PHILIPS

COMPACT ELECTRONIC ENGINEER

INSTRUCTION HANDBOOK FOR THE EE 1050 BASIC KIT AND THE EE 1051 AND EE 1052 ADD–ON KITS.

WARNING.

All the circuits in these kits have been designed to operate from a 9 volt supply. This voltage is provided from six 1.5 Volt batteries, (Ever Ready HP 7, or their equivalent). Never attempt to attach these circuits to a Mains Voltage Supply. You will burn both the components and yourself.

IMPORTANT: This book should be kept safely. It describes experiments which are possible using the 1050 Basic kit *and* the ADD–ON kits 1051 and 1052.

Experiments possible using the **EE 1050** kit only

Circuit and Mounting Card Number	Description
1	Flashing Light and Burglar Alarm
2	Flashing Light with Adjustable Frequency
3	Traffic Beacon with Adjustable Frequency
4	Gramophone Amplifier
7	Automatic Night Light
8	Wetness Indicator
9	Tell-Tale Light
11	Acoustic Relay
13	Morse Code Trainer
15	Light Dependent Tone Generator
21	Lightmeter
22	Time Switch

Experiments possible using the **EE 1050 Kit** AND **ADD–ON Kit 1051** together

Circuit and Mounting Card Number	Description
5	Gramophone Amplifier with single ended push-pull
6	Gramophone Amplifier with frequency correction
10	Tell-Tale Light with Sound
14	Morse Code Trainer with Loudspeaker
17	Ambulance Klaxon
18	Telephone Signal Generator

Experiments possible using the **EE 1050 Kit** AND **ADD–ON Kit 1052** together

Circuit and Mounting Card Number	Description
16	Variable Audio Frequency Generator
19	Telephone Amplifier
23	Two-Transistor Medium Wave Radio

Experiments possible using the **EE 1050 Kit** AND **ADD–ON Kits 1051** AND **1052** together

Circuit and Mounting Card Number	Description
12	Acoustic and Light Dependent Relay
20	Telephone Amplifier with Loudspeaker
24	Medium Wave Radio with Loudspeaker

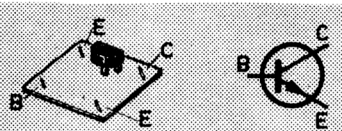
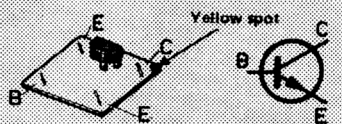
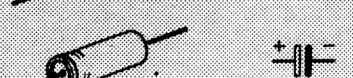
PHILIPS

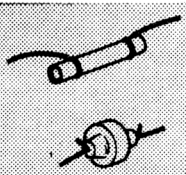
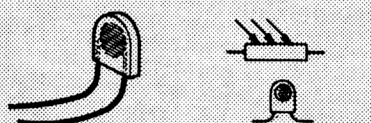
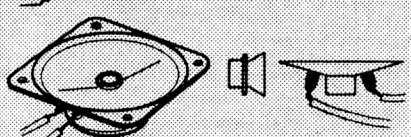
Compact Electronic Engineer

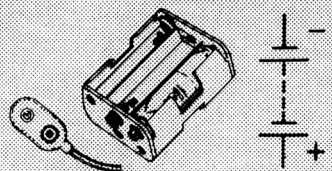
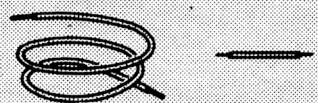
Instruction Handbook for the **EE 1050** Basic Kit and the **EE 1051** and **EE 1052 ADD-ON Kits**

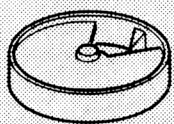
CONTENTS

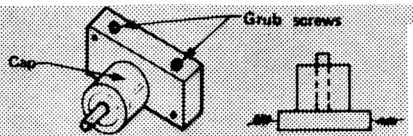
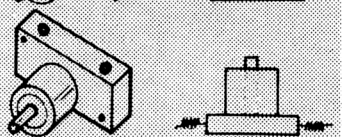
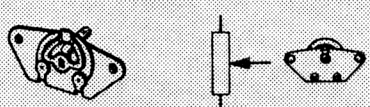
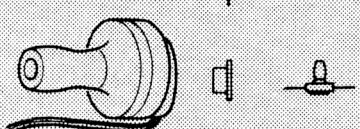
LIST OF COMPONENTS

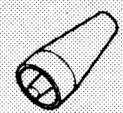
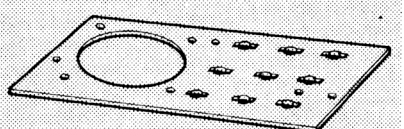
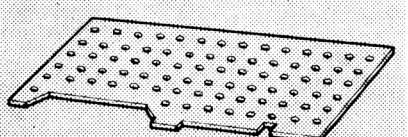
Component and Symbol	Reference Number	Description	Quantity per Kit 1050	1051	1052
	1	**Transistor (T) BF194**	1	—	—
	2	**Transistor (T) BC148**	1	1	—
	3	**Diode (D) OA85**	—	—	1
	4	**Resistor (R)** EE 1050: 1 x 47 Ohm, 1 x 220 Ohm, 1 x 1,000 Ohm 1 x 2,200 Ohm, 1 x 3,300 Ohm, 1 x 4,700 Ohm, 1 x 10,000 Ohm, 1 x 47,000 Ohm, 1 x 220,000 Ohm, 1 x 470,000 Ohm. EE 1051: 1 x 10 Ohm, 1 x 100 Ohm, 1 x 470 Ohm, 1 x 1,500 Ohm, 1 x 4,700 Ohm, 1 x 10,000 Ohm, 1 x 15,000 Ohm, 2 x 22,000 Ohm, 1 x 47,000 Ohm, 1 x 100,000 Ohm. EE1052: 1 x 10,000 Ohm, 2 x 22,000 Ohm, 1 x 100,000 Ohm.	10	11	4
	5	**Polyester capacitor (C)** EE 1050: 2 x 0.1 uF, 1 x 47,000 pF. EE 1051: 1 x 22,000 pF. EE 1052: 1 x 0.22 uF, 1 x 22,000 pF.	3	1	2
	6	**Electrolytic capacitor (C)** EE 1050: 1 x 125 uF, 1 x 10 uF. EE 1051: 1 x 125 uF, 1 x 4 uF.	2	2	—

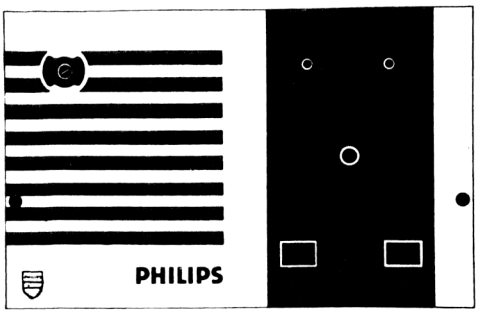
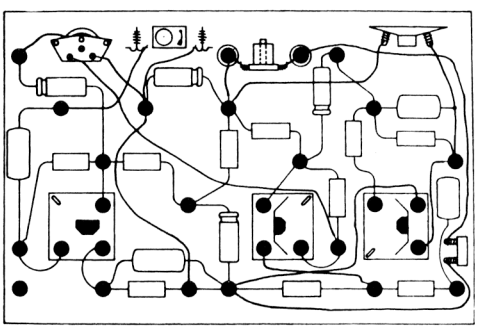
Component and Symbol	Reference Number	Description	Quantity per Kit 1050	1051	1052
	7	**Ceramic capacitor (C)** EE 1052: 1 x 1000 pF.	—	—	1
	8	**Choke (L)**	—	—	1
	9	**Aerial coil (L)** **1 = red 3 = green** **2 = yellow 4 = grey**	—	—	1
	10	**Light Dependent Resistor (LDR)**	1	—	—
	12	**Variable capacitor (C) 5-180pF**	—	—	1
	13	**Loudspeaker 150 Ohm**	—	1	—
	14	**Lamp 6 V, 50 mA**	1	—	—

Component and Symbol	Reference Number	Description	Quantity per Kit 1050	1051	1052
	15	Battery holder for 6 penlite cells and push-on contact (Ever Ready HP7 batteries or their equivalent)	1	–	–
	17	Insulated wire	4 m	4 m	4 m
	18	Ferroxcube rod	—	—	1
	19	Rubber grommet	—	—	2
	20	Hairpin spring	23	23	23
	21	Large coil spring	23	23	23

Component and Symbol	Reference Number	Description	Quantity per Kit 1050	1051	1052
	23	Dial knob	—	—	1
	24	Plate for mounting variable capacitor	—	—	1
	25	Knob	1	—	—
	26	Lamp holder	1	—	—
	27	Window for lamp	1	—	—
	28	Rubber band	5	—	—

Component and Symbol	Reference Number	Description	Quantity per Kit 1050	1051	1052
	29	Push on/push off switch (Black)	1	–	–
	30	Push button contact switch (Brown)	1	–	–
	32	Grub screw (3 mm)	1	—	1
	33	Square nut (3 mm)	3	—	3
	36	Screw (3 x 12 mm)	—	—	2
	40	Potentiometer (R) 10,000 Ohms	1	—	—
	41	Earphone	1	—	—
	42	Extension shaft for potentiometer	1	—	—

Component and Symbol	Reference Number	Description	Quantity per Kit 1050 1051 1052
	44	Screw (3 x 8 mm)	2 — —
	45	Screw for mounting chassis	2 — —
	46	Bracket for mounting chassis	2 — —
	47	Leg	2 — —
	48	Frontpanel	1 — —
	49	Mounting plate	1 — —

Component and Symbol	Reference Number	Description	Quantity per Kit 1050	1051	1052
	63	Front Card	1	1	1
	64	Mounting Cards (1–24)	1	–	–

MOUNTING INSTRUCTIONS

Introduction

In this kit you will find a number of mounting cards which are marked from 1 to 24. Some of these are for use with the Add-On Kits *EE1051* and *EE 1052* and you should, therefore, keep all the mounting cards which are in the *EE 1050 kit.* Each card shows which kit has to be used. These mounting cards must be put on the mounting plate to show which components must be used and how the components are connected together.

