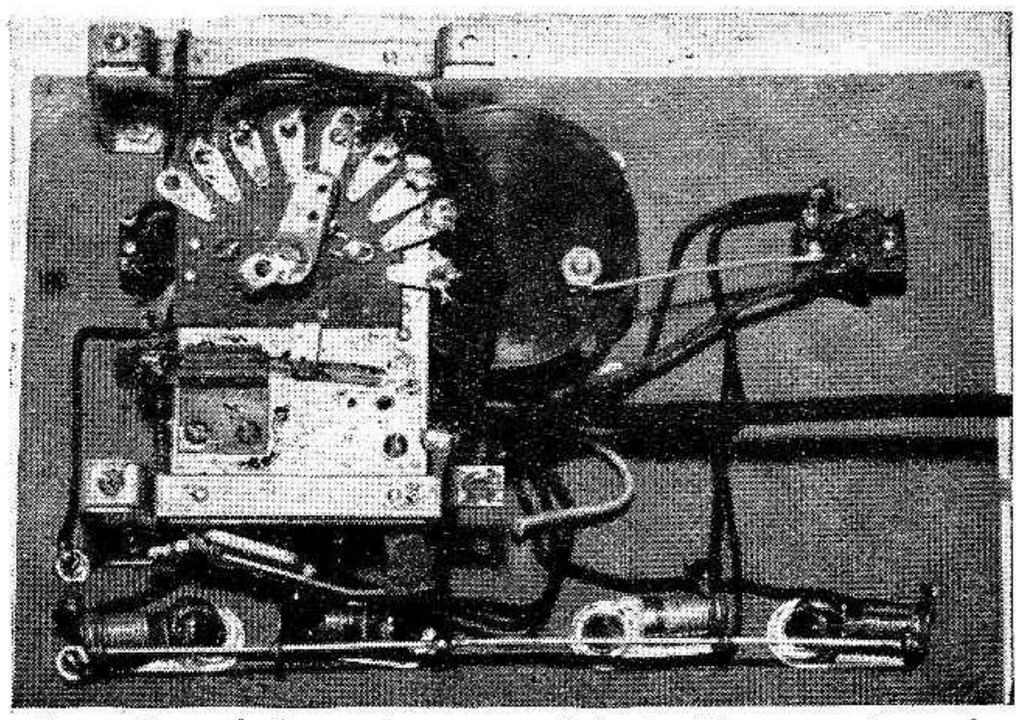
REMOTE Radio Control

An Outline of a Complete Radio Control System for Model Planes

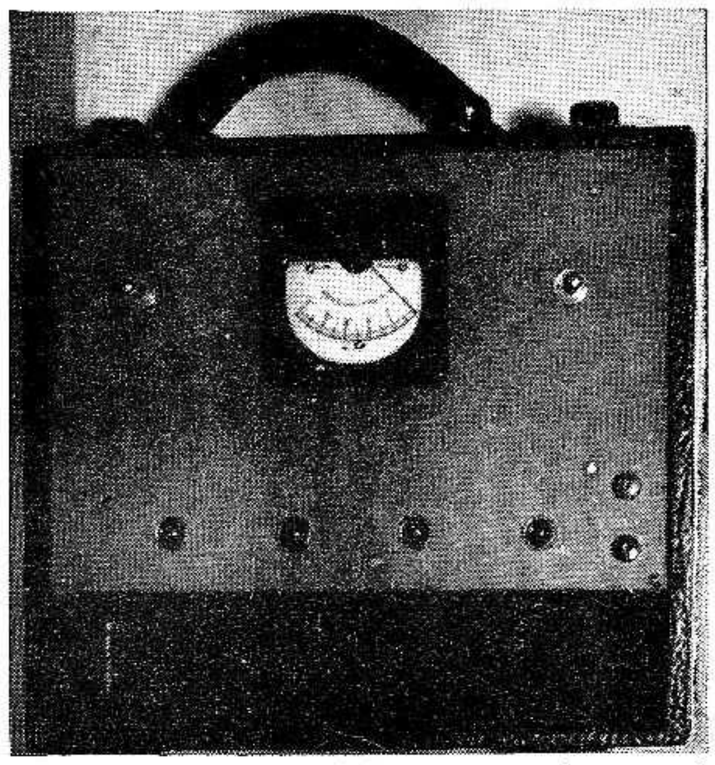


Rear view of electronic type conjulator. Note stepping relay made from pinball machine relay

