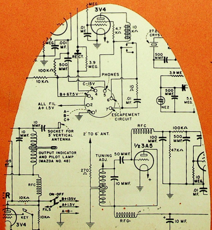
COLLECTION No. 3

commercial RADIO CONTROL *equipment*

FOR THE MODEL BUILDER

Plus . . . special articles on R/C operation and trouble shooting.



an outstanding selection of articles from Air Trails Hobbies for Young Men on radio control for model builders of all ages.

A HOBBY HELPERS PUBLICATION

INTRODUCTION

The two previous collections of radio control articles from the pages of "Air Trails HOBBIES For Young Men" assembled and printed by Hobby Helpers as a service to R/C fans everywhere met with well-deserved enthusiasm. You probably have a personal copy of "Basics of Radio Control For The Model Builder"—the first ATH-HH compendium—and the Collection No. 2: "Application of Radio Control For The Model Builder." Yet successful as both have been and continue to be neither brought forth the pre-publication interest that has been demonstrated in this third collection on commercial equipment. Here for the first time in any book, pamphlet or compiled form you have details, descriptions, photos and schematic drawings on twenty-five commercially manufactured radio control receivers and transmitters. The enormous task of selecting, checking, field testing, rechecking, photographing, analyzing and breaking down the parts into schematic drawings is one that few individuals can comprehend. For if there is anything you can spend hours doing it's checking out R/C equipment. AT HOBBIES is the only publication that has performed this service for radio control fans; you will find new commercially manufactured sets similarly covered in forthcoming issues of our publication. We are glad to see that one home-built project has been included here—that combination meter will provide a good start for the would-be experimenter. Valuable as the transmitter and receiver set reports may be, we feel that two articles alone are well worth "the price of admission." For if you will study closely "Bug Hunting" and "Primer on Power Loading" you may save yourself countless hours of fruitless tinkering and frustrated ground work. The information and data which you find in those two articles represent suggestions from hundreds of radio controleers who have built thousands of models and learned the hard way—by experience. Through this valuable collection of ATH articles Hobby Helpers enables you to short cut through the R/C wildness and benefit from what the pioneers have learned. A salute to Hobby Helpers, then, for making this booklet available and best wishes to you for a long and satisfying radio control career.

Albert L. Lewis, Editor
Air Trails HOBBIES *For Young Men*

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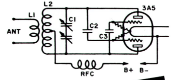

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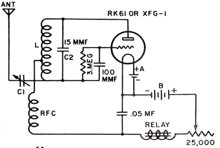


1A

Converting to 27¼

By HOWARD McENTEE

■ Now that we have an R/C spot at 27.255 mc., owners of some 50 mc. R/C outfits will want to change over, so they can operate without any license worries. Those who have built their own equipment will probably have no great trouble making the shift, if they will follow the notes here.

The transmitter and receiver we converted is an RCH, a good choice since it is typical of probably a majority of the equipment used on 50 mc. The receiver employs an RK-61, and the transmitter a 3A5 in the standard push-pull oscillator circuit. Owners of other makes of apparatus will be able to follow virtually the same procedure we used, providing their equipment employs these same tubes (or the XFG-1, in the case of the receiver).

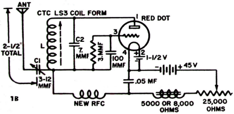
Let's start on the receiver, since it is the easiest. The original gas tube circuit of most of the receivers used on 50 mc. is shown at Fig. 1A. The only change needed is in the tuning circuit. On the RCH receiver, we found it necessary to change only the coil L and the choke RFC. L was made of 15 turns of #18 wire ⅝" dia. and 1¾" long. RFC has a form 3/16" dia. and about an inch long, with a 13/16" long winding of #34 enamel wire. This is not at all critical, but if you make any change, make the form larger. An ordinary carbon resistor of about 1 meg. value, and with a body of the above size or larger makes an ideal choke form, since it has the leads already on it.

It is OK to give the choke a *thin* coat of model dope to hold the wire in place. But don't let it get too thick.

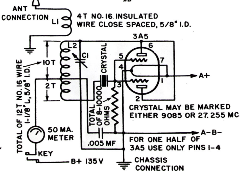
The set-up described worked nicely with the RK-61 but was rather inconvenient since tuning had to be done by squeezing or spreading the coil turns. In order to make the receiver work with either the RK-61 or XFG-1, it was necessary to go to the circuit of Fig. 1B. Since more turns were needed on the L, a CTC slug-tuned coil form was used, and this also allows easy tuning to the transmitter frequency. This circuit gives about equal results with either of the gas tubes. The antenna we used is about 2½ ft. long and C1 should be near the minimum setting (with the metalized part of the movable plate away from the mounting holes). As the tube gets older, it will probably be found that this condenser needs to be set at higher capacity, and it may also be necessary to lengthen the antenna.

The receiver was operated at 1.2 ma. with either tube, this current dropping to .1 ma. on reception of strong signal. We used 7 mmf. for C2; if you can't get

Headin' for the license-free band? This conversion job is easy and with Mac's instructions takes little time

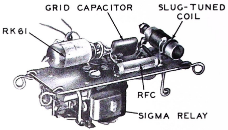


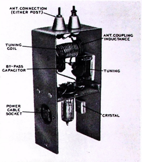
1B



2B

Revamped RCH 27¼ rig is not too different from the "50"





this value, most radio supply houses carry either 6.8 or 8.2 mmf., and 10 mmf. will also do, though the latter is a bit high. These are all fixed ceramic condensers.

It was found that the set worked best with the leads from the tube connected exactly as shown; the plate lead is the one with the red dot, and is considered #1.

The transmitter is another story. It has to be changed radically, but we were able to use most of the pieces, including the 3A5 tube. Practically all 50 mc. R/C transmitters have a circuit very similar to Fig. 2A. This is called a push-pull capacitive feedback circuit (for those few who are interested!), but it cannot be well adapted to crystal operation. The final circuit is shown in Fig. 2B. This circuit makes it mandatory to use crystals of the tiny metal-cased variety, such as the Petersen Z9 or James Knights H-173. This transmitter, if made as specified, cannot operate on the wrong frequency, that is, if you have the correct crystal.

In this way it differs from other transmitter circuits that have been printed in Air Trails and the 1952 A.T. Annual, though these circuits could be used with practically any make of crystal; the circuit of Fig. 2B requires very active crystals.

