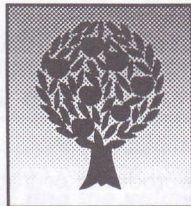


# INTERCOM LAB

**HAVE FUN AND LEARN ABOUT ELECTRONICS!**

**INCLUDES 2 CONSOLES - BUILD 2 PROJECTS AT THE SAME TIME!**

**Assemble your own: intercom, photocell alarm,  
lie detector, moisture meter and other simple projects.**



TREE OF KNOWLEDGE

# INTRODUCTION TO YOUR INTERCOMLAB

This kit is designed as an introduction to the world of electronics. You will learn about the different components, how to work systematically, how to read circuit diagrams, and finally, you will build various items that you can put to good use.

Among the several devices that you will build with this kit is an intercom. The intercom is the most difficult circuit, and therefore we suggest you leave it to the end and build it as your final project. The kit includes two consoles, so that you can build 2 different circuits at the same time. The instructions for the assembling each console are identical. Build the intercom after you have completed all of the other circuits, as you will need the two consoles for it.

Before you start working with this kit, please read the separate console assembly instructions. Do not open the bags in the kit until you have made room for the components on a convenient table. It is best to work on a clean, large and light surface, as there are many small parts which can be easily lost.

This is a kit for those who wish to try their hand at building simple electronic devices, without soldering, without complicated testing equipment, and with simple instructions. It is important to remember that all electronic equipment, simple or otherwise, is pre-soldered, tested with equipment, and assembled according to electronic diagrams designed by skilled people. Therefore, in order to succeed, you must follow all of the steps very carefully. It is best to work slowly, and to doublecheck every step. If, when you first assemble a circuit, and it does not function, do not despair. This happens to every engineer, and this is also the best way to learn.

## **HOW TO USE THE INSTRUCTIONS IN THIS KIT**

*GENERAL INSTRUCTIONS AND CIRCUIT EXPLANATIONS - in this booklet*  
*CONSOLE ASSEMBLY INSTRUCTIONS - on the large folded page*  
*CIRCUIT AND SCHEMATIC DIAGRAMS - on the large folded pages*

**SUGGESTIONS:** Some of you may have access to adults who understand electronics and wish to help you. These adults may try and assemble the various projects without looking at the circuit diagrams. Please make sure that if you get any help, that all of the written instructions are followed. The circuit diagrams are used by professionals. The diagrams include information for the person who builds the circuit. This is similar to the navigator who reads a map before attempting to explore a new area.

### **WARNINGS**

**BE CAREFUL WHEN USING PARTS WITH SHARP POINTS OR EDGES.  
KEEP AWAY FROM CHILDREN UNDER THREE YEARS OF AGE.**

**USE ONLY BATTERIES.**

**THE USE OF ANY OTHER ELECTRICAL SOURCE IS DANGEROUS.**

**DO NOT MIX OLD AND NEW BATTERIES.**

**DO NOT MIX ALKALINE AND STANDARD (CARBON-ZINC) BATTERIES.**

**DO NOT USE RECHARGEABLE (NICKEL-CADMIUM) BATTERIES.**

**ADULTS ARE ADVISED TO READ MANUAL AND SUPERVISE WHEN NECESSARY.**

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## COMPONENTS

### **PLEASE NOTE:**

DO NOT USE COMPONENTS UNTIL YOU HAVE MARKED THEM WITH THE APPROPRIATE STICKERS!

In this kit, there are two types of diagrams (or drawings) of an electronic circuit:

**SCHEMATIC** - which shows a circuit and its components in theory.

**PICTORIAL** - which shows the actual connections and the components of a circuit.

**WIRES:** The colours of the wires, with the exception of the **red and black wires**, are not important.

**PHOTOCELL** - The photocell used in this kit is an **LDR**, (LIGHT DEPENDENT RESISTOR). It is a resistor whose resistance varies according to light intensity. In our LDR, the higher the light, the lower the resistance. The LDR in this kit is used in circuits with various light-controlled systems.

**SCREWS** - Some of the screws are the "Phillips" type, and some are ordinary screws. Both types can be tightened with a small screwdriver.

**You should have the aid of an adult whenever assembling and installing components where screws are required.**

COMPONENT	SCHEMATIC	PICTORIAL
RESISTOR <i>Direction is not important.</i>	910 K 	
CAPACITOR <i>Direction is not important.</i>	0.1 μ 	
ELECTROLYTIC CAPACITOR <i>Direction is very important.</i>	+ 22 μ 	
DIODE (silicone) <i>Direction is very important.</i>	1N4148 	
LED (Light emitting diode) <i>Follow instructions in text.</i>		
PHOTOCELL <i>Direction is not important.</i>		
INTEGRATED CIRCUIT LM 324 <i>Follow instructions in text.</i>		
OFF/ON SWITCH <i>Follow instructions in text.</i>	SW1 	
BATTERY CONNECTION (power source)		

### LABELLING COMPONENTS

You should label the legs of all of your components like this:



### RESISTORS

Professional electronic engineers use a standard colour code for the values of resistors. Use the Resistor Colour Code on the following page to identify and label your resistors.

**If you have difficulties, you will find the values of each component on the printed card.**

## DIODES

Labels should be placed on the leg nearest the black line on the diodes.

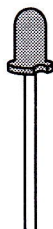
## CAPACITORS - ELECTROLYTIC AND CERAMIC

There are 2 types of capacitors included in this kit. Label them all according to the number written on them. Place the label on the longest leg of the **Electrolytic capacitors**. Please note that the **Electrolytic capacitors** must be connected as marked on the circuit diagrams, positive to "+", or negative to "-". You will see either the marking "+" or "-" on the side of the capacitor. Some **Ceramic capacitors** may have different numbers printed on them as below:

- 0.01 which is marked either 10nf, or 0.0,1 or 103
- 0.1 which is marked either 100nf, or 0.0,1 or 104
- 100pf which is marked either 470, or 471

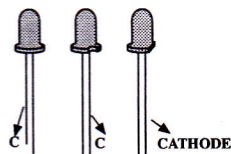
## THE LED (LIGHT EMITTING DIODE)

The LED (Light Emitting Diode) is a special kind of DIODE (Diodes are explained in a separate section). When current flows through them in the proper direction they will light up. How bright the light will be depends on the quantity of the current. LEDs are very sensitive, so only a small amount of current can go through them. Whenever you use them, make sure that you use resistors in series with them, otherwise you may overload them and then they will not give off light. You must also be very careful **not to put them in backwards**, because that can ruin them as well!



## INSTALLING THE LED:

Do this carefully because if the LED is connected incorrectly, you may damage it. Each LED is marked to differentiate the CATHODE from the ANODE. This is done in several different ways, but it is always that **cathode** that is marked. Identify the cathode.



**DO NOT USE ANY SOURCE OF ELECTRICITY OTHER THAN A 9V BATTERY!**

COLOR CODE			
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	X 10,000,000
GRAY	8	8	X 100,000,000
WHITE	9	9	X ----

THE FOURTH BAND INDICATES TOLERANCE (ACCURACY):  
GOLD = ± 5%    SILVER = ± 10%    NONE = ± 20%

**YOU ARE NOW READY TO START YOUR FIRST CIRCUIT !**

**REMEMBER: ASSEMBLE THE INTERCOM AS YOUR FINAL PROJECT !**

# THE CIRCUITS

## **Circuit No. 1 BLINKER**

This circuit is based upon an oscillator which operates on a low frequency. Only a few oscillations per second will cause the LED to blink. The oscillation is determined by the components. If you change the  $2.2\mu\text{F}$  capacitor and use the  $10\mu\text{F}$  capacitor instead, you will slow down the blinking by approximately 20 times.

## **Circuit No. 2 TIMER**

Take 2 wires. Connect one end of one wire to Terminal T1, and the second wire end to T2. Touch the bare ends on the other ends of the wires together. This will cause the LED to light.

When you break this connection, the LED will remain lit for a few seconds. The connection between T1 + T2 charges the capacitor. When the connection is broken, it discharges slowly through the 240K resistor.

## **Circuit No. 3 LIGHT ACTIVATED ALARM**

When the photocell detects light, it will light the LED. To make the photocell more sensitive, find a small tube, and put it over the photocell so that the light is directed to the cell. This will make it more sensitive. The other method is to change the value of Resistor RX. Use a resistor close to 10K.

## **Circuit No. 4 AUTOMATIC DARK SENSOR**

This is the same as your light-activated alarm-sensitive circuit, only it works the opposite way. The LED will light as long as it is dark. As soon as light falls on the photocell, the LED will extinguish. To make it more sensitive, follow the instructions in the previous circuit.

## **Circuit No. 5 NOISE DETECTOR (ACTIVATED LED)**

This is a sound-activated circuit. When you make a noise close to the speaker, it will cause the LED to light. In this circuit, the speaker is used as a microphone. When a noise is made, the speaker produces a very small current which is then amplified. This charges the  $0.1\mu\text{F}$  capacitor. When this is charged enough, it causes the LED to light.

## **Circuit No. 6 GROUND HUMIDITY METER**

This circuit can be used for checking the moisture in potted plants. When the soil of the plant is dry, the LED will light. The moister the soil, the weaker the light will be. To operate this, take 2 wires. Strip off the insulation (about 3 centimeters) at one end of each of the 2 wires. This will be your moisture detector. Push the bare ends of the wires into the soil, about 2 cm apart from each other. Connect the other ends of the wires to terminals T1 and T2. It does not matter which wire goes to which terminal.

The sensitivity is determined by three factors:

- 1) By the resistor RX from Terminal 3 to 4. Try resistors between 10K to 1.3M.
- 2) The length of the bare wire that is inserted into the soil.
- 3) The distance between the 2 bare ends of the wires in the soil.

For repeated results, always try to use the same resistors and length and distance between the wires in the soil.

## **Circuit No. 7 SIREN**

This circuit creates a voltage controlled oscillator, which is determined by the capacitor, connected between block I and No. 2 of the lower yellow housing. If you change this, the oscillator will change in sound.

## **Circuit No. 8 ALARM**

This operates by a simple principle of breaking a very thin wire which you can put around a door, window, and the floor, etc. While the thin wire is unbroken, the circuit is closed. As soon as the wire is broken, the oscillator starts sounding an alarm, through the loudspeaker.

## **Circuit No. 9 SOUND GENERATOR + LIE DETECTOR**

This is a Sound Generator which you build in one console (A) and you connect it to an amplifier in the second console (B).

The connections between the 2 consoles are with two wires from Terminals T1 and T2. You can experiment with the frequency and change the tone. To do this, change the capacitor 0.1 $\mu$ F (CP) in Console A, with the other capacitors in your kit, and make sure that the + (positive) and - (negative) are connected correctly.

### **MAKE YOUR OWN LIE DETECTOR**

Insert 2 wires in Console B, instead of the capacitor marked CX. Hold the end of the bare wire. You will notice a change in the tone of the sound. As you know, when people tell a lie, they tend to sweat and their hands get wet. This will change the resistance and therefore, the sound. This of course, is not a scientific detector, but it does explain the principle. You can use this on two people each holding the others' hand, and then holding the bare wire with their other hand.

## **Circuit No. 10 INTERCOM**

The intercom is the most difficult circuit to construct.

This is the first thing to do before you start:

Disconnect the switches in both consoles, Post B, and the slider.

Connect the black wire from the battery holder to B and the red wire to C.

Take a wire from the slider switch through hole 3 and connect to J.

Take a wire from Post B through one of the small holes above 1 + 2, and connect it to A. Do this in both consoles.

In your kit you will find a length of wire which has 3 separate strands of wire.

Connect these between Consoles A and B as shown in the diagram.

**You must make sure that you connect these one at a time so that you do not cross the wires.**

### **HOW THE INTERCOM OPERATES:**

When the switch in Console A is in the "down" position (switch open), the switch in Console B has to be in the "up" position (switch closed).

In this position, anyone speaking in Console A will be heard in Console B. When you reverse this, you can speak from "B" to "A."

## BEFORE BEGINNING THE CIRCUIT CONNECTIONS:

You have a separate booklet with all of the instructions for assembling ten different circuits. Each circuit includes a schematic drawing, a circuit drawing and a check list explaining each connection. We have left blank squares on these checklists so that you can check off each connection you have made. Please note that circuits #9 + #10 are the most complex, and therefore each of these circuits are explained on two pages, rather than on only one page.

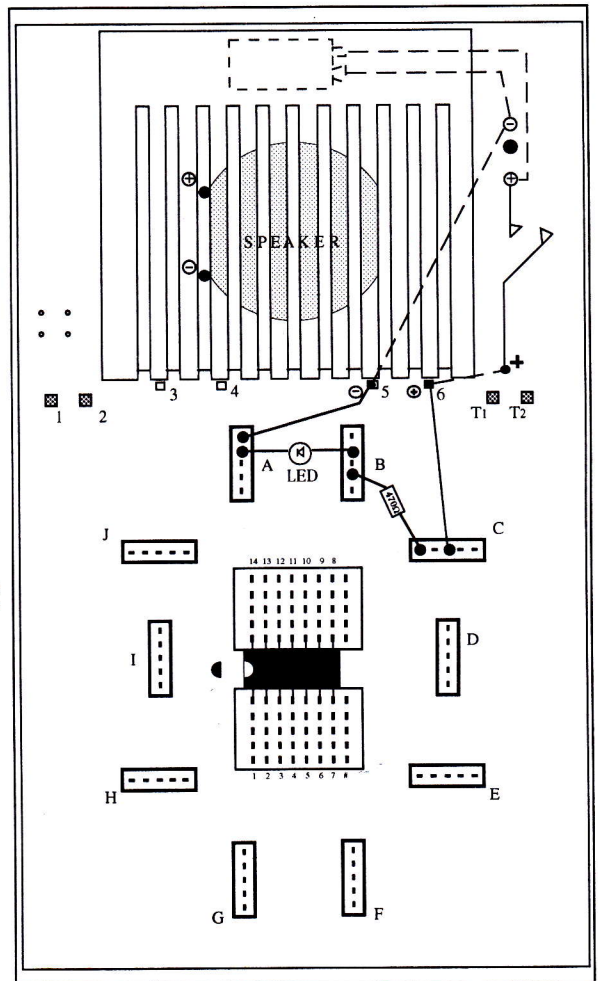
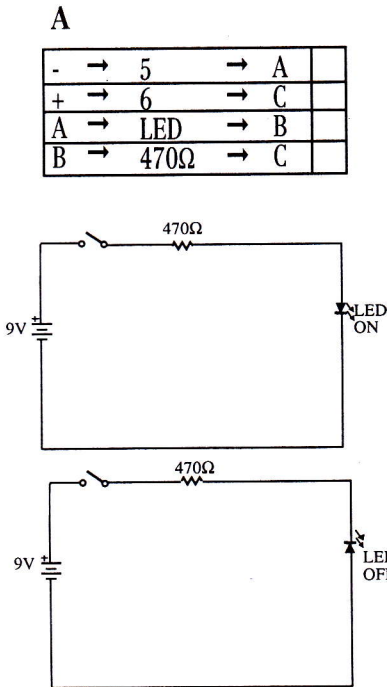
### *Don't panic - electronics is really lots of fun!*

In order to ensure your success with these circuits, we suggest that before actually starting, try to connect some of the basic components to the circuit board.

**Circuit A** will show you how to connect and light a LED.

**Circuit B** will show you how to connect and light a LED and a capacitor.

**Circuit C** will show you how to connect and light a LED, a capacitor and a diode, and you will assemble a simple forward-reverse circuit.