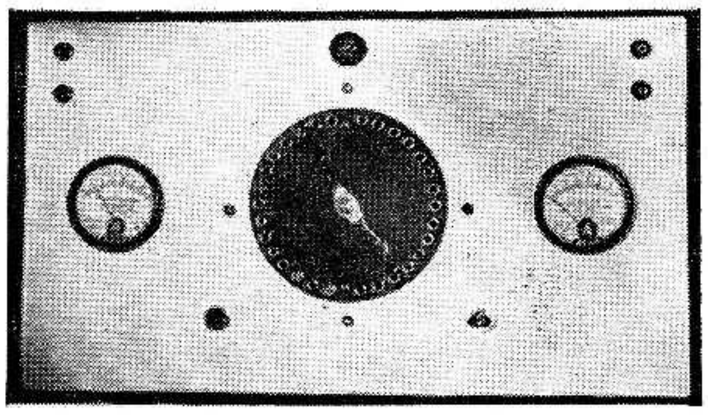
By LEON HILLMAN

"AA FLIGHT nine calling Dayton .... Calling Dayton .... Come in please" - - - Constantly the air waves are filled with such communications from pilots contacting remote points. Dialing to another radio band, we hear continually repeated code signals—the radio beam to guide pilots flying "blind." Radio with its important role in aviation today has required pilots to familiarize themselves with operation of this equipment.

Now in the model airplane field improvement of radio control apparatus has made it possible to increase the scope of model flying. Movable surfaces, variable speed and long distance flying are all possible by addition of this equipment. Of course this makes the requirements for models more exacting since they approach actual flying conditions; now the progressive, scientifically inclined builder must acquaint himself with radio equipment, just as it is necessary for pilots to do. Operation of an aircraft transmitter by a pilot requires that he be licensed by the Federal Communications Commission, and so, too, operation of a radio transmitter to control a model requires a license issued by the same Commission. There will be more about licenses later.



