

GILBERT
ELECTRIC EYE
INSTRUCTION
MANUAL

Manual of
Instructions

GILBERT
ELECTRIC
EYE

*Mysteries of
Electrical Action*

The A. C. Gilbert Company
NEW HAVEN, CONN., U.S.A.

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GILBERT ELECTRIC EYE

FUN WITH THE ELECTRIC EYE

Photoelectricity is the term applied to all electrical effects produced by light and the light sensitive device is known as a Photoelectric cell by scientists while the more popular term is Electric Eye.

Electric Eyes may be of many types as it has been found that light affects many chemical compounds to produce electrical effects. By electrical effects we mean that light falling on the compound may generate a current, or it may simply control the current flowing through the compound.

This latter effect is what takes place in the Eye in this outfit which uses as the sensitive substance the element Selenium. The Selenium is spread in a thin film over two conductors closely spaced and then heat treated to convert it to its light sensitive form.

When the Eye is connected into an electrical circuit it acts to control the amount of current flowing in the circuit in accordance with the amount of light falling on sensitive film. Thus, if the Eye is covered or in a dark place there will be very little current flowing but as the cover is removed or a light flashed on it the current will increase and it is possible to control other apparatus by this change in current value. The above fact seems like a miracle in itself. And one will never cease to marvel at the mystery of it. But let us assemble the outfit and see for ourselves that it really does work.

SETTING UP THE ELECTRIC EYE

Remove all the parts carefully from the carrying case and set the panel upright by slipping the two black wooden strips onto the lower edge as shown in Figure 1.

Examine the panel front and back and make sure that all screws and nuts are tight and no connecting wires disconnected.

See that the armature or moving strip in front of the magnets on both the relays is free and swings back and forth when touched with the finger.

Connect a 2 1/2 Volt C Battery to the two clips on the bottom of the panel marked 2 1/2 Volts.

Two flashlight units are snapped into the metal case with the switch and the leads from this case connected to the clips marked 3 Volts.

FOREWORD

Hello Boys:

Photoelectricity is possibly the most interesting and fascinating of all the branches of Electrical Research and Engineering. It has given to the world such things as Talking Pictures, Television, Picture Transmission by radio and wire and performs daily a thousand tasks necessary to our well being and happiness. It stops elevators, opens doors, counts, measures and sorts everything from beans to automobiles. And the story is by no means all told and many more uses will be found for the Electric Eyes.

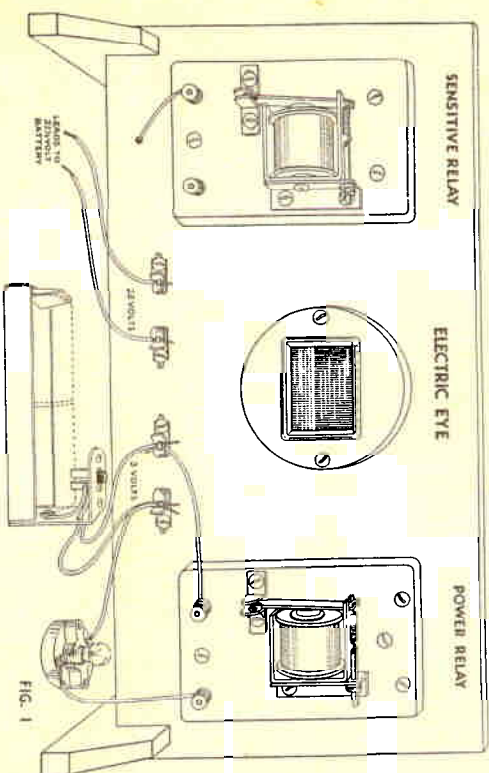
The experiments described cover but a portion of the many possible uses of Electric Eyes but they serve as a guide in devising other applications and stunts. The commercial aspects of Electric Eyes are many and varied, thus they could be used for switching on advertising signs automatically, or operating show window devices, or permitting inspection of stores by the police officer flashing his lamp on an Eye and so on almost indefinitely. These applications, however, are beyond the intent of the Gilbert Electric Eye which is intended primarily to amuse as well as instruct in the fundamentals of Photoelectricity.

