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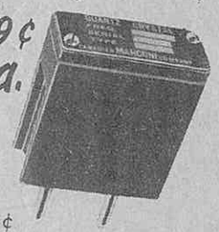

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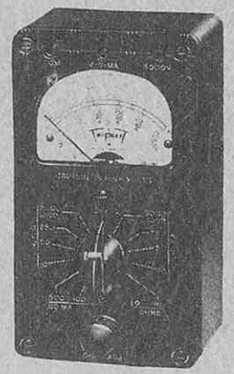
3559	3581	3608	3629	3655	3888	3922	3945	3967	7214	7243	7264	7286	7308	7339
3560	3582	3609	3631	3657	3889	3923	3946	3968	7216	7244	7265	7287	7310	7340
3561	3583	3610	3632	3658	3890	3925	3947	3969	7218	7245	7266	7288	7311	7343
3562	3584	3611	3633	3659	3892	3926	3948	3970	7219	7246	7267	7289	7313	7357
3563	3586	3612	3634	3660	3893	3927	3949	3972	7220	7247	7268	7290	7314	7358
3564	3587	3613	3635	3661	3894	3928	3950	3973	7221	7248	7269	7291	7316	7368
3565	3588	3614	3636	3662	3895	3929	3951	3974	7222	7249	7270	7292	7317	7371
3566	3589	3615	3637	3663	3897	3931	3952	3975	7223	7252	7271	7294	7318	7373
3567	3590	3616	3638	3664	3900	3933	3953	3976	7224	7253	7272	7295	7319	7374
3568	3591	3617	3639	3665	3904	3935	3954	3977	7226	7254	7274	7296	7321	7375
3568	3592	3618	3641	3666	3906	3935	3955	3978	7228	7255	7276	7297	7322	7376
3572	3593	3619	3642	3667	3907	3936	3957	3979	7229	7256	7278	7298	7324	7377
3573	3594	3621	3643	3668	3908	3937	3958	3980	7233	7257	7279	7301	7327	7378
3574	3596	3622	3644	3669	3913	3939	3959	3981	7234	7258	7280	7302	7329	7379
3575	3597	3623	3645	3672	3914	3940	3962	3983	7236	7259	7281	7303	7330	7380
3576	3694	3624	3646	3673	3915	3941	3963	3984	7237	7260	7282	7304	7331	7381
3577	4605	3626	3647	3677	3916	3942	3964	7189	7238	7261	7283	7305	7332	7382
3578	3606	3627	3648	3681	3917	3943	3965	7192	7241	7262	7284	7306	7337	7384



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November, 1951

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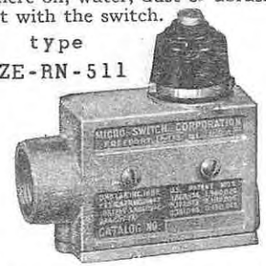

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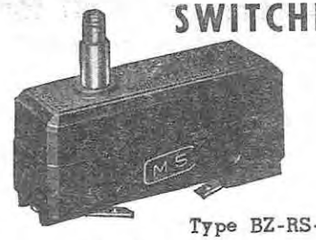

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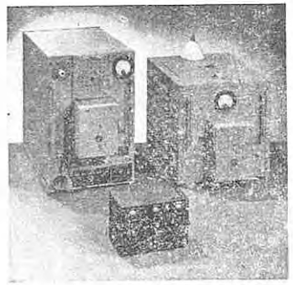

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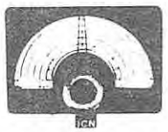

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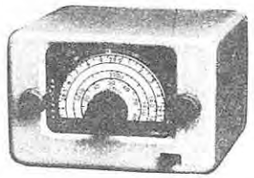

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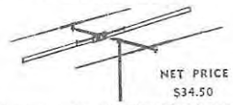

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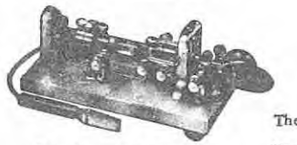

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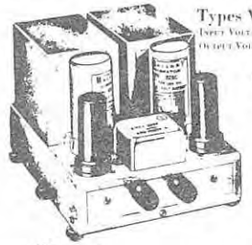

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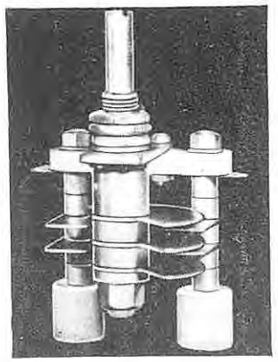

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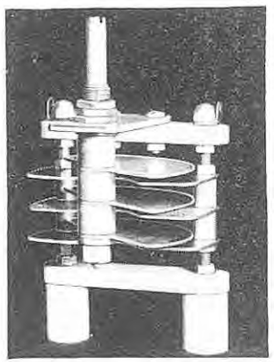

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SIDEBANDS

There have been a number of rumors voiced both on the various amateur bands, and in personal contacts, that the Canadian and American hams would soon be closed down! The Korean War was supposed to be the reason for this imminent loss of our privileges once more. Sounded reasonable to the boys who heard it, and so the rumors flew thick and fast, to every corner of the continent!

To ease your minds on the subject - these wild stories have no present foundation in fact. True it is that the Governments have now, in North America, embarked on a very ambitious preparedness program, but the last thing our leaders of state wish to do is kill amateur activity. Just the reverse is true, both here and in the U.S., where the ham is highly regarded by the authorities.

Fortunately the war news from Korea now is wonderful! Fortunately, because this will serve to spike any appearance of further fiction immediately. And if you can do anything to stop these supposedly official intentions, you'll be doing ham radio a real service!

A rapid check on the matter when it first came to our attention, showed that anyone who normally would know of such matters, gave a flat denial in answer to a flatly-worded question - Is there any truth in the rumor that we'll be put off the air now?

However, greater preparedness among the hams for emergency operation would be highly desirable, to lessen the possibilities of a complete close-down in the event of war being started on this continent by atomic attack. Now is the time to get that mobile rig you've been planning, whipped into shape and installed properly in the car. And small emergency powered rigs for base operation should be on hand in more shacks than now have them. They've proved their worth in a number of recent disasters, and the expense of putting a rig together from surplus is pretty small.

Several cases have arisen where hams have decided not to buy a long-planned-for addition to the shack on the strength of these rumors, which is the absolute height of conservatism. It's like planning to live in a tent someplace until the present cost of real estate deteriorates. Obviously, there is no way of telling when, or even if, such a thing will ever happen. But sitting around in that tent until it does could be very uncomfortable and unnecessary!

If you've been planning on adding to those rigs of yours, our advice would be to go ahead and do so and not keep putting it off, only to find at a later date that your fears were groundless. Go ahead and enjoy yourself now. The future has a way of always looking after itself.

Mobile units deserve more consideration by Canadian amateurs than they have been given to date, since it would seem that mobile operators, equipped to help in an emergency regardless of what it may be, are likely to get special consideration and privileges, as emergency ops have in the past. Being in the happy position of being able to help out in a bad jam won't hurt your pride either!

Don't feel that the future of ham radio is all roses on the basis of this column. Something could happen tomorrow to upset the applecart and there'd be nothing we could do about it. But let's cross those bridges when and if we come to them. Worry doesn't lead you anywhere, and there's an old saying that there's nothing sure but death and taxes! Crank up the rig again, and enjoy a new operating season just starting now!!!!!

de VE3WO

Rumors are flying thick and fast again on the above subject. Whenever you hear hams mention such a possibility discount it completely until world conditions deteriorate completely. There is no more foundation in fact to these rumors now than there was a year ago, when the above column was written - October, 1950. Spike rumors - don't be responsible for spreading them - and you'll do amateur radio a real service.

RF Power Amplifier for 144 mc

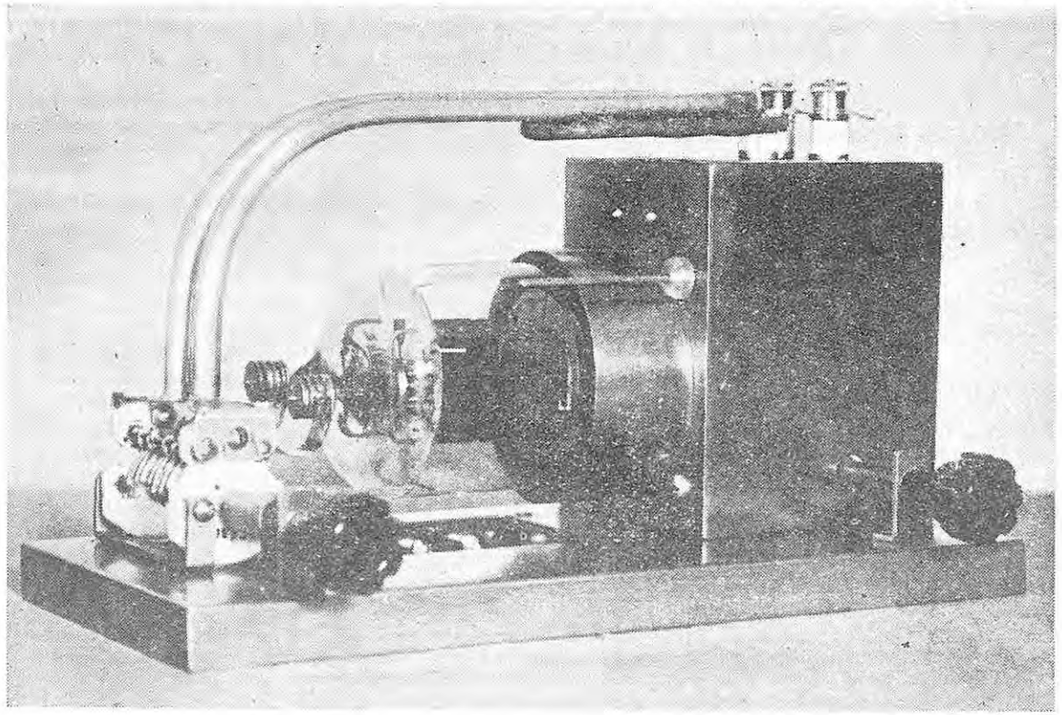
An 829 PA for 100-Watt Operation

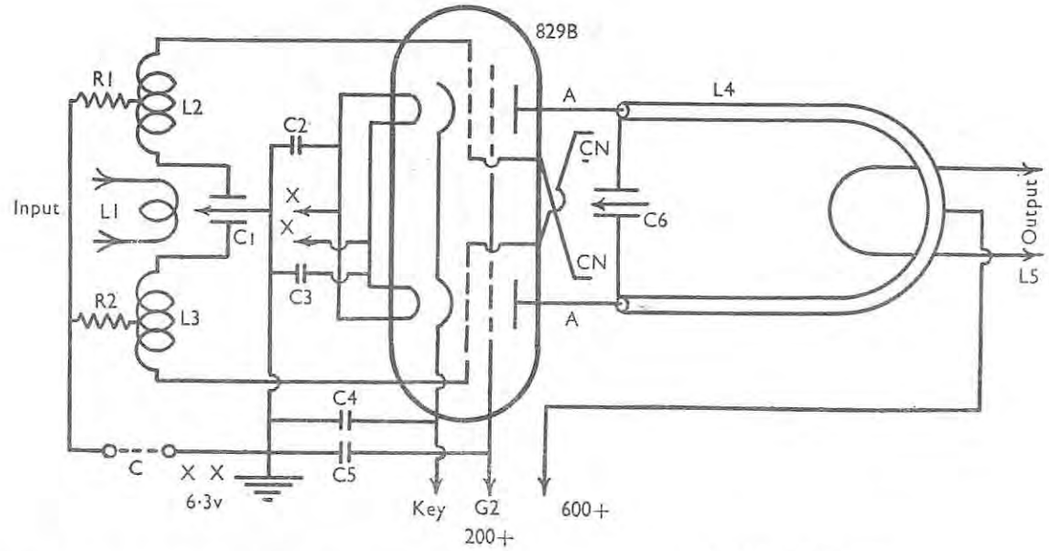
By **M. D. MASON**

There is nothing very unusual in the design, but a few useful circuit techniques have been combined in one amplifier to make up a very reliable stage for 144 mc.

