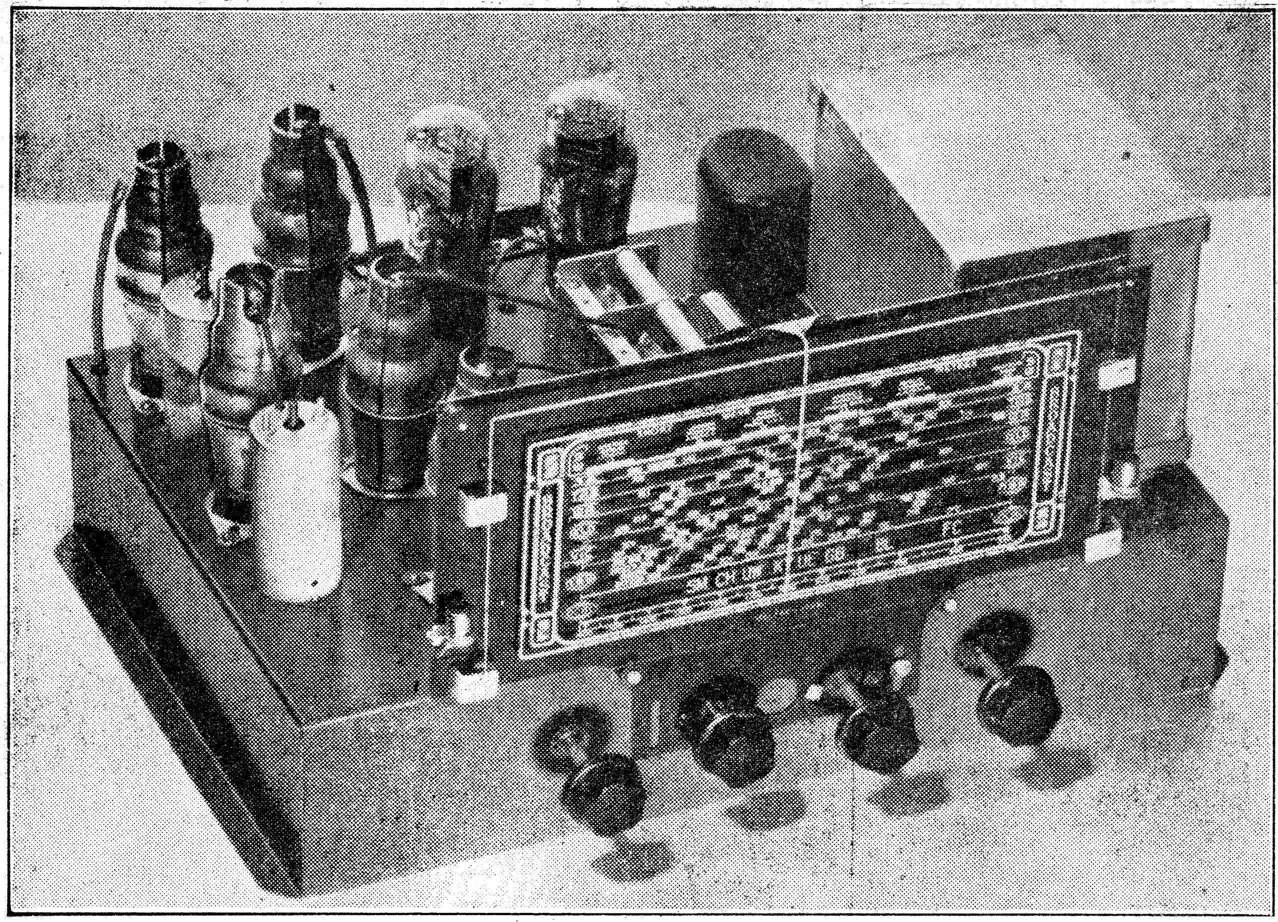


This picture gives a good general idea of the layout. It is very similar to that of an A.C. set except that the vibrator unit takes the place of the power transformer and rectifier. The speaker transformer can be seen at the rear of the chassis.

A BIG BATTERY RADIOGRAM

The Vibragram Seven is the finest receiver we have ever described for country listeners. Operating from a single six-volt accumulator, it provides two-band reception, with quality and power output not available from other battery sets. The push-pull output system with bass boost is ideal for gramo reproduction.

by W. N. Williams

EVERY time we describe a big set for power mains operation, we receive letters from country listeners requesting a similar design to meet their own requirements, for a receiver which is capable of higher power and better quality than the average run of commercial battery sets.