It is well to bear in mind that the apparatus should be treated as a scientific instrument and given a reasonable amount of care. It has been built as sturdy as is possible to assure delicacy and sensitiveness and should not be abused by throwing around or dropping. The Eye will continue to operate for many years if not abused.

The batteries will last for long periods of time as the current drain is very low.

Cordially yours,

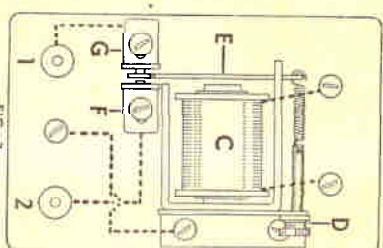
A. C. Gilbert
President,



ADJUSTING THE RELAYS

We will now acquaint ourselves with the adjustment of the relay and it is well to mention here that it is time well spent in learning to make these adjustments quickly and accurately. Since the current change through the Eye is at best very small, being but one thousandths of an ampere under most conditions it is clear why the relay must be adjusted correctly to obtain the best results but when once adjusted it will operate satisfactorily over long periods of time.

Let us study the circuit of the panel shown in the lid of the carrying case, to see just how the Eye operated the relay. By following the wiring from the 2.2 1/2 V. clips it will be seen the current flows through the Eye and then through the coil on the sensitive relay, then back to the other clip of the battery. It will then be apparent that if a change of light on the cell results in a change in the current flowing in the circuit, the magnetic pull of the coil of the relay will change. That is, an increase of light decreases the pull, greater pull on the armature while a decrease of light increases the pull. It is only necessary then to so adjust the tension of the spring on the armature so that the increase in current will cause it to swing over and close the circuit to contact F, Figure 2. Closing this circuit results in current from the



3 Volt battery passing through the coil of the other relay known as the Power Relay which will close with an audible click.

The reason for using two relays will be more apparent as the experiments progress but experience has shown that a sensitive relay as used here should not be used to control heavy currents so the sensitive relay is used to operate the heavy relay which can control appreciable power without sparking and burning of contacts.

It should be noticed likewise that when the armature of the sensitive relay is pulled over two things are accomplished, first of all the circuit to the left contact G is broken and then the circuit to the right contact F is closed. We may utilize either of these actions by changing the connection to the bottom terminals on the sensitive relay. For the purpose of preliminary adjustments let us have this wire connected to terminal No. 1 which gives a closed circuit when the Eye is darkened. You have already connected the leads from the battery case to the two clips marked 3 Volts. Next connect the small socket and lamp furnished with the outfit to one terminal of the relay and the other wire to the battery clip, also connect the other battery clip to the remaining relay terminal as shown in the setup, Fig. 1.

If all connections have been properly made and the Eye is in a dim light or shaded corner the small bulb should light up. If it fails to light turn the knurled nut D on the sensitive relay to increase the tension on the armature till it swings against the contact G. This will close the Power Relay and switch on the miniature bulb.

Now bring the lighted bulb toward the face of the Eye, as it comes close it should start to blink off and on. If it fails to blink reduce the tension on the relay armature gradually by slow unscrewing the nut D. The proper adjustment of the relay is indicated when the lamp blinks rapidly.

Now you have performed the trick, making a lamp turn itself off, for as the light falls on the cell it caused the relays to function and switch the light off. When the light is thus cut off the cell and the relays again act to close the light circuit and the action repeats itself rapidly resulting in the blinking of the light.

For one not familiar with electrical apparatus it may take a little time to get the knack of adjusting the relay and it is advisable to have the room dimly lighted at first to assure best conditions. Adjustment of the Power Relay is seldom if ever necessary as sufficient current for its operation is always available and no delicate adjustment necessary.

LIGHTING AN ELECTRIC LIGHT WITH A MATCH

This is a very simple trick and is quite startling and mystifying. Arrange the apparatus as in Fig. 1 except that the lead under the Sensitive Relay is connected to terminal No. 2. The Power Relay remains open with the cell in the dark.

By means of a small box support the miniature bulb directly in front of the Eye, the whole apparatus being turned so no light from a window or other source falls directly on the Eye. Now strike a match and bring it close to the bulb while it is still flaring and the bulb should light up and stay lighted because the light from the Bulb is acting upon the Eye to keep the circuit closed.

