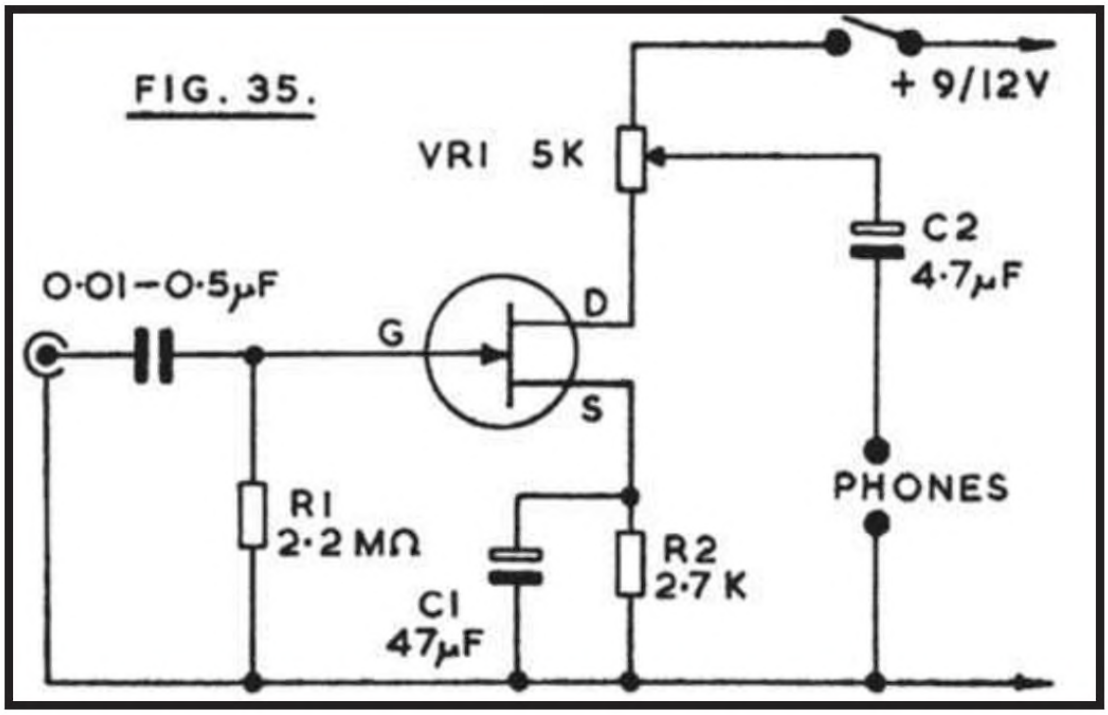
Preamplifier for Phones

Figure 35 is the circuit of a single stage preamplifier, incorporating a volume control, and intended for headphones. Component values are for the 2N3819 and similar FETs. Input to the gate is high impedance, so audio may be derived from virtually any source.