The output circuit uses shortened quarter-wave lines, tuned by a low capacity split-stator condenser, placed as near to the anode end of the line as is practicable. The efficiency of the quarter-wave line is good and is well worth while. The HT feed point is absolutely dead at RF, and there is no need to use RF chokes. It is very easy to couple any transmission line by means of a single turn loop.

Various methods of grid feed have been tried. The one finally chosen has several advantages, such as fairly large inductances, and is therefore very simple to construct and adjust. Another important point is the ease in which the grid drive to each section of the 829 can be correctly balanced. The grid coils may be compared to a pair of half-wave lines tuned at one end by the grid input capacity and at the other by a small condenser roughly equal to the input capacity. The two lines are wound in the form of one continuous coil split in the middle and separated by $\frac{3}{8}$ in. High voltages will appear at the grids and





across the tuning capacity. This will, of course, put the RF cold section of the coils somewhere near the centre of each coil. This is the place to connect the separate bias resistors. When the coils were mounted up for the most convenient layout, it was necessary for one section to have about three and three-quarter turns and the other section to have four turns. The total coil can be balanced by using closer spacing between turns in the smaller of the two coils. This will balance the inductance. The single turn coupling coil is mounted in the centre of the two coils. The drive to each grid may now be balanced by moving the coupling coil towards the side showing the lower grid current. The energy transfer is very efficient and coupling may be quite loose.

The filaments of the 829 have been wired for 6-volt operation and the heater leads by-passed right at the valve socket. The heater supply has been left floating so that cathode keying could be used.

Neutralising has been arranged by feeding two No. 16 gauge wires, one from each grid, out through the screening box and placing them alongside the correct

Table of Values

Fig. 1. The 829 144 mc RF Amplifier

C1	=	25-25 $\mu\mu$F
C2, C3	=	500 $\mu\mu$F
C4, C5	=	·001 μF
C6	=	2-6 $\mu\mu$F per section, ·07-in. spacing (*see text*)
R1, R2	=	7,000 ohms, 1 watt
CN	=	16 SWG enam., $\frac{1}{2}$-1 in. exposed to anode
A	=	$1\frac{1}{4}$ in. by $\frac{1}{2}$ in. wide ·01-in. thick copper connecting strip
L1	=	1 turn 16 SWG enam., $\frac{1}{4}$-in. dia.
L2, L3	=	4 turns each 16 SWG enam., inside edges coils spaced $\frac{3}{8}$ in. apart, $\frac{1}{2}$-in. inside dia winding
L4	=	15 in. of $\frac{1}{4}$-in. silver-plated copper tubing, folded, set $\frac{3}{8}$ in. centre-to-centre
L5	=	14 SWG insulated wire, 8 in. long, folded, set $\frac{3}{4}$ in. centre-to-centre

plates for a distance of 1 in. Two feed-through bushes were made to fit the normal mounting holes on one side of the 829 socket. This arrangement brought the neutralising leads out at a point about $\frac{1}{4}$ in. away from the glass envelope. The correct adjustment can now be made by moving the wires closer or farther away from the anode. The 829 socket was mounted from the two fixing holes nearest to the cathode end of the tube, and a small clip bracket made to clamp the top of the socket to the screening box.

The output tank condenser was made from two small Wingrove & Rogers trimmers (type C803). Six rotor and four stator plates are required. A new rotor shaft must be made from a piece of $\frac{5}{32}$-in. brass rod 3 in. long. The rotor plates are then sweated on to this shaft with a spacing of $\frac{3}{16}$ in. between each plate. Leave a piece of shaft each end so that a coupling can be fitted. The two ceramic end plates from the midget condensers are mounted back-to-back with $1\frac{3}{8}$ in. between the nearest edges. The stator plates are mounted on four pieces of $\frac{1}{32}$-in. wire, which is soldered into the normal stator mounting eyelets. The stator plates are mounted symmetrically with one rotor each side of a stator. There is no stator between the centre two rotors. This assembly will make a condenser with approximately ·07-in. spacing and a capacity range of 2 to 4 $\mu\mu$F per section. The tuning range will be from 143 to 150 mc, when the lines have the correct length and spacing. The spacing of the lines is quite critical with this small capacity swing. However, it is a simple matter to vary the line spacing, and therefore the tuning range, to correct for any capacity difference.

All the power connections are brought out along the back edge of the chassis by mounting Clix sockets on a piece of $\frac{1}{16}$-in. strip bakelite. The strip is mounted on the inside of the chassis and $\frac{7}{16}$-in. clearing holes are drilled in the brass so that there is no chance of a short or flash-over.

The components used in this amplifier have been selected so that the 829 may be operated at any input up to the recommended maximum ratings for the valve.

The tank condenser with ·07-in. spacing will stand 600 volt HT plate modulated, or 750 volt HT in CW operation. The screen grid can be supplied from the main HT through a 12,500-ohm, 20-watt resistor, or from the 300-volt exciter supply. In the latter case, a 3,000-ohm, 5-watt resistor in series with a 10 Hy. 30 mA choke is a useful method. The choke is incorporated when plate modulation of the 829 is used. This system gives "self screen modulation" and is not as wasteful of HT power as when the screen is fed from the 600-volt supply—and incidentally is easier on the screen by-pass condenser.

The power amplifier may be keyed directly in the cathode lead, or, alternatively, sufficient fixed bias for cut-off may be added and the driver stage is keyed.

For good stability in the 829 amplifier, it pays to use sufficient drive for maximum grid current operation. The lower the grid impedance the better.

Voltage/Current Readings and Output

The amplifier was checked under the following conditions :

Plate, 600 volts HT at 200 mA.
Screen, 200 volts at 30 mA.
Grid current, total 15 mA.
Fixed Bias, $-22\frac{1}{2}$ volts.
Total Bias, -75 volts.

A 100-watt lamp clipped on to the output lines looked very pretty when the 829 was loaded to 120 watts input.

Maximum Signal-To-Noise Ratio

Factors Affecting the Design of Communication Receivers

By G. H. COX, B.Sc., A.R.C.S.

(In this article the author discusses design only from the point of view of obtaining maximum signal/noise ratio, and makes a number of practical suggestions to that end.—Ed.)

AN analysis is made in this article of the noise developed in a radio receiver, and the procedure to obtain maximum signal-to-noise ratio is outlined.

It will be shown that the first stage in a receiver is the most important, with the mixer stage coming second. Thus, noise in the first stage is amplified by the following stages together with the signal. For example, a noise-voltage of 1 μV at the grid of the first stage gives a noise output of a volt or so, and will be comparable with the signal from a DX station. From this example it will be seen that noise voltages *must* be referred to a common point before a true comparison can be made.

Shot Noise

The anode current of a valve is not completely uniform but consists of a stream of electrons, each being a separate unit of electricity. The anode current can be considered as a uniform current upon which is superimposed a random fluctuating current. This fluctuation causes a voltage to be set up in the anode load of the valve, thereby manifesting itself as the shot noise. This noise, by its random nature, is distributed over the whole frequency spectrum used, so that the total noise energy within a band of frequencies depends on the width of the band. It will therefore be seen that a selective receiver develops less shot noise than an unselective receiver. The shot noise is conveniently referred to the grid of the valve as the equivalent voltage which, when applied to the grid, would cause the same fluctuations in anode current. This can be done by dividing the noise current by the mutual conductance of the valve. The noise voltage depends on the particular type of valve and circuit used but will be of the order of 0·2-2·0 μV for an RF pentode. If this voltage is developed at the grid of the first RF stage it will be of the same order as that produced by a weak signal.

Thermal Agitation Noise

Free electrons in a conductor have a random motion, thereby developing a random fluctuating current, producing noise within the conductor similar to the shot noise in valves. The extent of the noise produced depends upon the resistance of the conductor and the band width, being greater as the resistance is increased or as the pass band is widened.

In the case of a tuned circuit the noise can be regarded as being built up in the equivalent series resistance of the circuit. The thermal agitation noise is the limiting factor on long wavelengths but on short wavelengths the valve shot noise usually predominates.

Noise After RF Stage

Mixers have a higher noise-factor than RF valves due to the lower conductance of the mixer ; its higher noise constant (see appendix) ; and to noise introduced by the local oscillator. Thus a receiver starting with a mixer will have a poorer signal-to-noise ratio than one starting with one or more RF stages. Again, the mixer noise can be swamped by providing sufficient RF amplification,

such that the amplified noise from the first RF stage is greater than the mixer noise. Also these random voltages cannot be added arithmetically; they must be added as the root of the sum of their squares.

An example will make the whole argument clear:

Suppose the RF stage has a gain of 20 and produces a noise of 1 μV referred to its own grid, whilst the mixer produces a noise of 5 μV at its grid.

Thus the noise from the RF stage at the mixer grid is 20 μV.

Total noise $= \sqrt{20^2 + 5^2} = 20{\cdot}6\ \mu$V.

The increase in noise due to the mixer is therefore only 3 per cent. although the ratio between the amplitudes is 5 to 20.

It will be seen from this example that given sufficient RF gain, then the mixer will make only a negligible contribution to the total noise. The same consideration applies with even more force to stages following the mixer, since by then the noise from the RF stage will completely swamp any further contribution of noise. Thus the extent of IF and AF amplification is of little import from the standpoint of noise although sufficient amplification must be used to obtain a workable output. Also, the AF stages should not introduce hum or extraneous voltages. By careful design of the AF stages it is possible to avoid hum (*cf* microphone amplifiers) and since a fairly large signal is usually applied from the second detector to the AF stages, the extent of further amplification required is small.

Other Considerations Affecting Noise

In many communication receivers no provision is made for adjusting the aerial coupling, or perhaps only two couplings are provided—one for a dipole, the other for a random high impedance aerial. Except at certain spot frequencies, such coupling will not provide for proper matching and optimum signal transfer, so that the overall signal-to-noise ratio will suffer. The solution to this problem is simple—provide either an aerial tuning network with a proper matching line, or some form of adjustable aerial coupling.

Furthermore, it is highly probable that the aerial will influence the ganging of the first tuned circuit, thereby causing loss of signal. Thus some form of tuning correction is also necessary.

Ganging of the tuned circuits causes loss of signal, since the oscillator and signal circuits are tracked in most receivers for only three points over the tuning range. The solution is to use some form of bandspread system with the band set adjustable for each circuit, or to provide correction for each circuit. However, this complicates handling since it increases the number of controls. In practice, if only the first tuned circuit is provided with correction then the drop in signal-to-noise ratio will not be serious; since, in fact, the greater part of the noise does arise in this stage.

It is, of course, assumed that high-Q tuned circuits with the minimum of stray capacity and the proper tuning capacity will be used.

The question of noise generated outside the receiver has not been considered, but external noise can be much reduced by the use of a proper aerial (with, if necessary, a screened feeder). Noise interference and the like can be mitigated by using one of the well-known noise-limiting circuits, which enable a signal to be read through considerable interference of this type.

Conclusions

Starting at the aerial terminal the procedure adopted should be as follows:

(1) Provide proper coupling to the aerial.

(2) Provide some form of tuning correction to the first tuned circuit.

(3) Use high-Q tuned circuits with a low tuning capacity.

(4) Use valves with a low noise-level and high gain in the RF stages. In this position the EF54, which is a beam valve

APPENDIX

Shot Noise

This may be expressed as a component I_S of the direct anode current I_D of a valve as follows:

$$I_S = k\sqrt{I_D \times df} \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

where df is the width of the pass band in c/s and Is and I_D are in amperes; k is the noise constant and depends on the valve type. It has a value of $0{\cdot}4 \times 10^{-9}$ for normal RF pentodes but beam valves such as the EF50 and EF54 have a noise constant of about half this value.

The noise current Is can be referred to the grid of the valve as the equivalent noise voltage Es which when applied to the grid would produce the same noise current.

Thus

$$E_S \quad \frac{k\sqrt{I_D \times df}}{gm} \text{ volts} \quad \ldots\ldots\ldots\ldots (2)$$

where gm is the mutual conductance of the valve.

