FUZZ BOX

by M. SCIBOR-RYLSKI

APART from the usual tone controls, there are at least three different electronic effects that are currently in vogue amongst both individual guitar players and pop groups. They are:

(a) *Echo or Reverberation*—effected by a tape delay or a mechanical delay. This is made evident as a periodic recurrence of a single sound.
(b) *Vibrato*—sometimes mistakenly called tremolo—is produced by mixing a fixed low frequency oscillation with the guitar signal.
(c) *Fuzz Box*—a harsh yet not unpleasant sound effected by wave shaping circuits. Here the impact of this contrived distortion is most evident on low frequencies.

There are plenty of published designs for echo units and vibrato units yet there has been little available on Fuzz Box circuitry, although considerable interest has been aroused in the subject.

Commercial units are available but the price of these inclined the author to design and build his own.

TECHNICAL DESCRIPTION

The fuzz box is based on a three stage shaping circuit, shown in Fig. 1. The first stage TR1 is a simple pre-amplifier of medium gain the input being applied via an 0·47μF capacitor C1. The value of this capacitor can however be decreased to 0·1μF if fuzz bass is not to be used. Base bias current is supplied by R1, a more sophisticated means of bias stabilisation being unnecessary as any thermally induced changes of the working point can only introduce additional "fuzz".

The signal developed across R2 is applied to the single sided peak clipper diode D1. Any type of semiconductor diode could reasonably be applied here, point contact or junction types. The value of R3 is similarly non-critical, a choice of resistor between 600 kilohm and 1 megohm proving satisfactory in the prototype.

Squaring of the component tones of the guitar complex wave input is completed by the overdriven amplifier TR2, the output of this being fed to the compound-connected output amplifier composed of TR3 and TR4, which together further amplify and improve the squaring by reducing the rise and fall times.

This output is then differentiated by the CR network, made up of C3 and the output potentiometer VR1. The resultant spiked positive and negative pulses make up the rasping "fuzzed" sound which can be fed to an amplifier or other effects units by way of SK2.

A requirement of this kind of unit is its ability to be switched in and out of circuit without the instrumentalist using his hands. This was achieved by using a single-pole changeover switch S1 operated as a foot switch. This serves the dual purpose of by-passing the effects box when the switch is not depressed and energising the circuit, thereby breaking the by-pass when foot pressure is applied. As can be seen this provides a considerable saving in current.

The setting of the output preset potentiometer VR1 will be determined by the power output of the main amplifier and an optimum level can be found by individual experiment.

CONSTRUCTION

Since the unit housing would be subjected to continuous foot pressure, it was decided to use an 18 s.w.g. aluminium chassis, with the changeover switch being mounted at one end. This allowed for easy control of switching as the foot is allowed to pivot on the box.

Fig. 1 (right). Circuit diagram of the fuzz box with footswitch

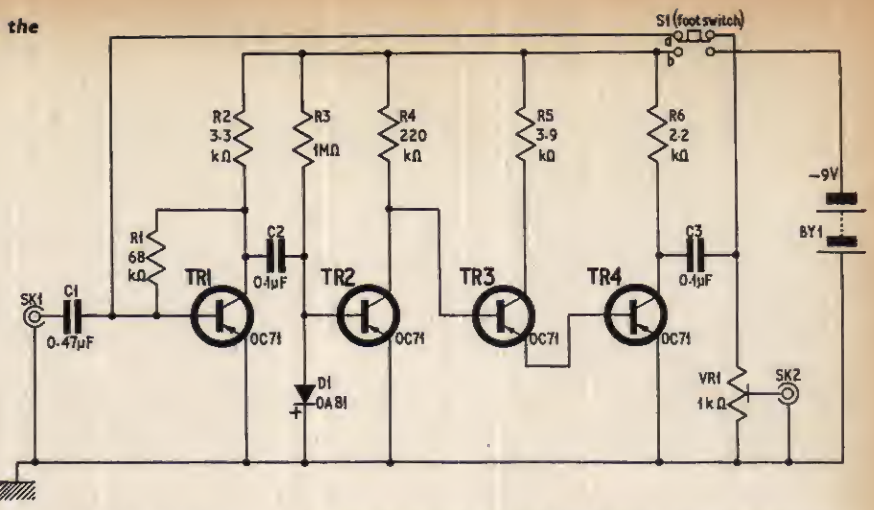
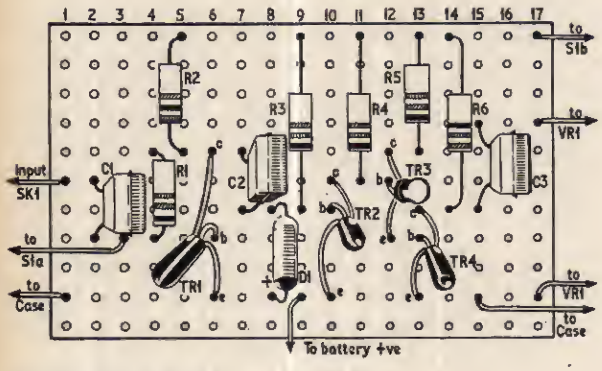


