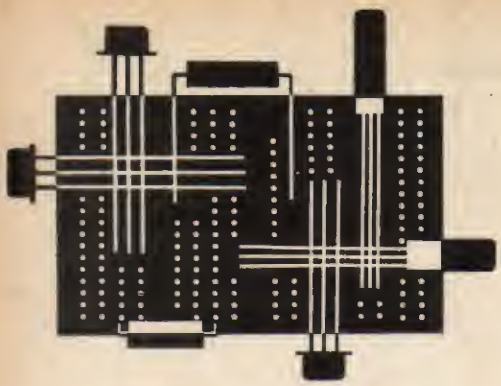

PROJECT

THE new series of practical subjects for beginners to build commences in this issue. Subsequent articles in the series will be easily identified under the "Beginners" heading in the Contents and by the symbol which will appear at the beginning of each article.

THE projects are shown built up on a "breadboard" system for four main reasons.

1. Whilst the initial cost of the systems may be high, this could be more than offset by the fact that components can be easily removed, re-positioned or used again in a more permanent construction.

2. The circuit can be assembled very quickly or expanded by adding extra functions later.

3. The actual layout of the components can follow a similar layout to that in the circuit diagram.

4. Soldering is only needed for connecting wires to large components, such as switches and potentiometers; inter-component wiring is already provided.

USING T-DEC

The "breadboard" system used is called T-Dec. It is a manufactured plastics base plate with a matrix of numbered holes. Certain combinations of interconnection are provided by spring strips underneath the holes. These are snown in Fig. 1a corresponding to the raised lines moulded on to the surface of the board itself.

T-Dec is divided into two sections which are electrically isolated, enabling two or more separate circuits to be built on to the same board. If required any part of one circuit can be connected to any part of the other circuit by using single strand copper link wires.

Some components have very thin connecting wires; these should be helped into the holes by holding the wire with a pair of long-nose pliers.

Transistor and diode wires can be inserted directly into the holes if spacing permits. It may be necessary to open up the spacing of these wires; in which case, careful bending with pliers at least $\frac{1}{8}$in from the encapsulation can do this without damaging the transistor or diode seal. Alternatively, special adaptor plugs supplied by the T-Dec manufacturers can be used to mount these components.

The component wires should be at least $\frac{3}{8}$in and preferably $\frac{5}{8}$in long to ensure satisfactory connection. Longer wires will of course, make the components more versatile in their use. It is never good practice to trim these wires short if they are to be used again.

Whole systems of breadboarding can be built by fitting two or more boards together by the dovetail tongues and grooves around the sides. Small panels for switches, potentiometers, lamps and so on are provided and are easily fitted into the slots on the edge of the boards.

HOLE IDENTIFICATION

Coming now to the numbering of holes for identification you will notice that the T-Dec has two blocks side by side with letter references A to H on both.

Fig. 1a. The T-Dec breadboard. Notice the connections between holes are shown as raised lines

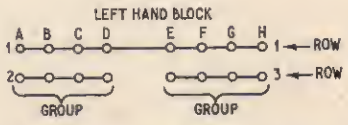

Fig. 1b. How the T-Dec holes are identified. Only the first two rows are shown here

Fig. 2a. Underside view of Veroboard showing the copper strips

BUILDING — for BEGINNERS

The numbers run in sequence for each row or group of holes in a row (see Fig. 1b). It is important not to be confused with these since, in each alternate row per block, there are two groups of four holes which are numbered separately.

In the other rows connection is already indicated between the two groups; these cannot be separated. If insufficient holes are available for a particular junction of components, a link wire can be carried to another vacant group elsewhere on the board.

ALTERNATIVE CONSTRUCTION

Some readers may prefer to use alternative construction systems, perhaps in a more permanent form. These will probably require the use of a soldering iron and, although component recovery is possible, it is not as easy as with T-Dec.

Suggestions for some construction systems are given here, using mainly some form of s.r.b.p. sheet machined or treated by proprietary manufacturers.

In order to simplify translation from T-Dec to these other forms, the same basic layout is assumed and connection code numbers correspond. If the board is too large, it can be trimmed before commencement to the size required, but the basic layout remains the same.

COPPER STRIP WIRING BOARD

Veroboard is the first of the alternative examples here because translation is very straightforward. Fig. 2a shows this board with the copper strips on the underside. To keep the same layout appearance the holes are numbered in sequence so that the top surface is that without the copper.

