Rebuilding an Ex-RAF RECEIVER, Type 1155

By J. COOK

Noise-Limiter

Before the signal is fed from the detector to the first of the audio stages, it passes through a series type noise-limiter (6H6) which facility is provided by one section of the double-diode. The tube is arranged under the chassis with the holder near the wave-range switch panel bushing—it is essential for this tube to be of the small metal type to fit in the space available. This device 'chops' noise peaks by means of biassing the diode which becomes non-conducting above a pre-determined signal level. The point at which cut-off occurs is selected by adjustment of the control potentiometer R27 and this is adjusted on a signal until distortion commences. The control is then retarded slightly to clear the signal of distortition and will then limit noise with a higher amplitude than that of the signal. Varying signal strengths will necessitate a readjustment of this control, but AVC action will assist under such circumstances. Care should be taken with bias is applied to the SFA, Frequency-changer and first IF stages. The majority of the AVC and noise-limiter components may be located on the tag board underneath the wave-range switch bushing.

'S' Meter Amplifier

The AVC coupling capacitor C37 also provides the necessary voltages to the EBC33 tube which is used to deflect the signal strength 'S' meter. This tube is mounted horizontally on a bracket attached to the guard rail above the output transformer which, provided the bracket is made of some rigid material, provides a substantial mounting. The rear bracket of the former system switch is suitable for this purpose. A separate tube has been used here primarily to operate the 'S' meter irrespective of whether the AVC is in use or not. Usually the 'S' meter is included in the plate circuit of one the AVC controlled stages with the limitation that it becomes inoperative when the AVC is switched 'Off.' A

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the screening of all wires of any considerable length carrying the audio signal from this stage up to the final amplifiers. A switch is provided to cut the limiter out of circuit as it does incur a slight loss of audio output besides complicating operation whilst tuning.

Automatic Volume Control

The remaining half of the 6H6 double-diode is used to supply the AVC voltages. The diode plate is fed from the second IF plate through a small coupling capacitor C37. The switch S3 cuts the AVC out of use by grounding the rectifier output. The time constant is arranged to give optimum results on slow fading although this part of the circuit may well be expanded by the use of a rotary switch offering a variety of time constants, if it is so desired. AVC control is not delayed in view of the fact that it may be switched off for the reception of weak signals. Control normal 0-1 milliammeter (*i.e.*, meter scale reading left to right) in a 'Bridge' circuit is arranged so that the meter reading and signal increase together. R60 should be adjusted for zero setting of the meter whilst R57 controls the meter sensitivity. It will be found that on strong signals the meter will be overloaded but, in fact, when this condition occurs it will be found that the frequency-changer is being over-loaded also (distortion will be apparent) so that if the gain of the receiver is adjusted such that the 'S' meter does not exceed its normal maximum deflection, protection against maladjustment will thus be afforded. Calibration of the meter is difficult as there does not appear to be any fixed standard for 'S' markings but, at all events, calibration will hold good only whilst the receiver is operated at the same frequency and conditions as obtained at the initial calibration. *E.g.*, use of a converter

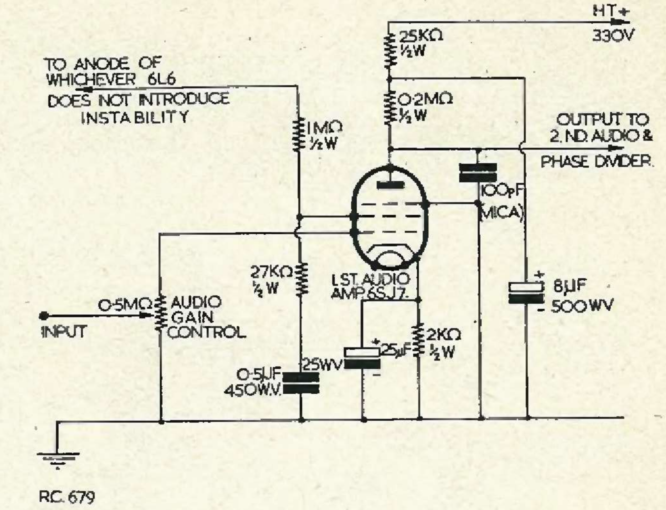

Fig. 4. Circuit of 1st AF amplifier using a 6SJ7 instead of a 6C5, with alternative method of using negative feed-back.