Fig. 2a (below). Layout of components on the laminated wiring board



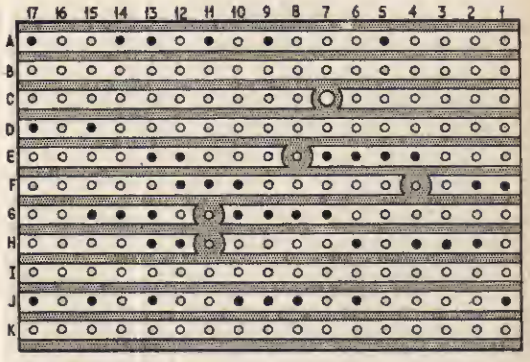


Fig. 2b. Underside of the component board showing holes which are used (black) and copper strip breaks

COMPONENTS . . .

Resistors

R1	68kΩ	R4	220kΩ
R2	3·3kΩ	R5	3·9kΩ
R3	1MΩ	R6	2·2kΩ

All ± 10%, ½W carbon

Capacitors

C1 0·47μF polyester 160V
C2 0·1μF polyester 150V
C3 0·1μF polyester 150V

Transistors

TR1—TR4 OC71 or NKT214 (4 off)

Diode

D1 OA81 Mullard

Potentiometer

VR1—1kΩ preset, linear

Switch

S1 Single pole changeover switch—S.M.357 Bulgin

Battery

BY1 9V battery. Ever Ready PP3 or Vidor VT2

Sockets

SK1–2 coaxial, surface mounting (2 off)

Miscellaneous

Chassis: 18 s.w.g. aluminium, 6in × 4in × 2¼in
Veroboard: 2¼in × 1½in. P.V.C. covered wire
Terry clip. Solder tags

Assembly of components is made on a piece of Veroboard and can be readily followed from the wiring diagram, Fig. 2. Stand-off insulators can be used for board mounting but in the prototype a section of barrier terminal strip (block) served equally well.

It will be noted that the positive line is taken to chassis by solder tags at the input and output sockets.

OUTPUT FILTER

A π network filter may be found necessary in some amplifiers which have relatively large coupling capacitors (see Fig. 4). Its inclusion is dependent on the fuzz quality required. Its exclusion gives a somewhat heightened string intermodulation which, in the author's opinion, epitomises the "wildness" of fuzz.

It is kinder to the loudspeaker however to use this filter if much high volume chord work is intended or if the speaker enclosure is found to resonate on account of too fierce a fuzz. The filter serves to reduce the harmonic content which is considerable due to the effectiveness of the squaring circuit.

The filter is inserted between the output capacitor and the output level control. The potentiometer VR2 is adjusted for the desired effect.

