R. C. Review Today

by ED LORENZ

This birdseye view of radio control, prepared especially for modelers, not radio experts, is a valuable assist for getting started in this new field without trouble.

Editor's Note:

In view of the present boom in radio control, resulting from license-free frequencies, M.A.N. has invited an outstanding expert in radio modeling to outline the subject in the following series of articles. This issue contains Transmitters, Receivers, Actuators, and a Glossary. The September issue will include Batteries, Relays, the Airplane, and Tips. This special service is in addition to the regular model projects. Thanks are due to Vernon C. MacNabb, Berkeley, and Control Research for their help.

▸ The Federal Communications Commission has allotted the frequency of 27.255 megacycles, in addition to 465 megacycles, for model use without the need of a ham license. The equipment on this new frequency may be built by the modeler as long as crystal control is used and FCC requirements are closely adhered to. Ready-built units and kits (Aerotrol) already are available. More will be available in the future months. The first free band for control purposes was the Citizens' Radio Service band of 460-470mc. The Vernon C. MacNabb Company of Indianapolis was the only company to produce equipment for this band.

Now that license-free operation is available, those of you having 52mc sets are wondering what can be done to convert to the new frequency. Transmitters will have to be reworked radically to comply with FCC rules. The receivers can be changed quite easily. The XFG-1 and RK-61 tubes will function with greater efficiency at 27mc than at 52mc, so no trouble should be encountered there.

In order to know the basic facts about radio control, we must know what operating units are used and how they work. A radio control set consists of a transmitter, a receiver or controls. Although there may be many variations of the individual units as outlined, we shall give a brief summary of the basic functions of each. (The glossary of terms accompanying this section will help in following this discussion.)

The transmitter (*Continued on page* 36)

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consists of a tube for generating the high frequency oscillations needed for radiating energy, a quartz crystal for maintaining this frequency at an exact point, a tank circuit where the high frequency energy is "manufactured" and stored, a power supply (usually batteries), an antenna for radiating the generated radio frequency energy, a key or switch for turning this energy on or off as needed, and small component parts such as resistors and condensers.

The receiver is composed of a tube used for amplifying and rectifying the incoming signal, an antenna for picking up the energy transmitted from the transmitter antenna, a tank coil for tuning to the same frequency as that produced by the transmitter, a relay used for converting small electrical currents into mechanical motion in order to close contact points, and a power supply from which to operate.

The actuator is the unit used to mechanically operate the rudder or other controls. This is an electro-mechanical device, since a small magnet coil is used in one way or another to release stored-up mechanical motion. The escapement is the most commonly used actuator because of its simplicity, low cost and weight. The magnet coil is connected in series with the relay contact points and a battery, usually 3 to 4-1/2 volts, for energizing the magnet.

This is the sequence of events that occurs in order to move a control. Remember that radio waves travel at the rate of 186,000 miles per second and the lag in time of the mechanical action of the relay and actuator is from 20 to 100 thousandths of a second. Thus the element of time can be disregarded. When the key on the transmitter is pressed, the tube and its associated parts generate the radio frequency which is radiated from the transmitter antenna. This energy is picked up by the receiver antenna and is amplified and rectified by the tube and its components. The change in plate current of the tube is fed through the relay. When the plate current changes so that the relay points are closed, this closes the circuit through the actuator and its power supply batteries.

This operation is for carrier control of one actuator only, and is typical of 90 per cent of the control systems used throughout the world today. By carrier control, we mean that only the radio frequency energy, or carrier, is used to operate the receiver circuit.

What makes the transmitter and receiver work is given under the "Transmitter" and "Receiver" sections. It is written to give you an acquaintance with the circuits rather than delving into the theory in detail. For those desiring more complete information on the radio theory, and detailed explanation of electrical and radio terms, applications and practical uses, we refer you to the following publications: THE RADIO AMATEUR'S HANDBOOK —$3.00; HINTS AND KINKS FOR THE RADIO AMATEUR, Volume 4—$1.00; A COURSE IN RADIO FUNDAMENTALS—$.50. These are published by American Radio Relay League, Inc., West Hartford, Connecticut.

For those who are interested technically in the FCC rules and regulations governing the use of this frequency, Docket 10086 may be obtained from the FCC, Washington, D. C. Basically, the highlights as interpreted by the writer are as follows, and we suggest that they be adhered to closely so as not to jeopardize radio control development and flying:

(1) The frequency of 27.255mc has been assigned for radio control use on a non-exclusive basis and is subject to such interference as may be encountered from industrial, scientific and medical equipment.

(2) Frequency tolerance is plus or minus .04 per cent from 27.255mc, the band width being from 27.230-27.280mc. Power input is limited to five watts to the section of the transmitter to which the antenna is connected.

(3) The control of model aircraft may be made by using a continuous radiation of an unmodulated carrier. For remote control of other objects only on-off unmodulated or amplitude tone modulation may be used.

(4) A standard FCC Form No. 505 must be filed with the FCC giving type of equipment being used.

(5) In the event that harmful interference results to services outside of either the 27.230-27.280mc or 460-470 mc band, the licensee shall discontinue operations at once upon notification from the FCC. The radiations of the transmitter shall be suspended until such defects and deviations have been corrected.

Another important question is what tools and supplies are needed. This matter can range from a few used components and a pair of "Ford" pliers to an elaborate bench setup with all the necessary meters for experimental work. However, the following items will give you a good start toward developing and building radio control units: 1 small pair diagonal cutters; 1 small pair long nose pliers; 1 soldering iron (Ungar iron with small and large tips or a small tipped 60 watt iron); A few small fine cut files, assorted sizes and shapes; 1 hand drill and assorted drills from 1/32" to 1/4"; 1 small pair tin snips; 1 bench multimeter (Precision Test Equipment Company, Series 40 or Series 86; Chicago Industrial Instruments Company, Multiplex Model 458-A; Radio City Products Company, Inc., Pocket Multitester Model 449-A; Hickok Model 450; Superior Model 770; Triplett Model 630; MacNabb multimeter); Tuning wand of plastic or fibre (for adjusting tuning condensers); Small screwdrivers; Assorted sizes of wire, solid and stranded, solid wire in enameled type in sizes from No. 14 to No. 36, as needed; Resistors and condensers, as needed; Assortment of sheet aluminum, brass, iron, and micarta insulation, in various thicknesses .020 to .062.

The wire, resistors, condensers, sheet stock, etc., should be gathered as needed for each particular job.

The meters listed above were chosen as being most suitable for radio work due to their voltage and current ranges. The prices vary from about $14.00 to around $40.00. These meters are of the portable type so they may also be used for field work. Individual meters (0-1ma DC, 0-5ma DC, 0-10 volt DC, etc., may be used but to cover the ranges needed would probably be too expensive. Remember, you get what you pay for and good tools and good equipment make for better workmanship.