ahead of the receiver will result in higher gain and higher 'S' meter readings in consequence. Nevertheless, a signal strength meter is extremely useful for *comparison* of signal strengths and also for accurate tuning and alignment.

First Audio Amplifier

From the noise-limiter the audio signal is fed into the first stage of audio amplification (6C5) which is of moderate gain in view of the relatively high output from the detector. A small degree of negative feedback from the output transformer is introduced into the cathode circuit but this arrangement is controlled by a switch on the control panel as the full audio output is restricted by its use and this may not always be desirable. A jack is included in the input to enable the TRF units or pick-up to be fed into the audio amplifier. It is advisable to use a tube here that is very good mechanically if a noiseless background is to be obtained. Should higher gain be required, a 6SJ7 (pentode) may be used, instead of the 6C5, in the manner shown at Fig. 4. In this circuit an alternative method of applying negative feedback is adopted (without switching) and the coupling to the output transformer is dispensed with. Another jack, for feeding a pair of high resistance headphones, is included in the plate circuit together with a tone control giving four degrees of bass cut and two degrees of treble cut.

Second Audio and Phase Inverter Stage

A 6SN7/GT double-triode is used in the second audio and 'Floating Paraphase' phase inverter stage to drive the two final push-pull 6L6's. V8(a) functions as a normal amplifier whilst V8(b) provides the necessary phase inversion. Little additional gain is obtained from using a double tube but the advantage is that only one of the output tubes has to be driven by each section—thus it is easier to obtain the necessary 50 volts, peak to peak, required by the final pair of tubes, *i.e.*, an input of 25 volts to each grid. Further, this circuit is substantially self-balancing*, obviating the necessity of special adjustment. The variable resistor in the anode circuits has been included in order to match the anode load resistors accurately and at the same time provide a small amount of decoupling.

Push-Pull Output Stages

The two output tubes are 6L6 beam tetrodes strapped as triodes and provide a maximum output of 6.5 watts as operated here in Class 'A.' Tubes must be of the metal or 'GT' variety in view of the space limitations. Output from the transformer, which should be a high grade component, is fed via the jack J3 to a filter circuit (housed in one of the speaker cabinets) which, with a cross-over frequency of about 1,000 cycles feeds two speakers with separate high and low frequency outputs. The position of these two speakers in relation to the listener has some importance in the resultant balance also they should be mounted in cabinets or on baffles of adequate dimensions. In the author's case, two 9" 'Grampian' units are used as they provide a wide and moderately level frequency response with large power handling abilities (7 watts apiece) for a reasonable outlay.

*For explanation, see "Radio Designer's Handbook" by F. Langford Smith.

The Power Supply

The power supply is housed in a separate unit. This is necessary because there is no possible room for these bulky components on the receiver chassis which is now full to overflowing! Not only this, but it is desirable to keep the transformers and chokes away from the main receiver as these components are always a potential source of inductive hum; also extra heat is generated by

H.T. CONSUMPTION UNITS IN USE	MIN	MAX
AMPLIFIER PLUS ADAPTER	—	150ma
RX ONLY	135ma	145ma
RX PLUS ADAPTER	140ma	150ma
RX PLUS ADAPTER PLUS CONVERTER		165ma
RX PLUS CONVERTER	150ma	160ma

