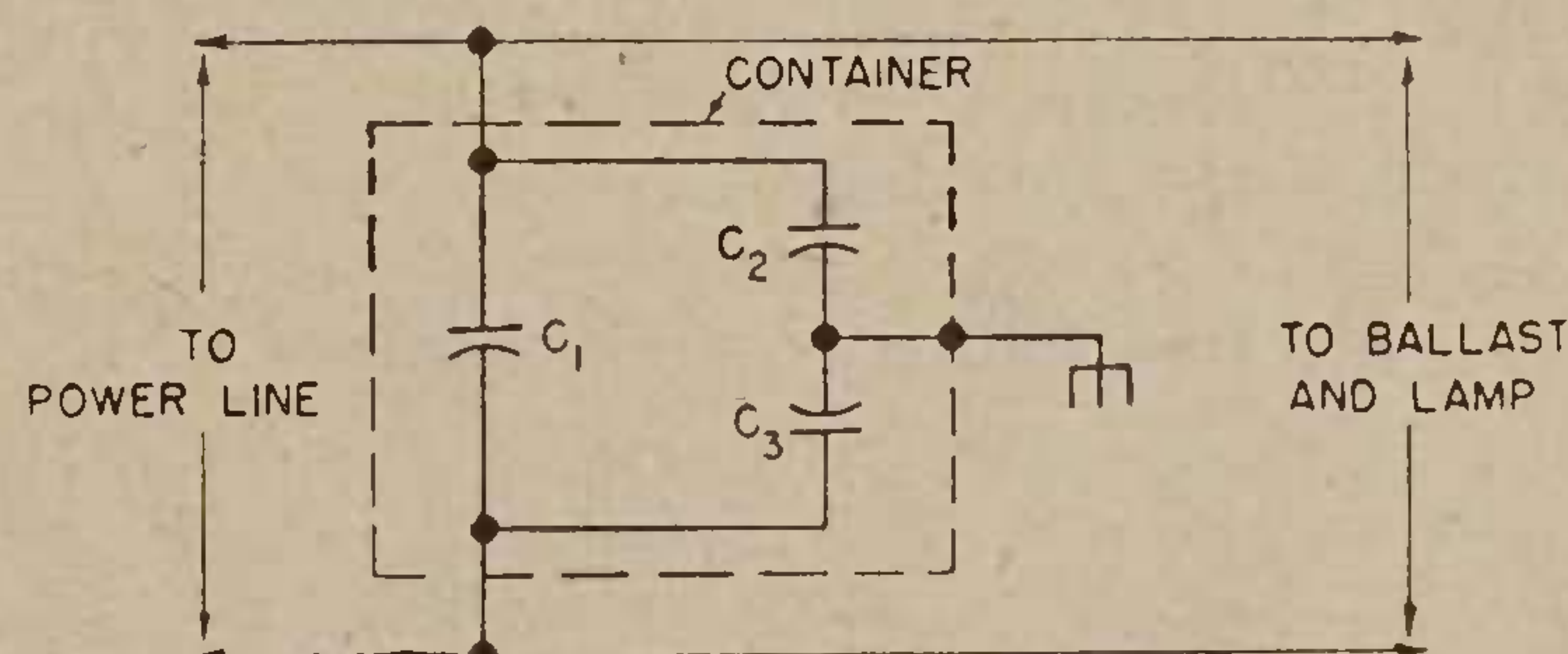
The radio energy radiated by a fluorescent lamp usually is dissipated within a few feet and therefore

can be controlled by sufficient spacing between the lamp and the radio or its antenna.

If the radio must remain within the bulb radiation range, the following precautions should be taken: (1) Install an antenna that is outside the noise area, connect it to the radio through a shielded lead-in cable and ground the shield. Reducing noise in a radio equipped with a builtin antenna is more difficult. Usually some lamp noise can be cancelled out by turning the radio to a certain position. However, some radios of this type are equipped with a separate antenna connection to which the shielded antenna lead-in wire may be attached. (2) Provide a good ground for the radio. Receivers having a "hot" chassis—one that is connected to one wire of the power cord—should have a 0.1- μ fd, 600-volt capacitor in series with the ground lead at the chassis.

Noise Filters

The ideal method for reducing both line radiation and feedback is to place a filter at each lamp or fixture. For most household type lamp fixtures, a simple delta-connected capacitor network, as shown below, is sufficient. The capacitors should be connected as close as possible to the line side of each lamp ballast. Typical



Circuit of a suitable filter for fluorescent lamps.

capacitor values are: C_1 , across the power line, 0.02 μ fd.; C_2 and C_3 , 0.002 μ fd. The ground connection between C_2 and C_3 should be made to the metal frame of the lamp fixture. All capacitors should have a D.C. working voltage rating at least four times the power line voltage. Example: 500- or 600-volt capacitors for a 115-volt line.

Direct radiation noise from a fluorescent lamp can be greatly reduced by shielding the lamp bulb. Since many fixtures partially enclose the bulb, complete shielding is possible simply by fitting a piece of aluminum screening across the opening and grounding it to the fixture. Obviously, the screen will absorb some light, and it will be necessary to choose a mesh for maximum reduction of interference and minimum absorption of light.

TRANSISTOR TESTER

(Continued from page 22.)

in the variable arm. Set the dial of the calibrating bridge to the reading for the required resistance for the first point on the scale, and find the balance point by adjusting the dial of the tester. This done, a fine pencil mark is made on the blank scale, and this is labelled with the appropriate value of α' , i.e., the one in the list corresponding to the resistance set up on calibrating bridge. Then set the latter up for the next calibration point. Whenever you come to a calibration point that gives a required reading on both measuring scales, make the pencil mark on both sides of the circle, just as can be seen on the dial in the finished instrument.

Using the Instrument to Measure Leakage

With the tester built and calibrated, it can be used immediately. The first thing to do with any transistor is to check it for leakage current. To do this, turn the voltage control switch to 6 volts, and make sure that S_1 is in the "off" position. Then, connect the transistor to the terminals, or plug it in. Before reading, make sure that S_4 is open, and that the input potentiometer is fully anti-clockwise. Then switch S_1 to either of the measuring positions (it does not matter which) and note if the meter reads more than 1ma. on the 10ma. scale. If it does, it is certainly a defective transistor, because none have a nominal leakage greater than a few hundreds of microamperes, while most have a leakage of less than 200 microamperes. Having ensured that it is safe to press the button, do so, and read the leakage current.

Measuring Current Gain

Having measured the leakage, or at least after checking that it is not excessive, turn the bias potentiometer until the transistor's collector current reads the required value, e.g., 1ma. If desired, switch the meter to its sensitive range with the push-button which adjusts the collector current. Next, advance the input control until the magic eye is closed, or nearly so. Then slowly adjust the main dial until minimum closure of the eye is obtained. If the minimum is fairly broad, increase the input to the transistor so that more signal is present near the balance point. If no balance point is found, switch S_1 to the other measuring range, and try again. A point worth noting is that when searching for the null point, the dial should not be turned too fast, because if this is done, one may pass through the balance point more quickly than the voltage at the grid of the magic eye can change, so that the balance is missed.

Some Points to Watch

When measuring α' or checking for leakage, make sure that the input control is not too far advanced. For the former, too much input overloads the transistor, so that the collector current is cut off for part of

the cycle, and a true reading is not given. It is a simple matter, however, to check whether too much input is being applied or not. One merely has to watch the D.C. collector current, which reads continuously on the meter, and make sure that there is no change as the input control is advanced. One can be sure in this way that the transistor is still working under Class A conditions.

For measuring leakage current, there should be no A.C. input at all. Thus, the input control should be right off for this test. In our own case, we sometimes found that a transistor which appeared to have a high leakage current was having its current driven upwards, Class B fashion, by some input voltage being inadvertently applied while the test was being done.

Checking Transistors for Balance

Ideally, transistors for use in Class B stages should be balanced at all frequencies, down to zero, or in other words, to D.C. This cannot always be achieved, so that the most important balance is that towards A.C. amplification. To check D.C. balance, take one of the pair, and adjust its bias so that it draws a collector current of, say, 2ma. Then, without touching the bias control, switch off the supply, using S_1 , and substitute the other transistor of the pair. Switch on again, and read the collector current of the second one, which ideally should have the same value as was set with the first one in circuit. Then at the same collector current, measure the α' of one transistor. Next, remove this transistor, plug in the other one, and read its α' with the same bias setting and the same input setting. Reference to the data sheets will tell whether the pair is matched to within the specified tolerance.

If one wants to be a bit fussy about matching, it is possible to check the matching of current gains at two or more values of collector current. In this case, a pair that shows better matching at two or three values of current will obviously perform better in a Class B stage than another which is well matched over a more restricted current range.

Still further checks can be made with the aid of the tester. For example, it is possible to measure α' over a range of collector voltages or currents, thus finding out how the amplification decreases at low currents and/or voltages. In this way it should be possible to find the answer to some difficulties that are met with in transistor tuners, whereby some transistor samples do not give as good A.V.C. action as they should. The serviceman coping with transistor sets and amplifiers should find innumerable applications for this tester. Nor should he find the slightest difficulty in building it and making it work properly.

BINDERS FOR "R. & E."

These are available to hold 12 issues

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ELECTRICAL AND TRADE SECTION

TRADE WINDS

Todd-AO Cinemas Increasing in Number

The number of cinemas where Todd-AO films can be shown is increasing gradually. In the United States some 65 movie theatres are equipped with the special projectors developed and supplied by Philips: the total number in other countries is more than 20. In Europe, Great Britain and Germany are leading with 8 Todd-AO cinemas each. There are two in Japan, whilst Italy, Mexico, and Malta have one each. In the autumn of this year Copenhagen's inhabitants will get the opportunity to see the new projection method and it is expected that Switzerland too will shortly have a cinema equipped with these special projectors.

The expansion of Todd-AO is tied up closely with the manufacture of films by this procedure. "Oklahoma", the first Todd-AO picture ever made, was also shown outside the United States! In Europe this first Todd-AO production was hailed with great enthusiasm. The second in the series, "Around the World in Eighty Days", was shown only in the United States, other countries receiving copies in normal 35mm projection. The third Todd-AO picture, "South Pacific", will be circulated outside the United States as well and is now showing in Britain where it is attracting a record attendance. The fourth film of this type, "Porgy and Bess", is now being produced.