The bulb may be extinguished by passing a card or other object between the bulb and the Eye, cutting off the light for an instant then the relays open. The trick may be repeated as often as desired.

Should the bulb fail to light, try reducing the tension on the sensitive relay armature slightly by unscrewing the tension nut. Be careful not to get the match too close to the cell face as excessive heat may endanger the cell. Disconnect the battery when finished.

A SUNRISE ALARM

If you like to see the sun rise in the morning it's easy to rig up an alarm so the sun will awaken you. Leave the panel connections the same as previously with the lead on relay terminal No. 2 but replace the miniature bulb and socket with an electric doorbell. If you don't have one handy and can't borrow one, have a talk with Dad and he will usually enter into the spirit of the thing and help you disconnect the doorbell for one night anyway.

When you retire set the panel on a table facing a window and have the bell located near your bed. You might test the apparatus by flashing a light on the cell to see if the bell rings and then retire.

In the morning when Old Sol first starts to brighten up the sky the light falling on the cell will cause the relays to close and you will be awakened in plenty of time to see the sun rise in all its glory.

OPERATION OVER A LONG DISTANCE

Experience will have shown you that the brighter the light the greater distance over which the Electric Eye can be operated. When use is made of sunlight it is startling the distance over which apparatus can be controlled by the use of a small hand mirror. Utilizing this method several amazing demonstrations and experiments can be performed, such as firing a cannon at a distance of several hundred yards and remote control of electric models.

HOW TO BUILD A LIGHT SOURCE

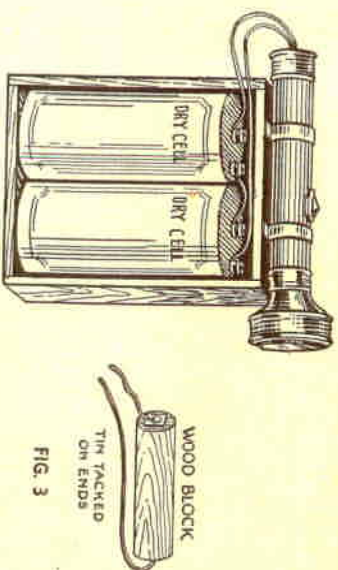


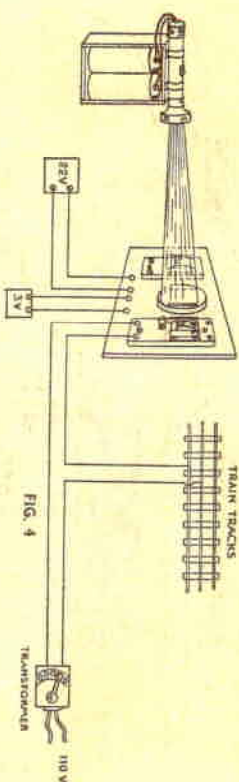
FIG. 3

In several of the following experiments you will need a more inexpensive source of light than the flashlight. Either a magic lantern or movie projector is ideal for this work. Another satisfactory light source can readily be made up as shown in Figure 3. It consists of a wood box large enough to hold two standard size dry batteries on which is fastened a two cell focusing flashlight case by means of two strips of tin.

To make connections to the flashlight case a piece of wood cut to the length of two flashlight units that will slip into the case has a small piece of tin tacked on each end. Wires are connected to the tin pieces and then lead out through a hole punched in the center of the screw cap on the flashlight case as shown and connected to the batteries. This arrangement permits focusing of the flashlight in the usual manner and the light can be switched on and off with regular switch.

CONTROLLING ELECTRIC TRAINS BY A WAVE OF THE HAND

Those who have electric trains will mystify their friends by using the Electric Eye so they can start and stop the trains simply by waving their hand. The set up is very simple and utilizes the light source previously described. The Electric Eye panel is set up in any convenient place near the trains to be controlled. The panel is connected to the tracks as shown in Figure 4 in



such a manner that when the Power Relay is closed the trains will operate. The batteries are connected to the panel in the usual manner. The light source is arranged about two feet away from the front of the panel with the light beam focused on the Eye. The flexible lead under the Sensitive Relay being connected to terminal No. 2.

