

British Radio Design

By MAJOR RALPH W. HALLOWS*

European conditions produce some very interesting circuit features

THE path of the British broadcast radio designer is not easy. Except for a few who specialize in fine-quality receivers, all manufacturing firms regard the low-priced set as their main source of sales and profit. Our idea of low prices in radio are very different from those which prevail in America. For reasons into which I cannot enter into here, it is scarcely possible in Britain to produce a domestic receiver selling at a basic price of less than the equivalent of about \$60, on top of which there is a 21.5% purchase tax, bringing the minimum price close to \$73. Our tube manufacturers sell competitively

For this reason and certain others, such as the prevailing shortages of manpower, components, and raw materials, the designer of low and medium-priced radio sets is limited to the use of not more than 4 tubes, in addition to the rectifier. We don't as a rule include the rectifier, which after all need not be a tube, in the number of tubes stated in receiver specifications.

For the \$70 to \$100 which he pays for the small radio receiver, the British buyer expects these things:

1. Besides ranges from 5-20 mc and 500-1,500 kc, the tuning bands must cover 150-300 kc, for much important

European broadcasting is done on the low frequencies;

2. Selectivity must be good enough to separate stations on channels 9 kc apart, for that is the basis of the present frequency allocation on this side of the Atlantic;

3. Arrangements for the use of a pickup must generally be provided;

4. The set must be adjustable to work on any line voltage between 200 and 250 volts.

The designer, then has at his disposal a maximum of 4 tubes with which to produce a set meeting all these requirements. Clearly, if he is to produce a best seller—or even a good seller—he must get the utmost possible performance from his quartet of tubes. At first sight it doesn't seem possible to ring many changes on 4 tubes. The set must be a superheterodyne. That seems to indicate a triode-heptode as mixer; a variable-mu pentode as i.f. amplifier; a duo-diode-triode as detector, supplier of a.v.c. voltage, and first a.f. amplifier; and a pentode as output tube. That is just about all that you can do with 4 tubes—or is it? Let's see. It would be an advantage if you could cut the tubes down to 3 and still produce a superheterodyne with the required performance. A 3-tube superhet, with ample output from its loudspeaker? We have several! The Mullard MAS 305, for example, is shown in Fig. 1.

In this receiver we have the curious and ingenious combination of 2 variable-mu triode-heptodes and a duo-diode-pentode. The first triode-heptode V1 functions quite normally as a converter, with injector-grid coupling between the 2 sections of the tube. V2 is used in an

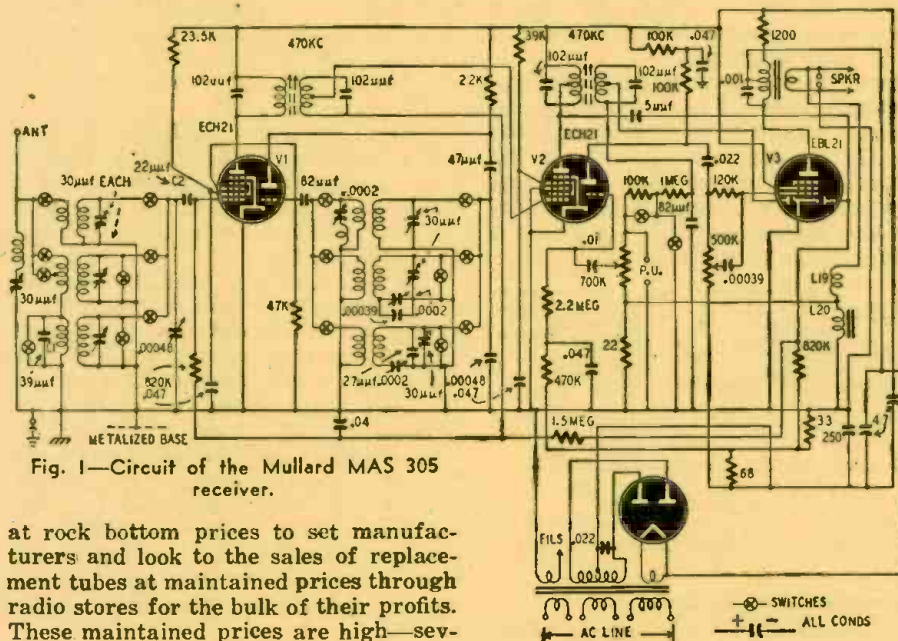


Fig. 1—Circuit of the Mullard MAS 305 receiver.