Thermal Agitation Noise

The noise produced in a resistor of R ohms for a band width of df cycles per second is given by

$$E_S = 12{\cdot}6 \times 10^{-11} \times \sqrt{Rdf} \text{ volts} \quad \ldots (3)$$

In the case of a tuned circuit the noise voltage Es is given by

$$E_S = 12{\cdot}6 \times 10^{-11} \times \sqrt{Z \times df} \quad \ldots\ldots (4)$$

where Z is the impedance of the circuit at resonance.

The noise voltage of a valve is often expressed as the equivalent resistor R in which the thermal agitation noise produces the same noise voltage. Substitution for R in equation (3) will give the noise voltage at the grid of the valve.

and has a high slope with a low noise-factor, is to be recommended.

(5) Use sufficient RF amplification to swamp the mixer noise; two stages will be sufficient up to 60 mc.

(6) Operate the first RF stage at full gain. Do not use AVC on this stage, but instead employ a manual control to avoid overload on strong signals.

(7) Run the oscillator to provide the proper voltage for maximum conversion conductance. The oscillator voltage should not exceed this and should have as pure a waveform as possible.

(8) Keep the band-width of the receiver just wide enough for intelligible communication. A band-pass crystal gate is recommended for telephony.

(9) Design the AF stages to avoid hum and amplitude distortion. A good top response is not necessary since the tuned circuits will not pass the high frequency side bands.

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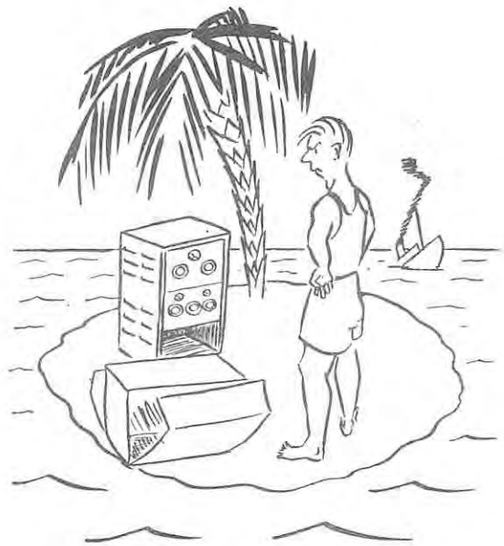

". . . . Just my luck—no power pack . . . . "

KEYING TECHNIQUE

Click Suppression and a General Discussion

By **I. E. HILL (G6HL)**

This is an essentially practical article on a most important subject and will be of interest to every operator of a CW transmitter. The author also suggests a method of clickless keying which while involving no new principle, is a system not often used in amateur working.—Editor.

EACH passing year seems to produce increased activity on the various amateur bands to the extent that it is now most unusual to receive one signal without a background of several others. 'Tis bad enough if the signals in the background are clean, but one or two indifferent ones and a few key clicks can strain the patience of the most saintly. Particularly is such interference annoying when one considers that it is almost entirely unnecessary and could be avoided. In this country, at any rate, there is no shortage of good equipment and an adequate supply of literature on radio theory and practice. Nevertheless, we still have bad notes, signals with unstable frequency control or no control at all, and shocking key clicks, particularly on the lower frequency bands where there is least excuse.

In the past, key click elimination has been practised only to the point where BC1 is avoided and radiated clicks do not trouble neighbouring amateurs listening off the transmitter frequency. To-day, it is necessary to go even further and completely remove clicks from the radiated signal.

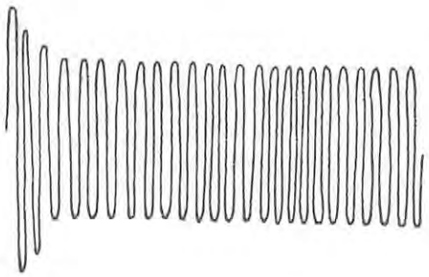

Fig. 1. Waveform to be expected of keyed CW signal with no key click correction.

Cause of Key Clicks

Key clicks, or apparent key clicks, are of three kinds, and can be classified as :

(*a*) Clicks caused by the spark at the key and radiated as an RF pulse of short duration and no particular frequency.

(*b*) Clicks caused by the start and/or stop of a CW signal.

(*c*) Apparent clicks associated with keying which are actually short bursts of parasitic oscillation.

By always keying a circuit carrying a minimum of current and including a small fixed condenser at the key contacts, together with RF chokes in the key leads, the click caused by sparking is not difficult to avoid. This type of click is normally only heard quite locally to the source.

At the instant before the key is depressed, plate supply is at a maximum voltage, and with the average amateur installation this is at least 10 per cent. above the loaded condition. As the key is depressed RF drive is suddenly applied and the radiated signal builds rapidly to a peak as illustrated in Fig. 1. This sudden change from no signal to a maximum peak will produce a click in the receiver on the fundamental and nearby frequencies. Similarly, when the key is released, the signal will fall rapidly to zero and another click will result.

In the old days of LS5B drivers and DET1's or T250's in the final, parasitics were almost unknown and in any case were easily avoided. To-day, sensitive tetrodes or pentodes are the general rule for both exciter and final stages. The sensitive valve is more prone to parasitic oscillation, particularly of the HF type. Careful design and the liberal use of carbon resistor "stoppers" in grid and screen feeds will do much to prevent parasitics. If preventative measures are not taken, it is likely that the action of keying will jerk the transmitter into producing parasitic oscillations, each of short duration. As these parasitics are often present only during the process of keying, absence of this trouble when the key is depressed does not give the transmitter a clean sheet ; 807's are particularly prone to such

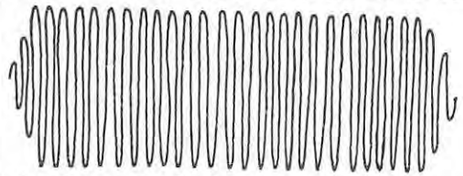

Fig. 2. Waveform of ideal CW signal, showing effect of click elimination. The build-up is slow, with constant amplitude of the "made" signal, followed by a slow fall-away.

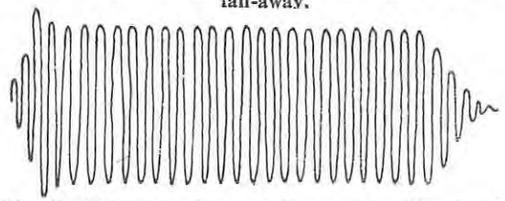

Fig. 3. Waveform of acceptable amateur CW signal, with adjusted key click correction. Slight peaking must be expected at "make" unless the power pack regulation is perfect. It is difficult to obtain exactly similar build-up and fall-away, and it is preferable to have the former faster than the latter, as suggested in this sketch.

It was explained earlier that the click is caused by the sudden application of RF drive and/or plate supply, and the rapid build-up of the RF output. If this process can be slowed down and the oscillation made to build up gradually to its peak and similarly to fall slowly to zero, then the clicks will be avoided. There is then less likelihood of shock excitation into parasitic oscillation, and if suitable precautions are taken that trouble will also be avoided.

If the slowing-up process is overdone, the keyed signal will become "woolly" and difficuilt to copy. A happy medium is the sort of waveform illustrated in Fig. 2—with a further comment in Fig. 3.

At "make" it is necessary to slow down the speed of build-up to the steady peak value. An inductance objects to any change of passing current and insertion of a suitable value in the plate feed of the keyed valve will have the desired effect. Increase of the inductance will increase the time taken to build up to normal and a minimum value should therefore be selected which will remove the click on "make."

So far so good ; use of a suitable LF choke will remove the click on "make," but when the key is broken the current in the keyed stage will fall to a minimum or zero. The choke is still in circuit and it will object strongly to the further change in passing current, and will demonstrate its objection by a spark at the key.

Sparking contacts—the cure is obviously a condenser which will be put across the key contacts. The spark occurring when the key is broken is now taken care of by the condenser which will be charged by the voltage previously producing a spark at the key contacts. The click on break is thus removed.

But next time the key is depressed a click is heard in the receiver, this time caused by the condenser discharging. It is now necessary to show up the discharge rate of the condenser. This can be done by the use of a series resistor of a few hundred ohms.

The final keying filter is the conventional circuit of Fig. 4. The size of the choke Ch. will

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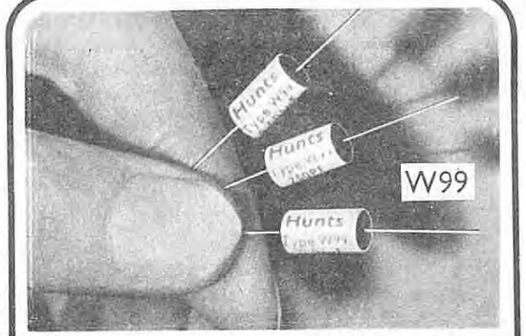

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determine the build-up on "make" and the condenser the fall on "break". The resistor must be adjusted to slow down the discharge rate of the condenser. Correct adjustment of the three variables will give clickless keying of the keyed stages for *one given value of current* and operating conditions.

Primary Keying

Primary keying using a heavy relay will give a slow build-up at "make." The power supply has to charge up the filter condensers ; the bigger the condensers and the bigger the filter choke, the slower the build-up. Similarly, on "break" the condensers will discharge slowly and again the bigger the condensers the slower the fall. Unfortunately, the power supply filter is limited to a relatively small size if the keying is to be readable ; it is therefore almost impossible to obtain a PDC signal. High speed keying is possible only if the filter size is reduced and a T7 or T8 signal is acceptable.

Bias Keying

A condenser takes time to charge up ; for a given applied voltage the bigger the condenser the longer it will take. Similarly, if the condenser is shorted by a resistor the time taken for the condenser to discharge will vary with the size of the resistor. The bigger the resistor the greater the time taken to discharge.

A condenser-resistor combination can be employed to avoid key clicks when using one of the various forms of bias keying. Unfortunately, however, the grid is the sensitive part of a valve and the slightest click produced in the grid circuit is amplified in the output. Bias keying can be used satisfactorily, but it is touchy and not easy to adjust. It is difficult to isolate completely the key from the RF circuits under control.

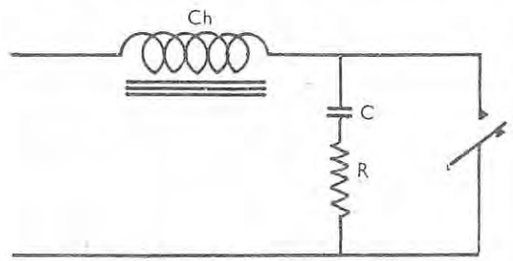

Fig. 4. The conventional keying filter, some points regarding which are discussed in the text.

Valve Keying

The use of a valve specifically for keying purposes has much to commend it. The key and associated circuits can be completely isolated from the keyed RF stage and are at low potential. The waveform of the RF in the keyed stage can be determined by the values of condenser and resistor in the bias keying of the keyer valve. By the provision of suitable selector switches a rapid change of condenser and resistor value can be made and thus the waveform of the keyed stage can be changed over a wide range of loading. Constructional details of a suitable valve keyer follow later.

Where to Key

Various handbooks and radio manuals detail keying methods and how they may be applied in a transmitter. To outline them all would be outside the scope of this article ; it must suffice therefore to specify the author's preference.

Undoubtedly the cathode circuit is the best place to insert the key and will minimise clicks before introduction of the keying filter. With cathode or centre tap keying raising the key breaks the plate circuit and at the same time puts a high negative potential on the grid, thus reducing plate current rapidly. On "making" the key, the high negative bias is removed from the grid and the plate circuit is completed.

In a transmitter which has fixed loading on the keyed stage the choke-condenser-resistor network, properly adjusted, will be satisfactory. But most amateur transmitters are used on several bands and inevitably the keyed stage loading varies somewhat. In this case, a valve keyer with its ease of adjustment is much to be preferred.

The location of the keyed stage in the transmitter is important.