# ASSEMBLING THE CONSOLE

Please read and understand all instructions before proceeding with your work. We suggest that before assembling, take a marking pen and mark the numbers and letters on the inside of the console as they appear on the diagram. This will make the assembling simpler for you. **You should have the aid of an adult whenever assembling and installing components where screws are required.**

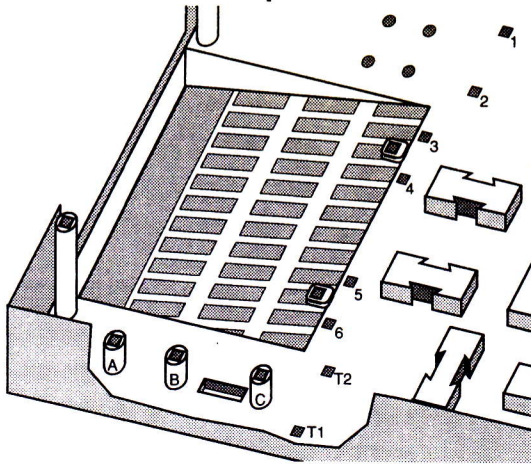


FIG. 1

## STEP 1 PREPARING THE CONSOLE

1. Firstly you need to insert the metal connectors into the yellow housing. (Figure 2)

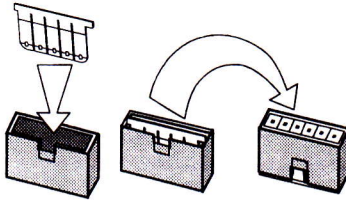


FIG. 2

2. Now push the assembled housing into the slots on the front of the console. (Figure 3)

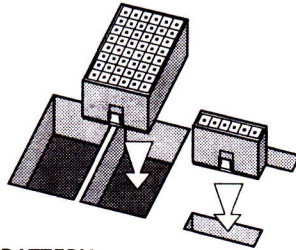


FIG. 3

## STEP 2 ATTACHING YOUR BATTERY

Turn the console upside-down so that the speaker grill touches the table.

A) Take the small metal caps and press them into each of the posts A, B, and C. (Figure 4)

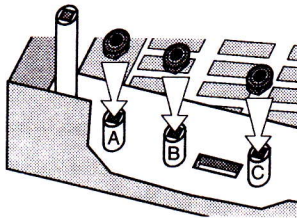
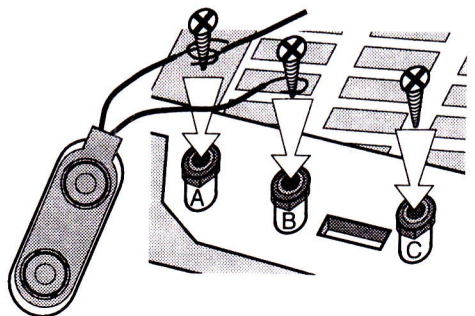


FIG. 4

B) Find the battery snap. Take the red wire and wrap the uninsulated part of the wire around the screw in a clockwise direction on post B. Now tighten this screw, making sure that the wire sits securely under the head of the screw. (Figure 5)

FIG. 5

C) Take the black wire of the battery snap and choose the black wire from your kit. Wind them both around the screw in post A. Tighten the screw as you did before on post B. Pass the other end of the black wire through the hole marked "6."

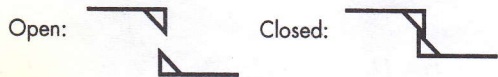


D) You may need Post C later.



## THE SWITCH

The switch is made for opening and closing a circuit. In diagrams, it is marked like this:



To assemble your switch, follow these instructions:

- 1) Take the switch slider (Figure 6) and push it through the oblong hole between Posts B & C. Do this from the front of the console.

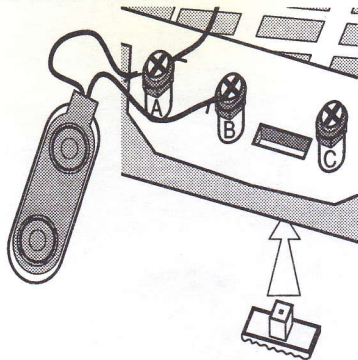


FIG. 6

- 2) Slip the large spring spacer over the square protrusion. This holds the slider in place. (Figure 7)

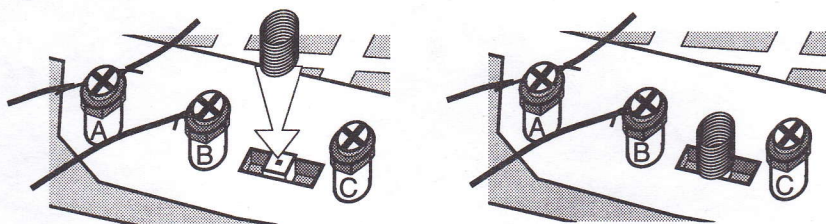


FIG. 7

- 3) Take the red, loose wire and wrap the uninsulated part of the wire around the screw, so that the wire rests between the washer and the head of the screw. Now tighten the screw into the slider. Push the other end of the wire through the hole marked "2". (Figure 8)

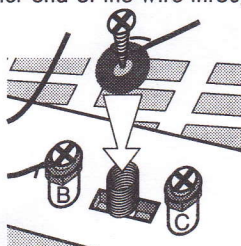


FIG. 8

- 4) To test the switch, push the slider back and forth. The washer should touch post B each time. When the slide is up and when you push it down, the marker should touch post C. Your console should look like this: (Figure 9)

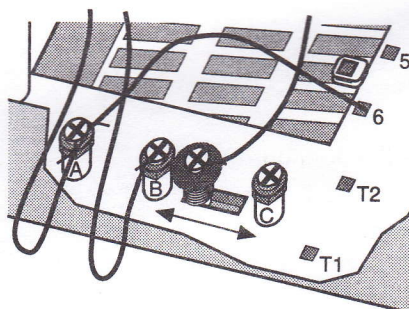


FIG. 9

### STEP 3 THE SPEAKER

- A) Place the speaker face down on the grill as shown in Figure 10.

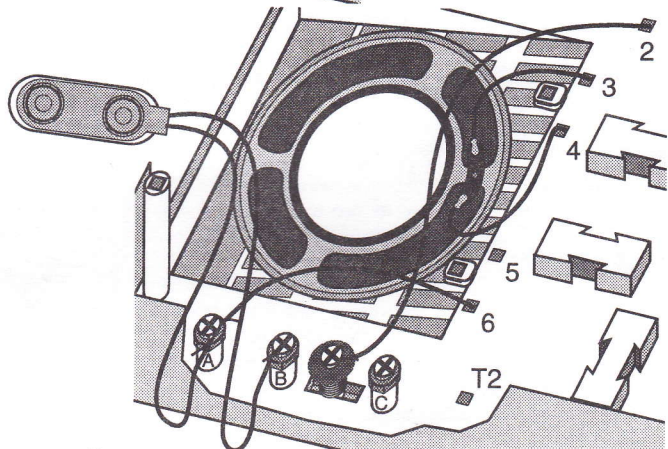


FIG. 10

B) Take the battery cover and screw down with 2 long screws. (Figure 11)

C) Push the speaker wires through holes 3 & 4. Your console should look like Figure 12.

FIG. 11

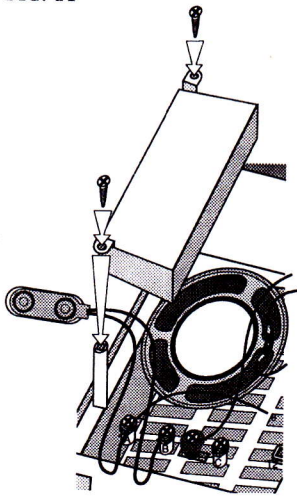
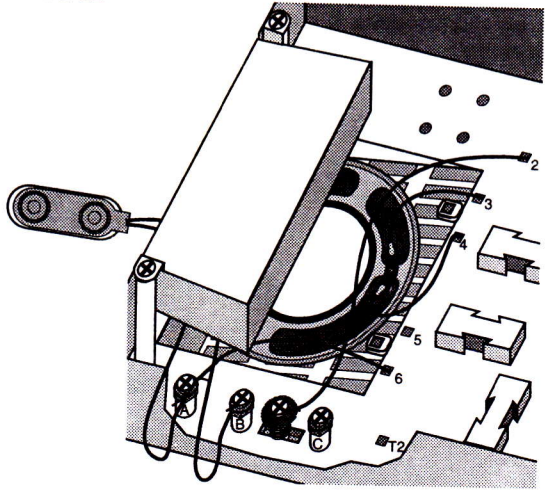


FIG. 12



#### STEP 4 THE INTEGRATED CIRCUIT (IC)

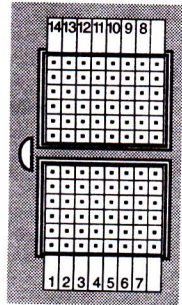
FIG. 13A

Label the central yellow housing on your board with numbers. Study figure 13A. **It is important that this is correct.**

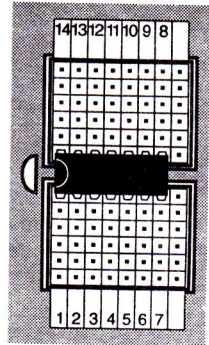
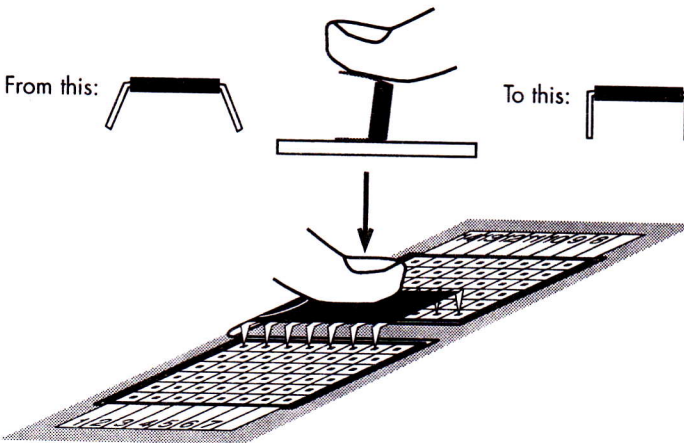
A) Take the label numbered 1 - 7. This label will go at the base of the lower yellow housing. Number 1 should be placed directly below the first hole on the left.

B) Now take the label 8 - 14. Place at the top of the upper block so that 14 is directly above the first hole on the left.

INSERTING THE IC - Follow these instructions carefully



Now add the Integrated Circuit (**IC**) to your console. Carefully study the figures below. The **IC** is a delicate component and you should have the help of an adult for the next bit. First straighten both sides of the pins so that they are parallel. To do this, press the outside edge of the pins very gently on a flat surface. Be careful not to over-bend them. The half moon shape on the IC is placed next to the half moon on the console. Provided that the pins match up with the holes, gently insert them into the central yellow housing exactly as in the following diagrams. **Once the IC is installed, it is not to be removed.**

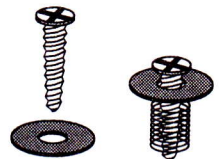


#### STEP 5 THE TERMINALS (T & T)

FIG. 14

To prepare T & T terminals, take a washer, a spring as in figure 14, and screw it a little way into the two square holes marked T and T.

These terminals are used in several circuits and are marked with a broken line ( - - ) where you need to add a wire. It does not matter which end of the wire you connect to which terminal. Make sure the insulation is cleaned off the copper. The connection is made by pushing the washer down on the spring, wrapping the wire around the screw, and releasing the washer so that it holds the wire against the head of the screw.

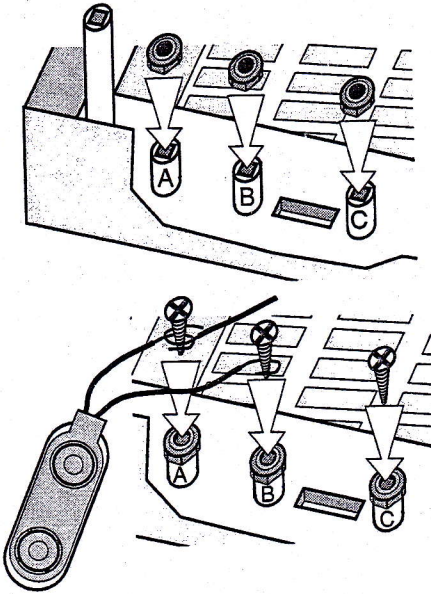


**YOU HAVE NOW COMPLETED ASSEMBLING THE CONSOLE.**

# Electronics 6 in 1 - Addendum

This note these additional instructions for:  
**HOW TO ASSEMBLE  
THE SPEAKER AND SWITCH (Pg. 1)**

In order to improve the contacts, we have added 3 metal caps to this kit. After you have turned over the circuit board, connect the caps to points A, B, and C accordingly. Note the illustrated instructions below. Continue with the assembly as explained in sections a, b, and c.



## **ADDENDUM - CIRCUIT SIX: RADIO CIRCUIT**

**Please add the following two paragraphs to your Circuit Six instruction sheet.**

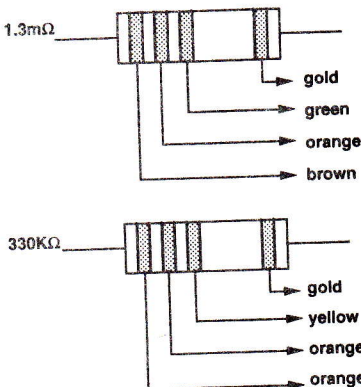
### **ANTENNA CONNECTION:**

Use the balance of your wire, or another wire, and strip the insulation from its end. String it up from the place where you will be working, as high and as far as you can. If you live in a house and can string it up through your window to an adjacent tree or pole... fine. If you live in a place where this is impossible, string it up along your wall towards the window.

### **GROUND CONNECTION:**

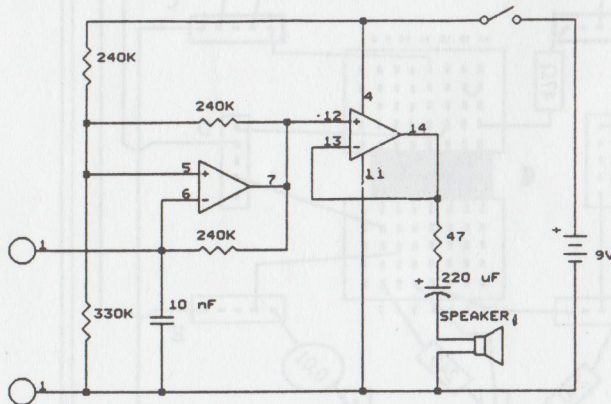
Take another wire and strip the insulation from both ends. Insert one end to the circuit board 'GROUND' and the other end to a water pipe, faucet, or a radiator in your house.