DESIGN PROBLEMS

The problem of designing a large battery set is, of course, complicated by considerations of current drain. The more amps and milliamps a set draws, the more frequent must be the owner's visits to the local garage or radio store—and every visit costs money.

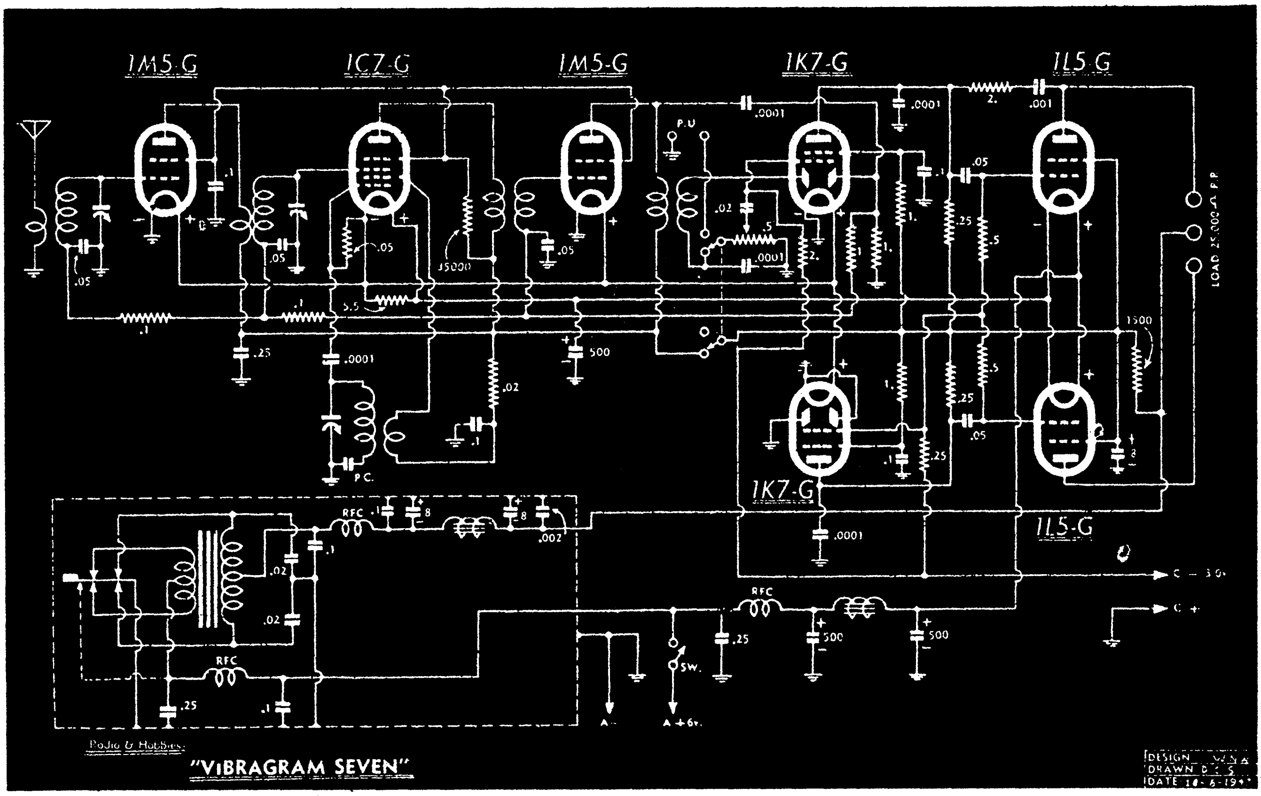
However, there are quite a few readers these days in the happy position of being able to charge their batteries from farm installations or vehicles, and, assuming a vibrator power supply, the upkeep of a set ceases to be a serious problem.

At least that is the line of argument adopted by readers in favor of better and bigger battery sets. Our new Vibragram is intended to meet this apparent demand and, in this respect, breaks new ground in set design. If readers show their interest in the receiver, it may well be the forerunner of other big vibrator sets.

But we are not trying to sell readers on the idea of large sets or high current drain. If you just want the news and markets, and a spot of entertainment during the evening, there is no particular point in operating more than a five-valve set. It is made for just that purpose.