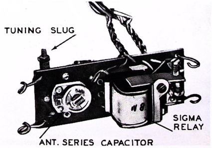
The RCH transmitter is housed in a small aluminum case, and has a double section tuning condenser. To make more room, we split this condenser, taking off the entire rear half. Also, the two semi-circular plates from the discarded half were slipped on the shaft, in place of the two disc plates. This latter operation just gives a wider range of capacity variation.

Most 3A5 transmitters have two grid resistors of from 15,000 to 20,000 ohms. We found the former value in this transmitter, and they were used in parallel in the final circuit. A single resistor of about 8 to 10,000 ohms would do as well. The two condensers C2 and C3 of Fig. 2A were discarded. Note that the new circuit has the two sections of the tube connected in parallel. You can use only one section if you wish, obtaining less power, of course, but the output will be ample for most R/C purposes, and the drain on the batteries much less. Also, with only one section, it is virtually impossible to harm the crystal; with the circuit shown, damage *can* be done, but we'll tell you later how to avoid it.

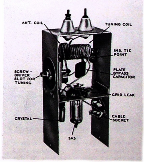
Provision must be made for the crystal socket; in this case it was mounted alongside the tube. The new coil L2 is supported only by its leads. To tune properly it was necessary to squeeze the turns quite closely together, and care must be taken to see that no turns short, especially where the tap comes off.

In converting other transmitters, where the layout may be entirely different, try to get the parts located so that the leads are fairly short and direct.

Most 50 mc. transmitters used twin lead for the antenna lead-in. The RCH has two insulators on top for such a



Receiver (above) and transmitter (right) after change-over



connection. The new setup uses a vertical rod antenna, and the insulators could have been repositioned on the front of the case to hold it. However, the transmitter is too light in weight to hold the required 9½ ft. antenna erect. The two insulators were just connected together inside the case, with one end of the coupling coil L2 connected to them and the other end run to the tab on the shaft of the variable condenser C1. The latter, incidentally, will vary in different transmitters, but you will need a condenser of at least 25 mmf. for the coil L2 we specify.

It was found necessary to push L1 right up against the end of L2, and note that it should be at the *plate* end. L1 should therefore be insulated; we used solid pushback hookup wire.

After checking your wiring very carefully, connect the batteries, using only 90 V. for the high voltage. It is much easier to get the outfit going without the antenna, but some sort of load *must* be used. About four turns of insulated wire soldered to a 2-volt pink bead pilot bulb will make an adequate load. Poke the bulb coil about halfway into L1 at the plate end.

You are now ready for the fireworks, so push the key and tune C1 to see if you get a dip on the plate meter. With good batteries, this meter will read around 20 ma. with the tube not oscillating, and will drop down sharply when C1 is tuned to resonance. At this point, your bulb load will light up. Check to make sure that C1 is not at full capacity (with the plates completely meshed) at resonance. If it is, add another turn to L2, or squeeze the turns closer together.

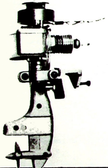
Now you can try 135 V. on the transmitter, but first, change the load bulb to a brown bead type (#40 or 47). This should light up fairly bright, and the plate current should be between 15 and 20 ma.

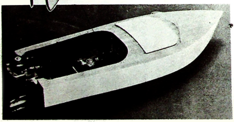
You will note that when approaching the point of resonance from the low-capacity side, the plate current will drop down smoothly till it reaches the lowest point. Then, as you rotate C1 further, the current will suddenly jump way up; this happens when the tube ceases to oscillate. We mentioned awhile back that crystals *can* be damaged in a circuit of this sort. Damage will be preceded by crystal heating, and when first tuning up the outfit, feel crystal holder occasionally. It may be just slightly warm, but if it gets hotter than this, it indicates that the circuit is not loaded sufficiently. Never operate this circuit with more than 135 V. on the plate.

Now you are ready to attach the antenna. It should be about 9½ ft. long, but any length between 9 and 10 feet will give good results. With the transmitter *on the ground*, push the key and tune the condenser for lowest plate current. It should hit this point at just about the same spot that it did with the bulb as a load, and plate current should be about the same. If it is too high—more than 20 ma.—push L1 away from L2 a bit. You will note that moving the key or pushbutton lead around will change the plate current a little. This changes the loading, and C1 should be set a little on the low capacity side of minimum plate current position. If this is not done, the tube may snap out of oscillation suddenly right at a critical moment in a flight.

The transmitter should always be set upon the ground. It is a good idea to put your batteries in a metal box, and attach the transmitter with its antenna to this box. That helps to keep the loading the same, no matter what sort of ground the transmitter is on.

After everything is tuned up properly, and a trial shows that it will stay that way, we strongly advise that the knob be removed from C1. You can put a slot in the shaft, if you wish, but you will seldom have to change it after the first tuneup, and lack of a knob will discourage the "knob-twiddlers."

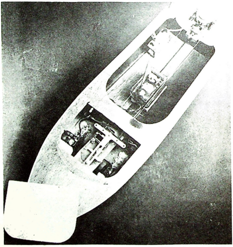




Mr. Ingham besides being a good photographer is a fine model builder as the clean lines of this boat model attest. To turn the miniature glow-plugged outboard engine, he runs two steering wires to an E.D. clockwork escapement. This runabout is 21 inches in overall length. Jack plans also to add motor speed control.

RADIO CONTROLLING YOUR MODEL OUTBOARD

Simple and logical is system devised by photoman Jackson Ingham, Jr. (Studio of Photography, 3765 10th St., Riverside, Cal.) to steer outboard via R/C.



With forward hatch removed you get a clear view of the steering mechanism and escapement installation. Note the large-size gas tank that has been installed at stern. Receiver is encased in plastic box to protect from spray or moisture. Batteries are placed to balance against weight of engine. "Boat is fast, fun"—JI.

BUG HUNTING

■ It isn't any time at all after you get into R/C that you begin to encounter "bugs." Bug-hunting is a universal R/C pastime, and new bugs crop up every day. Each one adds just that much to your experience; you learn to recognize them when they repeat, and can then save time in extermination. Here are a few of the more common bugs. Remember that some bugs can be kept out of your hair by a little preventative maintenance. For example: Relay contacts will get dirty in time, and your escapement or actuator may not operate reliably. This problem may be alleviated by making it a practice to clean the contacts at regular intervals, say, every two weeks. And *don't* do this with a file! Cut a strip of clean bond paper about ¼" wide and 2" long, and draw this

FIG. 1

between the contacts, while you press them together with your fingers.