The components which are mounted on the front panel of the kit which you are building are indicated with symbols at the top edge of the mounting card.

In each kit you will also find a front card, coloured blue and grey, which has to be placed on the front panel. The front card which has to be used with each circuit is as follows.

Front card from *EE 1050* is used with circuits 1, 2, 3, 4, 7, 8, 9, 11, 13, 15, 19, 21 and 22.

Front card from *EE1051* is used with circuits 5, 6, 10, 12, 14, 17, 18 and 20.

Front card from *EE1052* is used with circuits 16, 23 and 24.

Before you start to experiment check which mounting card and front card you need for that experiment. For example circuit 1 needs mounting card number 1 and the front card from the *EE1050.*

Having done this you can take the mounting plate and the mounting card, and the front panel and the front card and connect them together to form the chassis. You can then mount the front panel components – pushbutton switches, loudspeaker, potentiometer – where necessary. Table 1 shows the position on the front card of the various large components. The next step is to mount the resistors, capacitors and transistors on the mounting card in the positions shown.

The next instructions tell you how to mount each component in the kit, following that, you are taken step-by-step through the first experiment. After that you will be able to make the rest of the circuits by checking back to these instructions.

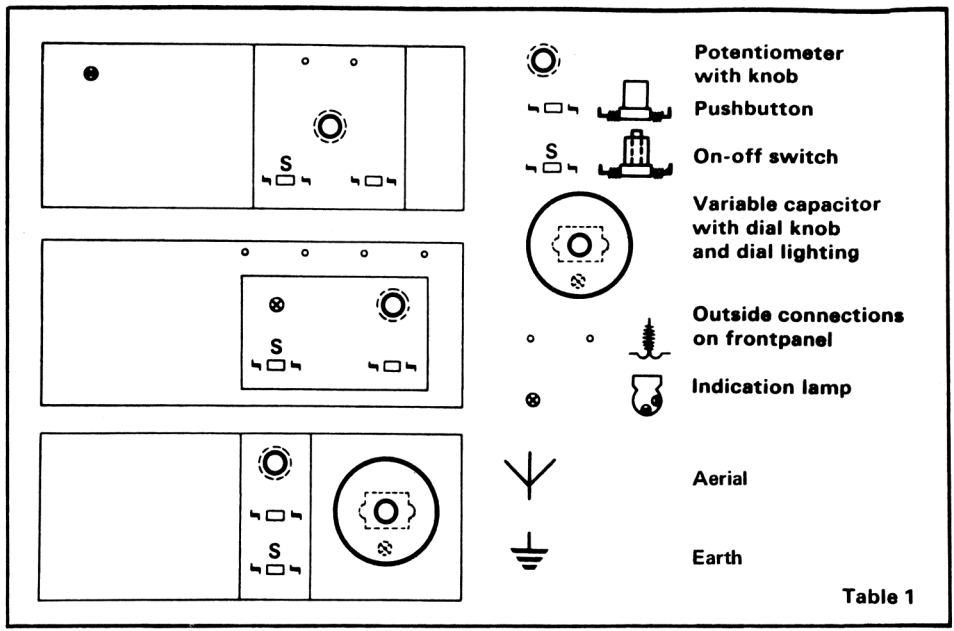


Table 1

The Chassis

Take the mounting plate (49) and the mounting card (64) for the circuit which you wish to build. Hold the mounting plate with the largest cut-out portion facing away from you and the shiny side uppermost. (Fig.1). Take the mounting card and push out all the cut-out holes, these holes are then the connecting points of the circuit. Place the mounting card on the plate so that you can read the numbers on the card.

Line-up the holes on the plate and the card and then push hairpin springs (20) through the plate and card from underneath. (Fig.2).

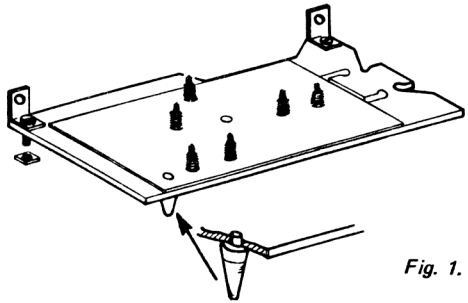


Fig. 1.

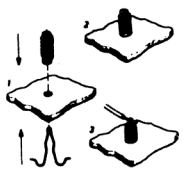


Fig. 2.

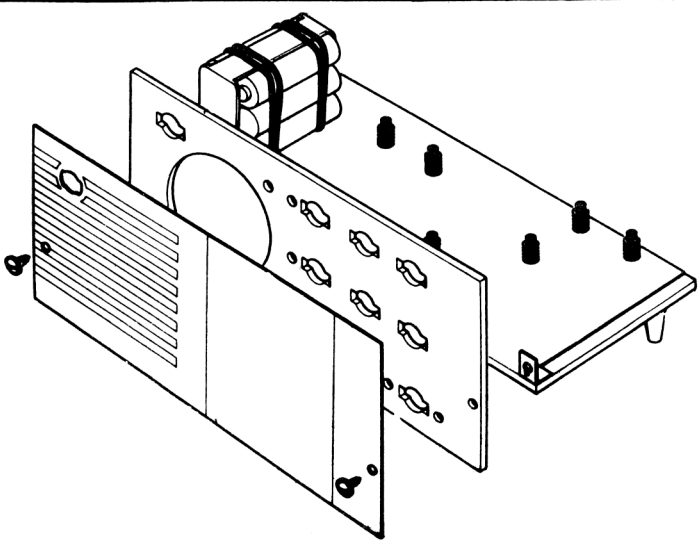


Fig. 3.

Do not push springs through the circled holes. Next place the mounting plate flat on a table and push the large coil springs (21) over the hairpin springs. Fix two brackets (46) to the mounting plate with two screws (44) and two nuts (33). Finally screw the front card (63) and the front panel (48) to the mounting plate with two screws (45) as shown by Fig.3 and push the legs (47) into the mounting plate.

FIXING THE VARIOUS PARTS

Loudspeaker Fig.4.

Position the loudspeaker (13) as shown in Fig.4 and put four hairpin springs into the front panel from the outside. Note that you might have to make holes for three of the springs. Put the mounting holes of the speaker over the springs and push four large coil springs (21) over the hairpin springs.

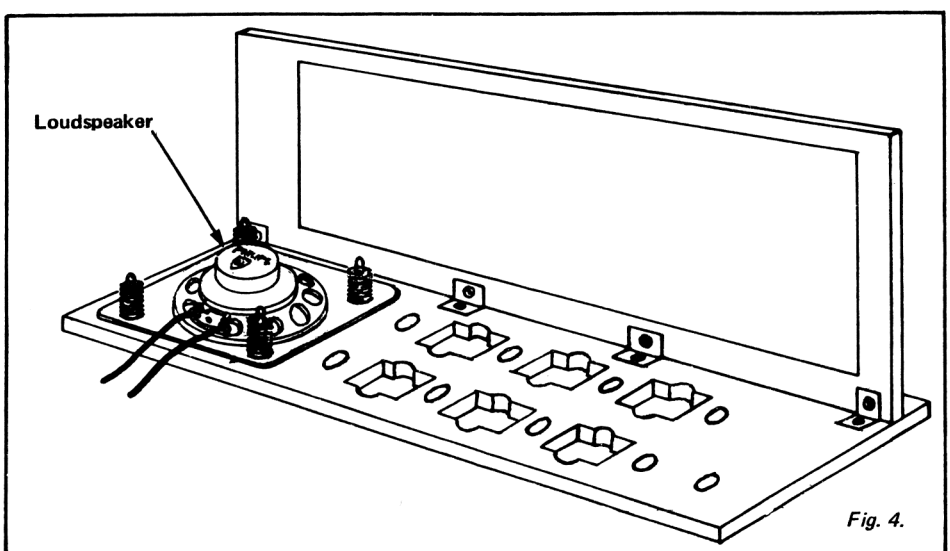


Fig. 4.