The new Vibragram is essentially for the quality enthusiast who feels the urge to "turn up the wicks" a little and let his orchestra really play —drums and all! And, if the static is too severe for good listening, he can flick the switch around to the next

CIRCUIT DIAGRAM OF THE VIBRAGRAM SEVEN



Here is the complete hook-up of the set including the power supply.

position, get out the record album, and provide his own music for the evening.

FOR DANCING

And for dancing? Yes, the new Vibragram has plenty of volume for a large room.

In planning the Vibragram there could be little doubt as to the general lines of the circuit design. Being an ambitious type of set, we felt it should provide for dual-wave reception. This feature is likely to be important to the country listener, who can thus tune on frequencies not so badly affected by static.

The set had to have an RF stage and conventional converter valve. We hesitated for some time about IF amplification, whether to provide one or two stages. A two-stage IF channel is an excellent scheme, provided suitable low gain IF transformers are used. While these are available, we rather feared that many constructors would try and make do with conventional transformers, and thus lead themselves into difficulty with instability.

ONE I.F. STAGE

Because of this and the extra cost involved, we ultimately chose to use a single IF stage with conventional high gain IF transformers. This is followed by a diode detector and pentode amplifier in the one envelope.

Coming to the audio end, there is again room for discussion. A push-pull audio system seemed an inevitable choice, but with what valves and what input system? One can obtain quite impressive figures of power output by using a-c type output valves, but only with a steep increase in operating current. And we felt that

PARTS LIST:

RECEIVER

1 Chassis 16 x 11 x 3½ inches.
1 3gang tuning condenser.
1 Tuning dial to suit (Efco USL-46).
1 Dual-wave coil kit.
2 455Kc. iron-cored I.F. transformers.
5 Valve shields.
1 3 x 3 Rotary switch.
1 Low tension iron-cored filter choke.
1 Low tension R.F. choke.

RESISTORS

2 2-meg., 4 1-meg., 2 .5-meg, 3 .25-meg., 2 .1-meg., 1 50,000 ohm, 1 35,000 ohm., 1 20,000 ohm, 1 1500 ohm, 3 Watt W.W., 1 5.5 ohm, 3 Watt W.W., 1 .5 meg. Volume control.

CONDENSERS

3 500 mfd., Electrolytics 12 P.P. 1 8mfd. Electrolytic 525 P.V. 1 .25 mfd. tubular, 4 .1 mfd. Tubular, 5 .05 mfd. Tubular, 1 .02 mfd. Tubular, 1 .001 mfd. Mica, 5 .0001 mfd. Mica.

SOCKETS

7 Octal, 1 5-pin.

VALVES

2 1M5-G, 1 1C7-G, 2 1K7-G, 2 1L5-G.

SPEAKER

12in. Permagnetic type, 25,000 ohm C.T. transformer.

