

SKYWIPE

THE CANADIAN RADIO AMATEURS' JOURNAL



February, 1951

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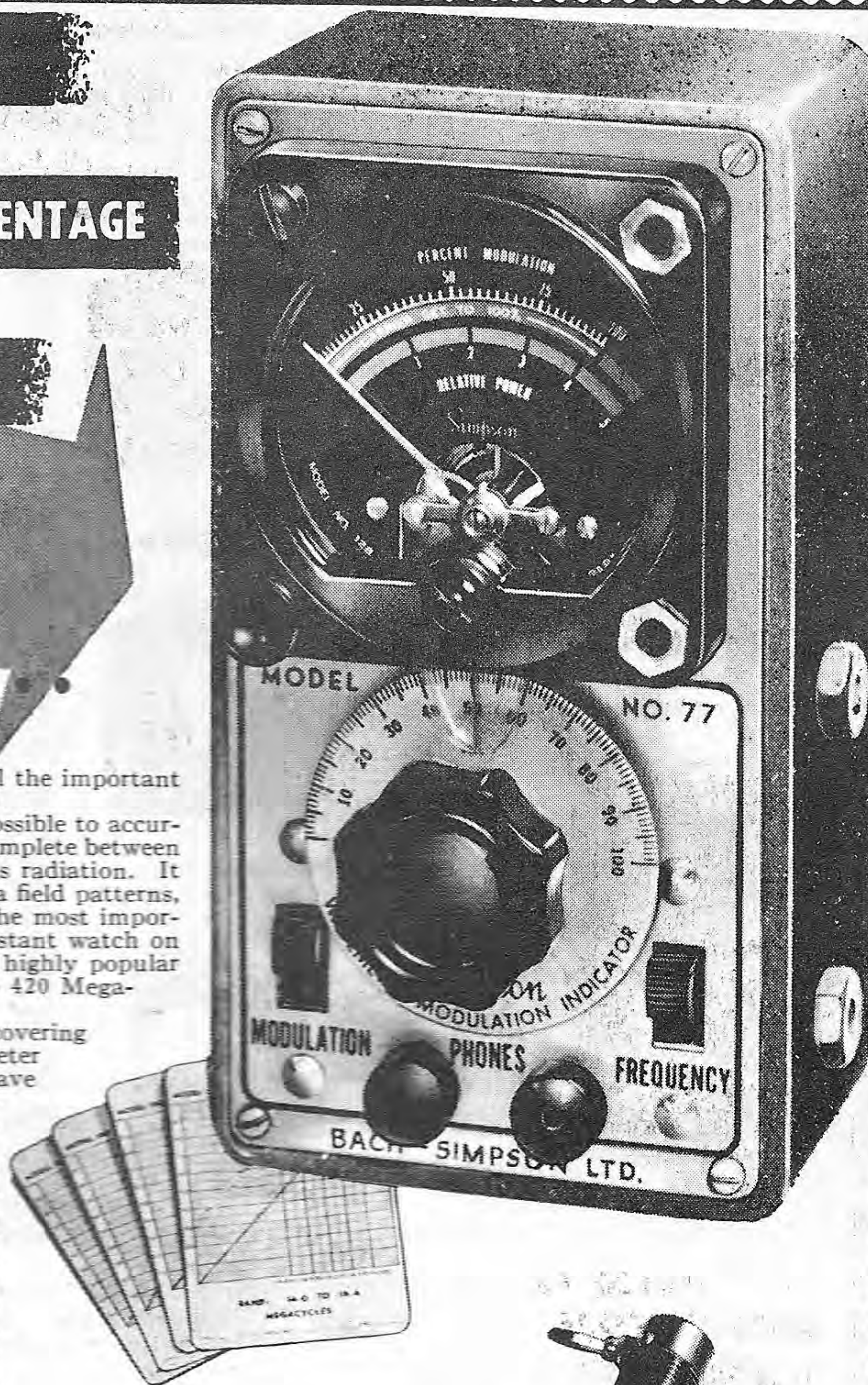
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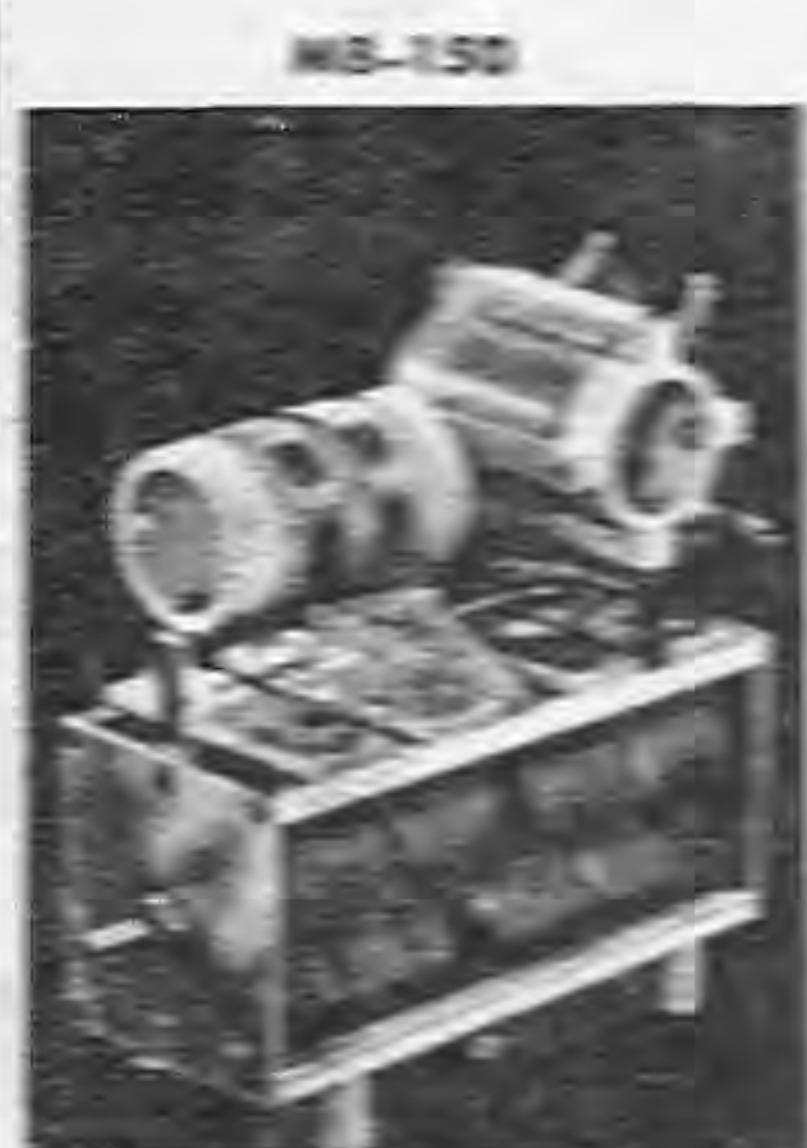


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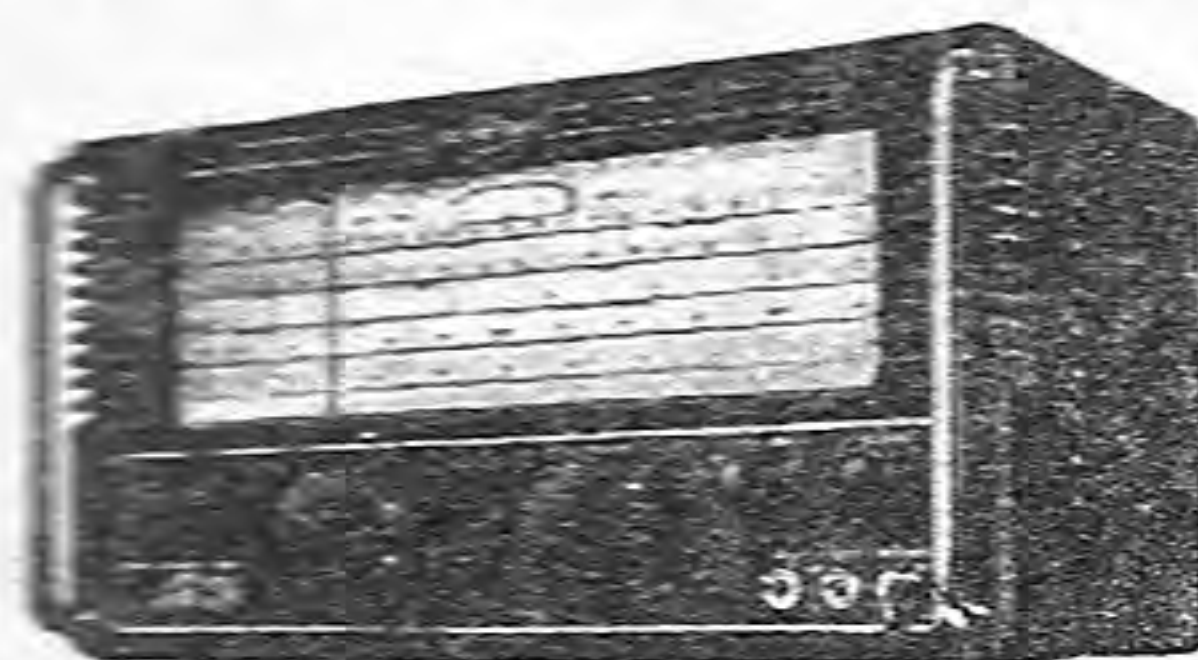
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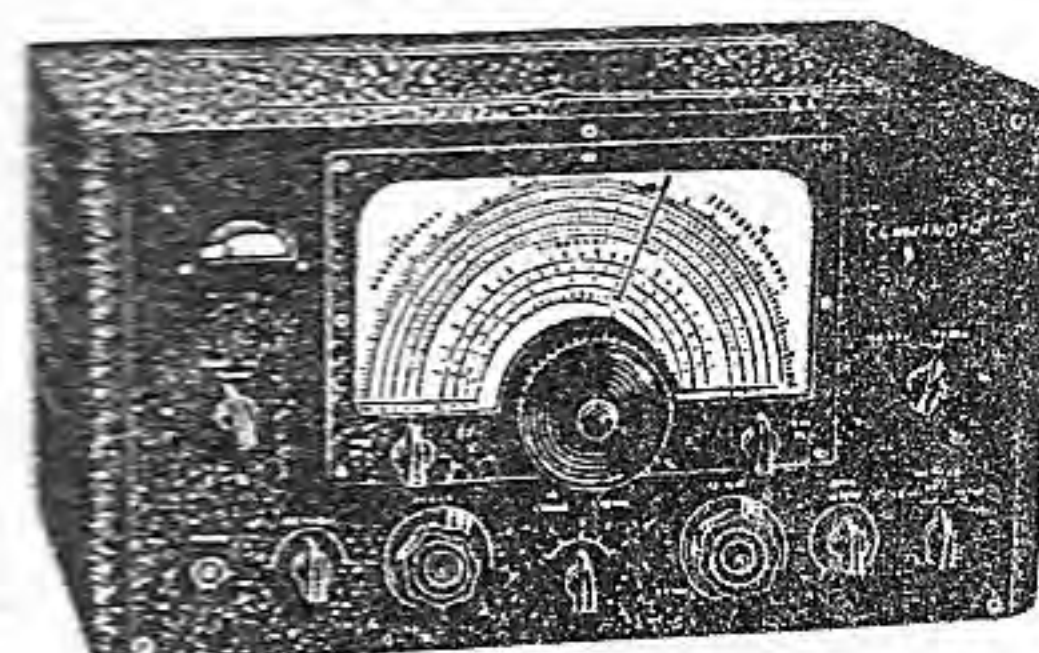
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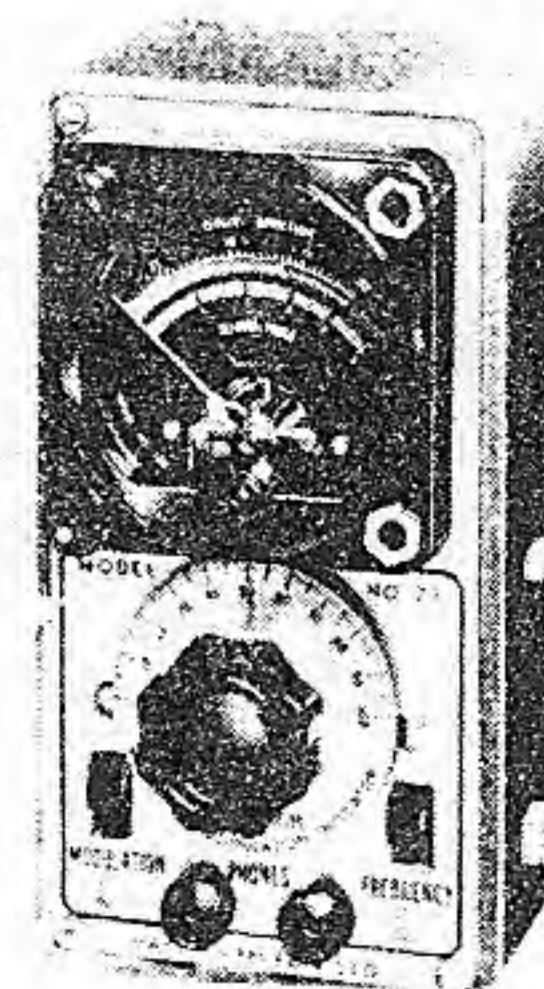
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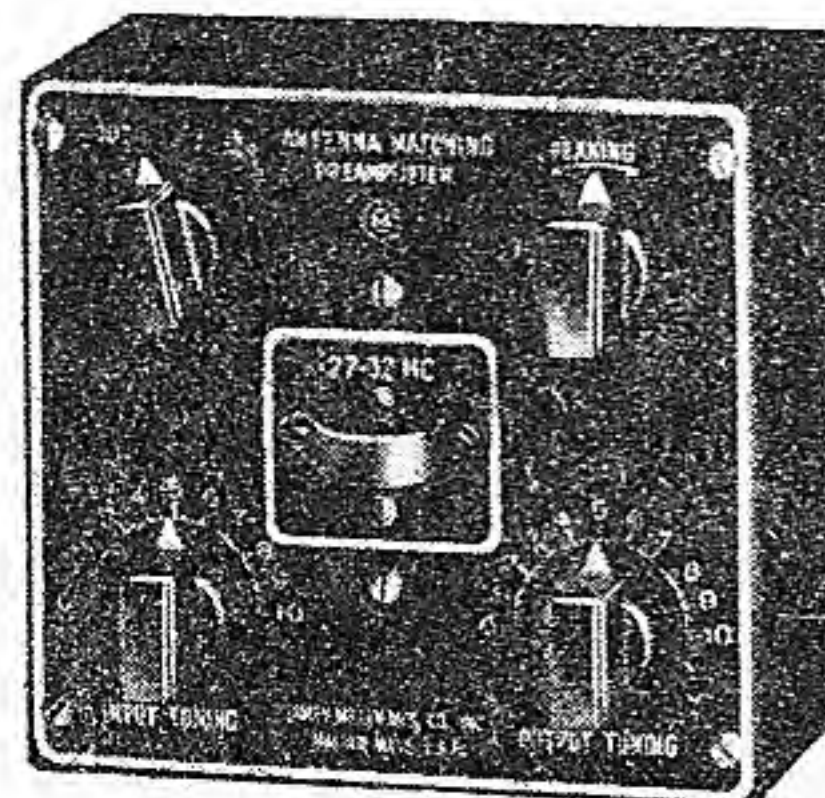
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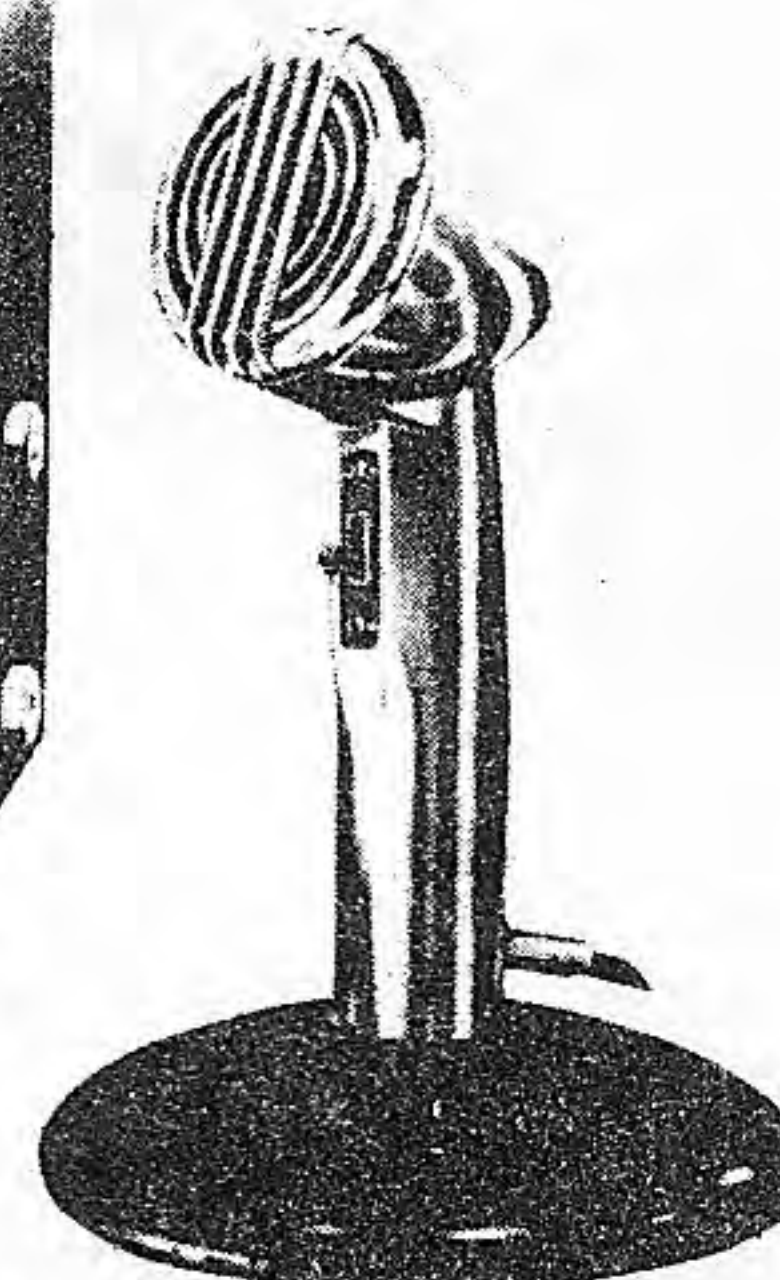
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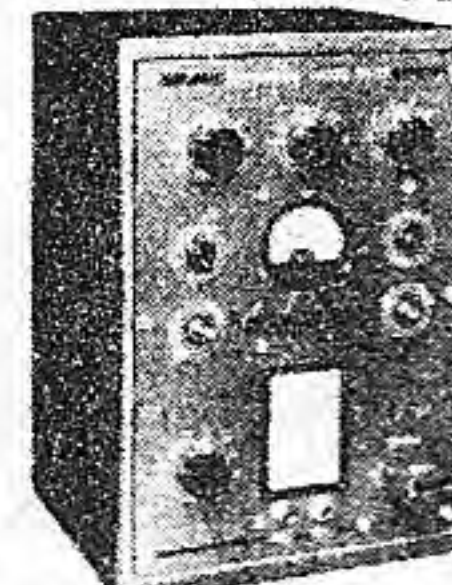


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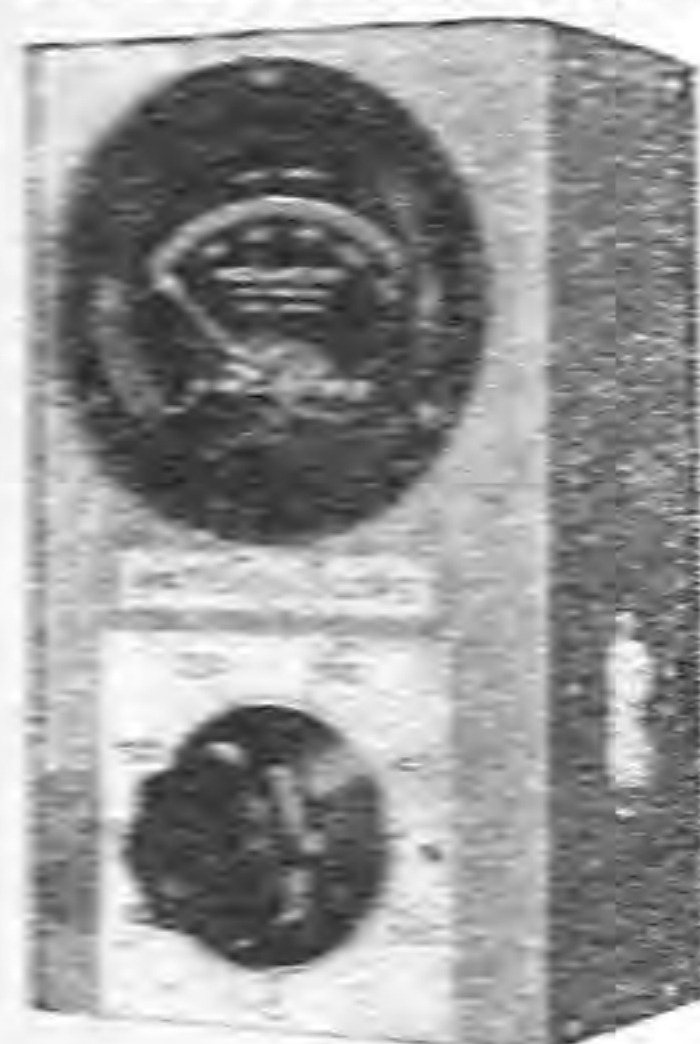
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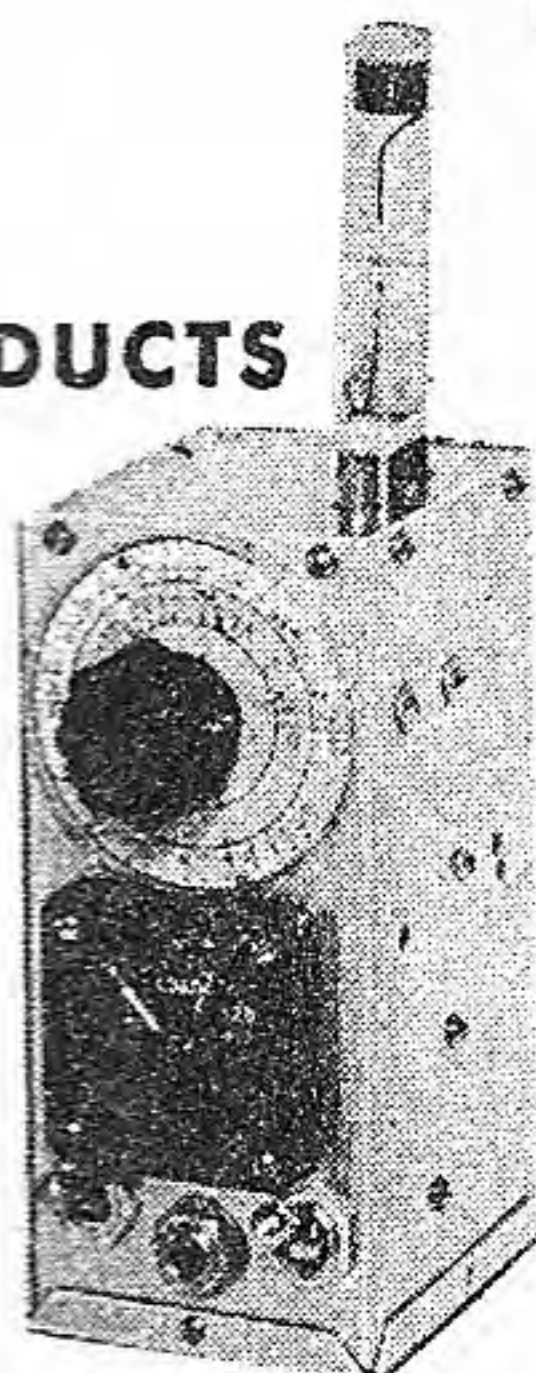
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Vol. 4