at rock bottom prices to set manufacturers and look to the sales of replacement tubes at maintained prices through radio stores for the bulk of their profits. These maintained prices are high—sev-

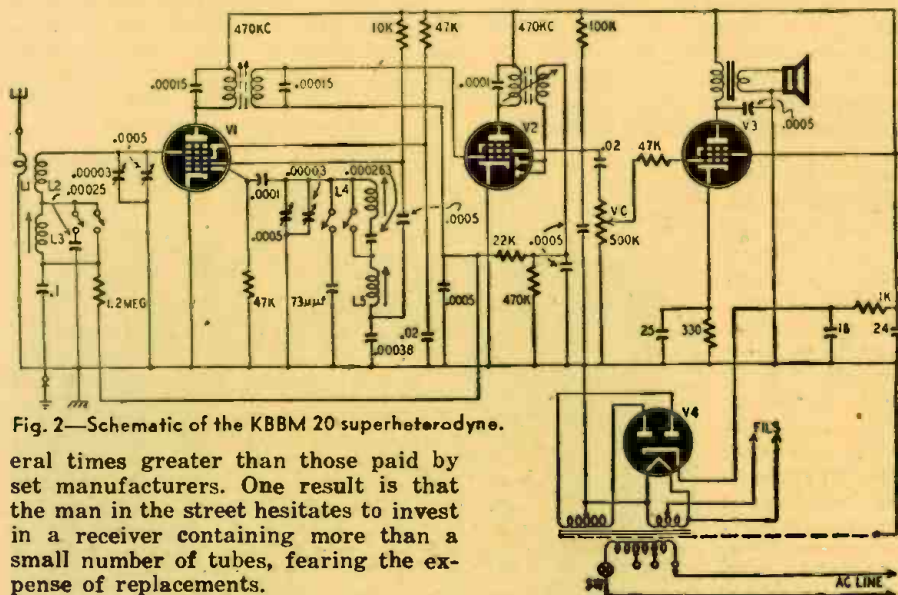


Fig. 2—Schematic of the KBBM 20 superheterodyne.

eral times greater than those paid by set manufacturers. One result is that the man in the street hesitates to invest in a receiver containing more than a small number of tubes, fearing the expense of replacements.

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Typical British console is the Murphy A-104.