Potentiometer Fig.5.

Push two hairpin springs through the front panel from the outside and put large coil springs over them. Take the potentiometer (40) and put the extension shaft (42) on to it. Put the potentiometer mounting holes over the two springs and fix it with two pieces of wire as shown in the figure.

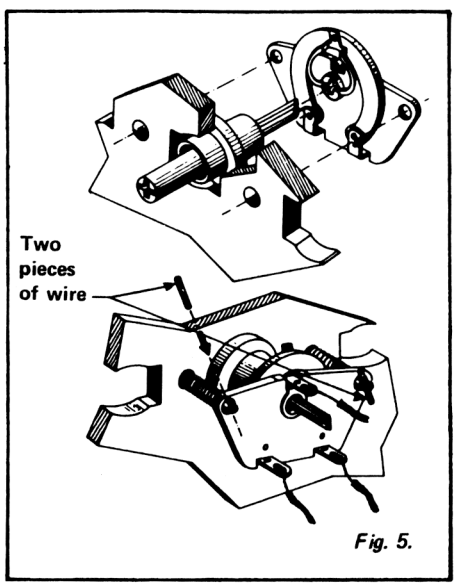


Fig. 5.

Variable capacitor Fig.6.

Attach the capacitor (12) to the front panel with two screws (36) and two nuts (33). Do not forget to put the plate (24) in between them or the shaft will protrude too far.

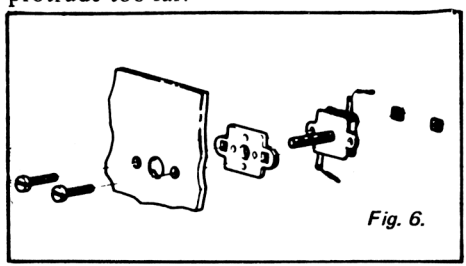


Fig. 6.

Push on/Push off Switch Fig.7.

The push on/push off switch (29) is the switch with the black body. To mount this simply unscrew the cap and, keeping the grub screws facing downwards, push the switch through the front panel from the back and screw the cap back in place. To connect this switch into the circuit when required, unscrew the grub screws one or two turns and push in the bared end of wire. Re-tighten the grub screws.

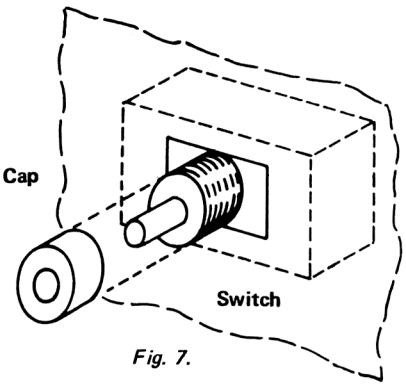


Fig. 7.

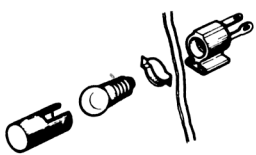


Fig. 8.

Fig. 9.

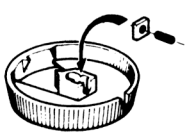


Fig. 10.

Pushbutton Contact Switch.

The pushbutton contact switch (30) has a brown body. It is mounted in exactly the same way as the previous switch.

Indicator lamp Fig.8.

Hold the lampholder (26) behind the hole and screw the bulb (14) into it through the hole.

Slide the red window (27) over the bulb with the tabs over the lampholder.

Knobs Fig. 9 and 10.

Put a grubscrew (32) into a square nut (33) for only a few turns. Put this assembly into the rectangular hole of the knob. Slide the knob on to the shaft and secure it with a small screwdriver. The dial knob has to be mounted so that the pointer indicates the P on the scale when turned to right.

Aerial rod Fig.11.

Slide the aerial coil (9) over the ferrox-cube rod (18). Put a rubber grommet (19) on both sides.

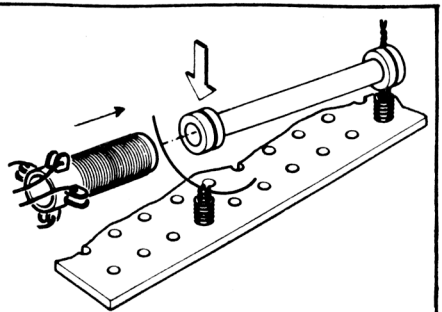
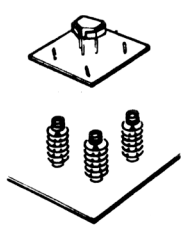


Fig. 11.



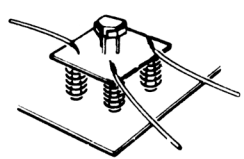


Fig. 12.

Take two pieces of wire (about 3 inches or 8 cm) and stick them through the hairpin springs on which the rod must be mounted. Pull the wire through the slots of the grommets and twist the ends.

The copper core of the ends must not make contact.

Transistors Fig. 12.

Slide the slotted base plate over the three hairpin springs. See that these springs are put in the right position. Push the plate down and push connecting wires through the springs.

Battery holder Fig.13. and Fig.14.

The battery holder (15) is made to hold six 1.5 Volt batteries which are Ever-Ready HP7 or their equivalent. These batteries then provide the voltage supply for all the experiments in this kit. You must never attempt to plug these circuits into the mains supply.

To load the batteries into the holder simply take each battery with the base

against the spring in the holder and push it into place. Attach the assembly on to the mounting plate by using two rubber bands as shown in Fig.14. Finally clip the push-on contact on to the battery holder, the red wire is the positive one.

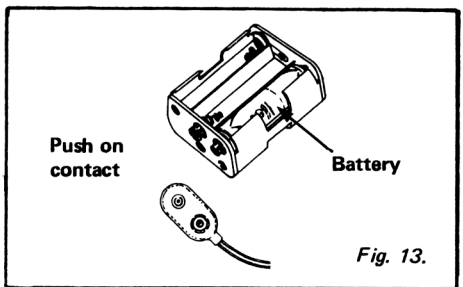


Fig. 13.

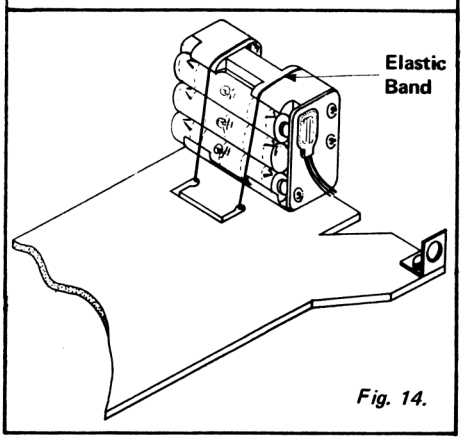


Fig. 14.

Outside connections on the front panel

A hairpin spring is put into the hole from behind.

A bared wire end is also put through the hole and a large coil spring is then pushed over the spring from the front side. Push the large coil spring firmly so that the wire is squeezed tightly between the spring and the panel and cannot be pulled out.

Note.

Transistor BC 148. This transistor (2) was once supplied with a heat sink, a

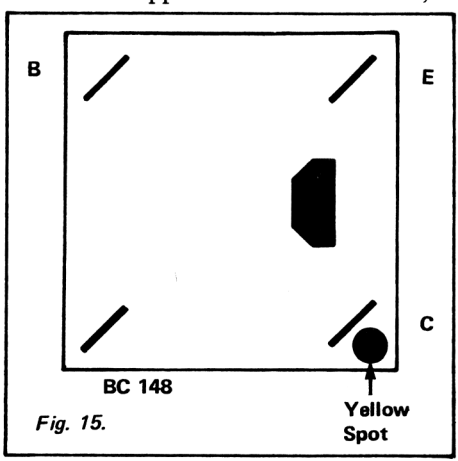


Fig. 15.

metal plate which enabled the heat from the transistor to be quickly lost. Better methods of making this component have meant that this heat sink has now been left off. But note that if you are using this transistor with a Philips *Mechanical Engineer* kit you should apply for this heat sink and clip it around the transistor.

So that you can easily see these components they are marked with a yellow spot next to the collector spring terminal. Place the transistor so that this spot is next to collector spring terminal marked C, as shown in Fig.15.

CAPACITOR NUMERICAL CODING

The capacitors packed with this kit may not at first sight appear to be correct. There are several ways that manufacturers use for marking. The markings are all based on the micro-farad which is expressed as the whole number from one.

micro-farad	(μF)	=	1.000000μF
nano-farad	(nF)	=	0.001000μF
pico-farad	(pF)	=	0.000001μF

Most numerically marked capacitors are either shown in μF or pF.

