



**INSTALLATION AND OPERATING INSTRUCTIONS
FOR THE
BABCOCK BC-21 RADIO CONTROL SYSTEM**

GENERAL INFORMATION:

The BC-21 System is composed of a transmitter, receiver and escapement, for the control of small to medium size model aircraft. The transmitter contains a crystal controlled oscillator, series modulator and multivibrator audio oscillator. It conforms with Part # 15 of the FCC Rules and Regulations and no license of any type is required.

The receiver consists of a super-regenerative detector followed by two (2) cascaded stages of frequency selective audio amplification, a driver transistor and an output transistor which in turn directly drives the 100 ohm Mark VII escapement. The Mark VII gives the commands of right rudder, left rudder and up elevator. This system has evolved from over one year of continued research, development and flight tests. The receiver audio selectivity is so great that an exact adjustment of the transmitted modulation frequency is required. The adjustment will be found on the panel of the transmitter.

THE CONTROL FUNCTIONS ARE AS FOLLOWS:

Press the button and hold, right rudder; press, release and hold, left rudder; press twice and release twice and hold is up elevator. Releasing the button at any time from any command position always returns the escapement to the same neutral. Thus the system is completely "fail safe". The audio modulation frequency is approximately 6,000 cycles per second. The human speaking voice frequency (and most of the harmonics) are between 300 and 3,000 cycles making the "21" System almost totally immune to Citizens Band interference. Occasionally, with an extremely loud Citizens Band signal at very close range the escapement may be triggered, but under no conditions of flight will anything more than a momentary triggering of the escapement take place. The receiver sensitivity is better than one (1) microvolt with an effective signal to noise ratio of almost infinity. The distributed inductance antenna on the transmitter is by far the best radiator for its length. The ground range is guaranteed to be in excess of 1,500 feet and ground ranges of 1½ miles are common. If the simple instructions are followed, the air range will far exceed the maximum distance at which you can see any size model aircraft. There are any number of models with wing spans from 20 to 60 inches, and with engine sizes from .020 to .19 which will accept this equipment.

At this date (September 1964) six of the most prominent American kit manufacturers have evidenced their desire to design kits specifically for this equipment. The October 1964 issue of **Radio Control Modeler** magazine gives a complete review of their tests of this equipment. They have compared the "21" System with all other available single channel systems and it has outperformed all including superheterodyne types. We urge that you read this review. Follow these instructions carefully.

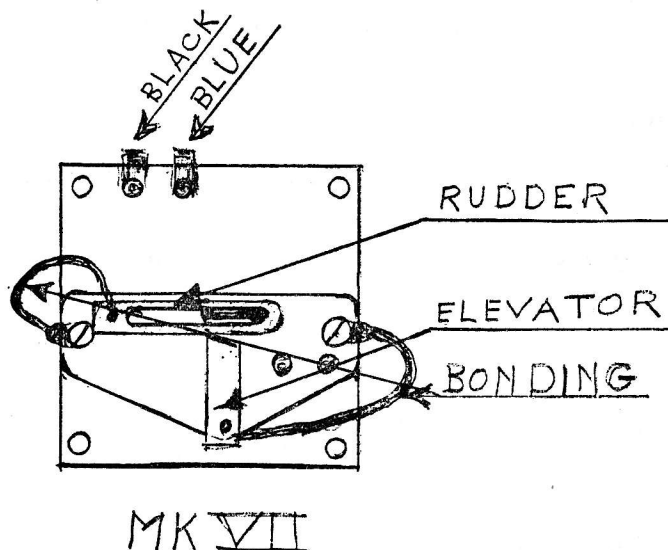
PART I: TRANSMITTER INSTRUCTIONS

The transmitter is powered by two (2) batteries which are obtainable in almost any drug or hardware store. These are Burgess, Type 2U6 and Eveready, Type 216. There are also many Japanese equivalents of these batteries which sell for 19c each to 39c each. Be sure that you purchase your batteries from a store which has high battery turnover so that the batteries are sure to be fresh. The batteries are installed by pressing them into the fiber connector, and placing these in the bracket adjacent to the 'on-off' switch. The screws which hold the transmitter back in place (and the transmitter loading coils) will be found in the cellophane bag in your equipment. The two (2) loading coils are inserted between the three (3) one (1) foot antenna rods furnished. The entire antenna is then inserted in the tube at the top of the transmitter. The transmitter is now ready for use. At various stages of the tuneup and checkout of the receiver the transmitter will use the entire antenna, only a single section, or no antenna at all.