The apparatus can now be adjusted. Switch the current on to the train tracks and the light on the Eye should keep the trains running by holding the Sensitive Relay closed. If the trains do not run reduce tension on the Sensitive Relay armature by unscrewing the tension nut till the trains start.

Now cutting off the light with the hand should cause the trains to stop. If not, increase the tension slightly. Should the action be slow it may be due to excessive light from other sources shining on the Eye and a cardboard shade over it might be necessary to get it working properly.

But when once adjusted just simply place your hand in the light beam and the trains stop, remove your hand and they start again, much to the amazement of the observer.

SILENCING A RADIO WITH A FLASHLIGHT

It does not seem fair to enjoy a radio program and then not listen to the advertising talks but there are some folks who would like to do this if it

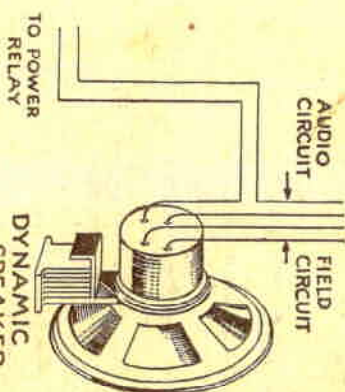


FIG. 5

to ask an older person who can pick it out for you. There are four leads from the speaker and if two of them have cord tips plugging into tip jacks in the set these would be the voice leads. One of the leads is cut and two wires spliced on and connected to the lower posts of the Power Relay as shown in Figure 5. In the case of a magnetic speaker, there are only two wires so it will be a simple matter to open one side of the circuit and make connections to the Power Relay.

After connections are made and the Eye kept darkened the radio should play in the usual manner when switched on. This is due to the left contacts of the Sensitive Relay being used which keeps the Power Relay closed so the circuit to the speaker is closed and the radio operates when the Eye is in a dim light.

Now flash a light on the Eye which should cause the Sensitive Relay to open the circuit to the Power Relay and thus open the speaker circuit and cut off the music instantly. It may be necessary to reduce the tension on the relay slightly to get the outfit operating exactly right.

When adjusted it is only necessary to sit near the radio and when the announcer comes on to flash a light from a hand flashlight on the cell to cut him off, removing the light permits the set to operate again.

The reason for using the leads to the speaker to control the set is to permit this instantaneous return to an operating condition. Were we to control the set by switching off the supply current to the set it would require some

required no particular effort. By means of the Electric Eye this can be done in a rather startling manner. To prepare the panel for the purpose have the lower lead to the sensitive relay connected to terminal No. 1.

Now, arrange the panel with the batteries connected, near the radio, either under it, if possible, or on top. It is now necessary to determine the audio current circuit to the speaker on the radio if it is of the dynamic type and if you are not familiar with radio circuits it is well

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time for the tubes to heat up again and destroy the effectiveness of the experiment.

MAGIC MUSIC

The set up of the Electric Eye as just described may be utilized to mystify your friends for you can apparently cause the radio to start or stop playing by a wave of your hand. The trick is done by arranging a light to normally shine on the Eye. The simplest method of accomplishing this is to arrange the Electric Eye panel on the floor at the rear of the radio set where it will not be noticed. A large chair placed in front of the radio can have a box concealed beneath it containing a large size focusing flashlight which throws a beam of light through a hole cut in the side of the box which can be of cardboard if nothing else is available.

After the batteries are connected to the Electric Eye panel and proper connections made to the radio as previously described, switch on the radio and tune in a station so it is fairly loud. Now switch on the flashlight and focus it carefully so it centers the light on the cell. The radio should stop immediately as in the previous experiment. If not, leave the light on and unscrew the tension nut on the sensitive relay till the Sensitive Relay pulls up the armature and shuts off the radio. Now interrupt the beam of light with the hand or other object and the radio should play again. Adjust the tension carefully one way or the other until the radio starts every time the beam is interrupted by the hand.

When you have this adjusted you are ready to demonstrate your power. Simply stand before the radio or sit in the chair where you can shut off the beam of light by slightly moving your foot into the path of it. Then by waving your hand or with a few mumbled words you can start or stop the music.

CAR LIGHTS OPERATE GARAGE ALARM

This might be considered as a commercial application of the Electric Eye but demonstrates another of the many uses to which it can be put. In large public garages having a watchman it is common practice to blow the horn when a car comes in late and wants the doors opened. This annoyance can be avoided by using an eye to ring a bell when the car lights fall on it.

