For radio fans

USE OF TRANSISTORS

By F. G. Rayer

DURING the last few years transistors have been coming into use, and they are now easily obtainable, at reasonable cost. Many of the circuits employed are complicated, requiring special parts, but this does not mean that simple transistor circuits cannot be wired up with success, as this is by no means so. Indeed, the simplest form of transistor amplifier need only employ a transistor and battery.

Transistors are of junction or contact type. With the former, thin layers of special crystal are fixed together, but with the latter, special electrodes make contact with a flat crystal base, as

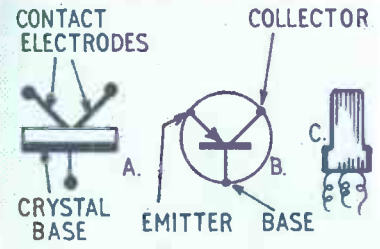

Fig. 1—The transistor

shown at (A) in Fig. 1. If a suitable circuit is being followed, the constructor need not concern himself with the kind of transistor, though such information may be wanted in experimental testing.

Current amplifier

The transistor has one very useful characteristic — if a very small current is passed from one contact electrode to the base (or from base to electrode), a very much larger current, when using a battery, will flow from the other contact electrode. This means that amplification, or an increase in signal strength, has arisen.

A valve also amplifies, but is controlled by a small change of voltage, applied to its grid. A valve also requires a H.T. supply of about 45 V upwards, and a filament or heater supply from a low tension source. The transistor has no filament or heater, and works with a battery voltage as low as 1½ V. In addition, the current it takes is only a few milliamps, so that small batteries have a long life. For example, the usual type of all-dry battery receiver valve will take 50 mA or 100 mA L.T., whereas the transistor takes only 1 mA to 5 mA, and needs no H.T. supply.

Transistors are thus very useful where economical running and small size are important. It must not, however, be thought that they are as efficient as valves. A receiver using one or two transistors is very much less powerful than a set with a similar number of valves. They are thus most suitable for small receivers, or deaf aids, etc., where the full advantage of economical running can be realised.

(B) in Fig. 1 shows the usual transistor symbol, the emitter resembling an arrow. The signal to be amplified may be applied to either base or emitter. The amplified signal then appears in the collector circuit.

(C) is a typical transistor. They are very small, with wire ends which can be connected directly to the other components.

Battery polarity

Transistor circuits are somewhat different from valve circuits, since the transistor is current operated, instead of voltage operated. This need not concern the constructor unduly. However, it is essential to note that with transistor circuits, the battery positive goes to the earth line, exactly opposite to valve

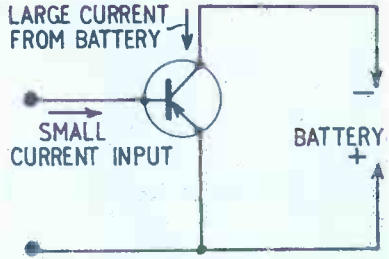

Fig. 2—Transistor amplifier

circuits. This is exceedingly important, as if the battery is connected up in the wrong polarity, the transistor will usually be damaged, so that it is of no further use at all.

Fig. 2 shows a transistor as amplifier, with battery positive to emitter, and negative to collector. In this case a small signal is being applied to the base, causing a large collector signal. This could be heard by wiring phones or a speaker in series with the battery circuit.

Any dry battery will do very well for such circuits. With the usual type of torch battery, the zinc case is negative, and the carbon rod, with brass top, is positive. With midget sets, tiny pentorch cells can be used.

Each such dry cell is 1½ V. One cell is enough for many transistor circuits, though some use 3 V (2 cells) or 4½ V (3 cells), or even more. The maximum voltage which can be used with any transistor is given by the maker. It is usually best to keep to 1½ V or 3 V with small circuits, as using a larger battery will not much improve results.

An on/off switch is usually included in one battery lead, to switch off. With proper use, the transistor is virtually everlasting. Wrong battery polarity, wrong transistor connections, excess voltage, or heavy currents can, however, damage it at once.

Practical circuit

A very useful application for a single transistor, with battery, will be found in providing amplification for a crystal set. A pictorial diagram of such a receiver, including the crystal set section, appears in Fig. 3.

It must be stressed again that the amplification does not equal that obtainable from a valve. However, a very useful increase in volume can be expected. If a crystal set gives insufficient volume, the transistor will boost this up to a level where phones may be used with comfort. On the other hand, if the crystal set were used in circumstances which gave good phone volume, then a small loudspeaker can be worked with the aid of the transistor. This is a very suitable arrangement for a bedside receiver.

The amplification obtained can easily be noted, if the phones are first wired from detector to earth, as with the usual crystal set. The transistor is then added, as in Fig. 3, and the increase in volume will be apparent.

It will be seen that the detector polarity is marked, negative going to transistor base. Many crystal diodes have red and black ends, to indicate positive and negative. If the detector has no polarity shown, it should be tried each way round, to find which is correct.

Tapped coil

The transistor amplifier can be added to a ready-made crystal set. But volume will be improved if the detector is taken to a tapping on the coil, as in Fig. 3. This tapping can be about one-quarter

the total number of turns from the earthed end of the coil, though a few trials, with different positions, will be helpful in securing best possible results.