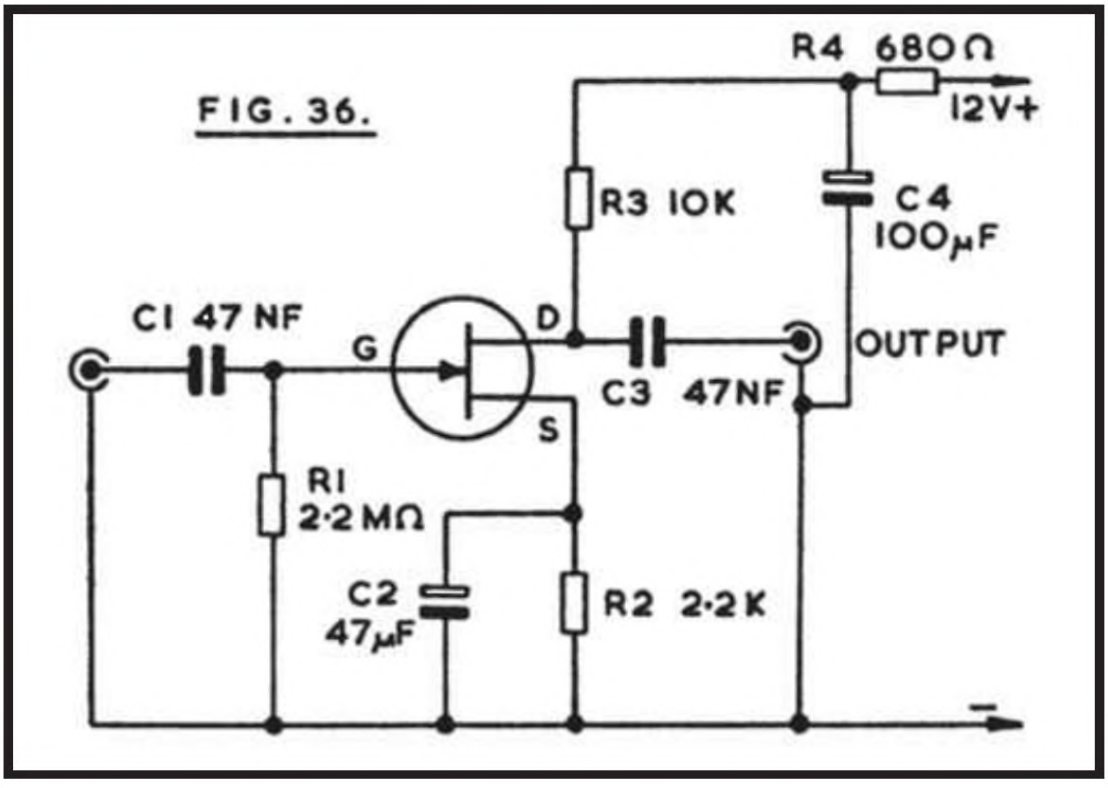
The DC resistance of the phones will not influence DC operating conditions (assuming C2 does not pass a significant leakage current). However, much the best results are obtained with high impedance headsets - say 2k, or at least not much under 500 ohm. A very useful degree of amplification is available, allowing weak audio signals to be boosted up to good headphone volume.

It is also possible to connect high resistance magnetic phones between drain and positive, omitting VR1. For other transistor types or a substantially lower supply voltage, it can be worth trying alternative values for R2, to secure maximum gain



Crystal Microphone Preamplifier

Figure 36 is the circuit of a preamplifier with high impedance input and an output circuit allowing coupling to a main amplifier. It will be found extremely useful for purposes such as boosting the signal from a crystal microphone.



The input socket, connected to C1, should take the microphone or other input plug, and a screened lead should be prepared to connect output and main amplifier. R4 and C4 provide smoothing and decoupling, so that current can generally be drawn from the main amplifier. It is preferable to use a 2-way power supply cord, not relying on the outer conductor of the audio lead for the negative circuit. A 12v supply is not essential, and the value of R4 may if necessary be altered in value to suit other voltages. The 2N3819 and other audio and general purpose FETs are suitable.

In some circumstances it may be possible to build this stage on a small insulated board which can be included in the main amplifier. This will greatly ease overall assembly. Alternative sockets can allow the preamplifier to be omitted, or included for greater sensitivity, as necessary. It should be clear of AC, power, speaker or similar circuits carrying high current or audio signals, to avoid any difficulties from unwanted feed-back.