EDITOR'S NOTE:

For those who have not heard of it, the Todd-AO system of film projection is a new method, said to out-perform Cinemascope and Cinerama. It uses a special 70-millimetre film also holding six magnetic sound-tracks. The special projectors (which can also run conventional film) were designed by Philips in Holland, and are being produced by them. It is believed that New Zealand is shortly to have theatres installed with Todd-AO equipment, so that some of the films mentioned above will be shown in their proper and original form, and not as 35mm versions.

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Philips, Coronet, etc.

Latest news of record business here is that Philips, after a temporary recession due to import restrictions are back in the L/P market in a big way. On Wednesday, October 1st, a record evening was held in Philips' new Carnegie Hall to signalize the event, and to usher in what Philips are calling their "New Disc Era".

The story is, of course, that Philips, Coronet, Polydor, and some important new labels, are from now

on being pressed in New Zealand, and that regular releases will bring to an end the dearth of these labels that has been apparent in the last few months.

This is not all, however. Also announced to the large audience of dealers present was the issuing here for the first time of records under two labels that are new to this country. These are Tops and Fontana. The former hails from America—Hollywood, to be precise—and will feature L/Ps mainly of the popular type. Fontana is the label originated by the French Philips organization, and which is now issued in no less than seventeen major countries throughout the world. Discs on this label will include a good proportion of the classics, but will also have releases in the popular class.

The quality of the records demonstrated was very high indeed, practically all the excerpts played being quite in the top class. Dealers need have no fear that the pressing of these locally-produced discs will not match the overseas ones in quality.

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"Mammoth Television" Shown in New Zealand for the First Time

Also on October 1st, at their New Disc Era party, Philips showed their big-screen television for the first time in New Zealand. This is a closed-circuit outfit that the Philips organization has been using throughout the world for publicity purposes, and which throws a picture on a full-sized movie screen. The camera is a vidicon, with a zoom lens, and the system works on the 625-line C.C.I.R. standard. Results on the large screen were most impressive, both as to brightness and picture quality, while a private view afterwards of the monitor screen in the control gear showed that the camera was resolving a good 450 lines in the horizontal direction.

MISSING AND STOLEN RADIOS

We have recently been asked by the Police Department to bring to the notice of Radio Dealers that frequently the serial numbers of stolen radios are not known. The recovery of such sets is greatly facilitated if the police have the serial numbers concerned. It is suggested, therefore, that Dealers should record the serial numbers of their sets so that in the event of theft this information may be given to the police.

AUDIO HAD BIG PLACE IN BRITAIN'S SILVER JUBILEE RADIO SHOW

The British radio industry, through the Radio Industry Council, put all it knows into the organization and presentation of its annual National Radio and Television Exhibition held at Earl's Court, London, from August 27 to September 6, 1958, with a preview for overseas visitors and other special guests on August 26.

It was the 25th National Radio Show and was distinguished by very attractive designs in radio and television receivers and radiograms, making use of the latest transistor and printed circuit techniques, with some special emphasis on export models, as well as by lively demonstrations of all kinds, some technical and some for entertainment.

Audio equipment for high fidelity reproduction of sound, always included among the exhibits, was given a hall to itself this year, occupying a huge area on the first floor previously used by the B.B.C. for its exhibition studio, scenery dock, dressing rooms, and executive offices. Forty-five firms had soundproof rooms for demonstrating the equipment in the manufacture of which Great Britain excels and which accounts for more than 20 per cent. of British radio exports, the U.S.A. being the biggest buyer. The exhibits and demonstrations included microphones, speakers, amplifiers, gramophone components, disc and tape recorders. The new stereophonic records were demonstrated for the first time, and for the first time in an exhibition in Britain there was a studio for stereophonic recording on tape.

Do You Want a Copy of "MY FAIR LADY"?

The one and only Broadway original cast recording, with Julie Andrews, Stanley Holloway, Rex Harrison, etc.

THE NEW ZEALAND L/P CLUB is accepting advance orders for this record, for delivery in the second week in December.

Whether or not you are a member of the New Zealand L/P Club, you can secure your order by sending only 5s. deposit to

**THE NEW ZEALAND L/P CLUB
P.O. Box 8028, Wellington**

N.B.—Full price will be advised on delivery.

ELECTRONIC COMPUTER EXHIBITION AND BUSINESS COMPUTER SYMPOSIUM

Patron: H.R.H. The Duke of Edinburgh

Olympia, London, November 28 to December 4, 1958

The Electronic Computer Exhibition, the first of its kind in Europe, is to be held under the patronage of H.R.H. The Duke of Edinburgh at Olympia, London, from November 28 to December 4, 1958. Concurrently with the Exhibition there will be held a Business Computer Symposium.

The Exhibition and the Symposium have been organized at the instigation of the National Research Development Corporation by the Electronic Engineering Association and the Office Appliance and Business Equipment Trades Association.

The Exhibition will be thoroughly representative of the British electronic computer industry and will show the outstanding contributions already made by British manufacturers to development and use of electronic computers and data processing equipment.

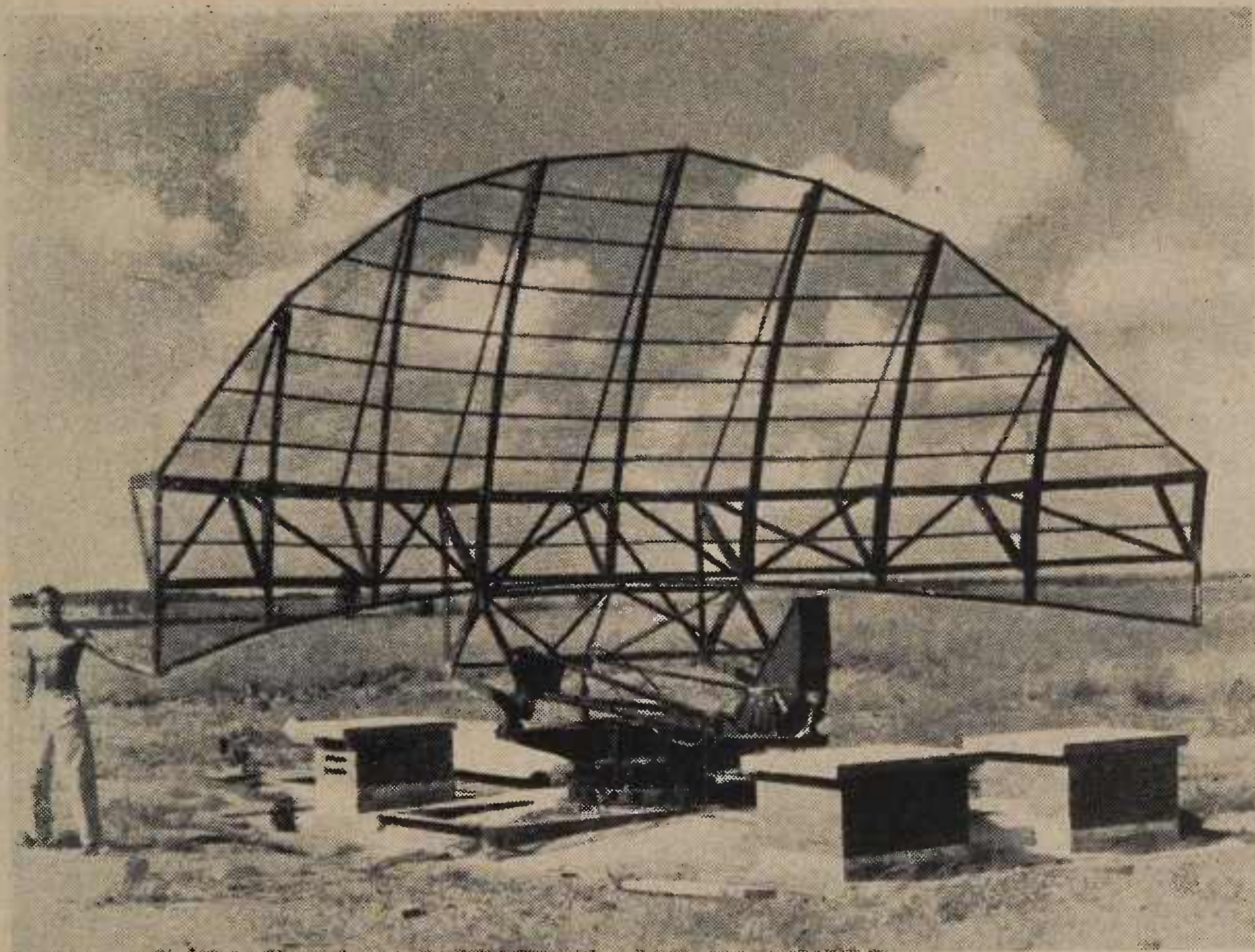
The Exhibition is likely to be one of the most significant business events in 1958. Visitors will be able to judge the progress made in the application of electronic computers in achieving greater productivity in office and factory. The comprehensive display of computers and ancillary equipment will cover research and application by leading business organizations and will show how computers have an immediate bearing on the many intricate problems of management today.

The British effort has not been confined to large-scale computers—the so-called "giant brains"—but more particularly with medium-sized electronic computers suitable for every type and size of organization in government, industry, and commerce.

Manufacturers exhibiting are:

Benson-Lehner (G.B.) Ltd., Boyden & Smith Ltd., British Tabulating Machine Co. Ltd., British Thomson-Houston Ltd., Bulmer's (Calculators) Ltd., Burroughs Adding Machine Ltd., Creed & Co. Ltd., Data Recording Instrument Co. Ltd., Egry Ltd., Elliott Bros. (London) Ltd., E.M.I. Electronics Ltd., E.M.I. Sales & Service Ltd., English Electric Co. Ltd., Fanfold Ltd., Ferranti Ltd., I.B.M. United Kingdom Ltd., Lamson Paragon Ltd., Leo Computers Ltd., Logabax Ltd., London Office Machines Ltd., Metropolitan-Vickers Electrical Co. Ltd., M.S.S. Recording Co. Ltd., Mullard Ltd., Equipment Division, Mullard Ltd., Component Division, National Cash Register Co. Ltd., Neosid Ltd., Ing. C. Olivetti & Co., Panellit Ltd., The Plessey Co. Ltd., Power-Samas Accounting Machines (Sales) Ltd., Punched Card Accessories Ltd., Rank-Xerox Ltd., Saunders-Roe Ltd., Short Brothers & Harland Ltd., Siemens Edison Swan Ltd., Solartron Electronic Group Ltd., Southern Instruments Computer Division, Sperry Gyroscope Ltd., Standard Telephones & Cables Ltd.