PART II: RECEIVER INSTALLATION

The receiver comes complete with a switch and test panel connected, as well as a battery clip which will receive one (1) 9 Volt battery identical with those used in the transmitter. This is the only battery required. The test panel should be installed in the side of the aircraft in any convenient position. The receiver may be installed in any position by glueing the piece of sponge rubber (furnished) to the bottom of the receiver and, in turn, glueing this either to the floor of the aircraft or a vertical bulkhead. The only precaution at this point is to make sure that the single tuning adjustment is in a convenient position. A tuning tool may be easily made by sharpening a 4" piece of hard $\frac{1}{8}$ " dowel so that it exactly fits and fills the slot in the iron tuning core. The escapement is normally mounted on a bulkhead. You will note a free black and free blue wire from the receiver. These should be soldered to the proper terminals on the escapement as shown on the accompanying drawing. The recommended antenna consists of a fine small gauge piece of piano wire 18" long mounted at the forward end of the aircraft in a vertical position. The purple wire from the receiver should be soldered to the lower end of this antenna. Other antennas may be used with complete satisfaction but the maximum range may be restricted. The torque rods are connected to the actuators (included in cellophane bag) of the escapement as shown in the drawing. The two (2) bonding wires on the escapement are connected to the actuators so that the torque rods are grounded. This is for the purpose of reducing shot effect noise due to metallic parts rubbing against each other and to increase the ground plane to enhance the pickup of the antenna. It is strongly suggested that the

entire torque rods be of wire ($\frac{3}{64}$ " or .046") rather than balsa, not only for the purpose of increasing the range but also to enhance the control function. When operating in the propeller blast, the wire torque rods' flexibility decreases the rudder and elevator deflection. However, after the engine stops and a landing approach is to be made the deflection is much greater without the propeller blast and the effective control under these conditions is much improved. If the span of the wire torque rods is greater than 12", a mid point bearing will be required—eyelets for bearings are furnished.



PART III: CHECK OUT FOR ADJUSTMENT

With the entire antenna inserted in the transmitter and the bulb furnished placed across the pins below the switch on the receiver switch panel (and the switch in an off position), adjust the tone control of the transmitter to approximately its middle position with a small screwdriver. Turn the transmitter on and press the transmitter button. Tune the receiver tuning core for maximum lamp brilliancy. Next remove all but a one foot section of the antenna from the transmitter. Repeat the tuning procedure on the receiver as well as adjusting the tone on the transmitter. Next remove the entire antenna from the transmitter and carefully repeat these two tuning adjustments. Carefully adjust for the maximum range (with no antenna on the transmitter) until a definite peak is determined by the light brilliancy. The range under these conditions should be at least 5 feet or more. Remove bulb, turn receiver switch on, install full antenna on the transmitter and check control functions at all ranges. The tone adjustment on the transmitter should be checked from time to time. With fresh batteries the no-signal current of the receiver is 5 or 6 MA and increases to 85 to 95 MA with command. Receiver will operate in range of $6\frac{1}{2}$ to 10 Volts. Check battery of receiver and transmitter under load, (with command) occasionally with voltmeter.

PART IV: SERVICE POLICY

The BC-21 System is good for many years of operation. If you have any reason whatsoever to return your unit to the factory either before or after the guarantee has expired, proceed as follows:

- (a) Carefully pack the unit and enclose a copy of (b) below with your name, address and \$1.25 for handling and postage.
- (b) Write a letter stating the circumstances as clearly as possible.
- (c) If the guarantee has expired we will charge you a base service charge of \$3.00, plus parts.

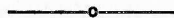
PART V: GUARANTEE

The complete BC-21 System is guaranteed unconditionally for 90 days except as follows:

- (a) The transmitter crystal is not guaranteed.
- (b) If the receiver has a fractured printed circuit board, repair will be made if possible, otherwise, a new receiver is required.
- (c) The guarantee is void if a unit has been obviously changed, misused, modified or "improved".