First, it should be emphasised that keying of the oscillator is outdated practice and bad. If BK is an essential requirement two oscillators

should be run, one fixed, one variable and fed to a mixer valve which can be keyed. The oscillators must be well screened and frequencies selected so that they add to the required output frequency but with neither giving low order harmonics in the amateur bands, *e.g.* a crystal oscillator on 2000 kc can feed the grid and a VFO on 1500 kc can feed the suppressor of a pentode mixer, the output of which is tuned to 3·5 mc. An untuned buffer should be used between the VFO and the mixer.

If BK is not a requirement—and except for traffic handling it is difficult to see its necessity in amateur communication—then the keyed stage should be moved as near to the PA as possible. The objectives are to reduce the likelihood of setting off parasitic oscillation in the post-key stages and also to isolate the keyed stage from the oscillator. Except for low-power work it is not good practice to key the PA owing to the difficulty in adjusting the keying filter and the higher voltages involved. In the case of the valve keyer the loss of power in the keyer valve is undesirable and for large plate current in the PA the keyer becomes unwieldy.

Suggestions

1. Do listen to your signal on a receiver with aerial off, RF gain turned down, AVC off, BFO off. If manipulating the key produces only a rushing sound in the receiver and there is no sign of click or thump on "make" and "break", and if you can find no other funny noises associated with keying—replace halo headdress and continue operating! In the more likely case of detecting clicks, make a resolution to remedy them and get started *now*.

2. Do put a ·0005 μF mica condenser (or larger in some cases) across the key at the contacts and insert HF chokes in the key leads at the key end. Screen the lot and take the key leads away in screened cable, earthed at the transmitter end.

3. Do locate the keyed stage as near the PA as electrically possible—not necessarily physically.

4. Do put parasitic stoppers in all stages; 25- to 50-ohm carbon resistors inserted in grid and screen leads at the valve holder and before the by-pass condensers.

5. Do use a well filtered and well regulated power supply. A condenser input filter gives a higher voltage output, it's true, but a choke input filter gives better regulation.

6. Do stabilise plate and screen supply of the oscillator *and* screen supply of the next stage. VR tubes will do the trick.

7. Do avoid paralled feed and use series feed, thus avoiding RF chokes in the transmitter. RF chokes are prone to help LF parasitic oscillations.

8. Do report key clicks or absence thereof when making contacts.

Practical Valve Keyer

The circuit at Fig. 5 is almost self explanatory and values can be varied somewhat to suit junk box parts available. The keyer has been built into a TU5B case and provision made for the use of up to four keyer valves in parallel. Any type of low impedance triodes can be used—45, 6B4, 2A3 and so on. Allow 50 mA per valve and expect a voltage drop across the keyer of 50 to 100 volts. In the writer's transmitter an 807 which operates on 3·5 or 7 mc is keyed and one 6B4 is adequate in the keyer. The 807 plate current varies from 25 mA when used as a doubler to feed other driver stages to 50 mA when used to drive the PA. The 807 cathode connects to the plate of the 6B4 and is by-passed for RF at the 807 holder.

As the TU5B case was large enough an additional LT rectifier was incorporated to give relay supply for aerial and control switching. The unit becomes a combined keyer and send/receive box.

The variable resistor across the bias supply is useful as its adjustment to give a lower value of bias voltage will precisely control the keyed stage input. This enables one to obtain a convenient signal in the receiver for oscillator setting when working on the higher frequencies and the oscillator harmonic is weak or inaudible. After setting the oscillator frequency the bias resistor must, of course, be restored to maximum or the keying will be woolly and a spacer radiated.

Skywire

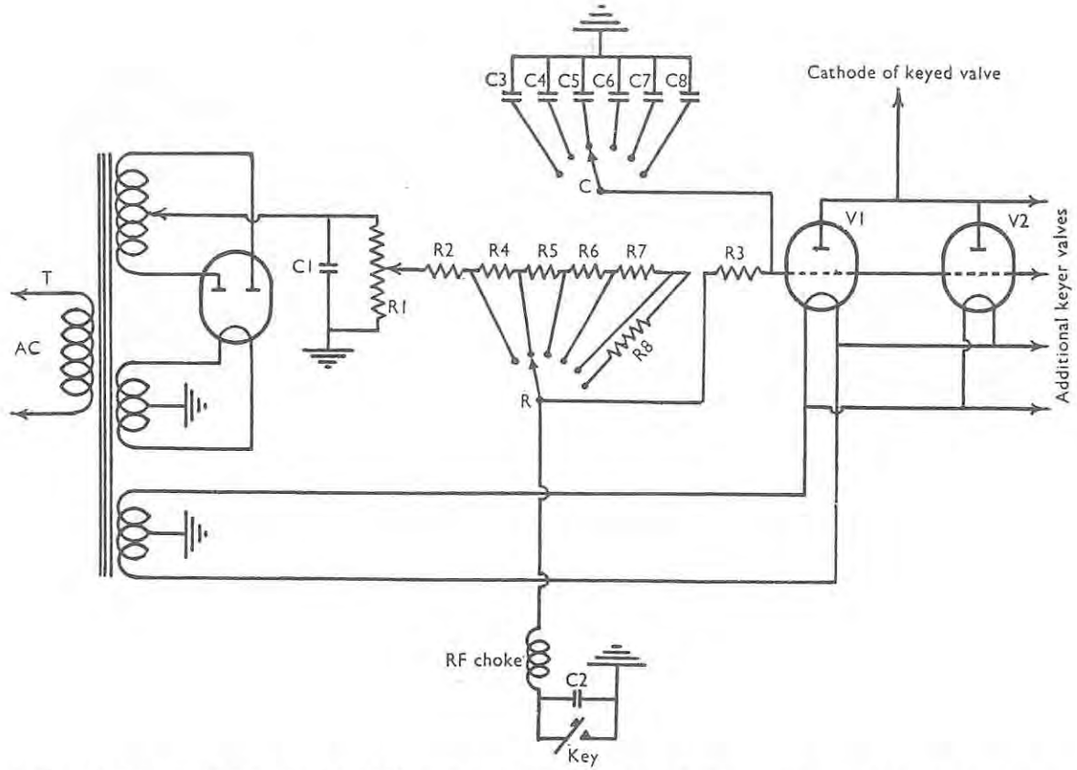

Fig. 5. The valve keyer suggested by G6HL; the current capacity can be increased by paralleling further valves with V1, V2. Values are given below and the method of operation is covered in the discussion.

Adjustment of the R and C switches for keying characteristic is quite simple. To reduce click on "make" increase R; to reduce click on "break" increase C. The correct adjustment is obtained when there is just a trace of click on make and the click has just disappeared on break but there is no tail. It will be found that the adjustments of R and C interlock; after setting R to optimum for "make" an increase in C will necessitate a slight readjustment of R, but a balance between the two can easily be found.

Finally, it is perhaps opportune to say "Check your transmission carefully and get a few opinions from *nearby* operators if you are in doubt. If it does not measure up to K9 it is time to do some hard thinking and make a few quite simple modifications to the transmitter."

Table of Values

Fig. 5. Keyer Valve Circuit Arrangement

C1	=	2 μF
C2	=	·0005 μF
C3	=	·0001 μF
C4	=	·002 μF
C5	=	·003 μF
C6	=	·005 μF
C7	=	·008 μF
C8	=	·01 μF
R1	=	50,000 ohms, 5-watt variable
R2	=	50,000 ohms
R3, R6, R7, R8	=	500,000 ohms
R4	=	100,000 ohms
R5	=	250,000 ohms
V1, V2	=	Any low-impedance triode (2A3, 6B4, 45)
T	=	250-0-250v,

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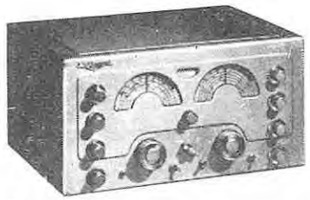

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Exceptional versatility and quality performance. Continuous tuning 540 kc to 31 mc, plus 6 meter Amateur band. Extremely high sensitivity and image rejection. Voltage regulated oscillator for minimum drift. Main dial covers full range in 5 bands; bandspread dial for 80 to 6 meter bands. Features: 6 position crystal filter; noise limiter; 8 and 500 ohm output; 8 watt undistorted output; phono input jack; phono-radio switch. In gray steel cabinet, 19¾ x 10⅛ x 15". For 110-120 or 220-240 volt, 50-60 cycles AC. With tubes, less speaker. Shpg. wt., 65 lbs.

HRO-50-1

The world-renowned communications receiver. Coils supplied cover 1.7-32 mc continuously; provide bandspread on 80, 40, 20, 11-10 meters. Features: Illuminated dial showing band in use; drift-free high frequency oscillator and BFO circuits; 6-step crystal filter with phasing control; ANL with threshold control; AVC; standby switch; RF gain; AF gain; tone control; calibrated "S" meter; radio-phono switch; 8 and 500-ohm output; universal antenna input. In gray steel cabinet, 19¾ x 16½ x 10⅛". For 115 or 230 volts, 50-60 cycles. Shpg. wt., 84 lbs.

Represented in Canada by

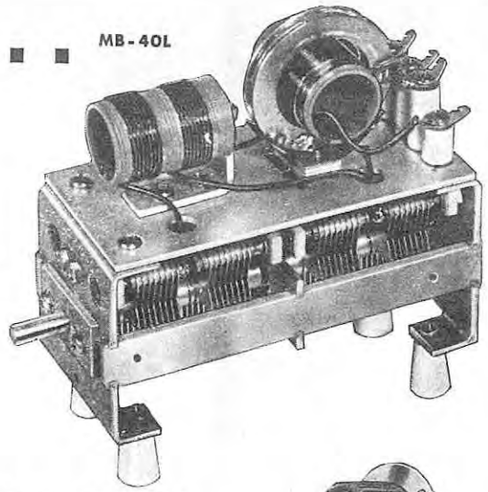
CANADIAN MARCONI COMPANY

861 BAY STREET, TORONTO, ONTARIO

VANCOUVER WINNIPEG MONTREAL HALIFAX ST. JOHN'S NFLD.

START RIGHT. . .

National



MB-40L

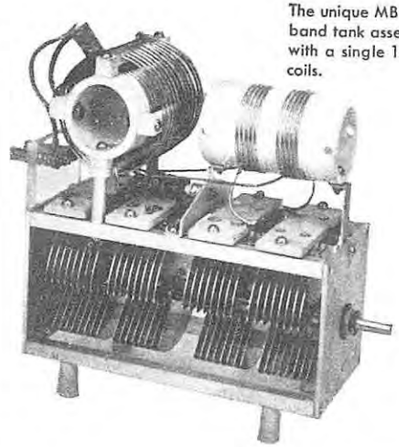
The MB-40L may be used in the grid circuits of tubes employing the MB-150L in the plate circuit. Will handle 40 watts if link is kept loaded.

HRT

HRS-1

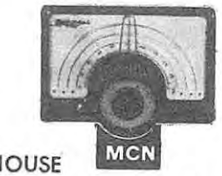
MULTI-BAND TANK ASSEMBLIES

The unique MB-150 high-power and MB-40L low-power multi-band tank assemblies will tune all bands from 80 to 10 meters with a single 180° rotation of the capacitor without changing coils.



MB-150

The MB-150 is intended for use in plate tank circuits having an input up to 150 watts. It is ideal for a pair of 807's, 809's or a single 829 B.