Two Channel Audio Mixer

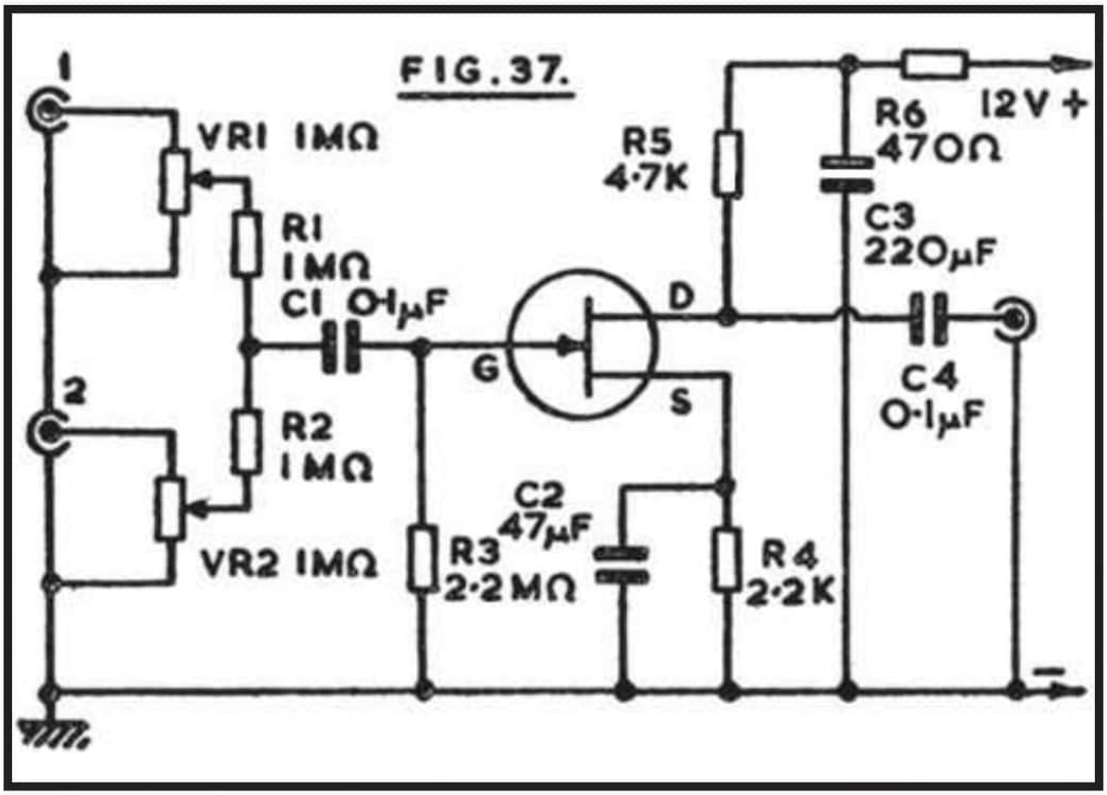
It is often convenient to be able to fade in or out or mix at any wanted level the inputs from two audio sources. The circuit in Figure 37 is suitable for this purpose.

One input is to socket 1, and the second to socket 2. Each input is suitable for high or other impedances, and has its own volume control VR1 and VR2. R1 and R2 are to provide isolation of VR1 and VR2 so that a minimum setting for one potentiometer does not ground the other input. This arrangement is suitable for all general purposes, with microphones, pick-up, tuner, tape, etc.

The 2N3819 and other audio and general purpose FETs will be found suitable. Output is to a screened connector, via C4, and is arranged as for Figure 36. Power supplies may also be provided in the same way as already described.

