everyday electronics

NOV. 71

15 p

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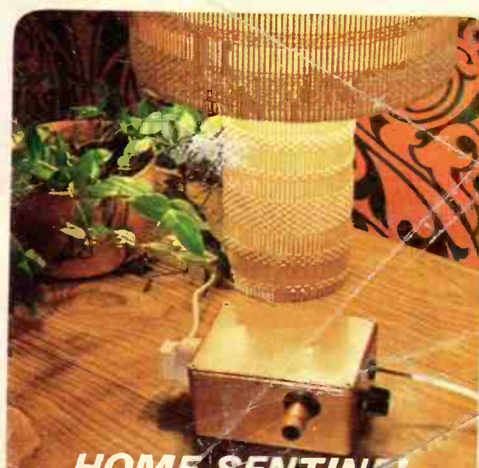

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M. L. Gayford

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Size approx 17″ x 10¾″ x 6¾″. Drive unit 13″ x 8″ with parasitic tweeter. Max. power 10 watts. 3 ohms. Simulated Teak cabinet.
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SPECIFICATION R101
14 watts per channel into 3 to 4 ohms. Total distortion @ 10W @ 1kHz 0·1%. *P.U.1* (for ceramic cartridges) 150mV into 3 Meg. *P.U.2* (for magnetic cartridges) 4mV @ 1kHz into 47K. equalised within ± 1dB R.I.A.A. *Radio* 150mV into 220K. (Sensitivities given at full power). Tape out facilities; headphone socket, power out 250mW per channel. *Tone controls and filter characteristics.* Bass: +12dB to −17dB @ 60Hz. Bass filter: 6dB per octave cut. Treble control: treble +12dB to −12dB @ 15kHz. Treble filter: 12dB per octave. *Signal to noise ratio:* (all controls at max) R101—P.U.1 and radio—65dB. P.U.2. −58dB. **R100** same as R101 but P.U.2 (for crystal cartridges) 450mV into 3 Meg. *Cross talk* better than −35dB on all inputs. *Overload characteristics* better than 26dB on all inputs. Size approx 13¾″ x 9″ x 3¾″.

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½	10%	3·3MΩ–10MΩ	E12	1·0p	0·8p
¼	10%	1Ω– 3·9Ω	E12	1·0p	0·8p
¼	5%	4·7Ω–1MΩ	E12	1·0p	0·8p
4	10%	1Ω–10Ω	E12	8p	8p

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AC127	12p	BSY56	30p	OC82	12p	2N3702	15p
AC128	12p	BSX21	25p	ORP12	48p	2N3703	14p
AD140	40p	BY124	7½p	1N4001	7½p	2N3704	17½p
AF115	20p	BYZ10	20p	1N4002	10p	2N3705	15p
AF117	20p	BYZ13	20p	1N4003	11p	2N3706	12p
BC107	10p	OA85	7p	1N4004	12p	2N3707	18½p
BC108	10p	OA91	5p	1N4005	13p	2N3708	10p
BC109	10p	OA202	7p	1N4006	13p	2N3709	11p
BFY50	22p	OC71	12p	2N4007	13p	2N3710	12p
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160V: 0·01μF, 0·015μF, 0·022μF, 0·033μF, 0·047μF, 0·068μF, **3p.** 0·1μF **3½p.** 0·15μF **4½p.** 0·22μF, **5p.** 0·33μF, **6p.** 0·47μF, **7½p.** 0·68μF, **11p.** 1·0μF, **13p.**

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250V P.C. mounting: 0·01μF, 0·015μF, 0·022μF, **3p.** 0·033μF, 0·047μF, 0·068μF, **3½p.** 0·1μF, **4p.** 0·15μF, 0·22μF, **5p.** 0·33μF, **6½p.** 0·47μF, **8½p.** 0·68μF, **11p.** 1·0μF, **13p.** 1·5μF, **20p.** 2·2μF, **24p.**

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17 × 3¾	100p	75p
17 × 5 (plain)	—	75p
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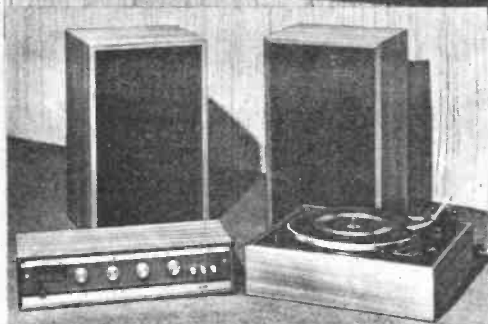

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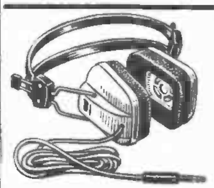

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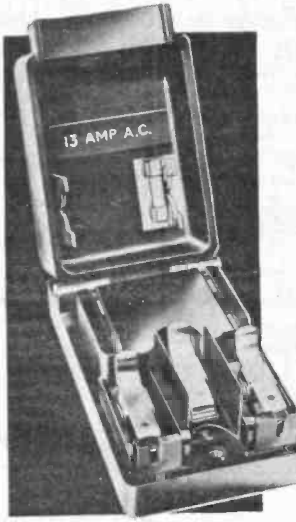

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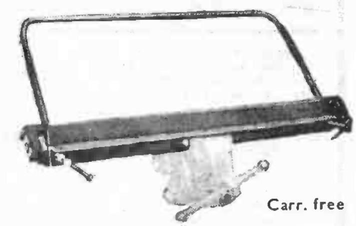

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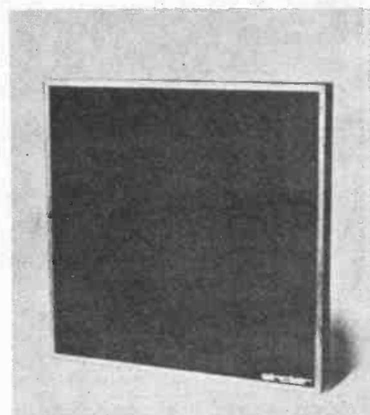

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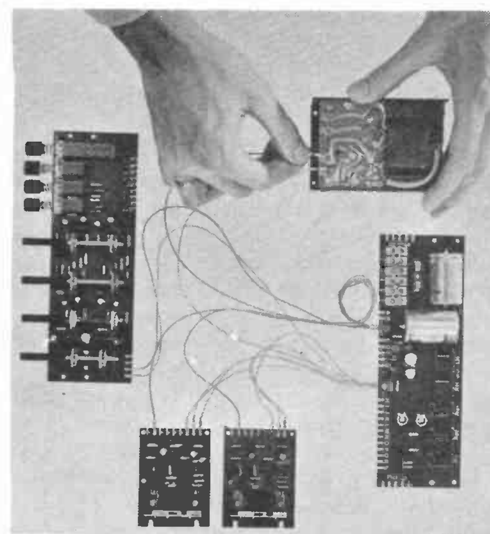

For several years now you have been able to assemble your own high fidelity system to world beating standards using Sinclair modules. We have progressively improved these technically but hitherto the method of assembly at your end has remained the same – there has been no alternative to a soldering iron. Now for those who prefer not to solder, there is an alternative – Project 605.

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Fred Bennett

Our December issue will be published on Friday, November 19

EDITOR F. E. BENNETT • ART EDITOR J. D. POUNTNEY • M. KENWARD • P. A. LOATES
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VOL. I NO. I NOVEMBER 1971

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Ward off the unwanted intruder!!

HOME SENTINEL

By Gordon M. Harvey

Your home can be "occupied" electronically whilst you are away. No elaborate setting up or wiring up required.

THE dictum that "An Englishman's home is his castle" would banish the word housebreaking from our language if only it were true. Unfortunately, there are no moats or drawbridges with "semis" so Mr. Average has to look to the home's impregnability with insurance or electronics.

Most popular burglar alarms usually involve spinning a web of wire round doors and windows, the breaking of the loop through unlawful intrusion triggering a bell alarm. The shortcomings of this arrangement are the labour of looping and the usual inadequacy of sound output of the bell alarm.

A simple deterrent like the sign "Beware of the dog" might warn off a daylight intruder but at night what better than a bedside, or hall, lamp; a sentinel that switches itself on at dusk and off at dawn to suggest occupation when the house is tenantless, particularly during summer vacations.

LIGHT SENSITIVE CELL

The transducer PCC1 in Fig. 1 is a light dependent resistor (l.d.r.) whose response to incident illumination produces a change in its conductivity or resistance. In complete darkness this resistance has a very high value which drops with increasing illumination. Both PCC1 and potentiometer R1 form a voltage divider.

Suppose the wiper of the potentiometer (R1) were fixed, then obviously the voltage that appears at the base of TR1 will vary with the amount of light falling on PCC1.

ELECTRONIC SWITCH

The succeeding stage TR1, TR2 and Zener diode D1 make up a variable sensitivity electronic switch. With light incident on PCC1 a large part of the line volts appears across R1. With R1 adjusted so that the turn-on base/emitter voltage of TR1 is about 650 millivolts this transistor conducts. Since this type of transistor saturates around 750 millivolts it is possible to control the conduction of the first stage for a particular ambient light level, by varying the "Set Level"

Approximate cost of components

£ 4·00 excluding lamp

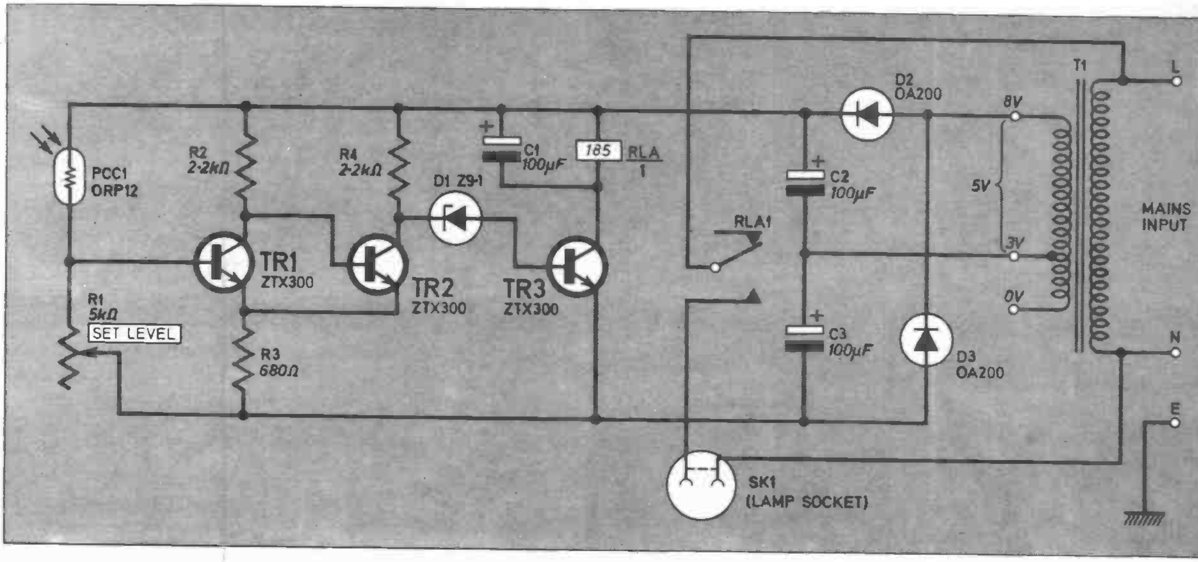


Fig. 1. Circuit diagram of the Home Sentinel. Relay is shown in position with the cell illuminated.

control R1 within these millivolt limits.

With TR1 set for least conduction the voltage at the collector is high enough to switch TR2 hard on. The voltage at the collector of this transistor then exceeds the breakdown voltage of the Zener diode D1 (9·1 volts), and TR3 conducts with consequent operation of the relay.

This is not the condition required however. The relay must be off until light to the cell is interrupted so the Set Level control is adjusted until the relay armature "falls out" with an audible click.

With no light to the cell, its resistance soars, TR1 is cut off, its collector voltage rises and the relay operates.

Components....

Resistors
- R1 5kΩ lin carbon potentiometer
- R2 2·2kΩ
- R3 680Ω
- R4 2·2kΩ
- All ±10% ½ Watt carbon

Capacitors
- C1 100µF elect. 15V
- C2 100µF elect. 15V
- C3 100µF elect. 15V

Diodes
- D1 Z9·1 9·1V 250mW Zener
- D2, D3 OA200 (2 off)

Transistors
- TR1–TR3 ZTX 300 Silicon *npn* (3 off)

Light Dependent Resistor
- PCC1 ORP12

Relay
- RLA PC2 CBB/12 6/12V operated. 185ohm coil.

Miscellaneous
- T1 Friedland bell transformer 240V Primary, 0–3–5V Secondary (Woolworths)
- SK1 2 pin lamp socket, 2A, 240V with plug to suit, grommets—½in and ¼in internal diameter (see text), 2in x ½in diameter plastic tube, tag strips, solder tag, nuts and bolts, 3 core mains lead, 3 pin mains plug with 2A fuse, 4¾in x 3¾in x 2$\frac{5}{32}$in diecast box

SENSITIVITY

Because variations in the Set Level voltages are very much magnified at the Zener diode it is possible to set the sensitivity for all kinds of ambient light conditions.

POWER SUPPLY

Since the sentinel will be expected to operate over long periods, batteries were ruled out, particularly since the total current drawn with the relay switched is in the region of 40mA.

The transformer T1 is a readily obtainable Friedland bell transformer. From Fig. 1 it can be seen that the secondary voltage tap used is 5V. Since this is inadequate for relay tripping a two-diode voltage doubler was used to raise the line volts.

One end of the selected secondary winding is taken to the common connection of C2 and C3 so that all of the transistor circuitry is fed from the two series capacitors.

Although the ripple on the line voltage is high (a characteristic of diode doublers) there will be no adverse circuit effects.

The capacitor C1 is included to prevent any relay chatter caused by such influences.

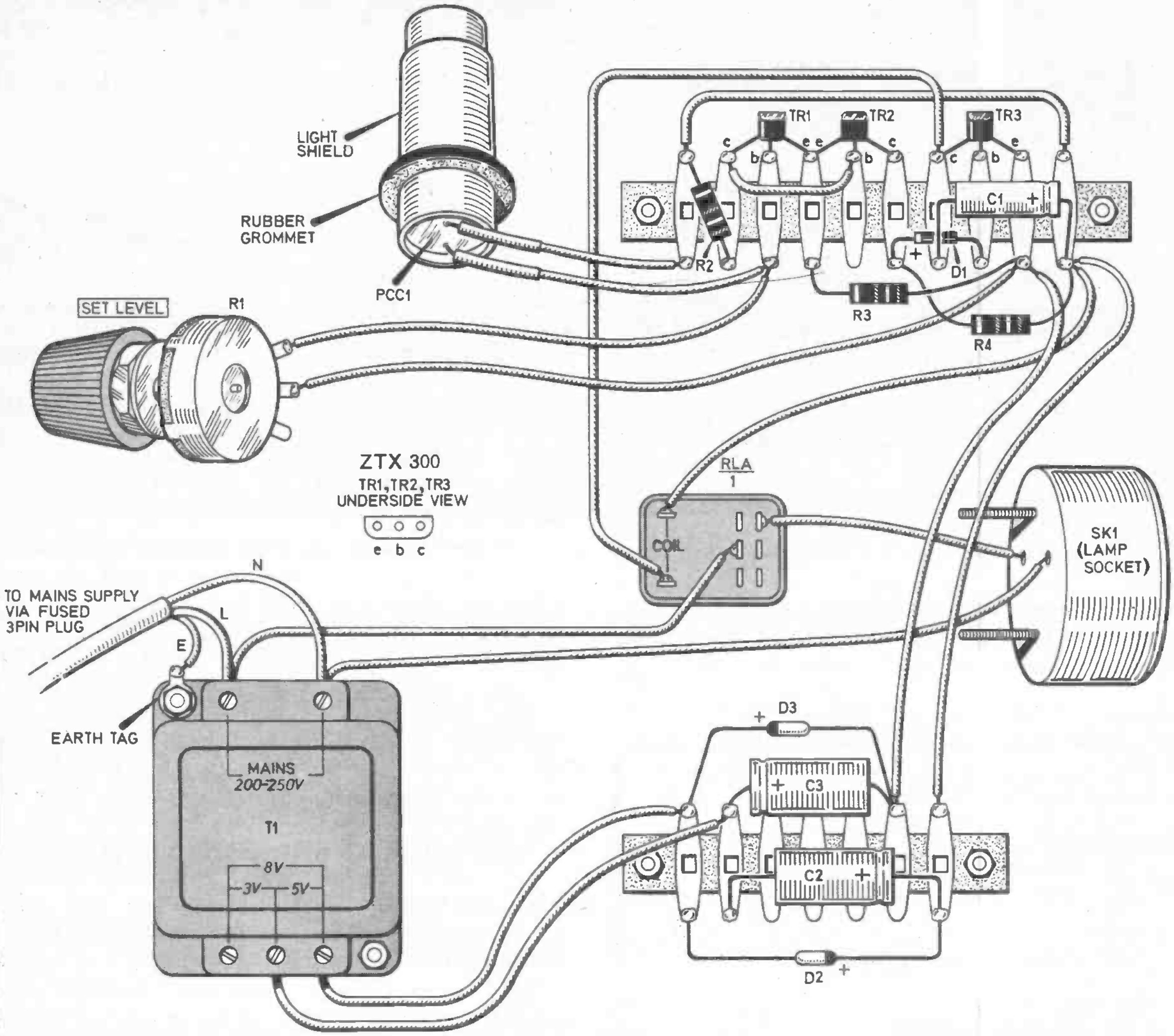
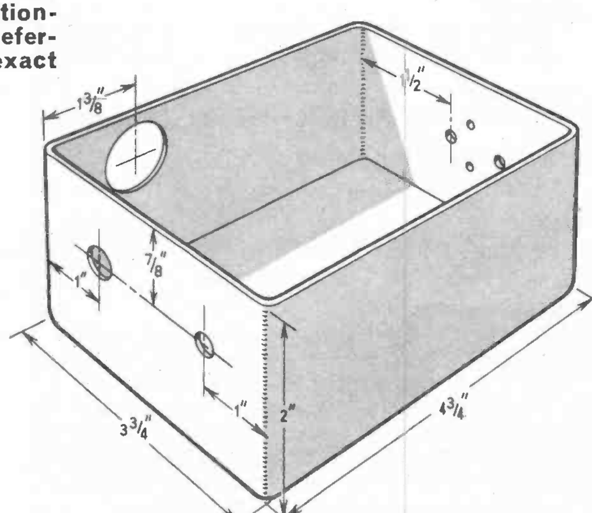
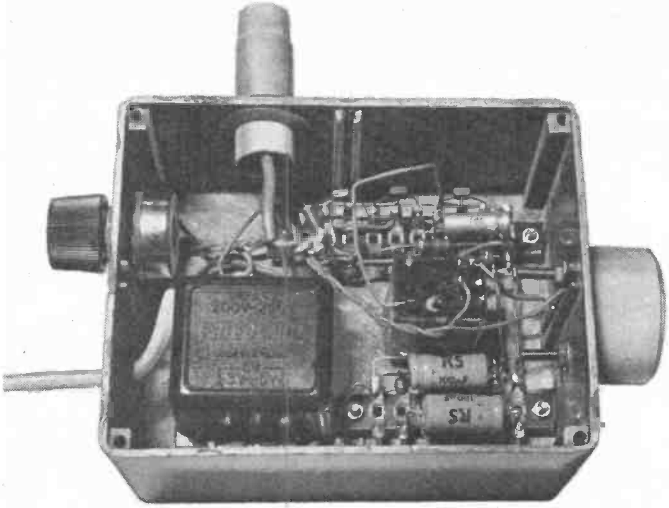


Fig. 2. Wiring diagram of the Home Sentinel, the components are shown roughly in relationship to their position in the discast box. Reference to the photograph will show their exact positions.

HOME SENTINEL
CONSTRUCTION

Fig. 3. Case drilling details.





CONSTRUCTION

Most of the small component circuitry is mounted on two tag strips as shown in Fig. 2. When mounting the semiconductors be quick with the soldering iron or use a heat shunt and do not bend the leads of the electrolytics too close to their bodies.

With the tag boards assembled the $4\frac{3}{4}$inch x $3\frac{3}{4}$inch x $2\frac{5}{32}$inch diecast box should be drilled. There is nothing electrically critical in the arrangement of the parts in the box, simple drilling details of the prototype are given in Fig. 3.

When cutting the hole for the light cell, start by making a hole of about $\frac{1}{2}$inch diameter. Carefully shape this with a half-round file to take a $\frac{1}{2}$inch centre diameter rubber grommet. This grommet must firmly retain a 2inch length of plastic tube which in turn retains the light cell at the box end.

The tube itself can be a lip salve or lipstick container, obtainable from any chemist. This tube provides some directional sensitivity to the Sentinel.

First bolt on the tag strip component assemblies using insulating bushes to prevent contact to case of any of the tags. Feed the three-core mains lead into the box using a $\frac{1}{4}$inch internal diameter rubber grommet to prevent cable chafing.

Wire the transformer before assembly, making sure there are no bare wires to the power supply tag strip.

Araldite proved an effective fixative for the relay.

LIVE WIRE PRECAUTIONS

When baring the leads to the lamp socket SK1, make absolutely certain that no wire is touching the chassis. If a three-pin plug, fused at 3 amps, is used at the supply and the box suitably earthed as shown there is no likelihood of danger.