L.T. CONSUMPTION VOLTAGE	UNITS IN USE	CURRENT	
5.0V	V14	3 AMPS	
6.3V	ALL	6.63 AMPS	PLUS PANEL LAMP
6.3V	RX PLUS ADAPTER	5.6 AMPS	
6.3V	RX PLUS CONVERTER	6.03 AMPS	

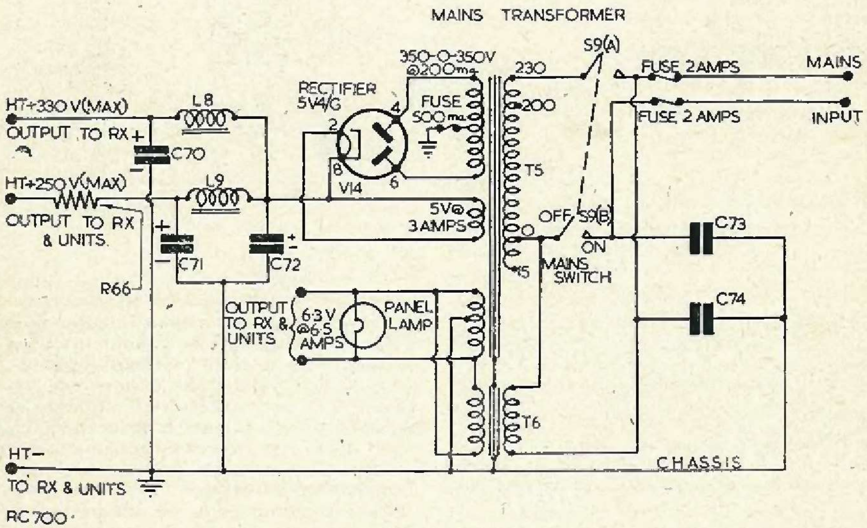

Fig. 2(c). Circuit of the Power Supply Unit.

the rectifier and dropping resistors which, again, is best isolated from the receiver.

This unit is required to supply a total of 21 tubes (excluding neon stabiliser) and, in consequence, the parts are of substantial proportions. Outputs are arranged to supply 250 volts and 330 volts to the RF and AF stages respectively. Separate smoothing chokes are used for each voltage in order that lower (current) rated chokes may be used. If chokes with differing DC resistance characteristics from those specified are used, appropriate adjustments to the dropping resistor R66 and a further dropping resistor in the output from the rectifier may be necessary to obtain approximately the above-mentioned outputs. Similar adjustments may be necessary if an alternative type of rectifier is used.

Smoothing is adequate, and if screening and layout has been given due care and attention in the receiver and amplifier, there should be negligible hum in the output.

Little need be said of construction because Fig. 5 shows the layout clearly, whilst exact dimensions and wiring are of little importance except that, once again, it must be borne in mind that the portion of the multi-cable carrying the 6.3 volts heater supply must be capable of passing the 5 amps current without any drop in voltage. The cable is terminated at the receiver end by an 8-pin 'Jones' type plug which fits into the remaining socket on the receiver chassis which now carries the supply voltages. In view of the heavy heater requirements when all the associated equipment is in use, an additional booster transformer is connected in parallel across the 6.3 volt section of the main transformer. It is important that the additional transformer is connected in the correct phase relationship—when connected in anti-phase this condition will be recognised by rapid heating of the transformer. Of course, if a transformer is obtained which is capable of supplying the requisite 6 to 7 amps the booster transformer will not be necessary—unfortunately few manufacturers seem to cater for such relatively large heater demands in the 200/250 mA class of transformer. The voltage regulator tube is properly part of the power pack but it is, for convenience, located underneath the main

receiver chassis next to and in line with the 6H6 rectifier and the associated load resistor R54 has been placed on a tag strip mounted on the coil pack near the side of the case for ventilation.