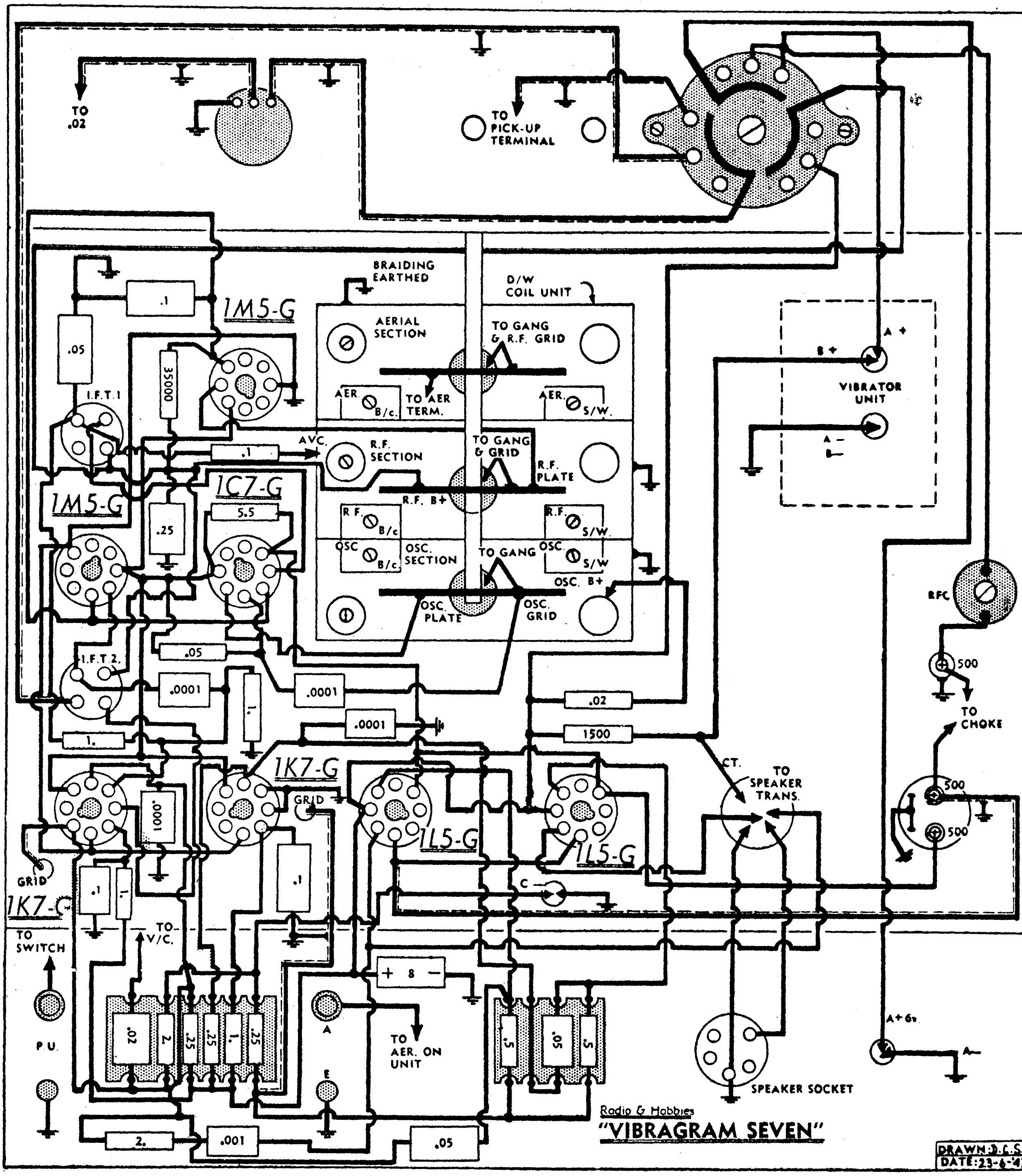
SUNDRIES

4 knobs, 4 terminals, hook-up wire, shielded wire, nuts and bolts, solder lugs, 5 small grid clips, 1 extension shaft, resistor strips, spaghetti, 2 dial lamps.

VIBRATOR

1 Metal Box, 6 x 4½ x 4¾ inches (see text).
1 Base plate, 5½ x 3⅞ inches (see text).
1 Vibrator transformer, 6V input, 200V output at 30mA.
1 Synchronous Vibrator Cartridge, Oak 35ZH or similar.
1 Valve socket to suit vibrator.
1 High tension iron-cored filter choke.
1 High tension R.F. choke.
1 Low tension R.F. choke.
2 8 mfd. Electrolytic condensers 525 P.V.
1 .25 mfd tubular condenser.
3 .1 mfd. tubular condensers.
2 .02 mfd. mica or tubular condensers (not less than 600 volt working).
1 .002 mfd. mica condenser.
Hook-up wire solder lugs, nuts and bolts, 4 long bolts for mounting Vibrator unit.

THE VIBRAGRAM SEVEN UNDER-CHASSIS WIRING



This is not a difficult set to build, but will need care and a complete understanding of the circuit. Study all diagrams carefully before making a start.

the whole purpose of the set would be defeated if the current drain became prohibitive.