Such a mixer can be constructed in a small screened box,

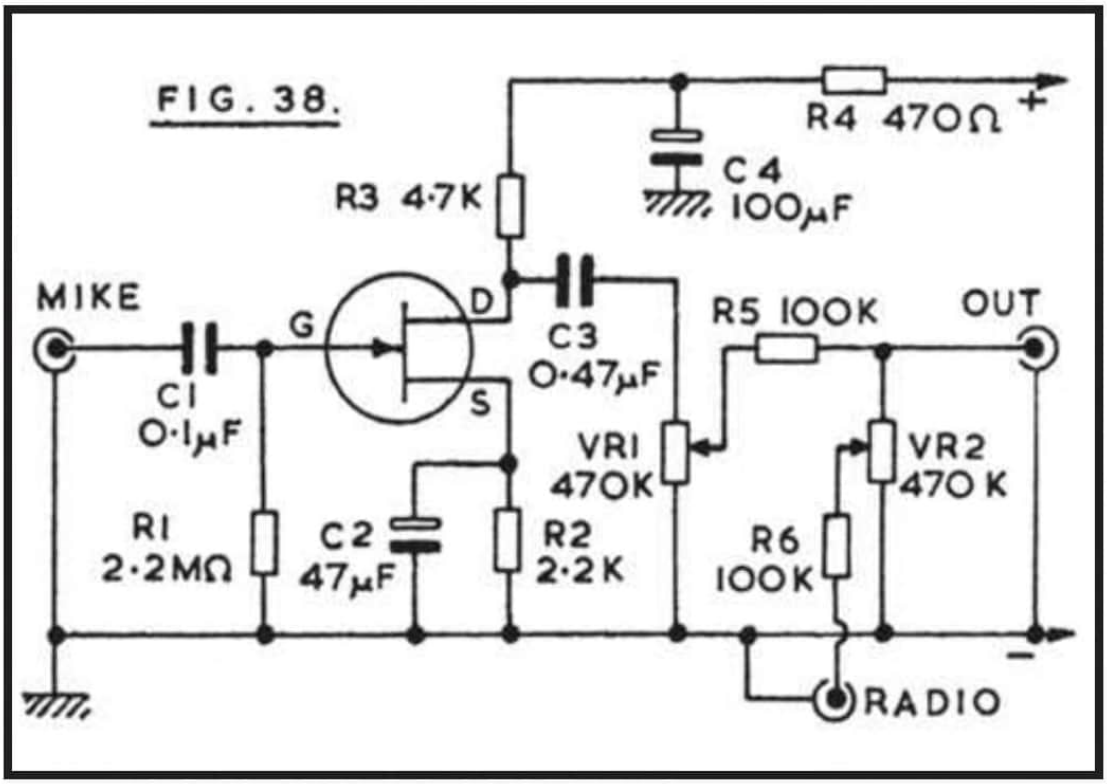
which is grounded to the negative line. The box will carry the input sockets 1 and 24 with associated volume controls. Running can be from an internal battery supply, if a power connection is not wanted to the main amplifier. An on-off switch will then be necessary in the positive battery lead. There is, some latitude in component values, without a very significant change in performance.



Both inputs receive amplification. When one input will be at a relatively high level, as from a radio tuner, it may be preferred to employ a circuit in which extra gain is available for one input only.

Preamplifier-Mixer

The circuit in Figure 38 permits mixing two inputs, and is particularly intended for one high impedance, relatively low-level input, and a lower impedance, higher level input. As example, the "Mike" socket can take a crystal microphone input, and will be, of high impedance. This input receives amplification from the FET. The 2N3819 is suitable. Other low-level inputs may of course be employed here if necessary.



The "Radio" socket is suitable for a tuner, or for other medium or lower impedance inputs having a higher signal level. VR1 control the level of the "Mike" input, and VR2 the level of the "Radio" input. This preamplifier-mixer will be found very useful when employed with a main amplifier where adequate gain is already available for full volume output with a radio or similar input, but which has no mixing facility, and possibly rather low gain for small input levels. Construction, power supply and audio circuits can be arranged as described for Figures 36 and 37. There is quite wide latitude in the supply voltage, but the value of R4 can be modified if necessary, if current is drawn from the main amplifier.

Circuits of this type are excellent for general usage. Where pick-up, tape or other equalisation circuits are required, er other considerations arise, reference can be made to Handbook No. BP35, Babani Press.

Safety

The need to observe essential safety precautions has been mentioned from time to time. Otherwise, in some circumstances,

shock hazards may arise in unexpected ways. These must be avoided in the interests of the safety of all users of the equipment.

With low voltage battery-operated equipment, there is of course normally no danger whatever of shocks. Preamplifiers or other units can thus be connected without any particular precautions.