Latest Overseas Developments



Since the introduction three years ago of the world's first crystal controlled 50cm. radar, Marconi's have received orders for more than a million pounds' worth of this type of equipment. Orders have been received from all over the world, including Belgium, France, Germany, Switzerland, Hong Kong, New Zealand, South Africa, and the United Kingdom. This picture shows the aerial head of the Type S232 radar recently installed at Jan Smuts Airport, Johannesburg. The aerial is mounted on a concrete plinth built below ground level, which houses the transmitting and receiving equipment and the aerial turning gear.

Radar for Rongotai Airport

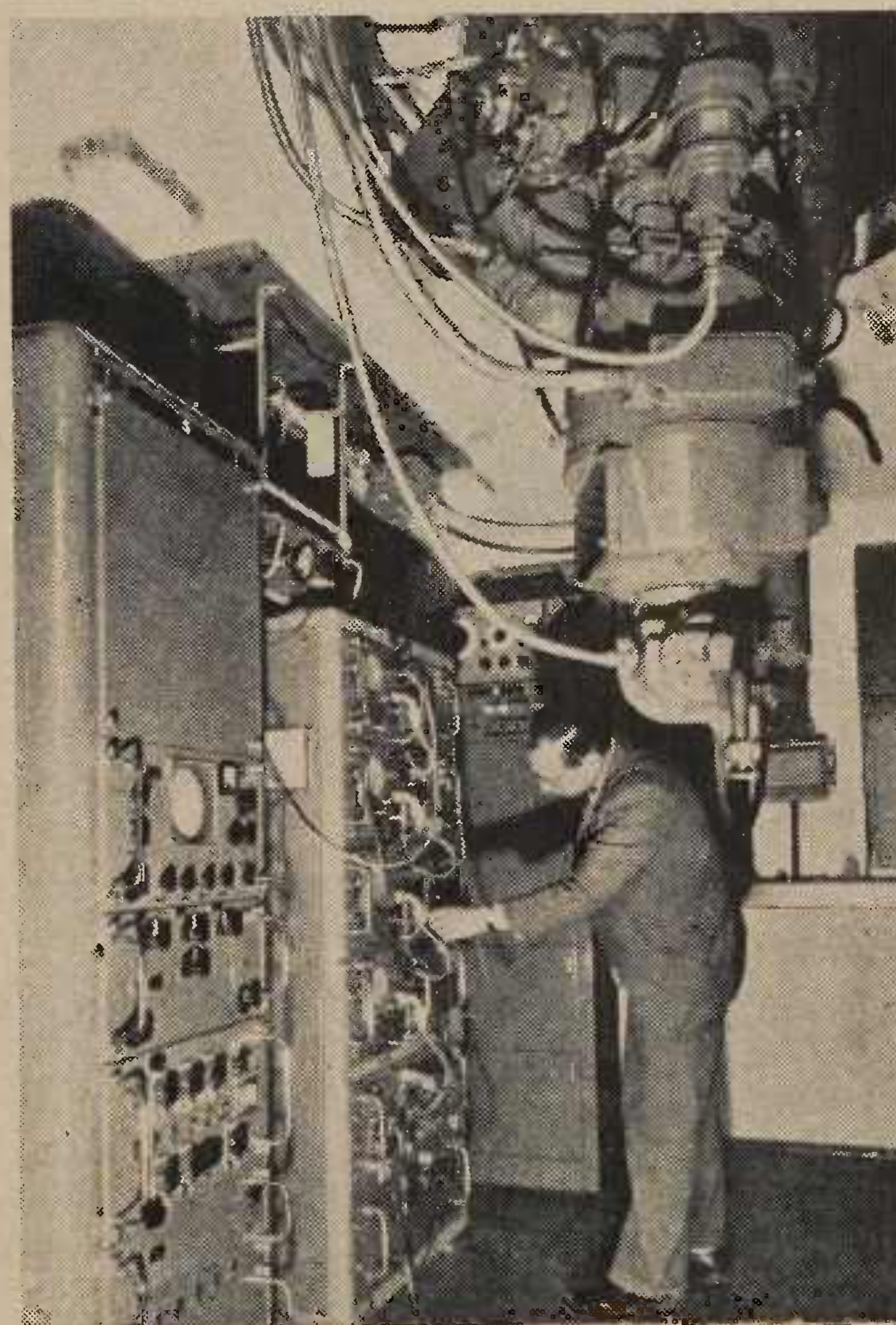
In the accompanying photographs are shown views of the Type S232 50cm. radar set, one of which is to be installed at the new aerodrome at Rongotai. It works on the 50cm. band, which is little affected by rainstorms, and other natural phenomena which upset the performance of 10 and 3cm. radar equipment by producing solid echoes on the screen.

* * *

Electronic "Eye"

An extremely sensitive new electronic "eye" which may disclose previously unseen details of the planets and distant nebulae, permit visual reconnaissance in almost complete darkness and provide a powerful new tool for scientific research has been developed by R.C.A. scientists.

The new device is a developmental, advanced type of camera tube, based on television principles and known as the Intensifier Orthicon. It was developed by Dr George A. Morton and Dr John E. Ruedy at



This photograph shows the transmitting and receiving units and aerial turning gear of this radar, whose aerial appears above.

R.C.A.'s David Sarnoff Research Centre, Princeton, N.J., in a research programme sponsored by the Aeronautical Research Laboratory, at the Wright Air Development Centre.

The new Intensifier Orthicon is probably 100 times more sensitive than the fastest known photographic film for the same exposure time at extremely low levels of light. Operating on principles employed in the Image Orthicon used in present television pickup functions, it can "see" in surroundings which appear completely dark to the human eye.

* * *

A Novel Motor Accessory Combined Wing Mirror and Car Aerial

A really new accessory has not been introduced to car owners in this country for some time, but Delta-Swift (motor accessories) Ltd., of Sheffield, have made up for this lapse with a really attractive and efficient car radio aerial. This is an aerial with a difference. It is also a high quality wing mirror . . . a true dual purpose accessory. Thoroughly tested, in various parts of the country, it has proved to give good reception under all conditions. Of the highest standard of manufacture throughout, simple fitting instructions are supplied with every unit, and it is worth noting that now only one hole is needed instead of the usual two.



The mirror is fully adjustable, but the unit needs no adjustment for radio reception. Selling at the average price of a conventional aerial, 57s.6d., it has the added advantage of an extremely attractive wing mirror and

* * *

New Telephone Service for Shipping off the Coast of Great Britain

A new public correspondence service, using VHF radiotelephony through the British Post Office coast station at North Foreland, was inaugurated today, 5th September.

To mark the occasion, the Right Hon. Viscount Simon, C.M.G., chairman of the Port of London Authority, embarked in the Marconi Marine Company's research yacht *Elettra II*; and from a position "somewhere off the Kent coast" spoke by telephone to the Postmaster-General, the Right Hon. Ernest Marples, M.P., who accepted the call on the General Post Office stand at the Radio Exhibition at Olympia.

The new service will enable vessels entering and leaving the Thames, or passing between the North Sea and the Strait of Dover, to speak directly to telephone subscribers anywhere in the United Kingdom. The frequency-modulated VHF transmitters and receivers at North Foreland have been supplied by Marconi's Wireless Telegraph Co., Ltd. The station will have two complete radio channels—a duplex working channel, and a simplex channel which will be used exclusively for calling and emergency working, operating on the internationally agreed frequency of 156.8 Mc/s. When contact has been made on the simplex channel the call will be transferred to the duplex working channel, which will operate on one of the internationally agreed channels for public correspondence.

To simplify monitoring and testing procedure special racking and test gear is designed. The transmitters and receivers are mounted in the racks together with their associated testing and monitoring units.

Elettra II, a 72-foot motor yacht used as a floating laboratory, has played a major part in the development of new communications equipment and electronic aids to navigation. Her wireless licence for the current year is believed to be the first ever issued to a ship authorizing the use of VHF frequencies for public correspondence with a Post Office or equivalent shore station.

But there is nothing experimental about the "Nautilus" VHF equipment used by Lord Simon on this occasion. This combined simplex/duplex radiotelephone equipment has been designed to enable ships to communicate on the international calling and intership VHF frequencies, and on port and harbour control and public correspondence channels. It provides for rapid selection of any one of up to fifteen pre-selected crystal-controlled channels in the 154 to 165 Mc/s band. Introduced early last year, the "Nautilus" conforms with the technical recommendations for frequency-modulated VHF marine equipment adopted at The Hague Conference in January, 1957; and a large number of British and foreign vessels are already communicating by "Nautilus" in all parts of the world. This was the equipment used by the liner *Mauretania* at the inauguration of the Southampton Harbour Board's new port operation and information service in January; and more recently, the Shaw Savill liner *Southern Cross* used her "Nautilus" to carry out long-range tests with a new station to be operated by Melbourne Harbour Trust.

Many other harbour authorities are now operating or planning port operation services; but none of these authorities can, of course, offer a public correspondence service. The British Post Office, with the establishment of the new VHF service at North Foreland, has brought VHF radiotelephone communication within the reach of every ship using the sea lanes around North Foreland.

For the Serviceman

A SIMPLE METHOD OF FINDING VALUES OF RESISTORS IN PARALLEL

Even a slide rule, or log. tables are not very satisfactory when it is necessary to find the values of resistances in parallel. Working out values by the formula is even worse, but the graphical method given here is even quicker than any of these three methods, and requires only a ruler and set-square, or some squared paper.

Introduction

Everyone who does radio work, whether professionally or otherwise, has to find the values of resistance obtained when two or more resistors are connected in parallel. It may be that you are building something, and the correct value cannot be found in your box of resistors, so that in order to get things going, this has to be made up with two or more resistors in series or in parallel. Sometimes, parallelling is the only way to get the correct answer, so that the simplicity of adding values together cannot be used. It is then a case of guessing the best values to connect in parallel in order to arrive at the desired value, and then calculating by some means or other, the exact figure given by the proposed pair. Doing an exact calculation using the formula

$$R = \frac{R_1 \cdot R_2}{R_1 + R_2}$$

is far too time-consuming, especially when several trials have to be made, and even if you are an inveterate slide-rule user, this is one of the simple sums which are not very well suited to slide-rule operation. The same remark applies to the use of logarithms.

From all of which it is apparent that a simpler means of calculating such sums is highly desirable, and at times, even essential.