Examples:

10 pF	=	0.000010	μF
22 pF	=	0.000022	μF
100 pF	=	0.000100	μF
1,000 pF	=	0.001000	μF
10,000 pF	=	0.010	μF
22,000 pF	=	0.022	μF
47,000 pF	=	0.047	μF
100,000 pF	=	0.1	μF

From the above a capacitor marked 6,800 pF would also be equal to one marked 0.0068 μF. Capacitors expressed in pF will often be marked with a k after the number which signifies 1000.

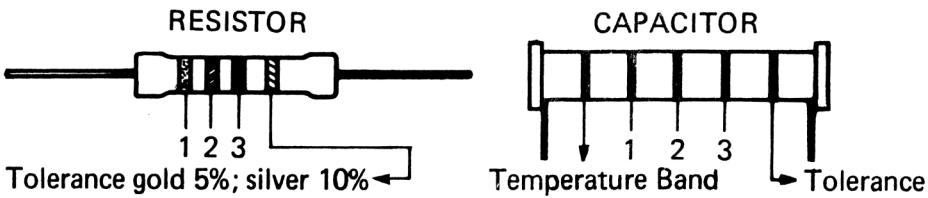
Example:

1k pF is the same as 1000 pF or 0.001 μF
22k pF is the same as 22000 pF
or 0.022 μF.

The nano-farad is often shown on circuit diagrams. As will be seen from the above 1 nF = 1000 pF.

Colour Code and Numerical Marking for Resistors and Capacitors.

All capacitors (5, 6, 7) and resistors (4) have their values marked on them by one of two methods. Resistors have colours on them which correspond to numbers and by using the Colour Code you can work out the value of any resistor coded in this way. Capacitors use both numbers (a numerical system of marking) and the Colour Code. Ceramic capacitors (7) are usually marked with the Colour Code and other types of



Colour	1st band (1st digit)	2nd band (2nd digit)	3rd band (multiplication factor)
black	0	0	X 1
brown	1	1	X 10
red	2	2	X 100
orange	3	3	X 1,000
yellow	4	4	X 10,000
green	5	5	X 100,000
blue	6	6	X 1,000,000
violet	7	7	
grey	8	8	
white	9	9	

capacitor, such as electrolytic (6) and polyester (5), use the numerical coding.

Any resistor or capacitor value may be worked out from the above table. The first colour gives the first digit of the value, the second colour gives the second digit of the value and the third band gives the multiplication factor. Thus a resistor marked brown, black, brown is 1 and 0, i.e. 10, times 10 = 10 X 10 = 100. The fourth band on a resistor gives the manufacturing tolerance, gold is a tolerance of 5% and silver is a tolerance of 10%. Some but not all capacitors have five bands of colour and in this case the first band shows the temperature range of the component.

Resistors which are colour coded have values of OHMS. Capacitors which are colour coded have values of PICO-FARADS (pF) = 1 X 10^{-6} Farads or 0.000001 Farad.

The following colours and values will be found on the resistors and the ceramic capacitor in the kits.

Resistors

10 ohm	brown black black
47 ohm	yellow violet black
100 ohm	brown black brown
220 ohm	red red brown
470 ohm	yellow violet brown
1,000 ohm	brown black red
1,500 ohm	brown green red
2,200 ohm	red red red
3,300 ohm	orange orange red
4,700 ohm	yellow violet red
10,000 ohm	brown black orange
15,000 ohm	brown green orange
22,000 ohm	red red orange
47,000 ohm	yellow violet orange
100,000 ohm	brown black yellow
220,000 ohm	red red yellow
470,000 ohm	yellow violet yellow

Capacitor

1000 pF	brown black red

A CHECKLIST

You are now ready to begin to build the first circuit and once you have you will want to see if it works. However before you switch on it is better for you and the components if you check the following points:

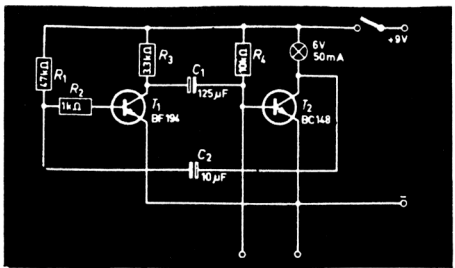
1. Have you correctly identified all your components with due reference to the explanation on the last page?
2. Have you connected up the front panel components, switches etc. correctly?
3. Are your transistors connected correctly and in the right position?
4. If you are using a circuit with the light bulb, is the bulb working? Connect across the battery wires to check it. Is it screwed into the holder tightly?
5. Are the batteries in your battery holder assembled the correct way round, and have you connected the wires to the circuit correctly? Red wire is positive.
6. Make sure that the hairpin springs are not touching each other underneath the mounting plate.
7. If you are using the aerial coils have you connected the wires from the coils as indicated?
8. Have you understood what the circuit does and how it should be set up if it requires adjustment? If not, read carefully the circuit descriptions.

CIRCUIT DESCRIPTIONS AND DATA

Flashing Light and Burglar Alarm Circuit One

Flashing lights are used a great deal in the world today. They are used for many purposes such as warning lights, direction indicators on cars, traffic lights, aeroplane beacons, obstacle lights, alarms etc. Turning the light on and off can be done in a number of ways. It is often done with the aid of a relay switch, but transistors are used for this purpose more often nowadays, since they have no contacts to burn out and no moving parts to wear out.

Circuit diagram 1 shows the way transistors are connected up to make an automatic flashing light. The transistor T2 switches the lamp current on and off, while the transistors T1 and T2 together with the resistors and capacitors deter-



Circuit Diagram 1

mine the rate at which this happens. The rate of flashing is not very fast as you will notice. This can be speeded up by replacing the resistor R1 of 47k ohm by a resistor of 10k ohm.

This circuit can also be used to construct a burglar alarm. The two outside contact springs are connected to two metal drawing pins on a doorpost or a window frame. A piece of metal foil on the door or the window makes contact between the two drawing pins. The light stays off as long as the door or window remains closed. As soon as the door or window opens, the contact is broken and the light starts flashing. Should the intruder be clever enough to cut the wire before opening the door, then the contact is broken anyway and the light will start flashing.

For this first experiment we will now go through the method of construction step-by-step.

Take mounting card (64) marked 1, 1050, in the bottom left hand corner. Place this card on the mounting plate (49) as shown previously. Push out the holes and push through the hairpin springs (20) and mount the large coil springs (21). Now connect the mounting plate and card and the front panel (48) and the front card (63) to form the chassis. You can now mount the front panel components which are needed for this circuit. These are the push on/push off switch (29), the indicator lamp assembly as shown in Fig. 8 and the two front panel contacts which can be taken to the drawing pins.

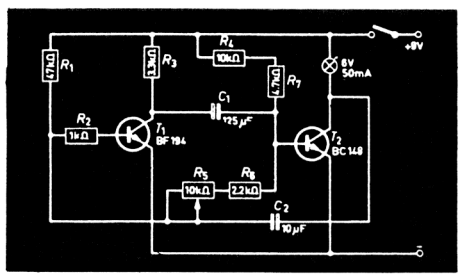
Now mount the components in the positions shown on the mounting card. Each component is mounted by holding down the large coil spring and pushing the wire of the component into the exposed loop of the hairpin spring and releasing the coil spring. Mount all the components shown and then all the black lines on the card will be covered by the wire from the components. You will still

be able to see red lines on the card and these red lines show you where to connect lengths of red insulated wire (17). Take the red wire and cut it into the lengths which you require. It is always better to cut the wire slightly longer than necessary. Bare both ends of the wire and connect them to the springs as you did with the components. Finally load the batteries into the holder (15) and clip on the push-on contact. The red wire is the positive one.

This experiment should now work and you can carry out the other experiments in due course since you now know how to mount every component. But before you switch on it is best if you read the section headed Final Check, on the last page of the handbook. If you follow the suggestions in that section we are sure you will get a lot of enjoyment from all your experiments.

Flashing light with adjustable frequency. Circuit Two

We can also vary the rate at which this alarm light will flash. This is done by connecting the variable 10 kΩ resistance in series with a fixed resistance between the base connections of the two transistors T1 and T2 (1) (2). By turning the adjustable knob on the potentiometer you will find that the time interval between flashes becomes longer and shorter. This is because by turning the variable resistance (40), usually called a potentiometer, first in one direction and then the other we are putting first more, then less, resistance into the circuit.

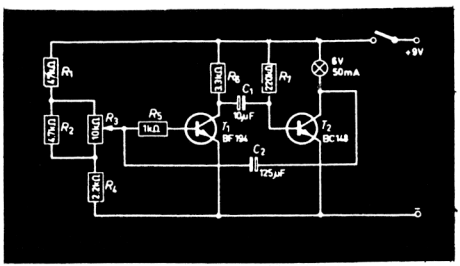


Circuit Diagram 2

Traffic beacon with adjustable frequency. Circuit Three

In Circuit 3 we can once again use the potentiometer to vary the rate at which the light will flash. In addition, with the resistances arranged as shown in this

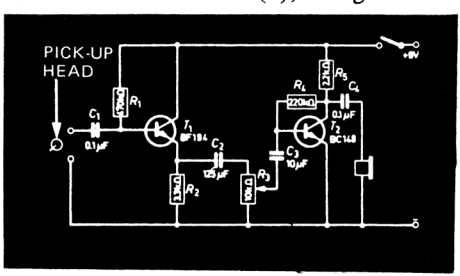
circuit, the actual time during which the light stays on is made very short. A flashing light of this kind can be seen almost anywhere, for example in the street, where it is used as a traffic beacon.