Electronic type conjulator ground control unit



Manual conjulator panel

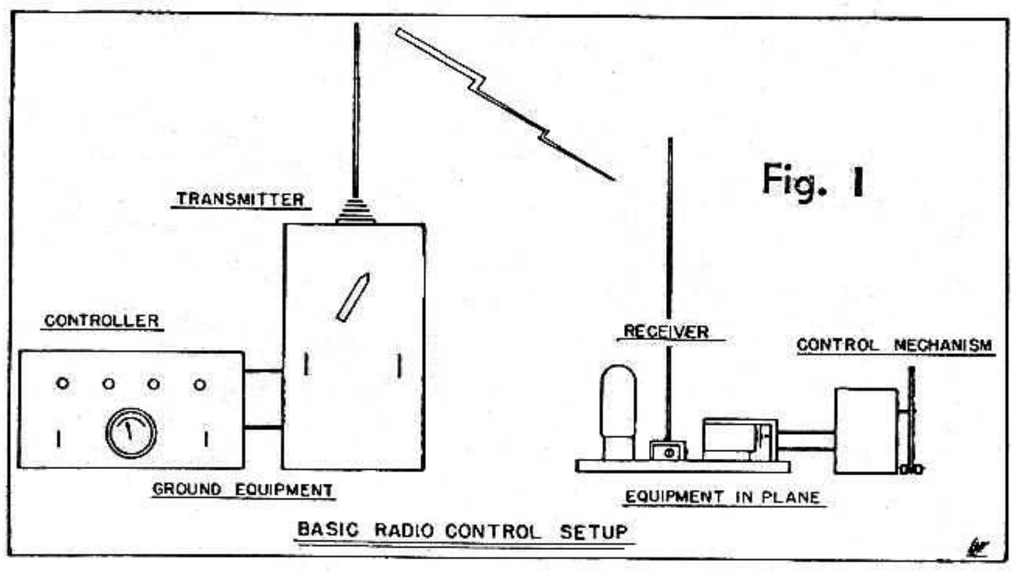


Fig. 1

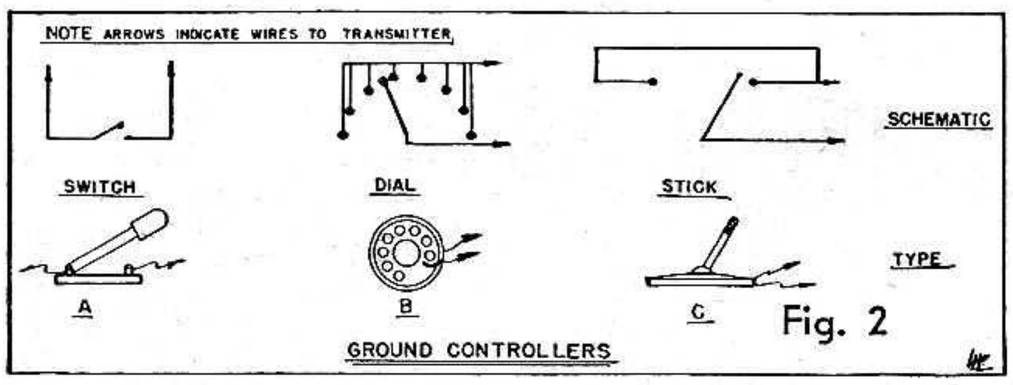


Fig. 2

The principle of radio control is easily understood: A radio signal is radiated into the ether by a radio transmitter on the ground. A sensitive receiving system in the plane intercepts this signal and converts it from electrical to mechanical energy, then performing the desired control action.

The transmitter is connected to an operating control enabling the ground pilot to send the required number of transmissions, thus getting the desired control to act. Figure 1 shows how the equipment is arranged. Starting from ground controller and trans-

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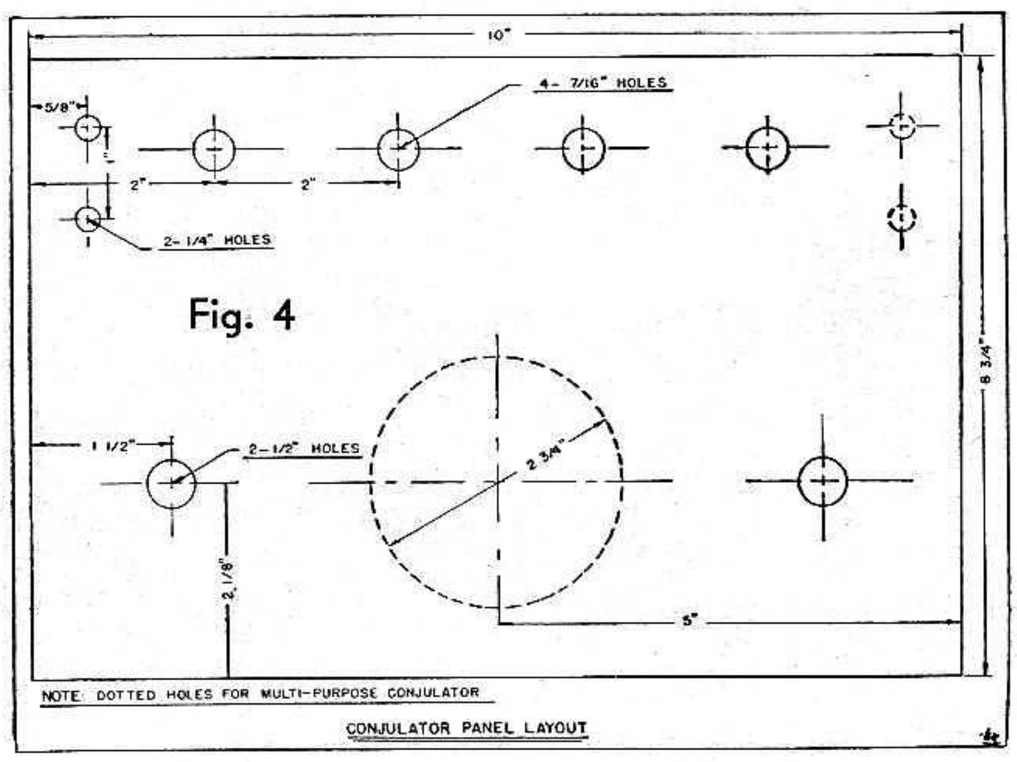