Fortunately, the problem has actually been solved, though for some unknown reason, not many people seem to know the method. It is for this reason that we are printing this short article, which may be of considerable assistance to a number of people.

First Published in "Wireless World"

The method about to be described was first published in 1942, in *Wireless World*, under the title of "Resistances in Parallel—Capacitances in Series", and it is possibly because of its publication in war-time that so few of us already know it. On the next page is found a diagram which can actually be used to operate the method, and from its inherent simplicity, it is obvious that if one possesses some squared paper, or even only a ruler and set-square, it can easily be set up and used in a few moments.

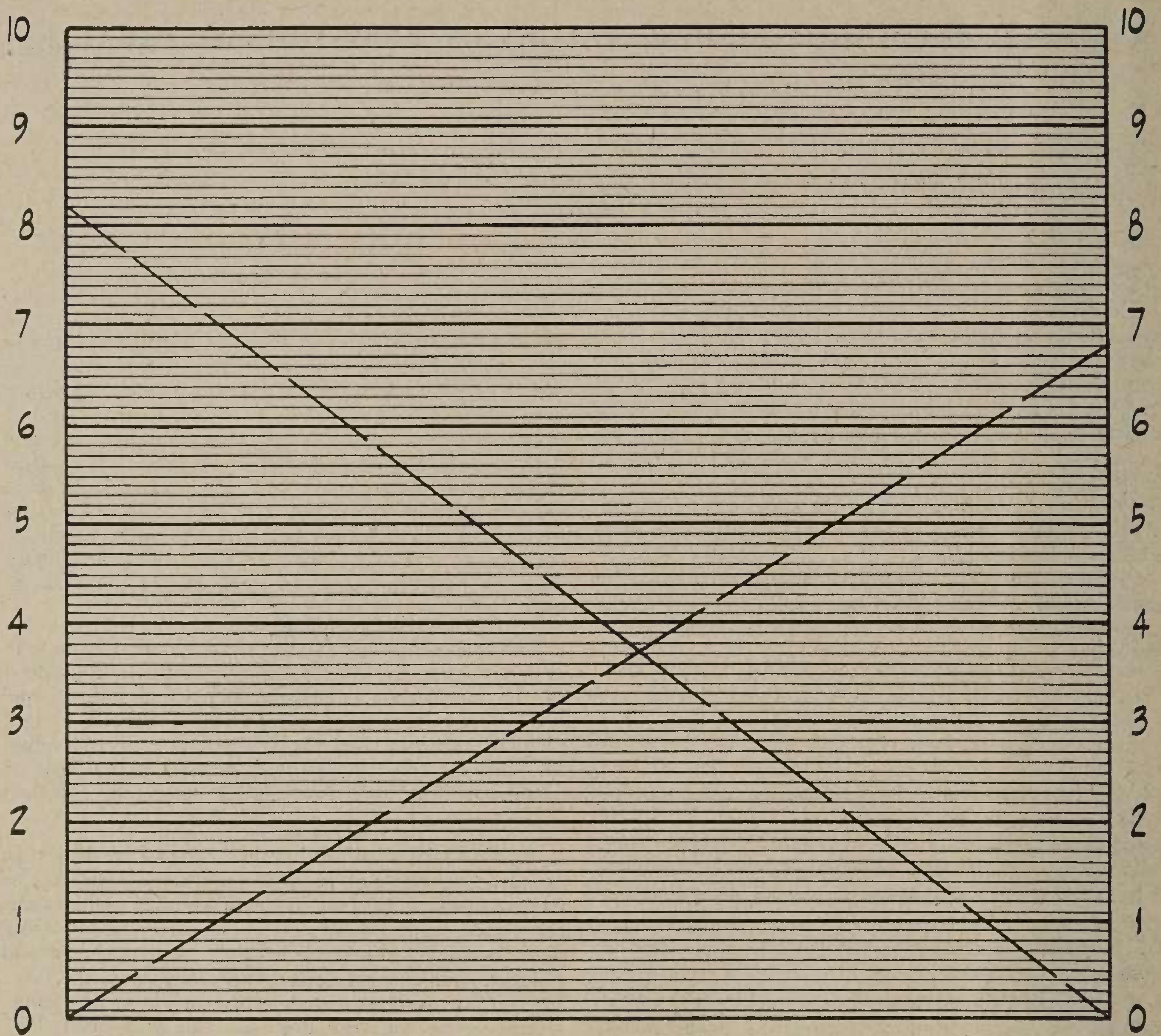
How it Works

It will be noticed that the chart consists of two parallel lines, vertically on the page. On these lines are two scales, both of which are linear, and run from zero to ten. Each scale starts from a base line which is at right-angles to the two verticals, so that any line drawn from one scale to the other, and joining equal figures, will itself be parallel to the base line, and at right-angles to the scales. The scales can be any convenient distance apart, but it is best to have the base line not too much longer or shorter than the height of the scales. In our case, we have made the scales higher than the base line so as to make the best use of the page space.

The reason for having the scales divided from zero to ten, is that any calculation can be made, regardless of the number of ciphers in the actual figures, and afterwards, the decimal point can be put in the right place by eye. For example, if the sum concerns values of, say, 680 and 820, we work it out on the basis of 6.8 and 8.2, and then multiply the answer by 100, and so on.

To find the combined value of two resistors in parallel, we proceed as follows. First, draw a line from the value of one of them on one scale to the zero point on the other scale. Then draw a line from the zero of the first scale to the value of the second resistor, indicated on the second scale. Then the combined value is represented by the height of the intersection above the base line, and can be measured by reading off on either scale. In the example shown, we have drawn a line from 8.2 on the left-hand scale to the zero of the right-hand scale, and another from 6.8 on the right-hand scale to zero of the left-hand one. The intersection can be seen to be at 3.7, so that the answer is 370 ohms.

If we have three resistors in parallel, their combined value can be found by first finding the value of any two in parallel, and then performing again with the third, and the combined value of the first two. For instance, if we have a 1,000-ohm resistor in parallel with our previous pair of 680 and 820, we operate again with the numbers 10 and 3.7, and get the final answer of 2.7, or 270 ohms.



Working Backwards

It is just as easy to work the sums in reverse, as when it is required to find what value must be connected in parallel with a given resistor in order to arrive at a given result. Using the same figures as before, suppose we want to find what value to connect in parallel with 680 ohms in order to get a combined value of 370 ohms. We connect 6.8 to one scale to the zero of the other with a line, and then run down this with a pencil until we intersect the horizontal line representing 3.7. We then join this point to the zero of the first scale, and project outwards

until the line intersects the second scale, from which we read off the answer 8.2, and interpret it as 820.

Capacities in Series

Since the law for finding the value of capacities in series is exactly the same as that for resistances in parallel, the same method, and exactly the same scales, can be used for finding capacities in series also. For instance, if we have to find the value of 820 μ fd. and 680 μ fd. in series, the working would be exactly as in the first example, and the answer would be the same in figures, viz., 370 μ fd.

“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 20th SEPTEMBER, 1958

Title	Artist	Position last week	Record make
1 Carolina Moon/Stupid Cupid	Connie Francis	3	M-G-M
2 Volare	Dean Martin	2	Capitol
3 When	Kalin Twins	1	Brunswick
4 Return to Me	Dean Martin	4	Capitol
5 Fever	Peggy Lee	7	Capitol
6 Splish Splash	Charlie Drake	10	Parlophone
7 Poor Little Fool	Ricky Nelson	6	London
8 Mad Passionate Love	Bernard Bresslaw	11	H.M.V.
9 Endless Sleep	Marty Wilde	9	Philips
10 Bird Dog	Everley Brothers	16	London
11 All I Have to Do is Dream/Claudette	Everley Brothers	5	London
12 Patricia	Perez Prado	8	R.C.A.
13 Tulips from Amsterdam/You Need Hands	Max Bygraves	12	Decca
14 Born Too Late	Poni Tails	—	H.M.V.
15 Volare	Domenico Modugno	13	Oriole
16 Trudi	Joe Henderson	14	Pye-Nixa
17 Girl of My Dreams	Tony Brent	15	Columbia
18 Yakety Yak	Coasters	17	London
19 If Dreams Came True	Pat Boone	20	London
20 Move It	Cliff Richard	—	Columbia

Lever Hit Parade

	11th September, 1958	18th September, 1958	25th September, 1958	2nd October, 1958
1	SECRETLY, Jimmie Rodgers	PATRICIA, Perez Prado	PATRICIA, Perez Prado	WHEN, The Kalin Twins
2	PATRICIA, Perez Prado	TULIPS FROM AMSTERDAM, Max Bygraves	WHEN, The Kalin Twins	PATRICIA, Perez Prado
3	YAKETY YAK, The Coasters	SECRETLY, Jimmie Rogers	SECRETLY, Jimmie Rodgers	FEVER, Peggy Lee
4	TOM HARK, Elias and his Zig-Zag Jive Flutes	WHEN, The Kalin Twins	SUGAR MOON, Pat Boone	POOR LITTLE FOOL, Ricky Nelson
5	TULIPS FROM AMSTERDAM, Max Bygraves	YAKETY YAK, The Coasters	FEVER, Peggy Lee	SECRETLY, Jimmie Rodgers
6	WHEN, The Kalin Twins	SUGAR MOON, Pat Boone	TULIPS FROM AMSTERDAM, Max Bygraves	SUGAR MOON, Pat Boone
7	BIG MAN, The Four Preps	TOM HARK, Elias and his Zig-Zag Jive Flutes	POOR LITTLE FOOL, Ricky Nelson	BIRD DOG, Everly Brothers
8	SUGAR MOON, Pat Boone	FEVER, Peggy Lee	YAKETY YAK, The Coasters	YOU NEED HANDS, Max Bygraves
Extra Ration	SAY 99, Doug Cladwell Trio		TORERO, Julius La Rosa	