Finally, assemble and wire R1 and the cell. Do not push the latter hard into the tube or you might fracture the leads. Remember, any spurious effect back-lighting on the cell will be cancelled by the lid when this is finally fitted. The entrance to the tube should be coated with matt black paint or Indian ink.

TESTING

Temporarily place the lid on, then sight the cell tube towards a bright source of light—a window, a lamp, etc. Now rotate R1 until the relay armature is heard to pull in. Next gradually back off the Set Level control at the same time passing your free hand across the cell.

It should be possible to switch the relay as the light entering the tube aperture is momentarily blocked. A little bit of experiment with the control and more removed hand waving will demonstrate the sensitivity of the device.

SETTING UP

For switching on and off a table lamp at dusk and dawn, first site the sentinel with the cell pointed directly at the nearest window. To simulate the switching condition there is the simple expedient of opening and closing the curtains and adjusting the Set Level control for correct working.

Since the relay contact ratings are 2 amps at 240 volts. A mains lamp with a bulb up to 200 watts can be used with complete safety. ▣

COMPONENT REFERENCES

Given below is a list of component references used in circuit diagrams and components lists appearing in EVERYDAY ELECTRONICS. The list does not cover all designations, only those used in this issue.

In general, we are following the latest British Standards recommendations (as per BS 3939), but there are a few exceptions.

B	battery
C	capacitor
D	diode
LP	lamp
LS	loudspeaker
M	motor
PCC	photo conductive cell (l.d.r.)
R	resistor
RL	relay (RLA_1 relay "A" having one set of contacts—"RLA1")
RPH	replay head
S	switch
SK	socket
T	transformer
TR	transistor

No more fights with the Snap Sequence Indicator! Press your button first and your opponent is blocked. Can be used for reaction testing games and quiz games.

In some games, such as snap and question games, it is necessary to know which person or team is first. If recognition of pairs or readiness to answer is declared by voice, it is not always clear who was first.

The device described here was built to avoid this difficulty. Its simple electronic circuit is arranged so that when one person has pressed a button, a later response by the opponent is blocked; and an indicator lamp shows who was first. The circuit automatically returns to its original condition when the push-buttons are released, and hence is ready for the next turn.

CIRCUIT OPERATION

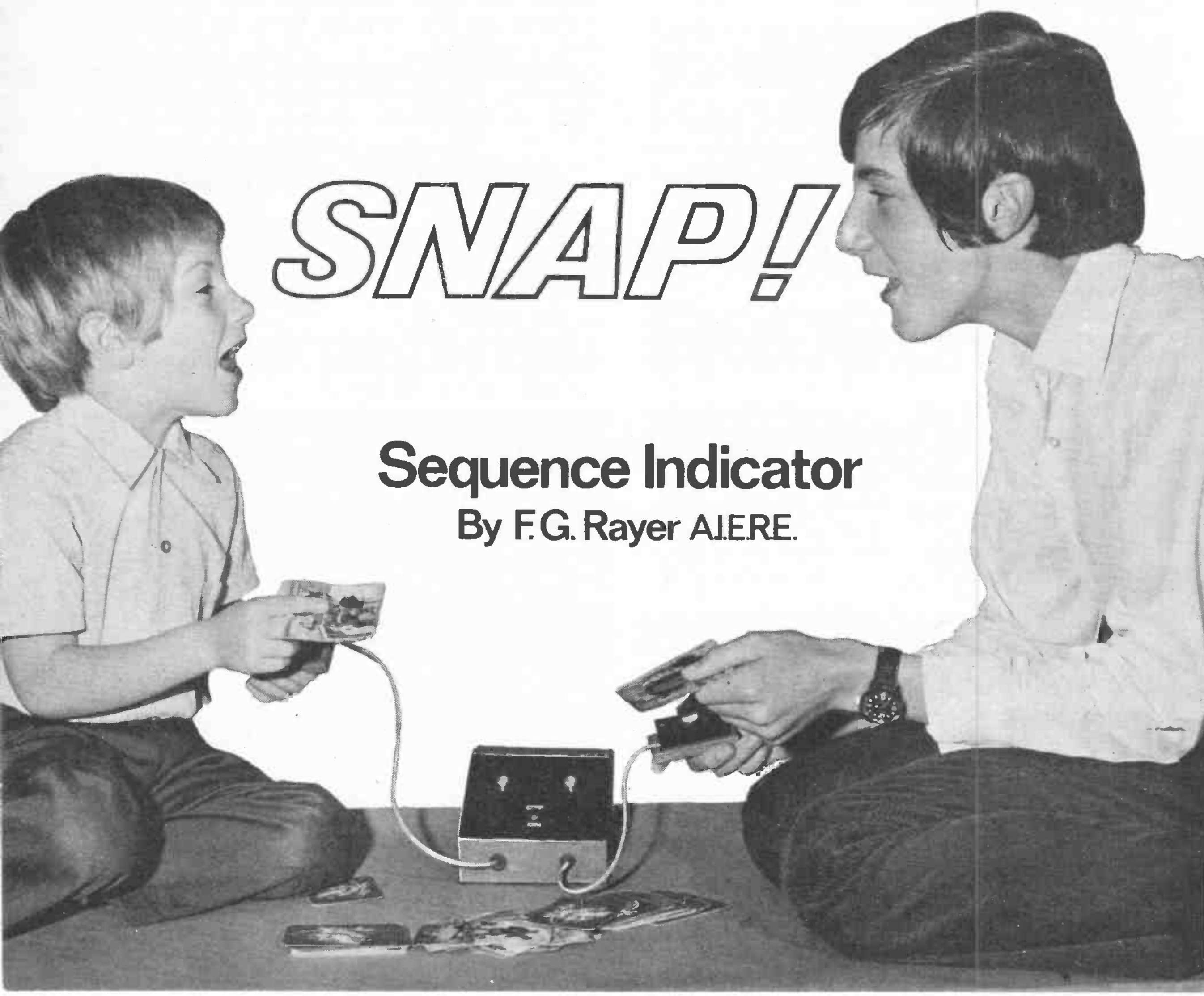
The complete circuit is shown in Fig. 1. Transistors TR1 and TR2 act as switches for LP1 and LP2 that are in the collector circuits of the transistors.

One push-button is operated by each player and S3 is the on/off switch. Normally S1 and S2 are open and the transistor bases are held off and no collector current flows.

If S1 is now pressed, connecting R1 to the base of TR1, this shifts TR1 into conduction so that the indicator lamp LP1 lights. Almost the whole supply voltage is dropped across LP1, so that the supply voltage between the negative line and TR1 collector, R3 junction is very small. If S2 is now closed, TR2 will not be turned on since its base will not be taken positive enough. Hence LP2 will not light.

Should S2 be closed first, LP2 lights and LP1 cannot be lit.

Push-buttons S1 and S2 are bell-pushes, suitably placed for each competitor. The button is pressed and held down, to show recognition of pairs or readiness to answer. LP1 and LP2



SNAP!

Sequence Indicator

By F.G. Rayer A.I.E.R.E.

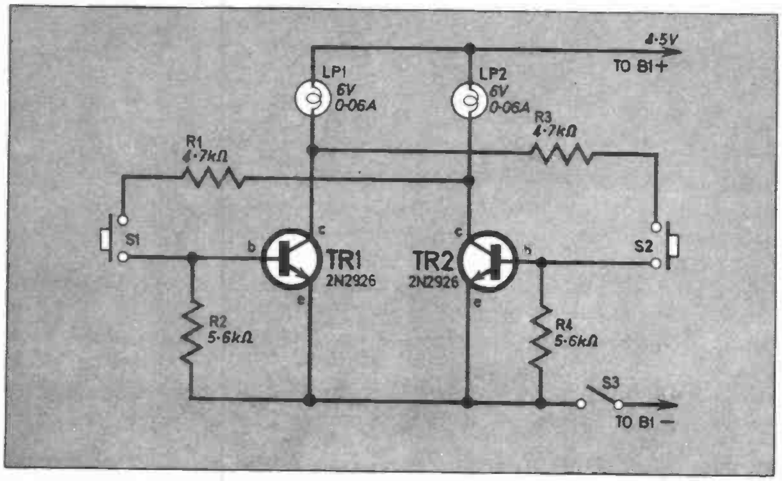


Fig. 1. Complete circuit diagram of the Snap Sequence Indicator.

Approximate cost of components

£1·00 plus case

are low-consumption bulbs (0·06A 6V) which limit collector current to a low value.

When both pushes are released, the circuit returns to the normal condition.

CONSTRUCTION

The limited collector current means that small silicon transistors may be used and hence all components except the lamps and switches may be mounted on part of the Veroboard enclosed in this issue. Fig. 2 shows the layout and wiring and the following article explains how to use the Veroboard.

The complete unit is housed in a small box, ours was a wooden box made up for the job but almost any small box will do. Holes are cut for the two indicator lamps (LP1 and LP2), the on/off switch S3 and the wires to S1 and S2.

The Veroboard mounting hole can be marked off inside the case through the board before components are mounted and the hole drilled ready to take the Veroboard. The lamps, switch and grommets, for the leads to the push switches, can be fitted and the battery can be mounted. The finished board can now be mounted, making sure that the mounting screw does not short any components. Fibre or nylon washers under the board will prevent the nut from touching any strips. The connecting leads can be cut to the required length and the remaining components connected up.

PUSH BUTTONS

Each push-button is a surface-mounted bell-push of the inexpensive type which does *not* take an internal bulb. The pushes are mounted on small wooden blocks.

Components....

Resistors

R1 4·7kΩ
R2 5·6kΩ
R3 4·7kΩ
R4 5·6kΩ
All ¼W±10% carbon except where stated.

Transistors

TR1 2N2926 Silicon *npn*
TR2 2N2926 Silicon *npn*

Lamps

LP1 0·06A 6V bulb and holder
LP2 0·06A 6V bulb and holder

Switches

S1 S.P.S.T. push button (bell push)
S2 S.P.S.T. push button (bell push)
S3 S.P.S.T. toggle (on/off)

Miscellaneous

B1 4·5V torch battery
Veroboard: 6 holes by 7 strips 0·15in. matrix (part of this month's give-away)
P.V.C. covered connecting wire (7 strand coloured)
9 B.A. fixings. Grommets. Case (approx. 5in. x 4in. x 4in.)

For team games, leads to S1 can run to two or more pushes connected in parallel, and leads to S2 similarly to the required number of pushes.

Always check for dry or badly soldered joints, incorrect wiring and polarities before testing, as it is all too easy to damage a transistor if it is wired up wrongly or the supply is connected wrongly.

CASE

A suggested case is shown in Fig. 3. This can be made of wood, varnished, painted or covered in cloth. Fig. 4 shows how the board is connected to the components mounted in the case and to S1 and S2.

The wires used to connect the circuit to S1 and S2 are twin core mains or bell wire. Small notches can be cut in the sides of the bell pushes so that the wires can be fed out.

In the prototype the battery was soldered to the leads but small paper clips can be used as connectors if soldered to the wires. This makes for easy replacement of the battery.

If a metal case is used it is a good idea to cover the metal area under the component board with insulation tape.

GAMES

The device can be used in any game where a score is obtained for the first correct answer. Questions may be put by a "question master" armed with general-knowledge, arithmetic, or other questions and answers suited to the age of the contestants.

For snap games, which are really a test of the competitor's speed of reaction, cards may be dealt by the competitors, or by a third person.

Reaction can be to any prearranged "sign"—a specific number on a thrown dice, head or tail of a coin, a flashed light, buzzer, etc. In all cases mistakes have to be counted as a penalty.

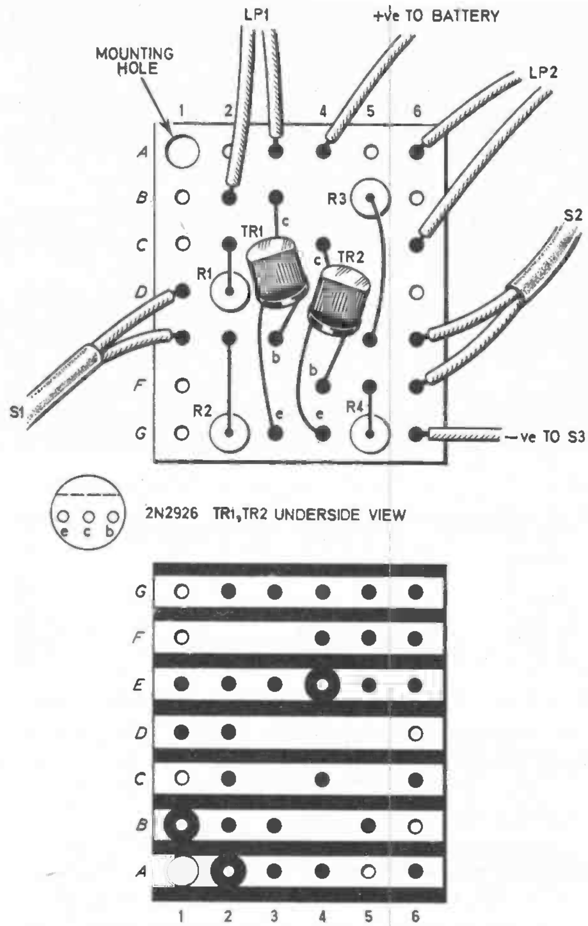
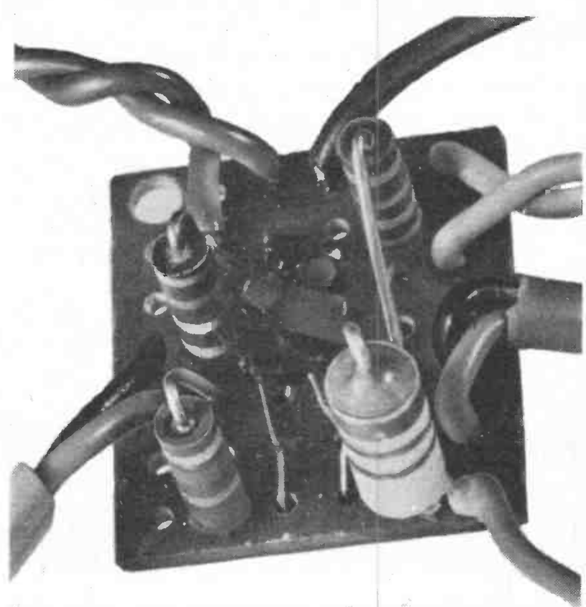


Fig. 2. Veroboard layout and wiring diagram showing both sides of the board and connecting wires.



CONSTRUCTIONAL SNAP! DETAILS

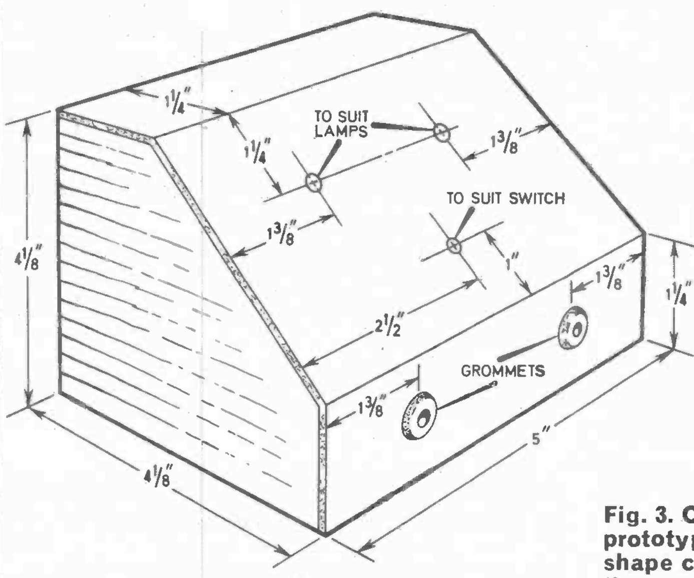
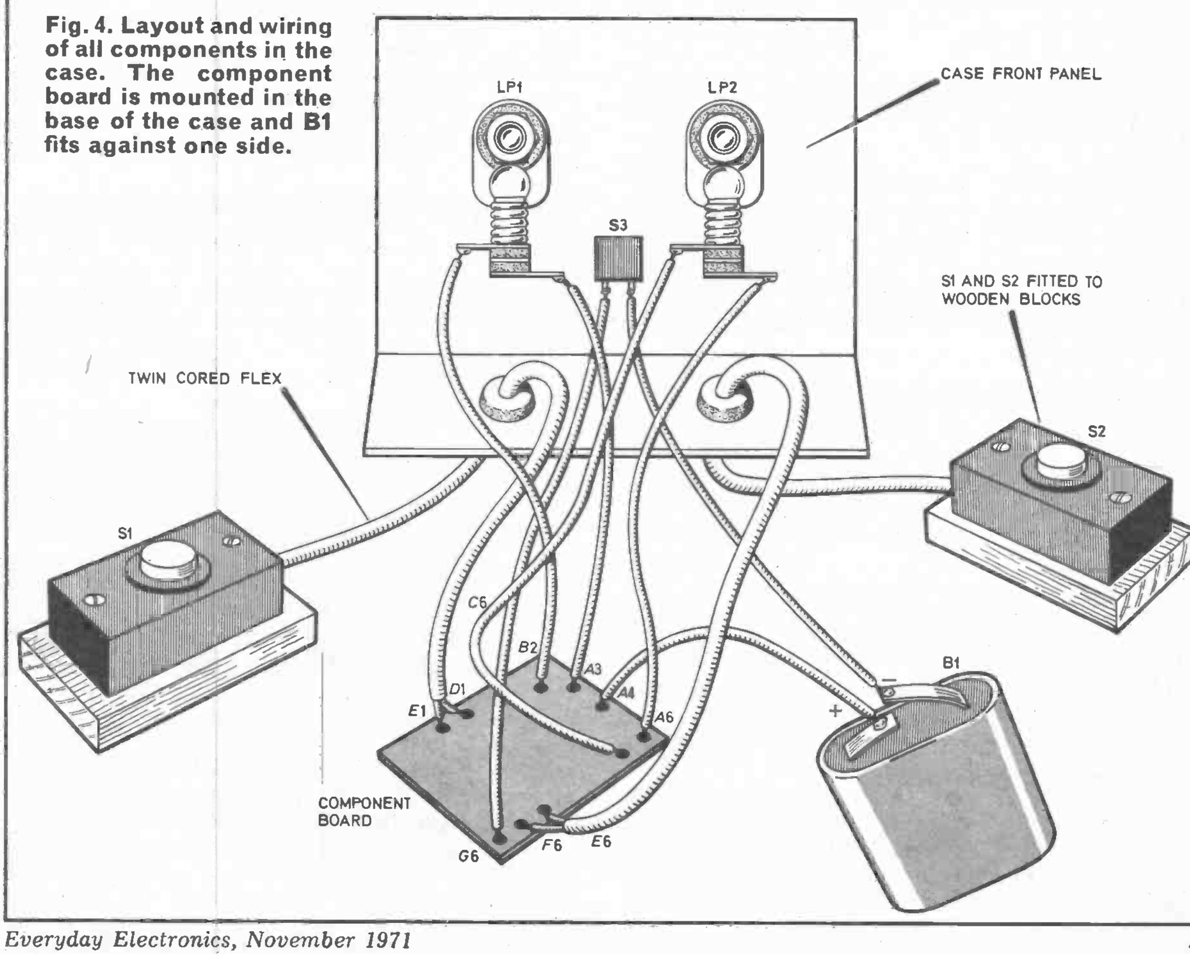


Fig. 3. Case details, this is the design of the prototype case made in wood. Almost any shape case could be used provided that all the components will fit inside. The back of the case should be removeable to facilitate battery replacement.

Fig. 4. Layout and wiring of all components in the case. The component board is mounted in the base of the case and B1 fits against one side.



USING PRINTED WIRING BOARD

The piece of printed wiring board given away free with this issue can be used to make two of the projects featured. This article shows you how to use the board.

THE series of photographs shows how to use the printed wiring board (Veroboard). These show the *Snap Sequence Indicator* being constructed. A picture showing the cutting of the board is featured in (a) although some constructors may prefer to use the board as it comes. If you are going to construct both the *Snap Sequence Indicator* and the *Windscreen Wiper Control,* both in this issue, you will need to cut the board as indicated.

Once this is done drill any mounting holes or special holes for component mounting as required and clean-up the board where necessary using a file and large drill to take off the burrs (b). The component and wiring diagrams in the relevant article show both sides and have numbers and letters in line with the holes for easy hole identification, when referring to the unit wiring diagram. The underside view shows the breaks in the strips and the filled-in holes indicate where wires pass through the holes. Comparing the top and underside views will soon make this apparent.

Now that the board is mechanically shaped the breaks in the copper strips must be made in the correct places (c). This can be done with a spot face cutter (sold especially for the job) or with a metal twist drill of say $^3\!/_{16}$inch diameter held in the hand as shown. Check carefully that the breaks are right across the strip and in the correct place.

FITTING COMPONENTS

Next mount all the components (except any transistors and diodes) and wire links on the board, holding them in place by their leads, bent over as shown (d). Check that all components are mounted in the right positions and that any polarities are correct, e.g., on electrolytic capacitors. Now cut off their leads so that only a small part is bent over to hold the components (e) and solder this part to the copper strip (f).

If you are new to soldering we suggest that you look at the *Teach-In* beginner's series and follow the soldering exercises before attempting to build any electronic devices.

Having soldered the components in position, check the joints and make sure that no solder has linked two adjacent copper strips. Next cut some lengths of p.v.c. covered stranded wire for the connected wires. It is helpful to use different colours for each wire for identification purposes, keeping red and black for battery positive, and negative and blue, brown and green for mains neutral, line and earth wherever possible.