The arrangement is simple and you should be able to figure out just how it is done from the experience gained in the previous experiments.

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The panel is mounted in some place where it will not be disturbed and connected as in the Sun Rise Alarm. It being advisable, however, to use two standard size batteries to operate Power Relay and bell. The bell is mounted wherever desired and wired to the panel.

The Eye is removed from the panel and mounted behind a hole drilled in the garage door or in a small waterproof box at the side of the doorway in such a position that the head lights of a car will strike the Eye when it faces the door of the garage. The Eye is connected to the panel by two wires. A switch can be provided to disconnect batteries during the day or when the device is not desired to operate.

Final adjustments are made by using a car's headlights to illuminate the cell while the Sensitive Relay is being adjusted, the lights closing the relays when on, resulting in the bell ringing. When the lights are switched off the bell should stop.

EXTINGUISHING LIGHT BY WAVING HAND

We come now to experiments utilizing lighting current and a few words of warning may not be out of place. Always be sure current is off when making connections to avoid shocks or shortcircuits. Be careful that all connections are tight and insulate all splices in lighting wires with friction tape before turning on current or plugging in.

This is a very startling experiment and not difficult to arrange. A suggestion for the general arrangement is given in Fig. 6 where we see a chair with end table and bridge lamp. The Electric Eye panel is shown under the table with the Eye dismounted and placed on top of the table under the light but connected to the panel by two wires.

To connect the bridge lamp to the panel make use of a plug and socket connected as shown in Fig. 7. The bridge lamp is plugged into the socket and the plug on the adapter is inserted in the wall outlet. Batteries are then connected and flexible lead on Sensitive Relay is connected to the right hand terminal No. 2.

With everything connected proceed to make final adjustments in this manner. With a pencil push the Power Relay armature which will switch on the light, illuminating the Eye which should close the Sensitive Relay and keep the light switched on. If the Power Relay does not stay closed, reduce tension on the Sensitive Relay till the Power Relay stays closed when the armature is pushed over and the light remains on. Now pass the hand over the Eye and the light should go out and stay out. It may be necessary to

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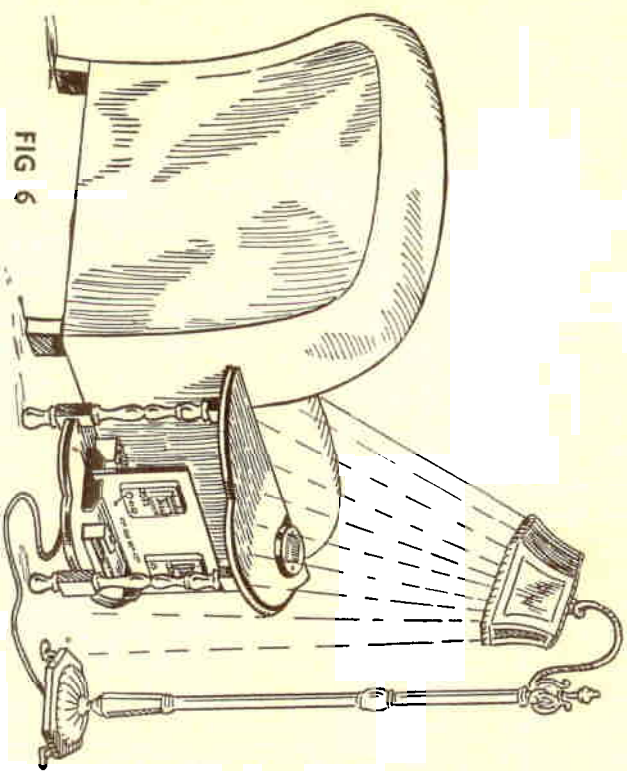


FIG. 6

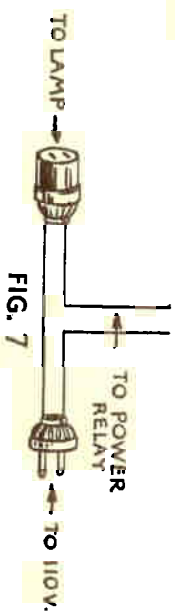


FIG. 7

put a higher wattage bulb in the bridge lamp before the outfit operates properly.