No. 2

Published monthly as

THE CANADIAN RADIO AMATEURS' JOURNAL

Editor - Fenwick Job, VE3WO

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February, 1951

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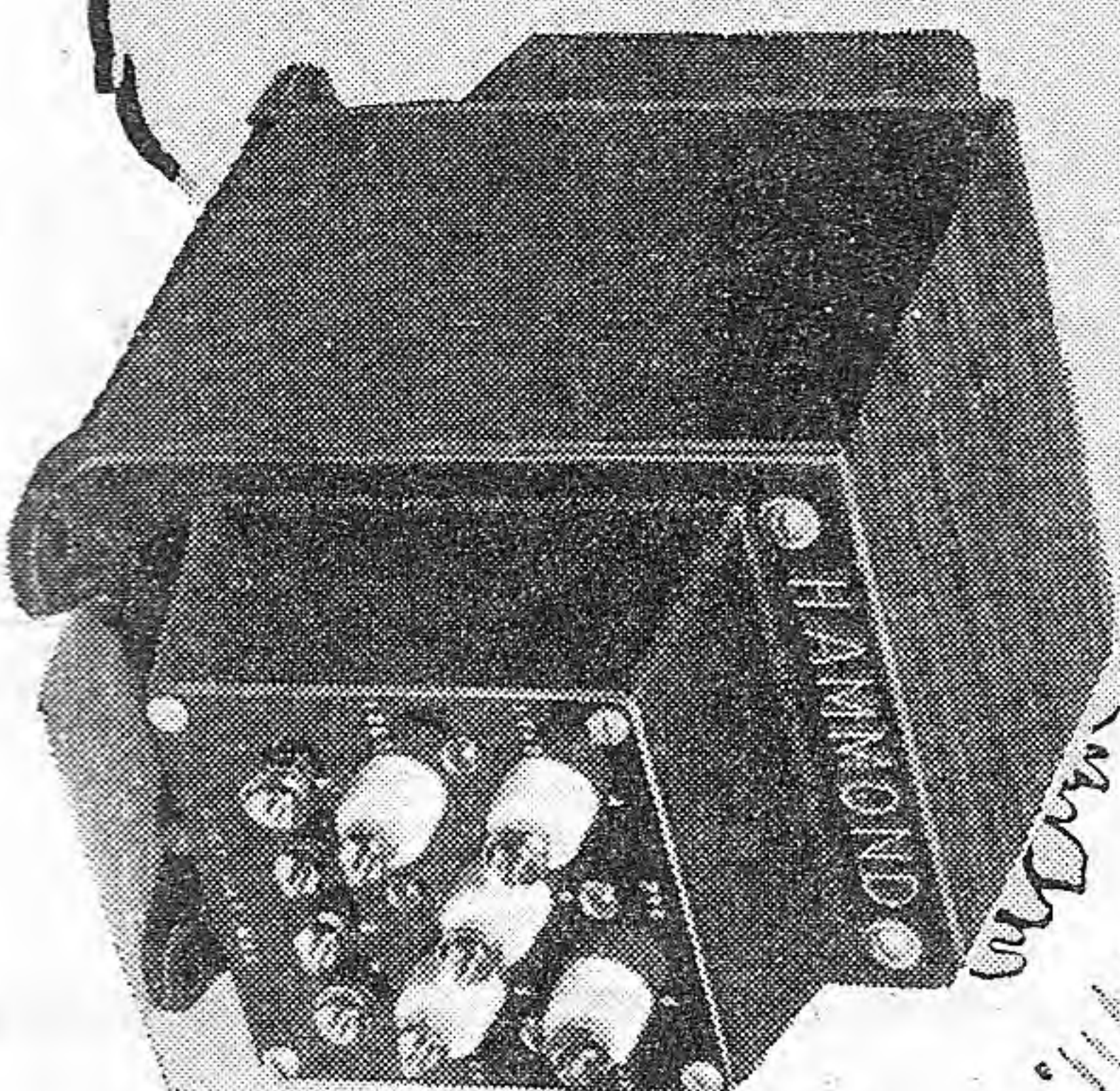
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SIDEBANDS

In the last couple of years, there has been a welcomed and ever increasing number of hams who have had the foresight to equip their cars with mobile-portable equipment. These installations have proven their worth already in several emergencies, and they will continue to provide a sure means of communication highly regarded by civil authorities.

Take a look at page 13 of this current issue. Official Broadcast number 276 is very significant, in that it allocates several amateur bands for W use during Wartime Civilian Defense crises. While not at this writing applicable to Canadian amateurs, it is significant that our regulations have closely paralleled those governing U.S. activity. Quite possibly those bands will be regulated here during an emergency, if one ever arises, in the same manner as they will be across the border.

Since our primary objective is communication work and public service as well as enjoyment of our hobby, it is very worthwhile to have a good, but simple, mobile-portable rig on hand for this possible disaster work. It will be a lot of fun to operate and will give you a thorough grounding in this very different type of hamming.

There are many fine installations that can be made in the back part of your car, home-grown or commercial products. Of the latter, from the standpoint of efficiency, and ease of operation, the Harvey Wells rig has no equal. A powerful and complete band-switching mobile or portable, it covers the bands allocated for disaster work, with a flick of a switch, and since both dynamotors (or vibrator) and AC power supplies are your source of power, it is completely flexible.

Other rigs which are widely used are those of the Command series, both low frequency and V.H.F. and their only shortcoming is

January, 1951

in not being able to flip from one band to another if needed, without a multiple rig installation. Still another possibility - an all-band home-grown type using the great National Multi-Band tank units!! If you ever use a rig with these in, you won't go back to coil plugging if you can help it.

Speaking of mobile - one of the big bugaboos is eliminating hash from your spark plugs. Many hams have disliked the thought of using suppressors, because of some things that have been said about them. That this thinking is definitely outmoded has been shown by the U.S. Signal Corps in a recent series of tests on army vehicles. The conclusions reached were several. First, rather than hindering cold weather starting, the resistor-suppressors actually improved it. And they by no means bring about horsepower loss, or reduced engine economy.

Page 132 of Radio and Television News for February, 1951 gives a full story on what Army engineers found. Inductive reactance seemed to be smoothed out, and shielding of ignition cables further helped. The conclusion was that suppressors were definitely beneficial, and not detrimental. In discussing this with Ted Pfeiffer of Erie Resistor, he added a couple of other very pertinent facts. One was that suppressors prolonged spark plug useful life up to ten times the normal given by the manufacturer. Ted used one set of plugs for an unbelievable sixty thousand miles. And he added that suppressors will show up a faulty plug faster than if you drove without them. So, install a set, drive a better car, and at the same time, decrease the amount of hash interference in your neighborhood.

This month, welcome to a great new Canadian Electrical Supply store for Western hams. In the C.E.S. tradition, this Edmonton store will serve the West quickly and completely. With three stores now, C.E.S. ranks as the largest radio supply organization in Canada.

REDUCING THE QRM

By Cutting the Cackle

By THE OLD TIMER

ON all sides we hear the mystic phrase "QRM" being bandied about by all and sundry. It always has been, and it always will be. It is, unfortunately, something that is always increasing and never diminishing. The growth of Amateur Radio has been the growth of QRM, caused simply by the ever-increasing numbers of stations pouring into our all-too-narrow bands.

It has been splendidly coped with, in the five years preceding the war and in the post-war years, by the improved quality of transmissions and, even more, by the development of more and more selective receivers. If you want to know what it could be like, use a 0-V-1 receiver on the CW part of the 3.5 mc band any evening after about 2230.

The almost universal adoption of good VFO's giving T9 or T9x notes has improved the state of the CW bands; the general increase in the use of speech-clipping, or, at any rate, modulation monitoring, has reduced the "splash" trouble considerably. But still we suffer from worse QRM than we used to in the days when most notes were T6 and most receivers were 0-V-1, simply on account of the population.

What is the obvious thing to do to reduce it further? I suggest that the matter is largely in our own hands. It could be reduced to pre-war level *to-morrow* if we all cleaned up our operating procedures, both phone and CW.

Cut the Cackle

The proverbial Sussex farmer who said "Cut the cackle and come to the 'osses" must have had a vision of Amateur Radio. Had he seen it more clearly, he would have added "And after the 'osses, cut the cackle again!" Our chief cause of suffering, believe me, is the trait of not knowing when to stop.

Listen to the average QSO (on either phone or CW—I don't hold a brief for either

Not everyone will agree with the views so forcibly expressed by our aged mentor, steeped in many years of practical experience—but he does at least offer some useful suggestions on a topic of pressing importance.—Editor.

method). The long-drawn-out good-byes, the afterthoughts, the multiple signing-off. Several times I have heard QSO's drag on for twice the length they should have been if the participants had only collected their thoughts. You all know the stuff: "Well, old man, I can't really think of any more to say . . . oh, by the way, did I tell you that I had tried out that so-and-so . . ." and then we're off again.

But even *then* it isn't over. "Well, I may as well sign off now, if you haven't anything further. So I'll come over for your final and then I must QRT. Just tell me whether you've heard anything of so-and-so . . ." And so the other chap's "final" leads on to another lengthy discussion, for at least another two "overs" from each end, after which the same thing happens in reverse.

Recently I heard two phone stations give four "finals" each, and then, as they were signing off, a third station called them both and the whole thing turned into a three-way which went on for another half-hour. What was so striking was the fact that at least fifteen minutes of this half-hour was spent in saying "Well, I really shouldn't stop on any longer . . . we were just going to QRT . . . I really intended that one to be my final . . . This time it really *must* be my final . . ." (But was it? You bet your life it wasn't.).

For goodness sake let us cut out this sort of senseless prattle. It wouldn't take place over the landline, where people have to *pay* for time; but on the air, where everyone else has to pay for it, there is no limit to it.

In the "good old days"—and they really were good in many ways—we were licensed as experimental stations and the subjects of conversation had to have a pretty close bearing on technical matters. Nowadays they seem to be invented as the QSO goes on, so that many contacts bear a close resemblance to a languid conversation alongside a bar or a weekly Sewing Circle.

Why should our narrow slices of the spectrum be used for time-wasting conversations that wouldn't even take place in the street if two people met face to face? If we all used needle-sharp beams and conversed with one another only, it might not be so bad, but all at large have to put up with the pointless chatter. Furthermore, some operators sound suspiciously as if they know this and therefore show off their "knowledge" all the more.

For the love of Pete, talk to some effect and stick to the point, if you happen to know what it is !

I have heard a G and a W6 get through an entire fast ragchew, exchanging quite a lot of news on either side, in the time it has taken another G to tell a *local* his name, QTH and the fact that he is using 150 watts and a dipole.

Slow Morse is all very well for those who have just passed the Morse test; but why don't some of them ever improve? I'll tell you—because the man at the other end sends doubles, slowly, and because a slow CQ is usually answered by another slow station. It's time we had more fast operators on the air, considering the time that some of them have been using CW. Remember that fast operating is not just a matter of showing off: it gets through the QSO in a shorter time and does more to reduce the QRM than any other single factor.

Fast operating on phone can also be learnt and put into practice. It doesn't sound abrupt or rude; it merely gives the impression that the operator knows his business, knows what he wants to say and is keen on finishing a QSO when it really is finished, instead of letting it die painfully for ten minutes.

Time-Wasting on Nets

"Nets" are a prime cause of wasted time, largely because all those who are dragged into them have to be "genned-up" with everything that has gone before, and also because everyone seems to feel that it is incumbent upon him to add tone to the conversation and to wax humorous over something or other. Remember, please, when you're in a net that you are a radio operator and not a star in the Bob Hope Programme.

February, 1951

By now a lot of people reading this will be ready to form the impression that all the friendly side of Amateur Radio would be killed if these suggestions were adopted. I refuse to believe a word of it. Personally I feel a far more friendly glow towards the man at the other end who has given me a slick, well-operated QSO than I ever do towards someone who has kept me chained to one frequency listening to a string of platitudes and a description of a by-no-means clever rig which at the moment is not working very well. If there is one thing that does *not* strike me as funny it is being told that "My PA seems to be full of parasitics (Hi); this 807 doesn't like 700 volts (Hi); and I don't know what's happened to the modulation but the monitor isn't working (Hi); I really ought to take time off for a rebuild (Hi)." Without the "Hi" part of it I might feel a small amount of sympathy for a struggling sufferer whose gear really is playing him up; but the "Hi's" put such an air of self-satisfaction into the whole thing that I feel like advising him to carry out future QSO's on a postcard. On CW you will hear a man who has just been given an RST 589 report go back and tell the other chap that he is "RST 589, 589, 589, RST RST 589, 589"; five minutes later you will hear him repeating his QTH and name three times.

The reason why I have dwelt on all these points (which to many may seem trivial) at some length is this: That by cleaning up our procedure along the lines as suggested we can *at once* reduce the QRM by an amount which would not be possible by any technical means in less than ten years. No number of Q5'ers, Rotary Beams, audio filters or even reductions in power could possibly effect such an instantaneous clean-up as this simple domestic reform among ourselves. And don't argue that the other countries won't do it—*someone* has to start it. We once used to have a reputation for starting things, and that isn't a bad reputation to have; let's do it again.

First, do it yourself—and then don't hesitate to suggest to the other half of your contact that he should do likewise. You may even work someone who suggests that *you* should cut down the verbiage a bit—and that will be the first sign that things are moving.

Page 7

Modulator Pre-Amplifier

Design for a Useful Unit

By C. B. RATHBY

THE unit which is here described was evolved after considerable difficulty had been experienced in overcoming hum and RF feedback troubles in a high-gain modulator when the early stages were in close proximity to the main transmitter.

Advantages

The amplifier has three main advantages: (a) Freedom from RF feedback, as it can be located well away from the PA and easily screened; (b) Freedom from induced AC hum, for the same reason; (c) Versatility; it can be used to feed any type of modulator or public address amplifier, even if located at considerable distances from the pre-amplifier, provided a suitable input stage is added.

Low impedance coupling is advisable between the pre-amplifier and the main modulator to avoid hum pick-up on the coupling line. Originally, identical transformers with 600-ohm windings were used "back-to-back" to couple from the pre-amplifier to the main modulator. However, even when parallel-fed, a serious loss in quality resulted, together with some hum pick-up by the input transformer at the main modulator end. Eventually, the circuit of Fig. 1 was evolved for the pre-amplifier.

V1 is in an orthodox circuit and can be altered to suit a crystal microphone if desired. The output from this stage feeds V2 in a cathode follower circuit, the output being taken from V2 cathode via 72-ohm coaxial cable.

In many stations, it becomes desirable, if not essential, to provide a pre-amplifier between microphone and speech amplifier-modulator: this enables the microphone lead to be kept short and also facilitates disposing the various units in such a way as to eliminate hum pick-up. A small input amplifier of this kind is useful for other purposes, as our contributor suggests in his article below.—Ed.

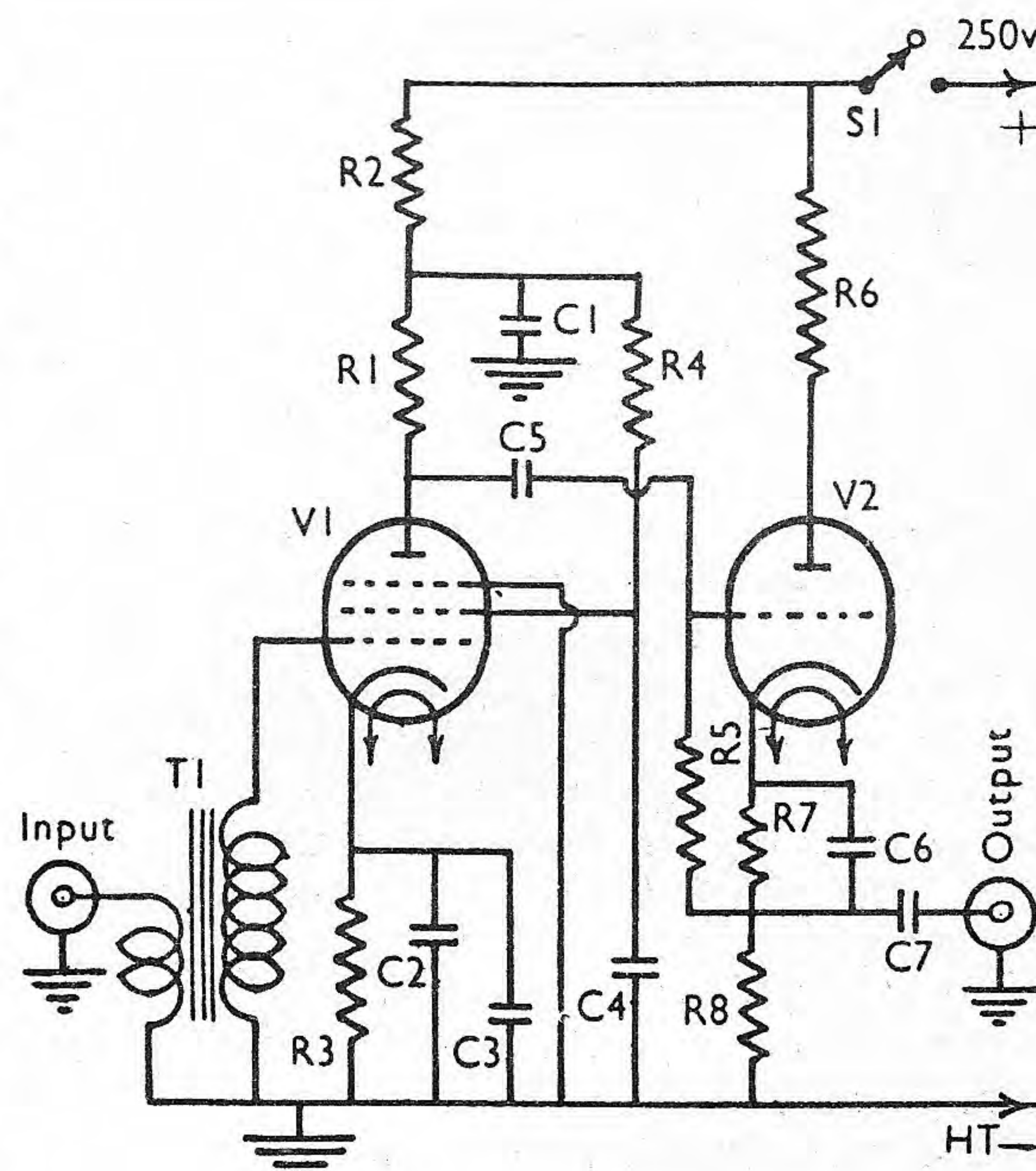


Fig. 1. Circuit of the pre-amplifier.

