Tuning Indicators

A Review of the Various Visual Tuning Devices Available and Some Suggestions as to Their Use

THE inclusion of A.V.C. requires that the receiver be brought into exact resonance with the transmitter for best quality of reproduction, and this has led to the development of a number of visual tuning indicators. The manner in which they function and how they can be embodied in existing circuits is discussed in this article.

A RECEIVER fitted with A.V.C., and few modern sets are now without this feature if the design permits, requires a little more care in tuning than one in which the volume is controlled manually, as the optimum tuning point is not quite so easily determined, especially when the received signals are very strong. The inherent selectivity of the set may be quite high, yet it seems that the station occupies more than its fair share of the scale. The action of the A.V.C. is generally responsible for this illusion, for there is no apparent optimum tuning point, as judged by the strength of signals within this area, but if attention is concentrated on the reproduction a decided change in the quality will be noticed. On first entering the tuning area the reproduction is thin and high pitched, then deepens to a good, round tone with everything nicely balanced, and, as the knob is further rotated, once again becomes thin and unnatural.

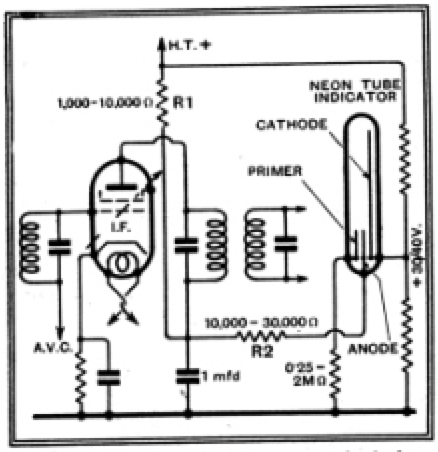


Fig. 1.—Circuit connections required for the Cossor neon tube tuning indicator.

Available Types

Accompanying this will be observed a marked difference in the background level, which will first decrease then rise again in relation to the signal strength. Only at one part of the scale is the tone quality at its best, and this, fortunately, is when the background is lowest, so it serves as an aural indication of the optimum tuning point.

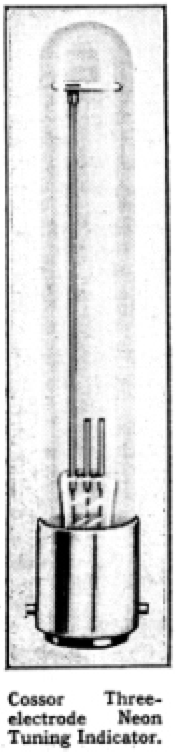
While many listeners may find its determination less difficult than others, a visual indicator which works in conjunction with the A.V.C. system, and gives a sharply defined maximum, would undoubtedly be of assistance to all. That this method of tuning is receiving some support is evident from the number of commercial receivers so equipped.

There are several types of visual tuning units on the market, but quite a satisfactory indicator can be arranged by fitting an ordinary milliammeter in the anode circuit of one or more of the valves linked up with the A.V.C. system.

Of the special devices there is one taking the form of a small neon tube, another is a miniature cathode-ray oscillograph, while some are merely milliammeters modified for the purpose and omitting the customary calibrated scale, which, of course, is not necessary, though an arbitrary scale is sometimes included.

Although the special units differ widely in design and operation, they all function by virtue of a change in current, but in some types this has to be converted into a difference in potential to operate the device, which is a relatively simple matter, since it only requires the inclusion of a resistance in the circuit.

One example of the voltage-operated type is the Three-electrode Neon Tuning Indicator developed by A. C. Cossor, for showing visually the correct tuning point of any station. This takes the form of a narrow glass bulb, some 3in. long, mounted on a miniature bayonet cap with two base contacts that fit the standard motor car two-point lamp holder. There are three electrodes in the tube, two quite short and one extending nearly the full length of the bulb. The short ones serve as anode and priming electrode respectively and join to the two base contacts, while the longest of all is the cathode, and is connected to the metal base cap. With the correct operating voltages a faint glow appears at the base of tube when no signals are received. On tuning in a station the column of light rises in the tube and reaches a maximum at the correct tuning point. The height of the glow depends on the potential applied to its anode, and, in practice, this is derived from the anode circuit of the valve, or valves, in the receiver which are linked up with the A.V.C. circuit.



Cossor Three-electrode Neon Tuning Indicator.