Try and estimate the connecting lead lengths required from the layout drawings and photographs and cut them with plenty to spare. Strip about $^3\!/_{16}$ inch of the insulation of one end of each wire, using strippers or a pen knife. Twist the strands together and tin the ends. Push the tinned part through the required hole, bend the end over and solder the wire to the strip as before. Check the positions and the soldered joints as you did with the components and twist any pairs of wires together.

Photographs showing how to use Veroboard.
(a) Cutting board.
(b) Cleaning up cut edge and deburring holes.
(c) Making breaks in strips.
(d) Mounting components—all except semiconductors.
(e) Cutting leads.
(f) Soldering leads.
(g) Soldering in the transistors.
(h) The completed board.

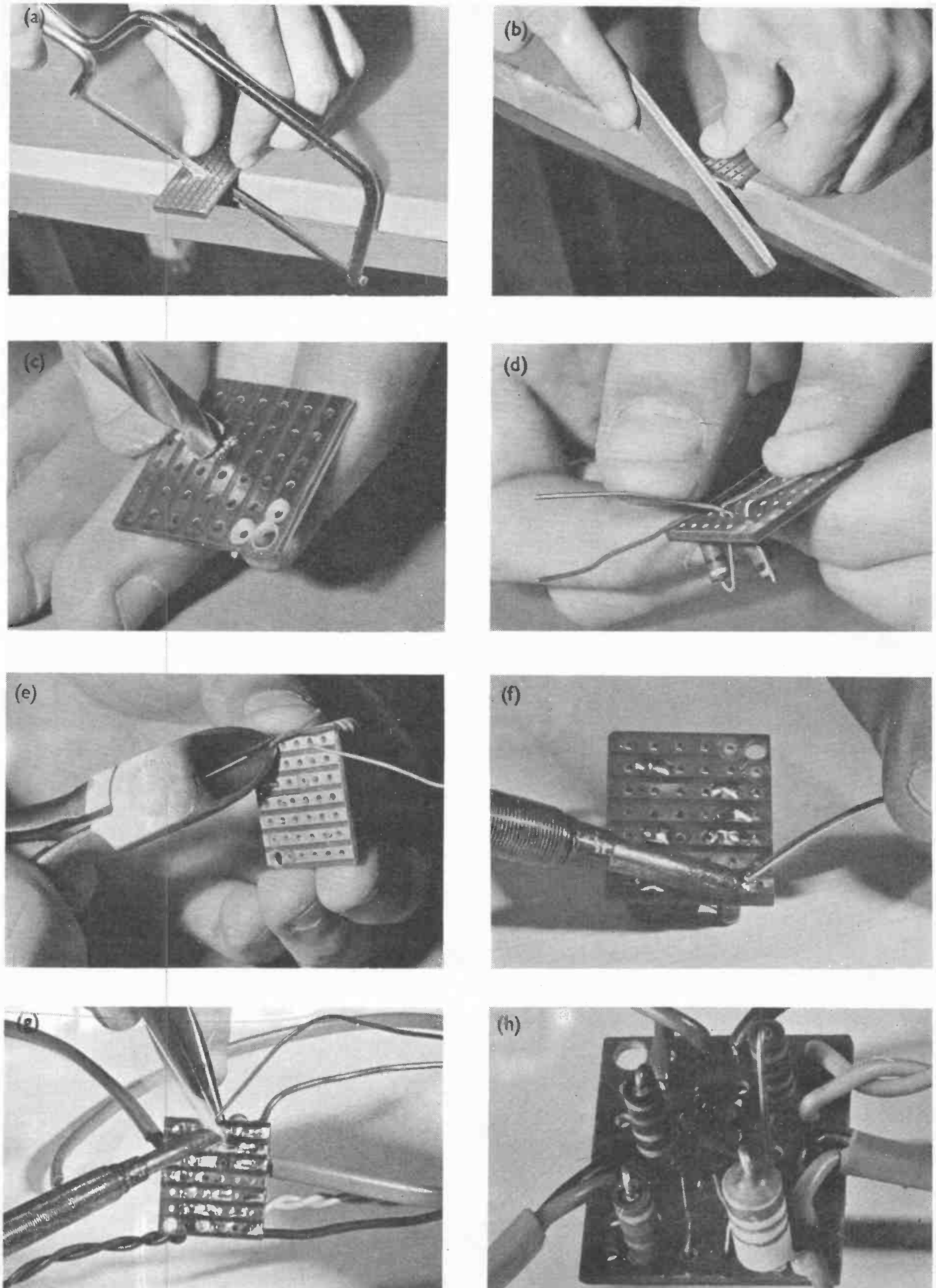
SOLDERING SEMICONDUCTORS

Finally, the transistors and diodes can be mounted and the board checked carefully. When mounting germanium transistors and diodes you must always use a heat shunt to protect them from the heat of the soldering iron and it is wise to carry out this practice when mounting silicon devices also.

The heat shunt, which can be a pair of long nosed pliers or a proper shunt sold for the purpose, is held between the component and the joint to be soldered, on the lead to which the soldering is being carried out (g). Keep the shunt on the wire until the joint has cooled down before transferring it to the next lead to be soldered.

Transistors and diodes are mounted on the board and soldered in the same way as other components—checking position and polarity before cutting the leads and checking joints after soldering.

Once all the components and flying leads are mounted (h) it is advisable to check the whole board against the circuit diagram, checking each joint of every component and making sure that no components link with any components or wires that they are not meant to. ▣


(a)
(b)
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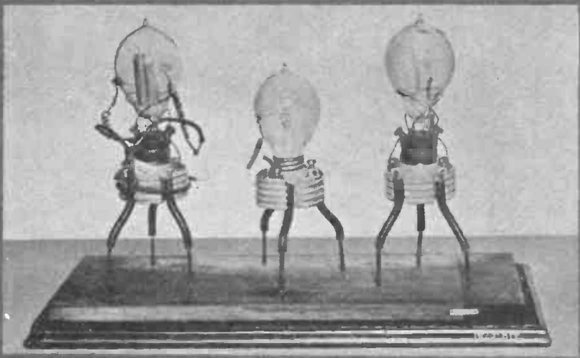
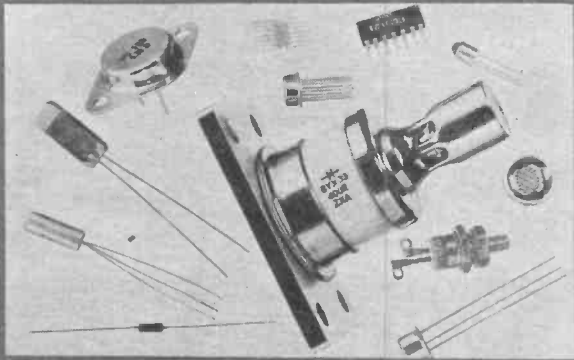
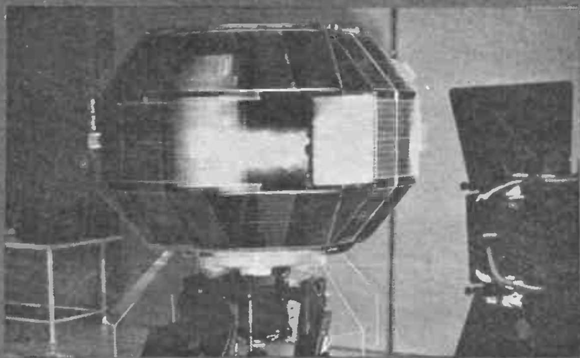
electronics







PAST & PRESENT

By Prof. G.D. Sims, OBE, PhD *(Southampton University)*

The rapidity of development of electronics and its associated industry has been almost without parallel in technological history. This article reviews the growth of the subject and describes some of the innovations to be expected in the future.

Top left: Some of Fleming's experimental diodes from around 1900. It was from experiments with such diodes that he discovered the rectifier effect about which he wrote to Marconi "it may become very useful" *(Marconi)*

Bottom left: G. Marconi posing at Signal Hill, Newfoundland, in 1901 with the instruments with which he received the first wireless signals across the Atlantic from Poldhu, Cornwall.

Top right: A selection of modern semiconductor devices. The large diode in the centre is capable of passing 250 amp—compare this with Fleming's experimental diodes on the left *(Mullard)*

Bottom right: The first all-British technology satellite, Black Arrow, X3, shown recently under test to confirm the solar cell power output and the power conditioning system *(Marconi)*

In the year 1883 Thomas Edison had become interested in the blackening of the envelope of electric lamps resulting from a carbon deposit thrown off from the filament. He was carrying out some experiments with a metal plate interposed between the glass envelope and the filament in an effort to minimise the trouble. In the course of the work he connected the plate to the positive terminal of the filament supply and noted that a small current passed in the plate circuit. He also observed that when the plate was connected to the negative terminal no current flowed. Little did he realise how near he was to a discovery which was to revolutionise life in the centuries to come.

REMARKABLE SOCIAL CHANGES

To say that electronics has revolutionised our way of life is no understatement: radio and television, the ability to communicate by telephone or radio with all parts of the world, the ability to travel safely in aircraft or at sea, the computers which deal with so many routine tasks and a hundred and one other things besides, have all combined to produce the most remarkable social changes in our way of life since the beginning of the industrial revolution.

A SCIENCE-BASED INDUSTRY

In the U.K. alone the electronics industry employs more than 400,000 people and thus is one of the major industries in the country. As one would expect in an advanced science-based industry it employs a very high proportion of highly qualified manpower, indeed more than 14·7 per cent of all the graduates employed in the manufacturing industry in this country are employed in the electronics industry, while 10·3 per cent of the nation's qualified technicians are concerned with various aspects of electronics.

Even this understates the position though, for we are continually widening the range of applications of electronic technology. More and more industries are standing in need of people with "electronic" skills. We find electronics becoming of increasing importance, for example in the medical field, in automobile engineering, in watch and clock manufacture, and even in the toy industry. Every one of these user industries also needs people with suitable interests and appreciation of what can be done with electronic devices and circuits.

In this article we shall look at the history of these developments and try to give some picture of electronics today and in the future.

THE THERMIONIC VALVE

Let us return to Edison's experiment. The phenomenon that he had observed and others like it had excited the interest of J. Ambrose Fleming (then Professor of Electrical Engineering at University College, London) and in a paper given to the Royal Society in 1890 Fleming appeared to have solved the mystery. More significantly, however, he had observed that by feeding the lamp from an alternating current supply, rectification (the process of converting alternating to direct current) had occurred.

Fleming, however, was a very busy man and also perhaps one who did not always see the immediate applications of the things on which he was working. Fourteen years, therefore, elapsed before he filed his momentous 1904 patent with which the thermionic valve found its first public announcement.

The actual detector on which he performed the experiments which were the subject of the 1904 patent, was one of these earlier valves mentioned in 1883 which he had stored away over the intervening period. He observed that the direct current, which passed through the valve was related to the amount of radio frequency power applied to it, and hence was born the rectifier principle, which remains one of the corner-stones of electronics even today.

In a famous letter to Marconi he wrote of his discovery and added as an afterthought "I have not mentioned this to anyone yet as it may become very useful!" Little did he know . . . !

ENTER THE TRIODE

Somewhat later, Dr. Lee de Forest found that by interposing a grid between the filament and the plate in the valve he could control the amount of current flowing. This was a key development for the valve could scarcely be considered as a versatile device at all, until the current could be controlled.

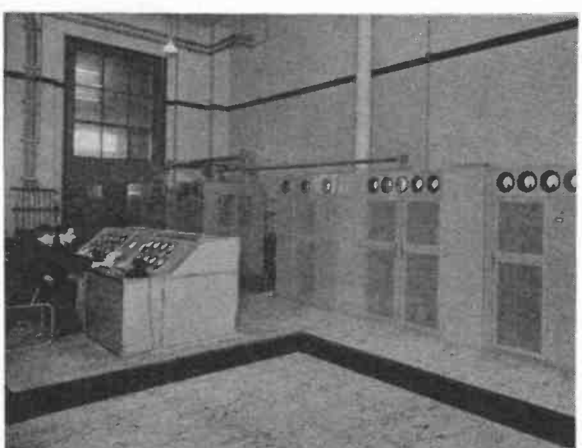
The first successful triode valves thus operated around 1906 and the first really useful oscillators, based on these principles, followed in 1913 as a result of almost simultaneous discoveries in Britain, Germany and the United States of America.

With the thermionic valve we had the ability to amplify small radio signals and the principle of amplification is still fundamental to almost all electronics systems—for whether we are trying to amplify a small signal transmitted from a distant point to a level at which we can receive it intelligently, or whether we are trying to pick up a signal, for example from a weak radio star (for many stars, both visible and invisible, emit radio waves) or from an artificial satellite, the principle is the same.

WIRELESS COMMUNICATION

As early as 1900 Marconi had conceived the idea of trying to establish wireless communication between England and the Continent of America. He did not at that time, of course, use thermionic valves as Fleming had not yet invented them, though Fleming, nevertheless, acted very much as Marconi's adviser in the

The television transmitting antenna, used for the first ever public television service in 1936, at the B.B.C.'s Alexandra Palace station *(Marconi)*



Original 1936 television transmitter at Alexandra Palace. The equipment cabinets and console look reasonably modern even by today's standards *(Marconi)*

design of his transmitter (which incidentally needed a 25 h.p. oil engine to drive it!).

With the possibility of wireless communication established, therefore, and with the necessary "electronic tools" now available, the development of radio communications was inevitable.

The first world radio broadcast took place in 1910 and included a performance by Caruso from the Metropolitan Opera House, New York. The "Titanic" disaster of 1912 first brought to the attention of the public the potential use of radio at sea; and the first celebrity broadcast in England on June 15th of 1920 by Dame Patti Melba commanded a fee of a thousand guineas, an astronomical sum of money at that time! Later in 1936 the first serious television service was established in England by the B.B.C., and much of the pattern of future development was thus determined.

Up till this point and a little beyond, electronics had been a mixture of scientific curiosity and amusing diversions, for although it had brought about the demise of the Victorian musical evening, by providing an alternative source of entertainment, its other social effects had not been of great significance!

It is true that radio at sea had made steady headway and that the inclusion of periodically spaced amplifiers in telephone cables had made trunk telephone services possible, but we had not yet encountered the major developments which were to fashion the shape of electronics as we know it today: the transistor was as yet undreamed of and the computer had yet to make its impact.

COMPUTERS

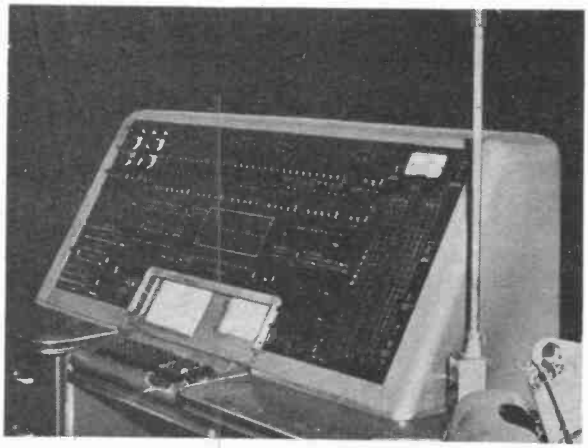
Although the first computer, Babbage's analytical engine, was designed in 1834, it was never built, for difficulties with finance and, in particular, the enormous cost of cutting the gear wheels which constituted the "thinking" part of the machine were prohibitive. It was only the ability, which electronics gave us, to produce systems which could "think" which made the computer a practical possibility.

Modern computers almost invariably work in the binary system of arithmetic. In place of the ten figures necessary in the decimal arithmetic system only two are needed, a 0 or a 1, and these can be simply represented in electronic terms by using an "electronic switch" so "biased" as to either allow a pulse of current to flow, or to inhibit it.

Clearly a system which can differentiate between two symbols must be capable of making a decision between them and can therefore make the "yes" or "no" decisions to which all of our thinking processes can in the last resort be reduced. We shall return to the subject of "machines which can think" later and also to the more general use of the "digital" electronics which they involve.

A SPACE PROBLEM!

The first electronic computers to be built used thermionic valves and it soon became apparent that powerful as even the early computer was, the time would soon come when we needed machines of even greater capability.



The world's first commercial data processing computer, completed in time for the 1950 U.S. Government population census. Large racks of equipment not shown in this photograph house the computer, the console being the data input and control point. *(Univac)*

To build these with valves presented problems —moreover it had been calculated that, for example, a valve machine, which could perform the sort of complex operations which the brain does, would require so many valves that the heat dissipated in them would require something of the size of the Chicago River to carry away waste heat. Further the machine concerned would be something like the size of the City of Chicago anyway.

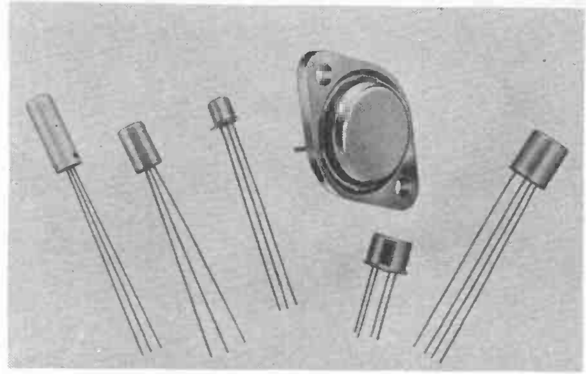
Clearly such a machine could never be produced. The thermionic valve had many disadvantages—it needed relatively high voltages; it tended to be unreliable because its hot cathode had a limited life; it used a lot of power and because it was often inefficient, it wasted a lot of energy, and it was moreover bulky and fragile. Not only, therefore, was it expensive to run but the problem of disposing of the waste heat in a large system was considerable.

Was there another solution? There was, but we had to wait until 1950 for it to be found!

THE TRANSISTOR ERA

Semiconductors were, in fact, used as long ago as 1906 by Pickard, who found that the contact between a galena crystal and a tungsten whisker would produce rectifying action. However, it was only after the Second World War that transistor action was first observed by Bardeen and Brattain at the Bell Laboratories in the United States of America. Using three-point contacts on a semiconductor they found that they could produce amplifying effects similar to those produced in thermionic valves.

Here at last seemed to be the answer to all of the problems which the valve presented—the transistor was not only small and dissipated very little power, but it would work off low voltages—no longer did we need 250V power



A selection of semiconductors, the development of which was to mean the demise of many valves. Small size, reliability and low voltage operation are the advantages of semiconductors *(Mullard)*

supplies, 6V would be quite adequate.

The technological problems concerned with transistor manufacture were not easy to overcome; the purity required of the semiconductors was challenging, and in the early days only germanium could be prepared to a standard which would allow transistor action to take place.

Further it was soon realised that the point contact transistor was not sufficiently robust for use in practical systems and the formidable task of developing the junction transistor was embarked upon. This device in due course became both reliable and robust and very soon suitable techniques were found for the purification of silicon which was a much better material in which to fabricate devices than germanium.

Not only did the use of silicon enable active devices with better rectification characteristics to be made, but these devices operated reliably over a much wider temperature range. Almost imperceptibly we were approaching the threshold of yet another revolution.

Submerged repeaters being finally assembled. In 1962 when this picture was taken, the transistor had made improvements to our communications systems by its employment in equipments such as these repeaters *(S.T.C.)*

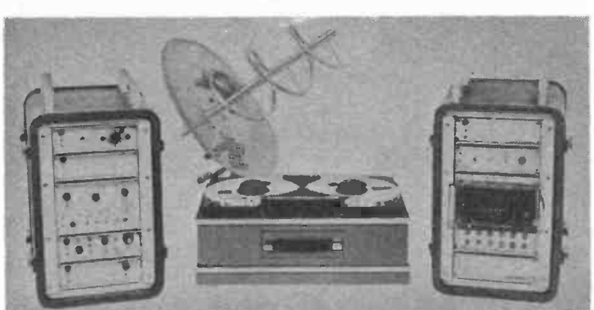
The first automatic colour television camera introduced in September 1970. Lengthy alignment and colour balancing routines necessary with previous cameras have been replaced by fully automatic corrections made by a miniature computer built into the camera channel *(Marconi)*

TRANSISTOR PROBLEMS

Transistors could do all that valves would do (for low power applications at any rate) and they were, moreover, possessed of the advantages which we have already enumerated—small size, low voltage operation and longevity. Surely the electronic engineer could ask no more!

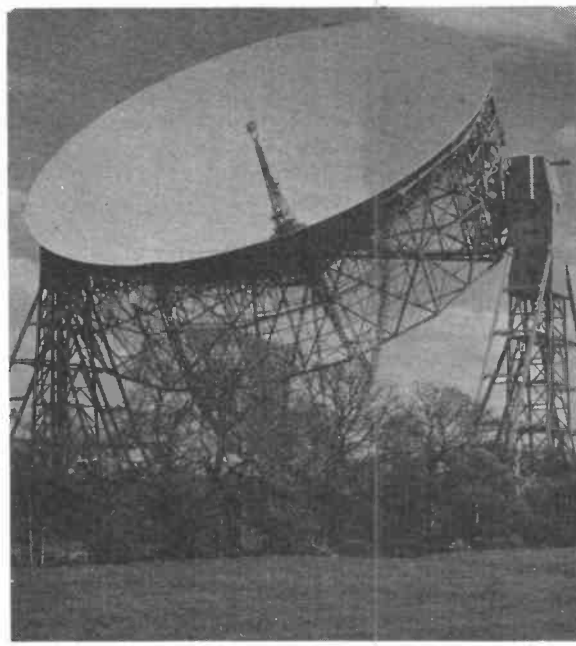
For a while he was content and the new properties were used to realise bigger and faster computers, to produce more compact instrumentation, artificial satellites, and in due time to improve our telephone systems and communication systems generally. The transistor radio made its appearance to the joy of some and the annoyance of many!