Circuit Diagram 3

Gramophone amplifier. Circuit Four

If you have ever seen an old gramophone you will know what very big and awkward things they were. This is because to make the sound loud enough to hear properly, these gramophones had to use a mechanical amplifier. This amplifier was a large horn-shaped object and it was attached to the needle of the gramophone. It could also be turned sideways so that it pointed towards the person or persons who wanted to listen to the record being played. Modern gramophones, or record players as they are more usually called, use an electronic amplifier to produce sounds loud enough to be clearly heard. By using such amplifiers the pick-up head, which has replaced the needle, can be made very light in weight and it does not damage the record being played. A record player has a screened cable which comes from the pick-up head, and to connect the pick-up to your amplifier circuit, which you have built from mounting card No. 4, you should attach the screen wire to the negative (minus) line of the amplifier and the one, or two, other wires to the other front panel connection spring. The screen wire is that marked (a) and the other wires are those marked (b), in Fig. 16.



Circuit Diagram 4

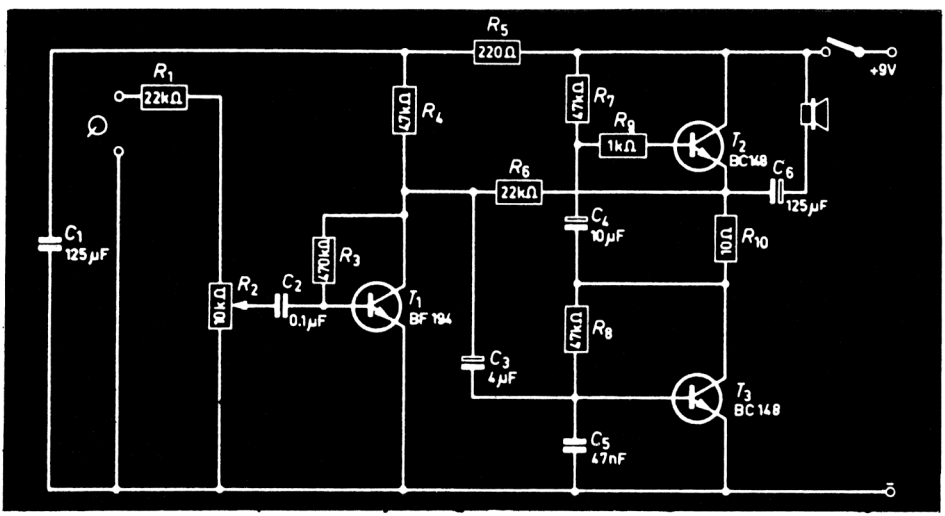
In this circuit the output sound from the amplifier comes from an earphone

and the sound volume is controlled by the potentiometer (R_3).

Fig. 16.

Gramophone Amplifier. Circuit Five.

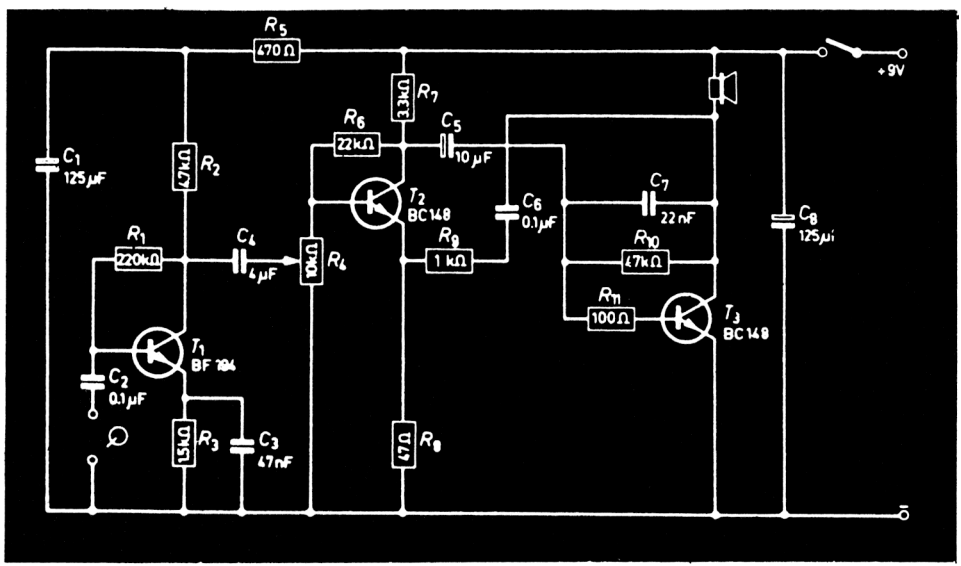
In this circuit the gramophone amplifier has a loudspeaker output unit. To make use of the loudspeaker we need more power than we did for the earphone output and to achieve this we use the transistors T2 and T3 in a special connection. These transistors, which form the output stage of the amplifier, are connected as a single ended, push-pull output stage. Such a system is used in many commercially available radios and amplifiers.



Circuit Diagram 5

Gramophone Amplifier. Circuit Six.

This circuit also uses a loudspeaker output and it has a special effect on the sound which this loudspeaker reproduces. The sound which comes from the loudspeaker is made up from a large number of different frequencies and some amplifiers do not reproduce the very high and the very low frequencies within this sound with as much sensitivity as they do the medium frequencies. This circuit corrects that fault by amplifying the high and low frequencies more than the medium, or middle, frequencies. The reproduced sound is therefore of an improved quality.



Circuit Diagram 6

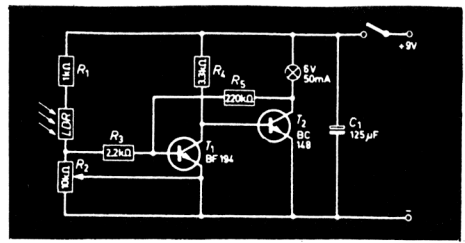
Automatic Nightlight or Parking Light. Circuit Seven.

Street lights go on when it gets dark. Does somebody switch them on? No, it is done automatically.

Circuit 7 does the same thing; the light dependent resistor (L.D.R.) senses the change of light and activates the switch formed by the two transistors. With the potentiometer, the level of light at which this happens can be adjusted.

When the L.D.R. receives less light from its surroundings its resistance increases. This decreases the current through transistor T1 and resistor R4. The voltage on the collector of T1 and the base of transistor T2 increases and this makes the transistor T2 conduct and the lamp lights up. The effect of switching over is amplified with the aid of resistor R5 of 220 kΩ.

When the surrounding light comes back on, the opposite effect takes place and the lamp goes out again. In addition to street lights, these circuits are used for turning on advertising displays, car parking lights and emergency lighting systems.



Circuit Diagram 7

Wetness Indicator. Circuit Eight.

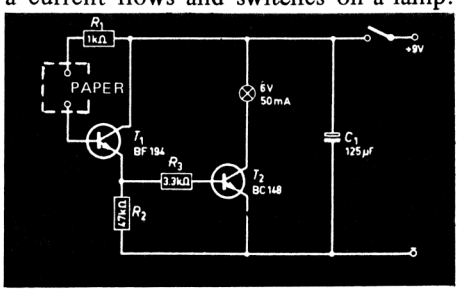
You have probably heard of the convertible car which automatically closes its hood when it starts to rain and no doubt you have wondered how this is achieved. The following circuit will make its operation easily understood.

Suppose we take a piece of ordinary paper and tape two bare wires to it at a distance from each other. If the wires are an important link in the circuit nothing will happen, since dry paper will not conduct electricity unless it is prepared especially to do so.

Water, when not in its purest form, does conduct electricity and therefore when the paper absorbs water it also can conduct electricity.

In Circuit 8 this effect is used to turn on a lamp. The current through the wet paper, which is connected to the input stage of the amplifier, is amplified in two stages and lights the lamp. In the case of the convertible car this current is used to switch on an electric motor which drives a mechanism to close the hood. Once the paper becomes dry again no current flows and the lamp goes out.

A similar arrangement is used in industry to indicate liquid levels in tanks. Two contacts are arranged inside the tank and when the water reaches the contacts a current flows and switches on a lamp.