Since the action of A.V.C. is to bias back these valves, they consequently pass less anode current, and to convert this change into a potential difference it is necessary only to connect a resistance in the H.T. supply line. It should be adjusted to give the longest column of light when receiving that broadcast station providing the strongest signals. It is shown at R1 in Fig. 1, and in general will be somewhere between 1,000 and 10,000 ohms. The best value can be found only by experiment, since it depends on the magnitude of the change in the current in this part of the circuit. This resistance, in conjunction with the one-mfd. condenser, serves also for decoupling the H.F. stages, which is very desirable when extra leads are added to, or additional connection made to, circuits in which H.F. currents flow.

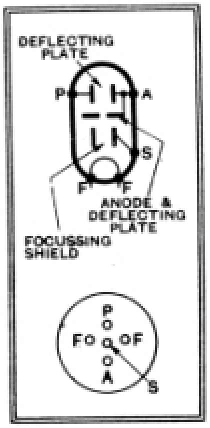


Fig. 2.—Arrangement of the electrodes in the Micromesh Tunograph and the connection to the base pins.

Neon Tube Operation

Resistance R2 may or may not be needed; it depends on the total H.T. voltage available. Its function is to fix the initial striking voltage of the tube and to maintain the glow when no signals are received. Between 160 and 180 volts are required for this purpose, under which condition some 3 mA. flow through the tube. Then a small potential—from 30 to 40 volts positive—must be applied to the cathode, and this is most conveniently derived from a fixed potentiometer joined across the H.T. supply, as shown. Finally, the priming electrode is joined to the H.T. negative through a resistor of from 0.25 to 2 megohms.

The tuning indicator functioning on the

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cathode-ray oscillograph principle is the Micromesh Tunograph, made by Standard Telephones and Cables, the form of assembly of which is given in Fig. 2. A stream of electrons is emitted from a hot cathode, concentrated into a beam by a focusing shield, and then through a hole in the anode. Then the beam passes between a pair of deflecting plates, and finally strikes a fluorescent screen inclined at an angle and mounted in the upper part of the bulb.

Cathode-ray Indicator

Here the beam of electrons becomes visible and is seen as a green spot. The beam can be moved laterally by applying a negative bias to one of the focusing plates, and about 40 volts are required to bring the spot over to the extreme left of the screen. Since the electron stream is free from inertia, and will, therefore, follow high-frequency alternating potentials, it is possible to so arrange the connections to the tube that visual indication of tuning is obtained by causing the spot of light to vibrate at the frequency of the received carrier wave. So far as the eye is concerned this would appear as a green line on the fluorescent screen and the length of the line can be made to vary with the strength of the incoming signals. The line method of indication, however, necessitates a very strong signal to give good definition, and it may be preferable in practice to utilise

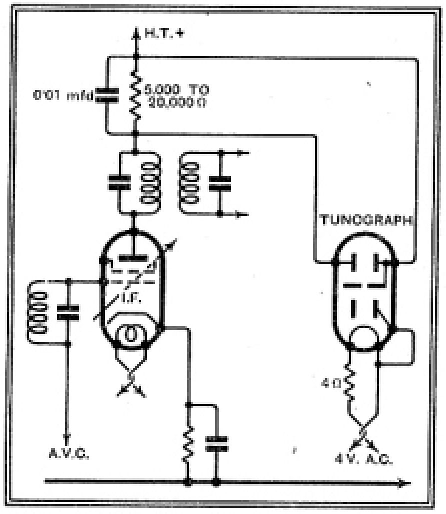


Fig. 3.—With this circuit arrangement the position of the light spot in the Tunograph varies with the anode current, and the optimum tuning point is determined by maximum deflection.

the arrangement in which the light spot is deflected from its quiescent position when a signal is received, and as the amount of deflection is then proportional to the strength of the signal the set is tuned to give maximum deflection.