You are now ready to demonstrate your magical power. Switch the light on by closing the Power Relay by hand and seat yourself in the chair. At the proper moment just passing your hand between Eye and light will cause the lamp to go out. And then by simply striking a match over the Eye you

can switch the light on again. If the Eye is partially concealed by books or other objects and the striking of the match done quite casually the effect is very startling.

SUN SWITCHES ON MORNING EXERCISES

One of the earlier experiments described the use of a sun controlled alarm. Here we utilize the same phenomena to switch on a radio to give the morning exercises for those who desire to keep fit.

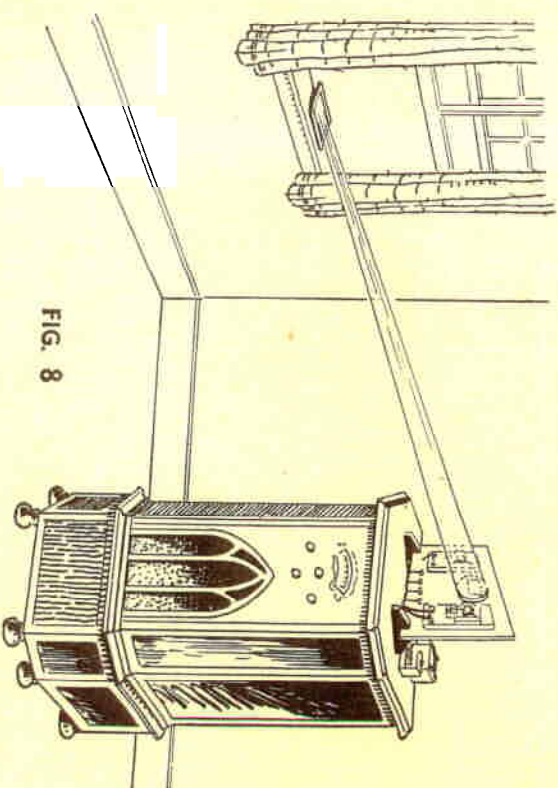


FIG. 8

Since a time element enters we must make some arrangement for timing the operation of the Electric Eye and this can be done with a mirror in the following manner. Mount the panel well back from a window in a more or less shaded corner. A mirror is placed on the window sill and tilted so the reflected sunlight will strike the Electric Eye at the time at which the radio is to be switched on. See Fig. 8. This setting must be determined by actual test at the time desired.

an inch or so either side will be satisfactory. Now slide the light up three times and make a record of the distance from the Eye at which the pilot light comes on. Add these readings and divide by three to get the average distance and note this down.

Now take the second lamp and screw it into the socket and slide that up to the Eye slowly three times and again add up the readings obtained and divide by three to get an average and note this down. We now know the distance at which both lamps give an equal amount of light.

However we cannot compare these distances directly to derive the relative intensities of the lamps for light varies as the square of the distance so we multiply each figure by itself and the products obtained indicate the relative intensities of the two lamps.

For instance, let us say the first lamp averaged 11 inches and the second lamp averaged $9\frac{1}{2}$ inches from the cell when the small light switched on. Multiplying each of these by themselves we obtain 121 and 90.25, dropping decimals we can say that the first lamp compares to the second as 121 to 90 or reducing to round numbers as 4 to 3. Thus the first lamp is one and a third times as bright as the second.

Many different light sources may be compared in the same manner, candles, oil lamps, gas lamps, etc., and the increase in light by the use of different reflectors may be studied in the same manner.

When a number of light sources are to be compared it is well to record the results on a chart in the manner shown in Fig. 10. A sheet of paper may be ruled off in equal spaces and the intensity of the various lights recorded by drawing a straight line from the left to a point below the number obtained by squaring the distance of the light from the cell. However all comparisons must be made without changing any adjustments of the relay.

COMPARING COLORED LIGHTS

As is well known lights of different colors affect the human eye to a different extent and with the same setup as used in the last experiment we can compare the various effects of colored lights on the Electric Eye.

A simple method of obtaining the various colors is to glue colored cellophane sheets in cardboard masks cut to the dimensions given in Fig. 10. These masks can then be clipped to the lamp holder by means of a rubber band as shown.