Fig. 4

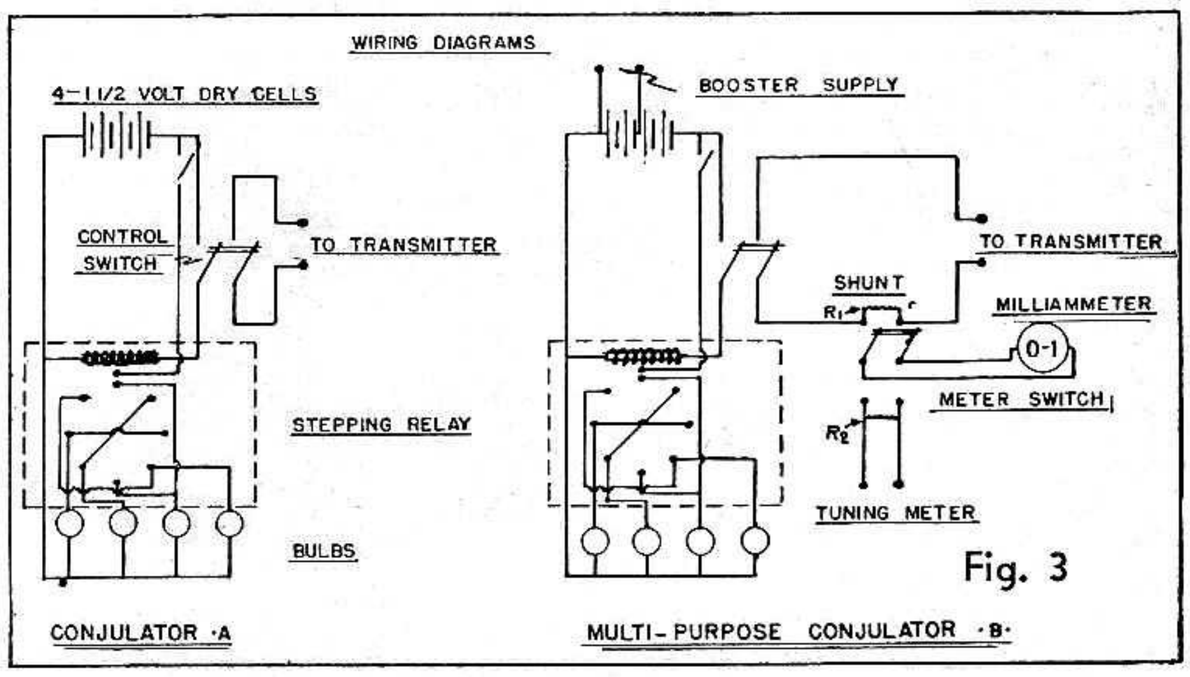

Fig. 3

Remote Radio Control

(Continued from page 15)

mitter, then to receiver and control mechanism, the detailed theory, construction, installation and operation of this equipment will be discussed. The latest designs and hints of interest will be shown to beginner as well as advanced radio control technicians.

It might seem necessary that the complete system to be installed in a plane should be decided upon before proceeding to build, since there is a choice of systems and controls depending upon their size, weight and number of controls used. However, this only concerns the receiver and associated control apparatus mounted in the plane, the ground controller and transmitter will in most cases, remain the same, regardless of the type of receiver used. Receivers for various size planes and wing areas will be thoroughly considered later.

Centering attention on the ground controller, the first device constructed, it is important that its functions and operation be understood. Actually, all that is accomplished by a ground controller is making and breaking an electrical circuit, which activates or shuts off the transmitter. Thus any ordinary push button, switch or telegraph key serves the purpose. A telephone-type dial has been used and is essentially the same but also provides for making several contacts in rapid succession; this is desirable so that the plane's desired control position can be rapidly reached. The use of a stick control, making contacts as it is moved through different positions, is another scheme; but loses value as there is no association of "feel" involved here. (See Fig. 2).

It is desirable to employ a system of making and breaking the circuit whereby, after completion of the control movement, the operator can still tell (by his control instrument) the position of the plane's controls. Also desirable is allowance in the instrument's design for several control operations and addition of other controls which might be added for future use. The above mentioned systems fail to fulfill com-

bined requirements.

A device has been developed that seems ideally suitable, since it fills desirable specifications and performs additional functions when used with receivers of an advanced nature. Because it is the joining control unit or conjunction with the plane, it has been technically termed "Conjulator," and hereafter will be referred to by that name. The conjulator consists of an electrical hookup connected to the transmitter in the power supply circuit, applying power to the transmitter each time the control switch is operated. There are small, colored, pilot-light bulbs arranged across the panel, each representing a different control position, such as right rudder, left rudder, advance motor, and so forth. The light that is lit indicates the position of that control in the plane. This gives the operator a visual indication of the controls and he need not rely on memory. Synchronization between plane and ground occurs because of a predetermined sequence of circuits, but does not cause contacts to act in sequence because of a time delay circuit in the receiver, permitting selection of any desired control.