MCN

SEE THEM AT YOUR SUPPLY HOUSE

Represented in Canada by

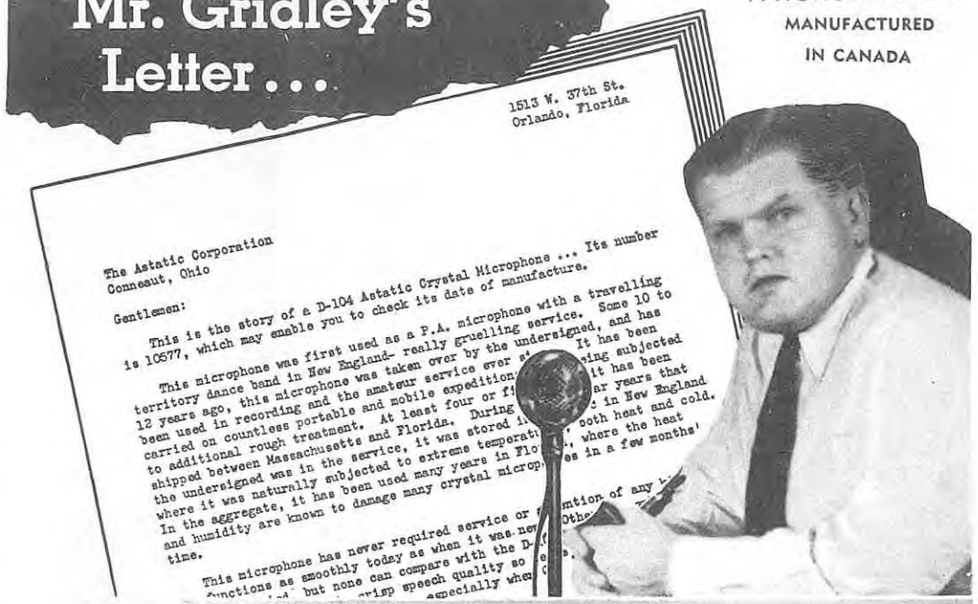
CANADIAN MARCONI COMPANY

861 BAY STREET, TORONTO, ONTARIO

VANCOUVER WINNIPEG MONTREAL HALIFAX ST. JOHN'S NFLD.

Mr. Gridley's Letter . . .

MICROPHONES
MANUFACTURED
IN CANADA



CONFIRMING Astatic's claims for the dependability of its products is the word of Ansel E. Gridley (WINWE/4, ex-W4GJO) of Orlando, Fla., in an unsolicited but greatly appreciated letter of commendation concerning Astatic's original Model D-104 Crystal Microphone. Mr. Gridley writes, in part: "This microphone was first used as a P. A. microphone with a traveling dance band, but was taken over by the undersigned some ten to twelve years ago and has been used in recording and amateur service ever since. It has been carried on portable and mobile expeditions . . . never required service or attention. Functions as smoothly today as when it was new. I have received more dollar for dollar value from the D-104 Microphone than from any electronic component ever purchased." Thank you, Mr. Gridley.

With many newer microphones, Model D-104 is still in the Astatic line.

CANADIAN LIMITED

ASTATIC

TRADE MARK REGISTERED

MANUFACTURED IN CANADA

2273 DANFORTH AVENUE TORONTO 13 CANADA

DX PREDICTIONS

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

PREDICTIONS FOR MONTH OF NOVEMBER, 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	7	7	7
Africa		7	-	-	14	28	28	28	28	28	7	7	7
Caribbean		7	7	7	14	28	28	28	14	14	7	7	7
S. America		7	7	7	14	28	28	28	14	14	14	14	7
Australia		-	7	7	7	7	-	-	-	-	-	-	-
U.S. - West		14	7	7	14	14	14	14	14	14	14	14	14
U.S. - Central		7	7	7	7	14	14	14	14	14	14	14	14
U.S. - South		14	14	7	7	7	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	14	14	14	14	14	14	14	14
Montreal		4	4	4	4	7	14	14	14	14	7	7	7
Sackville		4	4	4	4	7	14	14	14	14	7	7	7

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

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

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		7	-	-	28	28	28	28	28	14	7	7	7
Caribbean		7	7	7	14	28	28	28	14	14	7	7	7
S. America		7	7	7	14	28	28	28	14	14	14	14	7
Australia		-	7	7	7	7	-	-	-	-	-	-	-
U.S. - West		14	14	14	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		14	14	7	7	7	14	14	14	14	14	14	14
Vancouver		14	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	7	7	14	14	14	14	14	14	7	7
Montreal		4	4	4	4	7	14	14	14	14	14	7	7
Sackville		4	4	4	4	7	14	14	14	14	14	7	7

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		7	-	-	28	28	28	28	28	14	7	7	7
Caribbean		7	7	7	14	28	28	28	14	14	7	7	7
S. America		7	7	7	14	28	28	28	14	14	14	14	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	14	14	14	14	14	14	14	14
U.S. - South		14	14	14	14	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	14	14	14	14	14	14	14	14
Toronto		4	4	4	4	7	14	14	14	14	14	14	14
Sackville		4	4	4	4	7	14	14	14	14	14	14	14

HAMADS

Skywire Hamads must pertain to amateur radio. Rates are 20 cents per word, per insertion for commercial advertisements for profit, and 4 cents per word for all non commercial, non-profit advertisements by experimenters or licensed radio amateurs! Full remittance MUST accompany copy! Print plainly and count address in the total. Do NOT send personal checks unless exchange is included. Mail to Skywire, Toronto!

FOR SALE - 350 watt transmitter, 60 cycle pair 813's final. Transformer tapped for higher voltage. Speech unit has 300 watt audio transformer, with pair 805's final. Covers 20, 40, 80(75) meters. Will assist in installing. The price - $185.00. Also have brand new Signal Corps Radar Scope complete, less power unit - $25.00. Have Signal Generator for $20.00 and tubes - type 872, 866A, 2A5 and 5BP1 - what are your offers. Have Signal Corps BC-454-B receiver complete with 60 cycle power supply - $28.00, and BC-457 converted to 80 meter VFO, with power unit, complete, just $32.50. 10 meter converter, less any power supply - $18.00. Write Harold Stibbards, 110 Bald St., Welland, Ontario.

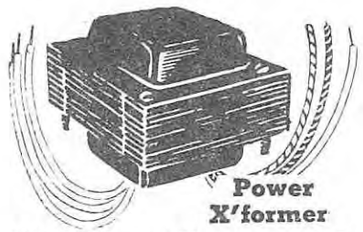
TWO TUBE super receiver with power supply National Vernier dials - $35.00. Three tube TRF with frequency monitor, less power supply - $35.00. Trade NEW Remington Noiseless portable typewriter, original ribbon for 2000 volt 25 cycle power supply, Mike Caveney, 29 Byng Avenue, Willowdale, Ont. Phone Willowdale 5571.

RCA AR-88 receiver at reasonable price available from original owner. For the details, write VE3GP, Rideau View P.O., Ontario.

FOR SALE - 815's at $3.00, 811's at $3.00 5BP1 at $5.00, plus 810's and 304TH's to highest bidders. Have quantities of all - BRAND NEW. Also have 5 small power transformers up to 500 volts at 200 mils plus numerous filament transformers - of 2.5, 5 and 6.3 secondaries. All are 60 cycle. Will trade for 25 cycle, plus cash if necessary. Have prop pitch motor all modified to go - $35.00 or bid. What offers or Swaps for this gear. Len Walker is the name. Write 197 Rosedale Heights Drive, Toronto, or phone MAyfair 2754.

Selling over half my radio parts and equipment. Low priced for quick sale. 75 watt transmitter, 815 final, 6 and 10m, in Hammond table cabinet. All stages are metered - $40.00. Power supply, 500vdc at 300 ma - $25.00. Barker and Williamson 75 watt plug-in coils, variable center linked, all bands, a buck each. B & W 150w coil for 80, center link - $2.50. National PW-0 micrometer dial and gear drive - never used - $10.00. Hammond transmitting condensers, single section 150 mmf, 1500 volt - $2.00, and single 108 mmf, 4500 volt Hammond, $3.00. Split stator, 50-50 mmf, 3000v Johnson - $3.00. Two 30 henry, 300 ma, 3000 volt Hammond filter chokes - $10.00 each. All the gear above is new or only slightly used, and in perfect condition. J. Clarke, VE3ALI, 228 medland Street, Toronto, Ontario, or phone JUnction 8582 or RAndolph 6463.

Ham Specials **From HAM Headquarters**



Power X'former

270-0-270 at 100 ma., with 5v at 2a and 6.3v at 3a. 110v 60 cycle primary. Special sale - just $3.75. Compare this!

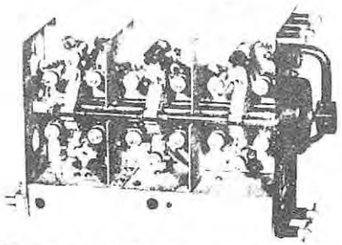
GERMANIUM DIODES

1N-34 crystals

Now only $1.75 ea.

PLEASE NOTE NEW ADDRESS

RF - 24 CONVERTER!



10 meter converters. Type 24. 5 frequency broad band unit. Covers 20 to 30 mc. Ready to use on 10. Complete with easy instructions - $12.00

LOOK. 4" PM, good quality. Our special sale price - $1.29

THESE ARE NEW SPEAKERS AT LOW COST TO YOU.

TUBULAR PAPER CONDENSERS

Fresh stock, 600v bypass

.002 .01 .025

.005 .02 .03 SPECIAL!

Just 8 cents each

Mallory, Pyramid TUBULARS

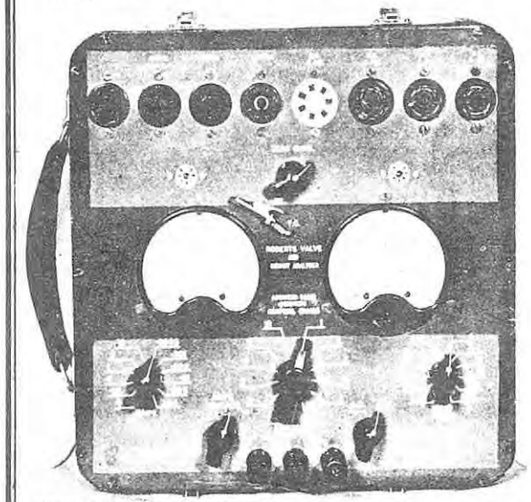
20-20-150v - .55¢ each.

8mfd -150v - .25¢ each.

XTAL MIKE, brand new, name brand. Now only $9.75 each

AS ADVERTISED LAST MONTH

6 tube Utah amplifiers, complete with 6" speaker, mike, phono, extension, speaker outlets. 110v/25 cycle $19.95 For 110v/60 cycles - $18.95.



ROBERTS Tube and circuit analyser. Does everything around shack. 30 ranges for the low price of $49.50. Don't miss this

$1.95

FRONT END - deluxe set of push button and manual tuning heads. See September Skywire. Low price still prevails. Set of 2 is just $1.95. Order several.

FREE RADIO CATALOG

Our new 1951 Catalogue Supplement is ready to mail. Be sure to get a copy! Write today.

The **RADIO CENTRE**

Supplies for Repairmen & Amateurs

72 CRAIG ST. WEST, MONTREAL

HOW'S UR OBS IQ?

Official Bulletin Nr 315, Oct 18, 1951. Slow speed practice for the Novice and prospective amateurs additional to the code practice nightly from W1AW is now transmitted by the following stations: W6JZ 3590 kc Monday through Friday at 1845 PST, W7FWD 7200 kc Monday through Friday at 2030 PST, W8BDF 3705 kc Monday through Friday at 2000 CST. W1AW code practice is transmitted on 1885, 3555, 7120, 14100 kc, 52 and 146 Mc daily at 2130 EST. Listeners are invited to take part in the Code Proficiency Qualifying Runs each month. For complete details see QST. Code practice stations, especially 28 Mc operators, are invited to submit their schedules for publication in QST. Write A.R.R.L. for details of conducting on the air code lessons.

Official Bulletin Nr 316, Oct 25, 1951. Word from W1DBM announces the availability of an eighty page book entitled Television Interference which contains articles reprinted from QST and other publications, a bibliography, and other helpful information on the subject of TVI elimination. A copy may be obtained free of charge by dropping a postal card with your name and address to - Phillip S. Rand, W1DBM, % Remington Rand, Inc., Laboratory of Advanced Research, Wilson Road, South Norwalk, Conn.

Official Bulletin Nr 217, Nov 2, 1951. You are cordially invited to take part in the Third A.R.R.L. Ten Meter WAS contest December 7, 8, 9 and 14, 15, 16. Phone, CW or both may be used. A certificate award will be given to the leading entrant in each A.R.R.L. section. Complete rules will appear in December QST. Send a postal or radiogram to your A.R.R.L. Headquarters at Hartford, giving the call of the station from which you copied this message and you will receive gratis convenient report forms for the WAS contest.