**Please use this revised colour code.**



### Circuit One: Simple Alarm System

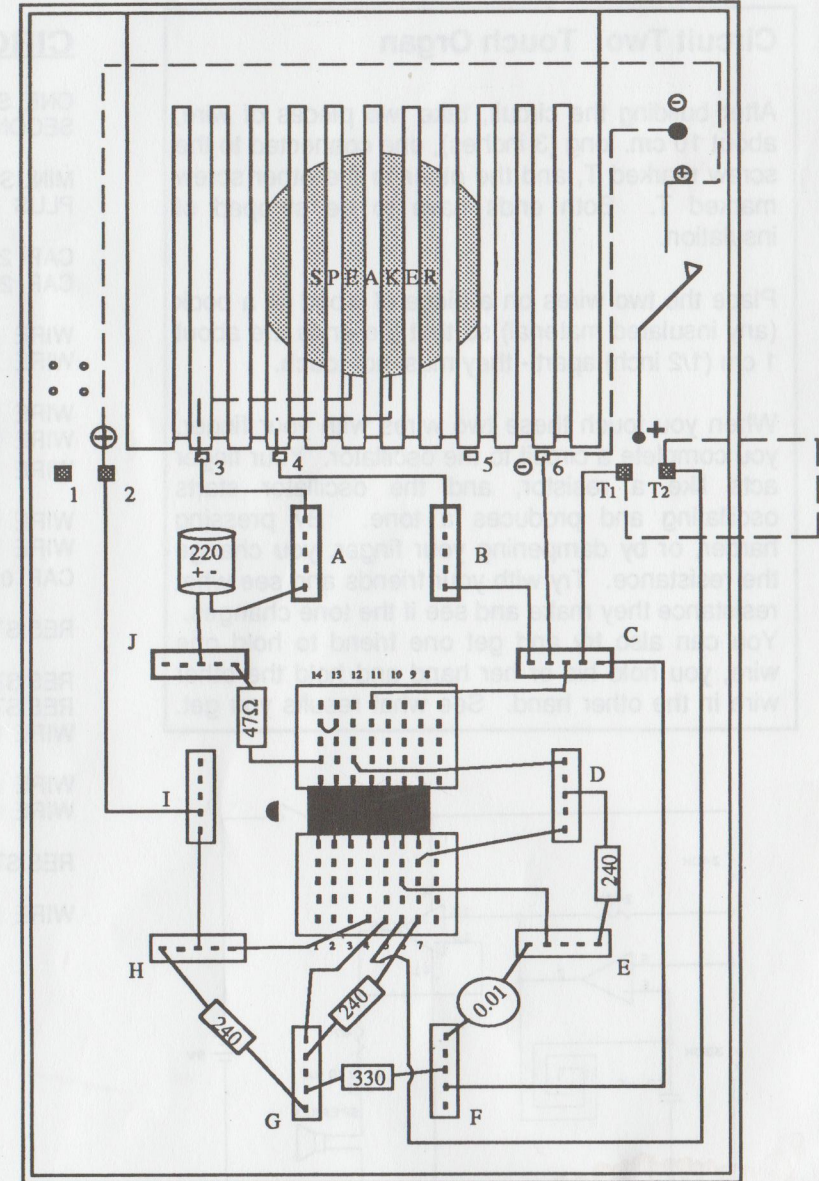
This operates on a simple principle by breaking a very thin wire which you can put around a door, window, and the floor, etc. While the thin wire is unbroken, it prevents it from oscillating. As soon as the wire is broken, the oscillator starts sounding an alarm, electric oscillations, which are then amplified by the loudspeaker.



### CIRCUIT 1 - ALARM

- |                                     |        |                |
|-------------------------------------|--------|----------------|
| ONE SPEAKER WIRE -----              | TO---- | A              |
| SECOND SPEAKER WIRE -----           | TO---- | B              |
| MINUS (BLACK) WIRE -----            | TO---- | C              |
| PLUS (RED) WIRE -----               | TO---- | I              |
|                                     |        |                |
| CAP 220uF (-) -----                 | TO---- | A              |
| CAP 220uF (+) -----                 | TO---- | J              |
|                                     |        |                |
| WIRE FROM B -----                   | TO---- | C              |
|                                     |        |                |
| WIRE FROM C -----                   | TO---- | T <sub>1</sub> |
| WIRE FROM C -----                   | TO---- | 11             |
| WIRE FROM C -----                   | TO---- | F              |
|                                     |        |                |
| WIRE FROM D -----                   | TO---- | 12             |
| RESISTOR 240K FROM D -----          | TO---- | E              |
| WIRE FROM D -----                   | TO---- | 7              |
|                                     |        |                |
| WIRE FROM E -----                   | TO---- | 6              |
| CAP 0.01 uF FROM E -----            | TO---- | F              |
|                                     |        |                |
| RESISTOR 330K FROM F -----          | TO---- | G              |
|                                     |        |                |
| RESISTOR 240K FROM G -----          | TO---- | 7              |
| RESISTOR 240K FROM G -----          | TO---- | H              |
| WIRE FROM G -----                   | TO---- | 5              |
|                                     |        |                |
| WIRE FROM H -----                   | TO---- | 4              |
| WIRE FROM H -----                   | TO---- | I              |
|                                     |        |                |
| WIRE FROM 13 -----                  | TO---- | 14             |
| WIRE FROM 6 -----                   | TO---- | T <sub>2</sub> |
| THIN WIRE FROM T <sub>1</sub> ----- | TO---- | T <sub>2</sub> |
| RESISTOR 47Ω FROM J -----           | TO---- | 14             |

### 1. ALARM

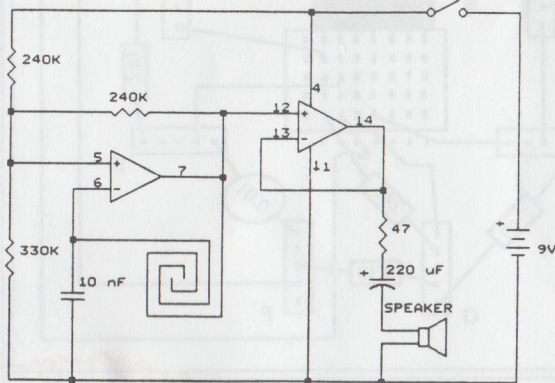


## Circuit Two: Touch Organ

After building the circuit, take two pieces of wire, about 10 cm. long (3 inches), one connected to the screw marked T, and the other to the other screw marked T. Both ends have to be stripped of insulation.

Place the two wires on a piece of wood or a book (any insulated material) so that the ends are about 1 cm (1/2 inch) apart - they must not touch.

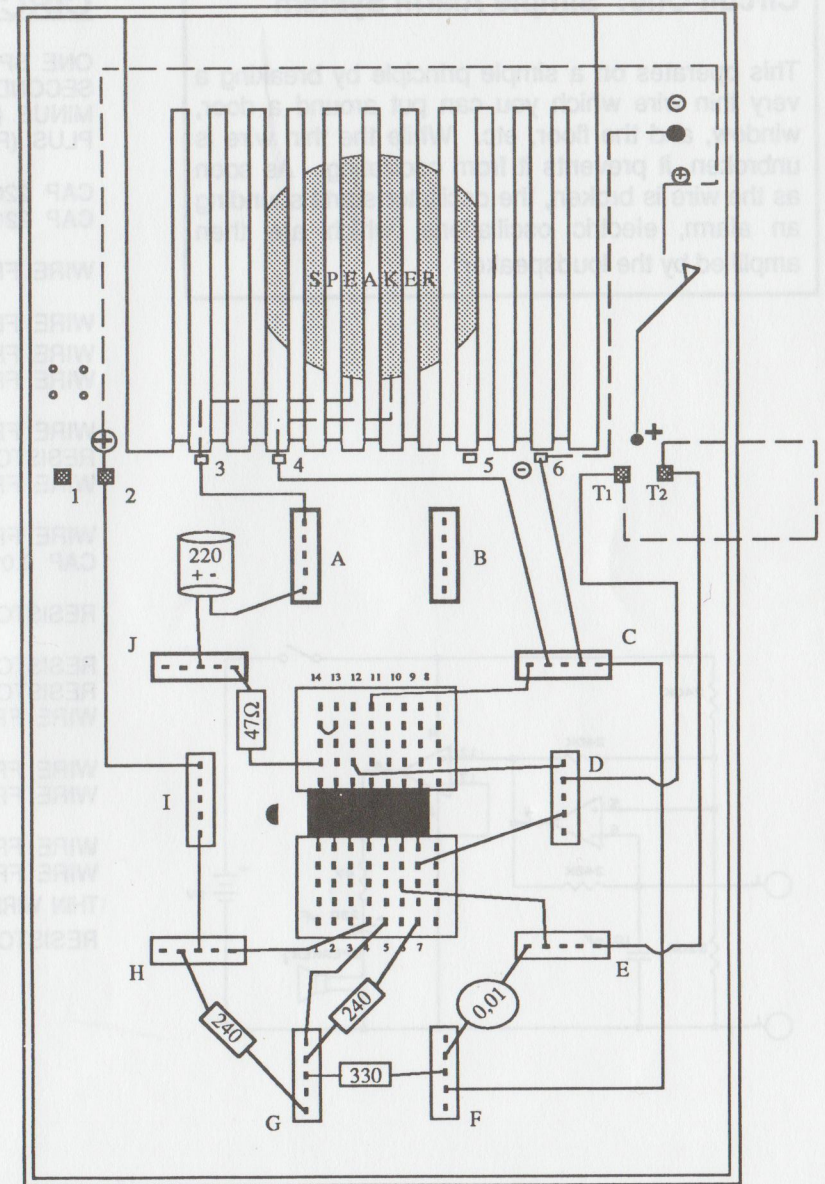
When you touch these two wires with your finger, you complete a circuit to the oscillator. Your finger acts like a resistor, and the oscillator starts oscillating and produces a tone. By pressing harder, or by dampening your finger, you change the resistance. Try with your friends and see what resistance they make and see if the tone changes. You can also try and get one friend to hold one wire, you hold his or her hand and hold the other wire in the other hand. See what results you get.



## CIRCUIT 2 - TOUCH ORGAN

ONE SPEAKER WIRE -----	TO----	A
SECOND SPEAKER WIRE -----	TO----	C
MINUS (BLACK) WIRE -----	TO----	C
PLUS (RED) WIRE -----	TO----	I
CAP 220uF (-) -----	TO----	A
CAP 220uF (+) -----	TO----	J
WIRE FROM C -----	TO----	11
WIRE FROM C -----	TO----	F
WIRE FROM D -----	TO----	12
WIRE FROM D -----	TO----	T <sub>1</sub>
WIRE FROM D -----	TO----	7
WIRE FROM E -----	TO----	6
WIRE FROM E -----	TO----	T <sub>2</sub>
CAP 0.01MF FROM E -----	TO----	F
RESISTOR 330K FROM F -----	TO----	G
RESISTOR 240K FROM G -----	TO----	H
RESISTOR 240K FROM G -----	TO----	7
WIRE FROM G -----	TO----	5
WIRE FROM H -----	TO----	I
WIRE FROM H -----	TO----	4
RESISTOR 47Ω FROM J -----	TO----	14
WIRE FROM 13 -----	TO----	14

## 2. TOUCH ORGAN



### Circuit Three: Siren

This circuit creates a voltage controlled oscillator, which is determined by the 240K resistor connected to pin No. 6 and pin No 9.

### CIRCUIT 3 - SIREN

ONE SPEAKER WIRE ----- TO----- A  
 SECOND SPEAKER WIRE ----- TO----- J  
 MINUS (BLACK) WIRE ----- TO----- J  
 PLUS(RED) WIRE ----- TO----- I  
 CAP 220uF (-) ----- TO----- A  
 CAP 220 uF (+) ----- TO----- B

(LARGE)RESISTOR 47Ω FROM B -- TO----- 14  
 WIRE FROM C ----- TO----- 11  
 RESISTOR 47K FROM C ----- TO----- 10  
 CAP 0.01 uF FROM C ----- TO----- 9

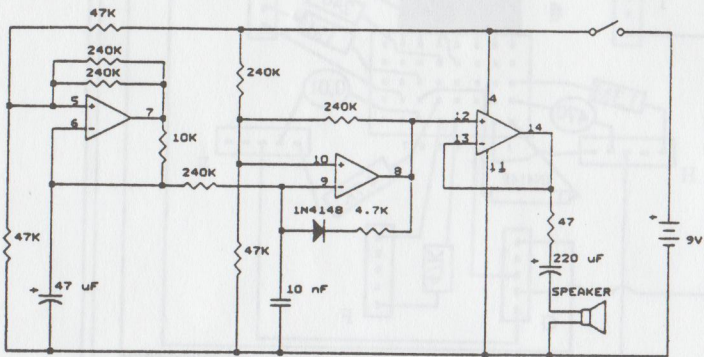
CAP 47uF (-) ----- TO----- C  
 CAP 47uF (+) ----- TO----- E

WIRE FROM C ----- TO----- J

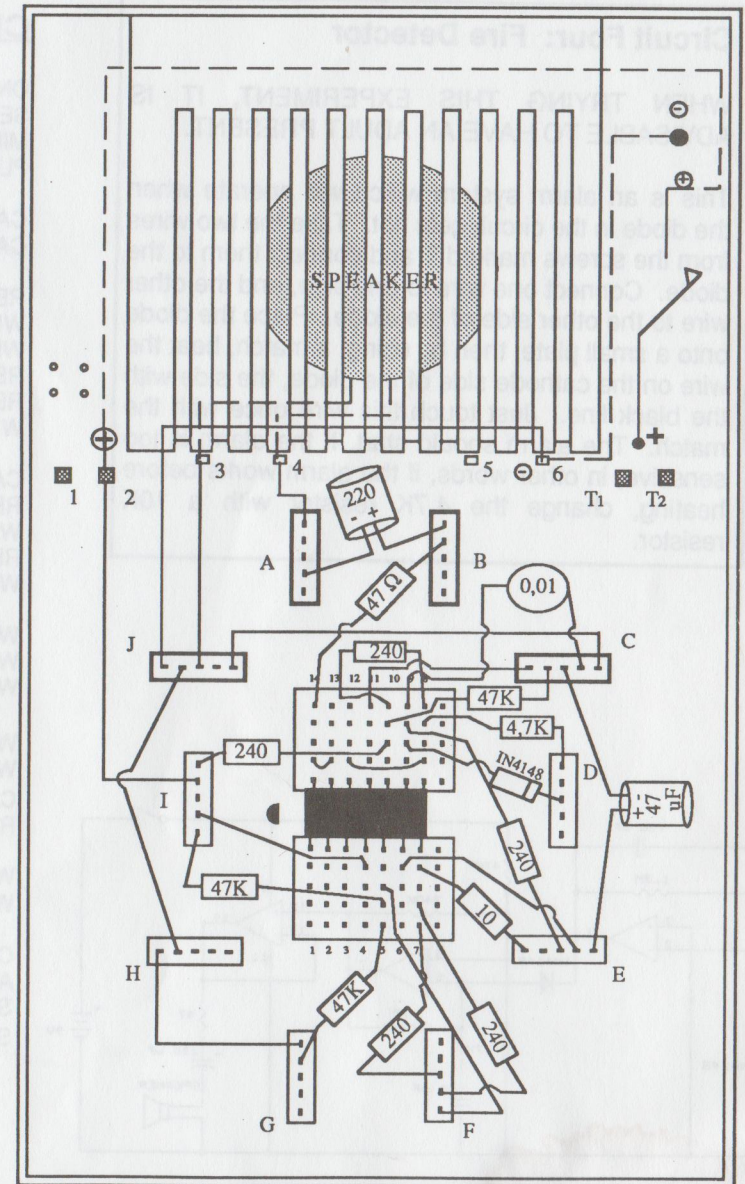
CATHODE OF SMALL DIODE --- TO----- D  
 ANODE OF SMALL DIODE ----- TO----- 9

RESISTOR 4.7K FROM D ----- TO----- 8

WIRE FROM E ----- TO----- 6  
 RESISTOR 240K FROM E ----- TO----- 9  
 RESISTOR 10K FROM E ----- TO----- 7  
 RESISTOR 240K FROM F ----- TO----- 7  
 RESISTOR 240K FROM F ----- TO----- 7  
 WIRE FROM F ----- TO----- 5  
 RESISTOR 47K FROM G ----- TO----- 5  
 WIRE FROM G ----- TO----- H  
 WIRE FROM H ----- TO----- J  
 RESISTOR 47K FROM I ----- TO----- 5  
 WIRE FROM I ----- TO----- 4  
 RESISTOR 240K FROM I ----- TO----- 10  
 WIRE FROM 14 ----- TO----- 13  
 WIRE FROM 12 ----- TO----- 8  
 RESISTOR 240K FROM 8 ----- TO----- 10



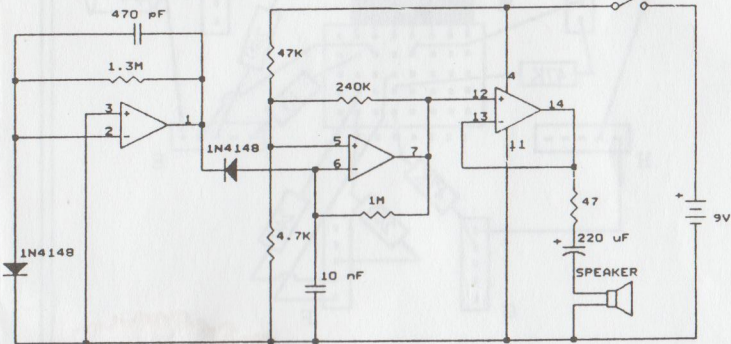
### 3. SIREN



### Circuit Four: Fire Detector

WHEN TRYING THIS EXPERIMENT, IT IS ADVISABLE TO HAVE AN ADULT PRESENT.