But another problem soon became apparent; if one was going to use a single transistor in a system it was no great problem but the transistor had tempted, and enabled, us to construct practical systems (computers particularly) with enormous numbers of devices all working together. Here we encountered another difficulty, for statistics were operating against us, and unless the mean lifetime of the individual devices was very long indeed, there was always a statistical probability that the most complex systems would never work because it was always probable that at least one device would be on the point of failure before the system was switched on!



The latest ship-borne telemetery receiving equipment for receiving and processing of missile performance. The units shown are, from left to right, receiver, tape recorder and helical receiving antenna and the data monitoring cabinet *(EMI)*

We needed even higher reliability than had yet been obtained even with the best transistors. Further we were beginning to be worried by the problems which arose from the failure of the wiring connections between components.



Jodrell Bank radio telescope; electronics plays a major role in improving our knowledge of the universe. From radio signals emitted by extra terrestial bodies scientists can learn a great deal about their make up and history *(Manchester University)*

A SOLUTION

How then could we possibly reduce the numbers of connections which we had to make and which were causing our complicated systems to fail? How could we take advantage of the peculiar properties of silicon, which had made the planar transistor possible, to this end?

Acknowledgement
Photographs kindly provided by well known members of the electronics industry, as indicated in the captions.

The electronics story is continued and brought up to date in the second and concluding part of this article next month

ELECTRONIC CIRCUITS– .....IN THEORY and PRACTICE

TEACH-IN

...FOR BEGINNERS

By Mike Hughes M.A.

1 INTRODUCTION: TOOLS & SOLDERING

The purpose of this series is to give the absolute beginner a gentle introduction to both the theoretical and practical aspects of electronics. There will be no unnecessary high-falutin mathematics but where essential, simple equations will be given and explained with practical examples of their use. Most important, each stage of theory will be designed around a special table top breadboard—the Everyday Electronics Demo Deck, the construction of which will be described next month. Only commonplace components will be used, and at all times the Teach-In series will be cost conscious.

Unfortunately, like all hobbies, electronics requires some degree of expenditure. Many people are put off by stories of vast costs, but this is not necessarily a correct impression. If the experiments are carried out carefully it is possible to re-use the components several times and beginners are recommended to start by purchasing the bare minimum of tools and to make the Demo Deck.

The series is designed to run for approximately twelve months and, therefore, can be used in much the same way as a formal course. Each month the components required for the following month will be given, this will save time for those ordering by mail.

By the end of the series those who commenced as absolute beginners should be capable of understanding most of the projects to be described in this magazine. In fact there will probably be occasions when the reader may see articles on other pages which he will feel quite capable of undertaking while this series is running. This is obviously to be encouraged, because the only real way to learn about electronics is to obtain practical experience.

TOOLS

There are four essential tools which ought to be bought right at the outset (the cost of these can then be lost in the mists of time!). These are: a small insulated handle screwdriver, a pair of pliers, a pair of side cutters and an electric soldering iron. It is worthwhile spending a reasonable amount of money getting the correct tools of the right quality.

All these tools come in different shapes, sizes, qualities and prices. Different people will have different ideas as to what is best, but we will now specify as precisely as possible what one will need to carry out projects described in this series. One will need occasional recourse to a drill, hammer, file and hacksaw, but it will be assumed that these are already to hand.

A useful screwdriver, to start with, ought to have a blade width of $\frac{1}{8}$ inch and a blade length of about 3 inches. Most important, the handle should be insulated to a minimum of 1,000 volts. It is also very useful to have a slightly larger screwdriver with a $\frac{3}{16}$ inch shaft and 4 or 6 inch blade.

Tapered nose pliers are essential. It is pointless buying anything other than the small tapered variety. The jaws should be about $1\frac{1}{2}$ inches long and the overall length of the pliers about $4\frac{1}{2}$ inches. It is not essential to have insulated handles. Make sure that the pivot is strong and that there is no sideways play in the jaws; also that good steel is used preferably with a rust resistant plating.

Side cutters are a tool that most beginners think about last of all and yet, apart from the soldering iron, they are one of the most used tools. Because of this and as they are a cutting tool, it is worth paying a little more and getting the highest quality. Like the pliers they ought to be small (about $4\frac{1}{2}$ inches in length) of good quality hardened steel and preferably plated. The cutting edges should be about $\frac{1}{2}$ inch long. Again insulated handles are not essential. The photograph below shows some suitable tools.

SOLDERING IRON

There is no such thing as a general purpose soldering iron, and the experienced amateur will probably have accumulated two or three different types to cover various applications. To start with, however, a conventional electric heating element type having a power consumption of about 25 watts at 230 volts ought to be purchased. The bit ought to be not more than $\frac{1}{8}$ inch in diameter. Make sure it is a reputable make and that the bit can be changed—these wear out faster than you think! Do not contemplate any success with an iron of much higher power or the type that has to be heated on a gas stove! Another useful, but not essential, item is a good soldering iron stand.

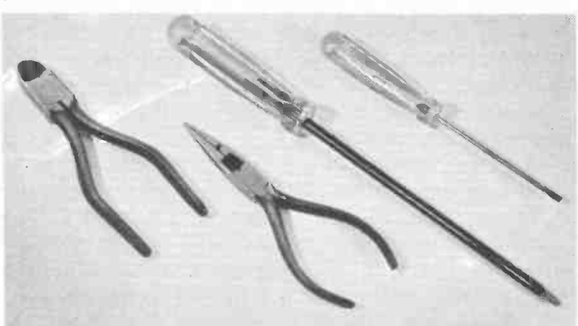
If someone is contemplating buying you a present you might be tempted to suggest an instant heating soldering gun; this type is not to be recommended for constructional work. Although they are admirable for intermittent use in servicing, they are often much bigger and heavier than you imagine and usually get extremely hot when used continuously.

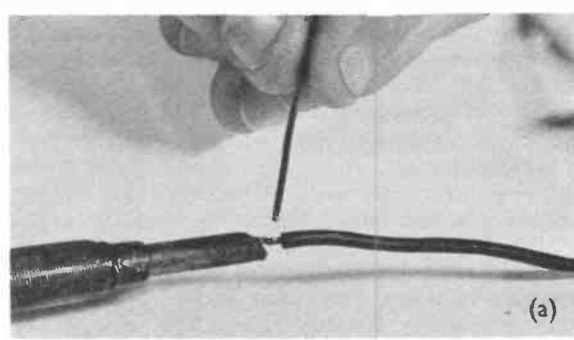
We cannot classify solder as a tool but it is always alongside the soldering iron. It is important that you use a self-fluxing solder which contains cores of resin flux, not *acid flux*. This can be bought in small and large reels but as solder contains a large proportion of lead it is expensive; nevertheless, it is cheaper in the long run to buy a large reel. You may not have much choice in the thickness you can buy, but life is made easier if you use a fairly thin gauge—22s.w.g. is excellent, but the more common 18s.w.g. is quite adequate.

SOLDERING

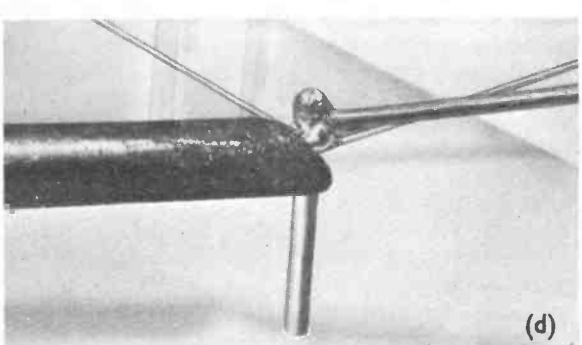
Everyone thinks he knows how to solder just as everyone thinks he knows how to dig a garden—but compare the results of your digging with that of a professional. As soldering is used to such an extent in electronics it is worth dwelling a little on the practical aspects.

The function of a soldered joint in electronics is twofold: it has to provide satisfactory mechanical support for the part and at the same time make a good electrical connection. Surprisingly enough, a great deal of metallurgical theory goes into the formulation of the correct type of solder for a given application but in most cases in electronics we are joining together





(a)



(d)

(e)

either copper, tin, gold or silver coated wires and components, and for these materials the most common solder contains 60 per cent tin and 40 per cent lead.

The principle behind soldering is similar to the dissolving of a solid material in water. If solid copper is placed in liquid (i.e. melted) solder it will dissolve and when the solder re-solidifies the resulting alloy will hold the dissolved copper in what is called a "solid solution". After a few months use, a soldering iron bit shows this effect quite dramatically by dissolving away.

TINNING

A good soldered joint is made by first "tinning" both surfaces to be joined (a). This means that starting with two bare copper wires we must allow solder to dissolve some of the surface copper of each wire and then solidify producing a graded alloy. This is done by heating up the copper with the soldering iron and touching the solder on the copper—only a small amount is needed. If the surface of the copper is dirty the solder will not make good thermal contact and hence will take some time to melt, and when it does melt will not "wet" the surface, it will form a ball, like water on dust (b).

Unfortunately, copper oxidises very easily when heated and hence even though the copper might have been clean to start with, the copper oxide formed during soldering might prevent a good wetting of the joint. To prevent this oxidation we have to use a flux and this is contained in cores running through the length of the solder, so that as the solder is applied to the work exactly the right quantity of flux is applied.

TEMPERATURE

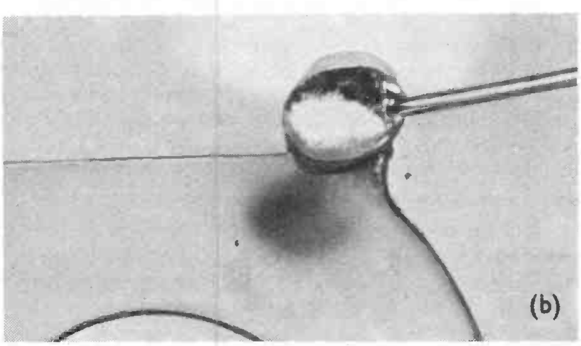
The melting temperature of 60/40 solder is approximately 188 degrees Centigrade, therefore it is essential that the soldering iron temperature is in excess of this.

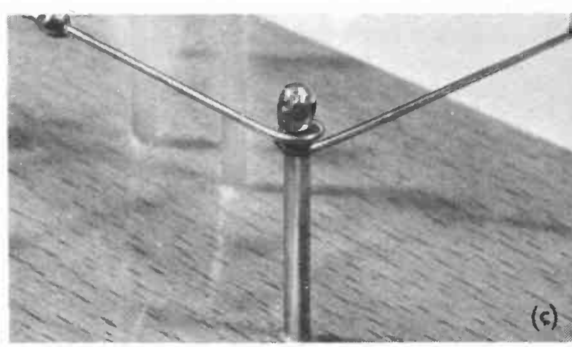
One can check, within broad limits, the temperature by the appearance of the solder on the bit. If it is of a pasty consistency, then the temperature is too low. If the flux spits and smokes excessively as the solder is applied to the bit, and after about a minute the shiny surface of the solder goes dull (this is due to the formation of oxides of the tin and lead), then the temperature is too high. The bit must be thinly tinned, but should not carry superfluous solder.

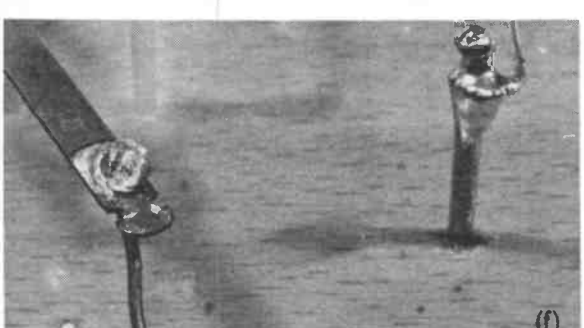
Smoke is bound to be given off while soldering is in process, this is due in the main to the resin flux burning off. For this reason it is essential that, to obtain a good joint, the solder is applied to the work while the work is being heated with the iron. Never carry solder on the bit of the iron to the work because by the time it gets to the job all the flux will have burned off and you will get a dry joint.

THE JOINT

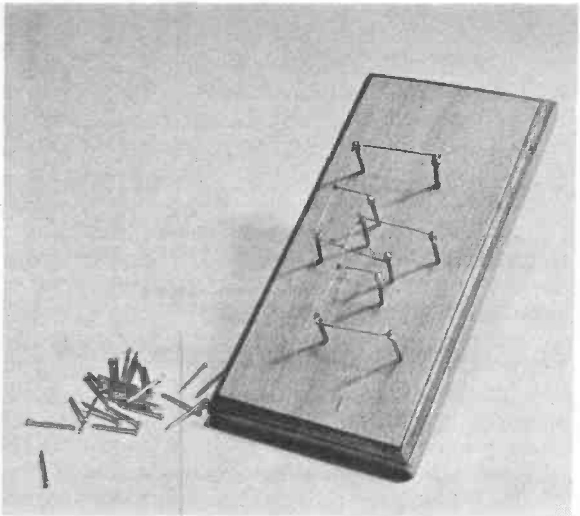
Once both surfaces have been tinned they should be placed in contact with each other—preferably allowing as large an area of contact


(b)


(c)


(f)

Photographs showing soldering technique. (a) Tinning the end of a p.v.c. covered copper wire. (b) This joint has not soldered properly because the tag was dirty and did not tin. (c) A wrapped joint ready for soldering—tin the parts first before wrapping. (d) Soldering the joint. Apply the solder to the joint, not the iron. (e) A good finished joint. (f) Two bad joints. The dry joint on the left can be a result of burning off the flux or moving the joint. The wrapping of the joint on the right is too loose and solder is bridging the gap. If you get joints like these, desolder and start again.



as possible; it is worth twisting wires together at this stage, or wrapping them round the object to which they will be attached (c). The soldering iron, carrying a small amount of solder to help thermal contact, is then touched on the area to re-melt the solder on the surface and at the same time a small extra amount of cored solder is applied (d) which runs into the joint (e).

Never use solder to fill a gap between objects (f). By itself solder is very weak and the more solder there is between surfaces to be joined so the weaker the joint. Never move the joint before the solder has soldified as this will result in a dry joint (f), of crystalline appearance.

Quite often you will find that wires or component leads have already been tinned. But it is advisable to clean these surfaces by scraping and then re-tin them so that you have a fresh alloy that will bond quickly.

Sometimes leads instead of being tinned are gold plated (particularly on transistors). It is best *not* to tin the gold surface. Gold does not oxidise, is most soluble in solder, and is usually only plated in very thin layers. These last two points provide a problem. Because gold dissolves so easily in solder it is very easy to remove all the plating from the wire, this will result in a bad joint.

Many electronic components can be destroyed by excessive heat and to overcome this problem ensure that you do not apply the soldering iron for a longer time than is necessary. Funnily enough, there is more danger of overheating a component if you use an iron having a low temperature. A high temperature applied for a short time is less damaging than a lower temperature for a long time. Here again is a good reason for keeping surfaces clean. When in doubt use your pliers as a heat shunt by gripping the component lead on the component side of the joint which is being heated—it is possible to buy special clips for this purpose.

AN EXERCISE

It is a little difficult to give an interesting project this month but why not go out and spend some time buying your tools and at the same time buy a small (4 oz) reel of 22 s.w.g. tinned copper wire and get a handful of small coppered nails from a hardware shop. The type used for hardboard are suitable.

Hammer the nails about $\frac{1}{4}$ inch into a piece of wood, tin the top ends and proceed to use the tinned copper wire to interconnect them. Twist the wire once round each nail and test the strengths of good and bad joints, Whilst doing this exercise try and keep all the kinks out of the wire and where you want to go round corners use pliers to give a nice sharp right angled bend. It is a good idea to make up a shape or letter using the nails and wire. The photograph shows our prototype that was used for the illustrated soldering guide.

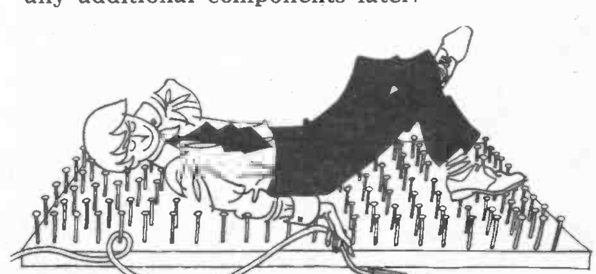
Next month we shall be dealing with the electric current, and will also be describing how to make the Demo Deck. All experiments in this Teach-In series will be described in relation to this board which in its simplest form can be made for approximately £1·30. Those who are more seriously interested in learning are advised to make the complete unit—this can cost £6 but will last for many years.

The electronic components required are:

1 RS Components Ltd. perforated board (0·25inch matrix), 1 gross RS Components small turret tags, 2 six-way and 1 four-way 5 amp insulated plastic terminal blocks, 6 terminals with insulated bushes (with 4mm sockets for banana plugs), 2 MES panel mounting lamp holders with coloured lenses, 1 One milliamp meter (SEW MR38P or similar), 1 $3\frac{3}{8}$inch diameter 35 ohm RS Components loudspeaker, 1 each of 100ohm wirewound 5,000ohm carbon 25,000ohm carbon, 500,000ohm carbon potentiometers (all linear), 2 $4\frac{1}{2}$ volt screw terminal bell batteries.

All these components are readily available and if ordered during this month will permit work to start as soon as you have next month's edition of Everyday Electronics.

If you do not want to spend so much money on these components you can start with the perforated board and turret tags and buy any additional components later.



SHOP TALK

By Mike Kenward

WE know readers will have problems from time to time concerning component and equipment buying, we have met them ourselves. This regular feature is intended to help readers in advance of their problems, wherever possible. We will chat about components specified that are not so easily obtainable and tell you where to buy them. We will also put you in the picture about general component trends and of course, all new products that we feel will interest you.

When it comes to ordering the components you want, the article in this issue entitled *Component Buying and Supplying*, will help.

Prices

The cost of components for constructional projects given in the relevent article is based on suppliers' current catalogue prices. Because of price fluctuation and variation between suppliers, some projects may cost more to build, whilst, with careful buying, others could cost less.

The price is given as a **guide only** and does not always include the cost of the case or the parts to make the case; this will be stated in the price box.

Catalogues

There is one simple way in which you can help yourself avoid searching through pages of ads or hunting around all the shops in your area—and that is to buy a catalogue or two. There are a few large firms in and around London that produce very good catalogues for around 50p and we would suggest that you buy at least one.

Record Player

One constructional project in this issue that provides a good example of variation in price is the record player. Taking the deck and cartridge, we have noticed that there are very large variations in the price of these items, so don't just rush out and buy.

It may prove difficult to get a 13-14V secondary mains transformer; again those catalogues will help, but if you cannot find one use a heater transformer with two 6·3V 0·5 amp secondaries and connect them in series to give 12·6V—this will be adequate.

Windscreen Wiper Control

Main problem on the wiper control is likely to be the price of the GPO 3,000 relay. Buy a used one and take off some of the contacts, it is easy enough—but you should leave one set on each side to balance the pressure. Again on the wiper control, for the suppression capacitor C4 values of 0·5μF to 1μF are suitable but the component must be rated at 400V d.c. or more.

Snap Sequence Indicator

No problems—we hope—with components for the *Snap Sequence Indicator*. Woolworths or an electrical shop are the best places to buy the push buttons. If you don't fancy making the case, G. W. Smith and Co (Radio) Ltd sell some good ones—shown above—for about £1. (6·5in. x 4in. x 4in). These are a fairly new addition to their range and should prove useful for many of our projects.

Home Sentinel

Once again, few buying problems should be encountered with components for the *Home Sentinel*. The diecast box provides a good sturdy case—this does not have to be exactly the same size as indicated but it cannot be much smaller or you won't have room for all the parts.

Teach In

The Demo Deck—to be described next month—will, we are sure, be very useful to both the beginner and the more accomplished experimenter and it should be a project worth spending a little time and money on. Some of the parts detailed in this issue are marked R.S. Components, this is the name of the company that produce them, not a retailer. The firm used to be called "Radiospares" and many of the retail shops may still use this name. Any shop can order parts from them and the delivery should be by return post.

Veroboard

You will probably not be able to buy the small pieces of Veroboard such as that given away with this issue, so a larger piece must be purchased and cut to size.

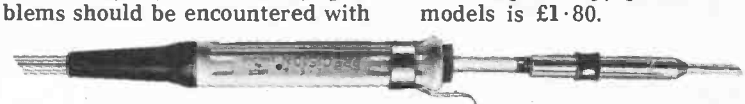
The 0·1 inch board used for the record player could prove expensive as you may have to buy a piece measuring 17 inches by $3\frac{3}{4}$ inches and costing nearly £1.

Incidentally, the cost of the large piece was taken into account when estimating the cost of the record player.

New Products

For those just starting electronic construction, a must is a good soldering iron and we have recently been sent information on a new small iron from Antex. This 15 watt iron—shown below—has a new ceramic enclosed element which is insulation tested to 2,000 volts a.c.; this should make the iron very safe to use.

A range of four general purpose bits are available ranging in size from $\frac{3}{32}$ inch to $\frac{1}{4}$ inch; the $\frac{1}{8}$-inch size will probably be most suitable for our type of work and this should be asked for when buying. Two general purpose models are available, the CCN 240 and CCN 220, these are for 230-240 volt and 220-230 volt operation respectively, price for both models is £1·80.