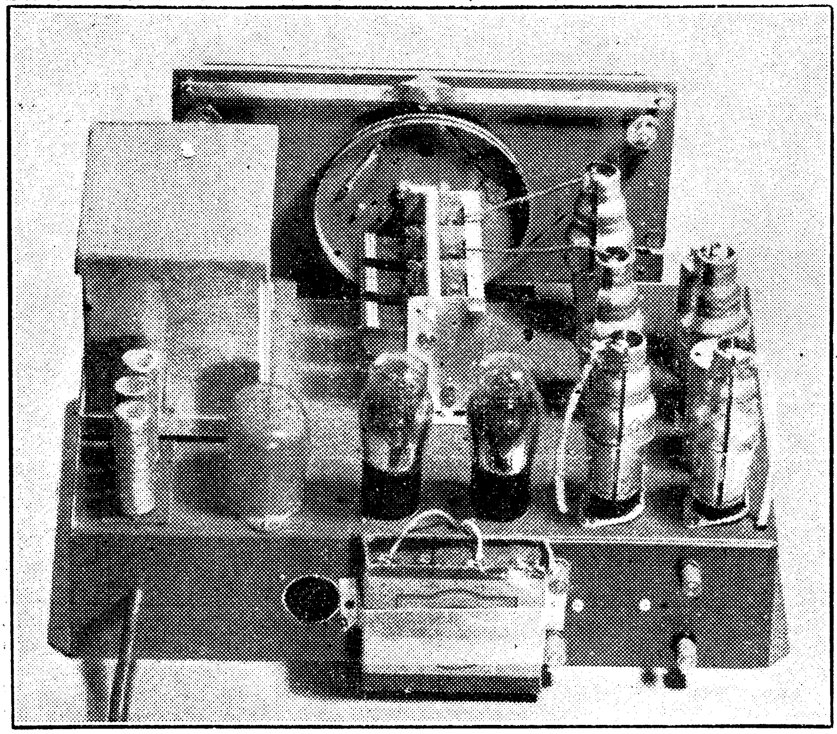
So the choice fell on a pair of battery output pentodes which we planned to operate at the maximum voltage considered safe for the valves. Good power output could thus be expected with the natural economy of battery type valves.

Then there is the matter of signal input system. An audio transformer was one obvious answer, but not necessarily the best one for the purpose. A good transformer is likely to cost a couple of pounds and, because of this and their relative scarcity, constructors sometimes end up by pressing into service some transformer inherited from the last generation. And nothing could be more futile than wiring a bad transformer into a luxury receiver.

The phase-splitter idea is not very practical with directly heated valves, so we turned to the so-called floating paraphase circuit, popular in USA. This was combined with a system of negative feedback and bass boost to provide what turned out to be a very effective audio system.

The choice of valves was never in doubt, the 2.0 volt Australian series being the only ones to merit consideration. The alternative 1.4 volt valves have economy of operation in their

A REAR VIEW OF THE VIBRAGRAM



This photograph illustrates further details of the chassis layout.

favor, but that is about all. The reliability is well below the more rugged 2.0 volt valves, and they are in short supply as well. So the valve line-up resolves itself as follows: 1M5-G, 1C7-G, 1M5-G, 1K7-G, 1K7-G, 1L5-G, 1L5-G.

In building up the set, we followed the obvious course of using the new chassis designed for the 1947 Senior Radiogram. The sequence of stages is exactly the same, right round to the output transformer. Three high capacity filament filter condensers mount over the rectifier hole and the vibrator power supply box occupies the space intended originally for the a-c power transformer.

The chassis has been made roomy enough to accommodate the largest of the coil units now available, so that the other two we know of can be made to fit in quite simply. You can use either an AWA or Stromberg gang condenser, with a dial of your choice calibrated to suit the gang. A few additional holes may be necessary to accommodate different combinations of gang, coil unit and dial, but this cannot be avoided. The problem of layout was discussed at greater length in the article covering the Senior Radiogram.

The RF amplifier and converter valves mount alongside the gang condenser, with the IF channel along the outer edge of the chassis. The audio system ranges in a straight line along the rear edge of the chassis—1K7-G voltage amplifier, 1K7-G phase inverter, the two 1L5-G output valves, and the output transformer.

The series-parallel arrangement of the filaments, necessary to operate from the 6.0 volt supply, affects the circuit design because of its relationship to the biasing of individual stages. The seven filaments can actually be arranged to avoid shunt resistors and to allow the first three valves to be switched off while the set is operated as a gramo-amplifier.

While this appears at first glance a neat scheme, it necessitates operating the IF amplifier at a high negative grid bias and also imposes unequal bias conditions on the four valves in the audio system. The network necessary to correct this condition is cumbersome enough to offset any gain in the filament circuit.