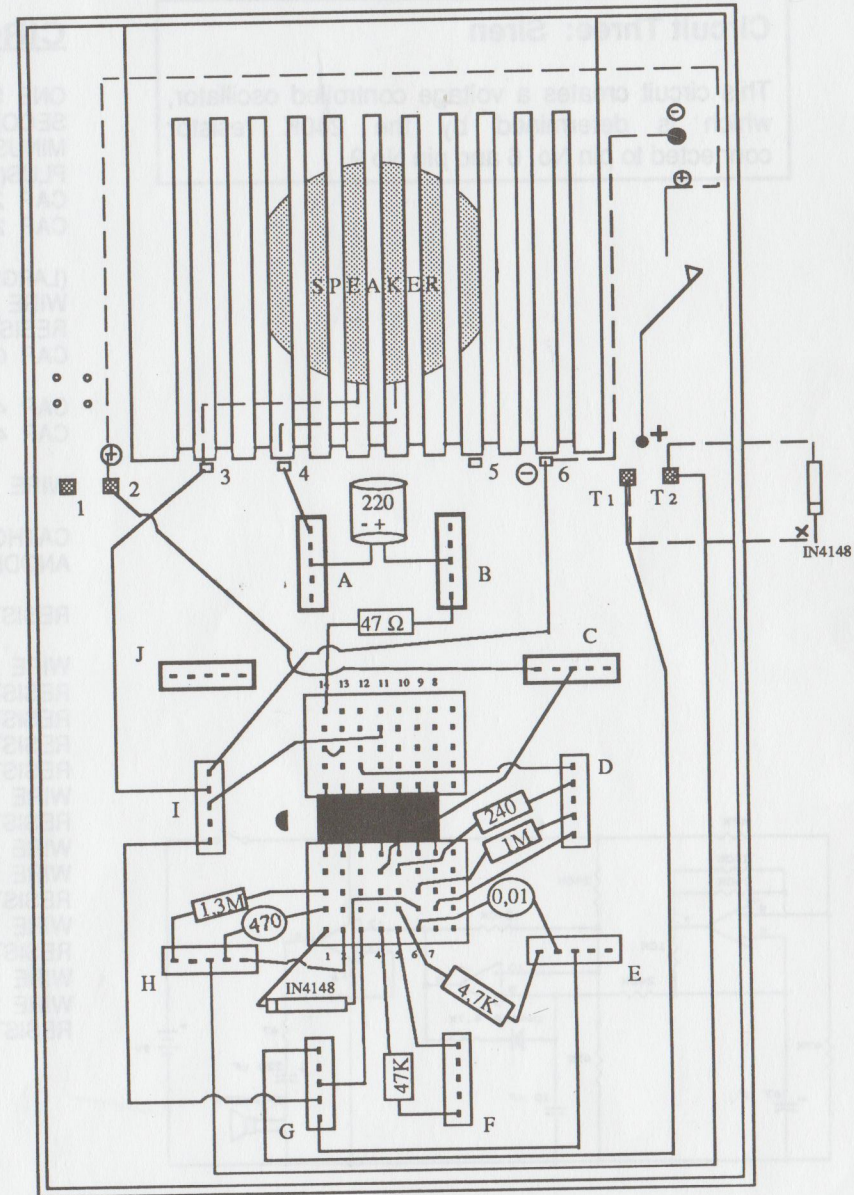
This is an alarm system which will operate when the diode in the circuit gets hot. Take the two wires from the screws marked T and connect them to the diode. Connect one wire to one side, and the other wire to the other side of the diode. Place the diode onto a small plate, then by using a match, heat the wire on the cathode side of the diode, the side with the black line. Just touch this wire once with the match. The alarm should start. If the alarm is too sensitive, in other words, if the alarm works before heating, change the 4.7K resistor with a 10K resistor.



### CIRCUIT 4 - FIRE DETECTOR

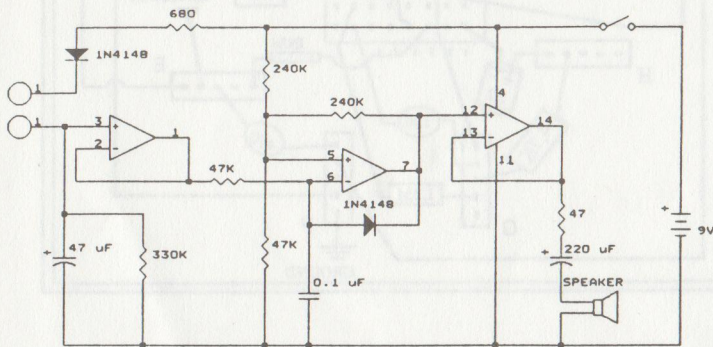
- |                              |        |                |
|------------------------------|--------|----------------|
| ONE SPEAKER WIRE -----       | TO---- | A              |
| SECOND SPEAKER WIRE -----    | TO---- | I              |
| MINUS (BLACK) WIRE -----     | TO---- | I              |
| PLUS(RED) WIRE -----         | TO---- | C              |
|                              |        |                |
| CAP 220uF (-) -----          | TO---- | A              |
| CAP 220uF(+) -----           | TO---- | B              |
|                              |        |                |
| RESISTOR 47Ω FROM B -----    | TO---- | 14             |
| WIRE FROM C -----            | TO---- | 4              |
| WIRE FROM D -----            | TO---- | 12             |
| RESISTOR 240K FROM D -----   | TO---- | 5              |
| RESISTOR 1MΩ FROM D -----    | TO---- | 6              |
| WIRE FROM D -----            | TO---- | 7              |
|                              |        |                |
| CAP 0.01uF FROM E -----      | TO---- | 6              |
| RESISTOR 4.7K FROM E -----   | TO---- | 5              |
| WIRE FROM E -----            | TO---- | G              |
| RESISTOR 47K FROM F -----    | TO---- | 4              |
| WIRE FROM F -----            | TO---- | 5              |
|                              |        |                |
| WIRE FROM G -----            | TO---- | I              |
| WIRE FROM G -----            | TO---- | 3              |
| WIRE FROM G -----            | TO---- | T <sub>1</sub> |
|                              |        |                |
| WIRE FROM H -----            | TO---- | 2              |
| WIRE FROM H -----            | TO---- | T <sub>2</sub> |
| CAP 470 pF FROM H -----      | TO---- | 1              |
| RESISTOR 1.3MΩ FROM H -----  | TO---- | 1              |
|                              |        |                |
| WIRE FROM I -----            | TO---- | 11             |
| WIRE FROM 13 -----           | TO---- | 14             |
|                              |        |                |
| CATHODE OF SMALL DIODE ----- | TO---- | 1              |
| ANODE OF SMALL DIODE -----   | TO---- | 6              |
| SECOND CATHODE -----         | TO---- | T <sub>1</sub> |
| SECOND ANODE -----           | TO---- | T <sub>2</sub> |

### 4. FIRE DETECTOR



### Circuit Five: Sound Effects

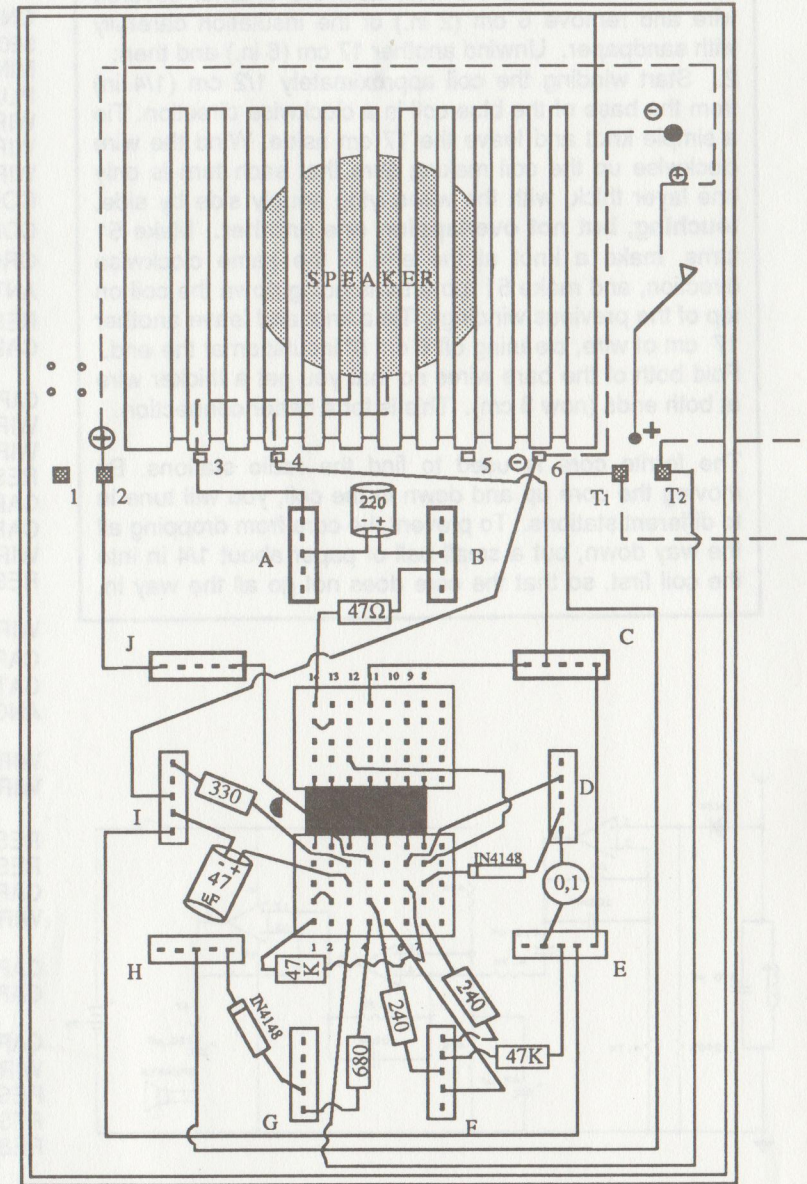
This will make a noise similar to a plane landing or taking off. Connect any conductor between the two terminals in such a way that you can disconnect one side easily. When the conductor is connected, you will hear a high-pitched noise. When you break the circuit, the capacitor discharges through the 330K resistor and the tone slowly disappears.



### CIRCUIT 5 - SOUND EFFECTS

- ONE SPEAKER WIRE ----- TO----- A
- SECOND SPEAKER WIRE ----- TO----- C
- MINUS(BLACK) WIRE ----- TO----- I
- PLUS(RED) WIRE ----- TO----- J
  
- CAP 220 uF (-) ----- TO----- A
- CAP 220 uF (+) ----- TO----- -B
  
- RESISTOR 47Ω FROM B ----- TO----- 14
- WIRE FROM C ----- TO----- 11
- WIRE FROM C ----- TO----- E
  
- WIRE FROM D ----- TO----- 6
- ANODE OF SMALL DIODE ----- TO----- D
- CATHODE OF SMALL DIODE ----- TO----- 7
- CAP 0.1uF FROM D ----- TO----- E
  
- WIRE FROM E ----- TO----- I
- RESISTOR 47K FROM E ----- TO----- F
  
- WIRE FROM F ----- TO----- 5
- RESISTOR 240K FROM F ----- TO----- 7
- RESISTOR 240K FROM F ----- TO----- 4
  
- RESISTOR 680Ω FROM G ----- TO----- 4
  
- CATHODE OF SMALL DIODE ----- TO----- H
- ANODE OF SMALL DIODE ----- TO----- G
- WIRE FROM H ----- TO----- T<sub>1</sub>
- CAP 47uF (-) ----- TO----- I
- CAP 47uF (+) ----- TO----- 3
- RESISTOR 330K FROM I ----- TO----- 3
- RESISTOR 47K FROM 1 ----- TO----- 6
- WIRE FROM 12 ----- TO----- 7
- WIRE FROM J ----- TO----- 4
- WIRE FROM 14 ----- TO----- 13
- WIRE FROM 1 ----- TO----- 2
- WIRE FROM 3 ----- TO----- T<sub>2</sub>
- THIN WIRE FROM T<sub>1</sub> ----- TO----- T<sub>2</sub>

### 5. SOUND EFFECTS





## 6. RADIO

### Circuit Six: Radio Circuit

1. In order to wind the coil, take the enamel covered wire and remove 6 cm (2 in.) of the insulation carefully with sandpaper. Unwind another 17 cm (6 in.) and then:  
 2. Start winding the coil approximately 1/2 cm (1/4 in) from the base of the blue coil in a clockwise direction. Tie a simple knot and leave the 17 cm aside. Wind the wire clockwise up the coil making sure that each turn is only one layer thick, with the wires lying snugly side by side, **touching, but not overlapping one another**. Make 51 turns, make a knot at the end in the same clockwise direction, and make 51 more turns going down the coil on top of the previous windings. Tie a knot and leave another 17 cm of wire, cleaning off 6 cm of insulation at the end. Fold both of the bare wires so that you get a thicker wire at both ends (now 3 cm). This is for a better connection.

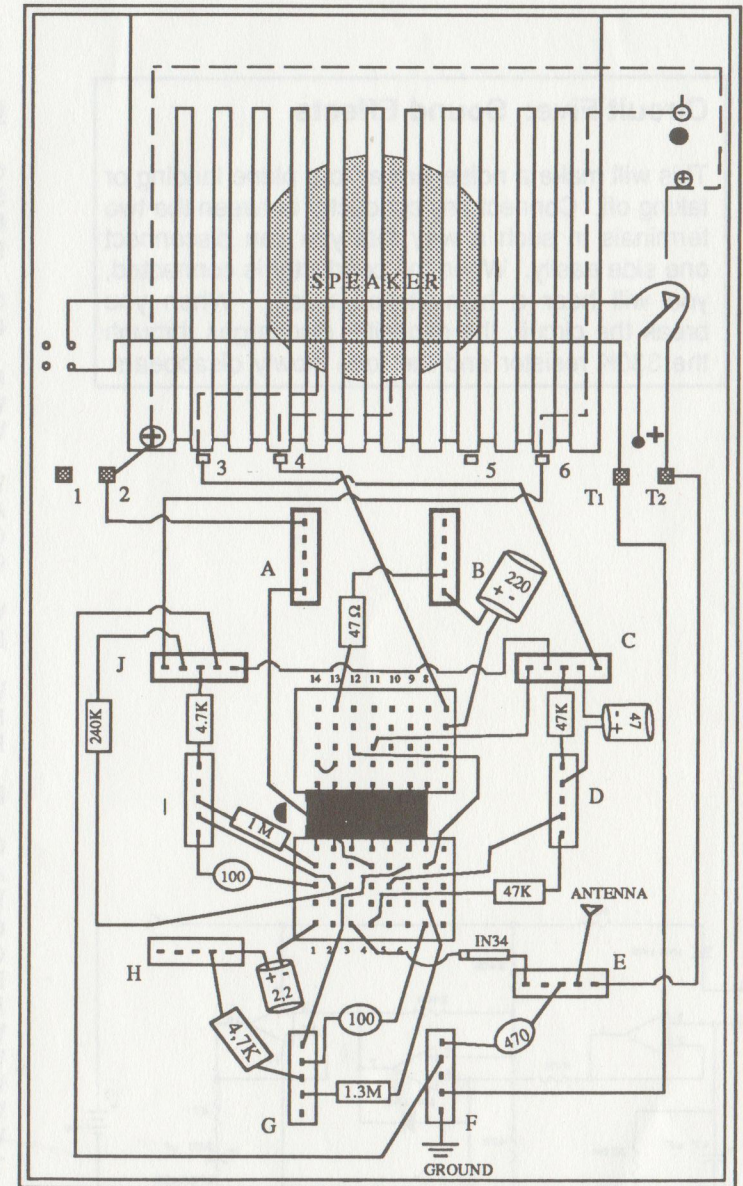
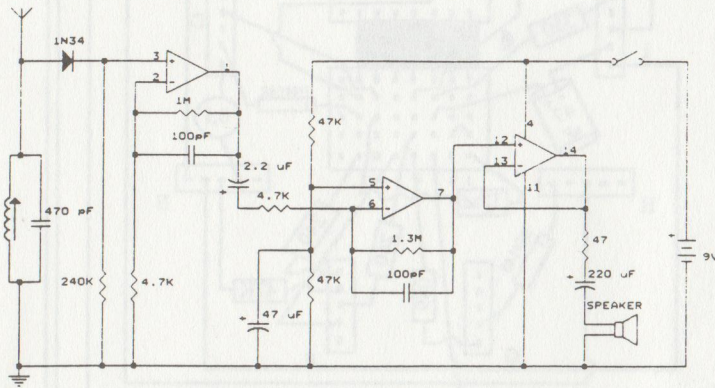
The ferrite core is used to find the radio stations. By moving the core up and down in the coil, you will tune in to different stations. To prevent the core from dropping all the way down, put a small ball of paper about 1/4 in into the coil first, so that the core does not go all the way in.