The Radio Society of Great Britain is inviting participation in the Firth All-European DX contest. The CW section of the contest will be held from 0001 GMT on December 1st to 2400 GMT December 2, and the phone competition from 0001 GMT on December 8th to 2400 GMT December 9. Certificates will be awarded to the highest scoring participants in each country and each W and VE licensing area. Rules are the same as last year and are printed on page 43 of QST for November, 1950. Mail logs to the Radio Society of Great Britain, Contests Committee, 28/30 Little Russell Street, London WC1, England no later than December 31st.

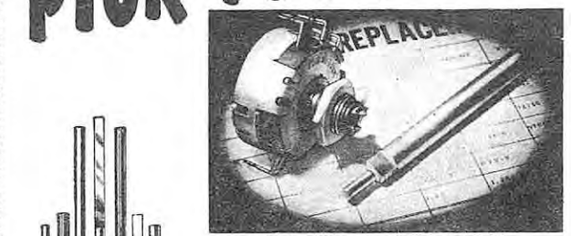
Special Canadian Bulletin, Nov. 15, 51. This is to advise all mobile VE's their local D.O.T. office would like to have a complete record of all such available equipment in each area. This information would be of tremendous value to civil authorities in the event of an emergency. Similarly, if you have other self-powered Field equipment, please let the D.O.T. office nearest you know about what bands and frequencies you can operate on.

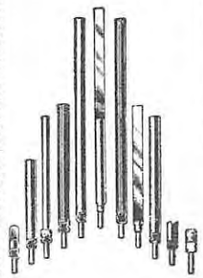
F.C.C. has issued a public notice that amateurs who have filed operator and station license renewal applications prior to the normal expiration date may continue operating their amateur stations beyond that date pending receipt of notice of action on their applications. This privilege is called to the attention of amateurs to insure their continued participation in civil defense drills and other activities while the Commission processes a large backlog of pending applications.

Skywire

CLAROSTAT

PICK YOUR OWN





the "PICK-A-SHAFT" way

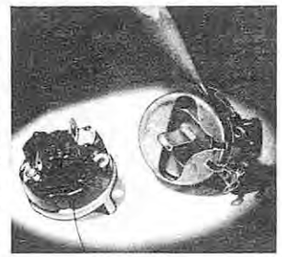
★ Pick the right Clarostat AM or AT control for resistance, taper, tap. Then pick the right shaft—choice of 11. Slight rap fastens Pick-A-Shaft to control—squarely, solidly, permanently. It's minimum stock for maximum replacement needs!

★Ask your Clarostat jobber to show you the "Pick-A-Shaft" way. Catalog on request.

SERIES SWB AD-A-SWITCH

These switches add to all Clarostat Series K, AK, G and AG controls in a matter of seconds for a permanent, excellent assembly. All are rated at 5 amperes at 125 volts ac.

The Clarostat Ad - A - Switch Series SWB may be attached in seconds. No time-consuming mechanical fitting necessary.



Represented in Canada by
CANADIAN MARCONI COMPANY
861 BAY STREET, TORONTO, ONTARIO
VANCOUVER WINNIPEG MONTREAL HALIFAX ST. JOHN'S,

ESICO

Electric Soldering Irons

IN STOCK AT YOUR JOBBER

● No. 61 Pencil Iron — Amateur Net $4.50

This pencil iron is only seven inches in length and weighs just 2½ ounces exclusive of cord. The handle temperature at the point where it is held in the fingers, is actually no higher than body temperature. Diameter of handle is ¾" and may be used as a pencil for the most delicate soldering operations. The element construction is of the same type as used in ESICO industrial irons and will give long service. The tip is the so-called plug type, held in place with a set screw. Three shapes of tips are available, Type B—¼" dia. pyramid point, Type A—⅛" dia. straight pencil point and Type C—⅛" dia. bent 90 degrees with a pencil point.

● RED LABEL LINE
For Production Line Continuous Operation. These Irons are of most rugged construction.

No. 38 - Net $6.30 - 3/16" Tip—100 Watts
No. 58 - Net $8.10 - 5/16" Tip—200 Watts
No. 78 - Net $9.90 - 7/16" Tip—300 Watts
No. 98 - Net $11.70 - 11/16" Tip—550 Watts

● GREEN LABEL LINE
For intermittent duty. Meets all requirements of the home craftsman.

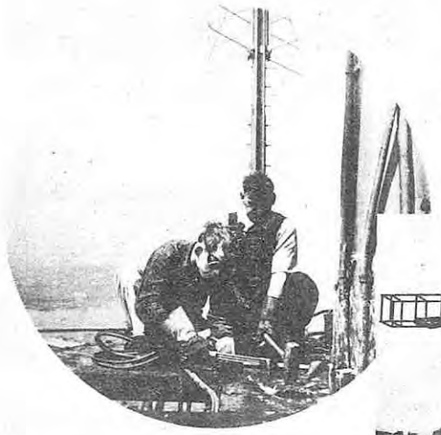
No. 415 - Net $1.80 - 3/16" Tip—55 Watts
No. 416 - Net $2.70 - ¼" Tip—60 Watts
No. 417 - Net $3.60 - 3/16" Tip—100 Watts
No. 418 - Net $4.50 - ½" Tip—130 Watts

● ORANGE LABEL LINE
For Professional Mechanics—light or heavy soldering where iron must withstand operation for eight hour periods or more on frequent occasions.

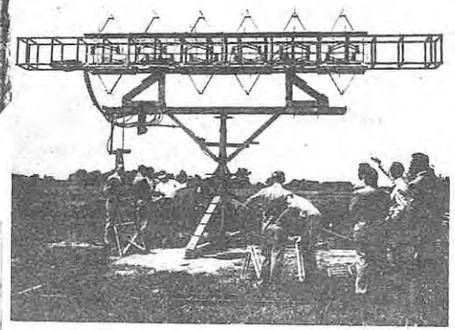
No. 62 - Net $4.50 - ¼" Tip—60 Watts
No. 63 - Net $5.40 - 3/16" Tip—100 Watts
No. 64 - Net $6.30 - ½" Tip—130 Watts
No. 65 - Net $7.20 - 5/16" Tip—200 Watts
No. 67 - Net $8.10 - 7/16" Tip—300 Watts
No. 69 - Net $9.90 - 11/16" Tip—500 Watts

Distributed in Canada by
CANADIAN MARCONI CO.
MONTREAL
VANCOUVER WINNIPEG TORONTO
HALIFAX ST. JOHN'S, NFLD.

Erecting New TV Antenna for the New York Area



Workmen with torch and sledge prepare to dismantle the old antenna mast which supported WNBT's TV radiator.

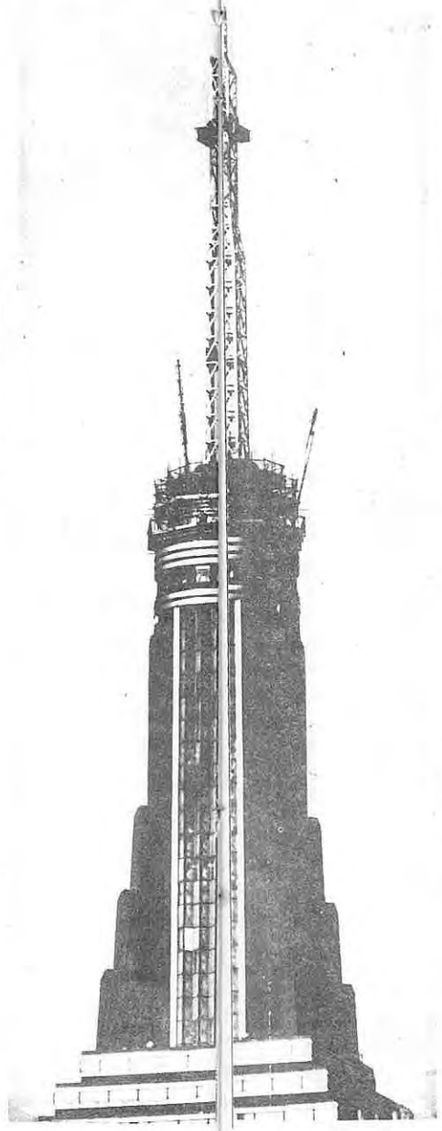


RCA engineers, working at a field laboratory near Camden, N.J., conduct tests on a model of the Empire State antenna.

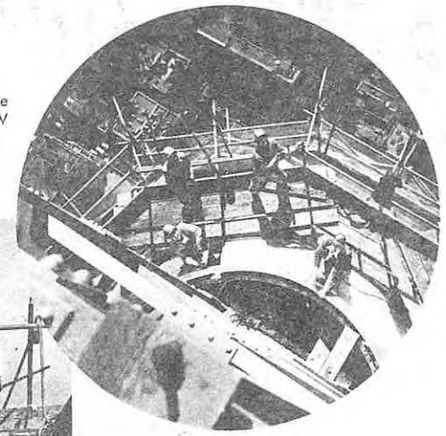
Steelwork for the 217-foot tower is raised from ground level to the top through one of the building's elevator shafts.

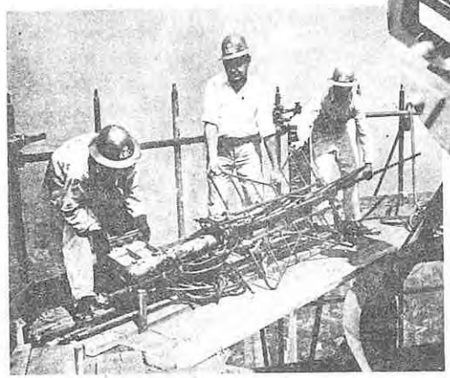
Temporary antenna is assembled and raised on support alongside the main mast.

Flanked on either side b the temporary antennas of WNBT and WJZ-TV t e new tower, in this view, has reached the 130-foo point with 80 feet to go.

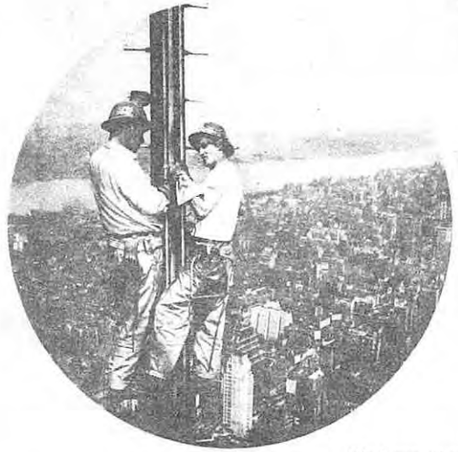


Looking down from the dizzy height of the steel lattice-work which will support five TV and three FM antennas.





Working on a narrow staging 1300 feet above the street riggers prepare to set up a super-gain TV antenna.

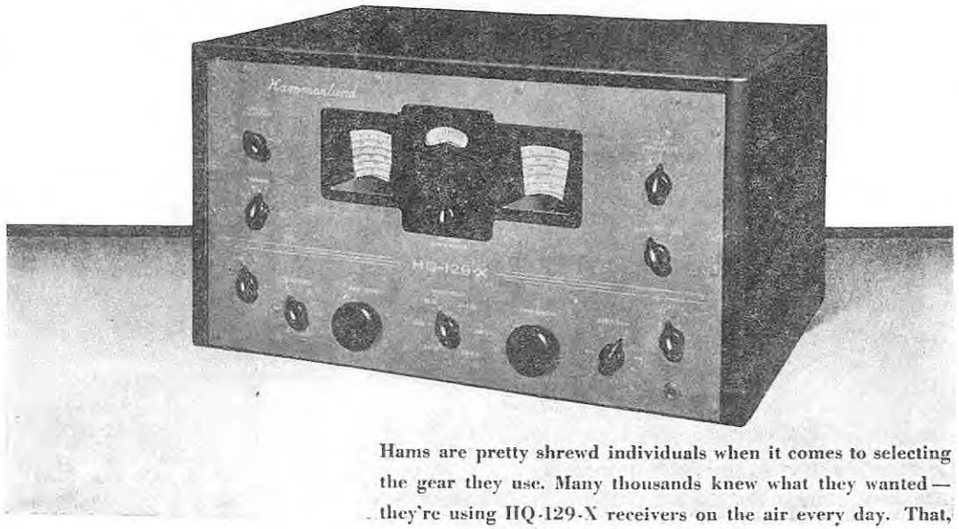


Workmen attach transmission cables to a temporary antenna which WNBT has been using while the new tower is going up.