Most R/C flyers have learned to make careful distance checks at frequent intervals, as the best way to check operation of both transmitter and receiver. Some aren't as careful with battery tests, though. Batteries should be checked before each flying session, and checked under load. It does little good to test them when not in use, with the usual high resistance meter; the safest way is to have them operating in their normal circuit positions, when the receiver or transmitter will supply the needed load.

When building equipment, remember that the parts you buy are not always exactly what you specify; all small parts such as resistors and condensers are sold not at exact values, but to a certain "tolerance." This means that they can vary considerably from what you order. The standard resistor tolerance is 20%: that resistor you have which is marked 100,000 ohms can thus be anything between 80,000 and 120,000 ohms. In most cases this makes little difference; if more exact values are required, article authors will usually tell you so. One more point; it is not unknown for these small parts to be incorrectly marked. The dealer seldom tests them when he sells them, so if you have built a unit that just won't work, yet all parts are new and marked as they should be, try to get them checked, or substitute others.

Soldered joints are prolific trouble spots; much has been written about "cold-soldered" joints, which simply means joints that have not had enough heat applied to properly melt the solder. Cold joints usually break apart under vibration. And then we have the matter of acid core solder; this stuff is fine for joining music wire landing gear parts, *but keep it away* from any electrical connection.

A solder job is often required at the flying field, and many builders do not know they can obtain 6V. irons that work right from a car storage battery; lots better than having to drive home to make a minor repair!

Installation Bugs. 1. We've mentioned it before, but it keeps cropping up again. Some kinds of slide switches are just plain *no good*. Use only the kind that have double wiping contacts, as in Fig. 1. Avoid those with ball contacts, or internal contacts that you can't see. Most toggle switches are OK, but they are heavier, of course.

2. Be sure your escapement is firmly mounted, if it is the single hole mounting type. See Fig. 2; an escapement fastened this way won't turn under vibration and throw your rudder positions all off.

3. Some receivers work fine on the test bench, but get very balky when installed in a plane. One cause is that wiring in the plane acts as additional antenna, and the receiver is just plain overloaded. This is especially true in large planes, where there are long leads to an escapement in the tail, or maybe a long metal pushrod to the rudder. All such metal appears to the receiver as more antenna, if it is tied in to the set. And don't forget, it must be considered tied in, even if there is no direct connection, through the effects of capacity (capacitance) in such units as the escapement.

4. Long metal push or torque rods can cause another elusive bug. This one usually shows up only when the motor is running; everything works fine with engine stopped. The various mechanical joints in the control system are the culprits; they cause "electrical noise" under motor vibration. There are two remedies. You can "bond" the joints wth short lengths of very flexible wire, or you can put in insulation, so that there is no metal-to-metal contact. Trouble spots to watch are shown

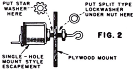


FIG. 2

in Fig. 3.

5. Vibration is a real enemy of receivers as we all know, but it can affect the receiver in queer ways. One of the most troublesome is to cause the relay to operate erratically; this is often the result of improper adjustment. Vibration has been known to render certain tubes useless, even though they work fine when the engine is not working. It can also shake the tuning coil of the receiver enough to make the circuit inoperative, so fasten every part down tight and with short leads.

6. When you install the receiver, keep the tuning coil, condenser, and tube away from large metal objects—such as batteries, etc., and don't run battery and escapement leads next to these parts. It is wise to separate the escapement and sensitive relay of the receiver by several inches: we have seen magnetic interaction render the relay very unreliable. Keep the lead to the antenna away from *all* metal parts and wires as much as possible.

Receiver bugs. 1. Keep the leads to your test meter *very* short. Remember that any wire you attach to the circuit in the plane looks like more antenna to the receiver; if your test leads are even a couple of feet long, it is apt to change the operation of the set enough to render any readings you make completely useless. If at all possible, attach your receiver test meter directly to a plug, and plug it in at the test jack, with no connecting leads at all.

2. Some receivers are bothered by the spark at the relay contacts, as the escapement is operated. This spark also dirties and wears out the contacts. It may be eliminated by the simple circuit in Fig. 4A. If you use proportional control and utilize both relay contacts, try the one in B.

3. Hard tube receivers are coming more into vogue right now. Some of these sets are a little fussy as to tubes, and won't work well (or even work at all) with some makes of tubes, even though these tubes test OK, and will work perfectly in other applications. Receiver tubes seldom burn out in use, but they do go sour. If your set just doesn't seem to have the pep it should, try a new tube.

4. Most B batteries we now use are of the layer-built type. The cells are in the form of flat wafers, stacked up and held together with a tape wrapping. These batteries have been known to open up in use, particularly after a hard jolt. They can sometimes be made to work by pressing on both ends with the fingers, but such batteries should naturally be discarded, at least for flight use.

5. Users of polarized relays should check occasionally to make sure that metal filings have not been attracted to the armature or pole pieces. This can happen to any type of relay, of course, but the polarized style is most susceptible, due to the built-in permanent magnet.

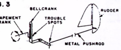
Transmitter Bugs. Transmitters are normally lots more reliable than receivers, as they use larger parts, heavier batteries, and are not operated in a "critical" condition, as are the receivers. Most of the problems associated with them are due to improper tuning and antenna loading. There are some troublesome bugs, though.

1. If you can't always get your antenna to load properly, try setting the transmitter upon a yard square piece of chicken wire, or hardware cloth. Sheet metal is OK, but more bulky, unless you use aluminum foil and roll it up for carrying. This metal under the set ties it closer to ground, allows better loading and more signal will go out. It also makes the key lead less "sensitive"; when you move it around with the button depressed, the plate meter will not show so much variation.

2. Crystals can go bad after continued use, even though they have been working perfectly for some time. They do not "wear out" with use; if yours fails—and you are sure you have not "strained" it, it is probably defective, and you might be able to get a new one for it.

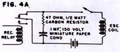
3. When you pack your batteries into the transmitter case, make sure that the flexible leads do not drape themselves over the plate coil and condenser, or in fact, over any of the R.F. parts and connections in the circuit.