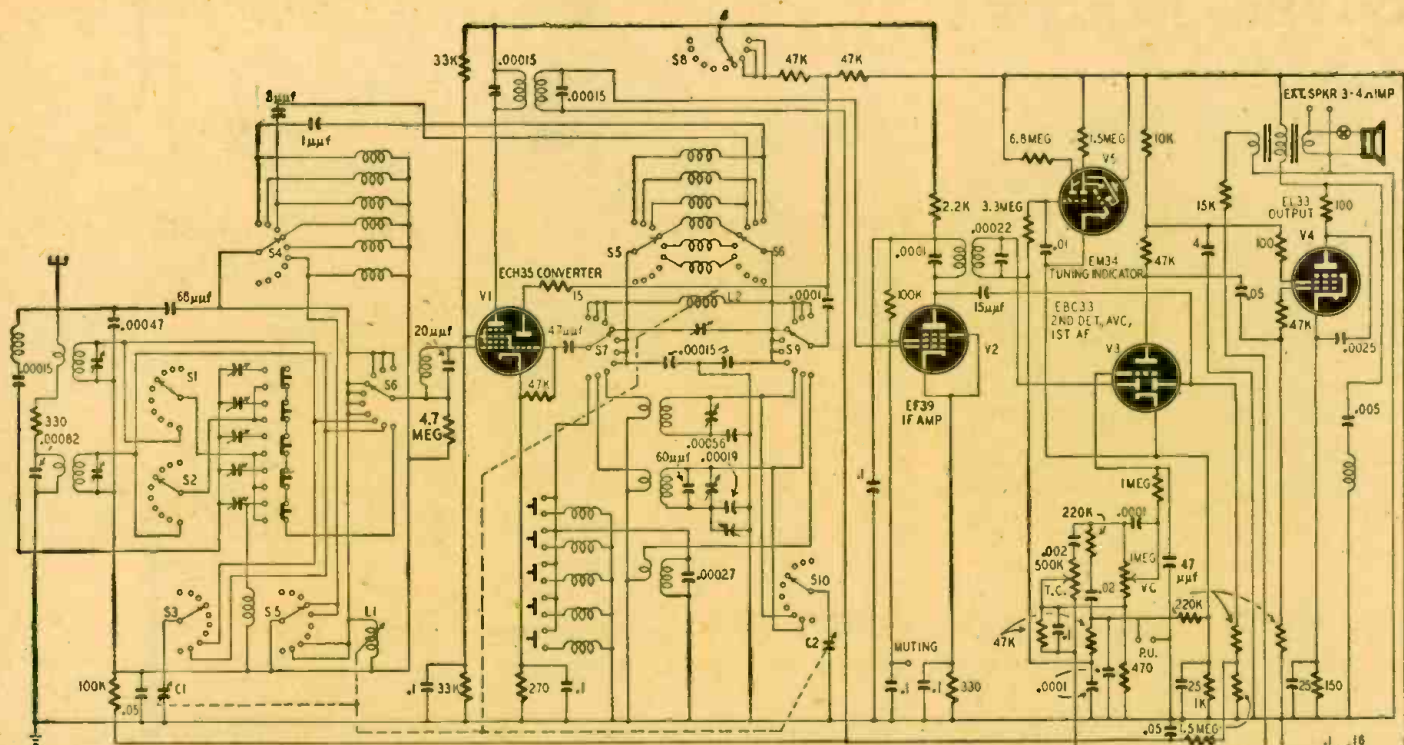


Fig. 3—The schematic of the Ecco A 28. This radio has a novel band-switching arrangement.

unconventional way. The heptode section is a variable-mu i.f. amplifier, the output of which is demodulated by the left-hand diode of V3. The a.f. voltage is fed back to the grid of the triode portion of V2, which becomes the a.f. amplifier. The triode control grid of V2 receives its bias from the power supply voltage divider through the 470,000-ohm decoupling resistor and the 2.2-megohm grid resistor. The a.f. from the detector is filtered by a 1-megohm resistor and an 82- μ f bypass condenser. A.v.c. voltage from the right-hand diode of V3 is developed across an 820,000-ohm resistor and is fed through a decoupling network to the heptode control grids of V1 and V2. The .0039- μ f condenser and the 500,000-ohm potentiometer in the grid circuit of V3 form a continuously variable tone control.

Negative feedback is provided in a novel way. A.f. voltage from the secondary of the output transformer is taken to the frequency discriminating circuit L19, L20, and the 22-ohm resistor in series with the volume control. The voltage across this resistor is fed to the control grid of the triode V2 in antiphase

to the signal voltage. A pickup can be connected to the socket marked P.U. Inserting a plug into this socket opens the switch shown above P.U., and closes the one beside it, silencing the radio section.

There with only 3 tubes is a superheterodyne complete with a.v.c., negative feedback over 2-stages, tone control, and provision for phonograph pickup. The trio of tubes is doing the work of at least 7 tubes. The set may be used either with its built-in plate antenna or with an outside aerial.