EXTRA UNITS:

BCT-21 Transmitter	\$27.95
BCR-21 Receiver	24.95
Mark VII Escapement	6.95



BABCOCK CONTROLS INC.

20762 Laguna Canyon Road

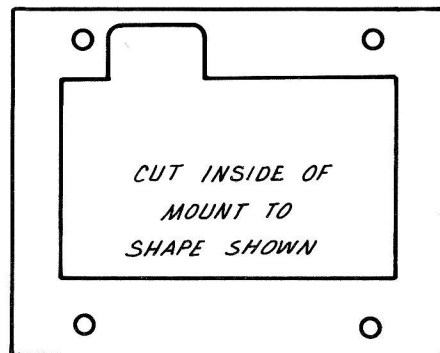
P.O. Box 666

Laguna Beach, California 92652

BABCOCK BC-21

SUPPLEMENTARY SHEET

ESCAPEMOUNT MOUNT



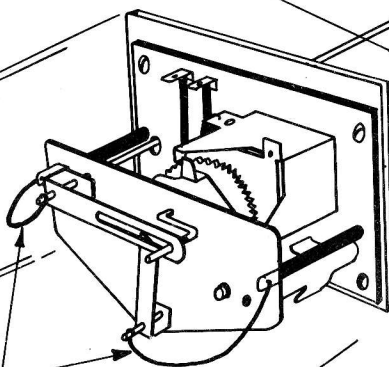
18" VERTICAL ANTENNA

USE LOOP OF 3/16" RUBBER 10 TO 15% LONGER THAN DISTANCE BETWEEN HOOKS

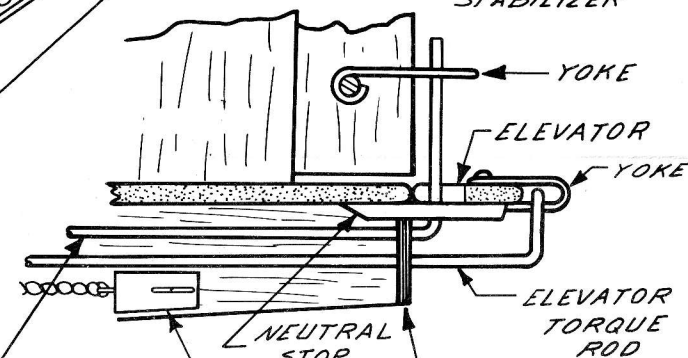
MUSIC WIRE TORQUE RODS
TO RUDDER
TO ELEVATOR

THIN MUSIC WIRE YOKES

ELEVATOR NEUTRAL STOP - GLUE ON BOTTOM OF STABILIZER



BONDING WIRE



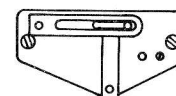
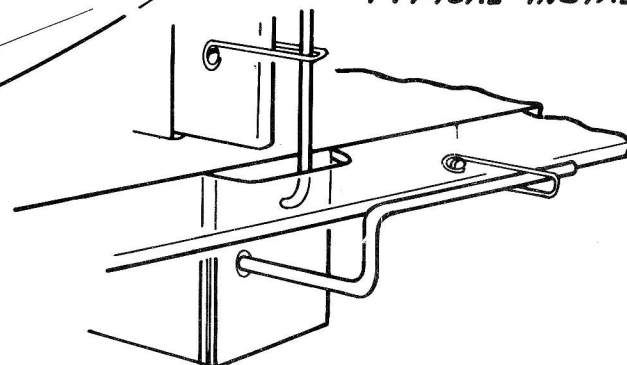
RUDDER TORQUE ROD

REMOVABLE PLUG (1/16" PLY) WITH MUSIC WIRE HOOK FOR RUBBER LOOP

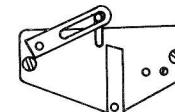
PLYWOOD BEARING PLATE

ELEVATOR TORQUE ROD

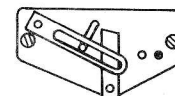
BABCOCK MK VII ESCAPEMENT TYPICAL INSTALLATION



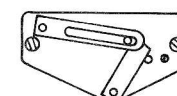
NEUTRAL



ONE PULSE RIGHT



TWO PULSES LEFT



THREE PULSES UP ELEVATOR