### CIRCUIT 6 - RADIO

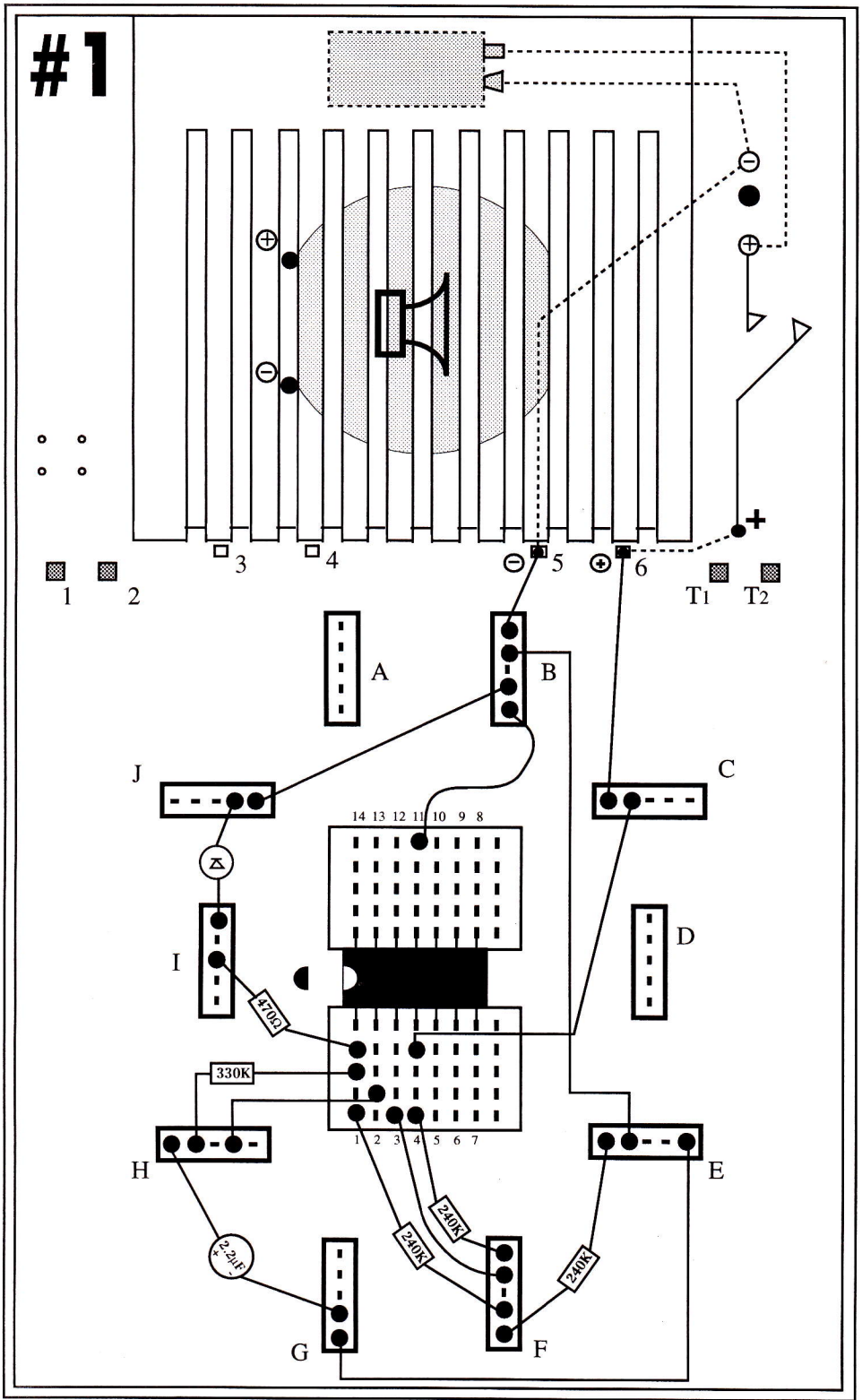
#### IMPORTANT TO BUILD CAREFULLY

ONE SPEAKER WIRE	----- TO	C
SECOND SPEAKER WIRE	-- TO -- HOLE UNDER	8
MINUS (BLACK) WIRE	----- TO	J
PLUS (RED) WIRE	----- TO	A
WIRE FROM A	----- TO	4
WIRE FROM 13	----- TO	14
WIRE FROM 7	----- TO	12
COIL WIRE	----- TO	T <sub>1</sub>
COIL WIRE	----- TO	T <sub>2</sub>
GROUND	----- TO	T <sub>1</sub>
ANTENNA	----- TO	T <sub>2</sub>
RESISTOR 47Ω FROM B	----- TO	13
CAP 220 uF (+)	----- TO	B
CAP 220 uF (-)	----- TO	8
WIRE FROM C	----- TO	11
WIRE FROM C	----- TO	J
RESISTOR 47K FROM C	----- TO	D
CAP 47uF (-)	----- TO	C
CAP 47uF (+)	----- TO	D
WIRE FROM D	----- TO	5
RESISTOR 47K FROM D	----- TO	4
WIRE FROM E	----- TO	T <sub>2</sub>
CAP 470 pF FROM E	----- TO	F
CATHODE OF DIODE IN34	----- TO	3
ANODE OF DIODE IN34	----- TO	E
WIRE FROM F	----- TO	J
WIRE FROM F	----- TO	T <sub>1</sub>
RESISTOR 1.3 MΩ FROM G	-- TO	7
RESISTOR 4.7K FROM G	----- TO	H
CAP 100 pF FROM G	----- TO	7
WIRE FROM G	----- TO	6
CAP 2.2uF (+)	----- TO	H
CAP 2.2uF (-)	----- TO	1
CAP 100 pF FROM I	----- TO	1
WIRE FROM I	----- TO	2
RESISTOR 1M FROM I	----- TO	1
RESISTOR 4.7K FROM I	----- TO	J
RESISTOR 240K FROM J	----- TO	3

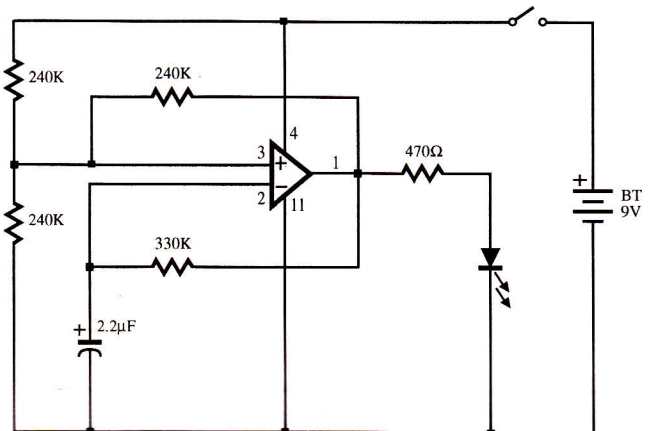
FOR BETTER RECEPTION, MAKE A LONGER ANTENNA AND MAKE SURE YOU HAVE A GOOD EARTH CONNECTION.



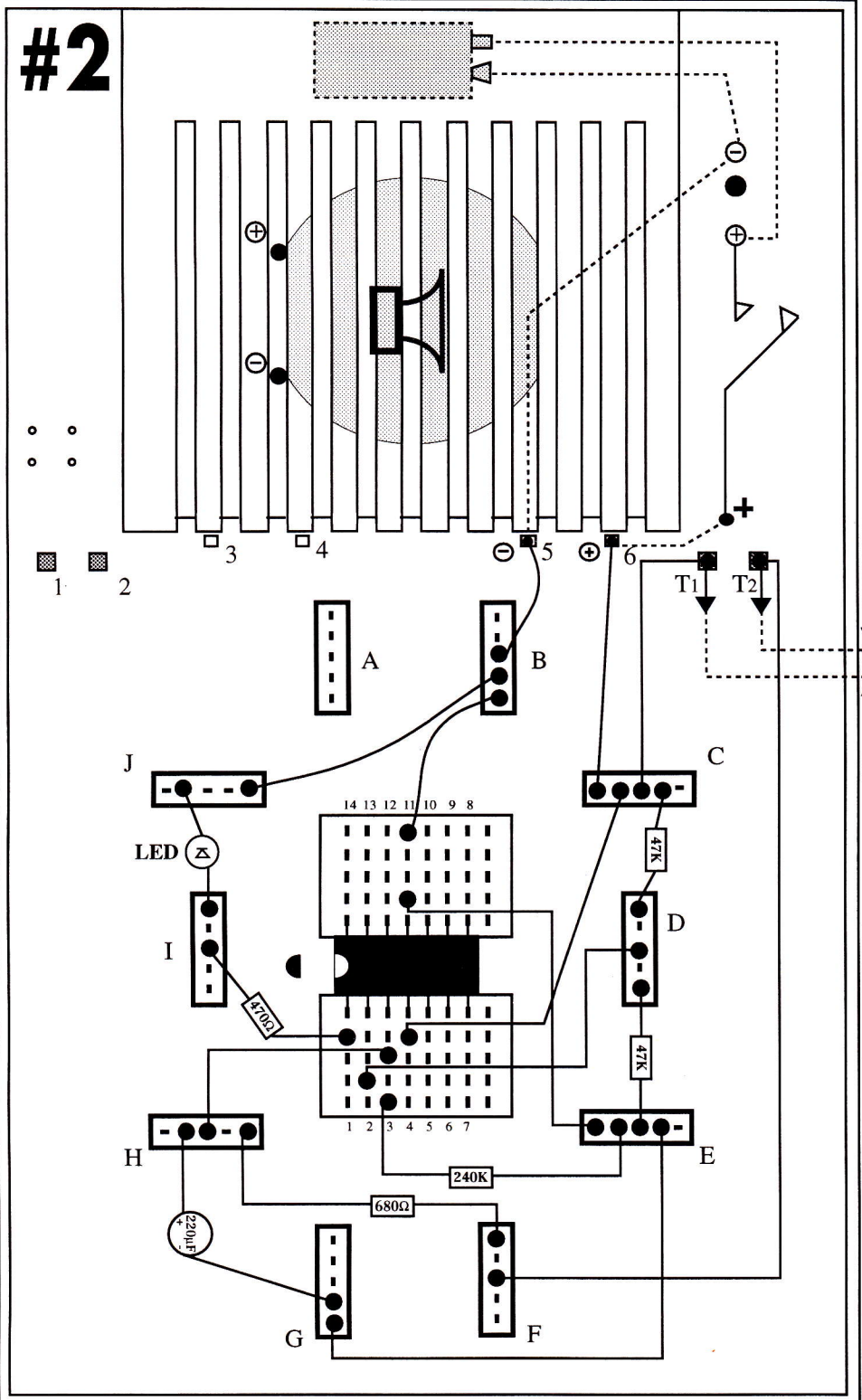
# #1



-	→ 5	→ B
+	→ 6	→ C
B	→ E	
B	→ J	
B	→ 11	
C	→ 4	
E	→ 240K	→ F
E	→ G	
F	→ 240K	→ 4
F	→ 3	
F	→ 240K	→ 1
G	→ -2.2μF	→ +H
H	→ 2	
H	→ 330K	→ 1
I	→ 470Ω	→ 1
I	→ LED	→ J

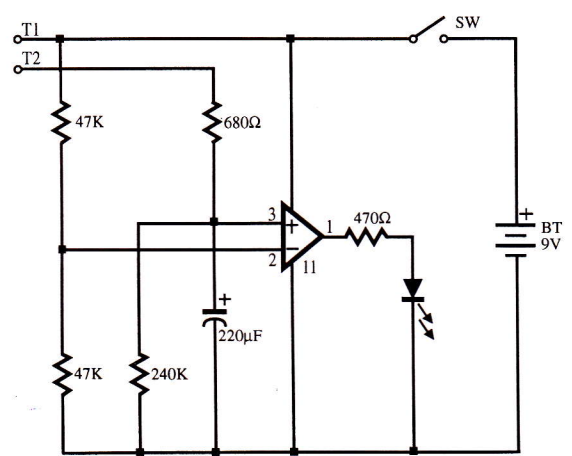


# #2

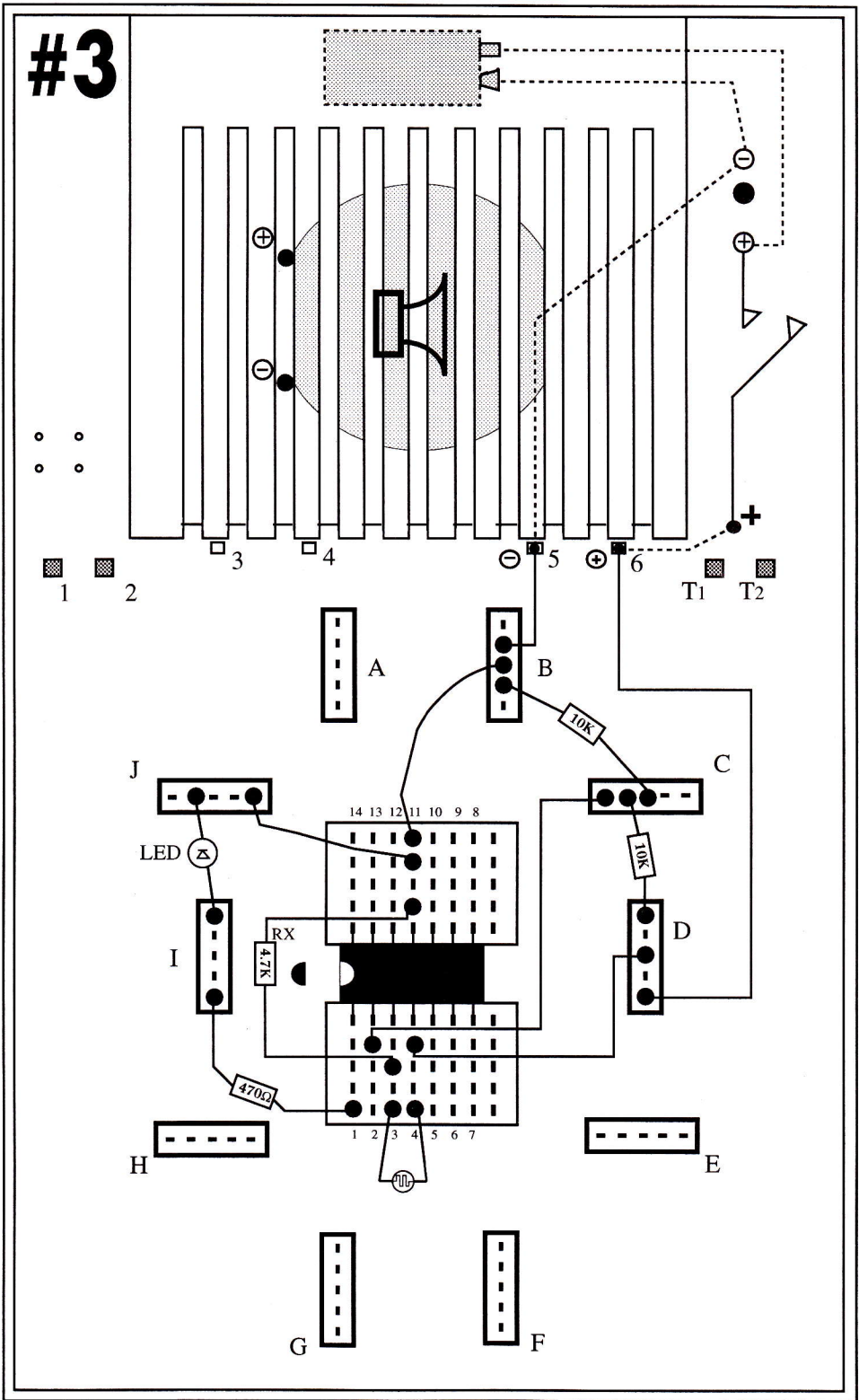


-	→ 5	→ B
+	→ 6	→ C
T1	→ C	
T2	→ F	
B	→ J	
B	→ 11	
C	→ 4	
C	→ 47K	→ D
D	→ 2	
D	→ 47K	→ E
E	→ 240K	→ 3
E	→ 11	
E	→ G	
F	→ 680Ω	→ H
G	→ -220μF	→ +H
H	→ 3	