Record Player

Good quality at a reasonable price. The mono reproduction is good enough for classical records as well as "pop", and you can fit a single play quality turntable or an autochanger.

By E. Pusey

THIS article describes a simply constructed record player using the Plessey SL403D integrated circuit audio amplifier. The internal circuitry is therefore very simple indeed, and is able to be driven directly from a standard ceramic cartridge fitted to the Garrard record deck used. An internal loudspeaker is incorporated in the design although a socket is provided to allow an external speaker to be used if desired.

RECORD PLAYER AMPLIFIER

The circuit diagram of the amplifier is shown in Fig. 1. This amplifier has a typical output power of 3 watts r.m.s. into a 7·5 ohm load with a pre-amplifier input of 250 millivolts r.m.s. The pre-amplifier (incorporated in the integrated circuit) is used at full gain—to offset the loss in the tone control network (20dB at mid band frequencies). The tone control network is an "insertion loss" type between the pre and main amplifiers.

To drive the main amplifier a maximum swing from the pre-amplifier of 2·5 volts r.m.s. is required. A potential divider R3, R7 (Fig. 1) in the d.c. feedback path is used to raise the normal pre-amplifier output from around 1 volt r.m.s. to the required 2·5 volts r.m.s.

The pre-amplifier input is fed from the mid-point of R3, R7 and the feedback is bypassed at audio frequencies by C8. The tone control characteristics are shown in Fig. 2.

POWER SUPPLY

The amplifier design is such that only a very simple unregulated power supply is required; Fig. 3 refers.

Transformer T1 should be capable of supplying 13 to 14 volts r.m.s. at 0·5 amp minimum. The smoothing capacitor C13 is shown in Fig. 1 and must be connected as shown in the printed board layout near to the integrated circuit to provide adequate amplifier de-coupling.

Specification...

Output power 3W r.m.s. into 8 x 5in internal speaker

Distortion 0·5 per cent*

Frequency response 20Hz to 18kHz**

Optional external speaker facility

Choice of Garrard record decks

9TAHC stereo/mono cartridge

Bass and treble tone controls

* Measured at 400Hz, 3W r.m.s. output
** At 3db down points—3W r.m.s. output

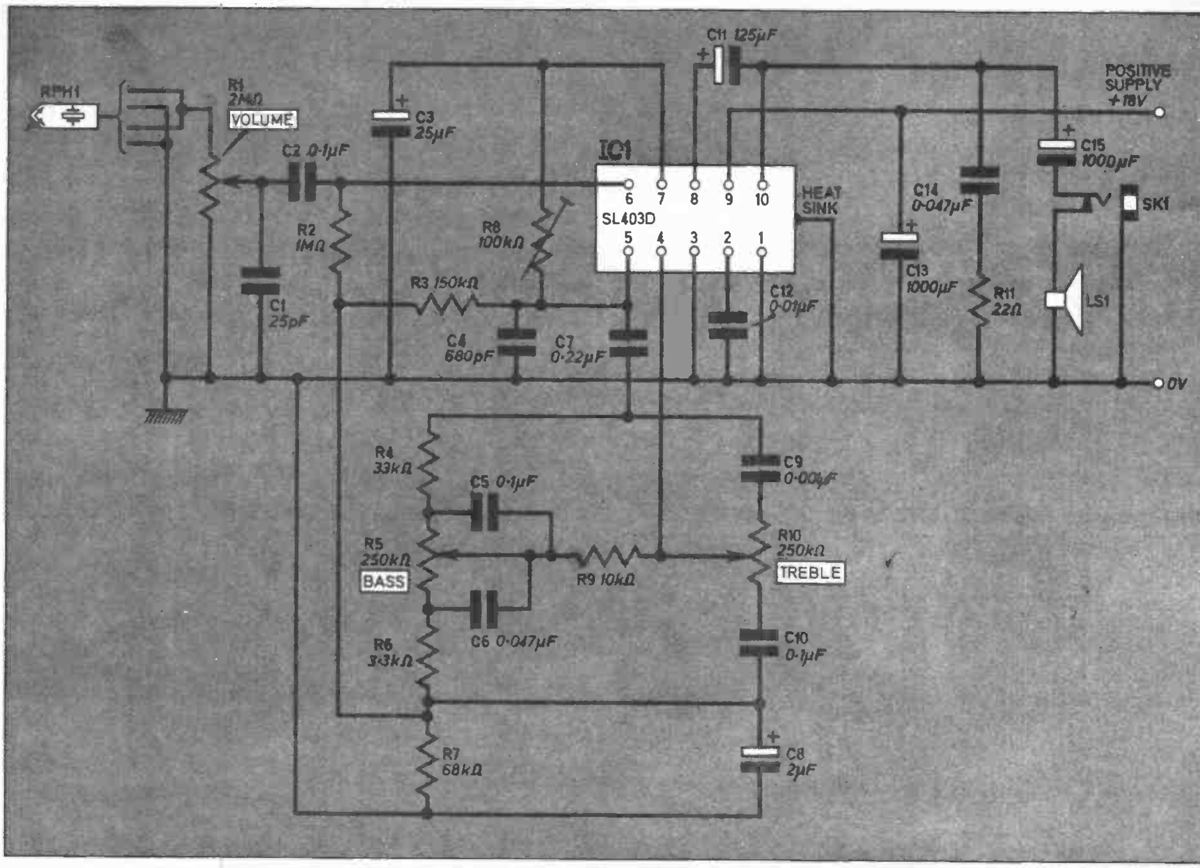


Fig. 1. Circuit diagram of the Record Player amplifier using a single integrated circuit.

Components....

Resistors
- R1 2 MΩ 1W log carbon potentiometer
- R2 1MΩ
- R3 150kΩ
- R4 33kΩ
- R5 250kΩ 1W log carbon potentiometer
- R6 3·3kΩ
- R7 68kΩ
- R8 100kΩ lin skeleton preset potentiometer
- R9 10kΩ
- R10 250kΩ 1W log carbon potentiometer
- R11 22Ω

All $\frac{1}{2}$W±10% carbon except where stated

Capacitors
- C1 25pF silver mica 15V
- C2 0·1µF polyester
- C3 25µF elect. 16V
- C4 680pF silver mica 15V
- C5 0·1µF polyester
- C6 0·047µF polyester
- C7 0·22µF polyester
- C8 2µF elect. 5V
- C9 0·001µF polystyrene
- C10 0·1µF polystyrene
- C11 125µF elect. 16V
- C12 0·01µF ceramic 16V
- C13 1000µF elect. 25V
- C14 0·047µF polyester
- C15 1000µF elect. 16V

Semiconductors
- IC1 SL403D Integrated Circuit
- D1–D4 1N4001 rectifier diodes (4 off)

Loudspeaker
- LS1 7·5Ω or 8Ω, 8in by 5in moving-coil type capable of handling 3 Watts r.m.s.

Record Deck

SP25 MkIII or similar Garrard deck (see text)

Pick-up

RPH1 9TA/HC Sonotone ceramic cartridge

Miscellaneous
- SK1 Mono jack socket with switchable connections
- T1 Mains transformer having 14V 0·5A secondary (see text)

Veroboard 7in x 3$\frac{3}{4}$in x 0·1in matrix
Knobs (3 off), screened lead (approx. 18in), 3 core mains lead, 13A or 5A fused mains plug, 3 way plastic connecting block, connecting wire, screws and wood for case, SPC4 MkII perspex cover

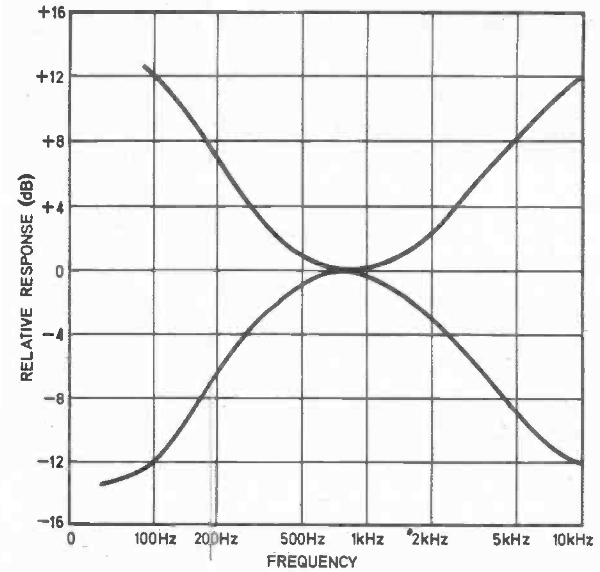


Fig. 2. Tone control characteristics of the Record Player.

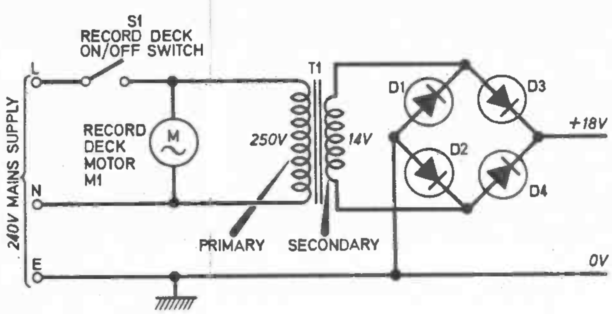


Fig. 3. Mains power supply of the Record Player.

The d.c. supply obtained from the circuit shown in Fig. 3 should be around 18 volts.

COMPONENT BOARD WIRING

A component board layout is shown in Fig. 4 using 0·1 inch pitch Veroboard. This design should be strictly adhered to to avoid instability.

The 0·1 inch pitch board is used to suit the lead spacing on the integrated circuit. This size is rather more difficult to use than the 0·15 inch pitch piece included in this issue, and anyone who has not used Veroboard before is recommended to build a simple project on the free sample before attempting this project. A full guide on using Veroboard is given in this issue. With 0·1 inch pitch board it is imperative to make good clean soldered joints and to check carefully that no two strips are bridged by solder.

The layout of the board is fairly open and it should be quite easy to follow Fig. 4. Because the three potentiometers are mounted directly to the board, using short lengths of 18 s.w.g. tinned copper wire, there are only a few flying connecting leads and this again helps to simplify construction. The potentiometers also provide a mounting for one end of the board as they are pushed through the front of the cabinet. The rear of the board is mounted on a block of wood, fixed to the base of the cabinet, by two wood screws.

MAINS WIRING

The method of connection to the Garrard SP25 MKIII turntable used enables the whole unit to be switched on and off using the record deck on/off switch. As can be seen from Fig. 5 the existing wiring is slightly modified so that the mains supply to the transformer is controlled by the deck on/off switch S1. This gives the added advantage of switching off the complete unit after a period of automatic play.

PICK-UP UNIT WIRING

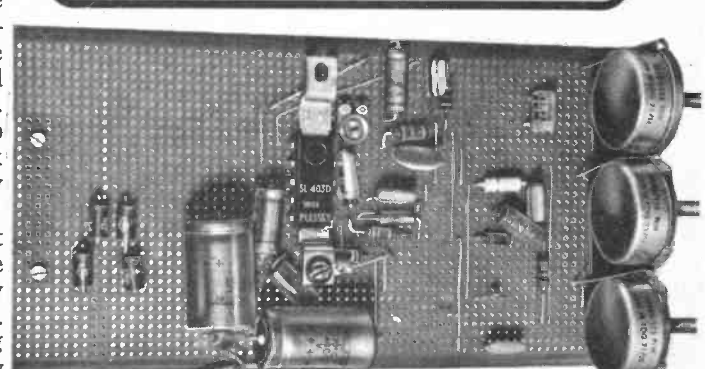
Pick-up wiring should follow manufacturer's instructions but the cartridge should be of the ceramic or crystal type and screened lead must be used as shown in Fig. 5.

The 9TAHC cartridge is a stereo cartridge and the record player can thus be used to play both mono and stereo records although the reproduction will be mono only. The two channel signals coming from the cartridge are combined by wiring the cartridge output leads together on the five way tagstrip under the deck (see Fig. 5).

On the SP25 MkIII deck the cartridge is held in a plastic pad which slides into the head shell on the arm. The 9TAHC cartridge recommended must be mounted on this pad with the extra balance weight provided as shown in our photograph. The four connecting leads are soldered to the pull out nylon plug in the base of the cartridge and this plug is then re-inserted in

Approximate cost of components

£ 20·00 plus case



the back of the cartridge. Never solder directly to the tags on a cartridge as this is likely to damage it. After connecting the leads slide the whole thing back into the head shell and wire up the connections under the deck as shown in Fig. 5.

For the 9TAHC cartridge the tracking weight should be set to 3 grams and the bias adjustment should be at position 3 (SP25 MkIII deck).

SETTING UP

Referring to Fig. 1 and Fig. 4, R8 must be used to adjust the quiescent amplifier output voltage—on pin 10 IC1—to half the supply rail voltage.

The quiescent output voltage is the voltage with the unit turned on, but with no record playing, and the controls set in their normal

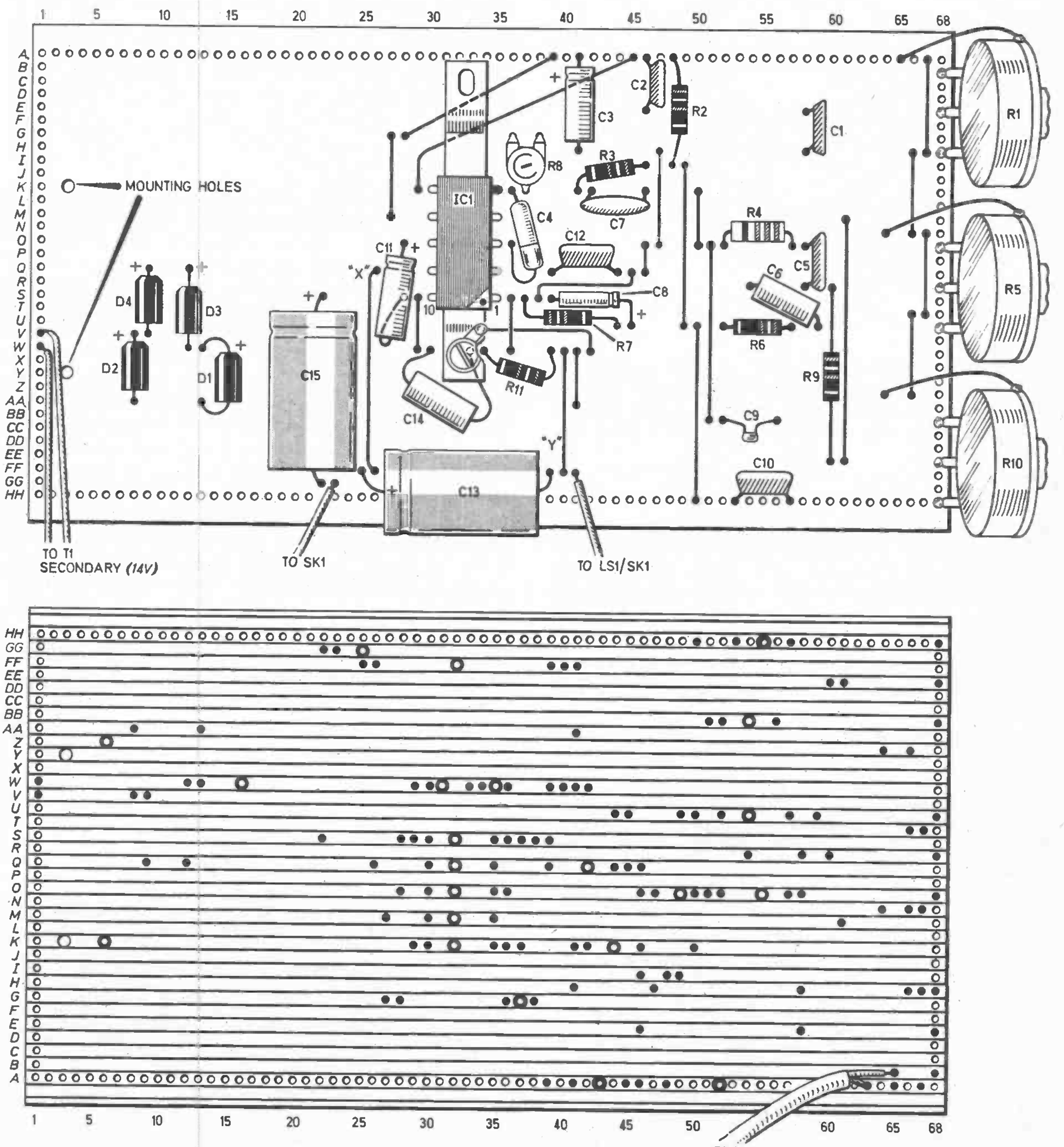


Fig. 4. Veroboard layout and wiring details. The board used is 0·1inch matrix.

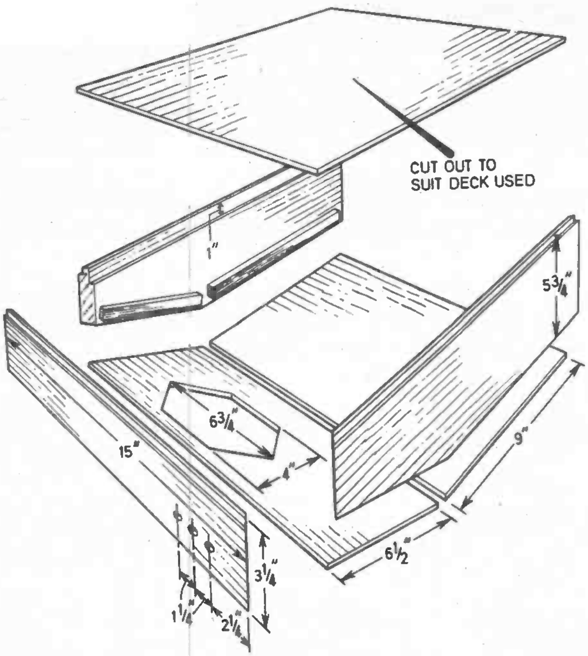
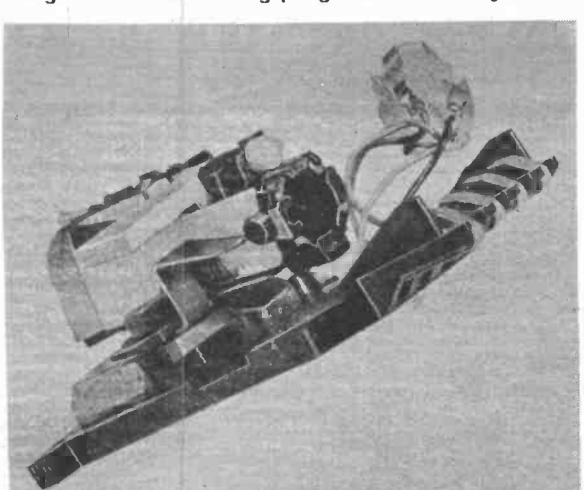


Fig. 6. Basic cabinet details of the prototype. This cabinet may be made to any design required. The back panel has not been shown but is rectangular with holes for SK1 and the mains lead.

positions. To set this, first measure the supply line at points X and Y in Fig. 4 (X is positive), this should be around 18 volts d.c., then move the positive voltmeter lead from point X to pin 10 on IC1 and set R8 to give a reading of exactly half that obtained across X and Y. If you do not have a voltmeter and do not wish to purchase one yet, you may be able to get a shop to set this for you or you can build your own voltmeter—a simple one will be described very soon in *Teach-In*.

The cartridge mounted in its shell. Extra balance weight and connecting plug can be clearly seen.



SPEAKER UNIT

Great attention was paid by the author to the proportions of the wooden plinth and the position of the speaker was decided upon to balance performance with acceptable plinth height. The listening tests carried out in fact show negligible high frequency attenuation due to the speaker position provided the unit is stood on a hard flat surface. For purists however, a socket is provided as shown in Fig. 5 for an external 8 ohm speaker. When such a speaker is connected it automatically cuts off the internal speaker.

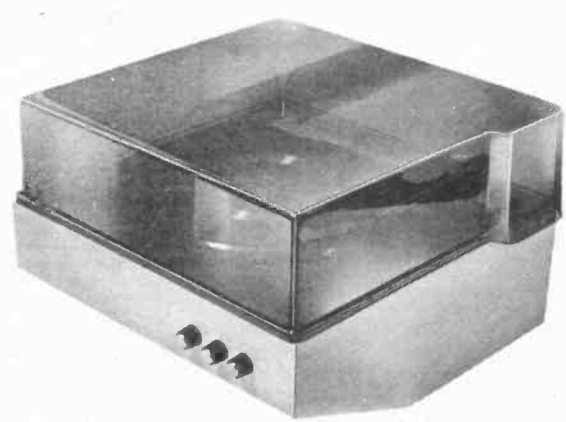
WOODEN PLINTH

The unit is designed to use a standard Garrard SPC 4 MkII perspex moulded cover and the shaping of the upper edges of the plinth to accommodate this was carried out using a Black & Decker circular saw attachment. The cabinet style and shape can of course, be made to individual requirements and Fig. 6 only provides basic information on the prototype.

The mounting for the record deck should be cut to the manufacturer's template, and will obviously vary depending on the type of deck decided upon. You do not have to use the SP25 MkIII deck or the 9TAHC cartridge as recommended. This cartridge can also be fitted to any of the following alternative decks: Garrard 2025 TC; Model 3000; Model 40B; Model 3500.