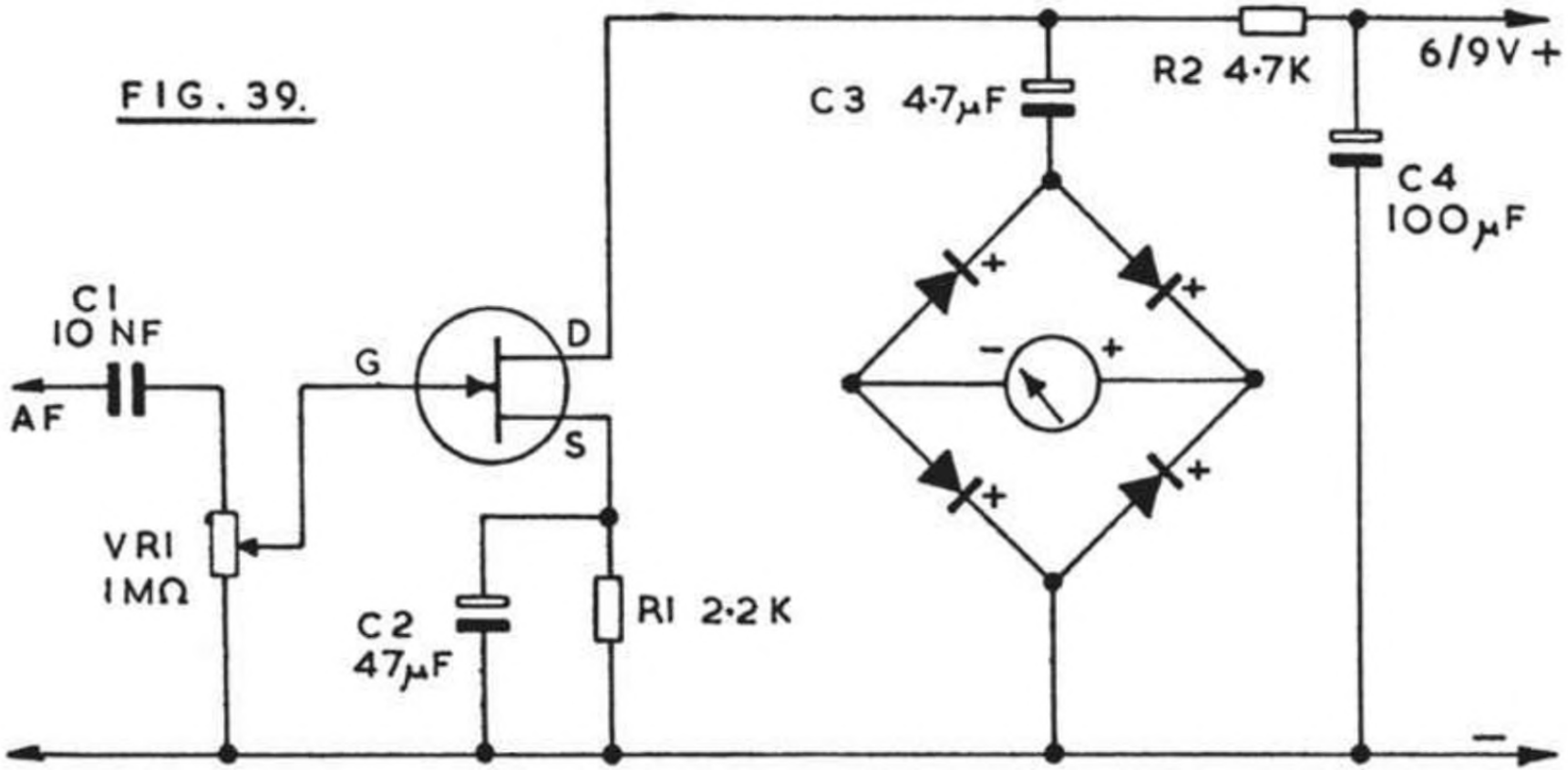
In the case of larger amplifiers, current is generally derived from the mains. It is usual to have a transformer, which both reduces the voltage, and isolates the equipment from any direct contact with mains circuits. Where the transformer is of approved double insulated type, in good condition; or where safety earthing and fusing are used, no mains voltages can arise in the amplifier itself. These low voltage circuits thus present no particular hazard.