FIG. 3



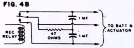
CHECK ESCAPEMENT SHAFT BEARINGS ALSO; A TOUCH OF GRAPHITED OIL MAY HELP THERE

FIG. 4A

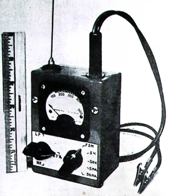


MOUNT RESISTOR AND CONDENSER RIGHT ON RELAY, IF POSSIBLE

FIG. 4B



R/C COMBO METER



By
HOWARD McENTEE W2SI

■ The final test of any transmitter is whether it will operate your receiver at the desired distance—and with a good factor of safety. However, such tests require lots of time and long-distance walks; for rapid checks close by there is nothing to beat a Field Strength Meter. This simple instrument can show if your transmitter is loaded properly, if the batteries are still good, how the crystal is behaving, give a rough idea of the power output, and so on. There are two approaches to the construction of a FSM; the simplest is to purchase the most sensitive micro-ammeter you can get, and hook it to a crystal detector and an antenna. Unfortunately, this is also by far the most expensive approach, for meters in the range of 50 or 100 micro-amperes don't sell for peanuts; furthermore, they are delicate, and should not be carried around for general field use.

To make the FSM shown here, we took the other possible path. A meter of medium cost was employed—to ease the pocketbook strain—and the desired sensitivity was insured by the use of a tuned input circuit. The latter offers an extra advantage, in that the unit serves as a fairly accurate indicator of frequency, too. It is certainly nowhere near what the F.C.C. calls a "Frequency Standard," but it will show if your transmitter is "taking off" in self-excited operation without benefit of crystal.

Since a good meter was to be used, it seemed a shame to keep it strictly for FSM purposes, so a switching circuit and a few resistors allow us two voltage and two milliampere ranges, which just about cover all the needs for transmitter and receiver servicing.

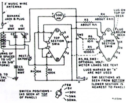
The search for a rugged small case turned up a surplus job that serves very well, and in addition comes with several parts that are needed for the final circuit. All components are fastened to the cover of the box; before it is used, the box should be stripped of parts and wiring. There are a couple of long studs that must be cut down; these are cast as part of the cover. They were sawed as short as possible and the stumps were then chewed off with a hand grinder. Another removal operation must be performed on a rib that is cast inside the cover on the end which holds the two jacks. This sounds like a lot of work, but isn't, since the box is made of cast aluminum, and cuts clean and fast. The meter requires a 2 1/16" hole, which may be made by the time-honored method of drilling a circle of holes, and filing them out to the required size. The two original jack holes are filed outward, so that the final position is as shown on the sketch; all holes shown thereon are those needed for this instrument. There are a couple of extra holes that may be plugged up by some such material as Testors Fyll.

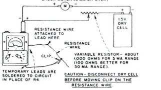
The two jacks must be insulated from the case. This may be by fiber or Bakelite washers. The jack that is used for volt and milliampere connections is one of those that came in the BC-366—the one with the large hole. The antenna jack is of the banana type and can be taken from the basket full of 'em that is in the BC-366.

As much wiring as possible on the switch should be done before it is fastened in the cover of the box. This switch needs a bit of modification; disassemble it (mark the two sections, so you can get them back together the original way) and remove the heavy wire spring. Also, with a hand grinder, cut the detent disc so that the last two positions may be reached reliably; there won't be much detent action on them, but the detent disc should center the contacts correctly.

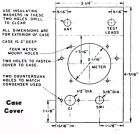
Many of the switch contacts are not used. Follow the sketch carefully in wiring up, and after the job is done, check your work *several* times. This is the sort of job where it is easy to go wrong—and some wrong connections can ruin the meter.

The slug-tuned coil is mounted right on the variable condenser, and if you get the one specified, it will be ready-wound and tapped. You can make your own from the specs on the drawing. We chose the two voltage ranges of 5 and 50 V. as probably the most useful. If you normally use 67½ V. batteries, you might want to extend the meter range to 100 V.; any voltage range may be had, the necessary series resistor being figured by multiplying the desired full scale meter reading by 2000. Thus, for 100 V., you would need 200,000 ohms at (*Continued on pg. 23*)

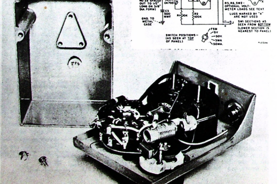




Calibrating for 5MA. range



Case Cover



Telecommander Revamps Its Hard Tube Receiver

An improved model of the E.C.C. 27¼ mc. single hard-tube receiver has been announced by American Telasco Ltd., American representatives for this well-known R/C line. The No. 951B supersedes the previous No. 951A, and is equipped with the Telecommander P100 polarized relay (which may also be purchased separately).

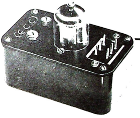
Basically the new model is pretty much like the earlier one, but a few improvements have been made, in addition to use of the much sturdier relay. All connections to the receiver, including that to the antenna, come out to six metal pins, and a six-prong socket is furnished for the battery leads. Since the socket will go on the pins in either of two directions, red dots are painted on the set and the socket, and should be lined up before snapping the socket in place.

All parts of the receiver are attached to a molded bakelite "chassis"; this plate has a hole through which the tube projects. A strong protective bakelite cover fits over the works, and is held on by four corner screws, which also hold hooks useful for suspending the receiver by rubber bands. There are two coil forms molded integral with the top plate, and these have been strengthened considerably over those in the earlier model.

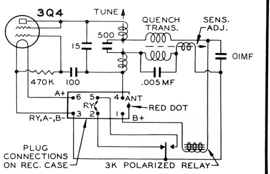
Adjustments for tuning and sensitivity are made by means of threaded slugs which project through the top of the case on the opposite side of the tube from the connection pins. The slugs are waxed so that they will hold their settings regardless of vibration. These are all the adjustments to be made on the receiver; the relay comes already set to operate at 2.2 ma. and release at 1.8 ma., and should not require readjustment. In fact, it is wise not to open up the set at all, for the manufacturer's guarantee is voided if the cover is removed.

The receiver is intended for use with 60-90 V., and like most hard tubers, will be found somewhat more sensitive with the higher voltage; however, sensitivity was found to be adequate when used with the standard 67½ V. battery. Specifications show the currents obtained at this voltage and with a weak signal. With 90 V. on the plate, the idling current was about 1.4 ma. higher than shown, but the on-signal current was only .2 ma. higher. With a strong signal, the on-signal currents were both .2 ma. lower.