The circuit arrangement that produces this effect is given in Fig. 3, where the Tunograph is shown connected to the last I.F. stage in the receiver. The resistance in the anode circuit of the I.F. valve is chosen to give a potential of minus 40 volts on the free focusing plate, the

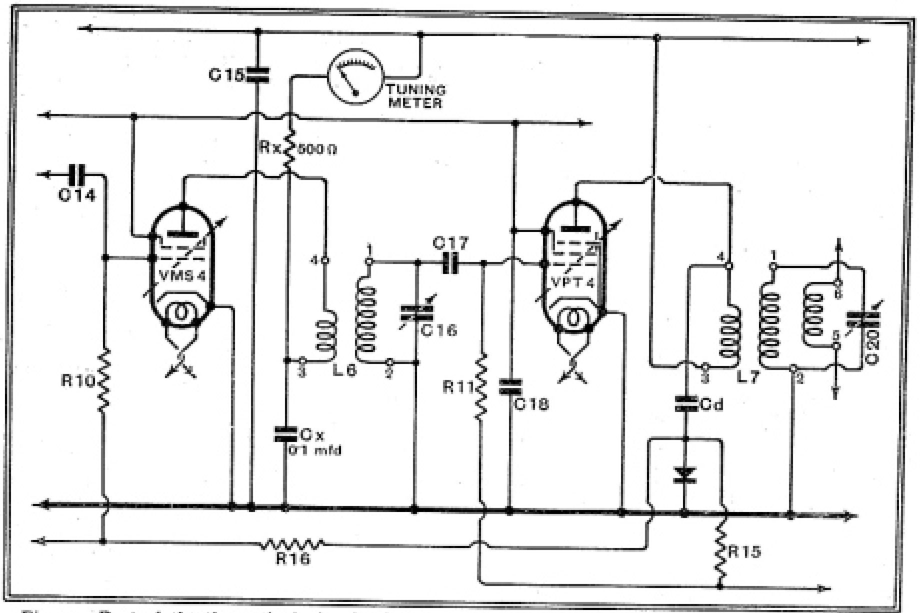
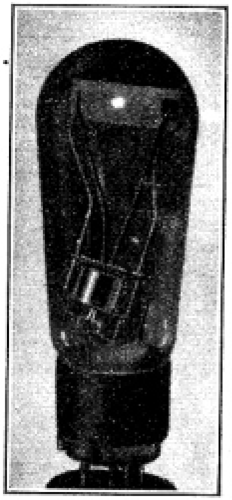


Fig. 4.—Part of the theoretical circuit of the modified Single-Span Receiver, showing alterations necessary to include a visual tuning meter or similar device.

spot then being normally at rest at the extreme left of the fluorescent screen. When a signal is tuned in the A.V.C. circuit biases back the controlled valves, the current through the anode resistance falls, so a smaller potential is developed across its ends and the spot moves over to the right. At the optimum tuning point the A.V.C. bias is greatest and maximum deflection of the spot is obtained.

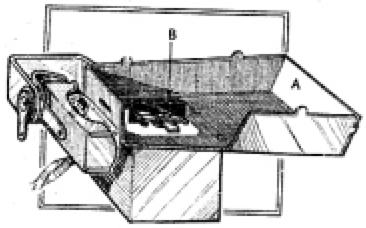
The potential on the anode of the Tunograph must be not less than 180 volts, while its filament requires slightly less than one ampere at from 0.5 to 0.6 volt. This can be taken from the L.T. filament winding by inserting a four-ohm resistor in one of the filament leads as shown.

The current-operated devices will usually have a moving member of some kind, such as a pointer, or it may even take the form of a moving vane throwing a shadow on to a translucent screen as in the Shadow Tuning Meter made by Philco Radio and Television Corporation of Great Britain. This type is the simplest of all to install, and entails the least alteration to the set. The H.T. supply lead to the anode or anodes of the H.F. or I.F. valves controlled by the A.V.C. is broken at a convenient point and the meter, or special unit, joined in the circuit. With the Philco model a pair of leads must also be taken from the



Micromesh Tunograph, a visual tuning indicator functioning on the principle of the cathode-ray oscillograph.

L.T. supply to illuminate the lamp, or if a dial light is used the tuning indicator lamp can be joined in parallel with it. The small bulb fitted is obtainable for mains, battery or car radio receivers, and is of the low-consumption type. When no signals are being received a broad shadow is thrown on the screen, and this contracts whenever a station is tuned in, the narrowest shadow indicating the correct adjustment.



Sketch showing the principal features of the Philco Shadow Tuning Meter; A is the screen and B the vane which intercepts the beam of light projected by the lamp.

The Sifam Electrical Instrument Co. has developed a meter-type tuning indicator which is employed in much the same way as the Philco model, but in this case the optimum tuning point is given by the greatest deflection of the pointer in the direction of the arrow engraved on its dial. An arbitrary scale is provided, but it has no relation to the current flowing, though it might be useful as a means of keeping a check on the state of the H.F. valves, if the position of the pointer is noted with the set detuned or with the aerial disconnected, when the meter is first fitted.