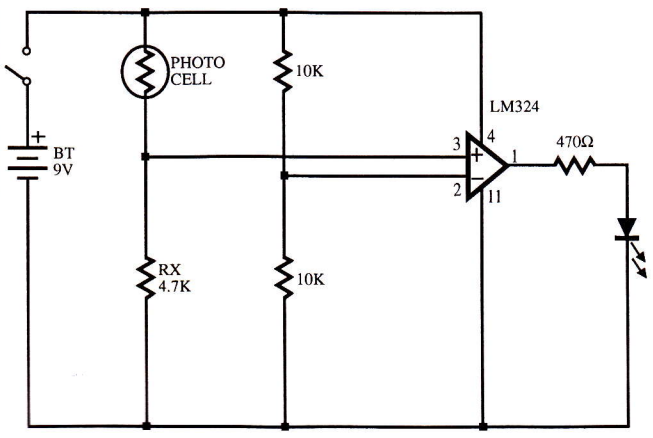
I	→ 470Ω	→ 1
I	→ LED	→ J



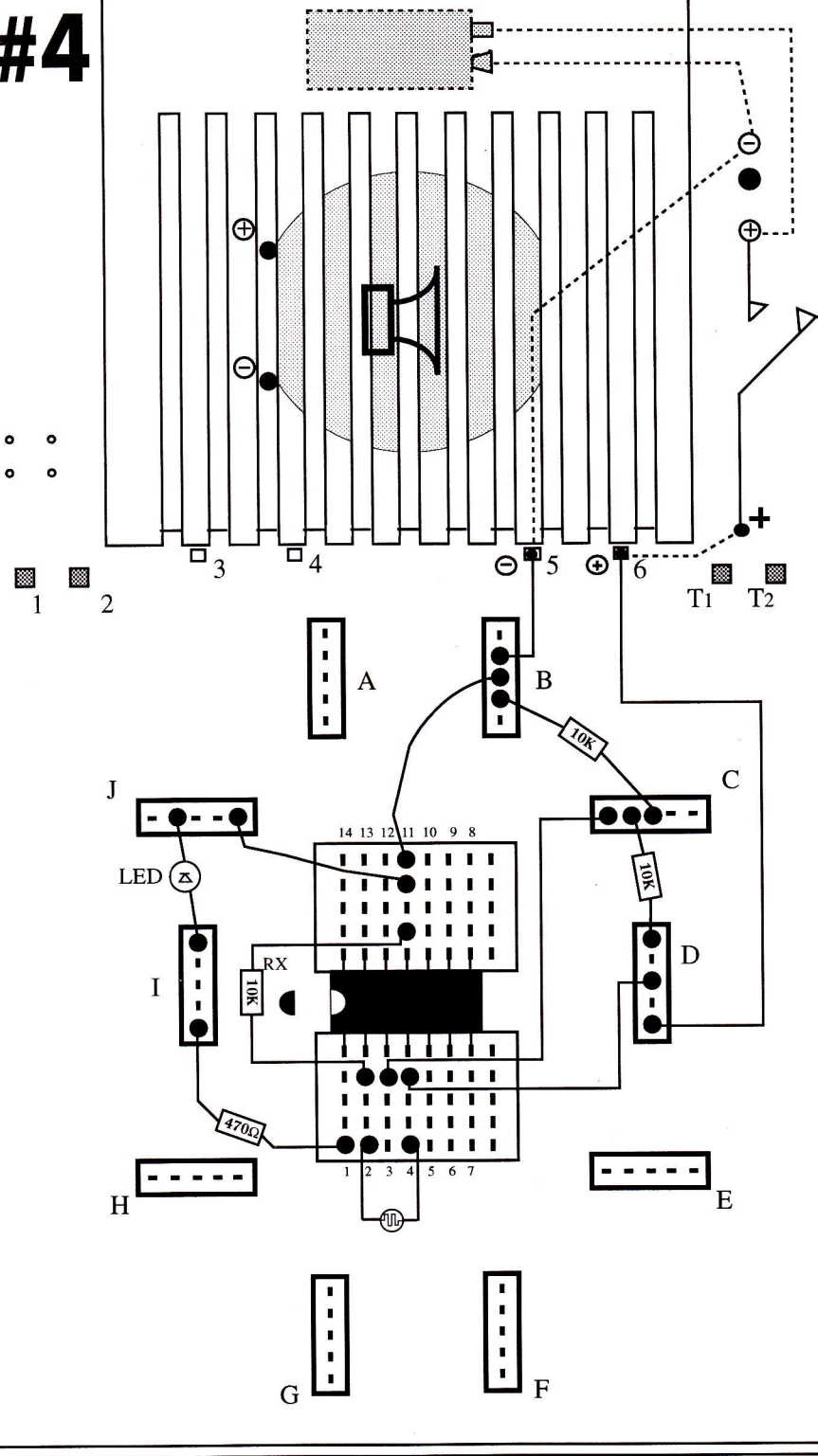
# #3



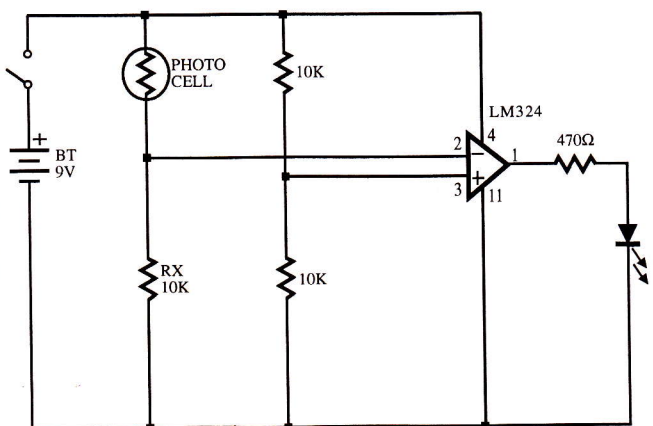
-	→ 5	→ B
+	→ 6	→ D
B	→ 11	
B	→ 10K	→ C
C	→ 2	
C	→ 10K	→ D
D	→ 4	
I	→ 470Ω	→ 1
I	→ LED	→ J
J	→ 11	
11	→ RX 4.7K	→ 3
3	→  → 4	



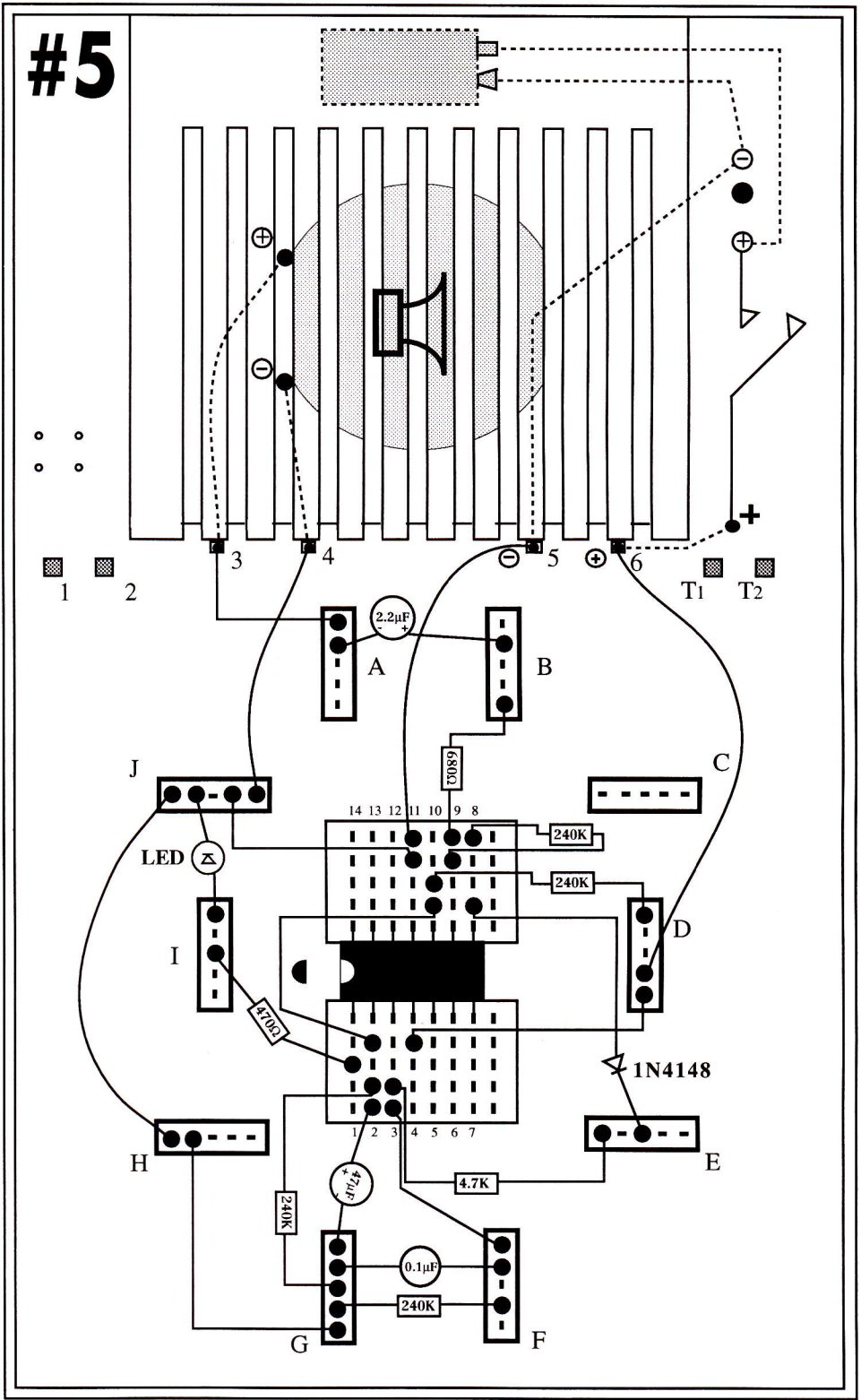
# #4



-	→ 5	→ B
+	→ 6	→ D
B	→ 11	
B	→ 10K	→ C
C	→ 10K	→ D
C	→ 3	
D	→ 4	
I	→ 470Ω	→ 1
I	→ LED	→ J
J	→ 11	
2	→  → 4	
11	→ RX 10K	→ 2



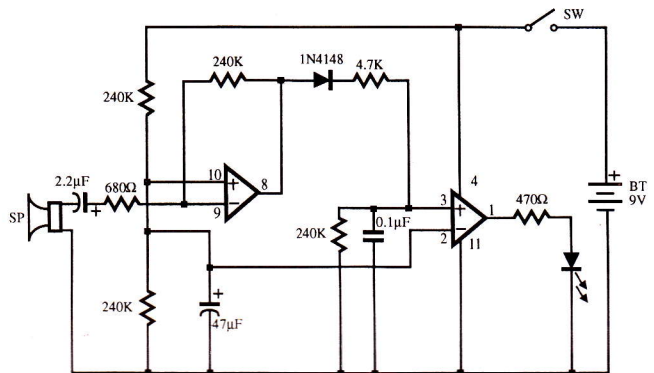
# #5



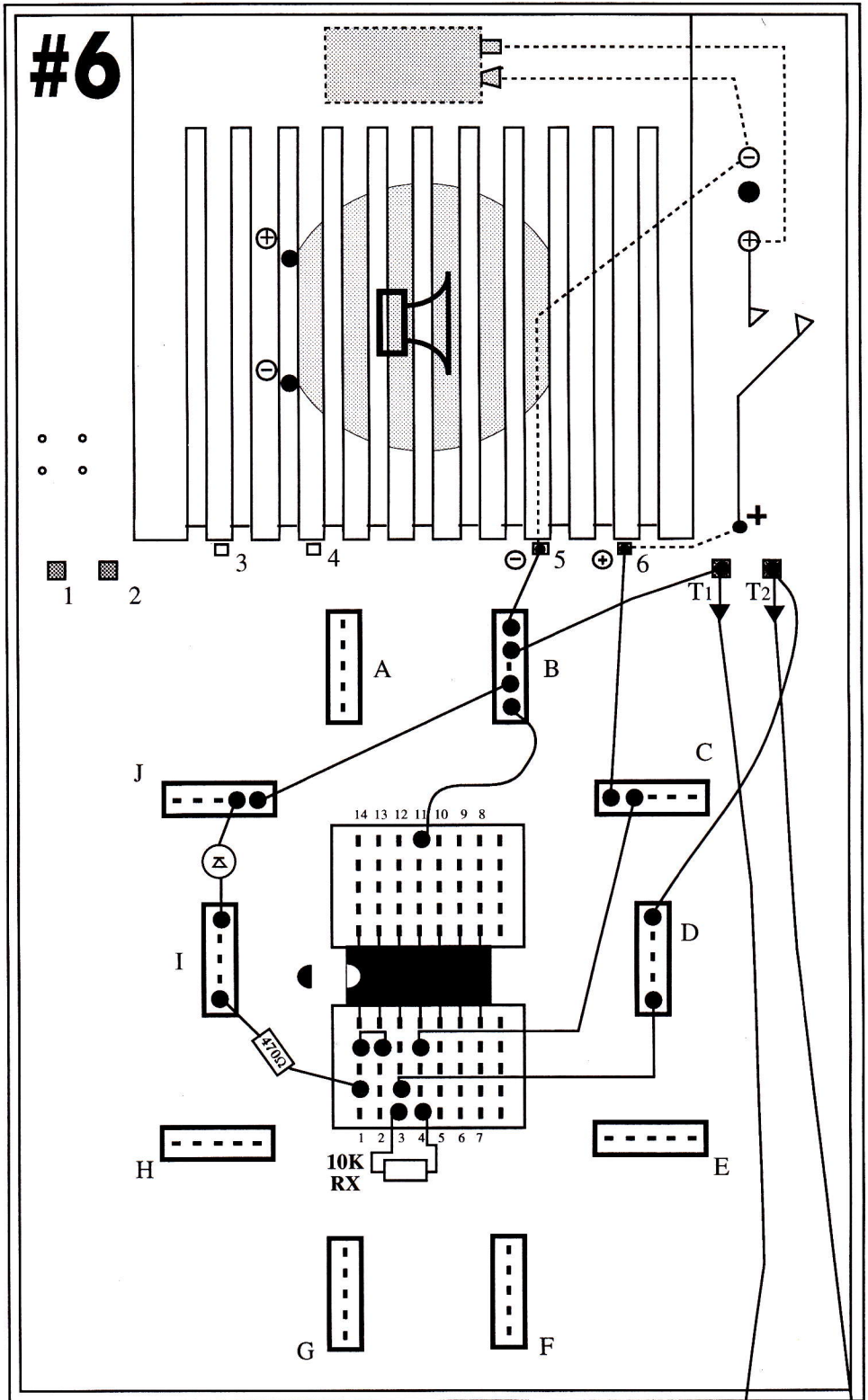
-	→ 5	→ 11
+	→ 6	→ D
A	→ 3 +	
A	→ -2.2μF	→ B
B	→ 680Ω	→ 9
D	→ 240K	→ 10
D	→ 4	
E	→ 1N4148	→ 8
E	→ 4.7K	→ 3
F	→ 3	
F	→ 0.1μF	→ G
F	→ 240K	→ G
G	→ H	
G	→ 240K	→ 2
G	→ -47μF	→ +2
H	→ J	