FILAMENT NETWORK

The final arrangement puts the two output valves in parallel at the positive end of the network, with the 1C7-G suitably shunted in the centre of the string. The resultant 2.0 volts effective bias fits in very neatly with the requirements of this valve. The other four valves are at the earthed end of the network, having no initial bias with respect to chassis.

When wiring up the filament network, be very careful to follow the circuit exactly and never switch the set on unless all the valves are in place. Special efforts may be necessary to obtain the 5.5 ohm resistor shunting the 1C7-G filament, but the need for this cannot well be avoided.

The circuit around the first three valves is quite conventional and requires no particular comment. Arrange the wiring to keep the leads short and the components as near as possible to the circuit points they are intended to serve. A couple of the AVC filter components may already be built into the coil unit box, and this point should be checked to see that they are not unnecessarily duplicated.

DIODE CONNECTIONS

Be careful not to confuse the two diodes in the 1K7-G valve. The diode at pin 5 must be used for detection and pin 4 for the AVC circuit. Confusion of the two diodes will cause loss of sensitivity and severe distortion at low modulation levels.

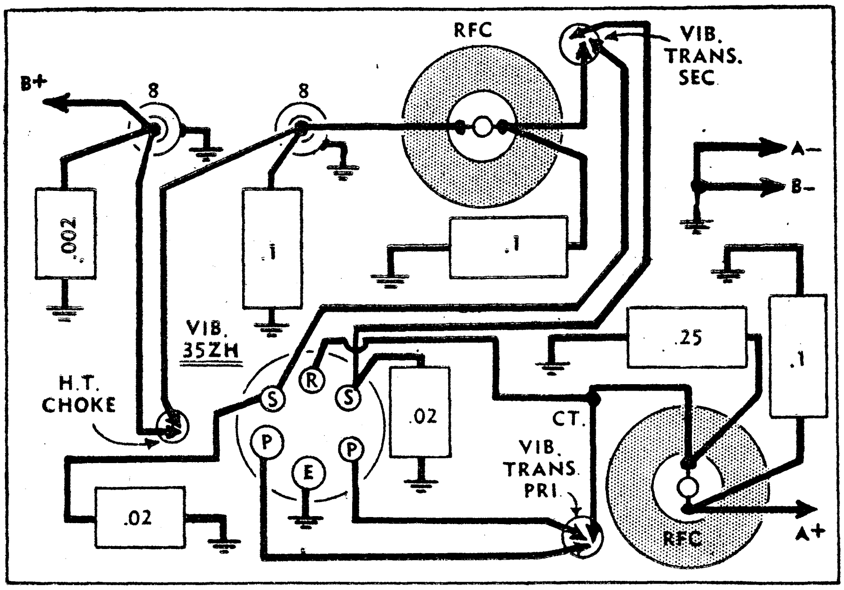
The first 1K7-G is wired as a conventional pentode audio voltage amplifier giving a gain of about 70 times. This feeds into the upper output pentode.

The grid resistor for this valve joins the grid resistor for the lower valve, passing through a third resistor to the bias source. Thus portion of the grid return circuit is common to both valves. The lower 1K7-G receives its signal from the junction and is resistance-coupled to the grid of the lower output valve. This valve thus operates purely to reverse the phase of the signal for the lower output valve.

If one assumes equal and opposite signal voltages on the two output grids, there can obviously be no signal for the grid of the 1K7-G phase inverter. Hence the circuit does not and cannot provide exact balance. However, the very high gain of the 1K7-G phase inverter ensures that the out-of-balance factor is no more than 1 or 2 per cent., and, in actual fact, we could not notice the mismatch by inspecting the signal grid voltages on an oscillograph.

Feedback is applied between the plate of the upper output valve and its associated voltage amplifier. A similar circuit published elsewhere some years ago showed feedback resistors between each output valve and its voltage amplifier—a circuit arrangement which appears on the surface to be nicely balanced. In actual fact, just the reverse is true, and application of feedback across the lower valves completely unbalances the operation of the amplifier.

Feedback in the position shown is effective for both output valves and, in operation, corresponds closely with the single-sided screen feedback in the phase-splitter type amplifier we have used so frequently. A small condenser in series with the feedback path reduces the feedback at the very low frequencies and gives a degree of bass boost. We liked the idea so well in the Senior Radiogram that it was natural to make a similar provision in the Vibragram.



The wiring of the vibrator unit is very similar to that used for previous "Vibra" receivers. A larger power transformer is employed.