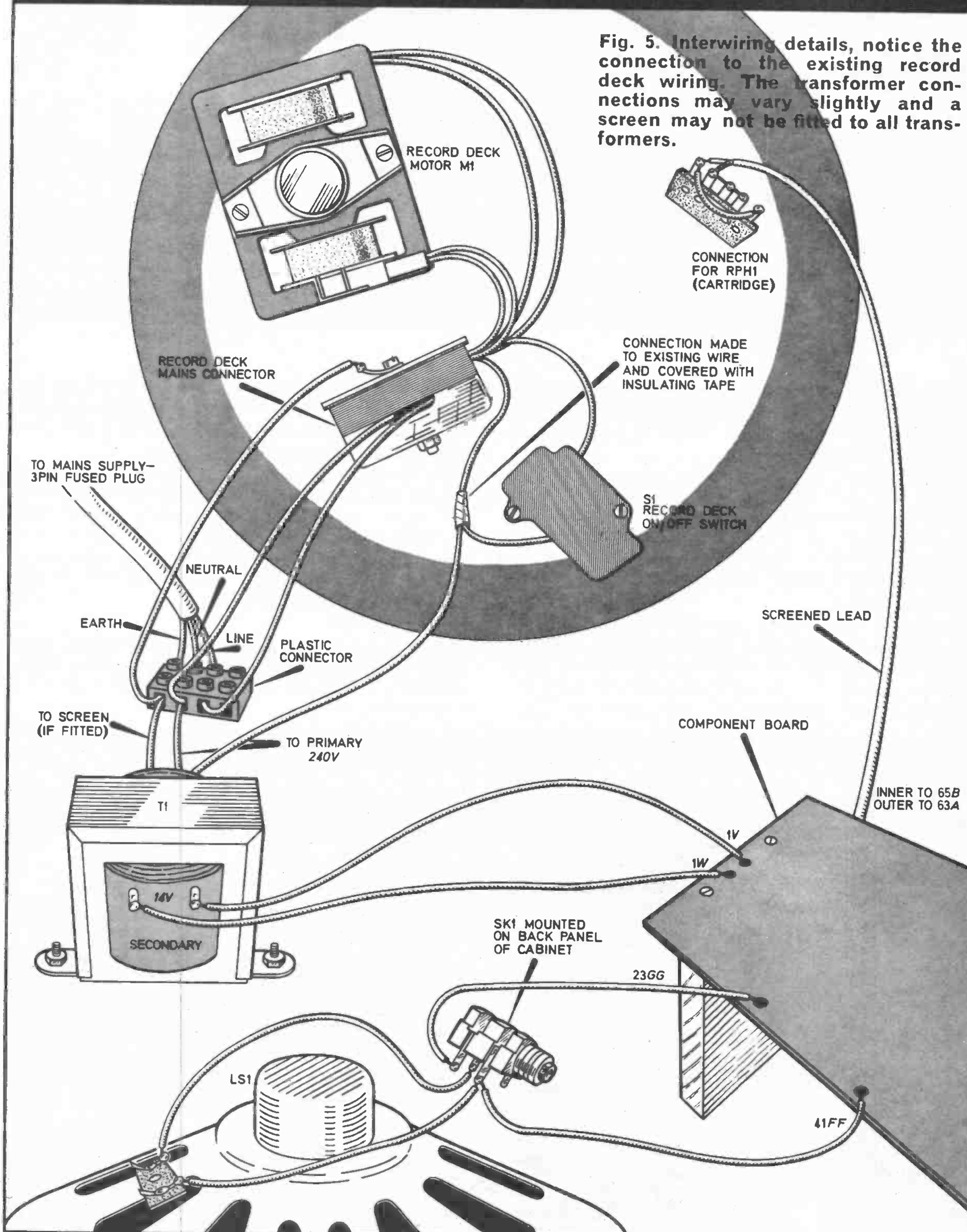
Under music and speed conditions as prevailing in this application, it is not necessary to use a heat-sink with the SL403D. If, however, continuous sine wave power is applied at full output power for testing then a heat sink must be fitted.

The SL403D integrated circuit is an upstaged version of the SL403A. The SL403D includes internal protection against permanent a.c. and d.c. short circuits of its input and output terminals to ground. Make sure that the type you buy has the suffix D. ▣



RECORD PLAYER_WIRING DETAILS

Fig. 5. Interwiring details, notice the connection to the existing record deck wiring. The transformer connections may vary slightly and a screen may not be fitted to all transformers.



Windscreen Wiper Control

By S.B. Squire

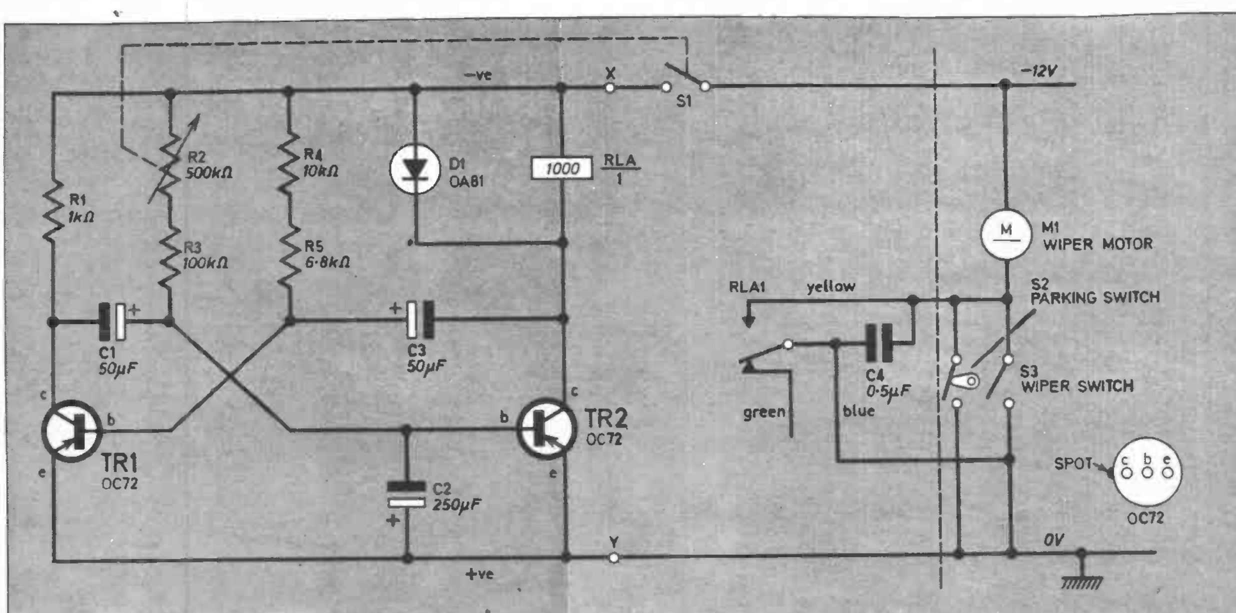
Dirty wet road! Drizzle! Fog! Smeared screen and scraping wipers. EVERYDAY ELECTRONICS comes to the motorists aid with this intermittent, add on, wiper control.

THIS wiper control has been designed to operate with self-parking windscreen wiper motors either 2 wire or 3 wire (permanent magnet type) on 12 volt positive or negative earth systems.

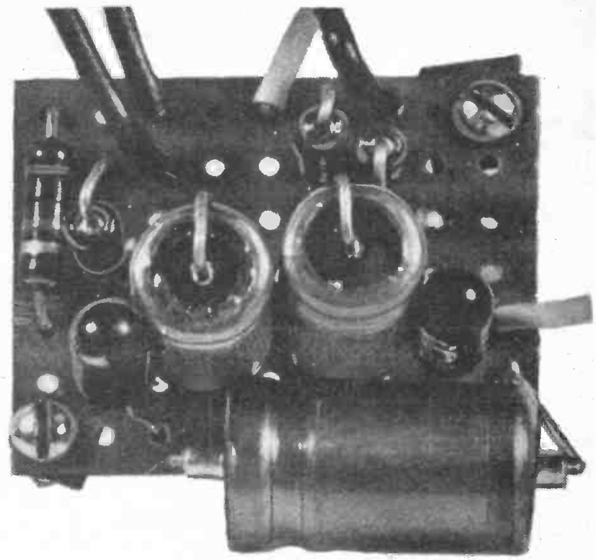
Summer and winter the British motorist has to put up with driving through mist, fog and light rain, though the motorist is probably used to this, the device to be described will give the driver a more pleasant and safe journey.

One of the hazards of driving through mist, fog and light rain is that the windscreen does not get wet enough between normal sweeps of the wiper blades to prevent smearing or to stop that annoying sound of scraping, as the wiper blades brush over a near-dry surface. To prevent the driver having to keep switching the wipers on and off, this device will provide a variable delay between wiper sweeps. The duration of the delay is adjusted by the driver to suit prevailing weather conditions.

Fig. 1. Complete circuit diagram of the car wiper control. Wiring on the right of the dotted line is that for a 12V positive earth car with a 2 wire field coil motor.



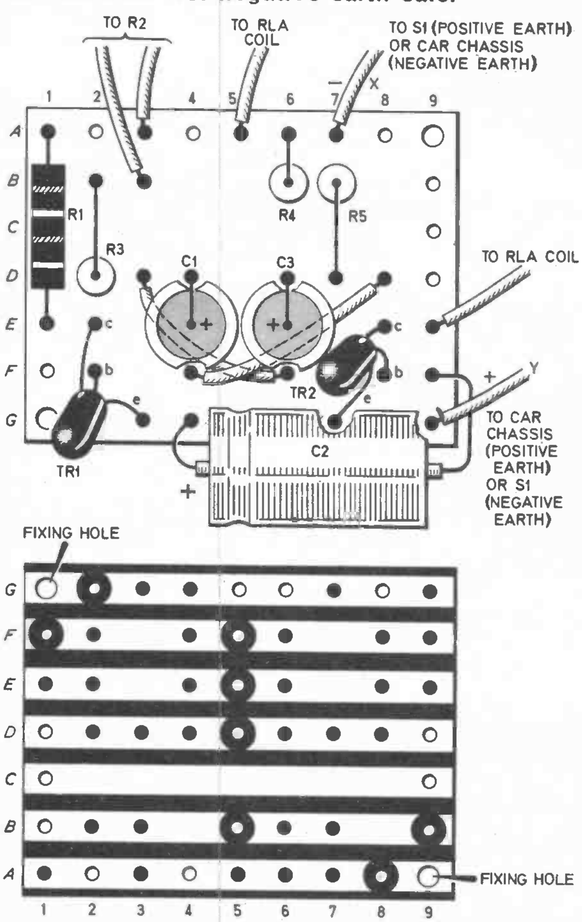
CIRCUIT DESCRIPTION



The basic circuit with wiring for a 2 wire motor is shown in Fig. 1. The circuit uses two small power transistors in an astable (free-running) multivibrator which operates relay RLA via which the wiper motor obtains its power. The sweep delay time is adjustable by means of the potentiometer R2, the ganged switch S1 being used for switching the unit on and off. Overall circuitry is such that normal function of the car's windscreen wiper is unimpaired—though a small wiring modification is required for permanent magnet wiper motors which will later be described.

The values for C3, R4 and R5 have been chosen to ensure that over the timing range the relay does not remain energised long enough to enable the wiper blades to make more than one sweep at a time. This is not necessarily critical, but one sweep per relay operation was aimed at. Capacitor C2 decouples the base of TR2 against variations on the supply voltage, caused by the dynamo or alternator, that could produce a switching transient. The high back e.m.f. produced in the relay coil when TR2 is cut off (thus de-energising the relay) is prevented from damaging transistor TR2 by diode D1 providing a shunt path for the back e.m.f. Capacitor C4 suppresses any transients at the relay contacts caused by sparking and should be a high voltage type mounted close to the contacts.

Fig. 2. Veroboard layout and wiring diagram. This diagram applies to all car wiring configurations, connecting wires X and Y are reversed—as indicated—for negative earth cars.



CONSTRUCTION

The components are assembled on to part of the piece of Veroboard enclosed in this issue (Fig. 2) which is then mounted along with the relay on a simple metal chassis (Fig. 3). The board is held by two 6BA screws.

Some constructors may not wish to mount everything under the dashboard in the form shown, but a virtue of this unit is that its operation is not affected by long leads so the main unit may be mounted remotely from R2. Flying leads from the unit to the car may be terminated in bullet snap connectors, this enables the unit to be quickly connected and disconnected if necessary.

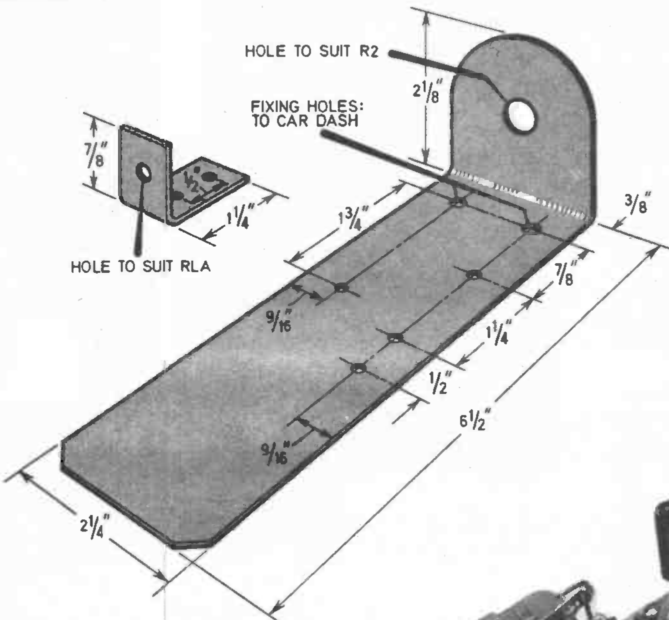
The supply to the unit should be obtained from the car ignition switch via the fuses in order to give some protection. Earth return is made via a short lead through the car chassis.

The relay used is a G.P.O. 3,000 type with

Approximate cost of components

£ 1·75 plus case

WINDSCREEN WIPER CONTROL CONSTRUCTIONAL DETAILS



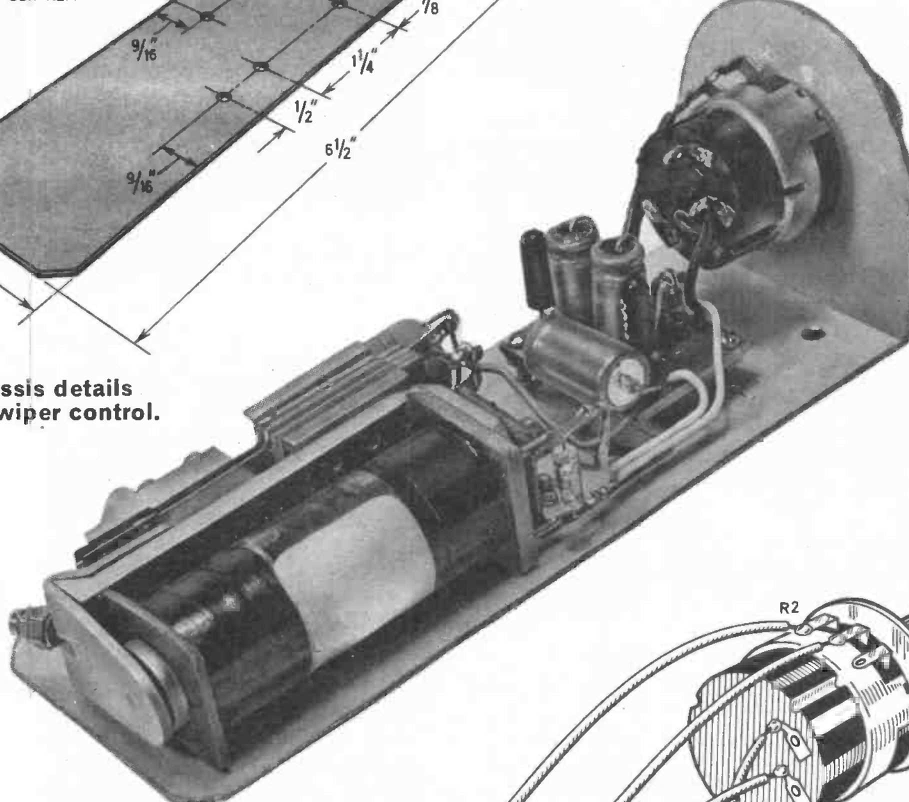


Fig. 3. Chassis details for the car wiper control.

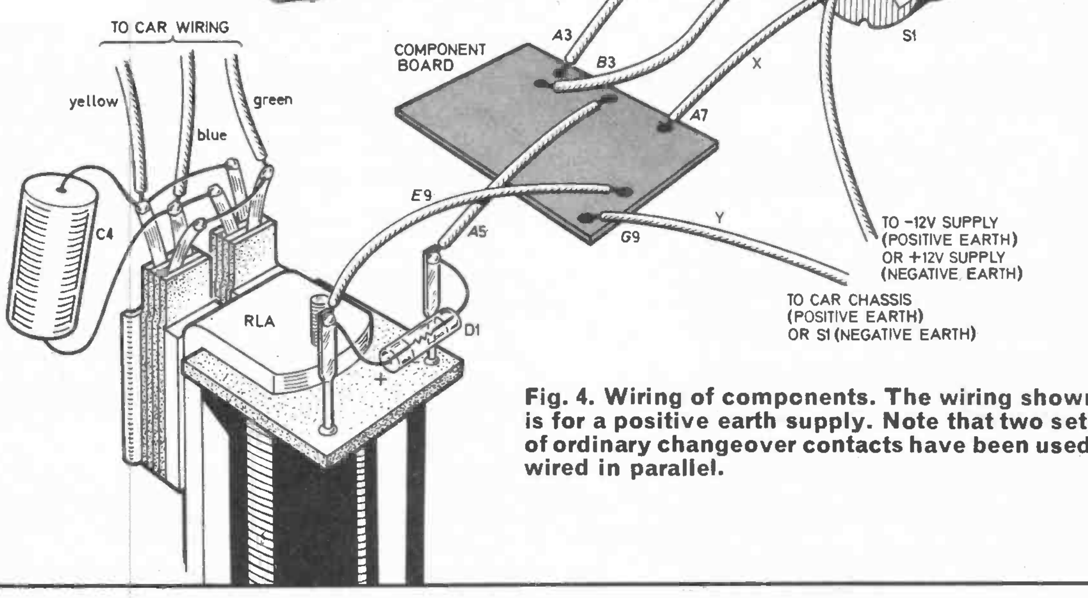
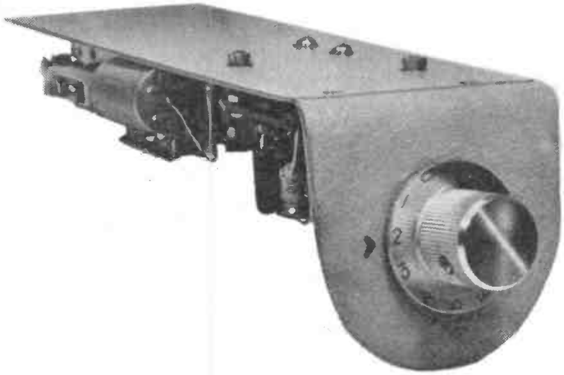


Fig. 4. Wiring of components. The wiring shown is for a positive earth supply. Note that two sets of ordinary changeover contacts have been used, wired in parallel.



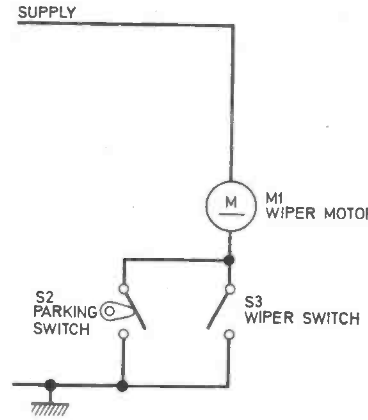


Fig. 5. Wiring diagram of a two wire field coil wiper motor with self parking facility.

heavy-duty changeover contacts and a coil resistance of 1,000 ohms. Obviously any other relay possessing the same specifications and workable on 12 volts will suffice. In the case of the contacts, because they are well suppressed and only make momentarily, two sets of ordinary changeover contacts wired in parallel will work quite satisfactorily if heavy-duty contacts are not available. It is pointed out that any relay having a coil resistance different to that stated, if used, will seriously affect the timing range.

LAYOUT AND WIRING

A layout and wiring diagram of the Veroboard is given in Fig. 2, this diagram applies to all car configurations discussed later in this article. Anyone who has not used Veroboard before can find a complete photographic run down on how to go about wiring up the board in the special article in this issue, this article refers specifically to the *Snap Sequence Indicator*, but the method of use is the same and the wiring is carried out with reference to Fig. 2 in this windscreen wiper control article. Notice the two links on top of the board—these should be fitted before the components.

FITTING

Diagrams will be given to show how the unit may be wired to almost any car having a 12V system and self-parking wipers. Fig. 5 is the diagram for older cars using field coil motors with a self-parking switch. The wiring of a positive earth system using self-parking, field coil motor is that shown in Fig. 1 and Fig. 4, only the yellow and blue wires on RLA1 are used, the green need not be fitted, remember Fig. 2 applies to all systems. For a negative earth self-parking field coil motor system simply reverse wires X and Y. The polarity of the supply to the electronic circuit must always be kept the same way around.

You will be able to tell if your car is wired for positive or negative earth by looking at the battery and finding which side is connected to the chassis.