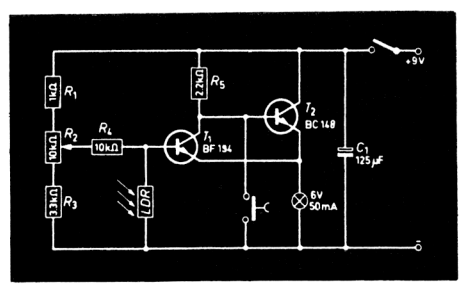


Circuit Diagram 8

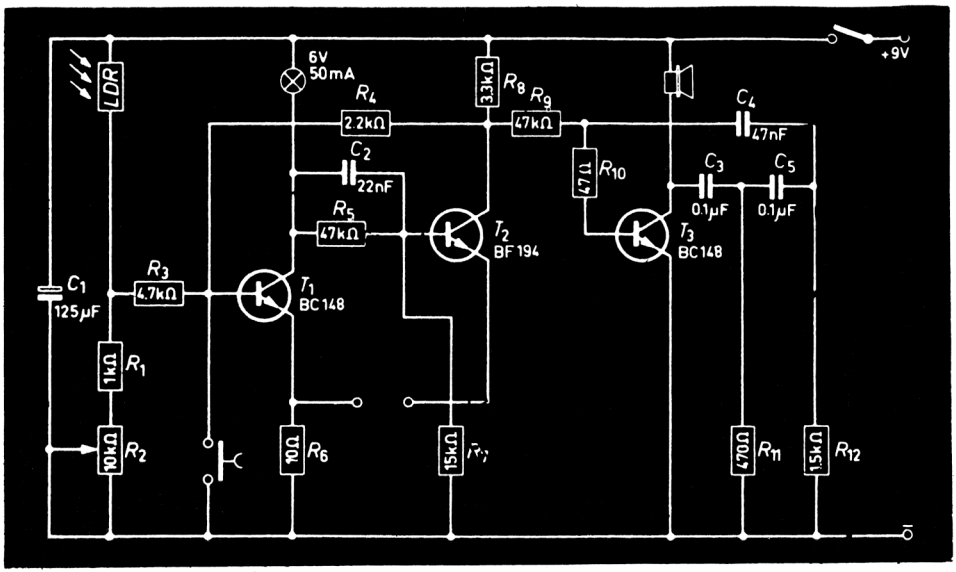
Tell Tale Light Alarm. Circuit Nine.

Someone intrudes into a dark room and starts looking around with a torch-light: a burglar. At a distance a warning light flashes on.

Circuit 9 is such a warning installation. When light falls on the Light Dependent Resistor (LDR) its resistance decreases. The voltage on the base of T1 drops and the current through T1 decreases, the voltage on the base of T2 increases and T2 switches on and the lamp lights. Even when the light on the LDR disappears again the lamp remains lit, so that afterwards you can tell that somebody was in. The circuit can be restored to its original state by pushing the push button switch. The level of light at which this alarm operates can be set with the aid of the potentiometer.



Circuit Diagram 9



Circuit Diagram 10

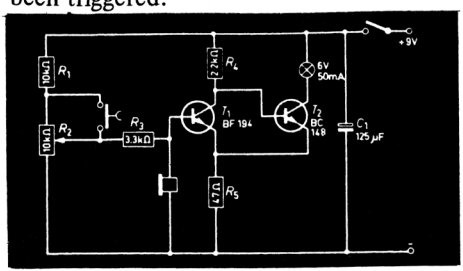
Tell-Tale Light With Sound. Circuit Ten.

Circuit 10 not only reacts to a light on the LDR but also operates when a door or window is opened. The door or window is connected into the circuit in the same manner as described in Circuit 1. In addition to the lamp lighting up, the audible alarm also sounds. This circuit is reset in the same way as Circuit 9.

Acoustic Relay. Circuit Eleven.

Sound waves can trigger off a circuit just as light did in the case of the burglar-alarms. In Circuit 11 the earphone is used as a microphone. The voltage generated when sound hits the microphone trips the transistor switch and

lights the lamp. The sensitivity is adjusted with the potentiometer. This potentiometer has to be moved very carefully to obtain maximum performance. With the button the circuit can be reset once it has been triggered.



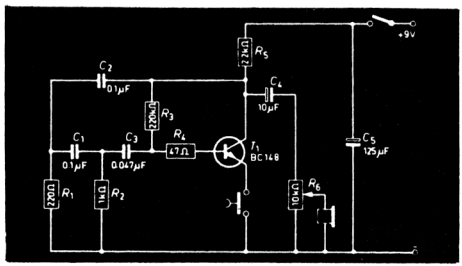
Circuit Diagram 11

Acoustic and Light Dependent Relay. Circuit Twelve.

A very sensitive circuit which reacts to both sound and light is shown in Circuit 12. The loudspeaker is used as a microphone and the sensitivity is again adjusted by using the potentiometer. This circuit is reset by using the reset switch button provided. This experiment is a very practical one to warn against intruders since the slightest noise will cause it to operate. (Diagram over page).

Morse Code Trainer. Circuit Thirteen.

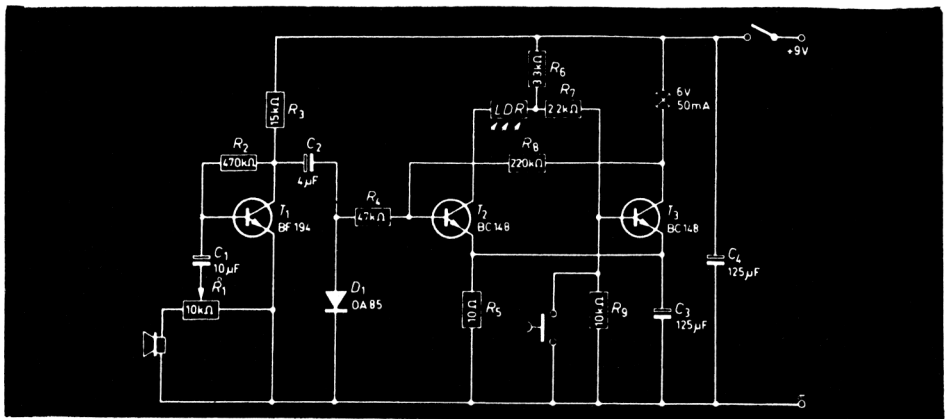
To be able to send messages in Morse you need a Morse Code Trainer in order to learn the code. Circuit 13 is such a trainer. Each time the key (which is the push button switch) is depressed the circuit generates a sound which is made audible in the earphone. The volume is controlled with the potentiometer.



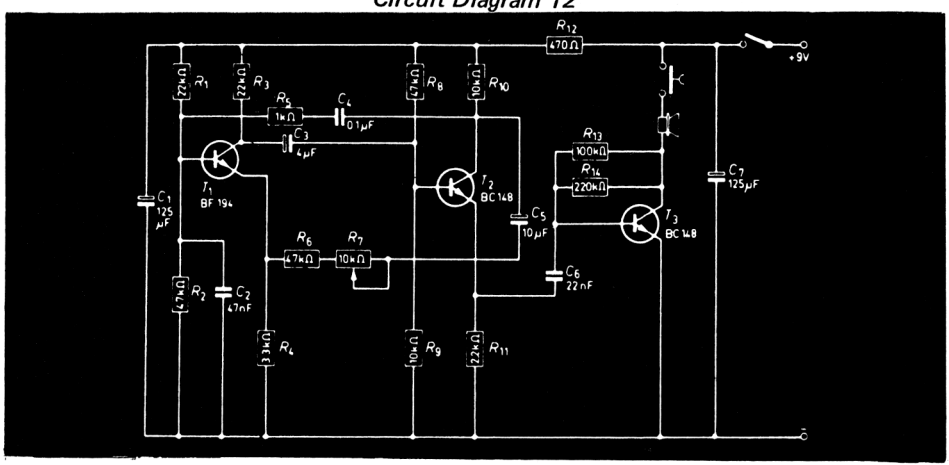
Circuit Diagram 13

Morse Code Trainer With Loudspeaker. Circuit Fourteen.

Circuit 14 is also a Morse Code Trainer, but in this case we have a loudspeaker output. In parallel with the pushbutton are two spring connections to which a real Morse key can be connected.



Circuit Diagram 12

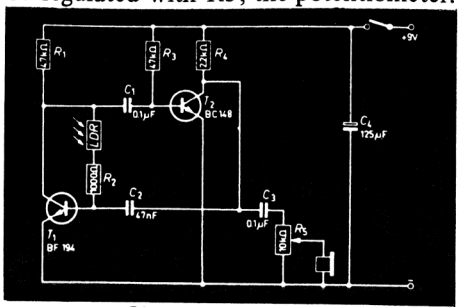


Circuit Diagram 14

Light Dependent Tone Generator. Circuit Fifteen.

Sound is electronically generated for a great many purposes. One example is the Morse Code Trainer above, but there are also musical instruments where the sound is electronically generated, for instance, in the case of electronic organs. Another field in which sound plays an important role is in the transmission of information from radiosondes, rockets and satellites. One example in which this is done is in Circuit 15. The pitch of the sound in this generator is determined by the LDR. The LDR changes its resistance under the influence of light changes. Therefore when we connect this LDR across the base and the collector of T1, a change of light will result in a change of pitch. If this sound is transmitted from a radiosonde we know the level of light at the place where the radiosonde is located.