With thermionic valve equipment, circumstances may be dissimilar. An amplifier may derive HT and heater supplies from a transformer, so that it can have an earthed chassis. This offers maximum safety, though high voltages will be present in anode and other circuits. However, some economically priced amplifiers draw HT and heater current directly from the mains. As a result, a metal chassis, or other items, may be dangerous to touch. It is thus recommended that such appatatus should never be used in conjunction with any circuits in this book, in view of the special isolating and other safety precautions which are essential. Failure to understand or observe such precautions can result in preamplifier cases, microphones, or any other equipment becoming alive at mains voltage, and thus highly dangerous.

Sensitive Level Meter

This circuit incorporates an amplifier, so can be operated from. Circuits having a signal level similar to about that of a radio tuner or from higher levels. In Figure 39, C1 isolates the circuit from the audio stage monitored. VR1 adjusts the input to the gate of the FET, so acts as a sensitivity control.

FIG. 39.



Audio power from the drain develops a voltage across R2, and is coupled to the full-wave rectifiers by C3. Current from these flows through the meter, so that a reading is obtained which depends on the strength of the audio signal.

A level meter of this type is useful for recording, a calibrated scale being provided for VR1. It can also be used to monitor the strength of audio signals generally. The loading provided by the circuit C1/VR1 will be of negligible importance for most medium or relatively low impedance circuits. For obvious reasons, AF is best taken at a point after any gain or volume controls in the equipment. Where the signal level is substantially too high, a resistor may be placed in series with C1, at the audio circuit take-off point. The value of this resistor will depend on the signal voltage, but can be expected to lie between about 470k and 10 megohm.

A 6v to 9v supply is not essential. A resistor may be put in the positive circuit, where current is taken from a higher voltage line.

The use of a 50uA meter allows high sensitivity. Any general purpose or detector type germanium point-contact diodes and similar rectifiers will be satisfactory. Care should be exercised when first testing the circuit, by advancing VR1 slowly from zero, so that a sensitive meter movement is not damaged. If damping of the meter movement is required, this can be obtained by connecting a capacitor across positive and negative terminals of the instrument.

Tone Controls

Adjustable tone controls allow reproduction to be altered to suit individual taste, or permit some measure of compensation to improve overall frequency response. They are very useful for general purpose equipment which may be used with crystal or magnetic input units, or for radio and tape, etc., but which do not have input circuits designed for these particular purposes.