Table of Values

Fig. 1. Pre-Amplifier Unit

C1	= 8 μ F elect., 350 volt DC working
C2, C6	= 25 μ F elect., 25 volt DC working
C3, C4, C5	= 0.1 μ F paper, 350 volt DC working
C7	= 0.5 μ F paper, 350 volt DC working
R1	= 100,000 ohms 1 watt
R2, R6	= 50,000 ohms 1 watt
R3	= 500 ohms $\frac{1}{2}$ watt
R4	= 500,000 ohms $\frac{1}{2}$ watt
R5	= 1 megohm $\frac{1}{2}$ watt
R7	= 1,000 ohms 1 watt
R8	= 4,700 ohms 1 watt
S1	= Toggle on-off
T1	= Microphone transformer, mu-metal screened
V1	= 6J7
V2	= 6J5 (or equivalent)

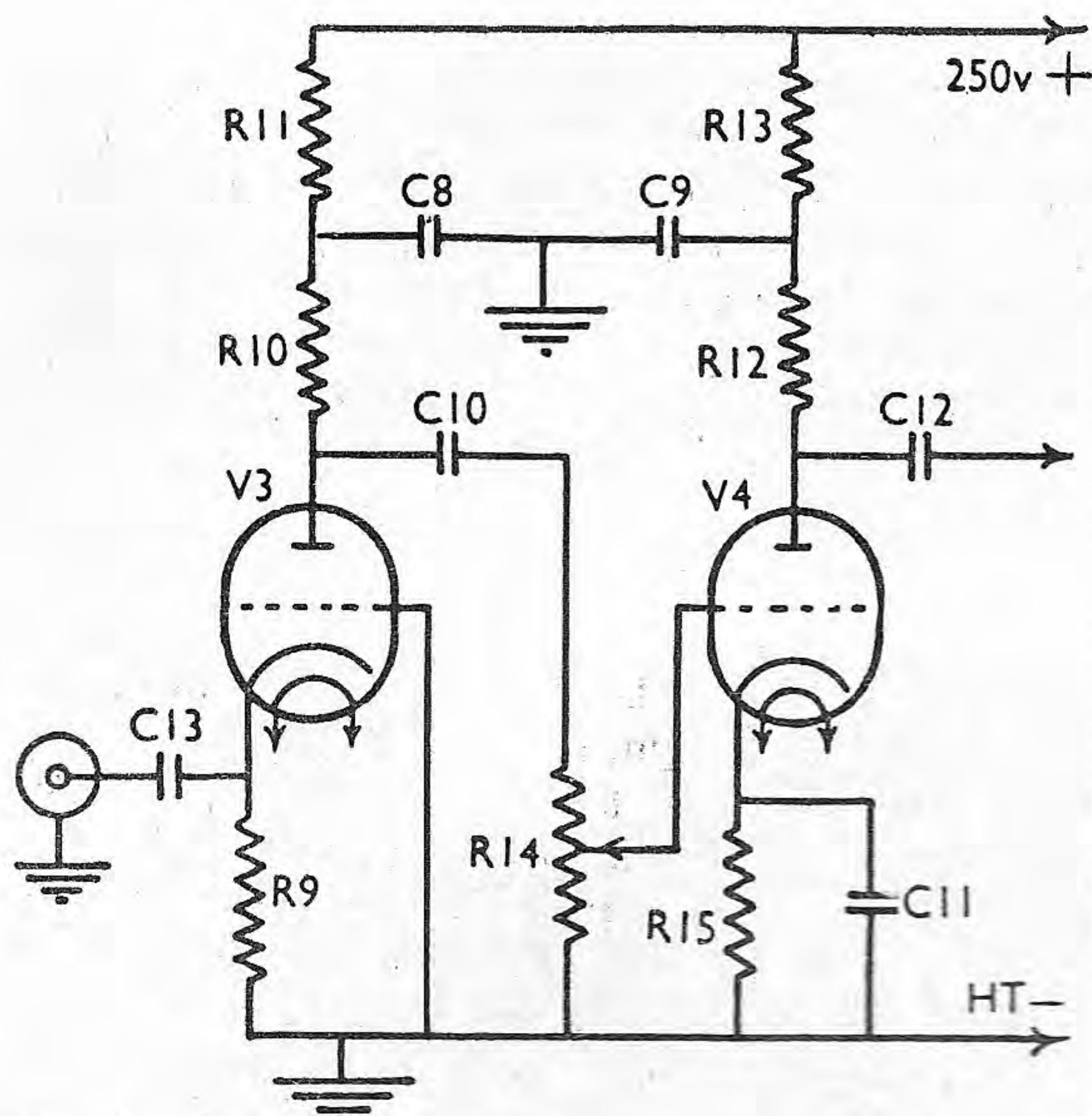


Fig. 2. Circuit for the input stage of the main modulator.

Fig. 2. Input Stages of Main Modulator

- C8, C9 = Dual 8 μ F elect., 350 volt DC working
 C10, C12 = 0.1 μ F paper 350 volt DC working
 C11 = 25 μ F elect., 25 volt DC working
 C13 = 0.5 μ F paper 350 volt DC working
 R9 = 330 ohms 1 watt
 R10, R12 = 50,000 ohms 1 watt
 R11, R13 = 20,000 ohms 1 watt
 R14 = 1 megohm variable
 V1, V2 = 6J5 or equivalent

At first the output from the pre-amplifier was fed into the 600-ohm winding of a transformer which drove the grid of the first valve of the main modulator. This was fairly satisfactory, but distortion and hum still existed and it was obvious that some type of input which did not need an input transformer was wanted. After much trial the arrangement shown in Fig. 2 was tried and has proved most satisfactory.

Controls

It may appear strange that no volume control is fitted to the pre-amplifier. In many installations one would probably be desirable and should be fitted in place of R5 in Fig. 1; such a control was not used in the writer's case because the gain control (R14 in Fig. 2) happens to be conveniently placed.

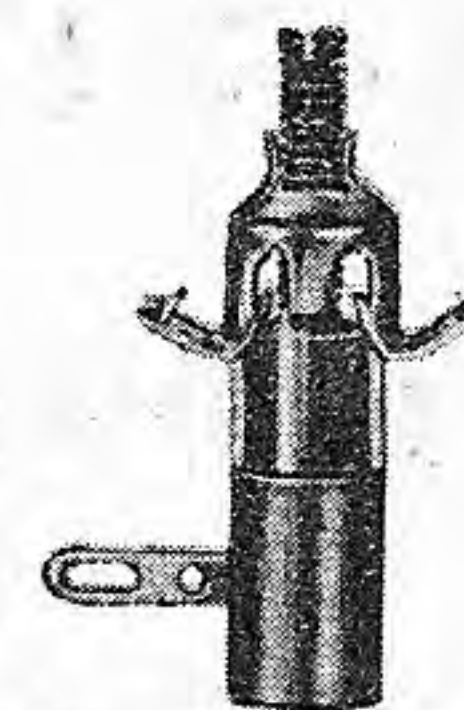
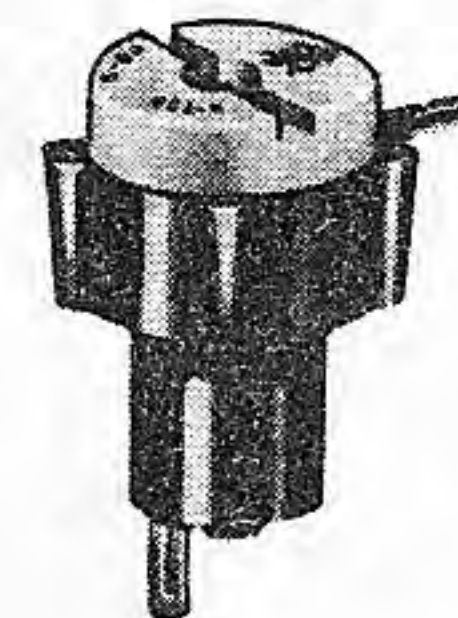
February, 1951

Type 557
Ceramicon
Trimmer



1.5-7 MMF
3-12 MMF
5-25 MMF
5-30 MMF
8-50 MMF

Type 554
Ceramicon
Trimmer



Type 531 and 532
Tubular Trimmers
0.5-5 MMF
1-8 MMF



Type TS2A Ceramicon Trimmer
1.5-7 MMF 3-13 MMF 4-30 MMF
3-12 MMF 5-20 MMF 7-45 MMF



Type 535

Tubular
Trimmer
.75-3 MMF



Type 720A
Insulated



Types 323
and 324
Insulated



Type 2322

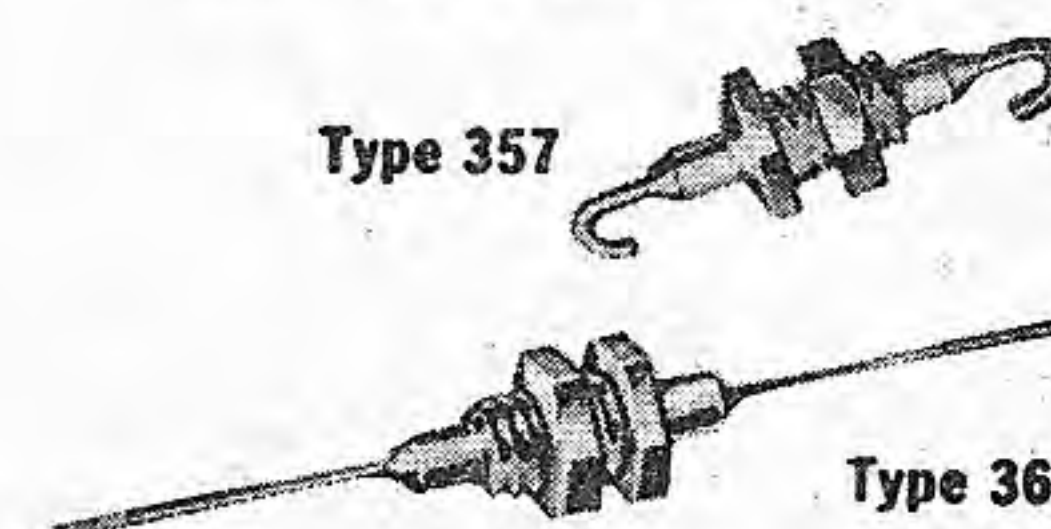


Type 2336



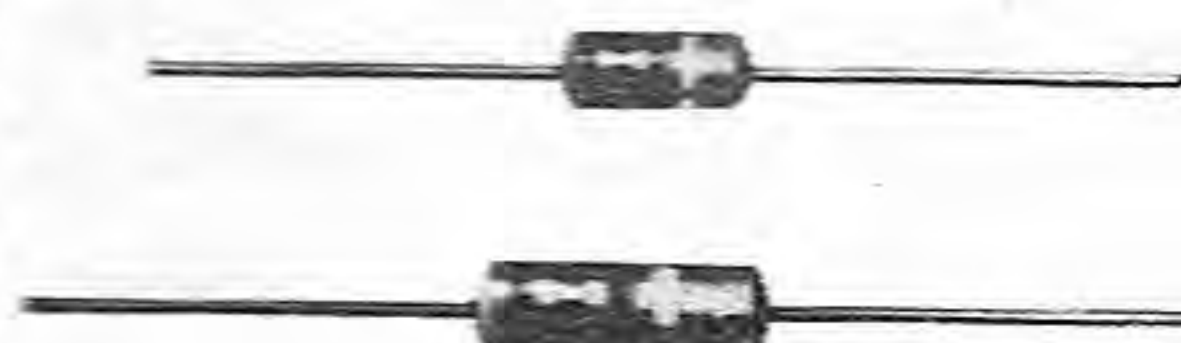
Type 325

Type 357

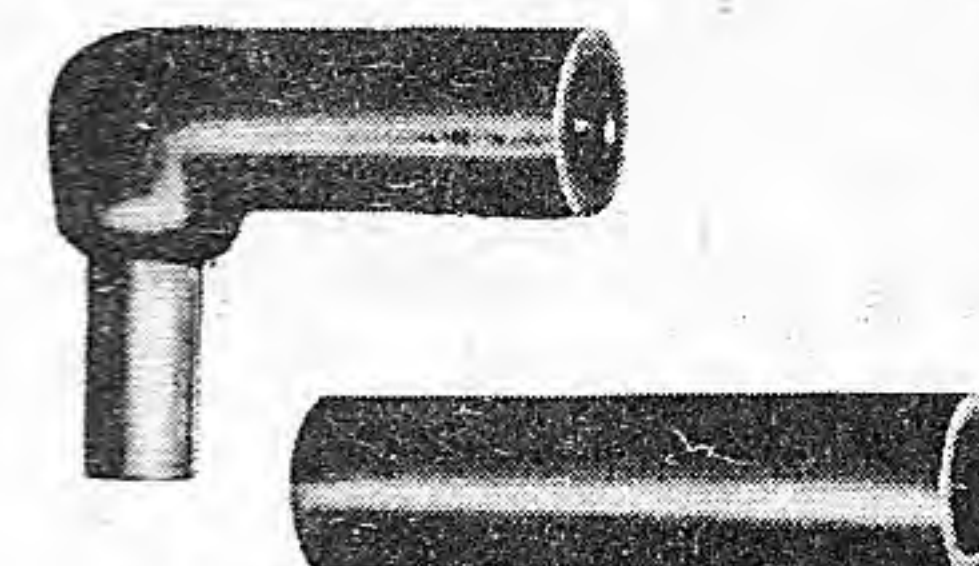


Feed-Thru Ceramicons
5 MMF—1,000 MMF
5 MMF—1,500 MMF

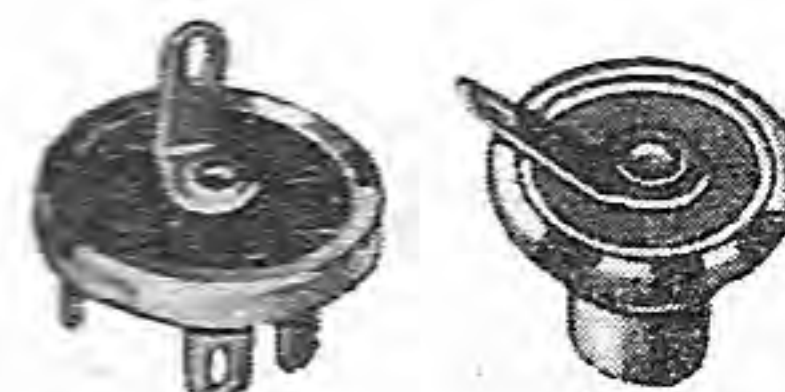
Erie Stand-Off Ceramicons
5 MMF—5,000 MMF



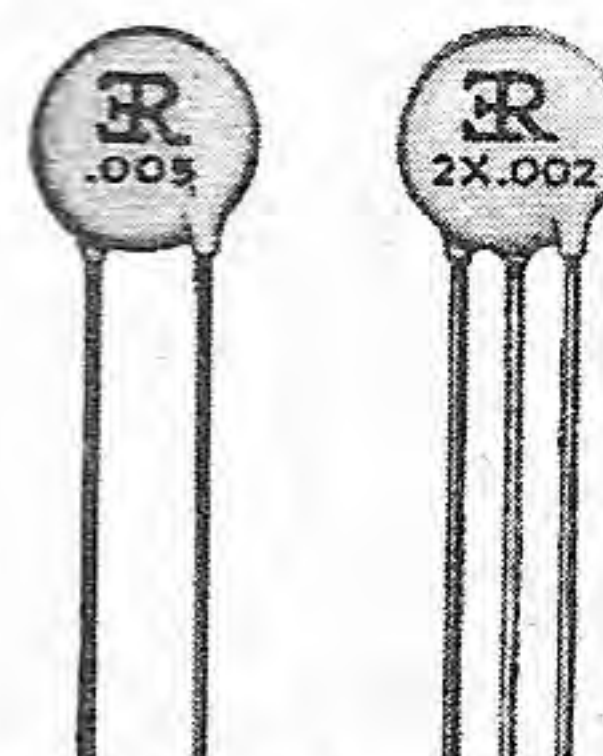
1/2 Watt 1 Watt
Resistors
10 ohms—22 megohms



Types L-4, L-7, S-5 Suppressors
for Spark Plugs and Distributors



Button Mica Condensers
15 MMF—6,000 MMF



Erie Disc Ceramicons
Up to .01MFD



Erie "GP" Molded Insulated Ceramicons
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BASS CUTTING

To Improve Readability

By R. C. RAY, B.Sc., A.R.C.S.,
Assoc.Brit.I.R.E., (G2TA)

THE old adage "you can't work 'em if you can't hear 'em" is no doubt very true, but more properly it ought to run "you can't work 'em if you can't *read* 'em." That this is generally realised today is evidenced by the various designs for Q5'ers which have appeared in the literature. The idea that improved readability can be obtained by restricting the audio bandwidth has also received some attention, and there are few of us today whose receivers do not employ at least a simple "top cut" tone control. In modulator design too, more people are making use of restricted range amplifiers; they are of course essential if any form of speech clipping is used. It seems, however, that few operators realise the advantages to be obtained by cutting out the bass notes, and it is proposed to mention these briefly at this point.

The Factors

Extensive tests carried out during the war have shown that the normal bass tones (up to about 300 cycles) contribute relatively little to readability under weak-signal conditions. However these same bass tones comprise quite a large proportion of the power in normal speech. So it can be seen that if modulation is restricted to 100 per cent on peaks, then the lower frequencies will be the ones which set a limit to the modulation depth when using "high fidelity" equipment. Restriction of the bass therefore enables the carrier to be modulated more deeply by the intelligence-carrying tones before 100 per cent. modulation is reached. This simple fact is of course the origin of the idea that you "want plenty of top to work DX"—though admittedly there are two schools of thought on the subject.

From the receiving point of view, too,

Our contributor argues the case for bass attenuation to gain the advantages of more intelligible speech under QRM conditions, deeper average modulation and more efficient operating conditions on both receiving and transmitting sides. He suggests some simple circuitry, worth trying to establish the facts.—
Editor.

restriction of the bass offers several advantages. For example, a signal read through a crystal filter will show an apparent increase in low tone due to attenuation of the higher frequency sidebands. This often makes the speech boomy, and in the presence of noise and splatter the readability can be very poor. But if the incoming signal starts by lacking in bass tones this effect practically disappears, and readability is not impaired. So, to the transmitting amateur, bass cutting gives improved readability owing to the greater *useful* modu-

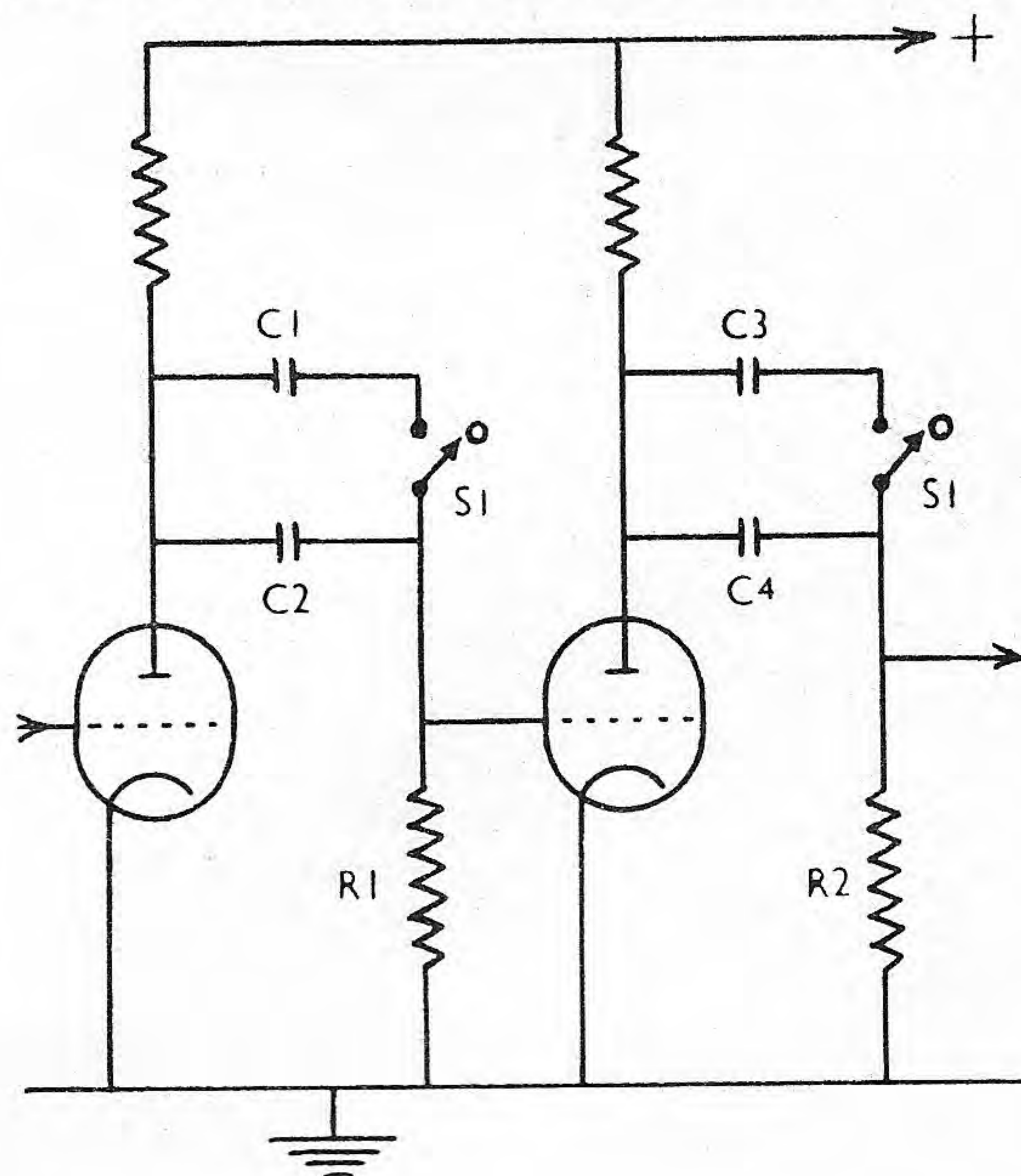


Fig. 1. Applying bass attenuation to a receiver or speech amplifier having two stages suitable for modification (see text). Values are: C1, C3, 0.1 to 0.01 μ F; C2, C4, 0.01 to 0.001 μ F; R1, R2, 500,000 ohms.

lation depth which can be employed and to the greater readability obtained under QRM conditions.

Receiver Side

To those requiring the utmost in receiver performance, the inclusion of a simple bass reducer will also be found very beneficial. In addition to improving the readability of normal signals through the crystal filter, bass cutting makes an even greater improvement where the signal is frequency-modulated at power frequencies, as is often the case with some of the mid-European and Latin-American stations. Here the crystal converts the unintentional FM to AM with the result that the speech is drowned out by hum on bringing in the crystal. This is normally of such a low frequency (25-50 cycles) that it disappears completely when the bass cut is employed. Low frequency heterodynes are correspondingly reduced (especially the "zero beat" type) while rapid flutter is also reduced to some extent. In addition, ignition noise is surprisingly reduced when the circuit follows a not too effective noise limiter. The limiter removes the high frequency components, but leaves a low pitched buzz which the bass attenuation takes out completely. Finally, a useful check on incoming "quality" is provided by switching in the attenuator—if it makes practically no difference to the voice quality then the signal may be reported as having very little bass component.

The above arguments show that the inclusion of a bass attenuator is very desirable in both receiver and modulator, and once installed, the average operator would never be without it. The circuit changes are fortunately very simple, and both receiver and modulator can be modified in about an hour.