SCREEN FEED

Another point of note is that separate screen feed resistors are used for the two 1K7-G valves. We had originally provided for a common feed resistor and bypass, but found that it produced a tendency to motorboat at a very low frequency—something down around one cycle per second. The valves operate quite happily with the three volts bias, which is also common to the grid circuit of the 1L5-G output valves. It is obviously desirable to have some common bias value for all valves in this audio circuit if the necessity for too many coupling circuits is to be avoided.

If you feel that the bass response is too high, simply connect the feedback resistor between the two plates without the series condenser. Omitting the condenser and resistor altogether removes the feedback. The gain increases, but the reproduction becomes thinner in quality.

So far as the 1L5-G valves are concerned, their actual operating bias is -7.0 volts, 3.0 volts applied directly to the grids and 4.0 volts by virtue of the filament connection. This higher bias was desirable because it was intended to operate the valves with 180 volts on the screens and up to 200 volts on the plate. A high plate and screen voltage is essential in the interests of good power output. Thus, increasing the voltage from 135 to 180 volts, more than doubles the power output.

The output transformer should reflect a load of 25,000 ohms plate-to-plate. It can be of the type normally fitted to permagnetic loudspeakers, but we suggest that it be mounted on the chassis to avoid long plate leads.

One point we missed. The audio end of this set is intended for alternative use as a gramophone amplifier. The radio-to-pickup switching is controlled by the off-on switch, which can be of the 3x3 single-bank variety.

SWITCH CONNECTIONS

In the first position, one section breaks the low tension circuit, so that the set is inoperative. The centre position closes the low tension circuit, connects the volume control to the diode detector circuit, and applies high tension to the valves in the tuner portion of the set. The final position leaves the low tension supply on, transfers the volume control to the "hot" pickup input terminal, and lastly breaks the high tension supply to the valves in the tuner. All leads to the volume control, pickup switch and pickup terminal need to be shielded.

POWER SUPPLY

The receiver requires a high tension supply of between 180 and 200 volts at about 30 milliamps, and this can be provided economically only by a vibrator type supply. To meet the requirements of this set, we therefore arranged with a manufacturer to turn out a vibrator transformer giving approximately 200 volts filtered d-c at a nominal current drain of 30 milliamps. These transformers should be available on the market as a standard line, and it is possible that other manufacturers, too, may produce vibrator transformers to the same specifications.

Every effort should be made to obtain something like 200 volts on the output plates and about 180 volts on the screens. A higher voltage would be hard on the valves, while a lower voltage will reduce seriously the undistorted power output.

THE VIBRATOR

In electrical design, the vibrator unit for this set is somewhat simpler than the unit specified for the Vibra Four and Vibra Five receivers. Split reed type vibrators are not in good supply just now, so that the ordinary synchronous type cartridge was selected. The elimination of the back bias circuit with its additional filtering makes a noticeable difference to the number of parts required.

Instead, a 4.5 volt C-battery was attached to the rear of the chassis to provide the three volts bias for the four audio grid circuits. It is no great trouble to replace the battery every 12 months or so.

For the vibrator power supply, we followed the same unit construction plan that proved so successful with the smaller Vibra sets. The vibrator transformer, cartridge, filter choke and filter components are all mounted

(Continued on Page 69)

THE VIBRAGRAM SEVEN VALVE SET

(Continued from Page 29)

above and below a flat base plate measuring 5¼in. by 3¾in. The component can be completely wired up, leaving three leads only for connection to the rest of the receiver, namely, B-plus, 6-volt input, and the common earth return lead.

A long brass bolt is passed through each corner of the assembly plate and secured in place, with the end of the bolt protruding downwards. The four bolts pass through holes in the bottom of the vibrator shield box, and the plate is held clear of the bottom of the box either by suitable distance pieces or by extra nuts screwed on to the long bolts.

MOUNTING

The same bolts are used to lock the vibrator box to the main receiver chassis, but they should be insulated electrically from it. One of the secrets of eliminating vibrator hash is to have the vibrator supply earthed to the main chassis only at some point where interference is least noticeable.

For this reason, large clearance holes should be drilled through the chassis to allow the four long bolts to pass through. The bolts can then be insulated from the chassis by bakelite washers or rubber grommets. The grommets provide some measure of mechanical insulation as well, but they can perish or chaff through, and possibly allow interference to become apparent.