Next month we will describe how to identify your car wiring system and methods of fixing the control to other cars.

Components....

Resistors:
- R1 1kΩ
- R2 500kΩ lin. potentiometer with s.p.s.t. switch (S1)
- R3 100kΩ
- R4 10kΩ
- R5 6·8kΩ

All ± 10%, ¼ W carbon except where stated.

Capacitors:
- C1 50μF elect. 25V
- C2 250μF elect. 25V
- C3 50 μF elect. 25V
- C4 0·5 μF 400V

Semiconductors
- TR1 OC72 Germanium *pnp*
- TR2 OC72 Germanium *pnp*
- D1 OA81

Miscellaneous
- RLA1 GPO 3000 type relay, 1000Ω resistance with one set of heavy duty changeover contacts or two sets of ordinary changeover contacts (see text) control knob numbered 0 to 10.
- Veroboard 9 holes x 7 strips, 0·15in. matrix (part of give away), metal for chassis, connecting wire and 6BA fixings.

COMPONENT BUYING & SUPPLYING

. . . *I sat down and did some thinking.*

No. I Customers

First of a series of three articles

by Alan Sproxton, Home Radio (Components) Ltd.

WHEN the Editor of EVERYDAY ELECTRONICS asked me to write some articles on supplying components I sat down and did some thinking. I have now fully recovered . . . but it did occur to me that this business is a team venture, involving the contributor responsible for the Constructional Article, the Component Supplier, and the Customer.

To get a balanced picture, all facets must be shown. I would like particularly to show how the customer can help us, how we can give better service to the customer—and how the author can assist us both. I will start with the most important member: *you* the customer.

Your Needs

Theoretically your needs are relatively simple; you require the right components for your project, delivered quickly, and at the right price. We shall see that in practice the fulfilment of this ideal is not so easy. You may be lucky enough to have a good Component Shop close at hand, but I'm sure that many of you are thrown on to the resources of the various Mail Order firms who specialise in electronic components. Most of them are efficient and painstaking, but a little co-operation from you can work wonders. I would suggest that if they have a Catalogue *this should be your first purchase.* I will now discuss the basic problems and suggest what to do and what to avoid.

There are three basic problems, the customer must transmit the order to us, the supplier, also sufficient money to cover the transaction, and lastly the supplier must get the goods to the customer.

We will consider for the moment the first two. If I deal with this rather thoroughly it is because the Postal Strike opened our eyes to the fact that there are other ways of transmitting orders and money besides the G.P.O. However, let us start at square one and please bear with me if I state the obvious, remember it may be news to some!

. . . *this should be your first purchase.*

Making Out The Order

You have just decided you would like to build a piece of equipment described in EVERYDAY ELECTRONICS and you turn to the list of parts required. Some of them you may already have so you list out the others. In the article the designer will number the components so as to be able to refer to them in the text: thus the capacitors will be numbered C1, C2, C3, etc. and the resistors R1, R2, R3, etc. Please remember C1 or C2 or R1 or R2 will convey nothing to your supplier! But customers continue to ask for a C1 or an R1 without telling us from what article they are quoting!!

So take a sheet of lined paper and at the top write your name and address in "Block Capitals" *yes please* BLOCK CAPITALS. Of course *you* know you live in "Little Squiggletown" but written in your best copperplate longhand, to the dealer it looks halfway between the Plessey Trademark and an invitation in Arabic to visit the Cairo Museum! We have a file in our office full of orders with no name or address *at all*!! So if you do not get your goods within a reasonable time just check with your supplier!

Now write down your requirements giving adequate descriptions and prices. *Total it up and add something on for postage.* Many firms supply their own Order Forms and it obviously helps them (and you) to use them.

Transmitting The Order

Now the order and money must be transmitted to your supplier. If you have an account with your supplier you can just pick up the phone and perhaps even the same day the parts are on their way to you. You must give your dealer adequate references before he will consent to your opening an account, but I think you will find it less difficult than you suppose. For those of you who have a steady and regular demand for electronic parts there are big advantages in having an account.

During the Postal strike customers who had accounts with us

. . . *halfway between the Plessey Trademark and an invitation in Arabic to visit the Cairo Museum!*

. . . if you are in a hurry for goods, don't ask for them to be sent C.O.D. It takes about three times as long as ordinary post!!

were able to order as usual. Of course the more usual way, and one whose popularity will not diminish, is the Postal Service. I would however, like to draw your attention to another method which is independent of the Post and has the additional advantage of saving you money. I refer you to the Bank Giro System. *Not* the Post Office Giro which is of course dependent on the Postal Service.

You can walk into *any branch of any Bank* and ask for a Giro Credit Transfer form. You may write your order on the back of the form and the amount to pay on the front. You will need to know the account number and bank code of your supplier, but having completed the form, hand it in to the Bank with your money.

Now here is the bit which appeals to us Scotsmen: if you hand it in to your own Bank it will cost you *nothing,* if it is another bank it will cost you 2p!! But remember you have saved yourself the cost of a Postal Order or Cheque plus a stamp and an envelope!

We were so taken with the idea that we printed our own Bank Giro Forms with an order form on the back. In case other dealers would like to emulate us, the size of the form must not be less than $6\frac{1}{8}$ x 3in or more than 8 x 4in. Another advantage is that security is 100 per cent!! One slight disadvantage is that it probably takes about a day longer than the post!

Sending The Money

You are now only left with the problem of how to send your money. We have already mentioned the Bank Giro—during the strike several customers telephoned their orders to us and sent the money by Bank Giro.

Then there is the Post Office Giro which is being used, with either a Giro Cheque or a Credit Transfer. Still by far the most popular way of payment is the Postal Order, and although the security it gives is not 100 per cent very few seem to go astray. Lastly, by cheque, and this method is gaining in popularity every day.

Delivering The Goods

Now we will turn to the problems of getting the goods to you. This can be done by:

(1) Parcel Post (up to 22lb or 3ft 6in size)
(2) British Road Services
(3) British Rail Express Parcels Service
(4) Private Carrier

Number one is the most popular but for the larger, heavier items one has to use one of the other services. British Rail is quite good and provided you collect your parcel from the station probably takes the same time as the Post. It does cost a few shillings more, but we found it a very useful alternative during the Postal Strike! Private Carriers are expensive but good. They do a door-to-door service and are usually very zealous of their reputation for delivering the goods with nothing missing and undamaged. We use them occasionally for expensive consignments.

Finally, if you are in a hurry for goods, don't ask for them to be sent C.O.D. It takes about three times as long as ordinary post!!

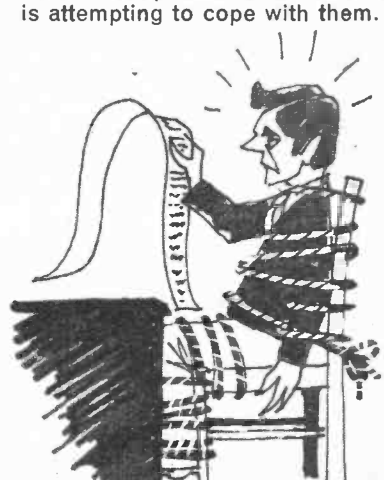
Queries

The only type of query you can reasonable expect your dealer to accept, is whether he has a certain item in stock and how much it costs. Technical queries should be sent to the magazine concerned and here again should be limited to articles appearing in that particular magazine.

We frequently are asked "Please supply me with a price list for a complete set of parts for the XYZ Signal Generator appearing in the current issue of "Sparks Weekly". We always try to be helpful as I am sure do other suppliers, but most of us work with a small staff and pricing a long list can tie up one member for quite a while. Sometimes we are asked to produce a list for an article that appeared three or four years ago, and I freely admit we cannot always oblige.

Above all when making your request *do* include a stamped addressed envelope!

In my next article I will talk about the supplier and explain some of his problems and how he is attempting to cope with them.



. . . pricing a long list can tie up one member for quite a while.

Beginners' Brief

MAY we introduce . . . let's skip the formalities and get straight to the heart of things. There are in fact two very important "things" or components that the newcomer to electronics must quickly become acquainted with. They are both members of the **semiconductor family,** but don't let the name worry you unduly.

The **transistor** is that rather wonderful device around which modern electronics is chiefly built. Please understand we are talking of that tiny, three-legged device about the size of a pea—often nowadays more closely resembling the split variety, actually. Non-technical folk refer to the portable radio receiver as a "transistor"—but we know better of course.

The transistor is the **solid state** or **semiconductor** (take your pick, it doesn't really matter which term is used) counterpart of the **triode valve.** It provides similar functions, all of which boil down essentially to the ability to **amplify;** in other words, a very small electric current in one circuit can be made to influence or control a very much larger current flowing in another circuit.

This basic amplifying action permits us to perform a number of other useful operations, such as the generation of signals of various **frequencies,** and of all manner of **waveforms.** All of these operations are determined by the use of circuits composed generally of a number of **resistors** and **capacitors** arranged around a transistor.

The transistor is therefore quite obviously the "heart" of the electronic circuit; it is known as an **active** device in due recognition of its ability to actively affect and control current flowing in the circuit. In contrast, the other associated components, such as resistors, capacitors and inductors, are known as **passive** components because their action or influence upon the current flowing in the circuit is of a more limited nature.

Like its "valve" equivalent, the transistor has been developed from a more humble electronic device—the **diode.** As the name suggests, this latter device has only two external terminals or leads. The solid state diode, the ancestor of the transistor, has been around a very long time—in its early form it was known as a crystal detector and in those far off days was frequently associated with a "cat's whisker."

The function of the diode is more simple and more limited than that of the transistor. Nevertheless it plays a very important part in modern electronics—indeed it is employed far more extensively in computers than in radio receivers.

The feature of the diode is the capability of passing current **in one direction** only. Change **the** polarity of the supply (reverse positive and negative) and the diode literarily "closes up". It is a very efficient high speed '**electronic switch.**'

The semiconductor family does not comprise the diode and transistor alone. From these two fundamental types have been developed a large host of different yet allied devices. These are usually more complicated in their operation, but they increase greatly the possible applications of electronic circuits. They include devices known as **thyristors, triacs, field effect (f.e.t.) transistors,** and **phototransistors,** and there are many others.

But the newcomer to electronics need initially be concerned only with the two founder members the transistor and the diode. With these two common devices many simple yet interesting and very useful circuits can be built.

Well the introduction is over. There will be plenty of opportunity for getting better acquainted, in due course. Semiconductors have their own peculiarities and need proper understanding, if the best is to be coaxed from them. But have no fear, plenty of detailed technical advice will be forthcoming in various EVERYDAY ELECTRONICS articles.

ABBREVIATIONS

The following is a list of abbreviations used in the text of articles and in components lists. Only the direct meaning of the abbreviations is given, no attempt has been made to describe the meaning of the words in full. For further information and full descriptions readers should follow the *Teach-In* series.

A	ampere (amp)
a.c.	alternating current
BA	British Association (nut and bolt sizes)
dB	decibel
d.c.	direct current
elect.	electrolytic
e.m.f.	electromotive force
Hz	Hertz (cycles per second)
in.	inch
l.d.r.	light dependent resistor
lin.	linear
log.	logarithmic
mm	millimetre
n.p.n. / p.n.p.	transistor structure (two types)
Ω	ohms
oz.	ounces
p.v.c.	polyvinyl chloride
r.m.s.	root mean square
s.p.s.t.	single pole single throw
s.w.g.	standard wire gauge
V	volt
W	watt
k	kilo (×1,000)
M	Mega (×1,000,000)
m	milli (÷1,000)
μ	micro (÷1,000,000)
p	pico (÷1,000,000,000,000)

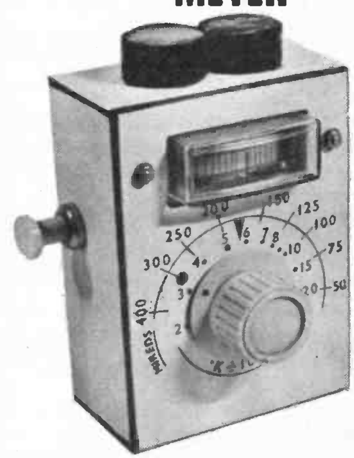
DECEMBER WITH ee

'FUZZ' BOX

For the modern music man. Add the "fuzz" effect to guitar playing with this solid state Fuzz Box

Build this small, inexpensive unit in a few hours. Essential for "heavy" music and guitar solo effects.

PHOTOGRAPHIC COLOUR TEMPERATURE METER

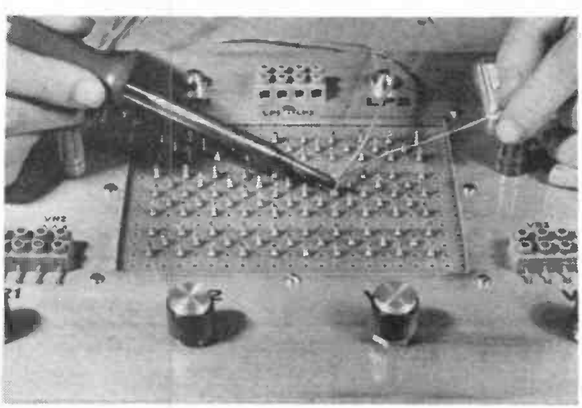


This simple inexpensive meter is a must for the colour photographer. Gives quick indication of the colour filters necessary for correction in any light. Can be used with natural or studio lighting.

DEMO DECK

Although originally designed with the beginner in mind, this circuit building deck has proved very useful for experiments and prototypes of every kind.

We recommend the Demo Deck as a useful experimental system to all our readers. Carefully constructed it will last for years and can house many of your tools and components.



BEGINNERS!

DO NOT MISS PART 2 OF

TEACH-IN

Which deals with the electric current, resistance and resistors.

TO AVOID DISAPPOINTMENT—Order Now! DEC. ISSUE ON SALE NOV. 19

Ruminations
By Sensor

Moonshine

The launching of men into space hardly makes headlines these days—we have all become too blasé! But thanks to modern electronics, we can share the experiences of the space travellers from the safety and comfort of our own homes. The excellent television pictures, live from the moon, showing the Apollo 15 astronauts Scott and Irwin collecting rock samples and engaged in various other tasks, made compelling viewing for millions.

It was, perhaps, unfortunate that the low lunar gravity gave the movements of the astronauts a strange inhuman quality which reminded me of those television puppets, "Bill and Ben, the Flowerpot Men". The effect was heightened by the space suits and the poor sound quality—which, one presumes, was due to technical limitations imposed by the space suits (I swear someone said, "Bo, Bo, shugalug"). However, no criticism of the project is intended; a great deal of scientific work was done and, in consequence, our knowledge of the universe will be increased.

When Uri Gagarin became the first man to orbit the earth (when was it, 1962?) the news broke here at breakfast time. In the development laboratory of a large computer manufacturer the engineers gathered together to discuss this fantastic achievement. Men normally dedicated to their work left 'scopes and soldering irons untouched and began to calculate rocket thrusts and speculate on trajectories. The chief development engineer, anxious to bring his team down to earth, was heard to murmur that here was, surely, the most subtle form of industrial sabotage!

Words and Music

The urge to "have a go" at someone else's job, something different from our bread and butter activity, seems to exist within most of us to a greater or lesser extent. Our hobbies and pastimes satisfy this urge to be someone else and, perhaps, help us to keep our sanity.

One form of "game playing" that was popular with computer engineers in their lighter moments, particularly around Christmas time, was the transcribing of music for the computer. A programme had been written containing instructions which caused the computer to perform a number of 'shifts' so as to generate the required audio frequencies. A paper tape had to be prepared from the written music of the piece that the computer was required to perform and, if the whole tedious and time consuming process had been correctly carried out, some semblance of the tune could be obtained from the loudspeaker of the computer, after feeding in the tapes.

The performance was very much inferior to those given by sea lions at the circus; the timing was better but the spontaneity and élan were sadly lacking. Sea lions customarily applaud themselves by clapping their flippers together; no doubt this could be simulated by the tape punch accompanied by 'Hoinks' on the loudspeaker.

MEMORY STORE
Retrieval By Harry Kitchen

THE name of the man who first aroused my interest in radio is, alas, no longer in my memory store. It was an RAF wireless "OP" stationed near my father's mine situated in a remote part of India during the last war. It all started innocently enough, with a pile of American radio magazines given me by my friend; the fires of enthusiasm were lit and are still burning brightly.

What mattered was the fact that circuit diagrams were a profound mystery. (Stand up the rotter who said they still are). The mine blacksmith produced a monsterous soldering iron, a native radio shop produced a pile of components that were ancient when Victoria was Empress, the cooks' charcoal fire was commandeered, and it was every man for himself.

The soldering iron glowed red, (well it had to be hot hadn't it?) resistors smouldered, wax sizzled from paper capacitors, (what a pyromaniac's delight when one "went up") solder flew everywhere but on the joint, the cook muttered devilishly. Coils were wound on anything that stood still long enough; 175 turns on the former, *the rest still on the reel.* Scratching ones head produced no sound in the phones, only a mysterious silence where glorious music should have been. My friend had been posted, (wonder how he managed it?) and advice was very conspicuous by its absence. I still wonder how much my friend knew besides morse.

Time passed, and my store of knowledge grew. Being in the wilderness undoubtedly saved my life. An absence of mains meant oil lighting and batteries for wireless power; batteries can shock, (and did they shock) but mercifully lacked the capacity to kill.

All good things come to an end, and soon enough it was time to start thinking of further education. An apprenticeship; that was the thing, and letters flew between our little part of the world and several illustrious British radio manufacturers. One offered what I wanted, and so it was that an ex colonial returned "home."

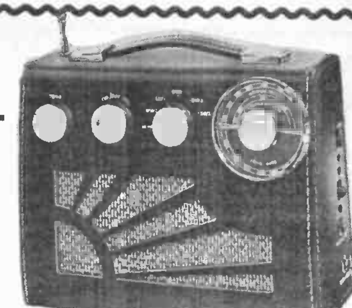
The apprenticeship completed, I was rapidly acquainted with the most fundamental tenet appertaining to ex apprentices; that reasonable jobs were only for the very clever, good jobs only for those with friends or relatives in high positions. Since I had lacked the foresight to appoint a friend or relative to a suitably high position, and since I wasn't terribly keen on the job I was put on, there was no alternative but to seek greener pastures.

Here I did myself a great favour. Having leaped off the dung heap at a relatively tender age, subsequent leaps onto better (?) jobs came much more easily. The unknown is almost always less fearsome than was thought. Fifty years in one job can mean contentment; it can also mean lack of confidence, or lack of ambition. A rolling stone gathers no moss; equally, a static person gathers no experience.

Electronics as an occupation, or as a hobby, is rarely equalled, never surpassed. It has been both to me for 18 years and I like it. Most decidedly, I like it.

Build yourself a TRANSISTOR RADIO

NEW! ROAMER 10 WITH VHF INCLUDING AIRCRAFT



10 TRANSISTORS. 9 TUNABLE WAVEBANDS, MW1, MW2, LW, SW1, SW2, SW3, TRAWLER, BAND. VHF AND LOCAL STATIONS AND AIRCRAFT BAND

Built in Ferrite Rod Aerial for MW/LW. Retractable, chrome plated 7 section Telescopic Aerial, can be angled and rotated for peak short wave and VHF listening. Push Pull output using 600mw Transistors. Car Aerial and Tape Record Sockets. Switched Earpiece Socket complete with Earpiece. 10 Transistors plus 3 Diodes. 7in × 4in Speaker. Air Spaced ganged Tuning Condenser with VHF section. Volume on/off, Wave Change and Tone Control. Attractive Case in black with silver blocking. Size 9" × 7" × 4". Easy to follow instructions and diagrams. Parts price list and easy build plans 30p (FREE with parts).

Total building cost £8·50

P. P. & Ins. 50p

(Overseas P. & P. £1)

ROAMER EIGHT Mk I

NOW WITH SWITCHED TONE CONTROL

7 Tunable Wavebands: MW1, MW2, LW, SW1, SW2, SW3 and Trawler Band. Built in Ferrite Rod Aerial for MW and LW. Retractable chrome plated Telescopic aerial for Short Waves. Push pull output using 600mW transistors. Car aerial and Tape record sockets. Selectivity switch. Switched earpiece socket complete with earpiece. 8 transistors plus 3 diodes. 7in. × 4in. Speaker. Air spaced ganged tuning condenser. Volume/on/off, tuning, wave change and tone controls. Attractive case in rich chestnut shade with gold blocking. Size 9 × 7 × 4in. approx. Easy to follow instructions and diagrams. Parts Price List and Easy Build Plans 25p (FREE with parts).

Total building cost £6·98 P. P. & Ins. 41p.
(Overseas P. & P. £1)

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MEDIUM and LONG WAVE PORTABLE. Specially designed circuit for easy construction incorporating 7 transistors and 2 diodes, air spaced tuning capacitor, push pull output using 600 mw transistors, heavy duty loudspeaker for quality sound and room filling volume, internal Ferrite Rod aerial. Volume/on/off control, tuning control and wave change switch. Handsome, strongly made wooden case, size 11¼" × 7½" × 3½" with carrying handle and black knobs with spun silver inserts. The ideal radio for those who are comparatively inexperienced in electronic construction. Easy build plans are supplied free with parts or available separately for 25p.