The conjulator can be constructed in three different types: Manually operated, spring or motor driven, and electronic.

The manually operated type is primarily useful where dual receivers and transmitters are used. It is operated by sliding an arm over contacts, until desired contact is reached; each contact representing a control position. The left row of contacts can be used for rudder positions, for example, and the right set for motor speed positions.

The spring or motor driven type (April, 1941 issue of MODEL AIRPLANE NEWS) is operated by depressing a key which releases a spring motor, turning a contact disk until the light bulb, indicating the control desired, is reached. This type of controller is extremely effective, but requires skill in building and is sensitive to operate.

The electronic type conjulator controller, which is the latest design, offers the best solution to automatic control and flexibility problems. It is operated by throwing a switch which simultaneously closes the transmitter circuit and a self-contained battery circuit which operates a stepping relay. This stepping relay, operating on a ratchet principle, closes the light bulb circuits in rotation, by means of which it is possible to keep track of the plane's control position. The standard circuit hookup is shown in Fig. 3A.

To construct the electronic controller secure or build a portable case into which you install the device. The one in the photograph measures 10-1/2" across, 9-1/2" wide, and 5" deep, with a small compartment 2" by 10" for carrying connecting cables. All parts are mounted directly on the panel, except for the four small 1.5 volt dry cells, which are strapped to the bottom of the case. The panel layout is shown in Fig. 4.

Tempered masonite has been used as the panel material.

The indication bulbs are 6.3 volt radio pilot bulbs, which glow through colored glass jewels. These jewel lights can be purchased reasonably, complete with lamp socket assemblies. Since the color is soon associated with a control, the ingenious constructor who wishes to retain this effect but not purchase unessential parts,

might substitute cellophane over the bulbs to replace the jewel light.

The stepping relay can be purchased complete, according to following specifications: 6 volt direct current coil, twelve to sixteen contacts (or more in multiples of four), continuously recycling. A stepping relay can be made from a number of types of circuit relays, which are found in most pin-ball machines. The relay contacts are connected in accordance with the number of control positions in the plane. Starting with only rudder control and using a ratchet escapement or electro-magnets to move the tab, four lights are used on the conjulator; namely, one each for neutral rudder, right rudder, neutral rudder and left rudder. This requires that every fourth contact be connected together. If eight movements are used, every eighth contact is connected together. In wiring use push back or other hookup wire and naturally, solder all connections.

Four 1.5 volt dry cells are required to operate the conjulator. These dry cells may be of any size but Burgess number 4FH or Merit No. 4 cells are recommended because of their compactness and high current capacity. If a storage battery is part of the regular gear it may be used to operate the conjulator and internal cells dispensed with.

The conjulator described can be built with a slightly more elaborate hookup in order to use it for measuring the transmitter current input, tuning the receiver and as a booster supply for starting the engine; all besides acting as automatic ground controller during the flight. The only extra parts needed are an O-1 millimeter, double-pole, double-throw switch, meter shunt resistors and several extra terminals. Fig. 3B shows the complete circuit arrangement.

Once ready for a test, switch the toggle switch to the "on" position and one of the bulbs should light. (If there is no light immediately, disconnect the dry cells and carefully check the wiring, until the mistake is found). Now operate the control switch and the next light should glow. Depress it several times and note the rapid succession with which you get to the desired control. With the ultra short-wave transmitter to be described and built next month, the transmitter switch portion of the conjulator will be tested.

Materials for Building Conjulator

4—one and one-half volt dry cells (see text)
1—stepping relay (see text)
1—double pole single throw switch
1—single pole single throw switch
4—6.3 volt pilot bulbs
4—jewel light sockets
2—binding posts

Extra Parts for Building Multi-Purpose Conjulator

1—Oto one milliampere meter
1—shunt resistor for above milliameter to read 0 to 5 milliamperes full scale (R_1 in diagram)
1—shunt resistor for milliameter to read 0 to 50 milliamperes full scale (R_2 in diagram
4—binding posts
1—double pole double throw switch