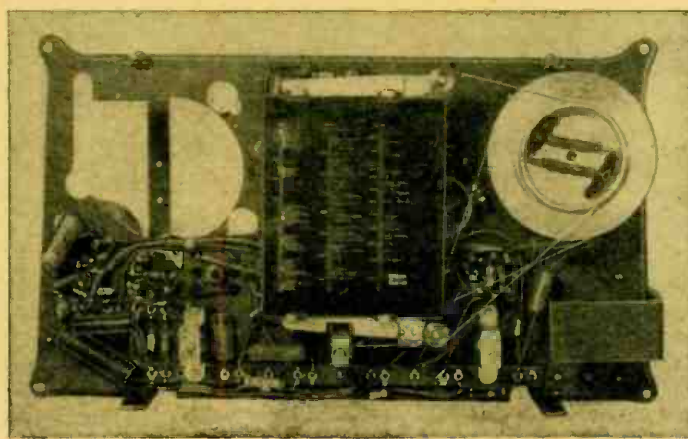
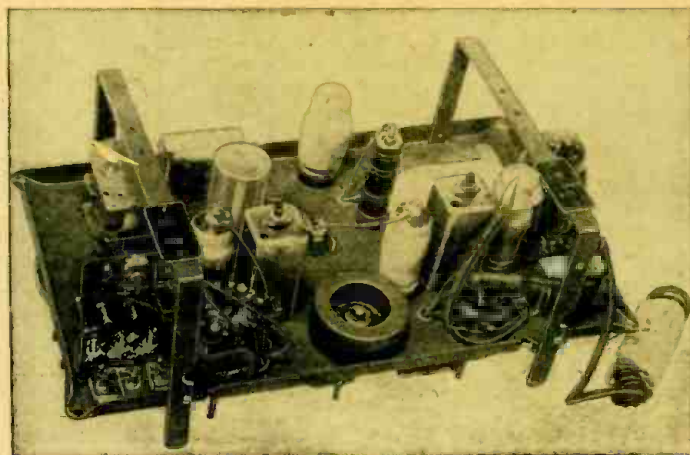
Another clever example of the 3-tube superheterodyne (the KBBM 20) is seen in Fig. 2. Here the tubes are a heptode, a variable-mu duo-diode-pentode, and a beam tetrode. The first tube is a straightforward electron-coupled converter. The pentode portion of V2 is reflexed and it acts first as an i.f. amplifier, transformer-coupled to the output of V1. The output of its pentode plate circuit is fed to the 2 diode plates. The a.f. voltage is developed across the 470,000-ohm resistor in the diode circuit, and fed through an R-C filter back to the control grid of V2, where it is amplified

by the triode formed by the cathode, control grid, and screen grid. The .02- μ f condenser in the screen-grid circuit couples the output to the control grid of V3, and the .0005- μ f condenser bypasses any remaining r.f. to ground. The resistor in series with the control grid of V3 is an r.f. stopper. Another part of output of the diodes is fed back to the control grid of V1 as a.v.c.

The intermediate frequency of these sets is 470 kc.

Radio manufacturers are beginning to pay more attention to the needs of the man who has to repair their sets when they go bad. Not so long ago receivers seemed almost to have been designed with a view to making repairs and adjustments as difficult as possible!

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Murphy U 102, showing straps which hold chassis clear of bench. The serviceman can reach every part of the Murphy U 102 easily.

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In contrast to these, the Murphy U 102 seen in accompanying photographs may be described as the serviceman's joy. The chassis stands vertically in the tall, narrow cabinet, and can be withdrawn simply by removing 4 screws. The projecting metal straps permit its being placed in any position on a workbench without the risk of damaging tubes, components, or wiring. Every part of every circuit is completely accessible. Another advantage of this type of construction is that the tuning scale and tuning drive are rigidly mounted without brackets.

Higher-class equipment

Turning to the more expensive receivers, the Ekco A 28 in Fig. 3 is one of the most interesting designs. The circuits of this set are by no means simple. Basically it is a superheterodyne with a magic-eye tuning indicator. Its com-

Negative feedback is carried out by means of a third winding on the output transformer. The feedback to the grid of V3 is divided into 2 branches, one going to a treble-boost filter and the other to a bass-boost filter. Both are continuously variable. The user can adjust the tone balance of the 10-inch loud-speaker's output to his own liking.