EFFECTS SWITCHING

There are three possible methods of installing and using the unit:

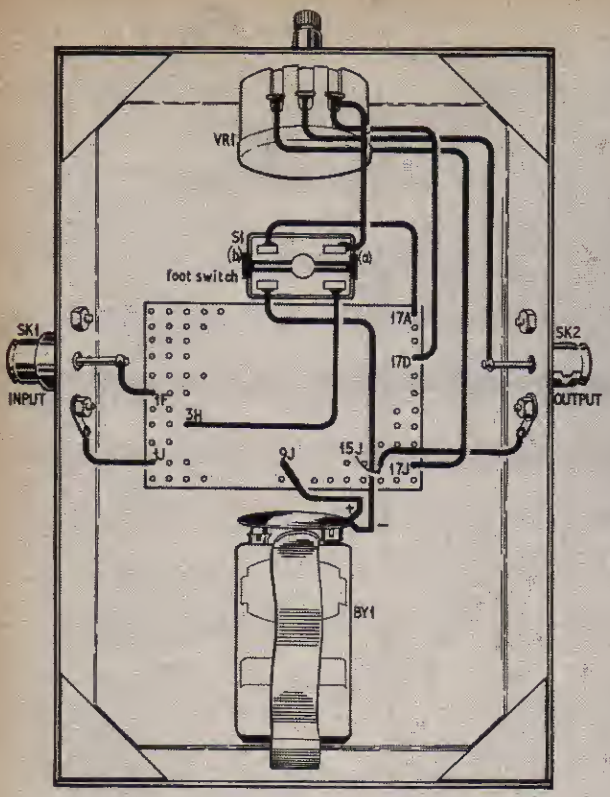


Fig. 3. Wiring details of the unit. The full details of the centre component board are shown in Fig 2

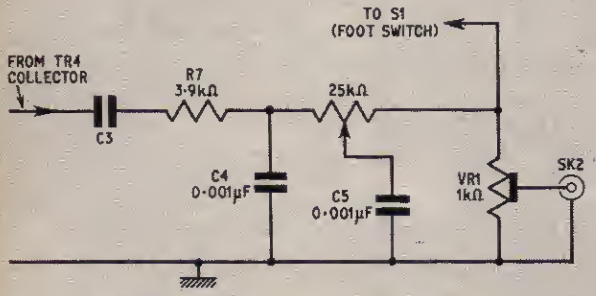


Fig. 4. Pi-filter connected to the output of TR4

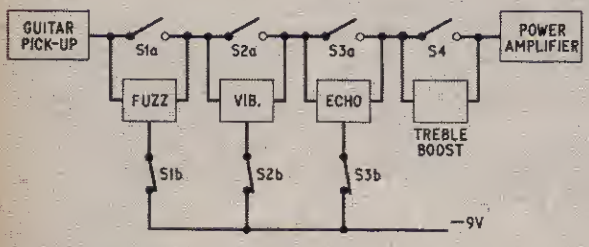


Fig. 5. Suggested method of coupling four effects units to the guitar amplifier input

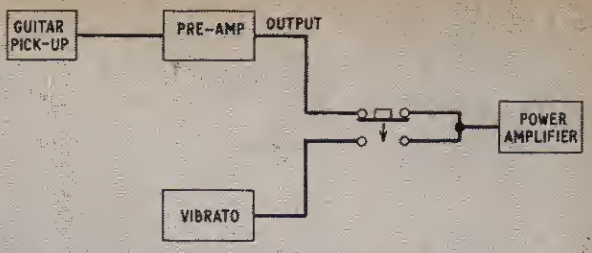


Fig. 6a. Footswitch used to introduce vibroto

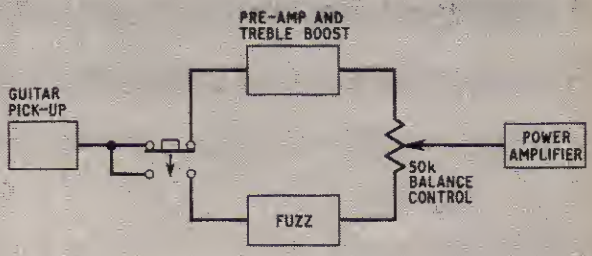


Fig. 6b. Footswitch used to introduce fuzz

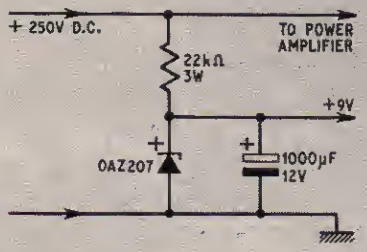


Fig. 7. Method of obtaining a positive low voltage supply from the power amplifier h.t.