We actually used the female portion of four insulated pin jacks, which served the purpose very well. The vibrator socket was shock-mounted on the base plate with the aid of small rubber grommets, and this provided all the mechanical insulation necessary to prevent hum being heard outside the unit.

The components which should be included in the vibrator box are shown inside the dotted shield in the circuit diagram. The remaining filter components are mounted beneath the main chassis and below the vibrator box. Don't try for any short-cuts in making the vibrator supply and wiring the filter circuits. Treat every lead as suspect for interference, and you will save yourself much trouble later.

The leads to the A battery should be no longer than necessary and run in very heavy cable. Heavy duty three-core cab-tyre flex can be used, with two of the leads wired in parallel to reduce resistance. Bond the negative lead to chassis and use this as the earth return point for the filament and vibrator circuits.

POSITIVE TERMINAL

Terminate the positive lead at an anchor point nearby and shield the length of lead running across to the off-on switch. It may be just as well also to shield the positive leads running across to the vibrator box and to the filament filter system. Note that the RF chokes in the low tension circuit should be of the low resistance type, likewise the iron-cored filament choke. The high tension filter chokes can be of conventional pattern.

Two 500 mfd. electrolytic condensers minimise hum in the filament circuit, while the third is connected part-way along the filament series network.

Much more could be said about vibrator supply problems, but space is at a premium. We suggest that you refer back to the December and January issues, last, and to other articles on the subject. What we said in connection with the Vibra Five receiver is essentially true of this one.

Having completed the set, check everything over and, in particular, the filament circuit. Plug in all the valves, connect aerial, earth, speaker and batteries and switch on. All being well, you should be able to feel a slight vibration from the vibrator supply and hear a hum in the speaker. In fact, stations should come through in the "Radio" position, and touching the pickup terminal in the "pickup" position should produce a healthy howl in the loudspeaker.

LOUDSPEAKER

The loudspeaker, by the way, should be of modern design. This set will justify the expenditure necessary for a new 12-inch permagnetic job. Don't spoil it by operating into some old-fashioned speaker, no matter how much affection you may have for it. Old prewar magnets just do not have "what it takes."

Anyhow, having got the set into operation, alignment is the next job. We can't launch into a full explanation of this, but the following are the steps to take:

1.—If you have an oscillator, align the IF transformers to 455 kc. Otherwise, leave them alone for the time being.

2.—Tune the receiver to a signal on the high-frequency end of the broadcast band and peak the aerial and RF trimmers.

3.—Tune in a low-frequency broadcast signal and peak either the aerial and RF cores, or the oscillator padder, whichever is provided.

4.—Set the dial-pointer so that it corresponds with the calibrations at the low-frequency end of the broadcast band.

5.—Re-tune the set to the high-frequency end of the band and bring it to line with the calibrations by shifting the oscillator trimmer. Then peak again the aerial and RF trimmers.

6.—If you have not previously aligned the IF transformers, peak them now on a weak signal.

7.—Switch to short-wave, tune to the 16-metre band, and peak the short-wave aerial and RF trimmers, preferably on background noise.

8.—Tune to the low-frequency end of the band and adjust the aerial and RF iron cores, or the oscillator padder, if either are provided. Not all coil

(Continued on Page 74)

A BIG BATTERY RADIOGRAM

(Continued from Page 69)

boxes have provision for alignment at the low-frequency end of the short-wave band.

9.—The short-wave stations may be shifted in relation to dial calibrations by varying the oscillator trimmer and then peaking the aerial and RF trimmers again.

For further alignment hints and more detailed instructions, we suggest you refer to the complete article on set alignment, as given in the July, 1946, issue.

When the receiver is aligned, it is just possible that vibrator hash may become evident at certain spots on the dial. Get your screwdriver and try earthing the vibrator case to the chassis at different spots. Choose the best one, and make a permanent link with the aid of a couple of bolts and solder lugs and a short length of copper braid.

BYPASSING

If there is still trouble, try bypassing various points in the filament network, try an additional high-tension or low-tension choke, or any of the other dodges suggested in the earlier articles.

As far as hash is concerned, there was no trouble in the original set — just plenty of gain and plenty of output.

Who better can we quote than the Editor, who introduced it to a fellow enthusiast as "the finest battery set I have ever heard." And it is good, even though we say it ourselves!