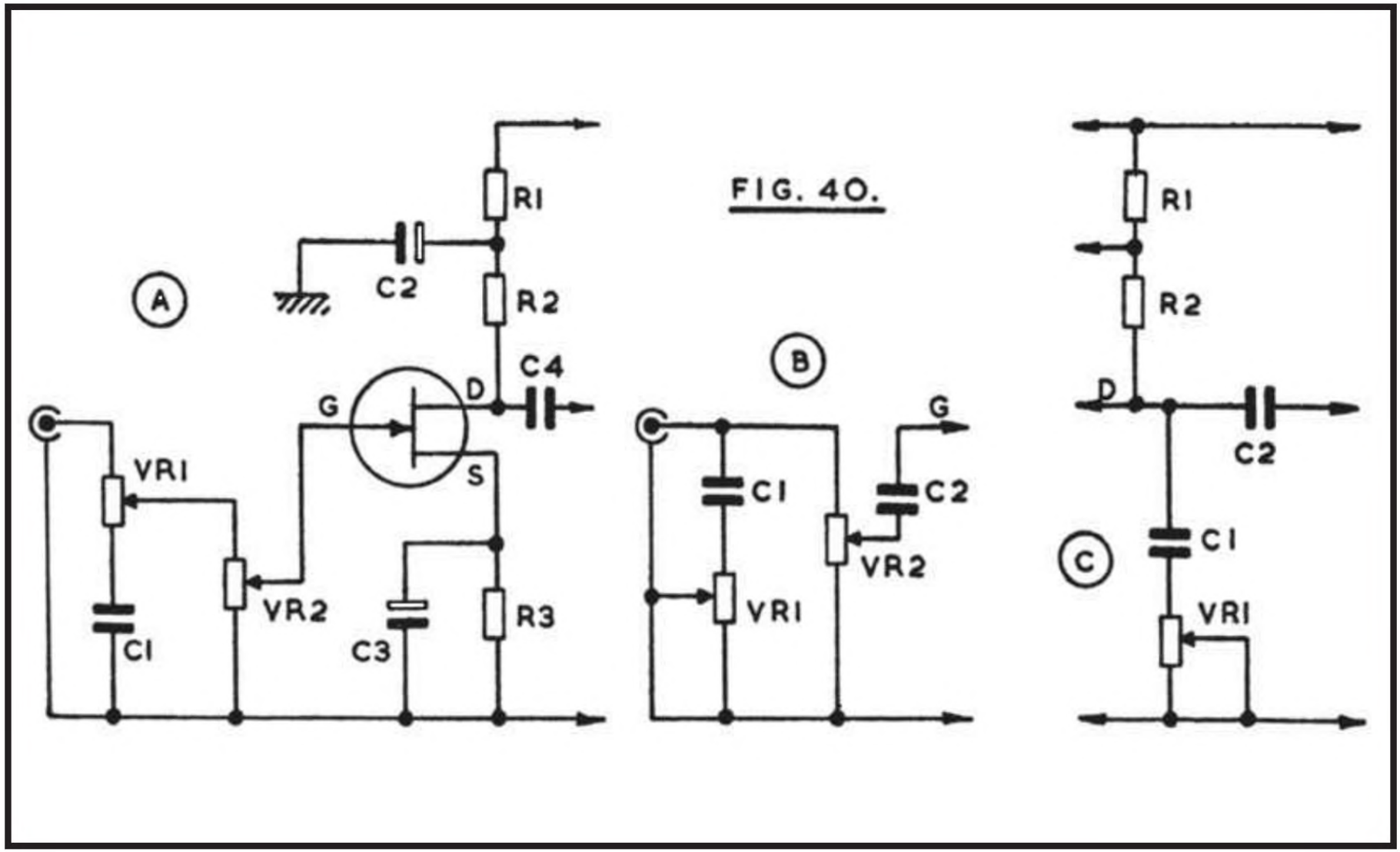


FIG. 40.

Three passive tone control circuits are shown in Figure 40. That at A incorporates a preamplifier stage shown in full. With passive tone control circuits of this type, there is an overall loss of audio so that the signal level is reduced. If the amplifier has easily adequate gain, sufficient volume can still be obtained. But if gain is already at maximum, the addition of a tone control network can result in output volume then being insufficient. This depends on the amplifier and other circumstances, arid when it arises the addition of a preamplifier will restore volume.

In A VR1 is the tone control, higher frequencies being reduced as the wiper moves towards C1. VR2 is a gain or volume control. R3 and C3 provide source bias and by-passing, and R2 is the drain audio load, with output from C4. R1 with C2 decouple the positive supply line.

Typical values for A are:

VR1	500k linear	VR2	500k log.
R1	1k	C1	2.2nF
R2	4.7k	C2	470uF
R3	2.2k	C3	47uF
FET	2N3819	C4	0.47uF

Operation is from a 12v or similar supply, and R1 can be changed if necessary for higher voltages. In this and similar circuits there is considerable latitude in the choice of values for positions such as C1.

At B VR1 is a top cut control, and VR2 the volume control. C2 is connected to the gate at G, and a 2.2 megohm resistor provides the DC path from gate to negative line, other components being R1, R2, P3, C2, C3 and C4 as at A.