Operation

The first step in putting the receiver into operation, assuming all is well, will be to align the IF stages as it will be found that rewiring will have altered the alignment considerably. Note that it is necessary to align the two secondary winding in their respective "Narrow" and "Wide" bandwidth positions. The IF trap L2 is adjusted so that instability does not occur when the receiver is operated near the IF frequency. Alignment of the SF and Frequency-changer stages should not be necessary if this was satisfactory before conversion but it will be found necessary to decrease the capacity and/or inductance of the SFA grid circuit coils to allow for the inclusion of the antenna compensator control.

The Ultra High-Frequency Converter

The highest frequency covered by the converted receiver is 17 Mcs so that a converter unit is necessary if it is desired to extend the frequency range.

The converter used by the author is basically the 'Eddystone' UHF 5-10 metre converter, described in 'Eddystone' Short-Wave Manual No. 5. HT stabilisation (VR105/30) has been incorporated to mitigate frequency drift which is an especial consideration when used in conjunction with the narrow bandwidth of the main receiver. A complete set of self-supporting plug-in coils can be constructed from 14 guage wire to cover 60 to 30 Mcs, and as the converter is capable of an

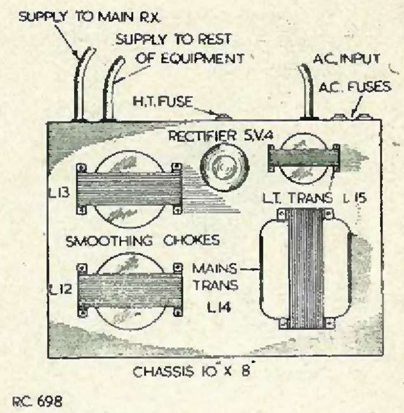

Fig. 5. Layout (not to scale) of the Power Pack.

exceptionally fine performance on the lower frequencies as well, coils may also be constructed to cover down to, for example, 14 Mcs. Formers will be necessary for these lower frequencies and polystyrene tubing will be found to be a convenient material for this purpose, using 6 BA brass rod for pins—the ends being turned down to the requisite diameter to fit the coil base sockets. The main receiver should be tuned to the highest frequency on range 3 for use with this unit, *i.e.*, approx. 1,550 kcs. It is interesting to note that this converter may be used very effectively as a two stage pre-amplifier when the SFA/Mixer gang is tuned to the desired frequency and the local oscillator coil is removed.

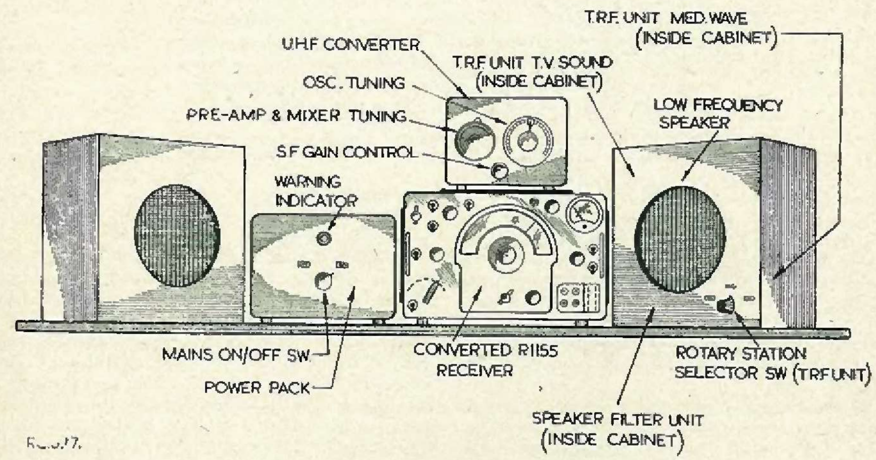

Fig. 7. General view of the equipment described.