An interesting short-waver

The last example is the Murphy A-104, a set designed to simplify tuning on the short waves. This again is a 4-tube-plus-rectifier set, only the circuits of the first 2 tubes being shown in Fig. 4. It achieves ease of tuning on the short waves comparable to that of the Ekco A28 by simpler and less expensive methods. The band switch, for instance, has only 5 gangs with 15 live contacts, in the place of 13 gangs with 59 live contacts. There is but a single short-

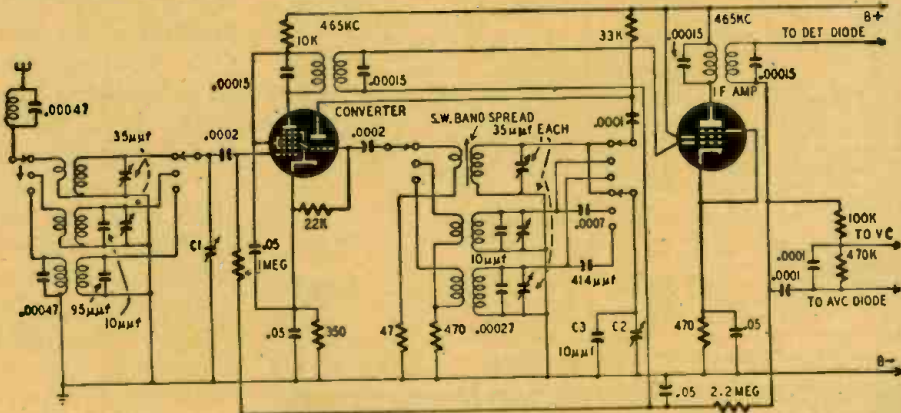


Fig. 4—The simple r.f. end of the Murphy A-104. Its tuning scale is over 50 inches long.

plexities are the band-switching and band-spreading arrangements, the tone control, the whistle filter, and the negative-feedback circuit. Besides the broadcast and long-wave bands with push-button tuning on 5 stations, the set covers the short waves from 5.8 to 21.7 mc and receives the sound accompanying television on 41.5 mc.

There are no less than 7 short-wave bands, each with full-scale tuning. As soon as the 13-gang band switch is tuned to one of the short-wave positions, the 2-gang variable tuning capacitor C1, C2 is automatically cut out; the oscillator is changed to the Colpitts type, and the ganged iron-dust cores of the master inductances L1 and L2 are moved inward or outward by the tuning drive. With this arrangement short-wave stations are as easy to tune in as those in the broadcast band. The 41.5-mc television sound channel is fixed-tuned, the second harmonic of the oscillator being used in conjunction with a setting on the 21-mc band.

With the European 9-kc separation between broadcasting channels, heterodyne whistles are apt to be troublesome. This receiver eliminates them with an acceptor filter tuned to 9 kc in the plate circuit of V4. It is a .005- μ f condenser in series with a large iron-cored coil.

wave range, but so good is the band spreading on this range that the effective length of the tuning scale is over 50 inches! When the switch is turned to the short-wave position a window in the front panel lights up. On this is projected the optically magnified image of a portion of the scale. The actual scale is photographed on a glass plate fixed to the spindle of the 2-gang variable tuning capacitor and moves with it. Concentric with the main tuning knob is a smaller one, which controls the movement of a plunger in the oscillator plate tuning coil. A hairline indicator, yoked to the plunger, moves over the enlarged scale appearing in the window. The optical and electrical components are so well co-ordinated and the band spreading is even over the whole range and a station once logged always reappears at the same dial setting.

Later I hope to describe further British radio and television receivers. Some very interesting new types of both are coming along.

A handy hearing aid is reported by W. B. Hutchins of San Antonio, Texas. Besides acting satisfactorily as a hearing aid, it also brings in the programs of local station KFYM, which is about a block from Mr. Hutchins' place of business.