Milliammeter as Indicator

The standard model requires 7 mA. for a full-scale deflection, but instruments taking more current can be supplied if required. It has a moving-iron movement which is sufficiently well damped for the purpose.

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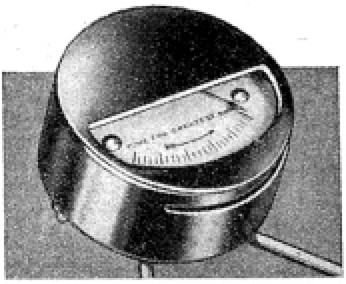
An ordinary milliammeter can quite well be used as a tuning indicator. It need not have an accurately calibrated scale, but should be reasonably dead beat, one with a freely swinging pointer being more of a hindrance than a help. The best position for it is in the anode circuit of one or more of the controlled valves.

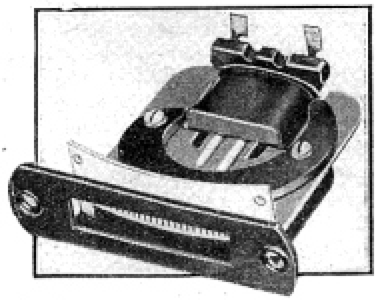


Sifam meter-type tuning meter ; the dial can be illuminated by a lamp mounted close to a window in the side of the case.

There is only one precaution that need be observed when making an addition to the H.T. circuit, and that is to see that the meter is inserted between the anode decoupling components and the main H.T. supply, for should it be connected on the valves' side of the decoupling there is a likelihood of the additional wiring causing H.F. instability. As an illustration of the practical installation of a meter-type tuning indicator a portion of the circuit diagram of the modified Single-Span Receiver[1] is given in Fig. 4. This shows the second and third I.F. stages, and it is suggested that if the meter is of the sensitive kind and requires less than 10 mA. to give a full-scale deflection of the pointer it would be advisable to connect it in the anode circuit of one only of the valves controlled by the A.V.C.

Position in Circuit

The VMS4 stage would seem the most suitable in this particular case, and the only alterations needed consist of disconnecting the lead joining C15 to terminal 3



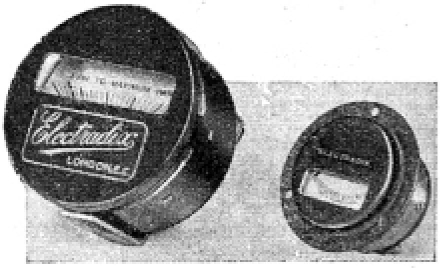
Howard Butler edgewise-type tuning indicator.

on the primary of the I.F. transformer L6 and interposing a decoupling resistance, the tuning indicator and an extra by-pass condenser. The position of C15 in this theoretical diagram may seem slightly different from that of the original, but reference to the wiring plan will reveal that in practice it serves as an H.T. junction point for several of the valves.

The additional decoupling resistance is shown at Rx, and one of 500 ohms would seem a suitable value, for some of the special tuning indicators have a considerable D.C. resistance. As for the extra condenser, one of 0.1 mfd. will suffice, and it should be of the same working voltage as the other condensers in this part of the circuit.

These changes will meet the requirements of such devices as the Philco Shadow Tuning Meter, the Sifam model, and the visual tuning indicator of Howard Butler, Ltd. Each of these functions satisfactorily with a standing current of about 6 mA.

There is a series of Electradix meters, designed by Leslie Dixon and Co. especially to meet the requirements of visual tuning. Three styles are available, one a moving-coil pattern, another fitted with a magnetic movement, while the third is a miniature moving-iron type instrument.



Two types of Electradix visual tuning meters ; the larger has a moving-coil movement and provision for illuminating the dial from the side.

Each has a full-scale range of 10 mA., but only an arbitrary scale is fitted. Provision is made in the two larger models for illuminating the scale.

Since preparing this article, details of a Ferranti tuning indicator have come to hand. It takes the form of a skeleton moving-iron instrument of the type incorporated in this firm's receivers, and, being a current-operated device, it can be fitted in the manner already discussed.

[1] *Wireless World*, June 22nd, 1934, pp. 420-421.