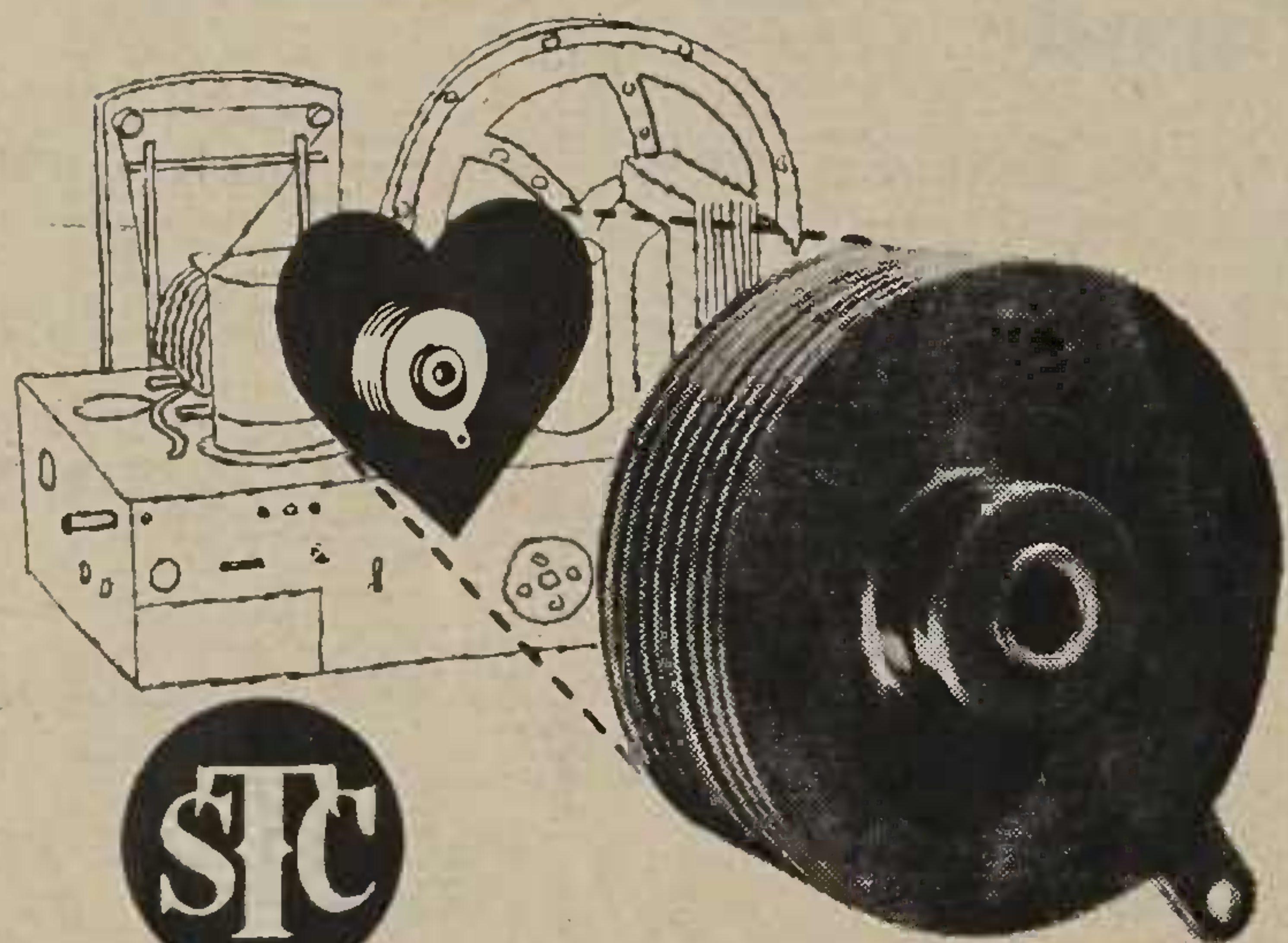


PRICE ERROR

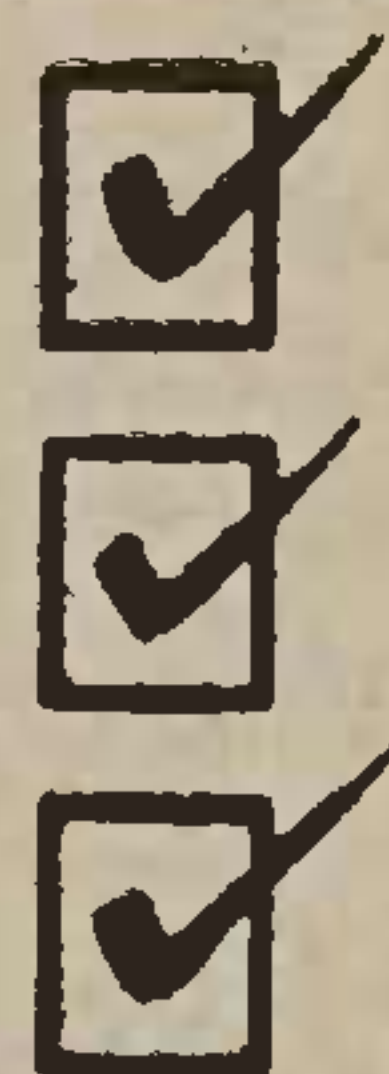


We regret having to record an error in Messrs Philips Electrical Industries of New Zealand Limited's advertisements in our July and August issues. The price of the "Festival Hall" was wrongly given. The correct retail price is 165 guineas. An illustration of the "Festival Hall" appears above.

The HEART of the Portable



MINIATURE RADIO RECTIFIER



- ★ Precision-built
- ★ Peak performance
- ★ Practically unbreakable

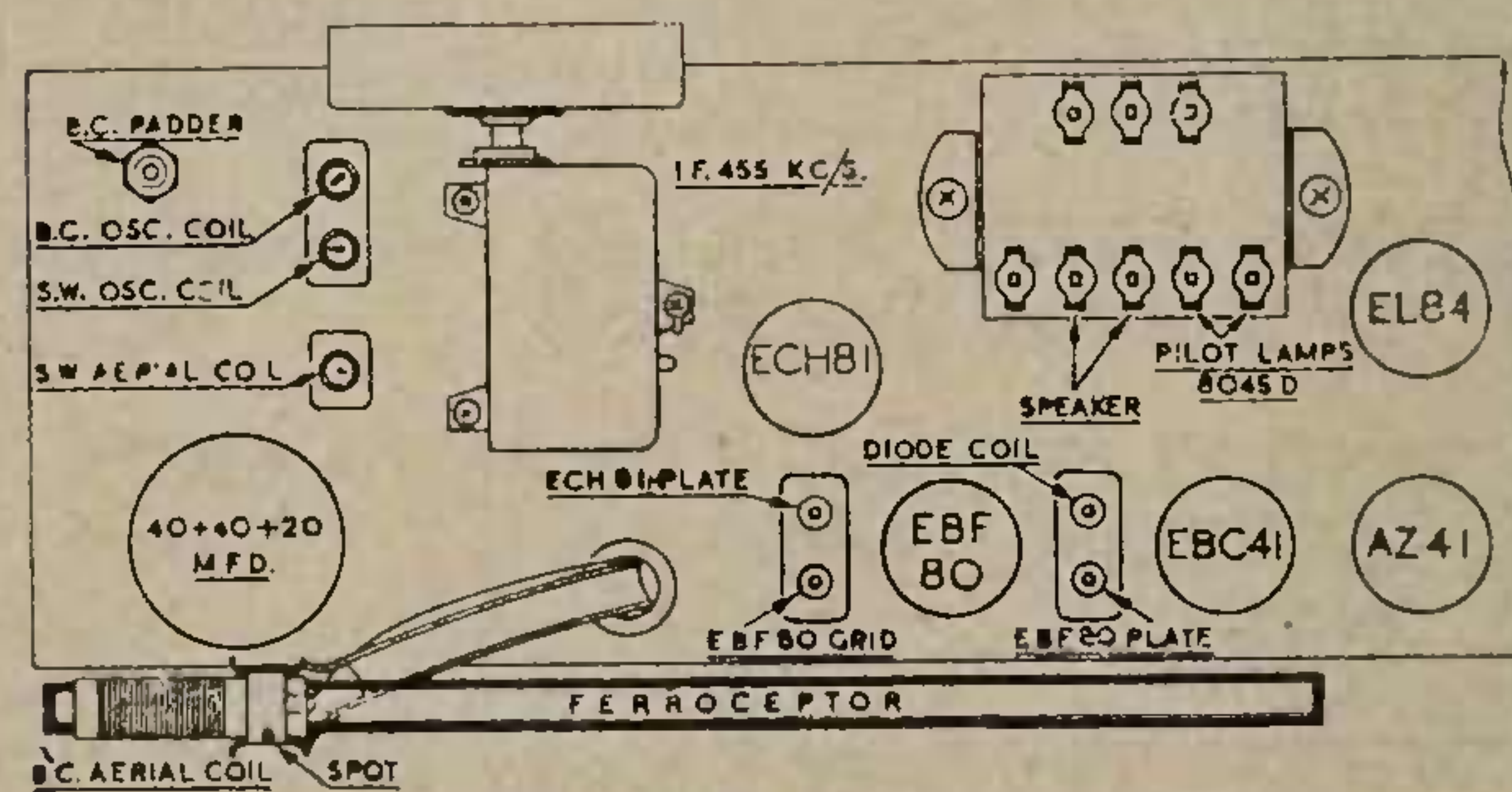
Servicing Portables? Replace with STC Miniature Radio Rectifiers. The world's standard first choice among progressive servicemen.