Since both contacts of the relay are brought out to connection pins, the receiver may be used for both escapement or proportional controls. The makers advise the use of an arc suppressor which may be connected externally; a 50 ohm resistor and a .1 mf. condenser may be connected across points 3 and 2, 3 and 5, or both, as required by the control system.



American Telasco's 951B Telecommander 27.255 mc. receiver for radio control features 3Q4 tube circuit and self-contained P-100 sub-mini relay.

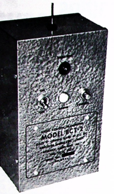


The Telecommander No. 951B receiver is available only in finished form, and is widely distributed through hobby shops. It comes complete with tube, relay, six-pin connection socket, battery connection wire, test meter plug and socket, and a 3 ft. length of antenna wire. Also, of course, complete instructions are furnished.

Specifications. **#951B receiver; single hard tube type using 3Q4 7-pin miniature tube. Overall size including tube—2½" x 1½" x 1⅜". Tube projects 1" above top of case. Two controls (for sensitivity and frequency) project from top of case, as do six connection pins. Weight with tube—2.96 oz. Antenna length from pin 4 on receiver—no greater than 3 ft.; may have to be reduced in some installations, such as in boat, or antenna series condenser used.**

Power requirements: A—1½ V. at 100 ma. B—60-90 V. With 67½ V., current drain on weak signal was 3.3 to .6 ma. Lightest possible power supply—about 4 oz. (two pencells in parallel and two Eveready # 413 or equiv. 30 V. batteries in series). Heavier batteries such as medium flashlight cells and Eveready #430 or equiv. are recommended.

Babcock Receiver and Transmitter



Specifications

Receiver #BCR-3. Overall size 4⅛" x 2⅛" x 2⅝" high. Weight with relay and tubes, 4.45 oz. Price $29.95.

Batteries: A-2 med. flash cells, 1.5V. at 370 ma. B—67½V.; idling current 1.2 ma., with signal on, 8 ma. C—15V., no current drain. Recommended battery complement weighs about 9.4 oz. (not including esc. battery).

Adjustments required: tuning only. Antenna length not critical. No tuning meter needed—tuning done with headphones. Non-adjustable sealed relay.

Transmitter #BCT-2. Size 4¾" x 3½" x 8" high. Antenna projects 34". Weight with batteries, 5 lbs. Price $39.95.

Batteries: A—2 large flashlight cells, 1.5 V. at 300 ma. B—2 67½V. units; current drain with key up, or down about 16 ma.

Controls: On-off switch and key button on front of case. No meter required for tuning; radiation indicator shows when signal is going out. Single tuning adjustment reached through front panel.

General information. The Babcock R/C equipment was designed for reliability and ease of operation. By going to a bit more complex receiver circuit, the designers have produced a set that has no "sensitivity adjustment" and few tuning tricks. Makers are large-scale producers of radio equipment for target drones; their R/C outfit for the hobbyists is simplified version of drone apparatus. Workmanship and appearance are top grade. Both receiver and transmitter are in grey hammertone finish cases, that for transmitter being of steel for strength.

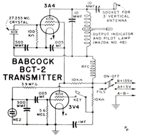
This equipment operates on a modulated signal, that is, the receiver will not operate unless it is receiving a signal with a superimposed audio tone. This has several advantages, not the least of which is that it makes the receiver much less susceptible to interfering signals from other 27 mc. transmitters. Receiver relay does not operate with straight unmodulated carrier, but only when the tone is sent out. Transmitter carrier is on all the time to minimize interference. Any failure at the transmitter, and most failures in the receiving end will leave the relay open; thus the system is termed "fail-safe".

The transmitter is entirely self-contained, with a 1/12 wave whip antenna which plugs in at top of the case. A lamp bulb on the front panel indicates power output, and is also used for tuning up, though once tuned for any particular crystal, retuning should never be required. Bulb goes on when power switch is turned to On position, and dims when key is depressed. Condition of batteries (and other parts of transmitter) is shown by brightness of bulb. Thus no meter is required for tuning or regular operation.

Transmitter circuit shows 3A4 tube is crystal-controlled oscillator, power output without modulation is about 2/5 W. Neon tube oscillator drives 3V4 modulator tube, which applies tone of about 900 cycles to screen grid of oscillator. Modulation percentage is about 85, and power output with key down about 1/10 W. This sounds low, but is ample, since tone systems normally require very little transmitter power, and receiver is very sensitive.

Transmitter batteries are all held by a single snap-on metal clamp, and are very easy to replace.

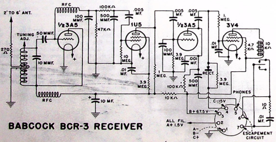
Receiver is actually a 4-tuber, since both halves of the 3A5 tube are utilized for different purposes. There is also a metallic rectifier between the last two tubes. Without signal, or with carrier only, last tube draws no plate current, due to use of C battery (this may be the tiniest 15 V. unit you can buy; no current is drawn from it). Transmitter carrier is normally on at all times, since this



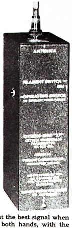
makes the receiver even less affected by interference. Relay current goes from zero to about 6 ma., assuring reliable operation, and making possible use of sealed lightweight unit here. It is normally set to operate at about 3 ma. and release at about 1.5 ma., to give large margin of safety.

Receiver antenna coupling system is designed so that there is little or no hand-capacity effect, and any length from 2 ft. to 6 ft. may be used; since there is no tricky sensitivity adjustment, receiver may be expected to work in the plane just the same as it does on the shop bench. Tuning is done by connecting a pair of headphones to terminal 5 on the receiver power socket; with no signal you will hear a strong hiss. When transmitter is turned on, hiss disappears; pushing key button brings a loud audio tone. Tune-up simply means turning the screw on receiver to get tone as loud and clear as possible. This should be done at a distance of 100 ft. or more, as with any R/C equipment.