The same procedure is gone thru with the colored lights, the same bulb being used the holder is slowly moved up to the Eye till the small light

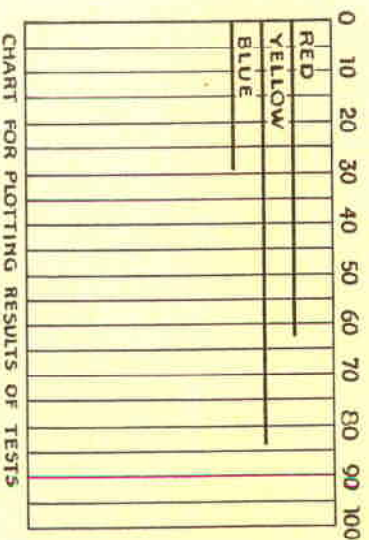
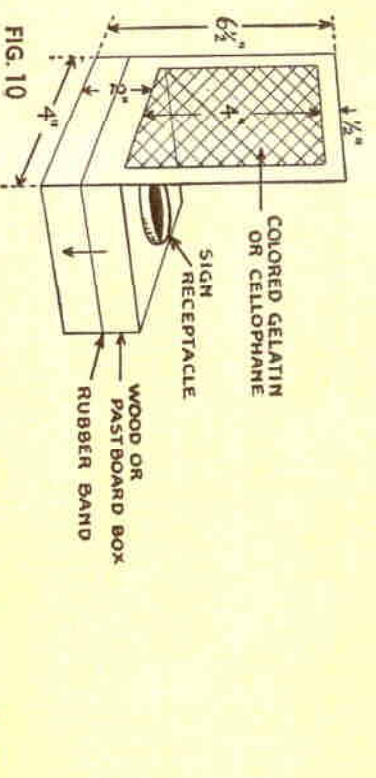


CHART FOR PLOTTING RESULTS OF TESTS

comes on three or four times and an average value obtained. This average value or distance is squared or multiplied by itself and the product recorded on the chart as shown in Fig. 10 by drawing a line and marking it with the color used. In this manner the effect of changing the color of the light on the Eye will be shown very clearly and the information recorded for future reference.

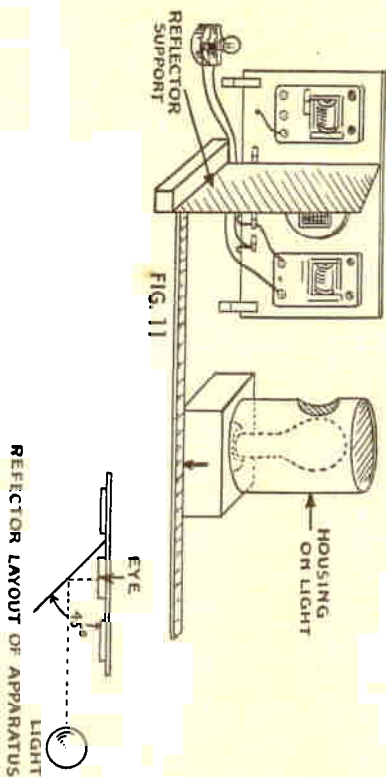
COMPARING REFLECTING SURFACES

Another field for experiment that is very interesting and a source of useful information is the comparison of the reflecting value of different surfaces as

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well as colors. Thus one can determine ahead of time which of two colors of paint would give the brightest effect in a room or two wall papers may be compared in a similar way.

The Electric Eye panel is connected as previously but a reflecting support is arranged at an angle of 45° with the face of the cell as in Fig. 11. The support may be made of a light piece of wood or stiff cardboard tacked to a wood block. A number of these may be made and painted various colors, or different colored papers pasted on them.



The light source is as previously used but to prevent stray reflections from confusing the results the light is covered with a tin can which has a hole cut in one side to give a beam of light. The light source described earlier in the book (Fig. 3) may be employed if the Electric Eye panel and reflector are raised on a box to bring the Eye on the same level as the light.