Intrepid riggers hail the completion of the lofty structure by raising a flag on the tower's peak, 1500 feet above the street.

for a Merry Xmas
HQ-129-X
Choice of THOUSANDS

Full range .54 to 31 mc in six accurately calibrated bands • Band spread with four calibrated ham bands and all-purpose scale • Variable selectivity crystal filter for phone or cw. • Antenna compensator for maximum image rejection and high sensitivity • Voltage regulation. Noise limiter that really kills noise • Adjustable S meter • *Three* IF stages . . . The HQ-129-X has every up-to-the-minute improvement that radio science has so far developed for amateur radio receivers.



Hams are pretty shrewd individuals when it comes to selecting the gear they use. Many thousands knew what they wanted — they're using HQ-129-X receivers on the air every day. That, we believe, is one of the finest endorsements any product can achieve.

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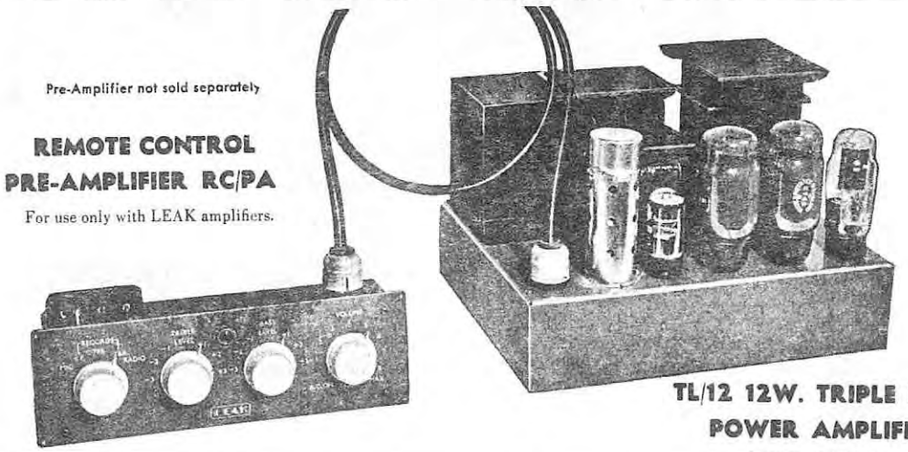

TL/12 12W. TRIPLE LOOP POWER AMPLIFIER

Standard U. S. Tubes

An original feedback tone-control circuit.
No resonant circuits employed.

- Will operate from Audak, G.E. or Pickering Cartridges; from any moving coil microphone; from any radio unit.
- Equalization circuit: Proper equalization positions for LP records, Foreign or American recordings of all speeds.
- Switching for Pick-up, Microphone and Radio, with automatic alteration of tone-control characteristics.
- Controls: Input Selector; Bass Gain and Loss; Treble Gain and Loss; Volume.

Output Impedance: 0-30,000*w* at 20 kc.p.s.
The unit will mount on motor-board through a cutout of 10⅛ x 3⅛ in., or it can be bolted to the power amplifier, when, with a top cover, the whole assembly becomes portable.

- Push-pull triode output stage. 400 V. on anodes.
- No H.T. electrolytic smoothing or decoupling condensers.
- Impregnated transformers; tropically finished components.
- H.T. and L.T. supplies for pre-amp, and radio units.
- Distortion: at 1,000 c/s and 10 W. output, 0.1%: at 60 c/s and 10 W. output, 0.19%; at 40 c/s and 10 W. output 0.21%.
- Hum and Noise: −72 to −80 db on 10 W.
- Frequency response: ±0.1 db, 20 c/s-20 kc/s.
- Sensitivity: 160 mV.
- Damping Factor: 20. Input impedance: 1 Meg.

Output impedances: 2*w*; 7-9*w*; 15-20*w*; 28-36*w*.
Phase margin 20° ± 10°: Gain margin 10 db + 6 db.
25 W. model available.

The Leak triple Loop feedback circuit (the main loop giving 26 db feedback over 3 stages and the output transformer) results in the following major advantage:

In the TL/12 amplifier the hum and noise levels fall within −80 db and −72 db relative to 10 watts. This amount of power, as hum and noise, is inaudible from the most efficient loudspeakers. Notice particularly that feedback is taken from the low side of the output transformer. Many circuits show it as taken from the anode side, which will result in higher hum levels than without feedback.
In this amplifier, due to magnitude of feedback, there can be no rise of voltage to cause "boom" in the loudspeaker at the frequency of bass resonance, and the capability of a loudspeaker to reproduce transients, especially low-frequency transients, is astonishingly improved.

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A Report On Microwave TV Networks

THERE ARE TWO WAYS to interconnect tv stations for network operation or for handling of programs originating outside the transmitting studio. These are microwave radio systems operating on frequencies where the channel-width requirements represent a small percentage of the operation frequency, or the use of coaxial cable with booster points located sufficiently close together to permit passing the required bandwidth without excessive attenuation. A wide variety of methods are already in use or destined to come into use during the early future using microwaves and coaxial cable facilities.

In one system a tv transmitting station is picked up in a conventional manner on a receiver and then the video is transferred by microwaves the rest of the way. This eliminates the need for the first station in the microwave relay setup. New Haven, Connecticut, picks up New York in this manner on a hilltop within New York's and New Haven's horizon. The program is then transferred to a simple microwave transmitter at that point and the program is sent direct to the transmitter in New Haven for rebroadcast. General Electric uses a similar method, but with additional microwave relay points for transferring WNBT programs from New York to Schenectady.

The A. T. & T. system between Washington and Boston with a choice of way points uses microwave relay facilities between Boston and New York. At New York, coaxial cable is plugged in for the route to Washington. The system is expanding in both microwave relay stations and coaxial cables and will eventually become nationwide in coverage.

Interconnecting microwave relay systems such as the Philco and NBC microwave networks are another network arrangement. Philco owns a system between New York and Philadelphia which operates on about 1,400 mc. It continues to Washington, D. C., with a Baltimore way-point over NBC microwave facilities on about 7,000 mc.

The Western Union microwave relay system for handling large numbers of multiplex channels also can accommodate two wide-band television channels of about 4½ mc bandwidth. These channels are common carrier facilities for the tv field similar to that available from the Bell System.

Microwaves have had to overcome a head start by coaxial cables. The magnitude of the Bell system coaxial cable program is illustrated in Figure 1. In late 1946, a total of 2,700 miles of coaxial cable was in existence. New construction was continuing at the rate of nearly 3,000 miles per year. Not all of these coax lines are yet available for the handling of tv programs until additional provisions and satisfactory booster station separations are provided. The current progress in new coaxial cable construction is subject to modification and re-determination as microwaves demonstrate their suitability to do the job technically better and financially less costly. Figure 2 shows the latest Bell System television network routes planned or already existing in the United States, no distinction being made between microwaves and coaxial cables in providing program relaying facilities. A basic charge of $35 per airline mile per month for eight consecutive hours of operation is currently the rate for the use of these facilities. Service beyond eight consecutive hours daily is at the rate of $2 per hour per airline mile on a monthly basis. A flat charge of $500 per month per terminal connection has also been set. In the case of service between New York and Philadelphia involving an airline distance of 83 miles, the charges are $2,905 per month for eight hours of consecutive operation per day, plus $1,000 per month for two terminal connections. Every additional hour per day costs $186 per month.

For occasional use, the charge for the first hour between New York and Philadelphia is $1 per hour per airline mile plus $200 per terminal connection and $10 per hour for the use of each station. This adds up to $503

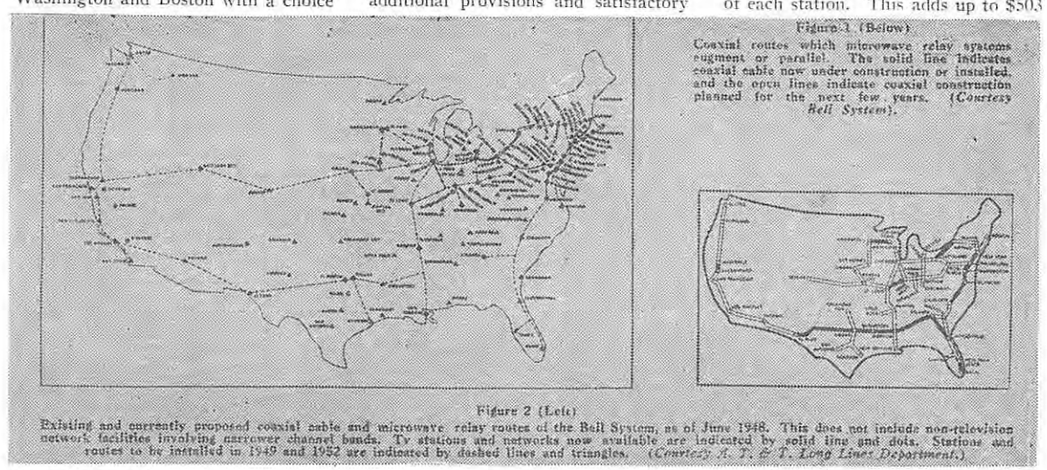


Figure 1 (Below)
Coaxial routes which microwave relay systems augment or parallel. The solid line indicates coaxial cable now under construction or installed, and the open lines indicate coaxial construction planned for the next few years. (*Courtesy Bell System*).

Figure 2 (Left)
Existing and currently proposed coaxial cable and microwave relay routes of the Bell System, as of June 1948. This does not include non-television network facilities involving narrower channel bands. Tv stations and networks now available are indicated by solid line and dots. Stations and routes to be installed in 1949 and 1952 are indicated by dashed lines and triangles. (*Courtesy A. T. & T. Long Lines Department.*)

Recently Completed Survey Provides Pertinent Data on Coax/Microwave Costs, Present and Possible Routes in Middle West, South and Far West Areas, and Detailed Analysis of Boston-N. Y. Link, Equipment Used and Its Operation.

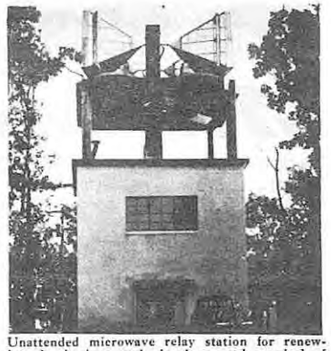
for a program occurring only once and lasting one hour. Each additional hour within the same month, where the terminal stations have been set up in accordance with the foregoing, costs $103 or minus the two terminal station charges of $200 each. Transmission over video channels are for one-way only. An additional channel and separate station connections are used for transmission in the other direction.

The technical superiority of microwaves lies in its ability to handle a wider bandwidth with greater separation between repeater-booster stations. At the present time, coaxial cable can handle the required bandwidths only by keeping the repeater-booster stations closer together. The present practice is to keep the booster points eight miles apart. With such spacings, it is currently feasible to handle tv programs with a 2.7-mc bandwidth. To use a wider bandwidth, the attenuation becomes excessive between the eight-mile coaxial booster points. A coax cable can handle any bandwidth provided increased attenuation with increase in bandwidth is compensated by closer spacings of coax booster points for the amount of signal level introduced into the cable. The Bell System limits their microwave network to the 2.7 mc bandwidth so that they may interconnect with the coax cable system.

When the subject of relative cost per channel arises, there are many interesting factors which can be cited for both coaxial cable and microwave relay stations. A coaxial cable as buried in the ground actually comprises several coaxial cables within the same sheath. An example is the eight coaxial tube lines, each a channel in itself, involving a material cost of a dollar per foot for the overall cable, or about $5,000 per-mile-material cost. This, however, is a fraction of the overall cost for a coaxial cable system. To this figure must also be added the cost of repeater-booster stations every eight miles, right of way, burying the cable underground in a variety of terrain and special equipment for handling video programs. When all elements of cost are included, the cost can go as high as $50,000 per mile. The figure varies greatly in different areas.