Write, phone, or call the Sole New Zealand Agents:

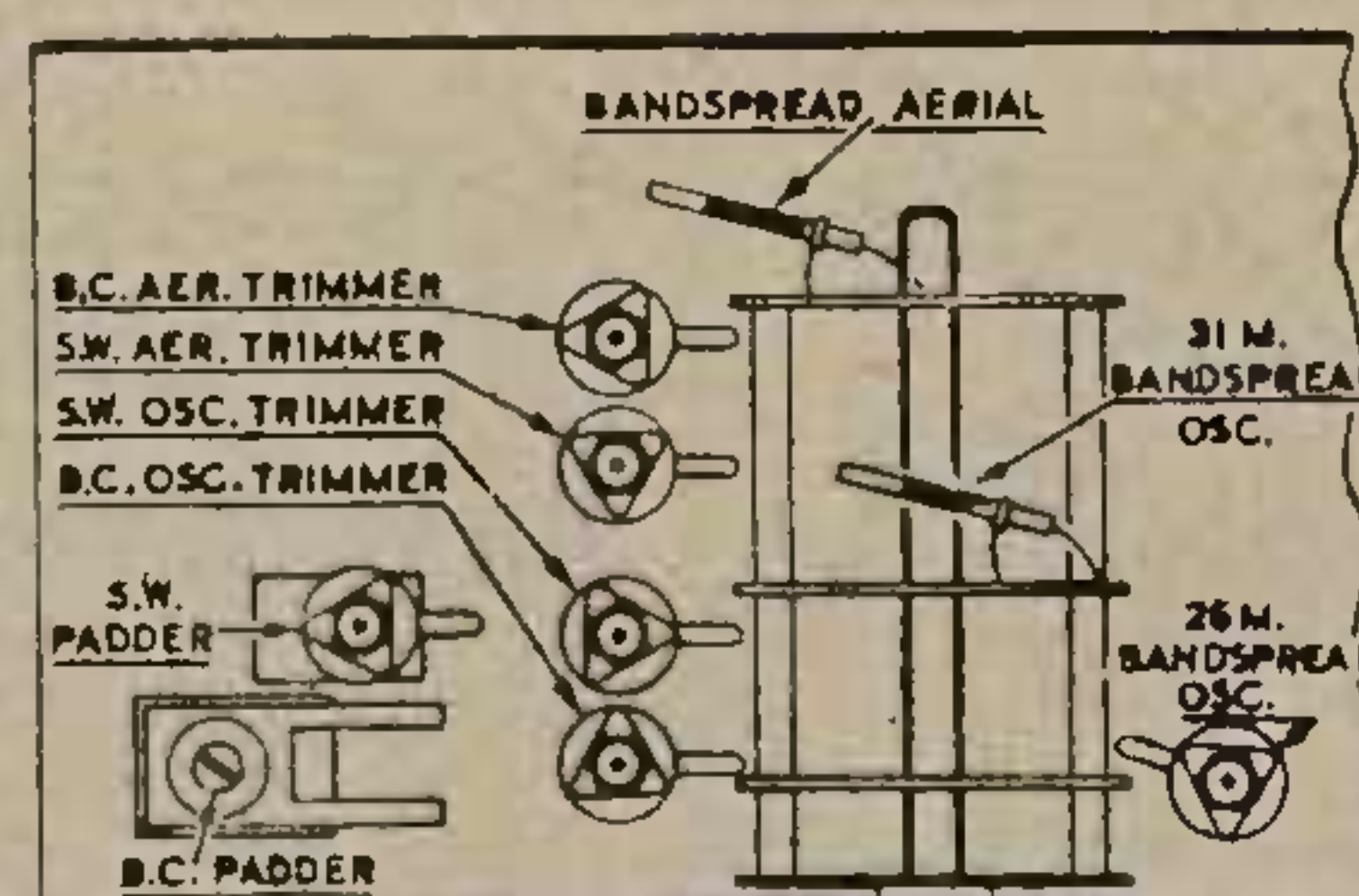
STANDARD TELEPHONES & CABLES PTY. LTD
 WELLINGTON Box 593 AUCKLAND Box 571
 CHRISTCHURCH Box 983 WANGANUI Box 293

For the Serviceman:

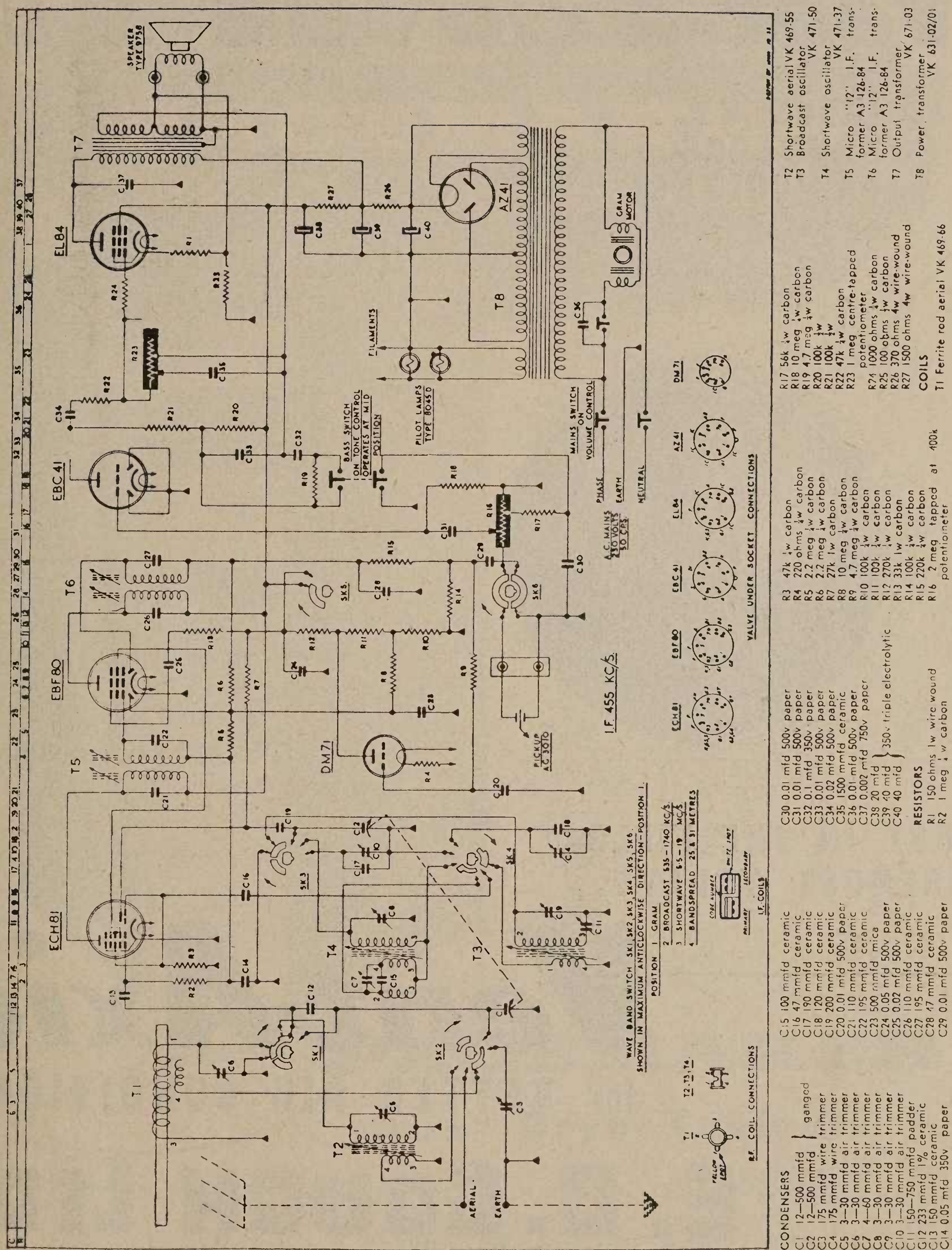
PHILIPS RADIO-GRAM MODEL F2956A



TOP VIEW



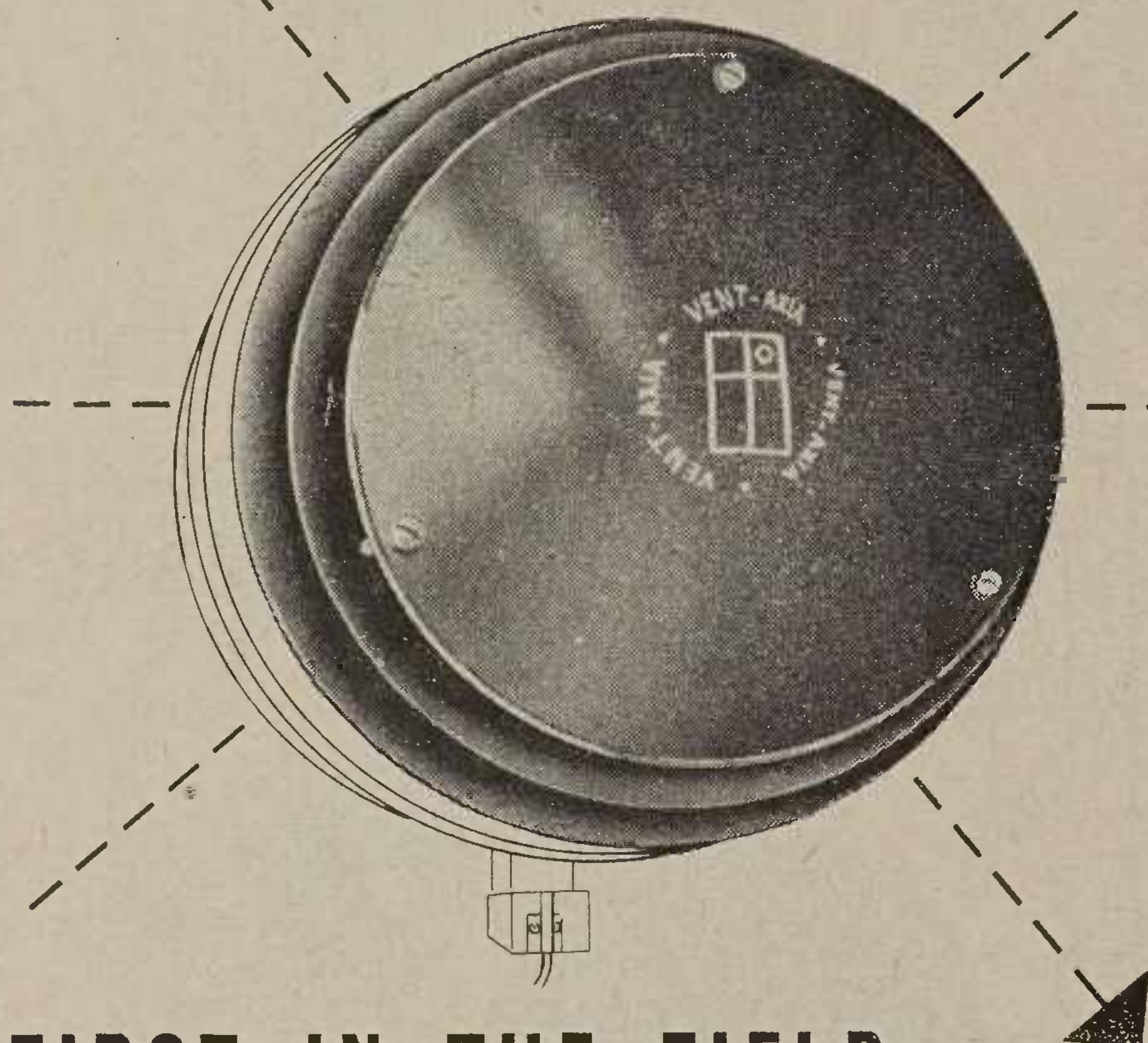
BOTTOM VIEW



***Vent-Axia* CLEARS THE AIR**

solving ventilation problems

**in INDUSTRY...
COMMERCE...
AGRICULTURE...
and IN THE HOME**



The elimination of fumes, fumes, smells, and steam, can all be removed directly by Vent Axia "Extract" Units. With the Vent Axia Reversible, you have only to turn a switch to change over to cooling "Intake" ventilation. From a wide range of models and accessories, Vent Axia thus caters for the widest possible variety of circumstances at all times of the year.