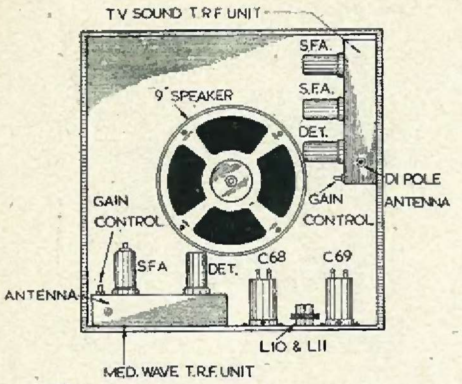

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Fig. 6. Loudspeaker Unit, housing the Filter and TRF units.

Medium Wave TRF Unit

A need for a unit of this type was felt because, with a superhet, it is difficult to obtain a band-pass sufficient to cover the 16 kcs radiated without attentuation of the side-bands due to the multiplicity of the circuits in the superhet. Two tubes are used—the first being a conventional signal frequency amplifier (6K7) incorporating a gain control to counteract 'blocking' of the detector when receiving strong signals. A second SF stage may be necessary in areas of low field strength or to improve adjacent channel rejection in difficult locations. In either case, efficient coils having a high 'Q' are desirable in this and the detector stage.

The detector is of the infinite impedance (negative-feedback) type and the circuit may be similar to that employed in the main receiver.

Station selection is effected by a rotary switch which selects alternative pre-set capacitors (high-permeability type); one position on this switch breaks the HT and antenna inputs in order that the main receiver may be operated.

Television Sound TRF Unit

For reasons similar to those stated above, a TRF receiver also offers the finest results when receiving the sound accompaniment to the television transmissions. Again an infinite impedance detector has been used, this time in conjunction with two stages of SFA using EF50's in a circuit similar to the "Wireless World" or "Electronic Engineering" televisor sound sections.

The two of these TRF units together with the loud-speaker dividing network are housed in one of the speaker cabinets, thus making for a neat installation as illustrated at Fig. 6.

When operating either of the TRF units and only using the amplifier portion of the main receiver, it is advisable to switch the 'Standby' switch (S1) to the 'Off' position for best quality as well as muting the RF stages.

SURPLUS RADIO EQUIPMENT

described by B. Carter

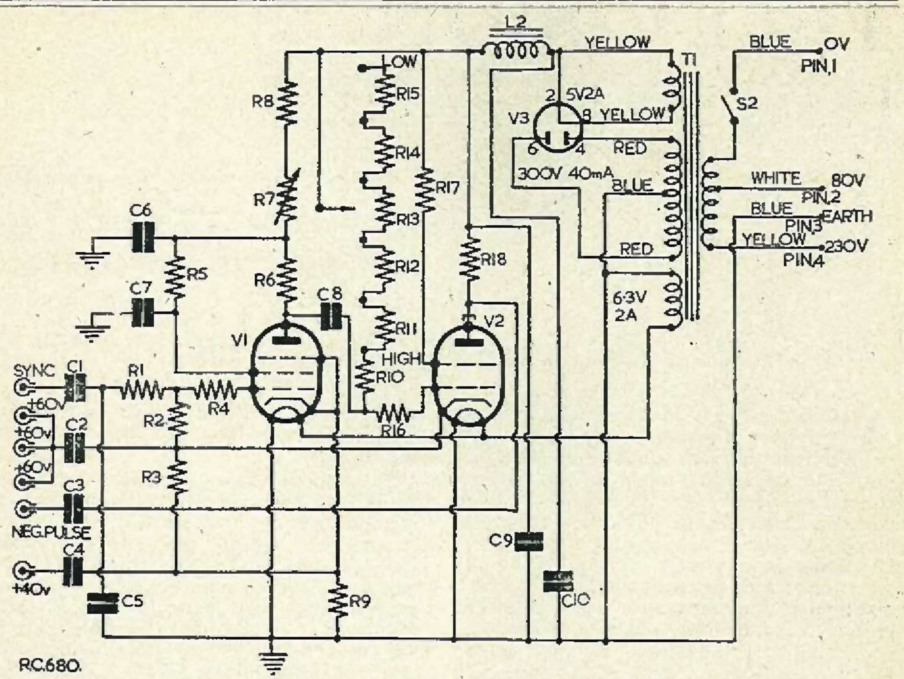
In this series of articles it is intended to describe units that have (a) immediate application, after some modification perhaps, in the amateur world, and (b) to list the contents of those units that can best become sources of valuable components. This month's unit with very little modification may be of use to many amateurs as it is purchased.