This method of measuring at a distance is known as telemetry and besides rocketry and aerospace engineering it is also used for measurements in places where it would be impossible for a human being to survive because of heat, pressure or radioactivity. The sound volume can be regulated with R5, the potentiometer.



Circuit Diagram 15

Variable Audio Frequency Generator. Circuit Sixteen.

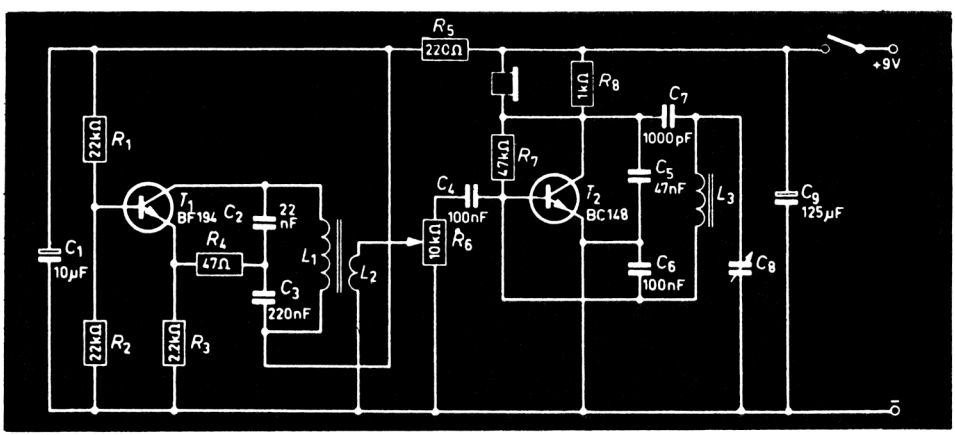
Circuit 16 is a very sensitive audio frequency generator. In principle two frequencies are generated which are in themselves too high to be audible. These two frequencies are mixed together and the difference can be made audible. By varying either one of the two generators the resultant difference frequency also varies as can be heard through the earphone.

With only a little coupling between the two generators the resultant audio frequency is weak. On the other hand a too strong coupling results in a tendency of

the variable oscillator to oscillate at the same frequency as the other. This results in a zero difference frequency and there is nothing to be heard. The procedure in adjusting this generator is as follows:

1. Turn the variable capacitor all the way to the left.
2. Turn the potentiometer till you can just hear a sound. (Also slightly move the coil on the ferroxcube rod.)
3. Adjust the coil on the rod till you hear a very low frequency note. Rotating the variable capacitor to the right makes the sound increase in pitch.
4. Turn the potentiometer to the right to increase the sound level. Too much coupling results in a failure to produce the lowest notes. Careful manipulation of the various controls will produce the desired effect.

This type of audio generator is often used in laboratories since it produces a wide range of audio frequencies with a single control.



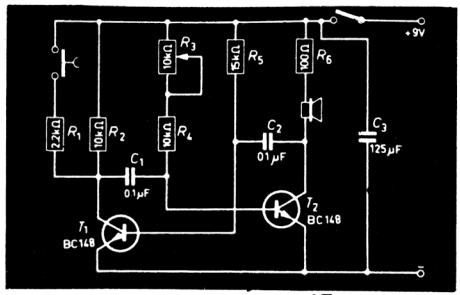
Circuit Diagram 16

Ambulance Klaxon. Circuit Seventeen.

The typical two tone sound of the city ambulance can be reproduced with Circuit 17. The pitch can be varied with the potentiometer. With the button depressed one note is reproduced; with the button released the other one can be heard. In fact this circuit is like the one used for flashing light except for the values of the resistors and capacitors. The switching off and on of the transistors is too fast to be seen with a lamp, but it is now audible through the speaker.

Telephone Signal Generator. Circuit Eighteen.

In Circuit 18 an installation is described to produce the signals you can hear on the telephone. With the right hand button depressed the calling signal is heard in the earphone. With the button released the engaged signal is heard. In principle the circuit is a flashing light which switches an audio generator on and off. The right pitch can be obtained by using the potentiometer R1.

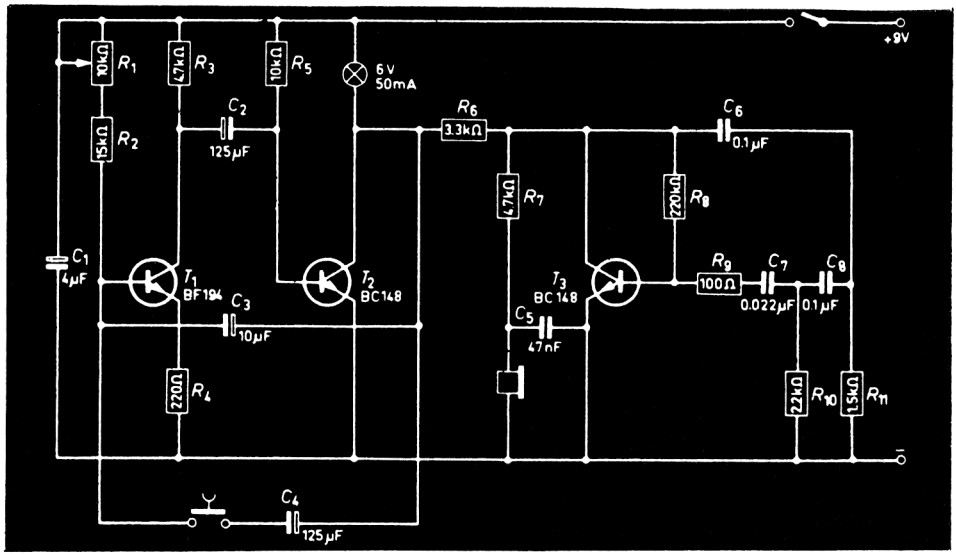


Circuit Diagram 17

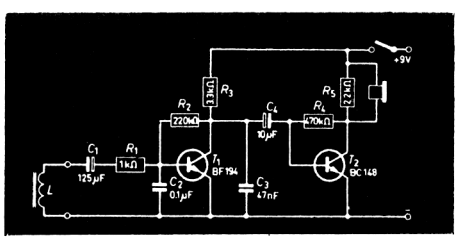
Telephone Amplifier. Circuit Nineteen.

Without making any connections to the telephone, Circuit 19 can provide you with an extra listening facility. With the coil from the kit it is possible to pick up the electromagnetic waves which radiate from a transformer inside the telephone. These waves cause a current to flow in the pick-up coil and after amplification this is made audible through the earphone.

To find the most sensitive spot on the telephone move the coil around the outside with the phone off the hook till you get maximum value: turning the coil also helps. With a piece of adhesive tape, fasten the coil to this spot. A few metres



Circuit Diagram 18



Circuit Diagram 19

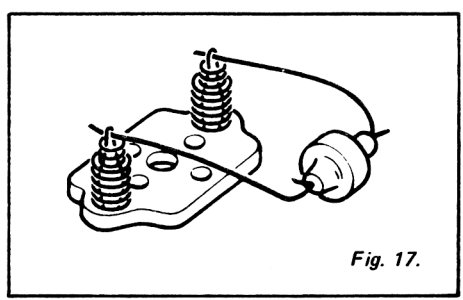
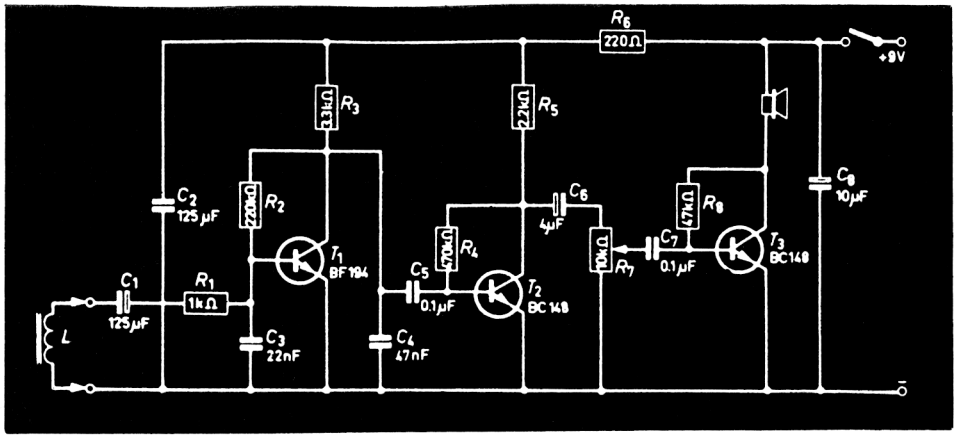


Fig. 17.



Circuit Diagram 20

of wire can be used to connect the coil to the connections on the amplifier. Fig. 17 shows how it is possible to connect the pick-up coil to a cable of a certain length. Keep the wire away from mains leads, since it can pick up hum from them.

Telephone Amplifier with Loudspeaker. Circuit Twenty.