CHOICE OF EQUIPMENT

It is important to choose a Vent Axia of the correct size and type for the duty it has to perform. Available in 4 sizes (6 in. 7½ in. 9 in. 12 in.) in either "Reversible" or Type 'X' units. They are available with a full range of accessories including weather cowls, darkroom attachments, etc.

**FIRST IN THE FIELD—
FOREMOST TODAY...**

Write for fully illustrated literature now.

Vent-Axia

for BETTER AIR CONDITIONS

*Full stocks available
from the New Zealand
Agents—*

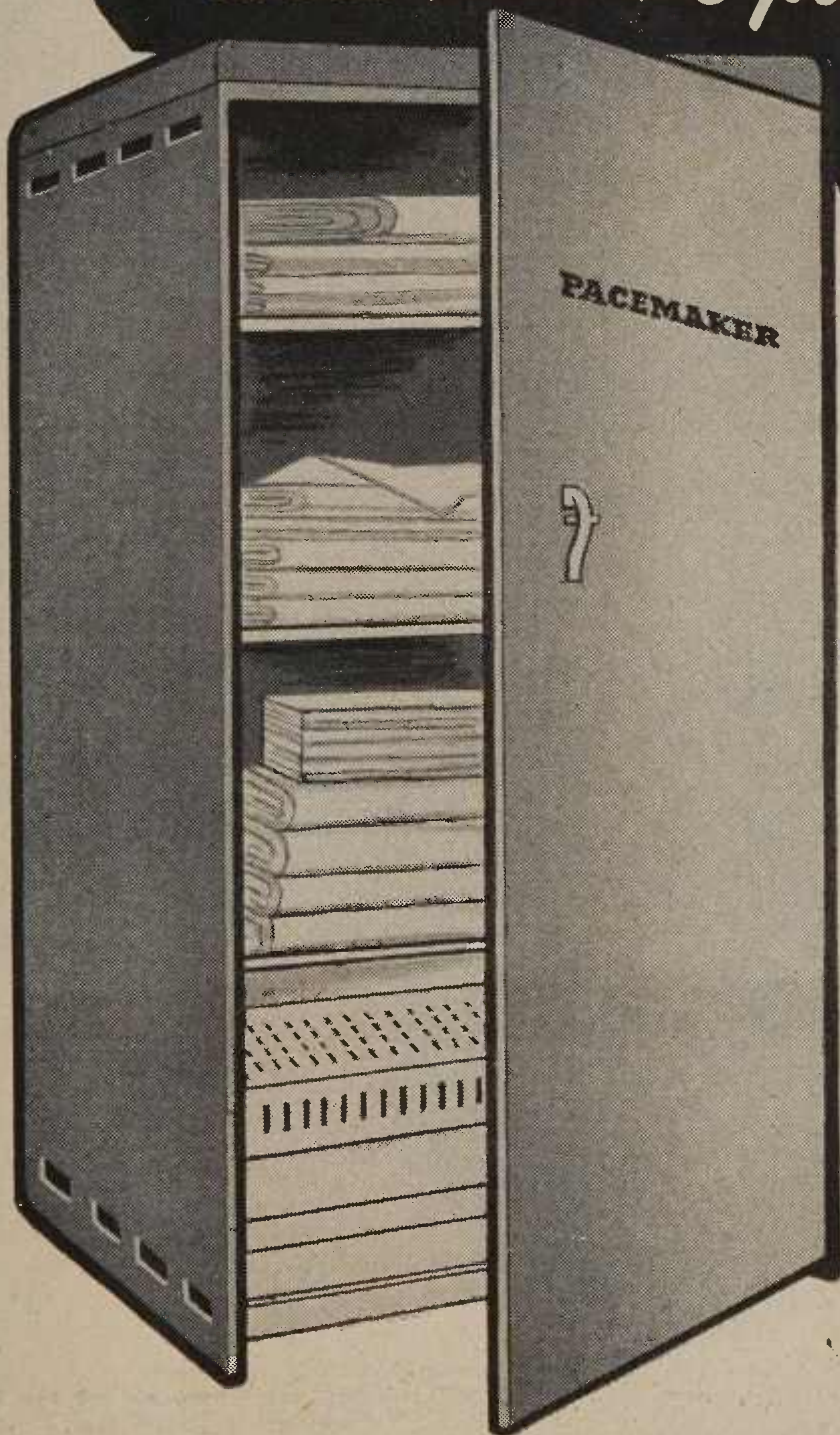
E. C. GOUGH LTD.

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PHONE 40-598

CHRISTCHURCH
AUCKLAND

Superior features...that's why*
PACEMAKER
will set the pace for sales!



PACEMAKER Airer-Dryer Cabinets will lead sales in this ever-expanding field because of these outstanding features:

* More soundly constructed, in 18-gauge steel, with gleaming white baked-enamel finish.

* Most economical on power (as a Dryer, uses only 3 units of electricity to dry 10 lb. wash; as an Airer, uses only 5 units to air clothes for ten hours). Incorporates 1000-watt element and special fan for drying, 500-watt element for airing.

* More effective positioning of racks, better air circulation, and special ventilation ensures 100 per cent. efficiency.

* Fully-protected element to eliminate accidental scorching of clothes.

* Racks are removable and special shoe rack is built in. Cabinet can be used for extra storage when not in use as dryer or airer.

DUAL PURPOSE

PACEMAKER

Airer-Dryer Cabinets

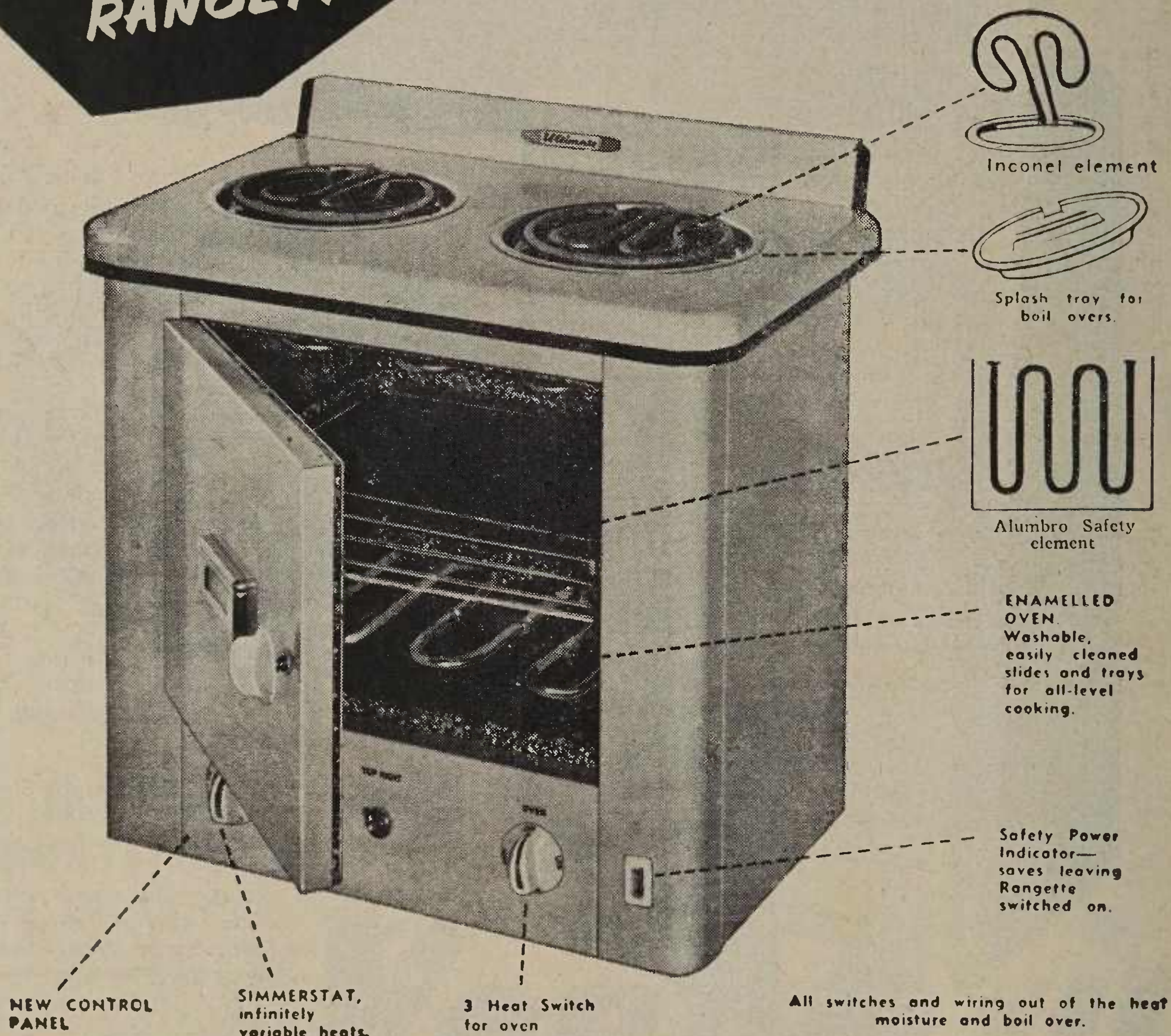
Display them in your Showroom! They'll sell!

Available from H. W. CLARKE (N.Z.) LTD. throughout New Zealand

A COMPLETELY NEW *ultimate* RANGETTE!

THE IDEAL "RANGETTE" FOR FLATS AND BACHES

The "Rangette" is especially made for New Zealand conditions from selected top-grade materials. With the advent of entirely new features and design, the manufacturers have ensured that the "RANGETTE" is the best "small oven" buy on the market today.