Receiver and transmitter come with all tubes, relay and crystal, also transmitting antenna. Receiver installation kit consisting of on-off switch, phone jack, battery connectors, wire, battery boxes, is available for $2.75. A complete instruction manual is also furnished; it contains both simplified and technical descriptions of the equipment, circuit diagrams, installation and operating data. There is also a circuit for "recharging" the receiver batteries from the power line, thereby greatly prolonging their life. The Babcock equipment is intended for use with escapements, but should work perfectly with pulse equipment, for those who prefer such operation; the relay is of SPDT type, though only one fixed contact is brought out to the power socket. The other fixed relay contact may be reached at the relay socket.



CITIZEN-SHIP "27"



Specifications

■ *Receiver*—Model No. LR. Overall size, 3¼" x 1¾" x 2½" high. Weight with tube (relay is built in)—4 oz.

Batteries required: A—1.5 V. at 100 ma. B—60 or 67½ V. Current without signal, about 1.5 ma (with 60 V. on plate); with signal, .5 ma. or less. Lightest recommended battery complement (two pen-cells and two 30 V. hearing aid B's)—4 oz.

Adjustments: one for tuning, one for sensitivity. Meter jack required on model, but no rheostat. Antenna—about 18-22" long. Relay has screw adjustments, quench coil has adjustable core; both are set at factory, seldom need resetting.

Transmitter—Model No. LC. Case is 9" x 2⅞" x ⅛" overall; switches and antenna connections project slightly more. Case is steel, gray crackle paint on outside, yellow protective coating inside. Weight with antenna and all batteries—5 lb. 6 oz. Antenna is three section aluminum tubing, 46½" long.

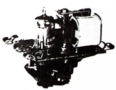
Batteries: A—1½ V. (Eveready 742 or equiv.) at 200 ma. B—135 V. (two 67½ V. units, Eveready 467 or equiv.), key-down drain about 17 ma. No B current drawn when key is up.

Controls: On-Off slide switch and push-button. Four screw adjustments inside case—normally need adjustment only when crystal or tubes are changed.

General Information. This equipment is intended for the Citizen's radio control frequency of 27.255 mc. The transmitter is unusual in that it is of the MOPA type, that is, master oscillator-power amplifier. While this circuit is a bit more complex than the simple crystal oscillators so widely used in R/C, it has the big advantage that nothing you do to the antenna will change the frequency or stop the transmitter from operating. You can actually hold on to the antenna, and while the signal will naturally be weakened, it will continue to go out on the original frequency. A circuit of this type is ideal for a hand-held transmitter, since the unit may be held in various positions, or even set upon the ground, without putting it out of operation. Actually, the unit is adjusted to put out the best signal when the case is held in both hands, with the antenna vertical.

Oscillator and amplifier tubes are the same—type 3V4—and this tube is also used in the receiver. Thus only a single spare is required for all positions.

The transmitter sends out an unmodulated signal when the key button is depressed; there is no signal and no B current drain with the button up. The antenna and amplifier output circuit are of a type that allow maximum power to be put into most any length of antenna. Thus, even though the power input to



the amplifier tube is relatively low—as judged by current R/C transmitters—the power put out into the air is ample for long distance control purposes. The use of the MOPA circuit further enhances power efficiency, since the amplifier circuit is inherently more efficient than the usual power oscillator. The power put into the oscillator of this transmitter is very small since it does not contribute to the actual output.

The Model LR receiver is a single tuber in the "hard tube" category. This means that tube life will be long and adjustments quite stable, varying only as battery voltages drop. The two main adjustments are made by means of slotted screws; one is marked "T", and governs tuning, while the "S" screw changes the sensitivity. These screws interact a bit, but the instructions detail clearly how they should be set. The receiver comes properly adjusted, of course, but some installations may require slight resetting for best results.

The receiver may be used up to about 100 yards from the transmitter with no antenna—plenty for boat operation on a small pond.

A plate current meter is required for tuneup; this may be a milliameter of about 1.5 to 3 full scale reading. Plate current of the receiver is highest when no signal is coming in; it runs about 1.5 ma. with a 60 V. plate supply and a bit higher with 67½ V. The relay is normally set to operate at about 1.2 ma. and open at .85 ma. Since the excellent Sigma 4F unit is fitted, this range of current results in very reliable operation. It is recommended that batteries be discarded when they drop to 50 V. or lower, as idling plate current will be getting too close to the relay operating point. For the same reason, A cells should be replaced when they drop to 1.1 V.

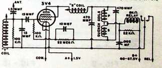
The receiver is mounted on a Fiberglas base, and there are five small Fahnstock spring clips to make connections. Four of these are on corners of the receiver base, and may be used to suspend the unit in the plane by means of rubber bands.

Like most hard tube receivers, this one may be affected adversely by spark ignition. However, a 10,000 ohm resister in the high tension lead right at the spark plug will usually clear this up.

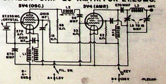
It is suggested that a double pole, single throw switch be used in the plane to control power to the receiver and escapement. This is necessary (unless a separate escapement switch is used) since the relay contacts close the escapement circuit when the receiver is turned off.

The instruction booklets furnished with these units are detailed and easily understood; that for the receiver includes six pages of written data, and three more of sketches showing installation, battery connections, and the like.

CITIZEN-SHIP LR RECEIVER (27.25MC.)



CITIZEN-SHIP LC XMTR. FOR 27.25MC.



Motor and Auxiliary Controls for R/C

FIG.-1

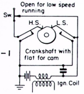


FIG.-2

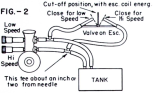
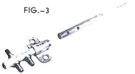


FIG.-3



■ It isn't too long after a flyer has mastered rudder control before he has the urge to branch out and add other controls to his system. The usual second control is motor two-speed, though some flyers contend that elevator is more important. There is good reason to try motor two-speed as your first multi-operation. If the mechanism fails in either high or low speed—or if the motor stops—you still have rudder action to bring the plane back. In other words, failure of the motor speed-change arrangement is generally not fatal, even though it may be annoying. On the other hand, if your elevator control sticks in the down position—brother! So it is wise to experiment with the different control systems connected to the engine; then when you have gotten one that suits you, apply it to elevator, if you wish.

All right, how can you make an engine change speed? Probably the simplest way is by means of twin needle valves on the fuel intake system. There are several engines on the market that come with twin needle valves built in—the K&B .19 and .15 engines and the Cameron .19.