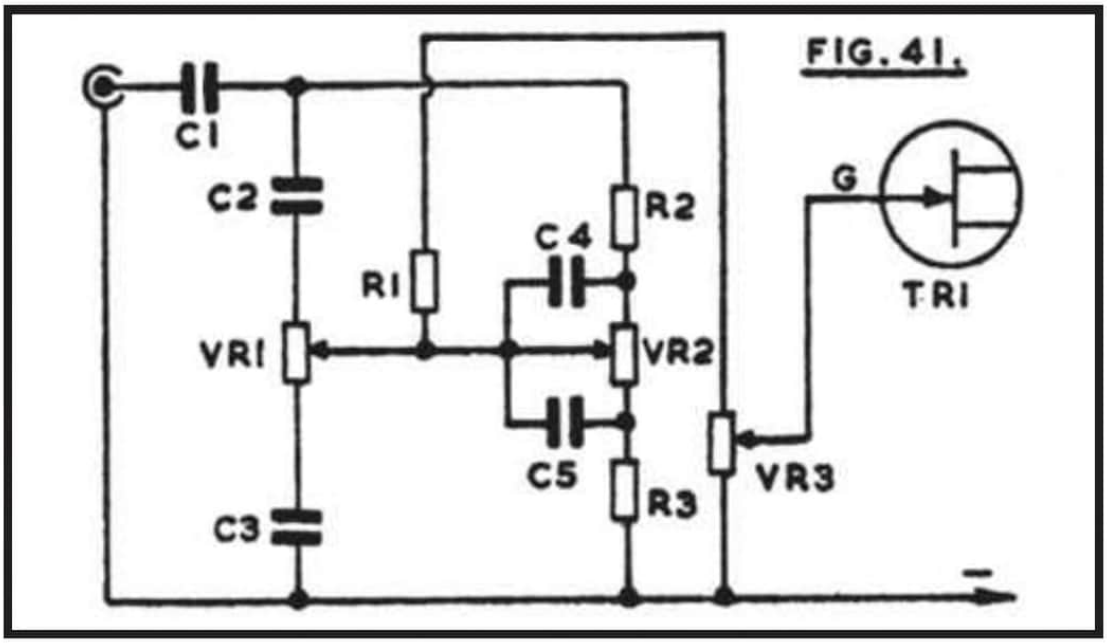
Typical values for B are:

C1	10nF	VR1	500k linear
C2	0.47uF	VR2	500k log

Yet another top cut control is shown at C. Here, R1 and R2 are the some as R1 and R2 in A, C2 of A being included as at A. In some cases such a tone control can be added to an existing stage without any disturbance to the circuit board. C1 at C can be 47nF, and VR1 25k. Higher values may be fitted for VR1, but tend to make most of the audible effect of this control occupy only a small part of its rotation. C1 can be increased, to give increased top cut. The results obtained with various component values are influenced by the impedance of the circuit.

With such circuits, low frequencies can be made more prominent by reducing treble with VR1, then increasing gain or volume.

Other circuits are able to offer control of both treble and bass frequencies. A passive circuit of this type is shown in Figure 41.



C1 is the input isolating capacitor, and may be unnecessary with some types of input. VR1 is for treble control. Treble is lifted with the wiper towards C2, whose reactance falls as frequency rises. With VR1 wiper towards C3, treble is reduced. VR2 similarly provides lift or cut in bass. Both are linear controls, supplying the volume control VR3 by means of R1. The source and drain circuits for the FET can be as in Figure 40.

Again, values are to some extent a matter of choice, but there is little point in using components which will provide extreme degrees of cut or boost, which wilt never be required. It is also of advantage to have approximately flat reproduction with VR1 and VR2 central.

Typical values for Figure 41 are:

C1	0.47uF	R1	270k
C2	470pF	R2	390k
C3	1.2nF	P2	18k
C4	2nF	VR1	500k lin
C5	5nF	VR2	1 megohm lin
FET	2N3819	VR3	1 megohm log