OTHER FEATURES OF THE NEW ULTIMATE "RANGETTE" —

- INCONEL SAFETY ELEMENTS: Hi-Heat, non-corrodible, shockproof, easily cleaned and washable.
- ALUMBRO SAFETY ELEMENTS: Non-burn-out, non-corrodible, washable, and shockproof.
- THERMOMETER: Easily readable dial on oven door for accurate heat control.
- OVEN INSULATION: Maximum power economy is ensured through thick insulation all round oven and inside the door.



ULTIMATE-EKCO (N.Z.) CO. LTD., QUAY STREET, AUCKLAND

Leading Amateur Designs

...use RCA Tubes



Close-up view of the "final" in the Gonset "Communicator"—showing the RCA-2E26.

Look at the popular Gonset *Communicator*, for example. In this compact mobile-or-fixed 2-meter station, the RCA-2E26 delivers a clean signal capable of covering a lot of territory.

Why do leading amateur and commercial designers recommend RCA Power Tubes for top performance? Because: (1) High-perveance RCA Tubes deliver the power you need—at lower plate voltages, (2) RCA Tubes have enormous reserve of cathode emission to supply peak plate-current demands, (3) RCA Tubes give you more for your money—in life and watts input

RCA Power Tubes—both beam power and triode types—are available at your RCA Tube Distributor. Walk in and name your type. For technical data on the 2E26, write RCA, Commercial Engineering, Section.



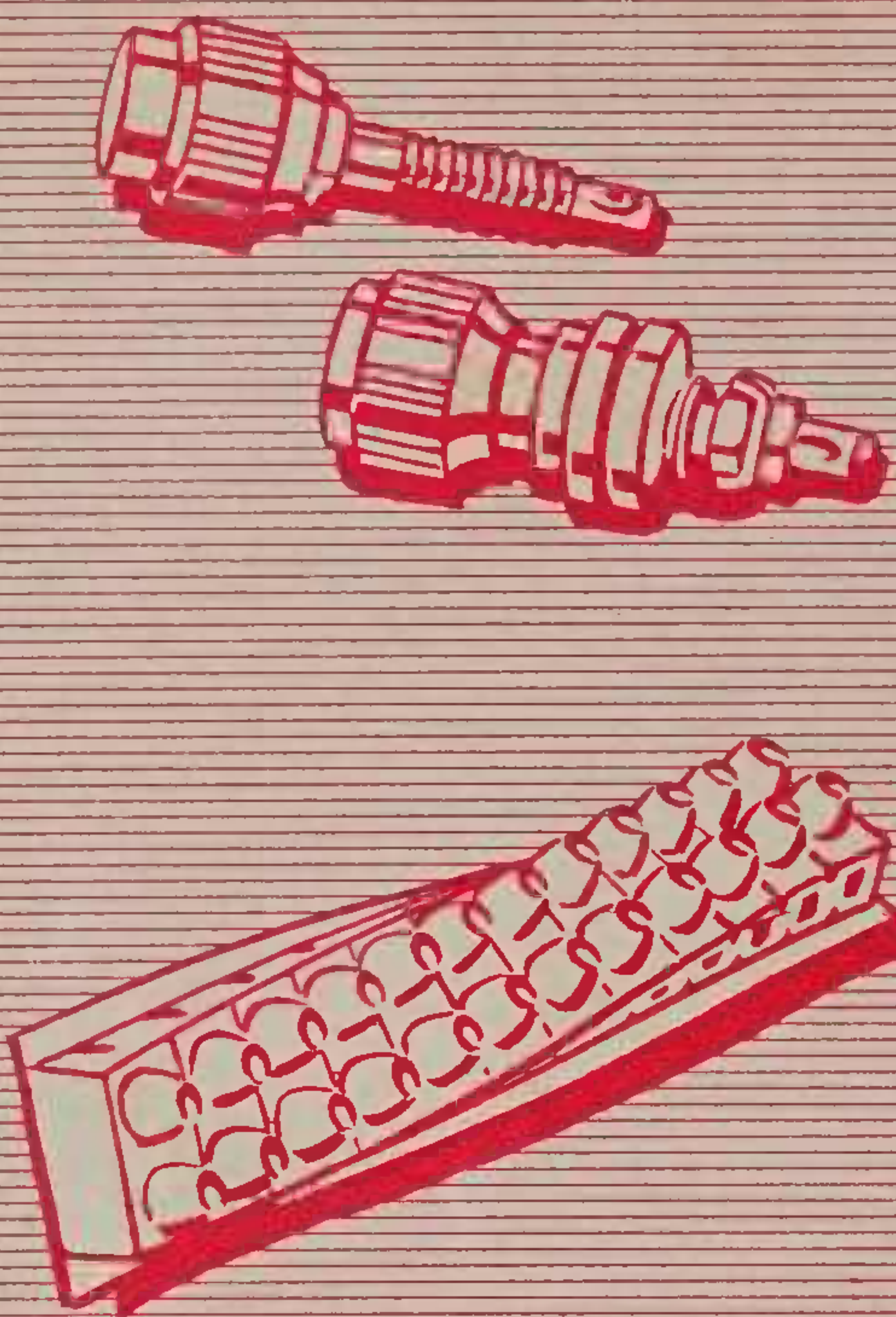
RCA-2E26 Beam Power Tube. Up to 40 watts ICAS input on cw; 27 watts phone. Full input up to 125 Mc; reduced input up to 175 Mc. Well-suited for mobile services. A 6AG7 drives it; a pair of 6V6-GT's, or a 6N7, modulates it.



SOLE NEW ZEALAND DISTRIBUTORS:
AMALGAMATED WIRELESS (Australasia) LIMITED
 P.O. BOX 830, WELLINGTON P.O. BOX 1363, AUCKLAND
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TERMINALS

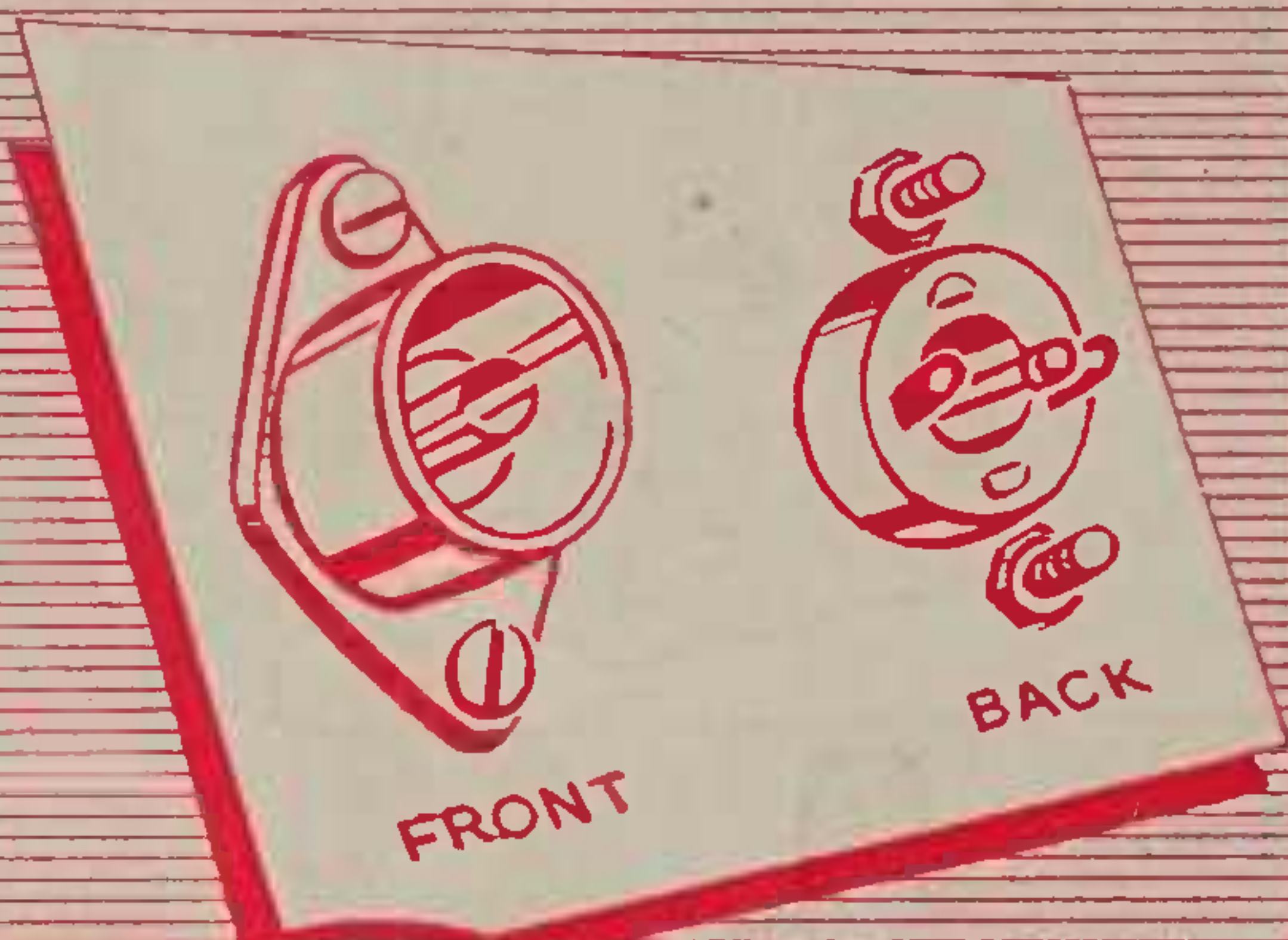


The comprehensive range of "B & L" terminals covers many applications. The design is fundamental and its excellence is proven by the fact that only minor improvements have been necessary over the past thirty years.

FLEXIBLE TERMINAL BLOCKS

are P.V.C. mouldings which, besides acting as an insulator, grip the terminal screws so securely that they cannot fall out. These components provide great flexibility in two planes. They can be secured to curved or irregular surfaces and are easily cut with a knife into smaller sections.

COAXIAL PLUGS & SOCKETS



The quality of "B & L" Coaxial plugs and sockets is unsurpassed and a wide range is available designed to meet the vast majority of applications.



"BELLING-LEE"

GREAT CAMBRIDGE ROAD, ENFIELD, MIDDX., ENGLAND.

**TERMINALS, PLUGS & SOCKETS, THERMAL
CUT-OUTS, FUSES, AERIALS & FILTERS.**

are obtainable from NEW ZEALAND agents:

TURNBULL & JONES LTD.

AUCKLAND, HAMILTON, TAURANGA, PALMERSTON NORTH, WELLINGTON
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