I	→ 470Ω	→ 1
I	→ LED	→ J
2	→ 10	

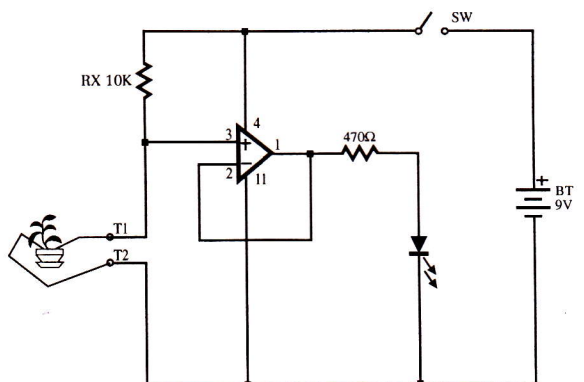
J	→ 11	
J	→ 4 -	
9	→ 240K	→ 8



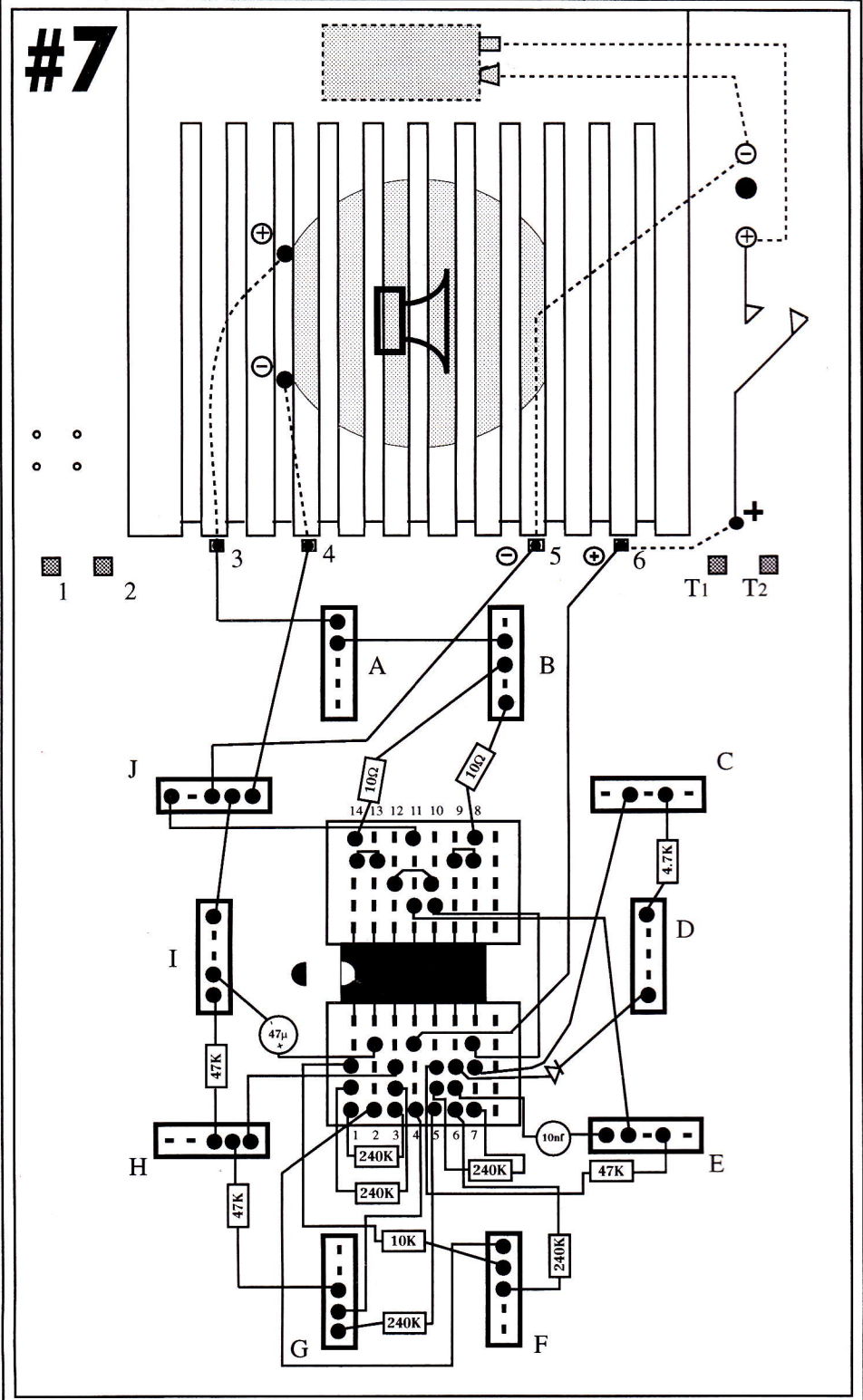
# #6



-	→ 5	→ B
+	→ 6	→ C
T1	→ B	
T2	→ D	
B	→ J	
B	→ 11	
C	→ 4	
D	→ 3	
I	→ LED	→ J
I	→ 470Ω	→ 1
1	→ 2	
3	→ RX10K	→ 4
T1	→	
T2	→	



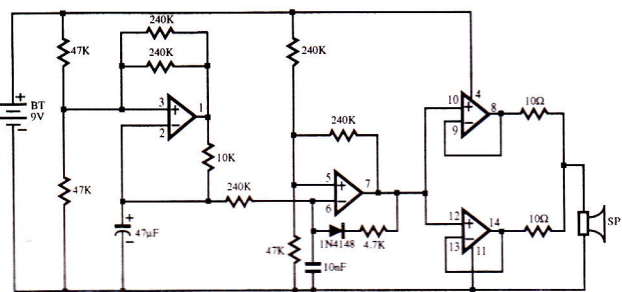
# #7



-	→ 5	→ J
+	→ 6	→ 4
-	→ 4	→ J
+	→ 3	→ A
A	→ B	
B	→ 10Ω	→ 14
B	→ 10Ω	→ 8
C	→ 7	
C	→ 4.7K	→ D
D	→ 1N4148	→ 6
E	→ 10nF	→ 6
E	→ 11	
E	→ 47K	→ 5
F	→ 2	
F	→ 10K	→ 1
F	→ 240K	→ 6

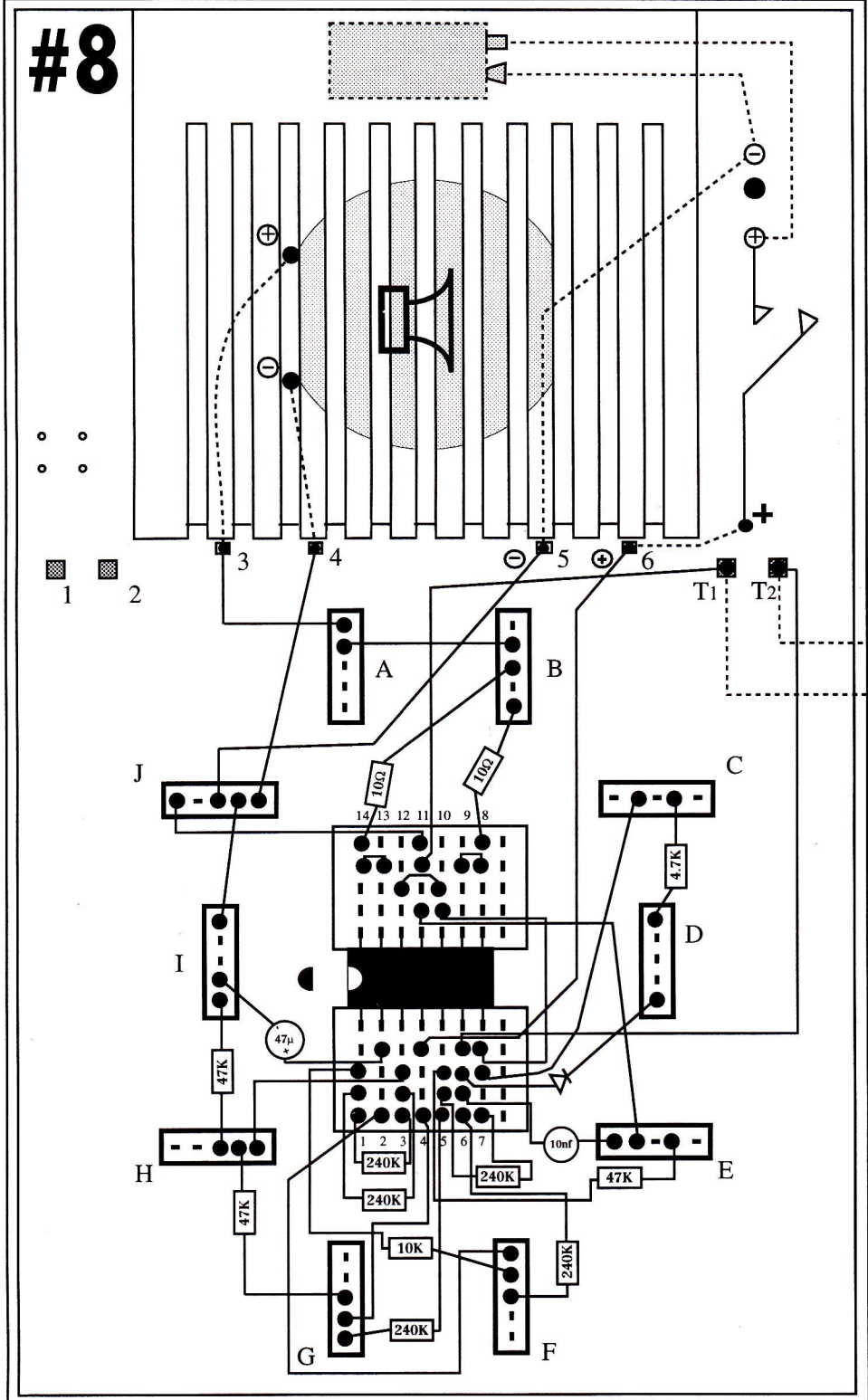
G	→ 240K	→ 5
G	→ 4	
G	→ 47K	→ H
H	→ 3	
H	→ 47K	→ I
I	→ -47μF	→ +2
I	→ J	
J	→ 11	

13	→ 14	
8	→ 9	
10	→ 12	
7	→ 10	
1	→ 240K	→ 3
1	→ 240K	→ 3
5	→ 240K	→ 7





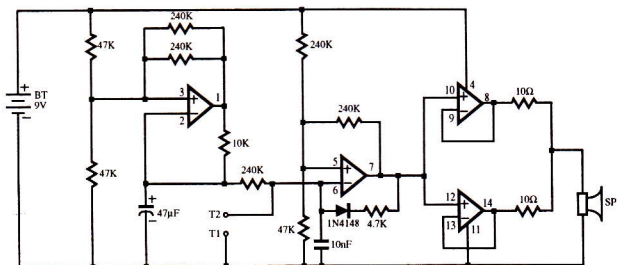
# #8



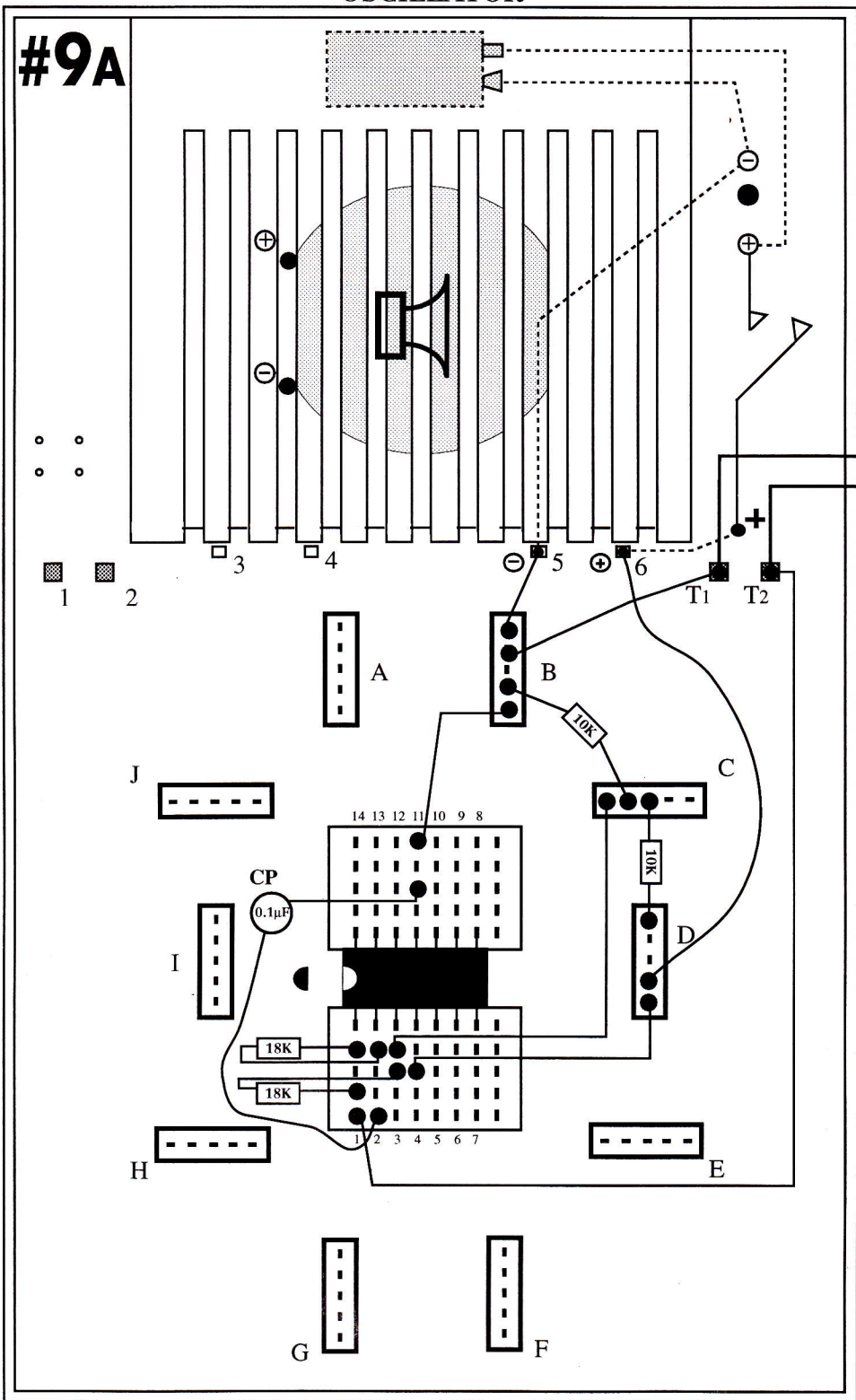
-	→ 5	→ J
+	→ 6	→ 4
-	→ 4	→ J
+	→ 3	→ A
A	→ B	
B	→ 10Ω	→ 14
B	→ 10Ω	→ 8
C	→ 7	
C	→ 4.7K	→ D
D	→ 1N4148	→ 6
E	→ 10nF	→ 6
E	→ 11	
E	→ 47K	→ 5
F	→ 2	
F	→ 10K	→ 1
F	→ 240K	→ 6