Circuits

Generally speaking, interstage coupling condensers are of the order of $\cdot 01$ to $0\cdot 1 \mu F$ and at least two such couplings usually exist. These should be replaced by condensers of *one-tenth the original value* and arrangements made to return the original condensers into circuit by means of a switch (Fig. 1). If only one stage of capacity coupling can be changed, then the circuit of Fig. 2 should be used,

February, 1951

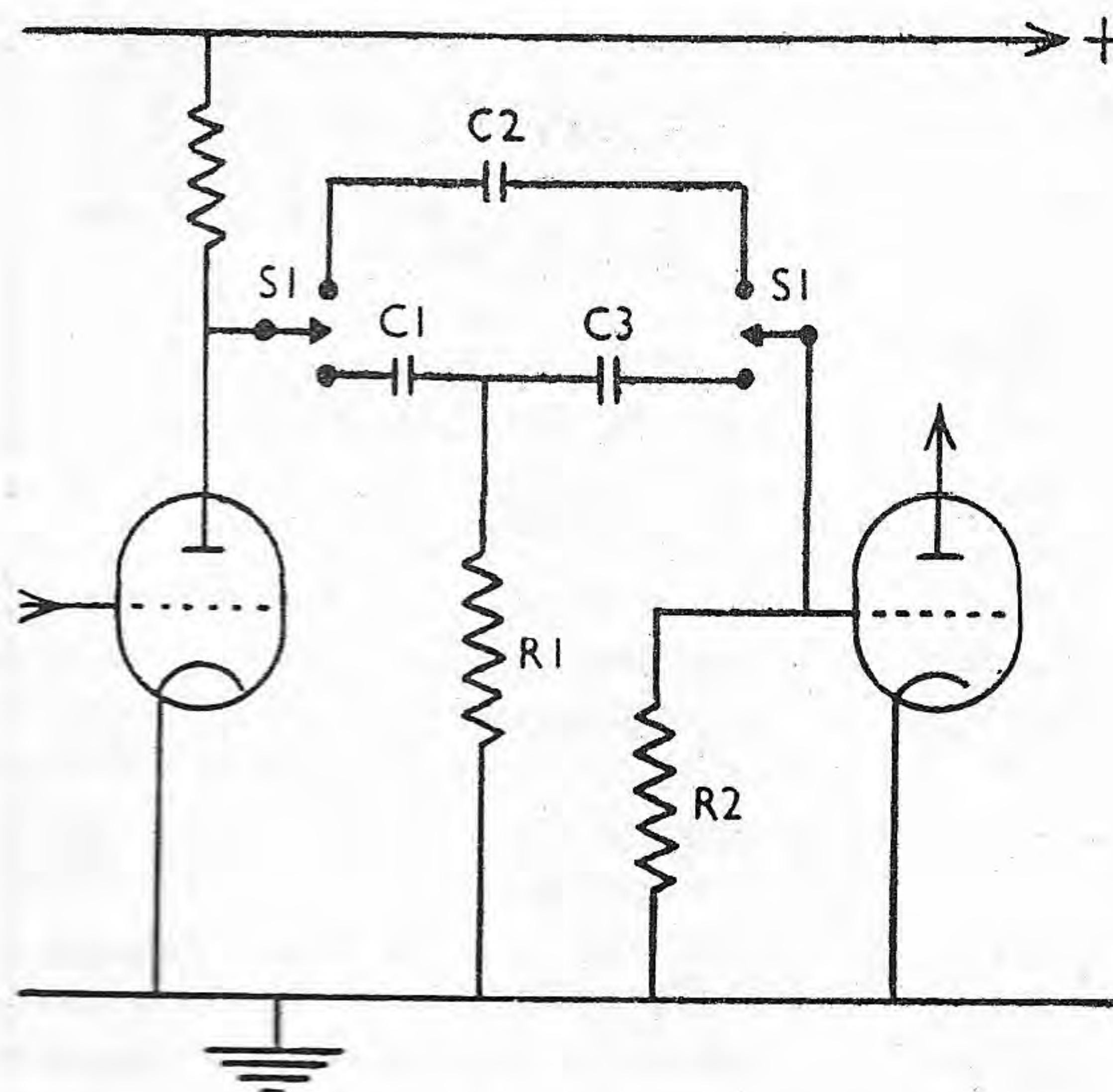


Fig. 2. Where only one inter-stage AF coupling unit can be opened, a suitable circuit is as shown here. C1, C3, $\cdot 01$ to $\cdot 001 \mu F$; C2, $0\cdot 1$ to $\cdot 01 \mu F$; R1, R2, 500,000 ohms.

since a better cut-off characteristic is obtained by several small steps than is possible in one large one. A simple DPST toggle switch will handle two stages satisfactorily and no trouble due to AF instability should be experienced.



"... Wotcha mean, poor quality only S3, pull the string tighter then ..."

DX QTH'S

AR8BC	Selim Chaeb, Rue Abdel Kader, Beirut, Lebanon.
CR7AY CR7BB	Box 812, Lourenco Marques, Mozambique.
CR7VAL	Aeradio, Quelimane, Mozambique
FT4AB	10 Boulevard Didon, Carthage, Tunis.
FT4AC	Henri Devaux, La Marsa, Tunis.
HK3FF	Box 584, Bogota, Colombia.
HZ2TG	c/o WØZRA, 805 South Lake, Sioux Falls, S. Dakota.
KV4AD	Box 171, Christianstad, St. Croix, Virgin Is.
KZ5ES	Box 658, Howard Field, Panama Canal Zone.
KZ5NB	US Naval Station, Balboa, Panama Canal Zone.
MD1H	Cyrenaica Signals Sqdn., Benghazi, MELF 6.
MD1I	LAC J. O. Brown, RAF El Adem, MEF 7.
MD1J	Sgt. A. Spillett, RAF El Adem, MEF 7.
MD5NB	L/Cpl. N. B. Wright, No. 1 Sqdn., 3 GHQ, Signal Regt., Fayid, MELF.
MD7DA	Maj. D. MacDonnell, R. Sigs., Cyprus Signal Sqdn., MELF 3.
OX3BC	c/o Arctic Weather Bureau, Washington, D.C.
OX3GE	AP0 859, c/o PM, New York City.
VQ2DH	Box 93, Livingstone, Northern Rhodesia.
VQ8AY	Ed. Goldsmith, Phoenix, Mauritius.
VQ8AZ	P/O R. J. A. Small, R.N., 15 The Camp, Phoenix, Mauritius.
YA3B	Box 5, Kabul, Afghanistan.
ZD1BD	Capt. S. B. Duke, Royal Sigs., Sierra Leone and Gambia Signals Sqdn., Freetown, Sierra Leone.
ZD4AT	Capt. E. J. Devaney, RASC, School of Infantry and Education, Teshi, Accra, Gold Coast.
ZS3G	Box 513, Windhoek, South-West Africa.
ZS4P	J. D. Leask, Tosing, Quthing, Basutoland.
ZS6OL	c/o RAF, Gaberones, Bechuana-land Protectorate.

DX QTH's

AG2AG	AP0 209, US Army, Trieste, F.T.T.
EK1AD	Spanish P.O. Box 2, Tangier.
FO8AC	c/o Radio FZP, Papeete, Tahiti.
HZ1AB	via W8UMQ (Station in Saudi Arabia).
I1YAT	Apiari Street 4, Trieste.
KG6IC	6254 ABU, AP0 264, Unit 1, c/o PM, San Francisco. (Station on Iwo Jima.)
LZ3SD	Stoianov, Korab 25, Sofia, Bulgaria.
MO1A	13/18 Royal Hussars, MELF 6,
OQ5RA	Box 271, Leopoldville, Belgian Congo.
VP9T	S/Sgt. S. Weiss, HQ 137 Sqdn. AACS, AP0 856, PM, N.Y.C.
VS2CH	BM/CQJ, London. W.C.1.
VS2CP	Phil Zeid, Linden Estate, Scudai, Johore.
VS7LA	Cpl. L. Adams, SHQ Sigs, RAF Koggala, Habaraduwa. Ceylon.
ZB1AR	Sgt. Watson, REME Workshops, AP0, Malta.
ZE2KH	Box 390, Salisbury, Southern Rhodesia.
ZL1GN	Ben Wallich (G6BW), c/o National Bank of N.Z., Box 18, Auckland.



.... Worked any DX this morning, dearie ?
(With apologies to Joe's YL)

Skywire

HOW'S UR OBS IQ?

The American Radio Relay League

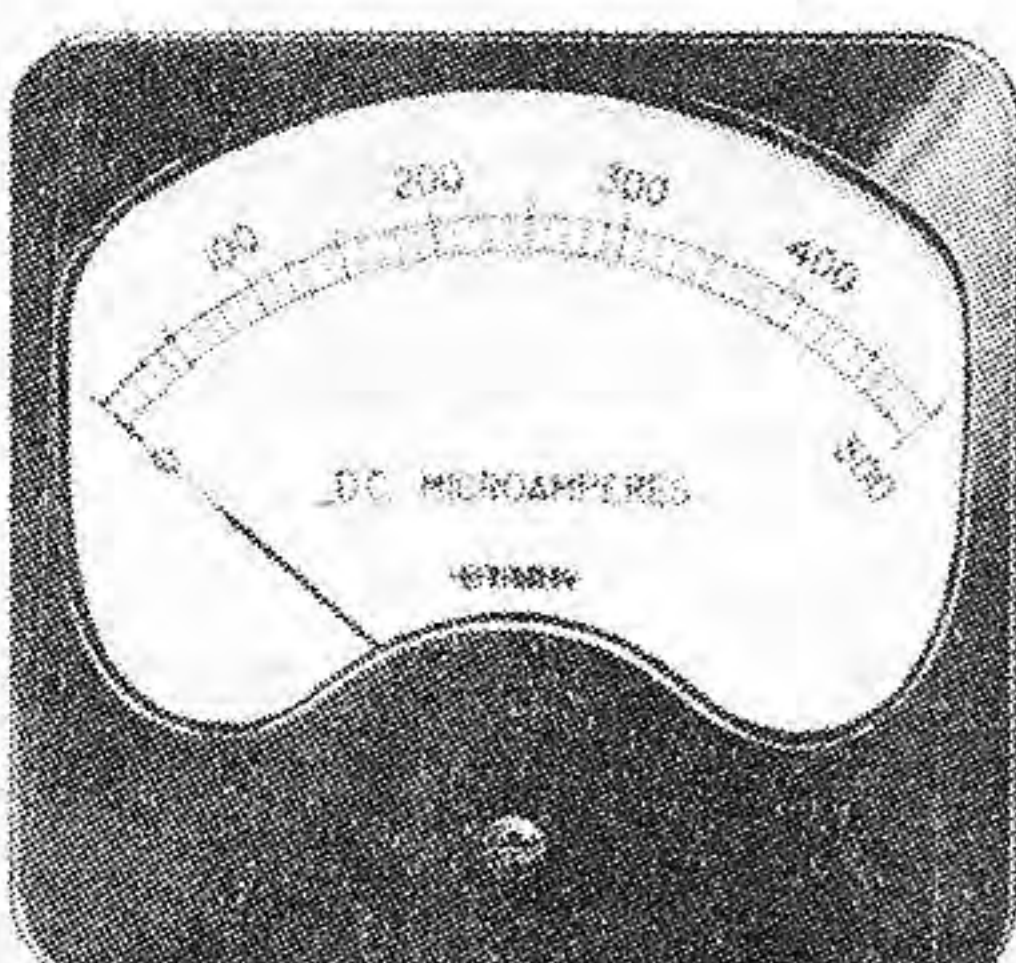
Official Bulletin Nr 274, Jan 5th, 1951
Participation is invited in a series of 160 meter DX tests arranged by East Coast U.S. and English amateurs. The following periods have been fixed for the main tests - January 14 and 28, February 11 and 25 and March 11. Attempts at DX contacts to be made between 0500 and 0800 GCT each day. Two special trial periods are scheduled - January 20 and 21, February 17 and 18 between 2200 and 0200 GCT. W and VE stations should call DX on the hour and each succeeding ten minutes after this. DX stations will call W and VE stations at five minutes past the hour, and every ten minutes thereafter. Reports from all participating U.S. and Canadian stations should be sent to Stewart Perry, W1BB, at 36 Pleasant Street, Winthrop, Mass. He will supply logs and report forms to all amateurs who request them. DX stations may send their reports to Austin Forsyth, 49 Victoria St., London, SW1, England. See page 52 of January QST for further details.

Official Bulletin Nr 276, Jan. 17th, 1951.
F.C.C. today announced that planning for amateur participation in wartime Civil Defense communication should be based on the following frequency bands. Two bands 200 kc wide, 28.55 to 28.75 and 29.45 to 29.65 Mc. Two bands 400 kc wide - 50.35 to 50.75 and 53.35 to 53.75 Mc. Two bands 540 kc wide - 145.17 to 145.71 and 146.79 to 147.33 Mc.

Entire 220 to 225 Mc band. Also 1800 to 2000 kc on presently limited basis, and two bands ten kc wide 3500 to 3510 and 3990 to 4000 kc probably only for certain medium distance requirements. This does not alter present amateur rules of operation in any manner, but is simply an announcement of intention to permit under suitable regulations, Civil Defense communication by amateurs in event of wartime general amateur shutdown.

Official Bulletin Nr 277, Jan 26th, 1951.
Since its initial publication by A.R.R.L. two years ago, many thousands of copies of Operating Aid number five, a DX operating code for all amateurs, have been distributed the world over. This code embraces all those principles designed to combine high efficiency with courtesy in DX contacts. Copies of the code are still available and may be obtained by any amateur upon request. Send a postal or radiogram to A.R.R.L. asking for Operating Aid number five.

Official Bulletin Nr 278, Jan 31st, 1951.
F.C.C. today released an order in Docket 9295 adopting amendments substantially as proposed on November 16th, 1949. See January QST for text. Most of New Rules become effective March 1st, 1951, although Novice and Technician Class Licenses will not be available until July 1st, 1951, and Extra Class License January 1st, 1952. See March QST



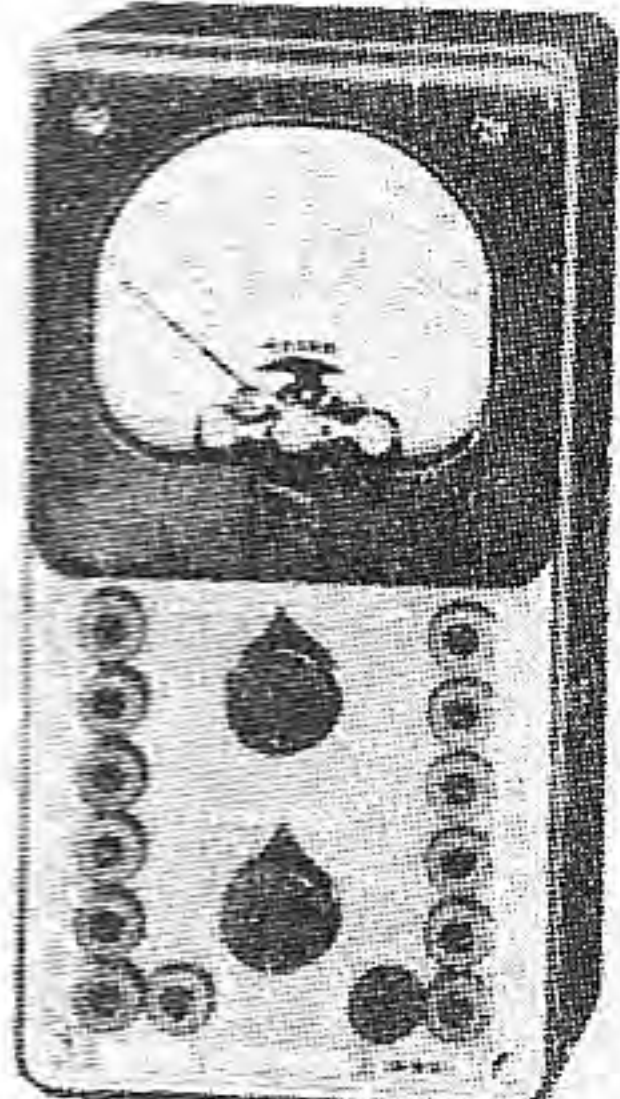
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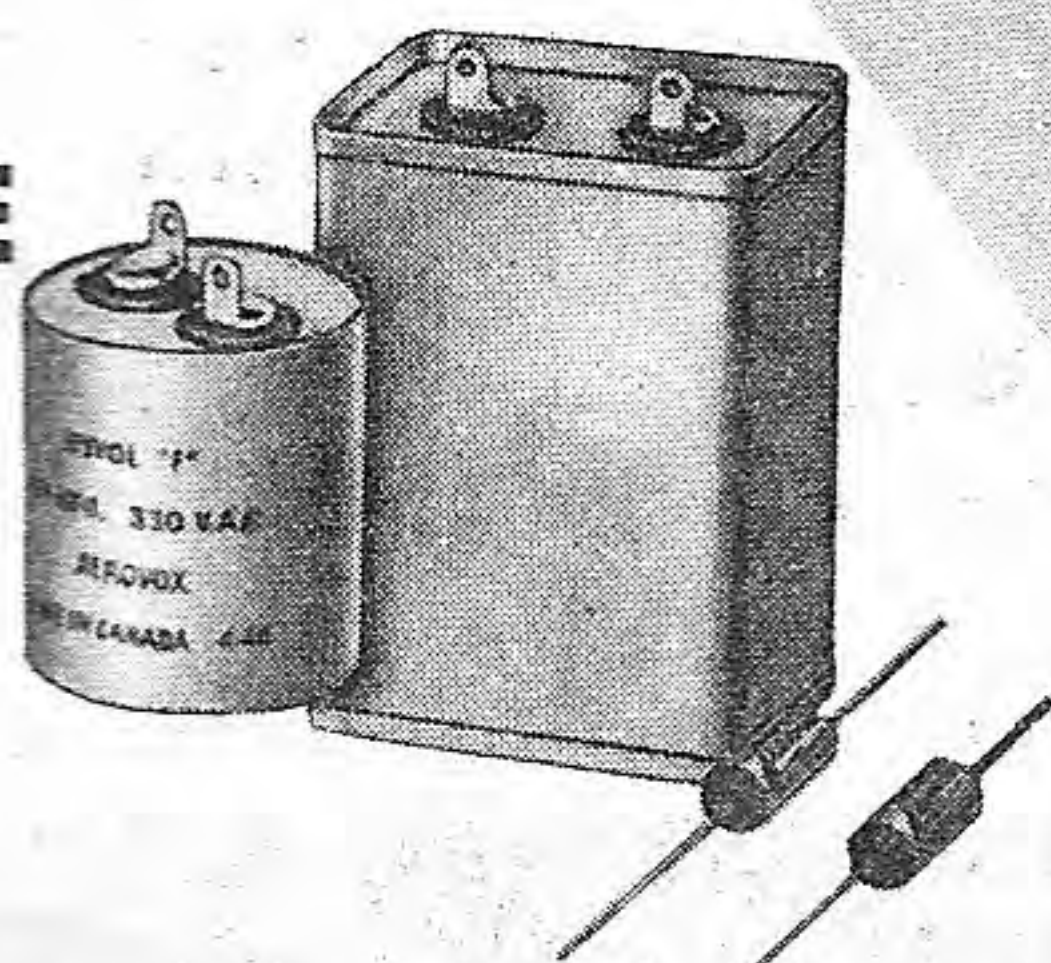
FOR SALE - HQ-129-X almost new and in excellent shape. \$195.00, and Express charges will be prepaid to anywhere in Canada - or - \$175.00 and it will be shipped collect. R.J. Tate, VE7DV, 389 Kerr Avenue, Victoria, B.C.

McElroy code teaching equipment, photo tube keyer G-813A. Tape puller, TP-890B McElroy phototube tapes, G-15AA, and a classroom recorder. All equipment was manufactured by McElroy and in perfect working order. Complete with 4-117N7 tubes. Valued at over \$200.00. Will sell for \$50.00. Write for picture if interested. C. Gutman, 7000 Somerled Avenue, Montreal, Quebec.

HARVEY WELLS All Band Transmitter and Power Supply! TBS-50 Bandmaster Jr., CMA-50 Speech Amplifier for use with a dynamic or crystal microphone, installed in unit for \$125.00 complete. APS-50 Power Supply for this - input 110VAC, 60 cycles, output 300 or 450 VDC at 275 ma. \$35.00, cables included. Also a National Select-O-Ject for \$35.00. R.K. Grant, VE2QQ, 72 Hudson Avenue, Apartment 5, Town of Mount Royal, Quebec.

SELL - Hammond 10V200 and 12S200 chokes at \$3.50 each. Plate transformer giving 1000-0-1000 V at 200 ma. (60 cycles), for \$9.00, used but in good condition. Reason for sale - need 10V300 and 12S300 chokes. Swaps? Contact VE1MD, G. Wilson, P.O. Box 1072, Edmunston, N.B.