Users of spark ignition engines—yes, there are still quite a few in R/C—have a very neat means of changing speed, by employing timers with two sets of contact points; some years ago, dual-speed timers were sold for several engines, including those made by O&R. The latter timers have been adapted to many other makes of engines; these timers are still available in some hobby shops. The circuit for this dual point ignition arrangement is shown in Fig. 1; there are two sets of points, but only one condenser and coil. Only a SPST switch is required; as connected in this circuit, you will have high speed as long as SW is closed. In this situation, the high speed points fire the charge, since they operate before the low speed points, during every revolution of the cam. With the switch open, the low speed points do the firing job, and since they function when the cam has turned further than the high speed points, the ignition is "retarded" and the engine slows down.

Most engines can be slowed down very nicely by simply restricting the air intake. Since the needle valve is set for best high speed running, with the intake wide open, the engine will run rich when the air is partially closed off. A slight disadvantage of this system is that the engine loads up, when running in low speed, and will not take hold at high speed instantaneously, since it has to clear out the rich mixture. With proper adjustment of the needle valve, though, the recovery is reasonably fast; there is no delay in the change from high to low.

There are other methods of securing two-speed operation, but most of them call for precision work on the engine, so the construction details will not be covered here. For those who want to use manufactured parts, there are a couple of possibilities; ready-made throttles have been available from Engine Aid Products (Box 524, Rahway, N. J.), and from Thompson Model Supply (Box 372, Guthrie, Okla.). The former is made for engines in the .29-.35 sizes, while the latter covers a wider range of engines, but is a custom-fitted deal—you send the maker your engine and he fits the throttle to it, and makes the needed adjustments.

Another throttle possibility is the one used on the English Mills diesel; this throttle is a rotary affair, and could doubtless be adapted to other engines in the .074-.15 sizes. The Mills engine is sold in this country by Polk's (314 5th Ave., N.Y.C. 1), and the throttle is available separately.

Now, how can we operate the twin needle valve arrangement? The simplest way is to go out and purchase a Bonner Motor Control escapement, which was designed expressly for this purpose. This escapement has two air valves built into it; it is made so that either one or the other of the valves is open, when the escapement coil is *not* energized. When the current is on, both valves are open. The escapement is attached to the engine as in Fig. 2; since all connection between the engine and the control unit are of flexible tubing, there is no alignment problem, and if the engine is knocked askew in a hard landing, the two-speed system is easily set up again.

For low speed, the L.S. needle valve is allowed to work by *closing* the bleed pipe leading to it (the escapement valves make either of the needle valves inoperative by permitting air to enter the fuel line, thus preventing the needle valve from sucking up fuel from the tank). As was noted, high and low speeds are obtained by opening the valve line connected to the unwanted needle; when both lines are open, both needles are starved, and the engine stops, since it receives no fuel.

The same escapement has been used with engines having only a single needle valve, by utilizing it to reduce the air intake; but only small engines can be accommodated, since the Bonner motor escapement was not designed for this use, and the tubes are too small to allow enough air to pass through for larger engines. Probably the .074 size is the maximum that can be employed, and this adaptation is ideal with engines around .049. The setup was described in detail on page 10, March 1953 issue of A.T.

If you want to make your own valve, try one like that in Figs. 3 and 4; it was dreamed up by Claude McCullough, and as shown here, can be used in the regular way with double needle valves on the engine. It is made from the brass tubing carried in most hobby shops, and a good smooth fit is required to prevent air leakage between the rotor and the outer body. The only precaution Mac gives in construction is that the side tubes be soldered on *before* the holes are drilled for them. If this sequence is not observed, you are almost sure to have solder run through the hole and "weld" the two tubes together.

This same sort of rotary valve may be adapted to the air reduction system of two-speed, by building the unit as shown in Fig. 5. Select tubing big enough to pass all the air your engine requires, so that top speed will not be impaired. No side tube is necessary for the high speed hole, but you can fit one to the low speed hole, so that adjustment of low speed is possible.

FIG.-9

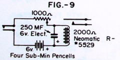


FIG.-10

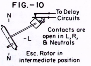


FIG.-11

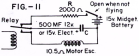
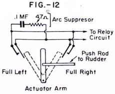
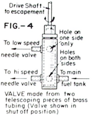
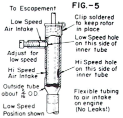
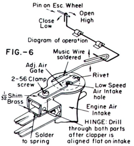


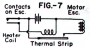
FIG.-12

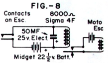












Tubing of the size shown should be ample for any .19 engine, and larger engines can be adapted to this system with larger tubes. Needless to say, all joints must be tight. Some arrangement to cut off air entirely is handy, for choking the engine to start; a pad of felt may be held on a spring strip over the high speed hole, and pushed against it with a rod from the outside of the fuselage.

It is usual to place the Bonner motor escapement, or the valve of Fig. 5 inside the fuselage, and *above* the level of the needle valves on the engine, so that excess fuel doesn't drain back and gum up the works.

One last method for getting two-speed also utilizes the air cut-off system, but is intended for easy construction and fitting to engines with front rotary valves—which means the majority of those made today. Carl Schmaedig showed us the version described here. The valve is a clapper that is lowered over the air intake of the engine to reduce speed. The top of the intake may have to be filed off to get a smooth surface for the clapper, and a good tight fit here assures reliable operation. Carl attached the valve by soldering a hinge piece to the spring that supplies tension to keep the needle valve from turning. Since the air intake must be adjustable so you can set the low speed to suit, a little vane is pivoted over the center hole of the clapper. A 2-56 nut is soldered on the underside of the latter, and a screw to fit holds the vane tight, after it has been adjusted to the desired setting.

A simple linkage goes back to an escapement in the fuselage, and flexibility of the torque rod holds the clapper tightly shut, for low speed. It is only necessary to raise the clapper 1/16" to 3/32" for top speed.

We now know several proven ways to get two-speed—how are they to be operated by radio? Well, again the simplest way is to purchase an escapement with a pair of electrical contacts built in, which will allow you to work the motor control escapement at will. The Bonner Compound escapement has such contacts, and you can choose motor control at any time, by simply sending three pulses to the plane; the third will click the motor escapement, or you can hold this pulse, to get motor cut-off, if your particular system is set up for this.