If the copper strips are cut to conform with the T-Dec

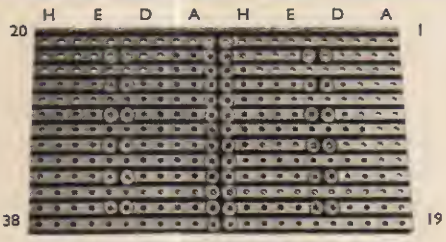

Fig. 2b. Veroboard with the strips cut to show the T-Dec wiring pattern

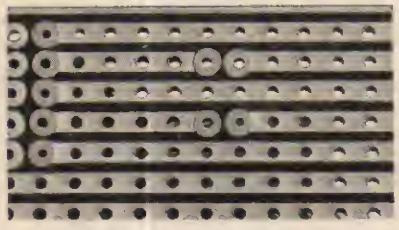

Fig. 3a. Veroboard strips prepared for the first project

Fig. 3b. The finished metronome project

Fig. 4a. Plain perforated s.r.b.p. sheet with copper wire connections and soldering pins

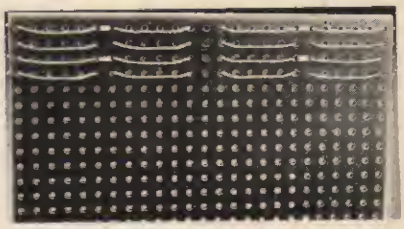

Fig. 4b. Plain s.r.b.p. with the connecting wire hooked through the end holes in the rows

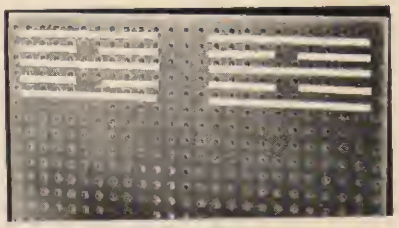

Fig. 5. Cir-kit adhesive copper strips fixed between rows of holes on plain perforated board

layout the appearance would be as shown in Fig. 2b.

The strips can be cut with a special spot-face cutter, a $\frac{1}{8}$in drill, or a sharp knife.

Before cutting any strips, study the project circuit layout in the practical article to see how many breaks are really necessary. If only one half of the T-Dec is used none of the centre breaks will be necessary. However, if at a later stage you decide to assemble another circuit on the same board, the copper around the centre columns of holes, between column H on the left and A on the right, will need to be cut. Before doing so, check to see if any links are needed between left and right, in which case leave the appropriate strips uncut.

Next look at the project layout to see if any connections are needed between column D and column E. Having established those required cut all the other copper strips between D and E to form the groups of four holes (Fig. 3a).

Now the columns and rows of holes can be numbered exactly as for T-Dec. You can do this by laying the board on a sheet of paper and marking through each required hole in the board with a pencil. Remember that the T-Dec numbering follows that for Veroboard that has the copper side face down.

Carry out the assembly and soldering making sure that no solder bridges two or more adjacent strips. Good clean soldering is the keynote to success; dry joints will not do. Fig. 3b shows the finished project.

PERFORATED S.R.B.P. AND WIRE

The next system is simple and follows the same lines as with Veroboard, except that plain perforated board has no copper face. All connections are carried out using soldering pins and tinned copper wire; see Fig. 4a. However, do not fit wires that are unlikely to be used; this is a waste of materials and effort.

The pins can be dispensed with if the copper wire is hooked through the end holes of each row and secured with solder. An example of a typical layout is shown in Fig. 4b.

STICK ON WIRING

The third system is a development of the previous one except that the wires are replaced by self-adhesive copper strips called "Cir-kit". The method is otherwise exactly the same (Fig. 5). The narrow strip will just fit between adjacent rows of holes on plain perforated board.

PRINTED CIRCUIT

There is no reason why printed circuit board should not be used. This will require more patience by following the instructions given with the printed circuit kit. Not all kits carry instructions, so if you are unfamiliar with printed circuit techniques try and obtain a kit that has.

It will probably be necessary to sketch out a layout of the copper pattern corresponding to the project actually being built. It is recommended that an experienced friend helps you with this as mistakes can be expensive.

This short introductory article is not intended to provide comprehensive details of using these alternative methods. Full details and instructions can be obtained from manufacturers of these and other proprietary items which are advertised in this magazine.

The project which follows can be built very easily using one of the methods described here. Future projects in the same series are to be dealt with in a similar manner.