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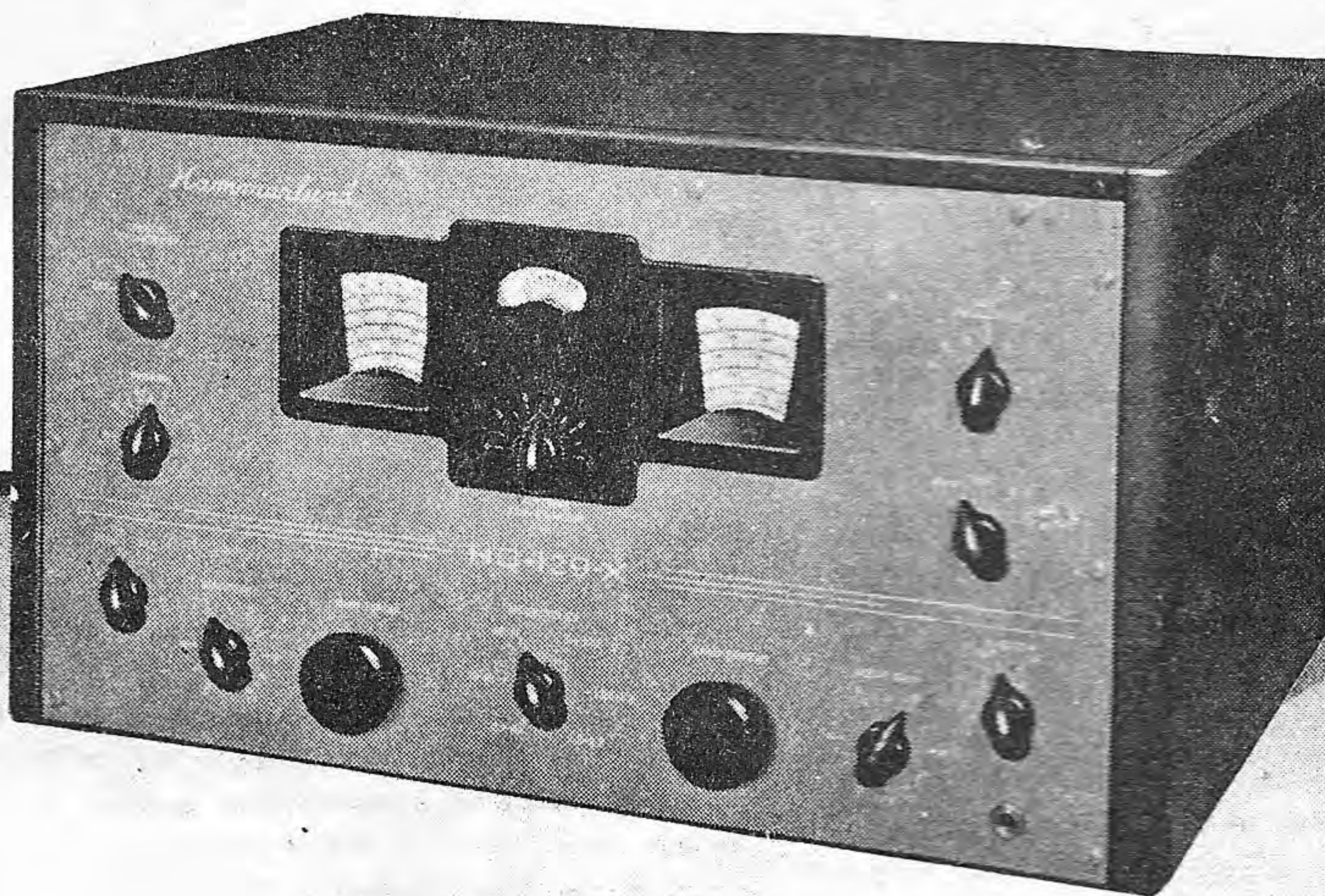
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4. Built-in power supply with heat resistant barrier.
5. Front-of-panel oscillator compensation control.
6. B.F.O. switch separated from B.F.O. frequency control.
7. Provision for incorporation of NFM adapter inside receiver, switched from front panel.
8. Dimmer control for dial and meter illumination.
9. Miniature tubes in front end and high frequency oscillator.
10. Speaker matching transformer built into receiver with 8 and 500 -ohm output terminals.
11. High frequency and beat frequency oscillator circuits not disabled when receiver in "send" position.
12. High-fidelity push-pull audio amplifier, 8 watts undistorted output.
13. Tip jack for phono input.
14. Accessory socket for Select-o-Ject (see page 4).

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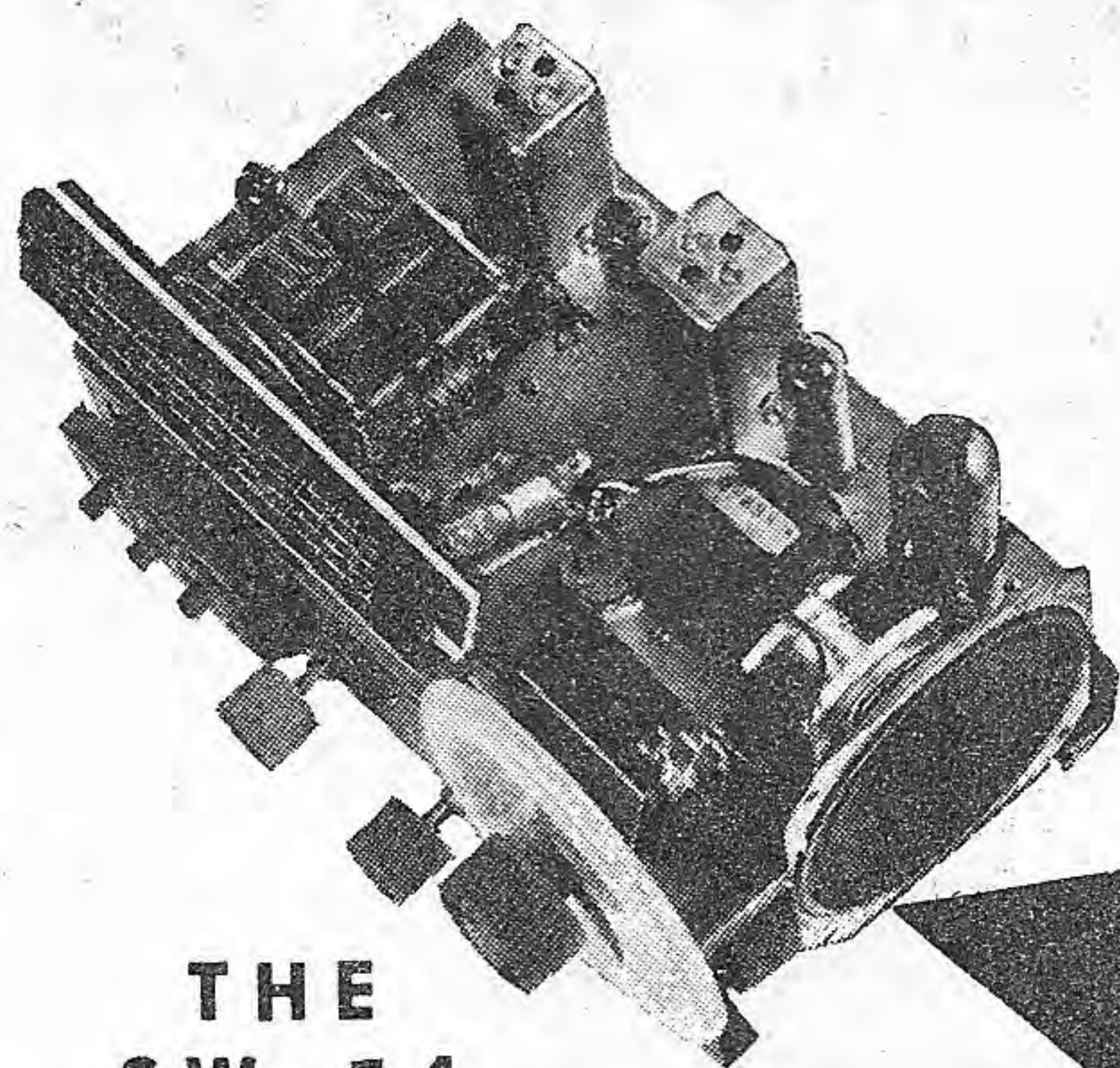
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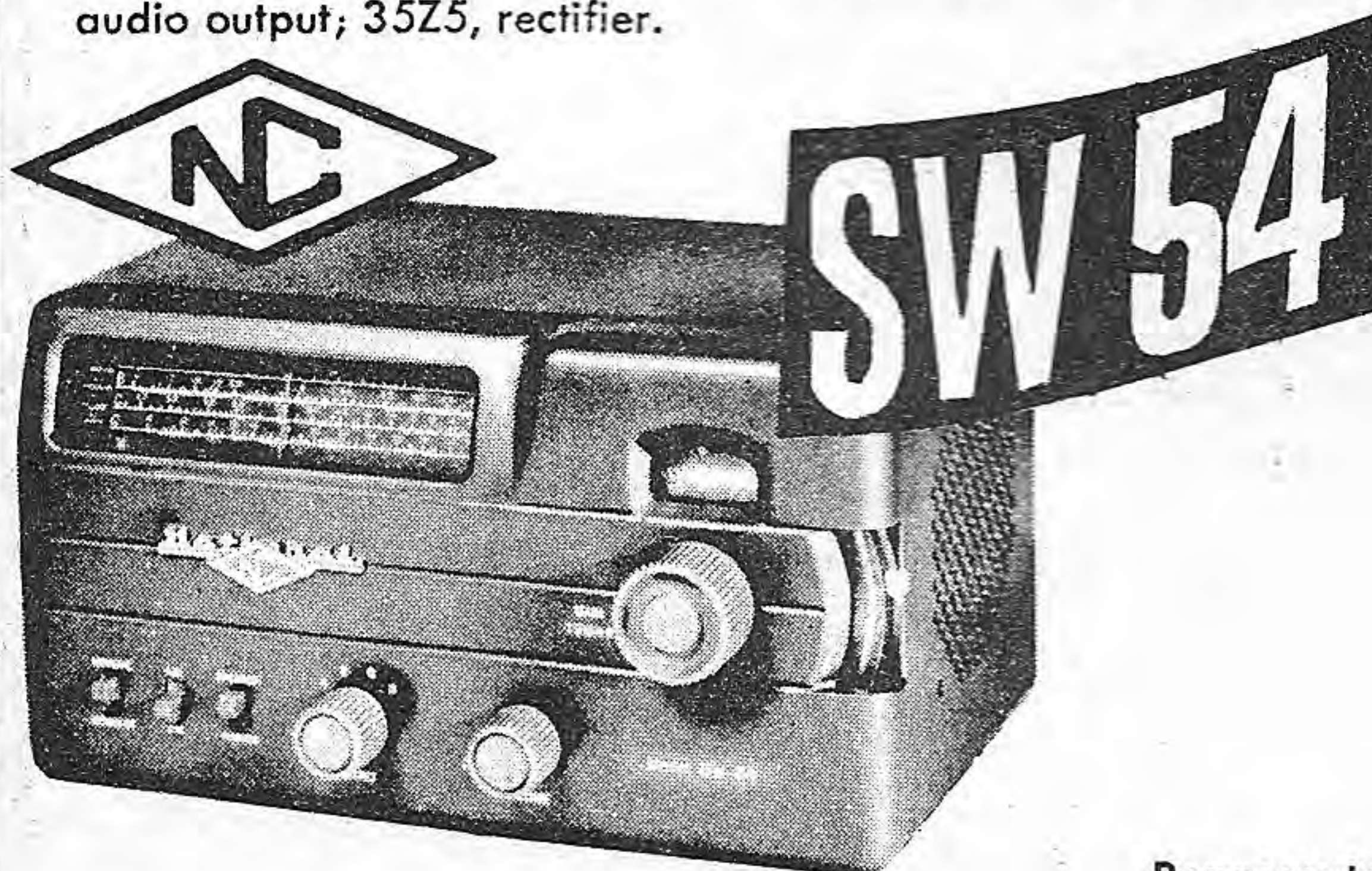
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6D

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ASTATIC PICKUPS

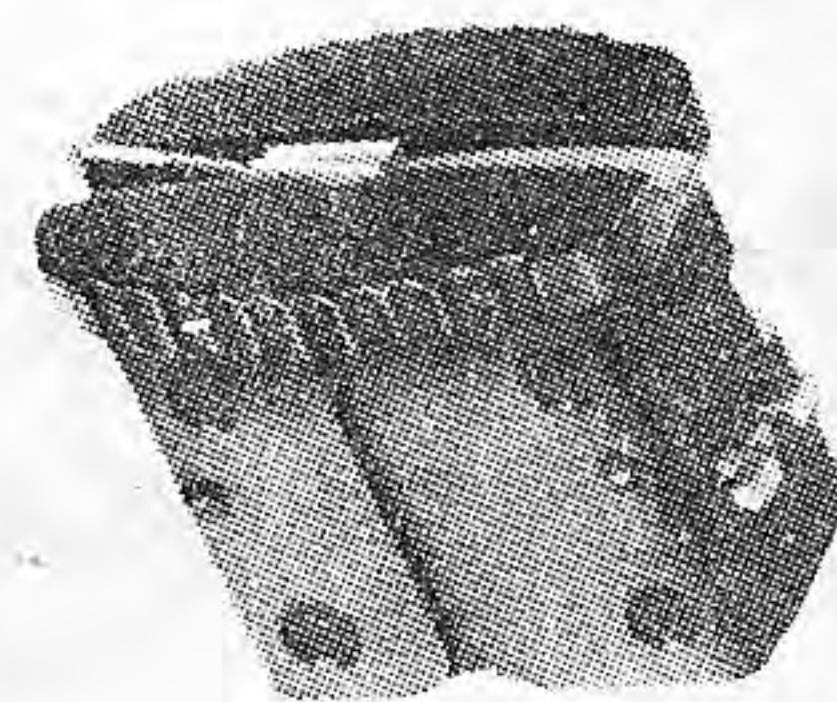
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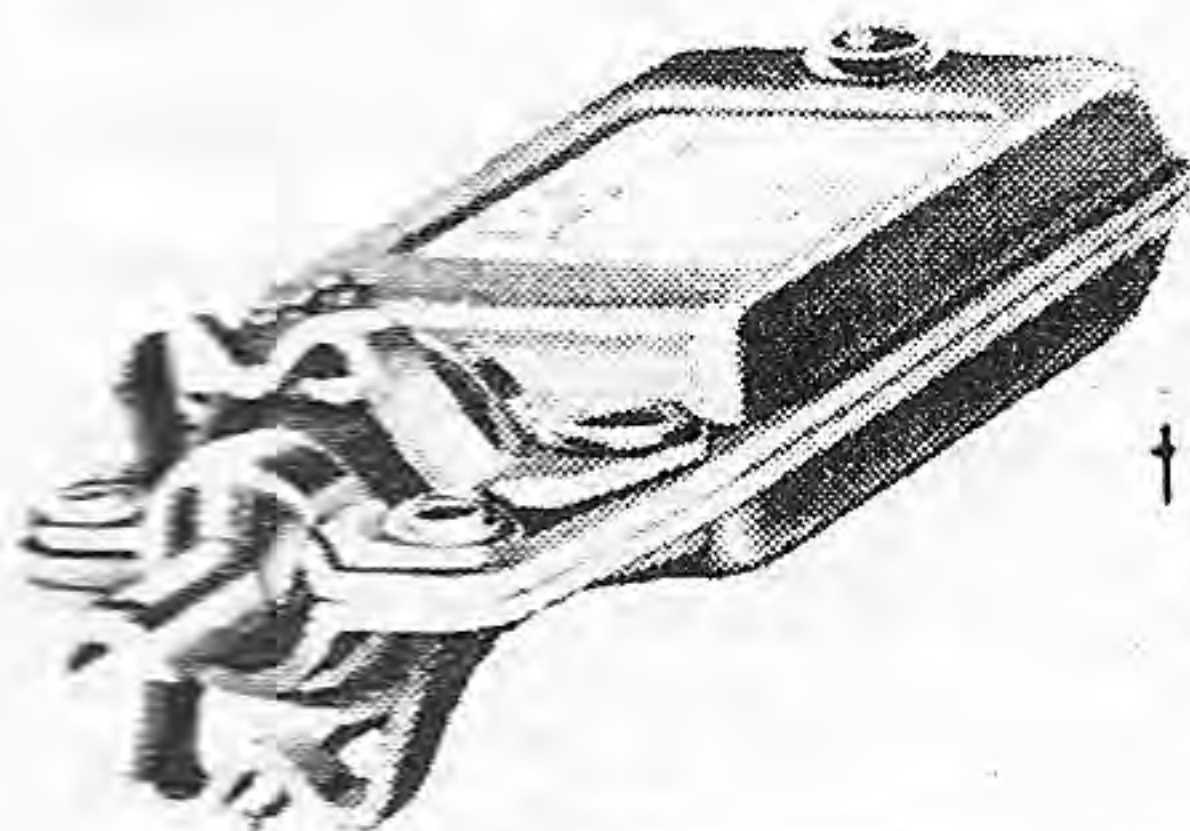
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††"U" Series

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DX PREDICTIONS

Prepared by C.B. McKee, Engineering
Division, CBC International Service

PREDICTIONS FOR FEBRUARY, 1951

Skywire frequency predictions are for amateur communications on various circuits to almost any part of the world. These tables are for five major areas in Canada, and amateurs who are operating reasonably close to the cities indicated will find these predictions quite adequate.

Figures shown are in megacycles and indicate the band to be used. They are for normal F layer transmission and don't consider Sporadic E which may provide unusual DX openings!

Toronto to: EST	00	02	04	06	08	10	12	14	16	18	20	22
Europe	7	7	7	14	14	14	14	14	14	14	7	7
Africa	14	-	-	14	14	28	28	28	28	28	14	14
Caribbean	7	7	7	7	14	14	14	14	14	14	7	7
S. America	7	7	7	14	28	28	28	28	28	14	14	7
Australia	-	7	7	7	7	-	-	-	-	-	-	-
U.S. - West	14	14	7	7	14	14	14	14	14	14	14	14
U.S. - Central	7	7	7	7	7	14	14	14	14	14	14	14
U.S. - South	7	7	7	7	14	14	14	14	14	14	14	14
Vancouver	14	7	7	7	7	14	14	14	14	14	14	14
Watrous	7	7	7	7	7	14	14	14	14	14	14	14
Montreal	4	4	4	4	7	14	14	14	14	14	7	7
Sackville	7	7	4	4	14	14	14	14	14	14	7	7

Sackville to: AST	01	03	05	07	09	11	13	15	17	19	21	23
Europe	7	7	7	14	14	14	14	14	14	7	7	7
Africa	14	-	-	28	28	28	28	28	28	14	14	14
Caribbean	7	7	7	7	14	14	14	14	14	14	7	7
S. America	7	7	7	14	28	28	28	28	28	14	7	7
Australia	-	7	7	7	-	-	-	-	-	-	-	-
U.S. - West	14	7	7	14	14	14	14	14	14	14	14	14
U.S. - Central	14	14	7	7	14	14	14	14	14	14	14	14
U.S. - South	7	14	7	7	14	14	14	14	14	14	14	14
Vancouver	7	7	7	7	14	14	14	14	14	14	14	14
Watrous	7	7	7	7	14	14	14	14	14	14	14	14
Toronto	7	7	4	4	14	14	14	14	14	14	7	7
Montreal	4	4	4	4	7	14	14	14	14	7	7	7

Watrous to: MST	22	00	02	04	06	08	10	12	14	16	18	20
Europe	7	7	7	7	14	14	14	14	14	7	7	7
Africa	7	-	-	7	14	14	28	28	28	14	14	7
Caribbean	14	14	7	7	14	14	14	14	14	14	14	14
S. America	7	14	14	7	14	28	28	28	28	28	28	14
Australia	-	7	7	7	7	-	-	-	-	-	-	14
U.S. - West	14	7	7	7	7	14	14	14	14	14	14	14
U.S. - Central	7	7	7	7	7	14	14	14	14	14	14	14
U.S. - South	14	14	14	14	14	28	28	28	28	28	28	14
Vancouver	7	7	7	7	7	14	14	14	14	28	14	14
Toronto	7	7	7	7	7	14	14	14	14	28	14	14
Montreal	7	7	7	7	7	14	14	14	14	14	14	14
Sackville	7	7	7	7	14	28	28	28	28	28	14	14

Montreal to: EST	00	02	04	06	08	10	12	14	16	18	20	22
Europe	7	7	7	14	14	14	14	14	14	7	7	7
Africa	14	-	-	28	28	28	28	28	28	14	14	14
Caribbean	7	7	7	7	14	14	14	14	14	14	7	7
S. America	7	7	7	14	28	28	28	28	28	14	7	7
Australia	-	7	7	7	7	-	-	-	-	-	-	-
U.S. - West	14	14	14	14	14	14	14	14	14	14	14	14
U.S. - Central	7	7	7	7	7	14	14	14	14	14	14	14
U.S. - South	7	7	7	7	14	14	14	14	14	14	14	14
Vancouver	7	7	7	7	7	14	14	14	14	14	14	14
Watrous	7	7	7	7	7	14	14	14	14	14	14	14
Toronto	4	4	4	4	7	14	14	14	14	14	7	7
Sackville	4	4	4	4	7	14	14	14	14	7	7	7

Vancouver to: PST	21	23	01	03	05	07	09	11	13	15	17	19
Europe	7	7	7	7	7	14	14	14	14	7	7	7
Africa	7	-	-	7	7	14	28	28	28	28	14	14
Caribbean	14	14	7	14	28	28	28	28	28	28	14	14
S. America	14	7	7	7	7	28	28	28	28	28	28	14
Australia	14	14	7	7	7	7	14	14	14	14	28	28
U.S. - West	7	7	7	4	4	7	14	14	14	14	14	14
U.S. - Central	7	7	7	7	14	28	28	28	28	28	28	14
U.S. - South	14	14	14	7	7	7	14	14	14	14	14	14
Watrous	7	7	7	7	7	14	14	14	14	14	14	14
Toronto	14	7	7	7	14	14	14	14	14	14	28	14
Montreal	7	7	7	7	7	14	14	14	14	14	14	14
Sackville	7	7	7	7	14	14	14	14	14	14	14	14

Insects, animals, Birds, ...AND CABLE

By WILLIAM H. CRAIG

Many and varied are the headaches of the lineman. Often he must combine the best qualities of scientist, big-game hunter, and ornithologist as he toils to keep in repair the intricate network of wires and cables that supply us with power and means of communication.

INSECTS are not ordinarily part of the equipment of the electrical man in this country but if a recent example of cable trouble is indicative of a trend, a fit gun may yet become a standard tool in the kit of the Canadian lineman who already has his wild-life problems involving squirrels, birds, bees, and other species of woodland fauna.

This particular example of trouble was encountered at the Shearer Street plant of the Northern Electric Company, in Montreal, where a test crew, working on a reel of paper insulated, lead covered, and jute protected cable, preparatory to shipment, found it to be defective. When the lags were removed, a small tapered hole was discovered in the lead insulation on an outside lay of the cable, completely perforating the lead. A corresponding hole was found in the lag which had been above the hole in the cable and, on further examination of the lag, a dead beetle dropped out of the hole.