On the other hand, experiences with the New York-to-Boston microwave radio system may indicate that microwaves are not markedly cheaper than coaxial cable per video channel. This may be true because of the completeness of installation and elaborate provisions for assuring completely reliable performance. This system has all repeater stations housed in excellent buildings costing about $60,000 each and paved access roads which cost about $30,000 per station. In addition there are the excellent vantage points acquired for locating the stations, power lines, order and alarm wires, emergency power, miscellaneous utilities, etc., all of which have been costly. All equipment is duplicated so that communication is unimpaired when any unit is in need of maintenance or repair.

A typical repeater-booster station between New York and Boston is shown in Figure 3. These stations are designed for unattended operation, made feasible by a landline alarm sys-



Unattended microwave relay station for renewing the horizon and signal strength, typical of the seven intermediate stations on hilltops between New York and Boston. Waveguides extend up through the roof to elevated antenna platform supporting four horn-type metal lens antennas. Two are beamed to the direction of Boston and two are beamed towards New York.

Figure 4

Route of the microwave relay system between Boston and New York. Changes in direction at each point minimizes the possibility of the sharply beamed signals being picked up from more than the adjacent station, should beyond horizon communication be possible. (*Courtesy Bell Telephone Labs.*)

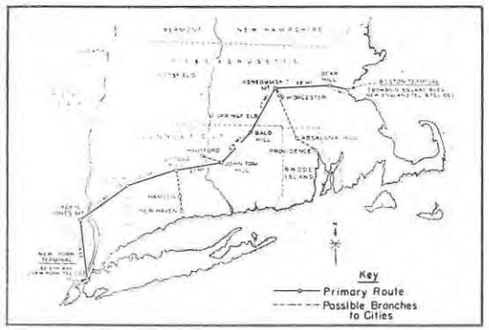
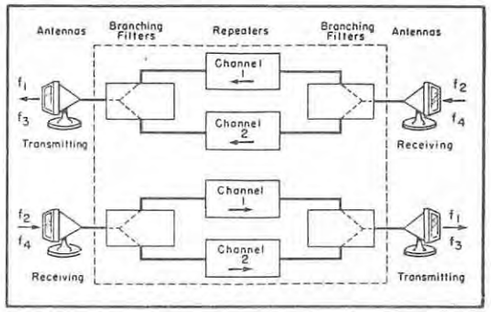


Figure 5

Repeater and branching filter setup used in microwave net setup. (*Courtesy Bell Telephone Labs.*)



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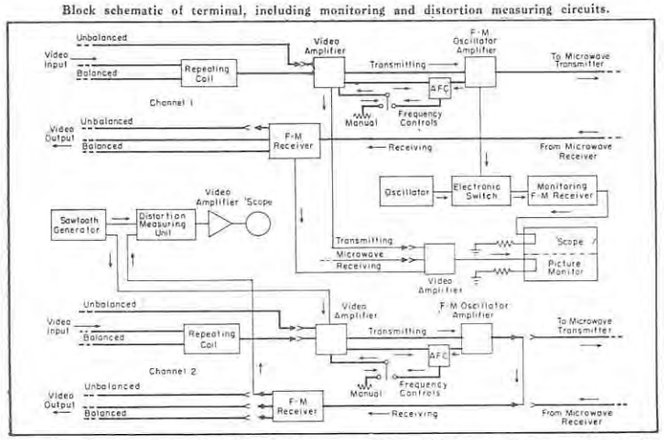
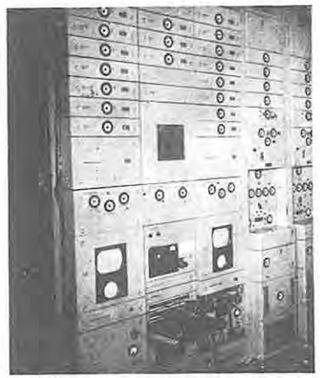
Block schematic of terminal, including monitoring and distortion measuring circuits.





Duplicate monitoring and communication equipment bays plus coaxial-radio interconnection bay, typical of the New York-Boston terminus points. *(Courtesy A. T. & T. Long Lines*

tem with step-by-step provisions to indicate at a distant maintenance center what the conditions are at the unattended relay station. An example is a 14-function step-by-step selector system, which in the case of the Jackie Jones mountain station, makes known at the Southfield, N. Y., maintenance center (12 miles away) which of the following typical conditions may exist:

(*1*) The opening of the door to make possible entry into the building.
(*2*) Temperature conditions (high or also low) and on which specific floor in the building.
(*3*) Equipment functioning or non-functioning.
(*4*) Failure of outside commercial power.
(*5*) Whether interim emergency power from batteries and a converter is in use.
(*6*) Whether main auxiliary gas-driven generator has started up, reached a stable operating condition and taken over the load from the interim emergency power.

The station normally operate on outside electrical power. When power fails, there often is a gap of time before the gas engine generator warms up and dependably functions. To prevent any interruption of even a few minutes, a bank of storage batteries automatically operate a converter-converter setup capable of providing sufficient power within two seconds after the outside power fails. In the meanwhile, the gas engine generator starts up and is allowed to reach a stable operating condition in about eight minutes. It then automatically takes over the load indefinitely until outside power is restored or as long as sufficient fuel is available in the storage tanks. The converter-converter then ceases to function.

It is still too early to arrive at the full cost of the system since it was the first full-scale trial of microwave relaying under actual operating conditions. Many of the economic and technical aspects of microwave relaying as a means of providing circuits for tv, multiplex telephony and various broadband services had to be determined. It is conceivable that the system to date may exceed in cost what coaxial cable might have involved between the same cities. This could have been brought about by the great interest in the subject, large amount of engineering time devoted to microwave planning and the fact that only two channels were provided in capital facilities that could accommodate several. It is generally anticipated that microwave relays should be cheaper than coaxial cable in connection with future systems. This should be particularly true on the next stage of expansion which is now commencing between New York and Chicago. This new system is expected to accommodate about six channels of wide-band communication with no marked increase in cost per station for buildings, real estate, access roads, power lines and utilities.

The average microwave repeater separation is about four times that of the coaxial repeater in the eastern part of the United States. When the mountainous regions west of Nebraska are reached, it can become over ten times further apart than coaxial cable. In such areas, accessibility is frequently a problem and it will be less convenient to install and service coaxial booster points at eight-mile intervals.

If the remote possibility of reflections from density stratifications of the atmosphere may be ignored, microwave stations can be spotted through most of the region between the Nebraska-Wyoming line clear to the Pacific coast at elevations exceeding 8,000 feet even along highways and areas convenient to public utilities. Such elevations can provide independent radio horizons in the order of 125 miles. Between two stations, these horizons may be added to give a total of about 250 miles airline coverage. Under such conditions, the very idea of coaxial cables becomes uneconomic when compared to microwaves. Even if microwave relay systems were to cost as much or more than coaxial cables between cities on the eastern seaboard or on the flat midwestern plains, it would still enjoy a great overall cost advantage on a nationwide basis.

The opportunities existing in the western part of the United States to do outstanding work with microwave relay systems are both plentiful and convenient. For example, one needs to be neither off a paved road or isolated from a modern community and utilities in order to enjoy elevations such as 8,835 feet near Laramie, Wyoming, looking downward through the plains of Nebraska or downward and upward to the west, north and south. The same holds true at 8,000-foot Laguna Mountain in southern California with a breath-taking view of the Salton Sea and the Imperial Valley towards the Arizona border, or from 6,200-foot Mt. Wilson with a horizon encompassing all of southern California to the Mexican border. Relative elevations also exist to provide unusual performances. For example, in southern California lies Mt. Whitney and Death Valley, the highest and lowest locations in the United States in close proximity to each other. In that region one laboratory enjoys an exclusive area for testing pilotless aircraft and missiles which exceeds in square miles all of the state of Rhode Island. Distances are great with most of the terrain characterized by mountains and deserts. It is primarily a job for microwaves. Coaxial cables can only get through under great physical difficulty and high cost both initially and for subsequent operation-maintenance. In fact, consideration has already been given to the use of microwaves for bridging gaps caused by rivers, mountain gorges and rugged rocky terrain in extending the coaxial cable system already started in the western part of the United States. Microwaves can enjoy locations of sufficient radio coverage as to be able to permit spotting of relay stations in the vicinity of paved roads, settled communities and existing public utilities. It will be entirely feasible to zig-zag the radio route to take advantage of such practical advantages. In addition, these changes of direction will safeguard against the picking up of distant repeater points, in addition to the signal from the adjacent repeater point, during periods of exceptional propagation paths.

Figure 4 shows the indirect route followed between New York and Boston. The advantages of taking other than the shortest and straightest route between cities are:

(*a*) Makes possible a change of direction at every station which may exceed in bearing the amount of antenna beam width. This minimizes the possibility of picking up the same transmission from more than one point at each repeater and thus avoiding the problem of coping with the same initial signal having several components with delayed characteristics. This is further minimized by alternating frequencies at each repeater point.

(*b*) Takes advantage of the most suitable elevations.

(*c*) Provides an alternative in the event property owners will not undertake reasonable negotiations for the necessary real estate.

The microwave relay system between New York and Boston is currently the best engineered and most costly network in the United States. It operates in the 3,700-4,200-mc band, each channel having been designed to handle a signal band extending from 30 cycles up to 4½ mc. In laying out this system, engineers recognized the fact that depth of fading increases with path length. They also recognized that if their frequency of operation was too high, there will be more attenuation during periods of rainfall as well as increased fading. On the other hand, if the frequency employed was too low, the antennas would be less directive for a given dimension. As a compromise, they chose the 3,700- to 4,200-mc band. Other considerations were:

Repeater Spacings: A maximum of about 35 miles was chosen even though longer line-of-sight paths might be readily obtainable. The seven relay sites shown in the map of Figure 4 were selected, with an average length of 27½ miles, the longest being 35 miles and the shortest (near Boston terminus) being 11 miles.

Factors Determining Location: Three considerations influenced the selection of each relay site, namely:

(a) Not too far from adjacent relay site in order to decrease fading.
(b) Not too close to adjacent relay site in order to minimize the number of repeaters.
(c) Not too inaccessible or expensive for roads, power lines and telephone wires.

Four broad-band channel r-f bands (each about 10 mc wide) are employed in this setup. These are centered at 3,930, 3,970, 4,130 and 4,170 mc and are used as pairs. One pair is required for each two-way channel. Whenever the signal goes through a repeater, however, a frequency change is made of 40 mc, as shown in Figure 6. This procedure prevents interference between the high-level outgoing and the low-level incoming signals. There is never a high-level and a low-level signal of the same frequency at any one repeater station. Each repeater in the system is required to introduce sufficient gain to offset the loss in the preceding radio path. At each repeater station, equipment is provided for converting the received microwave signals into an intermediate frequency of 65 mc. It is amplified at that frequency and then translated back to the microwave range for transmission over the next link on a frequency 40 mc removed.

Monitoring-Equipment Bays

In the monitoring and equipment bays (Figure 6), there are five equipment bays. From left to right, the first bay contains picture monitoring equipment, second bay contains distortion measuring equipment plus landline-coaxial connections, third bay is a duplicate of the first so that one may be kept in ready reserve, fourth bay is a complete channel transmitter-receiver, while the fifth bay is a duplicate of the fourth in reserve as a spare. In the case of relay stations, the first three bays are omitted. Instead, there are four bays identical to the fourth or fifth bay. Two are used for actual communication relaying (one in each direction) while the other two are available in reserve as spares.

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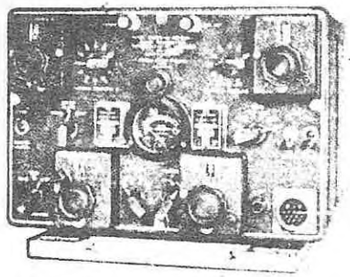

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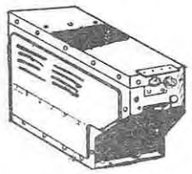

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