G	→ 240K	→ 5
G	→ 4	
G	→ 47K	→ H
H	→ 3	
H	→ 47K	→ I
I	→ -47μF	→ +2
I	→ J	
J	→ 11	

13	→ 14	
8	→ 9	
10	→ 12	
7	→ 10	
1	→ 240K	→ 3
1	→ 240K	→ 3
5	→ 240K	→ 7
T1	→ 11	
T2	→ 6	

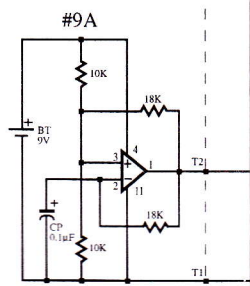


# OSCILLATOR



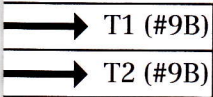
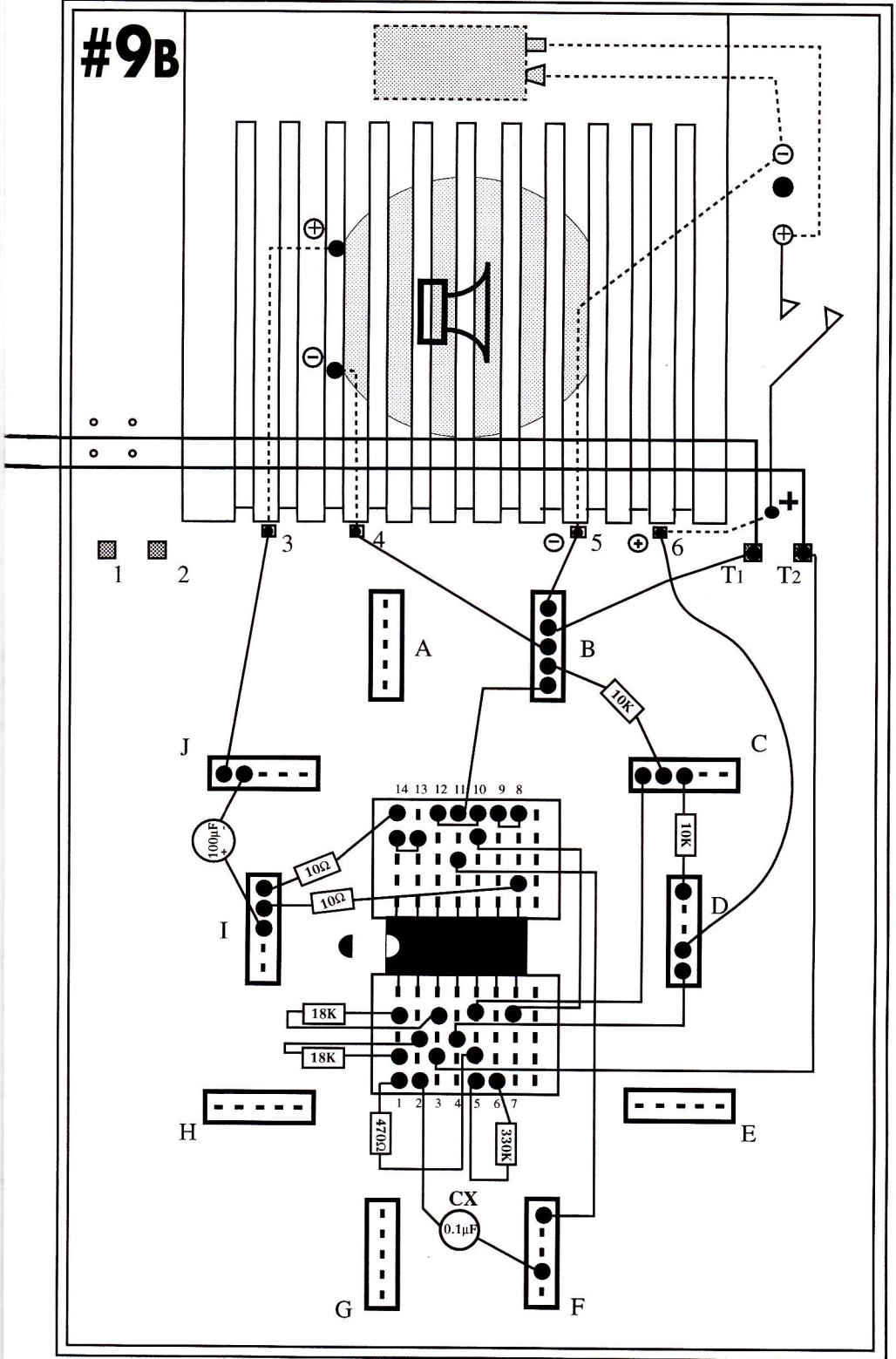
OSCILLATOR		
-	→ 5	→ B
+	→ 6	→ D
B	→ 10K	→ C
B	→ 11	
B	→ T1	
C	→ 3	
C	→ 10K	→ D
D	→ 4	
2	→ 0.1µF	→ 11
1	→ 18K	→ 3
1	→ T2	
2	→ 18K	→ 1

T1 (#9A)	—————
T2 (#9A)	—————



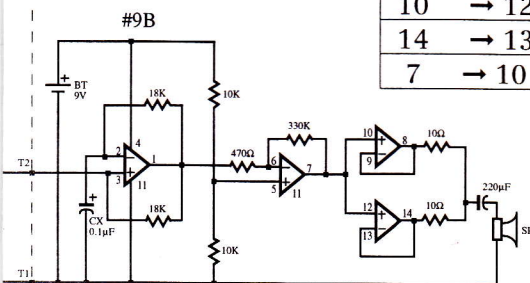
# AMPLIFIER

## #9B

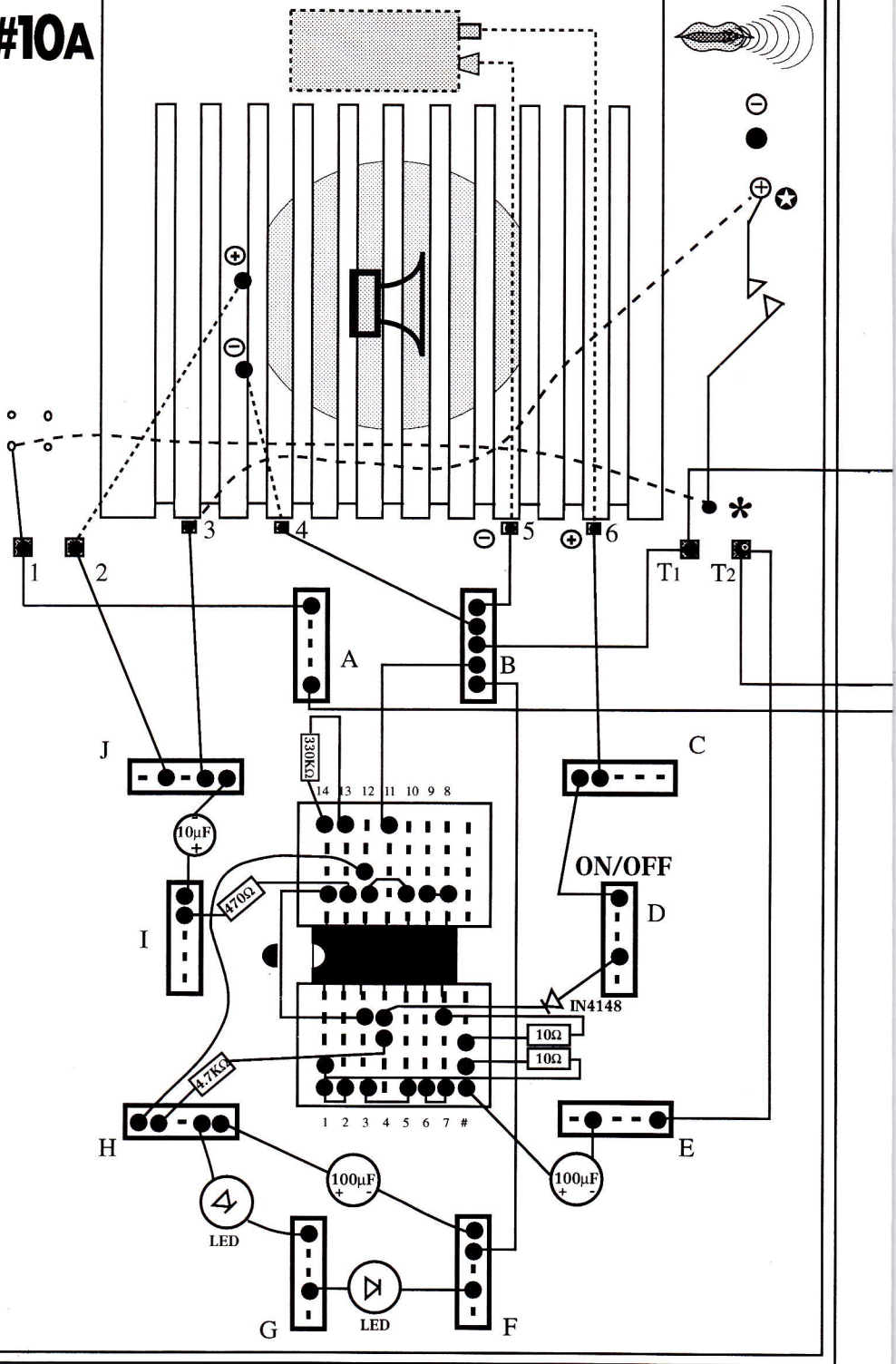


AMPLIFIER		
5	→ 330K →	6
5	→ 470Ω →	1
3	→	T2
1	→ 18K →	2
1	→ 18K →	3
8	→	9
10	→	12
14	→	13
7	→	10

-	→ 5	→ B
+	→ 6	→ D
-	→ 4	→ B
+	→ 3	→ J
B	→ 10K	→ C
B	→	T1
B	→	11
C	→ 10K	→ D
C	→	5
D	→	4
F	→	11
F	→ 0.1µF	→ 2
I	→ 10Ω	→ 8
I	→ 10Ω	→ 14
I	→ +100µF	→ J



# #10A

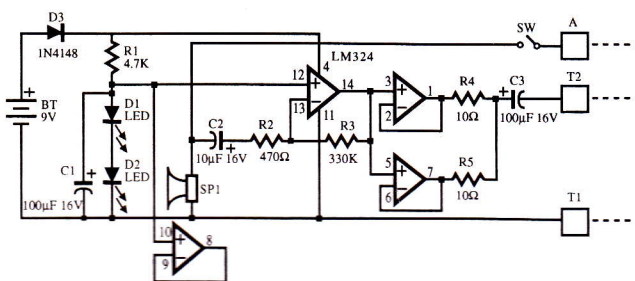


⊕	→ 3	→ J
-	→ 5	→ B
+	→ 6	→ C
+ [Speaker]	→ 2	→ J
- [Speaker]	→ 4	→ B
* [Star]	→ 1	→ A
B	→ T1	
B	→ 11	
B	→ F	
C	→ D	
D	→ IN4148	→ 4
E	→ T2	
E	→ -100μF	→ + #
F	→ -100μF	→ + H
F	→ LED	→ G
G	→ LED	→ H
H	→ 12	
H	→ 4.7K	→ 4

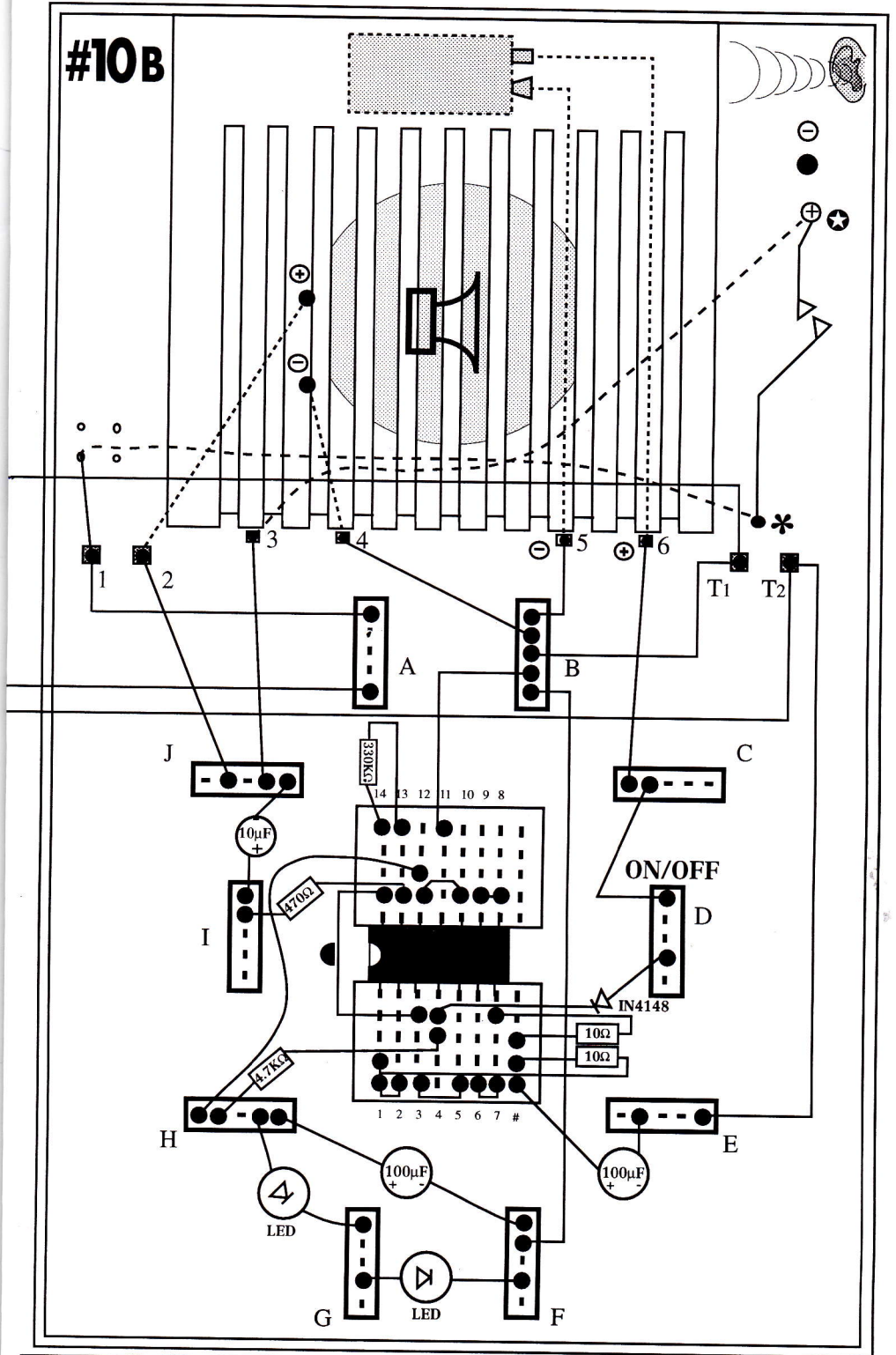
I	→ 470Ω	→ 13
I	→ +10μF	→ -J
1	→ 2	
3	→ 5	
6	→ 7	
#	→ 10Ω	→ 1
#	→ 10Ω	→ 7
8	→ 9	

10	→ 12	
13	→ 330K	→ 14
3	→ 14	

T1 (#10A)	—
T2 (#10A)	—
A (#10A)	—



# #10B



⊛	→ 3	→ J
-	→ 5	→ B
+	→ 6	→ C

+ ⊞	→ 2	→ J
- ⊞	→ 4	→ B
*	→ 1	→ A
B	→ T1	
B	→ 11	
B	→ F	
C	→ D	
D	→ 1N4148	→ 4

E	→ T2
E	→ -100µF → + #
F	→ -100µF → + H
F	→ LED → G
G	→ LED → H
H	→ 12
H	→ 4.7K → 4
I	→ 470Ω → 13
I	→ +10µF → - J
1	→ 2
3	→ 5
6	→ 7
#	→ 10Ω → 1
#	→ 10Ω → 7
8	→ 9
10	→ 12
13	→ 330K → 14
3	→ 14

- T1 (#10B)
- A (#10B)
- T2 (#10B)