As beetles go, this one appeared to have been a healthy specimen cut off in the prime of life by an overdose of lead and antimony. Inquiry revealed him to be a long-horned beetle of the *Cerambycidae* family, a family as common to this part of the province as the Smiths and the Lachances, though perhaps not so well known.

Rare in Canada

Lead boring beetles are comparatively rare in Canada, though they are quite common in parts of the United States, and constitute a serious maintenance problem in tropical countries. In North America, most of the damage caused by insects in cable-coverings is chargeable to the wood-boring beetle, known in bacteriological circles as "*Scobia declivis*".

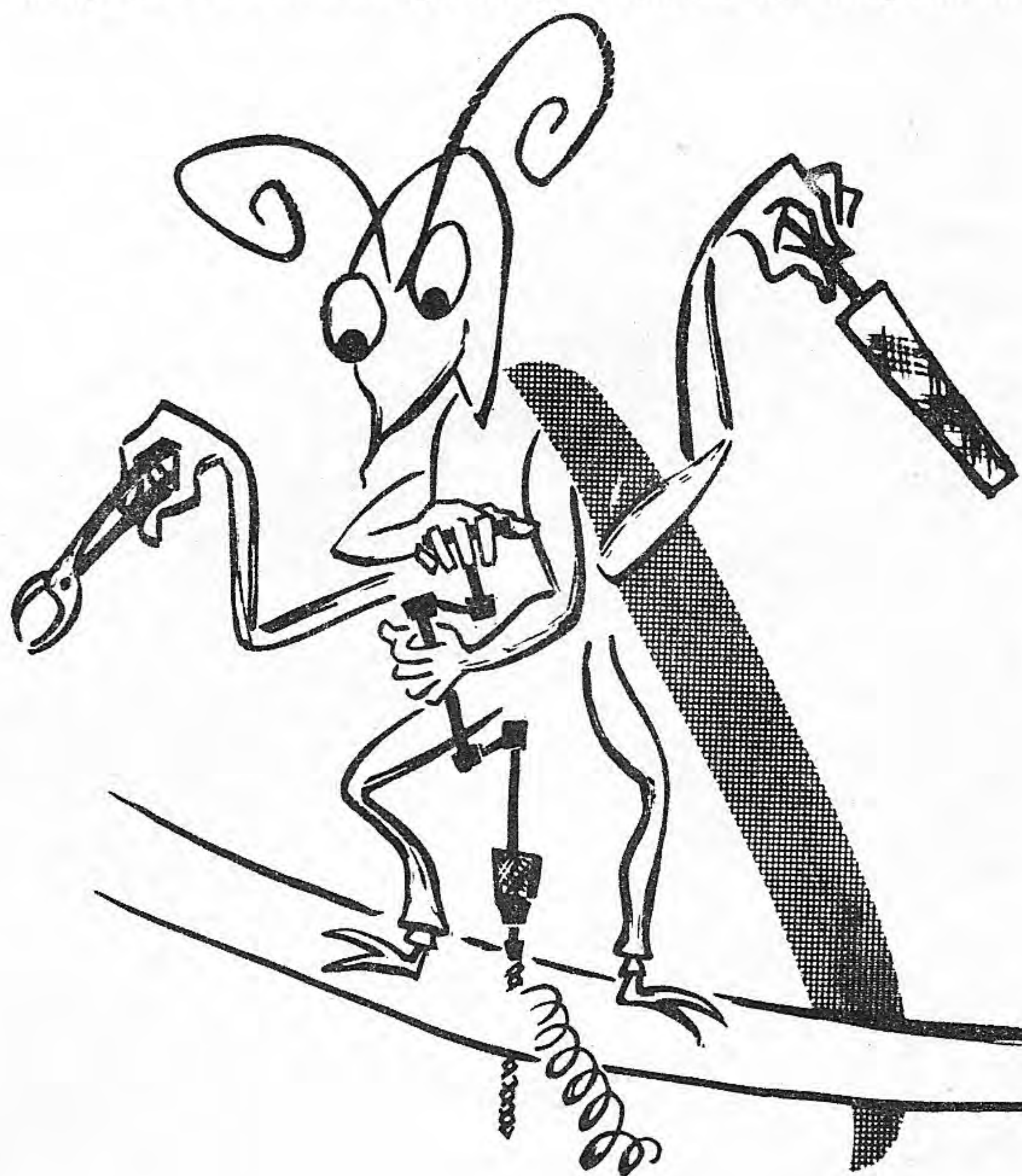
Most of the damage occurs when lead cable blocks the exit of an insect emerging from the wood in which its egg was laid. This seems to have been the case with Northern Electric's beetle. Experiments in the United States indicate that a determined beetle can penetrate any of the lead alloys used as cable sheathing and that poison introduced into the alloy is not generally effective, because the beetle does not feed as it bores and the lead borings pass harmlessly through its intestines.

This would make it difficult to account for the untimely demise of the Northern Electric beetle which could hardly have died of old age. Perhaps the *Cerambycidae*, being another family, may have a different internal construction which is not immune to the ravages of lead. On the other hand, perhaps it just died of starvation.

Insect damage to cable coverings in the temperate zones is by no means confined to North America. In England and France, the death-watch beetle, so called because it makes a ticking sound supposed to foretell the death of the person hearing it, has given the lineman a certain amount of trouble. A wood-borer, particularly fond of rafters and roofs, the death-watch beetle will blindly burrow its way through almost anything except the hard metals and stone. Like his North American cousins he is usually indifferent to poisons.

In the cooler areas of the temperate zones, damage has not been sufficiently serious from a maintenance standpoint to warrant taking special precautions, beyond making sure that cables are kept as free as possible from wood. All cases of lead boring seem to be casual and no examples exist of insects boring into lead cables except where the lead has made contact with the wood through which an insect was boring.

Lead boring insects in tropical countries are an ever-present maintenance problem. Short-circuits from this cause are many and necessitate special precautions and frequent in-



spectations. Wire and cable manufacturers in Great Britain find it necessary to protect cable sheathes for use in tropical countries with a lapping of brass or steel tape.

In countries where termites are prevalent, while the cables themselves are ordinarily free from these pests, the supporting poles will soon be riddled if of wood construction. For this reason, steel and concrete poles have to be used in termite areas.

Other Enemies

Except in the odd case, insect damage to cable in Canada does not cause the lineman to lose much sleep. He is much more concerned with other more serious enemies of the network of wires and cables under his care. One problem that interferes severely with the peace of mind of the telephone lineman is what to do about squirrels.

These chirpy little woodland acrobats are one of the chief enemies of overhead telephone cables. Cables, the squirrels feel, are put up on poles by a kind telephone company for their especial delectation. They jump onto the cables from nearby trees in high glee and proceed to sharpen their teeth and work up an appetite by gnawing right through the lead sheath to the wires beneath. They don't care if they do open up the cables to moisture and resultant short circuits.

One of the first methods of discouraging the squirrels without harming them was to coat the cables with a mixture of tallow and white lead. It was not a success. The squirrels were enthusiastic about the mixture, lapped it up, and gnawed away at the insulation as before.

Next, engineers tried another mixture. The cables were painted with asphalt mixed with sand and this time the squirrels learned to leave the cables alone. Their feet stuck in the asphalt and the sand got in their teeth, a combination that was just too much. The only difficulty was that the paint lost its effectiveness with age and weathering.

The repellent in use today is a mixture of asphalt and bitter aloes. Squirrels are not keen on bitter aloes and the mixture retains its effectiveness for about two years. In some localities where there are a great many squirrels even this method has had only partial success. Cables have still been damaged and it has sometimes been necessary to go to considerable expense to cover the cable with wire screening. This provides positive protection but interferes with inspection and increases the ice loads picked up in sleet storms.

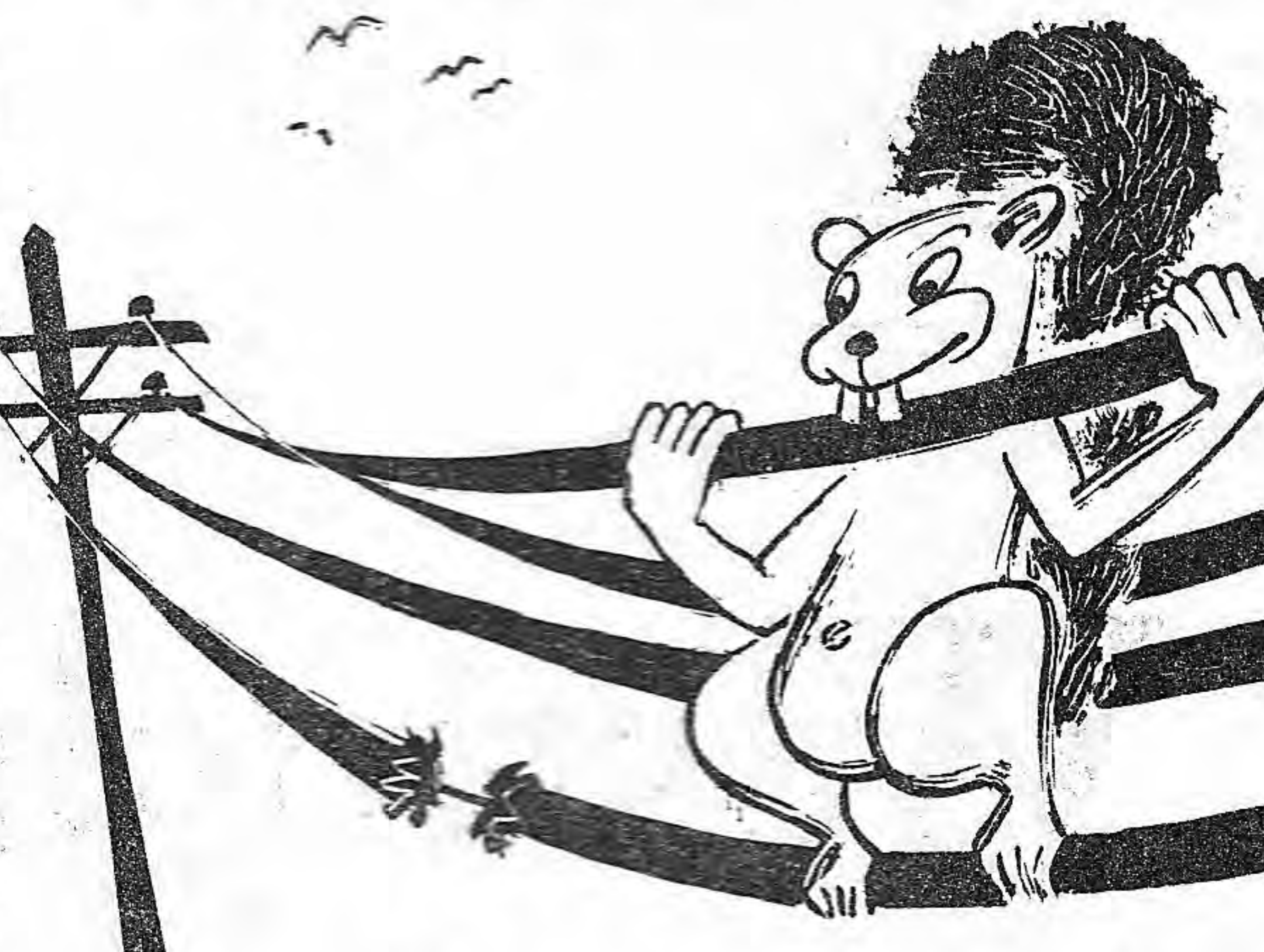
Other animals have caused trouble from time to time but not to a serious extent. Hordes of migratory birds sometimes perch on wires in the autumn in such numbers that they cause top wires to sag and touch the wires beneath. Bears have been known to molest cables running through bush country. Telephone repair men have had occasional trouble with wasps and snakes nesting in terminal boxes where wires from a house join the outside cable. Wasps or bees have even bored holes clean through lead insulation in much the same manner as the lead boring beetle.

In other countries birds are a more serious problem. On the Denver-Lamar telephone line in the United States, thousands of ravens build their nests each year on telephone poles. The birds line their nests with fence wire and the nests often become very effective short circuiting devices. To prevent this trouble it has been necessary to slip rubber sleeves over the wires near the pole.

An interesting example of bird trouble is found in Brazil. Here, a species of bird called the Joao de Barro builds nests of red clay on the crossarms of telephone poles. If left alone, the birds will gradually add to their nests until they reach skyscraper proportions, linking wire to wire, causing short circuits in wet weather and keeping Brazilian linemen busy moving from pole to pole.

In every country, occasional trouble is experienced through attacks on all types of wire and cable by rats and mice. The sea-going rat did a good job for Hitler during the war by eating in quantity the rubber insulation or degaussing cable. Often he succeeded in short circuiting the degaussing circuit and more than a few times gnawed the cable clean through, in both cases leaving the ship unprotected from any magnetic mines on its course.

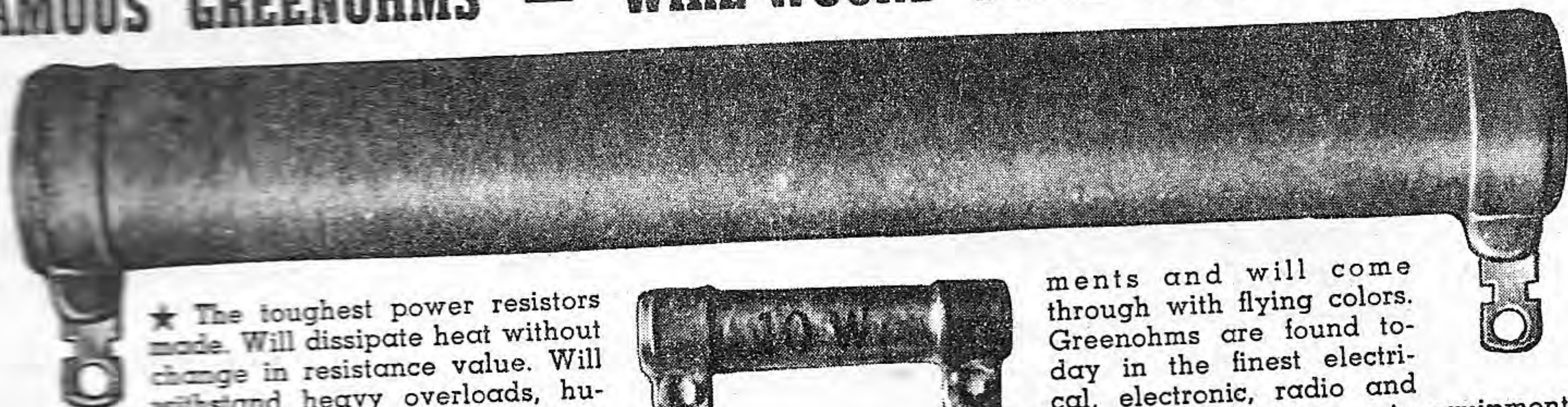
Canadian troubles with insect and animal damage are small in comparison with those of other countries. The squirrel may be a headache to the Canadian lineman but how would you like to maintain cable in the jungles of Africa or India where protection of cables against animal damage is a specialized and difficult art? How would you set out to make a telephone or power line elephant-proof?



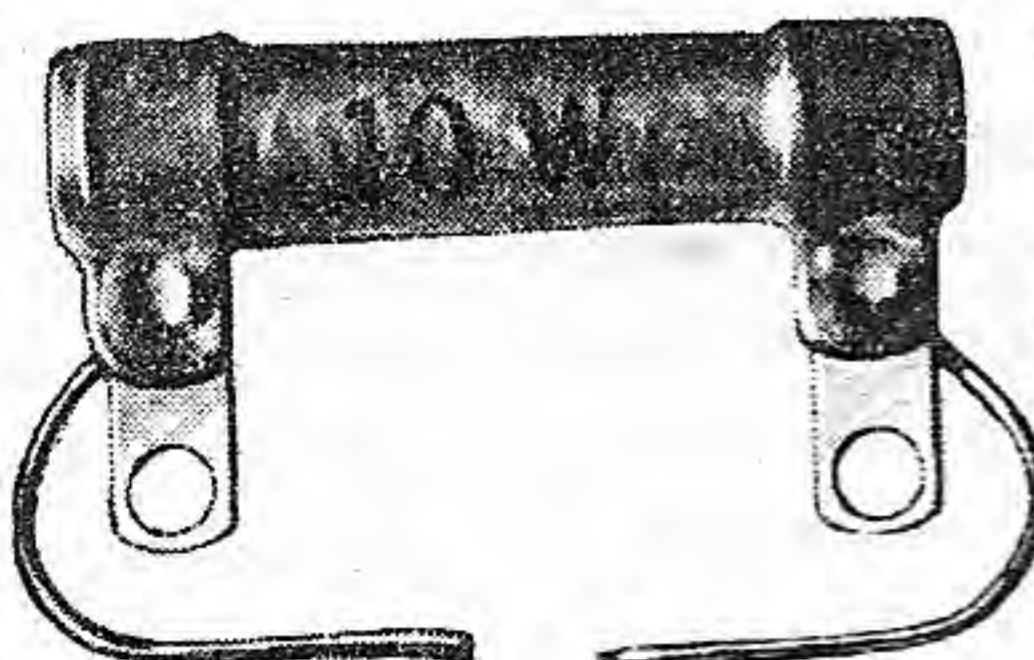
► **PAID . . .** All signs point to rapid adoption of radar in transoceanic marine passenger service, less than a year after civilian radar was first offered. The most compelling instance of its efficacy is the recent crossing of the Queen Elizabeth, during which she proceeded by radar at full speed for 720 miles through dense fog; saving twice the cost of the radar unit in a single day. In passenger service, even in small vessels carrying lower fixed costs, the economics of the situation will force general acceptance, it is hoped, before a preventable collision occurs and forces it through legislation. In cargo service there is still much reluctance to take on radar, particularly if an extra man must be hired to operate and maintain the equipment. But if radar sufficiently precise to permit docking in fog is forthcoming, even in freight service the savings will quickly outdistance the cost.

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CLUB ACTIVITIES

THE ONTARIO PHONE CLUB IS HOLDING A QSO Contest on Sunday, March 11th, 1951, from 10 a.m. to 10 p.m. The purpose - to enable CW and fone operators to become more familiar with both types of operating. Two suitable awards will be made. The Fone Trophy will be known as the Columbia Record Trophy and the CW award as the Sparton Radio Trophy. Both, donated by Sparton of Canada, will be engraved to show winner, and presentation year. A further engraving for each winner each year will be supplied by the donor!! You win permanent possession of either of these beauties, by winning three times! The rules are: 3500 to 3750 kc for CW operation. 3750 to 3800 for mobile fone stations of 100 and less watts. 3800 to 3850 is for fone of 101 and up watts. No multipliers. One point for fone to fone, fone to CW or vice versa, if contacts, at any time, are made in portions of band designated above. Any station may operate fone or CW in proper portions of band. Judges: VE3HP, Art Ferguson - VE3DU, Dave Hutchison of London, for CW. For fone, VE3YJ, George Foster, and VE3FQ, Earl Kimble. Contest logs are to be forwarded to E. Kimble, % Sparton of Canada Ltd., London, Ontario. You have until midnight, March 31st, 1951 to get your entry in!

THE NORTH BAY AMATEUR RADIO CLUB IS sponsoring the Northern Ontario Hamfest Picnic, scheduled for July 1st and 2nd, 1951, at North Bay. This is advance notice of the Hamfest so you can make plans to be there early enough to get your tickets before they're all gone. VE3EAW, VE3ACZ or VE3AHH will all see that tickets are reserved for you, if you write or send a message. Last year the top prize was an Eddystone 750, so you can have an interesting time at this years gathering. Plan NOW for it.

The Ottawa Amateur Radio Club is busy with plans for another great hamfest, scheduled for the May 24th holiday. Tickets are going to be a dollar per ham, with the xyl's and Jr. Ops riding free. The affair last year was a great

success, and the prize committee is planning lots of action. This is the club which has made standard connections for portable-mobile rigs a must among interested members. Then, if things get rough, such standarization makes the use of various hams rigs possible without stopping for rewiring. Joe's power plug on his mobile rigs will fit any of Bills' or Dicks' gear making pooling of equipment a simple fact. This is one idea that all other Canadian clubs could put to excellent use, in building up a solid Emergency Corps in each city.

Bill Choat, VE3IL was kind enough to provide a list of suggested emergency frequencies for VE operation. These, like a number of other things, are now temporarily among the unfound items, due to the move to this new QTH. They will be printed in March Skywire for you!