CONTROL UNIT TYPE 409 (10 LB/6009)

THE name of this unit belies its true value to the amateur, the main attraction being the power unit which feeds the control valves. The removal of the control section leaves ample room for modifications, for example as a stablised and regulated power unit, or as an output stage/power unit of the kind used for such receivers as the R1155.

The chassis and front panel are of heavy gauge steel welded together and the cover is similarly strong with louvres on all vertical surfaces. Anti-rattle clips are provided inside the front panel, making a very sturdy case 8½" long x 7¾" high x 8¾" deep.

The power unit is formed around a full-wave rectifier valve in the usual manner, employing a choke L2 and capacitor C9 for smoothing. The transformer HT secondary is labelled "300V 40mA" but it is thought that this is a very conservative estimate of its current rating, having due regard to the core size. The mains input is by way of the "W" plug, 230 volt 50 cycles between pins 1 and 4 or 80 volts 1,000 cycles between pins 1 and 2. The colour code shown may not be universal and may differ from that used in units of a different order.



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Circuit of the 409 Control Unit

CONTENTS LIST

R1, 4.7k ¼W	*C1, 30pF*
R2, 75k high stability 10C/3622	*C2, 0.1μF 350V*
R3, 110 ¼W	*C3, 0.1μF 750V*
R4, 220 ¼W	*C4, 0.1μF 750V*
R5, 3.3k 2W	*C5, 200pF*
R6, 22k 5W	*C6, 0.25μF 750V*
R7, 5k potentiometer	*C7, 0.25μF 750V*
R8, 2.2k 1W	*C8, 0.001μF mica*
R9, 220 ¼W	*C9, 4.0μF 500V*
R10, 3M ¼W	*C10, 8.0μF 500V*
R11, 3.3M ½W	
R12, 1.3M ½W	*L1, Mains transformer*
R13, 5.1M ½W	*L2, Smoothing choke*
R14, 2.4M ½W	
R15, 10M ½W	
R16, 220 ½W	
R17, 150 ¼W	*S1, Single pole 6-way*
R18, 330 ½W	*S2, Single pole changeover*
V1, VR91 (EF50) and holder	*One 4-pin plug type W198*
	Six single pole plugs 209
V2, 807 and holder	*Carrying handle*
V3, 5Z4 and holder	*Two groupboards*
	One 807 anode clip

(*SIGNAL GENERATOR—contd. from page 244*)

aligning a receiver by measuring the AVC voltage. Fig. 5 shows the circuit of a receiver which takes the AVC voltage from the anode of the last IF valve. This method of obtaining AVC is fairly common. It will be seen that the secondary of the IF transformer is not connected to the AVC circuit. However, this secondary may be adjusted by trimming it to give a *decrease* in AVC voltage. The reason for this is that the secondary tuned circuit acts as an absorption circuit, and, therefore, when accurately trimmed, it takes energy from the primary tuned circuit.

Whilst on this topic, the writer should like to state that if the constructor uses methods such as those shown above, then there is no reason why he should not make a really good job of aligning any receiver with which he has to deal. The actual procedure of aligning a modern receiver would require another series of articles to enable it to be adequately dealt with, and these would not readily fall in line with the subject-matter of the present contribution. Nevertheless, should readers be interested (and subject, of course, to the consent of the Editor), the writer is prepared to submit a series on the subject of modern receiver alignment, which may then be published in future issues of the "Radio Constructor." (What do readers think of this suggestion?—Ed.)

——To be concluded in next issue——