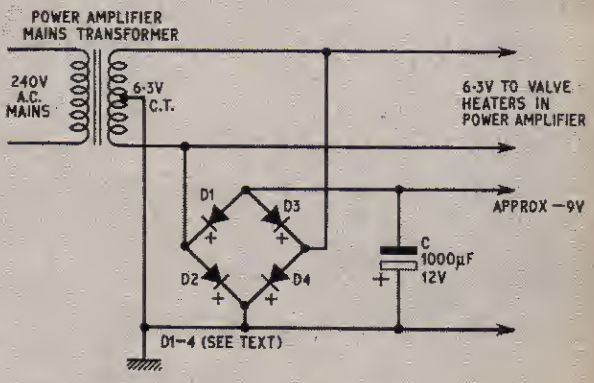


Fig. 8. Rectifying the heater supplies to obtain —9V output

(a) The unit can be installed in the amplifier itself, either with a separate footswitch control or with manual control to form a "fuzz channel".

(b) As a complete footswitch unit as described earlier incorporating all the electronics. The guitar lead plugs into the footswitch unit itself and the output from the unit is connected to the amplifier.

(c) As part of an "effects box" which is external to the amplifier. The remote control of this unit is difficult to achieve without either induced hum or "switchover click". However if good coaxial cable and a shielded microswitch are used then sufficient control is gained by just shorting out fuzz input to fuzz output via the footswitch. This system is really more suited to the type of unit described earlier.

If built into an effects box, one can have a number of facilities such as echo, fuzz, vibrato, treble boost and so on. All that has to be done is to link the required units to switches on a control panel; a suggested set-up is shown in Fig. 5. Alternatively a footswitch unit with one switch for each effect can be used.

It is possible to simplify the arrangement by making one footswitch perform two functions. This can be particularly useful in groups. For example, the rhythm section would use vibrato/pre-amplifier switching and the lead section fuzz/treble boost switching. Examples of footswitching for these are shown in Fig. 6.

POWER SUPPLIES

There are a number of different ways of providing power to the subsidiary effects circuits: battery supplies, separate mains driven power unit, or tapping the h.t. from the power amplifier. Polarities and connections of the supply are very important, particularly when using *pnp* transistors with a valve power amplifier. The fuzz box uses *pnp* transistors.

Taking the first method (battery supplies) this should present no problems, but remember that *pnp* transistors require a negative supply and *npn* transistors a positive supply. Never exceed the recommended voltage for each effects unit.

The second method (mains driven power unit) can be made up from one of the circuits which have been or will be published in these pages.

The third method calls for a certain amount of ingenuity and care. First of all make sure that the power amplifier supplies have enough reserve to enable up to about 10mA to be drawn from the h.t., which will usually be in the region of about 250V positive.

This h.t. is not likely to be stabilised so it is advisable to employ a Zener diode, for example OAZ207 or OAZ272 for 9V, to help maintain a steady d.c. supply voltage. One method of doing this is shown in Fig. 7; the extra components can be mounted on a small tag board inside the amplifier cabinet. This is only suitable for *npn* transistors.

Alternatively the 6·3V heating winding on the amplifier mains transformer can be used if suitably rectified and smoothed. This is illustrated in Fig. 8. It is important here to make sure that one side of the heater winding is not connected to chassis; it is best to connect the centre tap of the 6·3V winding to chassis, which will also be common to the "positive" line of the 9V d.c. output.

This method is suitable for *pnp* circuits and is probably the simplest. The polarity of the output can be reversed for *npn* transistors provided the *negative* line is connected to chassis instead of the positive. Almost any low voltage rectifier diodes of low current rating can be used, for example OA200 or OA90. ★