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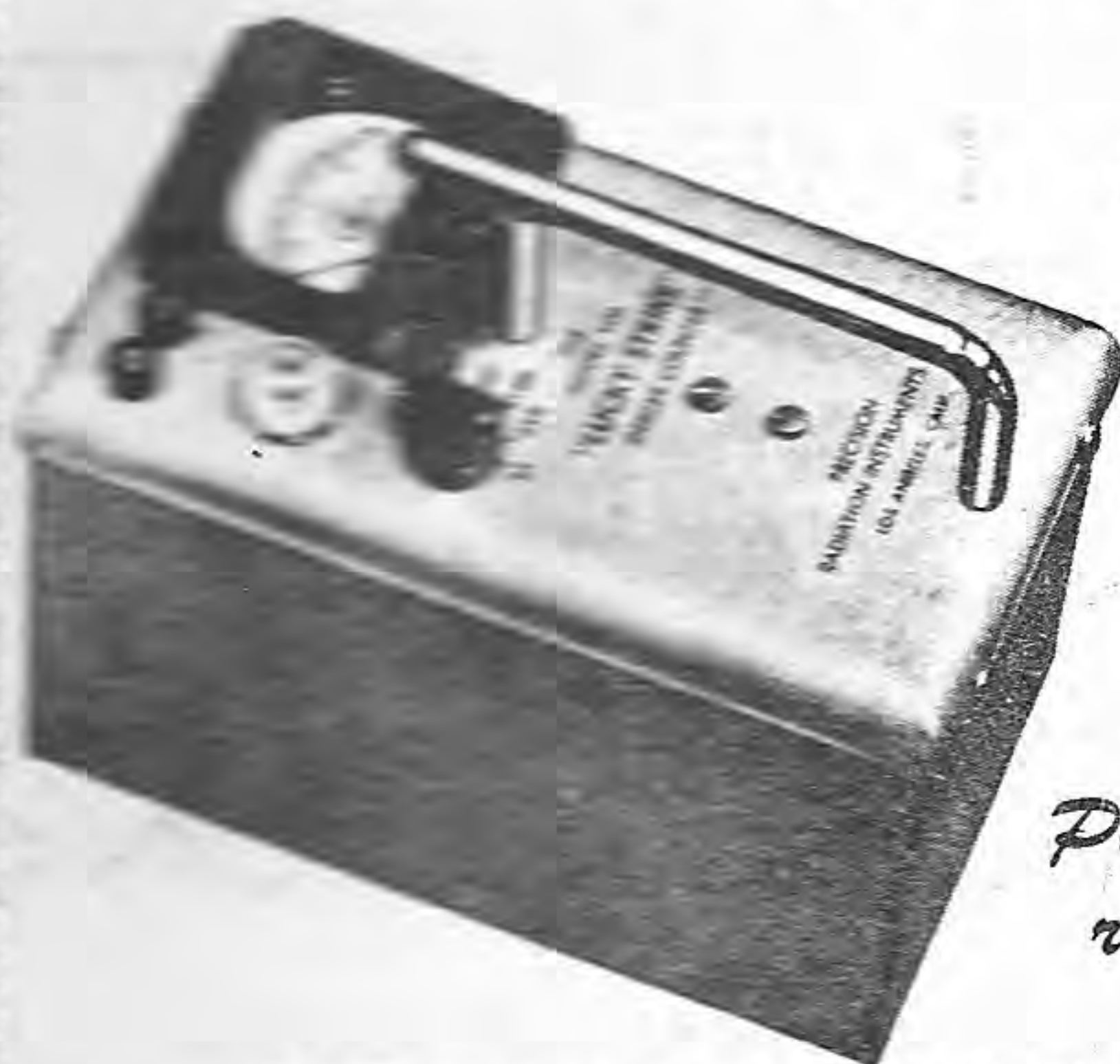
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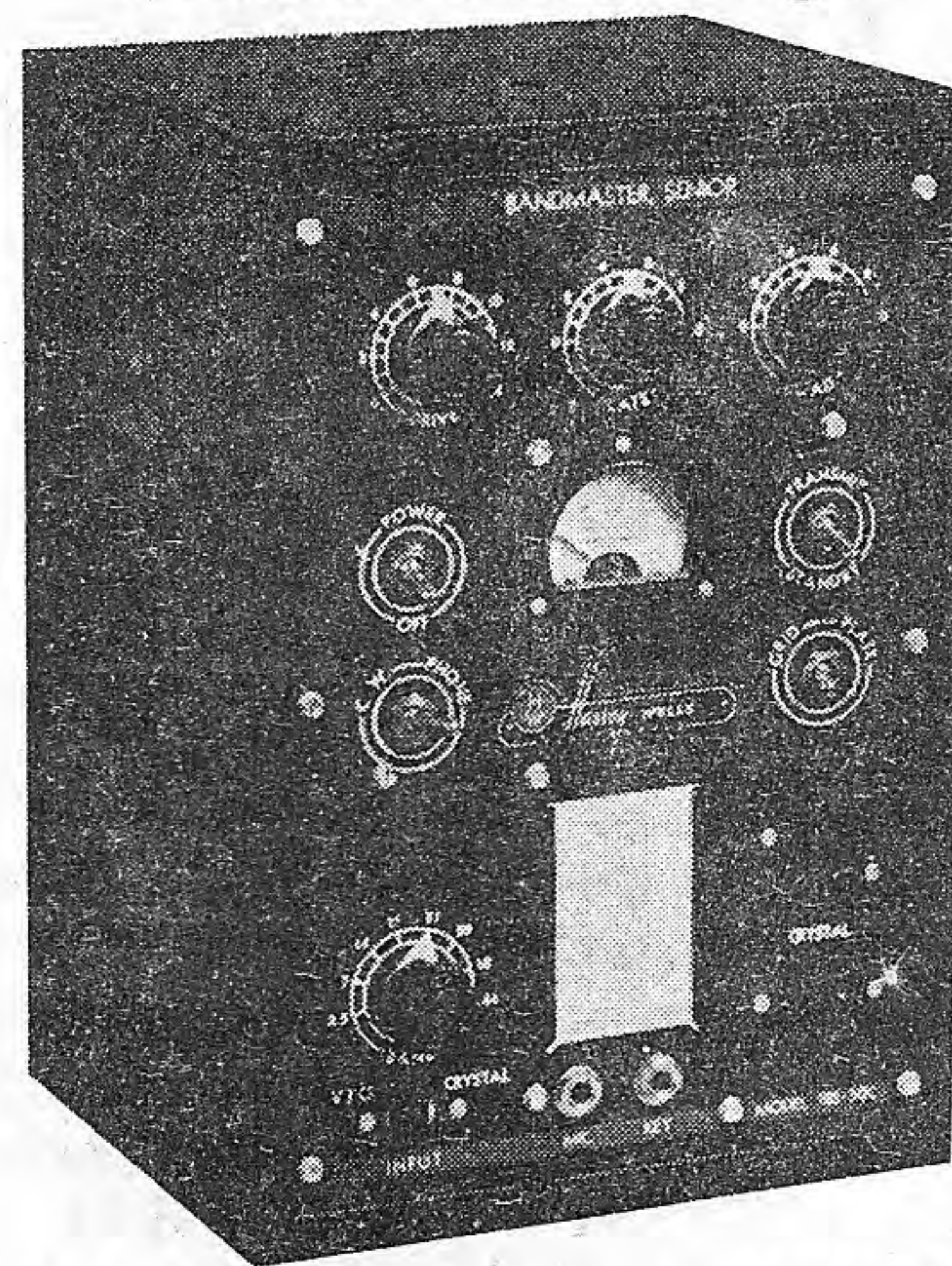
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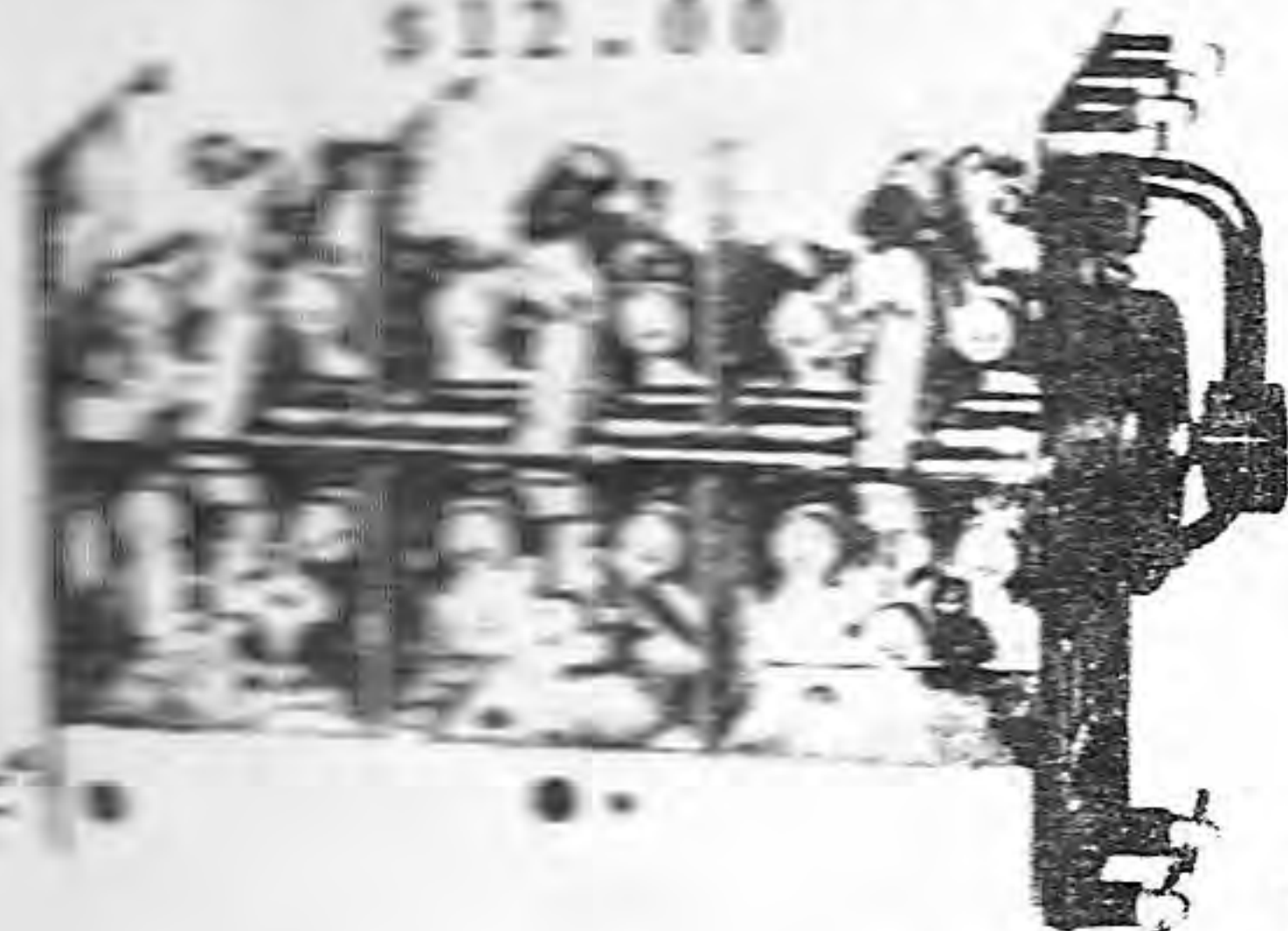
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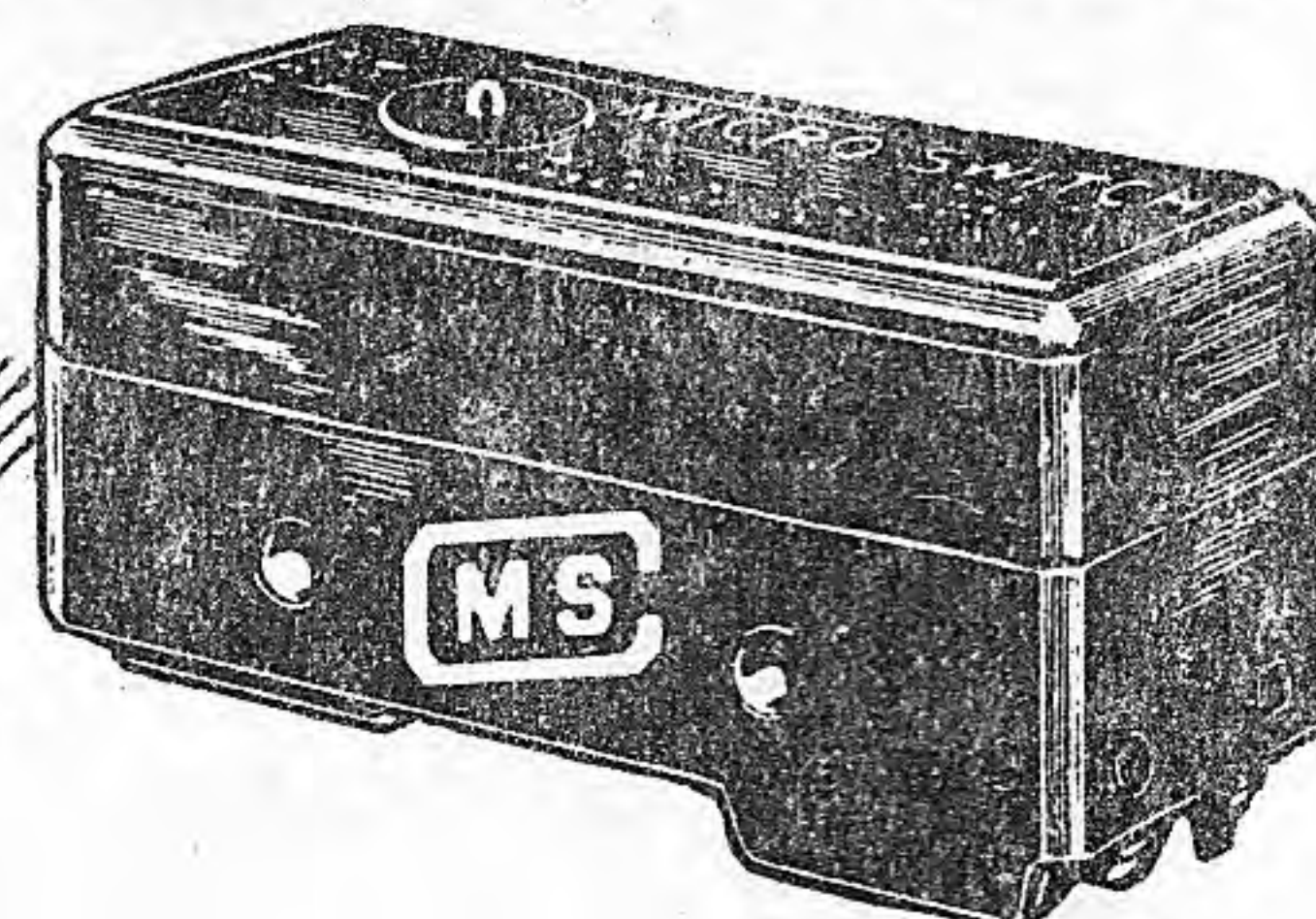
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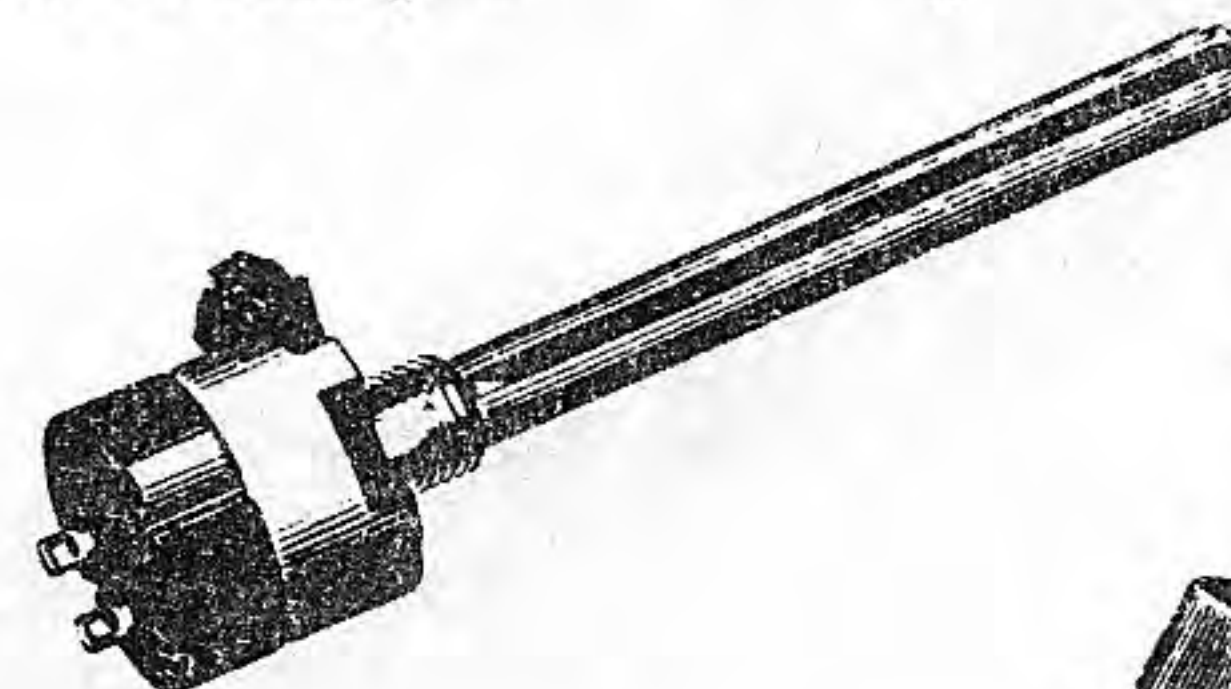
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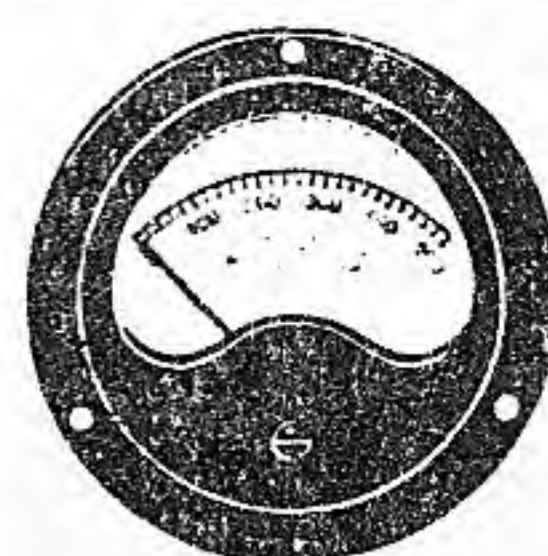
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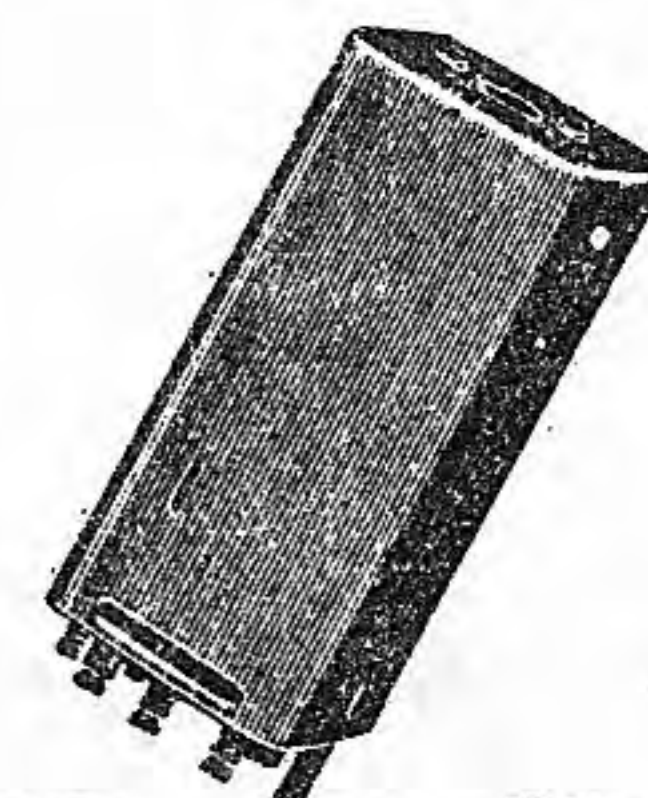
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TELEVISION

FUNDAMENTALS OF TELEVISION

WM. P. MUELLER

The servicing of home receivers, particularly the new TV sets, is rapidly becoming a big business, and it will require well trained technicians who are familiar with the instrument they are servicing and the most modern techniques for detecting and correcting any trouble that may develop. . . . Servicemen in the larger metropolitan areas are already deep in TV installation and servicing. In view of the growing popularity of this new medium and its rapid spread to more and more areas, it behooves every serious serviceman to learn as much about TV as possible, in order to be able to explain it to his present customer, and to be ready for it when TV signals eventually invade his neighborhood. This may be earlier than one anticipates due to the greater range made possible by "Stratovision" (the relaying of TV from a high flying plane), which is now undergoing experimental tests. The purpose of this article is to give a general explanation of the fundamentals of our present television system. Subsequent issues will take up the various parts of the television receiver in greater detail.

Frequency Channels and Assignments

The FCC has assigned twelve frequency channels to commercial television stations. Originally there were thirteen, but the FCC has recently found it necessary to delete Channel 1 in order to eliminate sharing of television frequencies with other services. A channel consists of a band of frequencies six megacycles wide. For example, Channel 2 extends from 54 to 60 mc. The video carrier frequency, upon which is impressed the picture information, is located 1.25 mc

from the lower edge of the channel, or at 55.25 mc. The sound carrier frequency, upon which is impressed the sound modulation, is located 4.5 mc higher, or at 59.75 mc for Channel 2. The present channels and their location in the frequency spectrum are shown in Table 1 for ready reference.