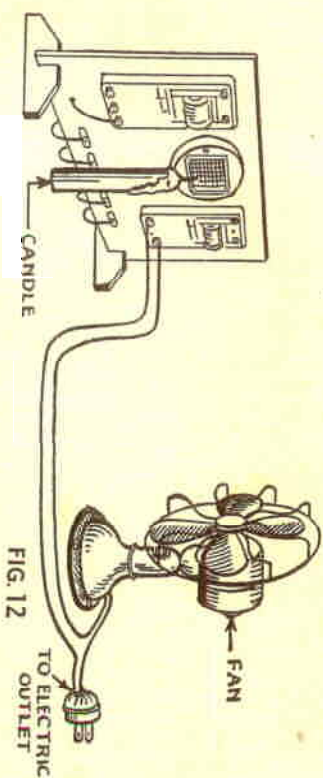
The measurements are made as previously. That is, the reflector is arranged before the Eye and the light source moved up slowly several times and the point at which the small lamp lights up recorded. In this case the full distance shown by the dotted line in Fig. 11 should be considered as the distance from light to Eye. Another reflecting surface can then be put in place and the test repeated. The averages of these distances are squared and may be recorded on a chart as previously explained and the relative reflective power of the various reflectors thus determined and compared.

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It is well to remember that all these values are relative and that results obtained with one setting of the relays can only be compared. That is, if the relay adjustment is disturbed in the middle of an experiment the whole thing must be done over. Further all tests must be done in a dim light.

THE MYSTIC CANDLE THAT WILL NOT STAY LIGHTED

The effect of this experiment is startling despite its obvious simplicity. The panel is set up in a dim light and the batteries connected, flexible lead on terminal 2. The terminals of the power relay are connected into the circuit of the electric fan shown by an attachment similar to that shown in Fig. 7. A candle is placed immediately in front of the Eye and the fan placed several feet away and arranged to throw a strong blast of air at the candle. The layout is shown in Fig. 12. Care should be taken not to have the candle too close to the window of the eye.



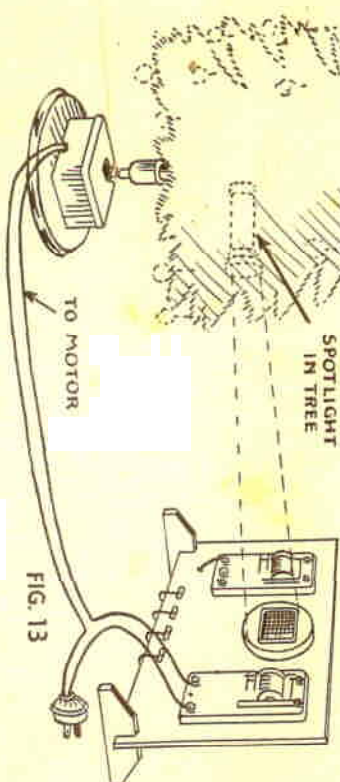
The action is obvious. When a match is applied to the candle wick the sensitive relay is adjusted so the power relay closes and starts the fan which will immediately blow the candle out. When the candle is extinguished the relays again open and the fan stops. If it is possible to disguise the panel with a little draping it makes a pretty trick and highly amusing.

CONTROLLING A REVOLVING XMAS TREE WITH A WAVE OF THE HAND

With a little ingenuity it is possible to make a very neat and unobtrusive installation on an Xmas tree of the revolving type that will permit the tree to make one revolution by simply waving the hand.

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The Electric Eye Panel is set up at one side of the tree as shown in Fig. 13 and can readily be concealed with a few Xmas decorations. The flexible lead is on terminal 1 so light opens the power relay. The terminals of the power relay connect into the motor circuit on the tree so that when the Eye is darkened the relay being closed causes the tree to revolve.



A spotlight is mounted in the tree so its beam will strike the Eye on the panel when the tree revolves. This spotlight may be made by mounting a 40 watt light in a tin can and connecting the light to the lighting circuit on the tree or the light source shown in Fig. 3 may be utilized, tying the flashlight to a bough of the tree and fastening the batteries to the trunk of the tree where they will be concealed.

With all batteries connected and the flashlight set to shine on the Eye adjust the sensitive relay till on interrupting the beam of light with the hand causes the power relay to close and start the tree turning. This will swing the spotlight off the Eye and the tree will make a complete revolution before the spotlight again strikes the Eye and stops the tree. This is a very attractive arrangement and the source of endless amusement.