Circuit 20 provides loudspeaker output and volume control for the telephone amplifier.

If the telephone microphone is held near the loudspeaker a whistling sound results. In this case either turn the volume down or move the amplifier further away.

Lightmeter. Circuit Twenty One.

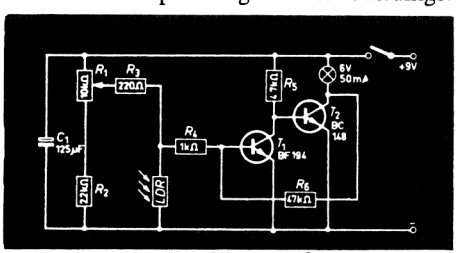
The light dependent resistor in the kit makes it possible to construct a lightmeter. The one in diagram 21, uses a transistor switch with a lamp and potentiometer to determine the light value at the LDR.

For each light value a position of the potentiometer can be found where the

lamp is just on the verge of switching on or off.

For different levels of light the potentiometer must be set at different positions. The position of the potentiometer is therefore a measure of the amount of light falling on the LDR and if we marked all the positions of the potentiometer we would have a lightmeter.

Modern photography would be unthinkable without lightmeters. Poor lighting results in bad work in industry and therefore lighting plays an important part in the design of modern factories. Lightmeters are indispensable in the construction and planning of such buildings.



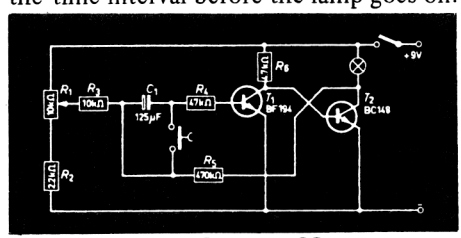
Circuit Diagram 21

Time Switch. Circuit Twenty Two.

The control of automatic processes frequently calls for a switch, to determine the time in which a particular function is performed. Think for instance of the fully automatic household washing machine in which each phase of the washing process is timed.

Another example is in photographic darkrooms, when light sensitive materials are exposed for a carefully controlled time.

Circuit 22 is a time switch which lights the lamp. The time during which the lamp is off is determined by the value of C1, and the voltage set by the potentiometer. The higher the voltage, the shorter the time interval before the lamp goes on.



Circuit Diagram 22

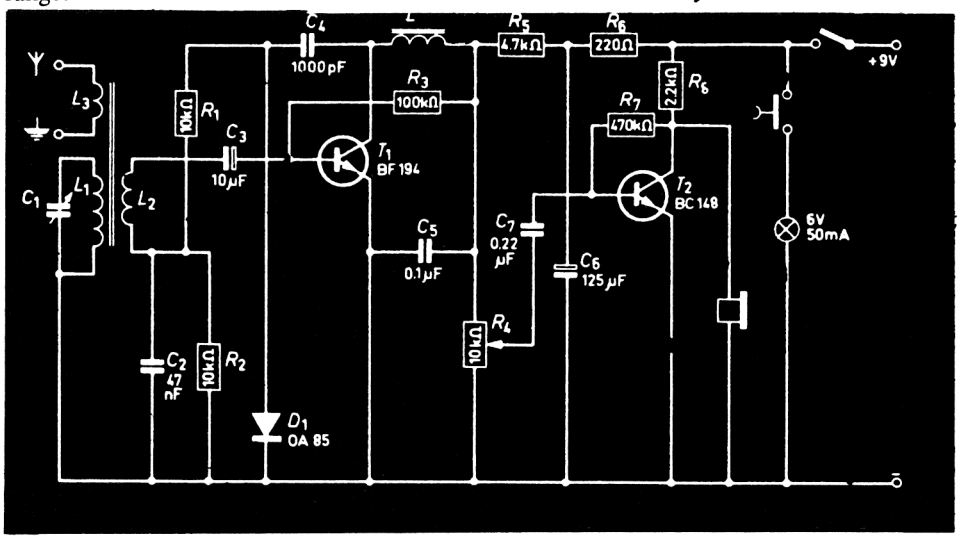
Medium Wave Radios. Circuits Twenty Three and Twenty Four.

With Circuits 23 and 24, one of the most attractive and also the most complicated circuits of this kit can be built.

Since the components are all physically very close together special care has to be taken to prevent short circuiting which happens when connections touch each other. The result will be a radio, receiving stations transmitting in the medium wave range.

amplification of the high frequency signal and after detection for amplification of the audio frequencies.

The pointer of the knob is adjusted by turning the variable capacitor all the way to the right and with the pointer on the line indicated by P the set screw is

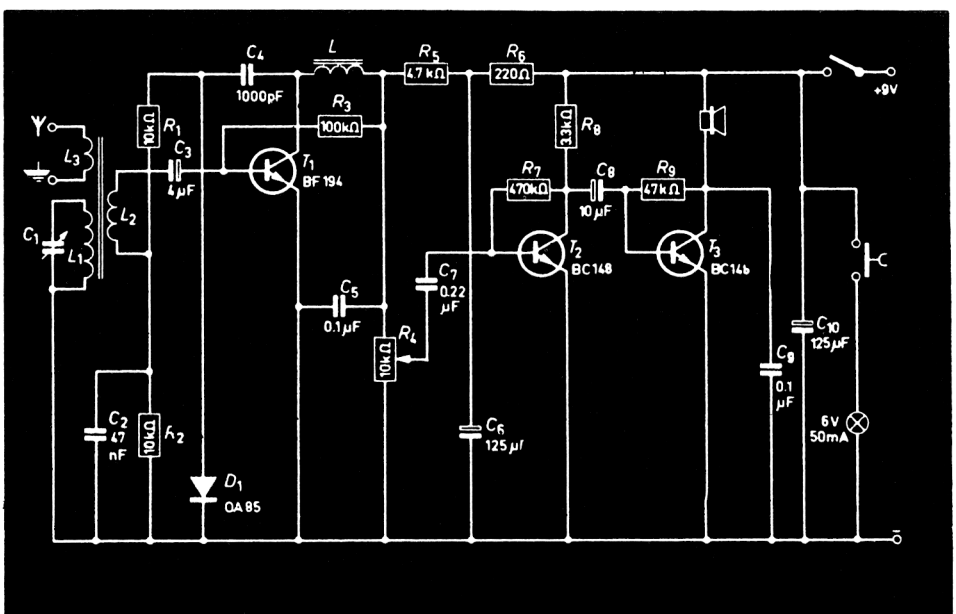


Circuit Diagram 23

To obtain maximum sensitivity with the components available a so-called reflex circuit has been chosen which means that transistor T1 is used first for

fastened. Both sets have a volume control and Circuit 24 also features loudspeaker output. Since the set is equipped with a direction sensitive aerial it must be turned

for the very best reception. The great advantage of this aerial is that it is less sensitive to interference from other directions. The set is also equipped with dial lighting which only works when the button is pressed, in order to save using the batteries too much. By making the inside of the knob white the dial lighting is made more effective. The coupling coil L3, 5 turns of insulated wire around the ferrite rod, can be used for connecting an outside aerial. Note the loudspeaker frame must be earthed as shown on the card.



Circuit Diagram 24

FINAL CHECK AND CHECKING FOR FAULTS

Read the instructions for assembling each set thoroughly and see whether there are any special remarks on it, such as the connection of the aerial coil, Morse key, etc.

When you have done everything stated in the general instructions and the instructions for assembling the sets, then the job is finished. First of all, check that you have not overlooked something. That is, ensure that:

- the components are in the correct place.
- the wires are not touching one another, where they should not be.
- all electrolytic capacitors are fitted properly with the positive end as marked.
- you have not connected any transistor the wrong way round.

When you have checked all this, including the assembly instructions, then you can switch on. If you have made no mistakes then your set will work well. If it doesn't, read the section on 'Checking for faults'.

CHECKING FOR FAULTS

If a set does not work properly switch it off immediately and start with the following points:

1. Check the wiring. Compare it with the wiring diagram on the mounting board. Make certain that you have not forgotten any connection or any component. Look and see if the wires make proper contact in the wire terminals and that they do not touch one another where they should not.

2. Check that you have not confused the positive and negative poles of the battery and that the batteries are in the correct position.

3. Check whether the transistors have been connected the right way (collector, base, emitter.)

4. Check whether the diode has been connected in the correct direction.

5. Check whether the electrolytic capacitors are connected in the right direction, that is, with the groove (+) as printed on the wiring diagram.

6. Look at the colour code information given to make sure that you have used the correct resistors.

7. If necessary take a new battery to see whether the lamp is damaged. The circuits only work with the lamp provided (6 volt at 0.05 Amp). Any other voltage or current rating lamp will not function properly.

8. Check that your batteries are not flat.

These kits are marketed in the United Kingdom by Mettoy Playcraft Ltd.

Spare components for these kits are available and you should write to:—

Philips Electrical Limited,
Young Engineer Department,
19 Commerce Way,
Purley Way,
CROYDON, CR9 4JA,
ENGLAND.

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