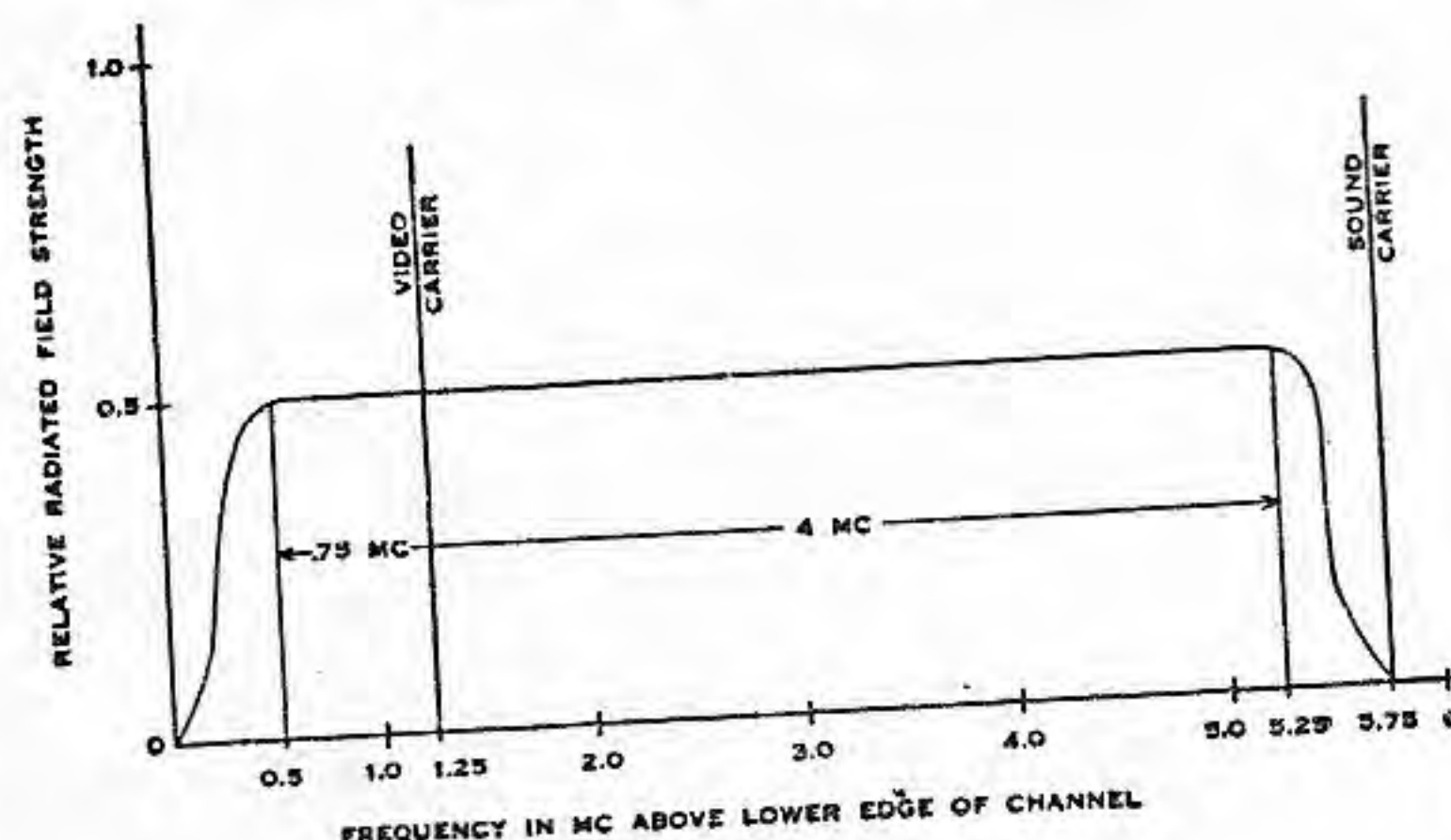
Table 1
Television Frequency Assignments

Channel No.	Band mc	Video-Carrier Frequency mc	Audio-Carrier Frequency mc
2	54-60	55.25	59.75
3	60-66	61.25	65.75
4	66-72	67.25	71.75
5	76-82	77.25	81.75
6	82-88	83.25	87.75
7	174-180	175.25	179.75
8	180-186	181.25	185.75
9	186-192	187.25	191.75
10	192-198	193.25	197.75
11	198-204	199.25	203.75
12	204-210	205.25	209.75
13	210-216	211.25	215.75

Television Frequency Assignments

Note that there are five "low band" channels and seven "high band" channels. There is also a 4 mc gap between Channels 4 and 5, these frequencies being assigned to other services. Since not more than seven channels have been assigned to any one metropolitan area, some receivers are aligned to tune to any eight of the total twelve channels. Thus these receivers are capable of receiving all the stations of that particular locality.

FIGURE 1
STANDARD VESTIGIAL SIDEBAND TELEVISION CHANNEL AS TRANSMITTED



The arrangement of a TV channel is shown in Figure 1. Most of the frequency spectrum is utilized by the picture modulation side bands of the video carrier. Vestigial side band modulation of the picture carrier is used. This means that one entire side band and a small part of the other side band are transmitted.

The sound which accompanies the picture is transmitted by frequency modulating the sound carrier. In view of previous articles in SYLVANIA NEWS on FM, nothing more need be said about this except that the maximum frequency deviation of the television sound is 25 kc instead of the 75 kc used in FM broadcasting on the 88 to 108 mc band.

How a Picture is Transmitted or, The Essentials of the Video System

The transmission of a picture by radio is inherently a much more complex process than the transmission of sound. Sound is a one dimension phenomenon; at any one particular, (infinitely small,) instant all that need be known is the loudness of the sound. To transmit a picture, it is necessary to examine one particular small spot on the picture, modulate the video carrier in intensity according to the shade of the picture at this particular spot, and at the same time to sweep the spot quickly across the picture according to some definite plan until the entire picture area has been covered. This process is called scanning. Obviously, it is necessary that the spot of light on the picture tube of the television receiver vary in intensity according to the shade of the spot on the original picture and furthermore that it keep i

by the dotted line between two successive horizontal blanking pulses. The drawing is not to scale, as the horizontal blanking interval occupies but 16% of the time between successive horizontal blanking pedestals. The equalizing pulses which occur at twice the horizontal frequency are required to maintain proper interlace.

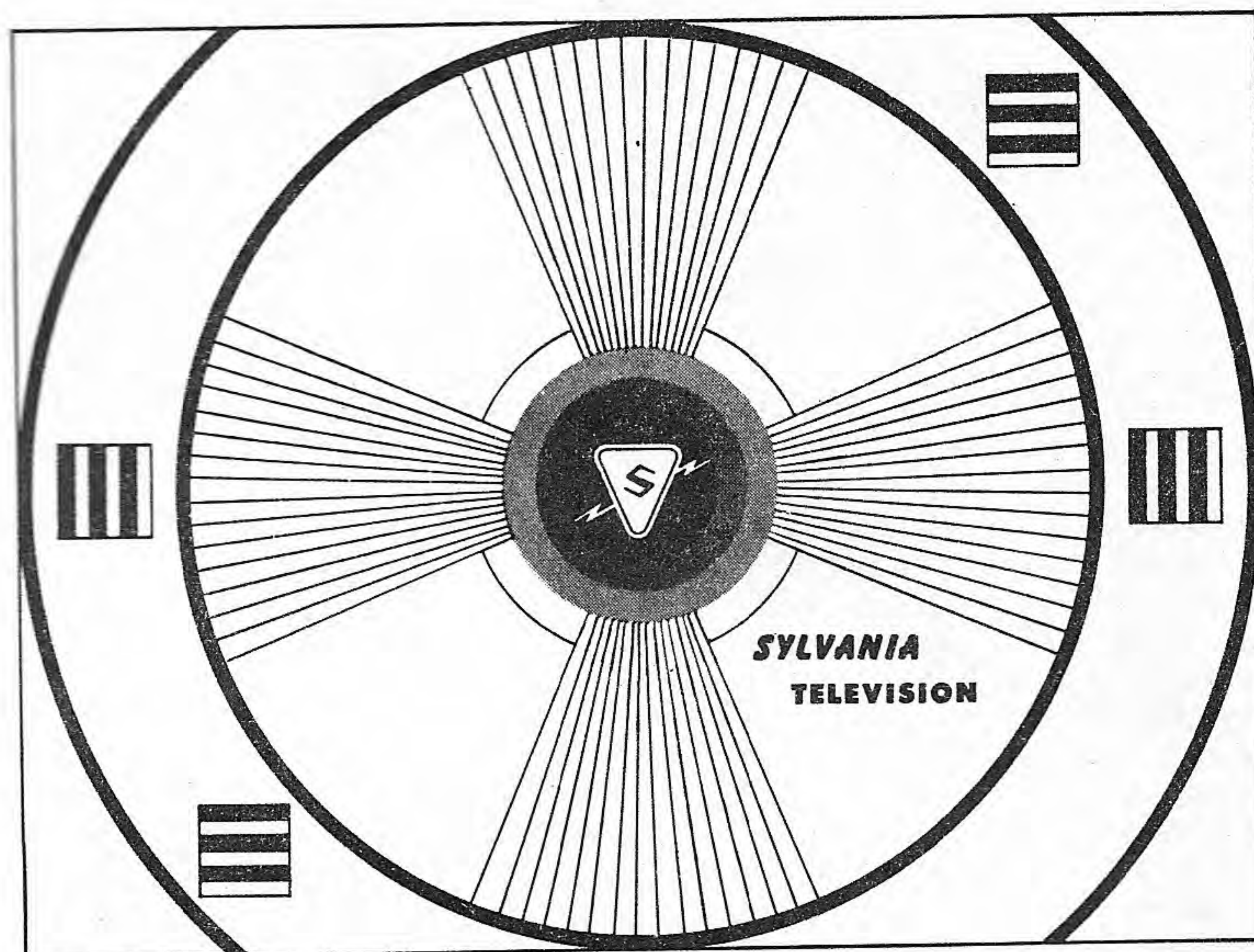
The remaining requirement needed to reproduce the picture in its proper proportions is that the picture have the correct ratio of width to height. This is called the aspect ratio and is 4/3.

The Video Test Pattern

To enable one to quickly and accurately adjust the TV receiver so that it has the proper aspect ratio, greatest linearity of scan, and proper focus, and to provide means for judging the resolution and degree of contrast obtainable, stationary test patterns are transmitted by the TV stations. A representative test pattern is shown in Figure 4. The proper aspect ratio is achieved by making the top and bottom of the picture tangent to the smaller circle and the sides tangent to the larger circle. Linearity of scan may be judged by how closely the circle approaches a true circle, and by the small squares of horizontal and vertical bars. Resolution may be determined from the ability to separate the lines in the four wedges of fine lines. Proper background and contrast are indicated by the ability to differentiate between the four degrees of illumination in the inner concentric circles. Focus is adjusted for the sharpest detail of the "Flashing S" emblem in the center of the pattern, as well as best reproduction of the letters "Sylvania Television".

In the next article the requirements of the television receiver will be taken up, and the function of the various circuits will be discussed in greater detail.

Television, like every new business, has been the subject of a series of experiments. In an industry destined to take such an important place in our way of life, this is, without a doubt, the key-stone to its success.



TYPICAL TELEVISION TEST PATTERN
FIGURE 4

Latest experiment has been the installation of a video receiver on a train. The train, the Marylander of the Baltimore and Ohio line, makes its run between Washington and New York. The experiment was conducted in cooperation with engineers of the Bendix Aviation Corp., radio division.

Reception throughout the 225 mile trip was good except for a brief stretch between Aberdeen, Md. and Newark, Del. when the train was out of range of stations in Baltimore and Philadelphia. During the trip the train traveled at speeds up to 80 miles an hour.

Use of a special device known as a "ram's horn" doublet mounted atop the railroad car intercepted the video waves. The device is said to be equally effective for both high and low band frequencies. The receiver differed from the ordinary home receiver through the use of faster electronic picture and gain controls which were used to steady reception. A special converter was used to provide the 110 volt AC supply from the car's battery power.

One of the big problems in television has been interference. Essentially, television waves haven't

behaved exactly as engineers thought they would. Basically this is along the line of sight. In many instances signals have been received up to 100 miles away from the transmitter. In some cases it has caused interference between stations in communities theoretically free from such disturbances. The outcome has been the need for more time to review the engineering standards for issuing applications. This means that the standards for separating stations will have to be revised, or the total number of stations which can be fitted into the present television band will have to be reduced.

So rapid has been TV's growth that many industry leaders feel that video will have to move into a higher band where there will be more room available. Such a move will directly affect the public. Present day sets will, under such eventuality, not be able to cover such new channels without the addition of more equipment. In such cases, television broadcasters will also have to spend thousands of dollars to change existing transmitters.

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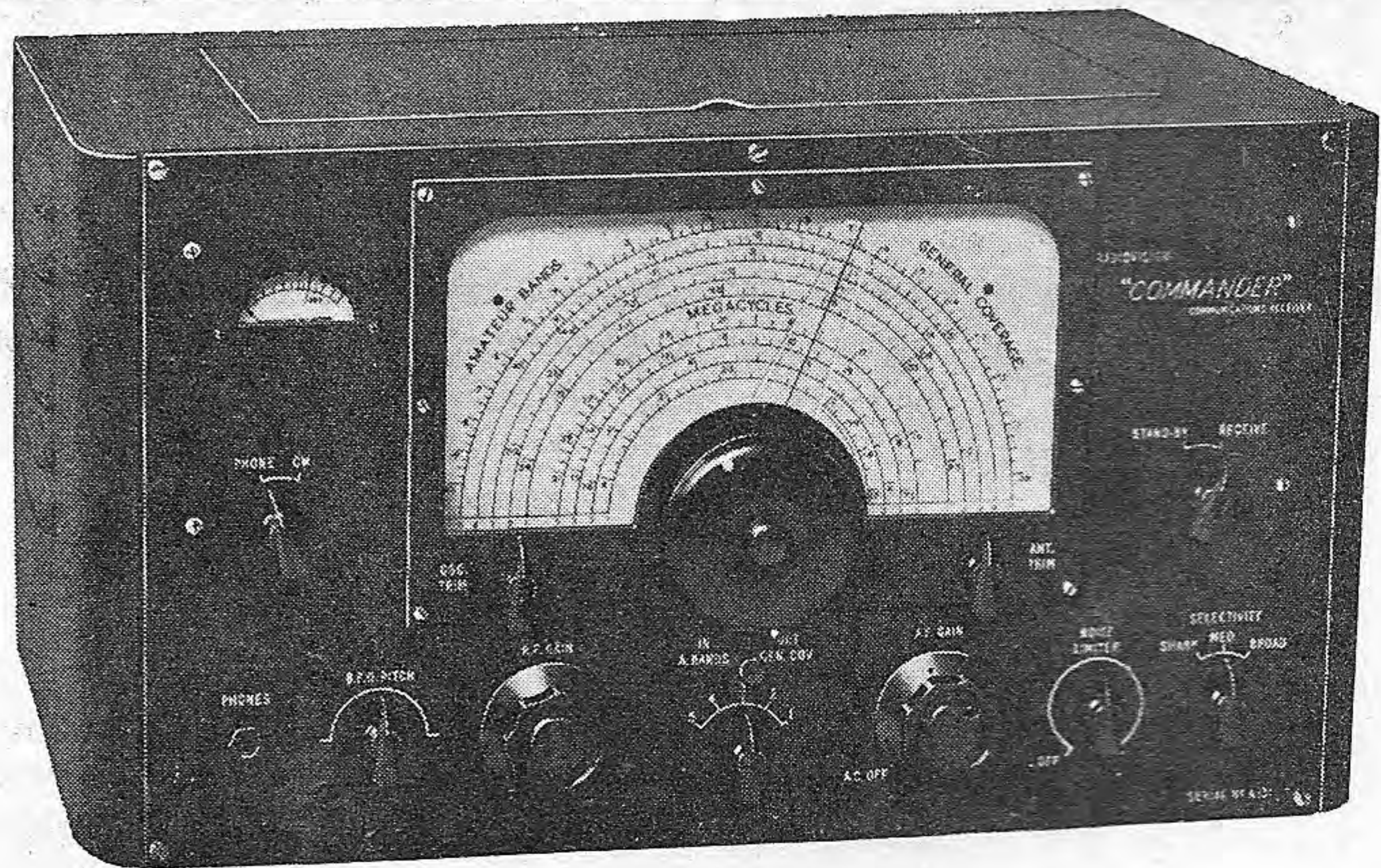
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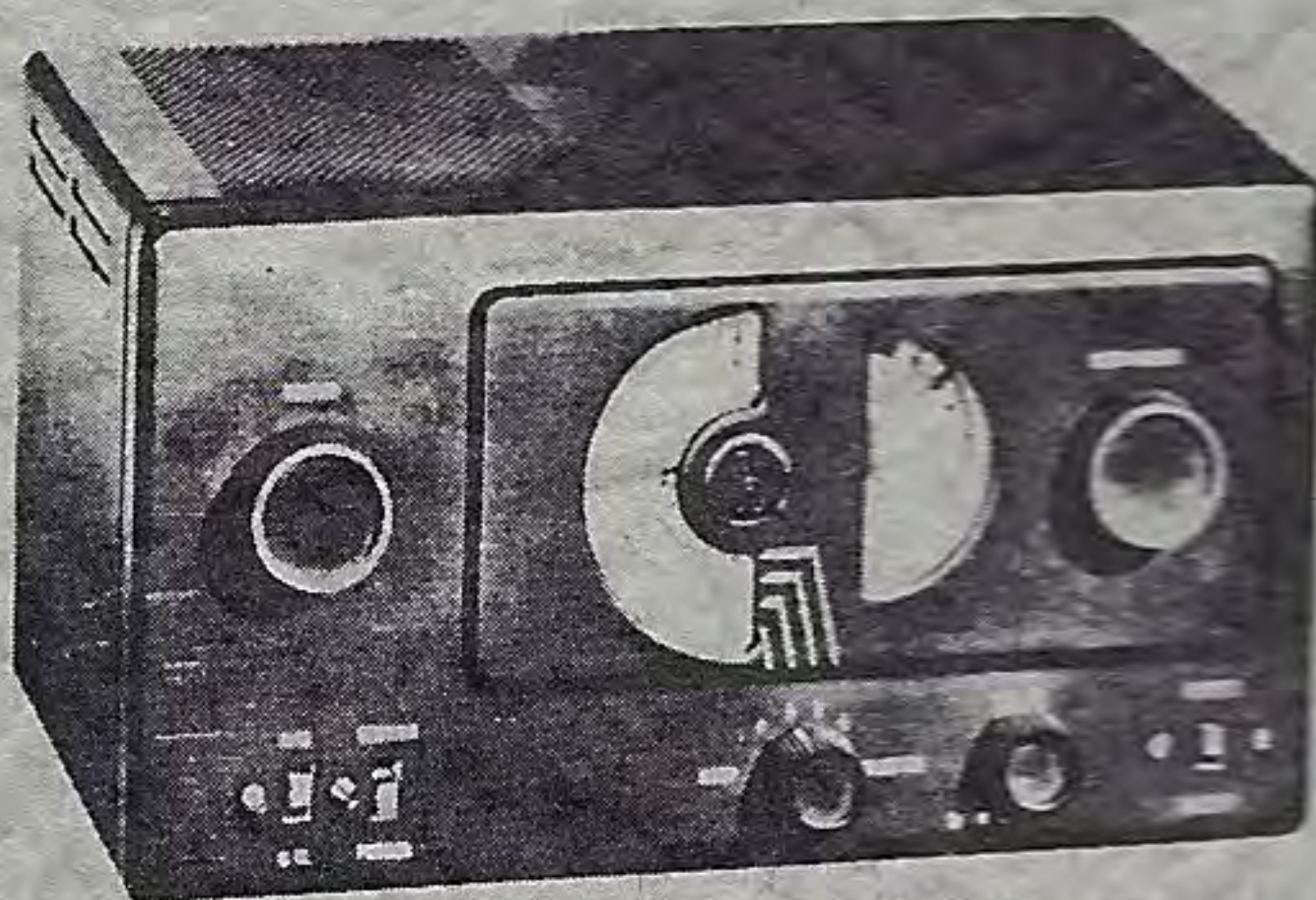
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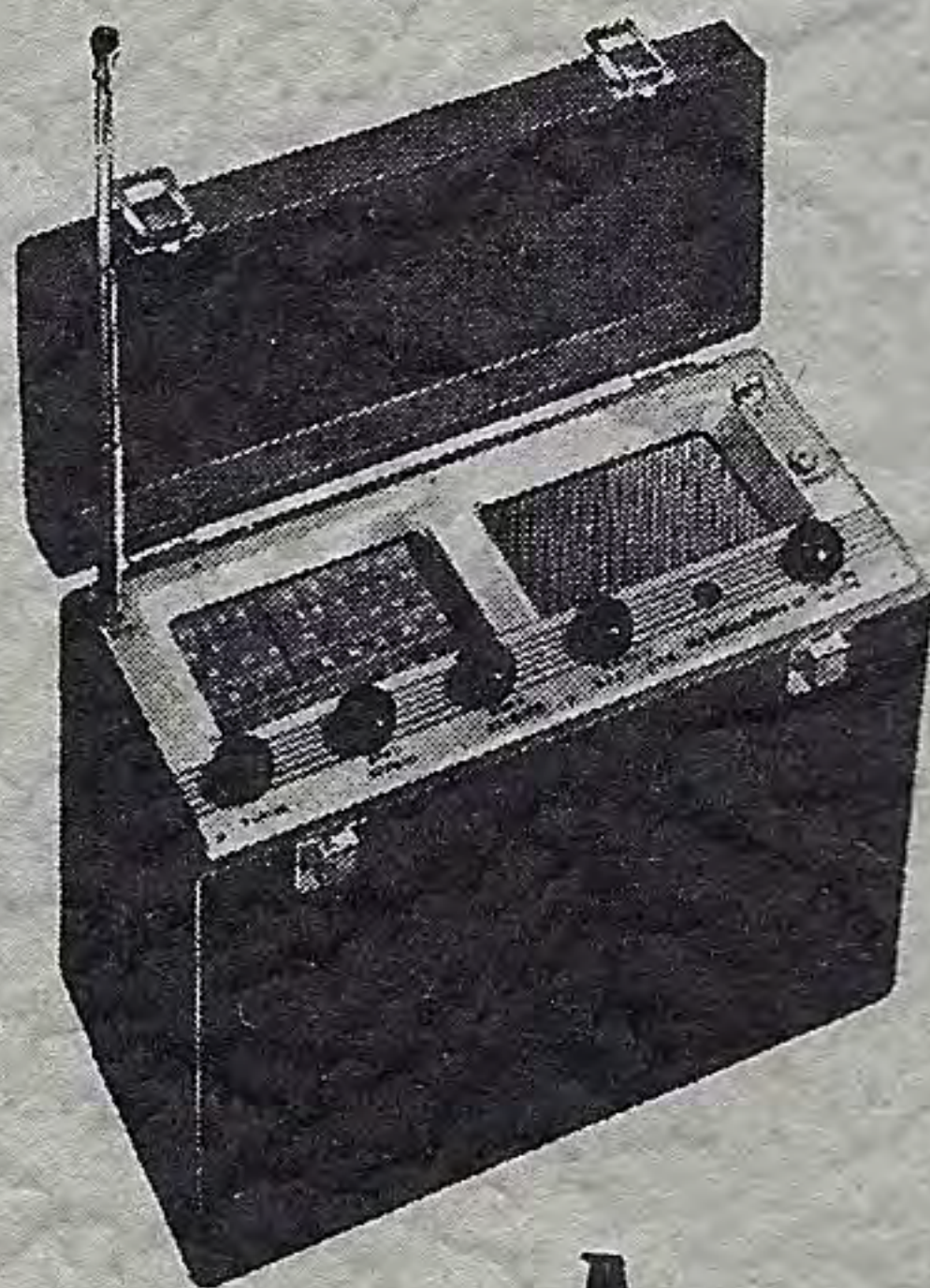
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