Total building costs £4·98 P. P. & Ins. 41p
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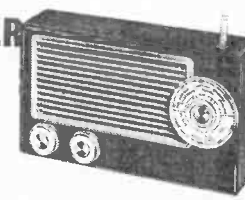
ROAMER SIX



6 Tunable Wavebands: MW, LW, SW1, SW2, Trawler band plus an extra M.W. band for easier tuning of Luxembourg etc. Sensitive ferrite rod aerial and telescopic aerial for Short Waves. 3in. Speaker. 8 stages—6 transistors abd 2 diodes including Micro-Alloy R.F. Transistors, etc. Attractive black case with red grille, dial and black knobs with polished metal inserts. Size 9 × 5½ × 2⅞in. approx. Easy build plans and parts price list 15p (FREE with parts). Earpiece with plug and switched socket for private listening 30p extra.

Total building costs £3·98 P. P. & Ins. 26p
(Overseas P. & P. £1)

POCKET FIVE

3 Tunable Wavebands: MW, LW, Trawler Band with extended M.W. band for easier tuning of Luxembourg, etc. 7 stages—5 transistors and 2 diodes, supersensitive ferrite rod aerial, fine tone moving coil speaker. Attractive black and gold case. Size 5½ × 1½ × 3½in. Easy build plans and parts price list 10p (FREE with parts). Earpiece with plug and switched socket for private listening 30p extra.

Total building costs £2·23 P. P. & Ins. 21p
(Overseas P. & P. 63p)

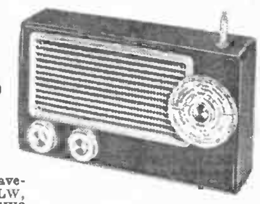
TRANSONA FIVE

NOW WITH 3in SPEAKER

3 Tunable Wavebands: MW, LW and Trawler Band. 7 stage—5 transistors and 2 diodes, ferrite rod aerial. tuning condenser volume control, fine tone 3in. moving coil speaker. Attractive case with red speaker grille. Size 6¼ × 4½ × 1½in. Easy build plans and parts price list 10p (FREE with parts). Earpiece with plug and switched socket for private listening 30p extra.

Total building costs £2·50 P. P. & Ins. 22p
(Overseas P. & P. 63p)

TRANS EIGHT



6 Tunable Wavebands: MW, LW, SW1, SW2, SW3 and Trawler Band. Sensitive ferrite rod aerial for M.W. and L.W. Telescopic aerial for Short Waves. 3in. Speaker. 8 improved type transistors plus 3 diodes. Attractive case in black with red grille, dial and black knobs with polished metal inserts. Size 9 × 5½ × 2⅞in. approx. Push pull output. Battery economiser switch for extended battery life. Ample power to drive a larger speaker. Parts price list and easy build plans 25p (FREE with parts). Earpiece with plug and switched socket for private listening 30p extra.

Total building costs £4·48 P. P. & Ins. 31p
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ROAMER EIGHT	☐	TRANS EIGHT	☐
TRANSONA FIVE	☐	ROAMER SIX	☐
POCKET FIVE	☐	EDU-KIT	☐

Parts price list and plans for ....

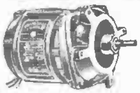
Name ....

Address ....

....

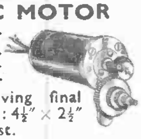
EE.1

BODINE TYPE N.C.I. GEARED MOTOR



(Type 1) 71 r.p.m. Torque 10lb. inch. Reversible. 1/70th h.p., 50 cycle, 0·38 amp. (Type 2) 28 r.p.m. Torque 20lb. inch. Reversible. 1/80th h.p., 50 cycle, 0·28 amp. "As new" condition. Input voltage of motor 115V a.c. Supplied complete with transformer for 230/240V a.c. input. Price, either type £3·15 plus 35p P. & P. or less transformer £2·13 plus 27p P. & P.

12 VOLT DC MOTOR



Powerful 1 amp. REVERSIBLE motor. Speed 3,750 RPM complete with external gear train (removable) giving final speed of 125 RPM. Size: 4½" × 2½" dia. Price 95p inc. post.

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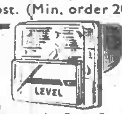
Fraction of makers' price. All at 75p incl. P.&P

MICRO SWITCH

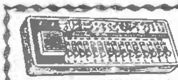
5 amp. c/o contacts. Fitted with removable push button assembly. Ex. P.O. 20 for £1 inc. post. (Min. order 20)

MINIATURE LEVEL METER



Approximately 300 micro amp basic, as fitted to Tape Recorders, etc. Strip type dual coloured dial. 50p + 8p P. & P.

ELECTRONIC ORGAN KIT



Easy to build, Solid State, Two full octave (less sharps and flats). Fitted hardwood case. Powered by two penlite 1½V batteries. Complete set of parts including speaker, etc., together with full instructions and 10 tunes. Price £3·00. P. & P. 22p.

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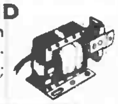
Complete set of parts, including: Crystal Diode, Ferrite Aerial, Drilled Chassis, and Personal Ear Piece. No soldering, easy to build, full step by step instructions. £1·75 inc. post.

230v AC SOLENOID



Extremely powerful with approx. 14lb. pull, 1" travel. Fitted with mounting feet. Size: 4" long, 2⅜" wide, 3" high. £2·00 incl. P. & P.

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280	9–12	2 c/o	73p*	2,500	36–45	6M	63p*
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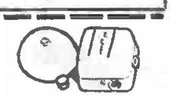

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BC108	11p	2N3704	17p	IN4007	19p
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50μF 25v	10p	500μF	36p	2500μF	77p
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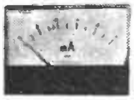

TYPE SW.100
100 x 80 mm.

50µA	£3·47½	20V. D.C. ..	£2·97½
50–0–50µA	£3·37½	50V. D.C. ..	£2·97½
100µA	£3·37½	300V. D.C.	£2·97½
100–0–100µA	£3·25	1 amp. D.C.	£2·97½
500µA	£3·12½	5 amp. D.C.	£2·97½
1mA	£2·97½	300V. A.C.	£2·97½
		VU Meter..	£3·75

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50µA	£3·12½	50V. D.C...	£2·47½
50–0–50µA	£2·97½	300V. D.C.	£2·47½
100µA	£2·97½	1 amp. D.C.	£2·47½
100–0–100µA	£2·87½	5 amp. D.C.	£2·47½
500µA	£2·62½	300V. A.C.	£2·62½
1mA	£2·47½	VU Meter..	£3·37½
20V. D.C...	£2·47½		

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Type MR.85P. 4½in. × 4¾in. fronts.

50µA	£3·60	50mA	£2·60
50–0–50µA	£3·10	100mA	£2·60
100µA	£3·10	500mA	£2·60
100–0–100µA	£3·10	1 amp.	£2·60
200µA	£2·87½	5 amp.	£2·60
500µA	£2·75	15 amp.....	£2·60
500–0–500µA	£2·60	30 amp.....	£2·60
1mA	£2·60	20V. D.C...	£2·60
1–0–1mA ..	£2·60	50V. D.C. ..	£2·60
5mA	£2·60	150V. D.C.	£2·60
10mA	£2·60	300V. D.C.	£2·60
		15V. A.C. ..	£2·60
		300V. A.C.	£2·60
		S Meter 1mA	£2·87½
		VU Meter..	£3·60
		1 amp. A.C.*	£2·60
		5 amp. A.C.*	£2·60
		10 amp. A.C.*	£2·60
		20 amp. A.C.*	£2·60
		30 amp. A.C.*	£2·60

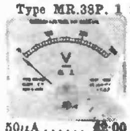
Type MR.52P. 2½in. square fronts.

50µA	£3·10	10V. D.C. ..	£2·00
50–0–50µA	£2·60	20V. D.C. ..	£2·00
100µA	£2·60	50V. D.C. ..	£2·00
100–0–100µA	£2·37½	300V. D.C.	£2·00
500µA	£2·25	15V. A.C. ..	£2·00
1mA	£2·00	300V. A.C.	£2·00
5mA	£2·00	S Meter 1mA	£2·10
10mA	£2·00	VU Meter ..	£3·10
50mA	£2·00	1 amp. A.C.*	£2·00
100mA	£2·00	5 amp. A.C.*	£2·00
500mA	£2·00	10 amp. A.C.*	£2·00
1 amp.	£2·00	20 amp. A.C.*	£2·00
5 amp.	£2·00	30 amp. A.C.*	£2·00

Type MR.65P. 3½in. × 3¼in. fronts.

50µA	3·37½	10V. D.C. ..	£2·10
50–0–50µA	£2·75	20V. D.C. ..	£2·10
100µA	£2·75	50V. D.C. ..	£2·10
100–0–100µA	£2·60	150V.D.C...	£2·10
200µA	£2·60	300V. D.C.	£2·10
500µA	£2·37½	15V. A.C...	£2·10
500–0–500µA	£2·10	50V. A.C...	£2·10
1mA	£2·10	150V. A.C.	£2·10
5mA	£2·10	300V. A.C.	£2·10
10mA	£2·10	500V. A.C.	£2·10
50mA	£2·10	S Meter 1mA	£2·37½
100mA	£2·10	VU Meter..	£3·37½
500mA	£2·10	50mA A.C.*	£2·10
1 amp.	£2·10	100mA A.C.*	£2·10
5 amp.	£2·10	200mA A.C.*	£2·10
10 amp.....	£2·10	500mA A.C.*	£2·10
15 amp. ..	£2·10	1 amp. A.C.*	£2·10
20 amp. ..	£2·10	5 amp. A.C.*	£2·10
30 amp. ..	£2·10	10 amp. A.C.*	£2·10
50 amp. ..	£2·37½	20 amp. A.C.*	£2·10
5V. D.C. ..	£2·10	30 amp. A.C.*	£2·10

Type MR.38P. 1 21/32in. square fronts.



50µA	£2·00	200mA	£1·37½
50–0–50µA	£1·87½	300mA	£1·37½
100µA	£1·87½	500mA	£1·37½
100–0–100µA	£1·75	750mA	£1·37½
200µA	£1·75	1 amp.	£1·37½
500µA	£1·50	2 amp.	£1·37½
500–0–500µA	£1·37½	5 amp.	£1·37½
1mA	£1·37½	10 amp. ..	£1·37½
1–0–1mA ..	£1·37½	3V. D.C. ..	£1·37½
2mA	£1·37½	10V. D.C...	£1·37½
5mA	£1·37½	15V. D.C...	£1·37½
10mA	£1·37½	20V. D.C...	£1·37½
20mA	£1·37½	100V. D.C.	£1·37½
50mA	£1·37½	150V. D.C.	£1·37½
100mA	£1·37½	300V. D.C.	£1·37½
150mA	£1·37½	500V. D.C.	£1·37½
		750V. D.C.	£1·37½
		15V. A.C...	£1·37½
		50V. A.C...	£1·37½
		150V. A.C.	£1·37½
		300V. A.C.	£1·37½
		500V. A.C.	£1·37½
		S Meter 1mA	£1·60
		VU Meter..	£2.10

Type MR.45P. 2in. square fronts.

50µA	£2·25	5 amp.	£1·50
50–0–50µA	£2·10	10V. D.C. ..	£1·50
100µA	£2·10	20V. D.C. ..	£1·50
100–0–100µA	£1·87½	50V. D.C. ..	£1·50
200µA	£1·87½	300V. D.C.	£1·50
500µA	£1·60	15V. A.C. ..	£1·50
500–0–500µA	£1·50	300V. A.C.	£1·50
1mA	£1·50	S Meter 1mA	£1·87½
5mA	£1·50	VU Meter..	£2·25
10mA	£1·50	1 amp. A.C.*	£1·50
50mA	£1·50	5 amp. A.C.*	£1·50
100mA	£1·50	10 amp. A.C.*	£1·50
500mA	£1·50	20 amp. A.C.*	£1·50
1 amp	£1·50	30 amp. A.C.*	£1·50

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Type MR.65. 3½in. square fronts.

25µA	£3·50	500mA	£1·75
50µA	£2·37½	1 amp.	£1·75
50–0–50µA	£2·25	5 amp.	£1·75
100µA	£2·25	15 amp.....	£1·75
100–0–100µA	£2·25	30 amp.....	£1·75
500µA	£2·10	50 amp.....	£1·75
1mA	£1·75	5V. D.C. ..	£1·75
1–0–1mA ..	£1·75	10V. D.C. ..	£1·75
5mA	£1·75	20V. D.C. ..	£1·75
10mA	£1·75	50V. D.C. ..	£1·75
50mA	£1·75	150V. D.C.	£1·75
100mA	£1·75	300V. D.C.	£1·75
		30V. A.C.*	£1·75
		50V. A.C.*	£1·75
		150V. A.C.*	£1·75
		300V. A.C.*	£1·75
		500mA A.C.*	£1·75
		1 amp. A.C.*	£1·75
		5 amp. A.C.*	£1·75
		10 amp. A.C.*	£1·75
		20 amp. A.C.*	£1·75
		30 amp. A.C.*	£1·75
		50 amp. A.C.*	£1·75
		VU Meter ..	£3·10

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Type ED.107. Size overall 100mm × 90mm × 108mm. A new range of high quality moving coil instruments ideal for school experiments and other bench applications. 3" mirror scale. The meter movement is easily accessible to demonstrate internal working. Available in the following ranges:

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100µA	£4·25	50V d.c.	£3·97
1mA	£3·97	300V d.c	£3·97
50-0-50µA ...	£4·25		
1-0-1mA.....	£3·97	Dual range	
1A d.c.	£3·97	500mA/5A d.c.	£4·25
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50µA	£3·00	500µA	£2·60
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100µA	£2·87½	300V. A.C.	£2·37½
100–0–100µA	£2·75	VU Meter..	£3·25
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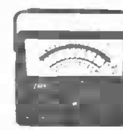

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Features A.C. current ranges. 20,000 o.p.v.
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0/2·5/10/50/250/500/1000 V AC.
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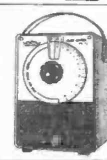
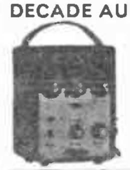


TE-20D RF SIGNAL GENERATOR

Accurate wide range signal generator covering 120 Kc/s-500 Mc/s on 6 bands. Directly calibrated Variable R.F attenuator, audio output. Xtal socket for calibration. 220/240V. A.C. Brand new with instructions. £15. Carr. 37½p. Size 140 × 215 × 170 mm.

BELCO DA-20 SOLID STATE DECADE AUDIO OSCILLATOR



New high quality portable instrument. Sine 1 Hz to 100 KHz. Square 20 Hz to 20 KHz. Output max + 10 dB (10 K ohms). Operation 220/240v. A.C. Size 215mm x 150mm x 120mm.
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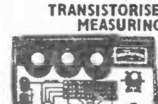

A new portable bridge offering excellent range and accuracy at low cost. Ranges: R. 1 Ω–11·1 meg Ω 6 Ranges ±1% L.1 µ H - 111 HENRYS 6 Ranges2=%C.10pF±1110mFd. 6 Ranges ±2%. TURNS RATIO 1:1/1000–1:11100. 6 Ranges ±1%. Bridge voltage at 1,000 cps. Operated from 9 volts. 100µA. Meter indication. Attractive 2 tone metal case. Size 7¾ × 5 × 2in. £20. P. & P. 25p

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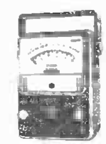
TMK MODEL TW-50K 46 ranges, mirror scale, 50K/Vol. D.C. 5K /Volt A.C. D.C.: Volts ·125, ·25, 1·25, 2·5, 5, 10. 25, 50, 125, 250, 500, 1000V, A.C. Volts: 1·5, 3, 5, 10, 25. 50, 125, 250, 500, 1000V. D.C. Current: 25, 50uA, 2·5, 5, 25. 50, 250, 500mA, 5, 10 amp, Resistance: 10K, 100K, 1 MEG, 10 MEG Ω. Decibels: −20 to +81·5 dB. £8·50. P. & P. 17½p

HT100B4 MULTI-METER
Features A.C. current ranges. 100,000 o.p.v. Mirror Scale, Overload protection.
0/·5/2·5/10/50/250/500/1000 V DC.
0/2·5/10/50/250/1000 V AC.
0/10/250uA/2·5/25/250 MA/10 Amp DC.
10 Amp AC.
0/20K/200K/2MEG/20 MEG.
- 20 + 62 db.
£12·50, P. & P. 25p.



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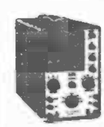
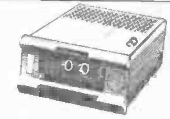
Model U437 10,000 o.p.v. A first class versatile instrument manufactured in U.S.S.R. to the highest standards. Ranges: 2·5/10/50/250/500/1000v D.C. 2·5/10/50/250/500/100v/ AC. DC Current 100 wA/1/10/100mA/1A. Resistance 300 ohms/3/30/300K/3M Ω. Complete with batteries, test leads, instructions and sturdy steel carrying case. OUR PRICE £5·97 P. & P. 25p.

TO-3 PORTABLE OSCILLOSCOPE



3in. tube. Y amp. Sensitivity 0·1v p-p/CM. Bandwidth 1·5 cps–1·5 MHz. Input imp. 2 meg Ω 25pF X amp. sensitivity 0·9v. p-p/CM. Bandwidth 1.5 cps –800KHz. Input imp. 2 meg Ω 20pF. Time base. 5 ranges 10 cps–300 KHz. Synchronization. Internal/external. Illuminated scale 140 × 215 × 330 mm. Weight 15½ lb. 220/240V. A.C. Supplied brand new with handbook. £37·50. Carr. 50p

HONEYWELL DIGITAL VOLTMETER VT.100



Can be panel or bench mounted. Basic meter measures 1 volt D.C. but can be used to measure a wide range of AC and DC volt, current and ohms with optional plug in cards. Specification: Accuracy: ± 0.2, ± 1 digit. Resolution: 1mV. Number of digits: 3 plus fourth overrange digit. Overrange: 100% (up to 1·999) Input impedance: 1000 Meg ohm. Measuring cycle: 1 per second. Adjustment: Automatic zeroing, full scale adjustment against an internal reference voltage. Overload: to 100v. D.C. Input: Fully floating (3 poles). Input power: 110-230v. A.C. 50/60 cycles. Overall size: 5¾in. x 2 13/16in. x 83/16in.

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2N697	15p
2N698	25p
2N699	42p
2N706	9p
2N706A	11p
2N708	15p
2N709	45p
2N718	25p
2N718A	30p
2N726	25p
2N727	25p
2N914	17p
2N916	17p
2N918	30p
2N929	22p
2N930	24p
2N937	52p
2N1090	22p
2N1091	22p
2N1131	25p
2N1132	25p
2N1302	17p
2N1303	17p
2N1304	22p
2N1305	22p
2N1306	24p
2N1307	24p
2N1308	25p
2N1309	24p
2N1507	17p
2N1613	21p
2N1631	35p
2N1632	30p
2N1637	30p
2N1638	27p
2N1639	27p
2N1701	110p
2N1711	24p
2N1889	32p
2N1893	37p
2N2147	72p
2N2160	57p
2N2193	40p
2N2193A	42p
2N2194	27p
2N2194A	30p
2N2217	27p
2N2218	20p
2N2219	20p
2N2220	25p
2N2221	25p
2N2222	20p
2N2222A	25p
2N2297	30p
2N2368	15p
2N2369	17p
2N2369A	17p
2N2410	42p
2N2483	27p
2N2484	32p
2N2539	22p
2N2540	22p
2N2613	27p
2N2614	30p
2N2646	47p
2N2711	25p
2N2712	25p
2N2713	27p
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2N2925	15p
2N2926G	12p
2N2926O	12p
2N2926Y	12p
2N3011	24p
2N3014	25p
2N3053	20p
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2N3714	200p
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40603	50p
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AC126	20p
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AC128	20p
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ASY50	25p
ASY51	32p
ASY54	25p
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ASY86	32p
ASZ21	37p
AUY10	160p
BC107	10p
BC108	10p
BC109	10p
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BC186	25p
BC187	27p
BC212L	12p
BC213L	12p
BC214L	15p
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BCY32	50p
BCY33	20p
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BCY72	15p
BCY78	30p
BCY79	30p
BCZ10	27p
BCZ11	40p
BD112	50p
BD116	112p
BD121	65p
BD123	80p
BD124	75p
BD131	75p
BD132	65p
BDY10	125p
BDY20	105p
BDY61	125p
BDY62	100p
BF115	25p
BF117	47p
BF152	28p
BF154	38p
BF158	28p
BF159	57p
BF163	35p
BF167	25p
BF173	30p
BF177	30p
BF178	25p
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BF185	20p
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BF195	15p
BF196	15p
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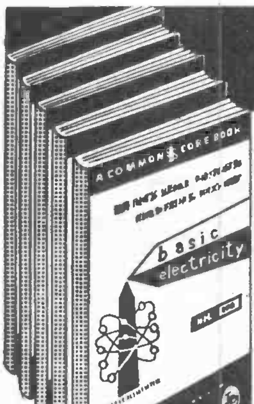

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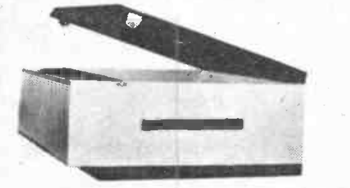

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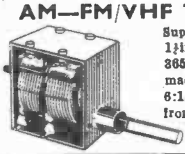

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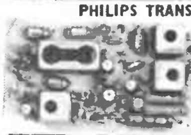

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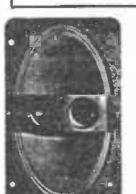

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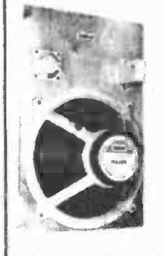

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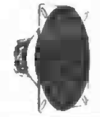

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