If a coil is to be wound for medium waves (200–550 metres), then 30 S.W.G. D.S.C. wire, or a similar gauge, and a 1½in. diameter former, will be satisfactory. With turns wound closely side by side, 70 will be required in all. The detector tapping is provided at about the 18th turn from the earth end of the coil, by making a loop when winding. If more selective tuning is required, the aerial can also go to this tapping, or to one at about the centre of the coil. This depends upon the type of aerial.

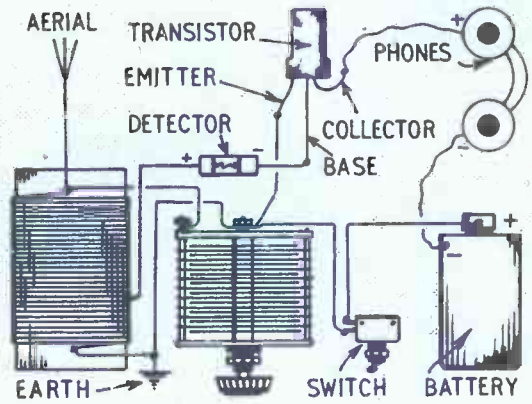

Fig. 3— Complete transistor receiver

Transistor connections

As explained, the transistor leads must never be confused, as wrong connections could cause damage, once the battery is fitted. The wires must also be soldered very quickly, to avoid heat travelling along them to the transistor.

When joints are to be soldered, the full length of the projecting wires should be left, and the lead should be held with flat-nosed pliers, just clear of the transistor body. The soldering iron must be really hot, and should only be applied just long enough to solder the joint — only a second or so. Blowing, or touching the joint with a damp cloth, will cool the wire more rapidly.

If heat is allowed to travel along the wires into the transistor, it will be permanently damaged. This also applies to the crystal diode type of detector.

If there is any doubt about soldering, for this reason, it is better to make small terminal connections, or even to twist the wires to longer leads, for connecting up.

Phones or speaker

The usual type of crystal set phones will be satisfactory. Those of high impedance, but fairly low D.C. resistance, such as good balanced-armature earpieces, are best of all.

The customary warning must be given against ex-service phones of low resistance, never intended for such purposes. These will generally be quite unsatisfactory, only giving weak signals.

If a speaker is to be tried, it should be of the type which would be used with a battery set, with a matching transformer. If the transformer has various tappings, these should be tried in turn, to find which is best. Very high impedance loads are not required, so that the transformer is best when it has a fairly low ratio, or is intended for triode output valves. However, it will be found that many transformers work quite well.

Midget speakers and transformers are best avoided, if space is not important, as the actual sound output will be reduced, compared with that obtained from a good 5in. or 6in. speaker. The speaker should also be fitted in a cabinet, for optimum performance.

UNUSUAL HOBBY

Collecting Thimbles

LIKE buttons, old thimbles are often found in Grandma's work box or among other oddments at antique shops and auction sales, where I once bought an old Victorian work box for 10/-. Besides many interesting buttons, it also contained an old thimble, which when cleaned, proved to be solid silver.

Thimbles are mentioned in writings of the 12th century. They were manufactured at Nuremberg in Germany in the 14th century. In 1534 the thimble-makers became a corporate body.

In 1572 a Nuremberg thimble-maker named Jorg Endthor invented a twisting wheel, but was forbidden by the authorities to use it, because it would have given him an advantage over other members of the craft.

15th-century thimbles, narrow and pointed, were adorned with ornaments and proverbs. Many were made of bronze and brass. Those made of gold and silver were designed by goldsmiths for the use of rich women or as presents for the pretty bride or the good wife and 16th century goldsmiths often produced perfect costly thimbles for their sweethearts.

Double thimbles — the under one quite smooth and gilded; the upper one of silver and entirely pierced through — were made during the 17th century.

Two 18th-century thimbles at South Kensington Museum deserve mention. The first is from a set of needle-case, thimble and box. The thimble is silver gilt covered with openwork scrolls filled in with coloured enamel. The second is of silver, the body is of open filligree work with scrolls. A 17th-century thimble at the British Museum is of silver with portraits of Charles II and his queen. There are some letters and figures on the lower border. This thimble was made in England.

John Lofting who came over from Holland at the end of the 17th century established a thimble factory at Islington to introduce the thimble as an article of common use.

In October, 1884, a celebration took place in Amsterdam. It was the bicentenary of the special thimble-making of Nikolaus Von Benschoten. It was at this gathering of thimble-makers that a new thimble was introduced which seems to avoid the faults of the ordinary steel and silver thimble by being made in three parts, the inner and outer being of silver and the middle one of steel, thereby rendering it impenetrable. It is known as the Dorcas thimble.

Thimbles are made by stamping and afterwards turning in a lathe, the indentations being produced by a specially adapted instrument. Continental operatives make them with punches in as many as five different mandrils.

The word thimble is derived from the Scots Thummel, or Thumb-bell, a sort of shield originally worn on the thumb.

This hobby is fairly popular and many collectors combine it with button collecting.

(R.L.C)