Some of the English escapements sold in this country (E.D. and E.C.C.) have contacts on them that may be adapted for such use. Or you can easily fit any escapement with a pair of electrical contacts. The usual way to do this—if you are using a two-arm escapement—is to have the contacts close in one of the two neutral positions of the arm. Thus, to get motor change, you pulse to this particular neutral, the motor escapement shifts engine speed, then you pulse to the other neutral. All this can be done so fast that the plane does not deviate from a straight course.

Users of four-arm escapements have an ideal way to get a motor control pulse, as contacts may be arranged to close in one (or more) of the "half-positions," which are not normally needed for rudder action.

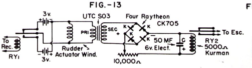
For this arrangement, and also for that where the added circuit is closed as a two-arm escapement passes one of the neutrals, a delay circuit is required, so that the motor control doesn't click into operation every time you pass through, in normal rudder movement. Two main types of delays have been used, the thermal, and the capacity-loaded relay. The thermal delay makes use of a strip of thermal metal, with a heating coil connected as in Fig. 7. It is necessary to hold the rudder escapement in the auxiliary position for several seconds to heat up the thermal strip and step the motor escapement along. As soon as the strip cools off, the contacts open and are ready for another operation. This system has been widely used and is simple and reliable, but it takes quite a lot of current, and is rather slow in operaation.

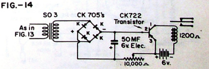
The capacity-loaded relay arrangement takes very little power, and can be made to operate as fast as you want; connections are shown in Fig. 8, with circuit constants for a Sigma 4F relay. In a circuit of this type, some of the tiny relays now on the market are entirely satisfactory, since the current change is from zero to the normal operate value. By using a relay such as a 2000 ohm Neomatic Model 5529, you can get a very lightweight setup, suitable for the smallest planes. It is helpful to add a variable resistor R, to control the delay. All the parts in Fig. 9 add up to only 2¼ oz., if you use cells similar to Eveready No. 912.

The same cells may be used to work the motor control escapement, if it has a reasonably high resistance, and doesn't take too much current. Or you can use your regular rudder escapement cells as part of the 6 V. auxiliary control circuit power supply, adding midget pencells as required to get up to the necessary 6 V. The circuit will provide enough delay so that you can pulse through the two-speed position without tripping it, but longer delay may be had by increasing the size of C. The next large standard size is 500 mf.

Another simple way to work your motor control escapement is depicted in Fig. 10. Here a square cam has been attached to the rudder escapement shaft; the contacts close four times per revolution of the shaft, but are open in all four of the normal operating positions. When the rudder escapement is either in neutral or in a turn position, the added contacts are open. To close the relay, and change motor speed, four quick pulses are sent; this charges up the delay condenser sufficiently to pull in the relay, and brings the rudder back to the position it had before you sent the sequence of pulses. The relay should be set with rather large contact spacing, and the tension adjusted so that the armature pulls on the four fast pulses. The cam contacts should be set as close as possible, but not so close that engine vibration might close them. An escapement with a tight well-fitting shaft is a necessity. Howard Bonner dreamed up this arrangement before he and Herb Owbridge had perfected the Compound escapement.

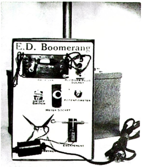
The circuit of Fig. 11 is of interest, as it takes very little power, and works the escapement with a real bang. In principle, it is something (*Continued on pg.* 23)





E.D.

ARISTROL



SPECIFICATIONS

Receiver: E. D. Boomerang (gas tube type). Overall size 3¼" long x 1¾" wide x 1⅝" high. Tuning lever sticks up another ⅜". Wt. with relay, XFG-1 tube, battery cable with plug, and protective case, 3 oz. Price of Boomerang outfit with switch, plugs and sockets, potentiometer and E.D. current-saving escapement—$29.50. Same equipment, less escapement—$24.95.

Minimum recommended battery complement: A—two pencells (Eveready 915 or equiv.), 1½ V. at 50 ma. B—two 22½ V. batteries in series (Eveready 412 or equiv.). Idling current about 1.5 ma.; with strong signal, .3 ma. or less. Lightest recommended battery supply, 3 oz.

Adjustments: Lever for tuning. Potentiometer to adjust idling current. Five jacks for antenna setting. Relay has two screw adjustments.

Transmitter: Aristrol. Steel case is 5" x 6" x 9" with one removable cover. Gray "hammertone" finish. Weight with antenna, key and all batteries, 7¼ lbs. All controls and antenna insulator are on top surface of case. Antenna is seven-section collapsible aluminum type, 7½ ft. long when extended, 15" long folded. Price with tube, crystal case, antenna, key and lead, $29.50.

Batteries: Recommended supply is one #6 dry cell and two 67½ V. batteries (Eveready 467 or equiv.). A power is 1½ V. at 200 ma. B power is 135 V. at 16-18 ma. No B current drawn with key not depressed.

Controls: A battery on-off switch. Snap action key on 7½ ft. cord. Socket for key lead on panel. Meter jack. Large insulator for antenna. Access hole for screw tuning adjustment.

■ **The E.D. Boomerang 27.255 mc. receiver is unique in that it comes to the purchaser completely wired up with on-off switch, battery cable socket and plug, meter socket and plug, potentiometer, and escapement. The set can be put into operation right in the box, if desired—an interesting setup from the dealer's point of view. The escapement leads go through the battery cable and plug, but there are extra terminals on the receiver, so the user can reach all relay contacts. The receiver is assembled on a strong Bakelite plate, and is protected by a moulded plastic cover. The XFG-1 tube and socket are on the outside; all other parts are enclosed. The tube is firmly held in place, but may be quickly removed.**

Receiver features an antenna coupling system giving five steps; as tube ages and more antenna is needed, a plug is shifted to the next socket.

Both contacts of the relay are protected with arc suppressors. The relay has screw adjustments for the contacts, with holes in the cover so they may be adjusted from outside. Relay is set to pull-in at about 1.3 ma. and open at about .9 ma.

Tuning is by iron core, with a small finger lever and a locknut to hold it tight. The Boomerang outfit may also be had with a hard tube receiver.

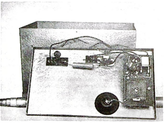
The transmitter has a printed circuit, the first R/C unit to use this modern feature. The entire R.F. section is on a Bakelite plate 2" x 4"; the plate and antenna coupling inductances are printed right on this plate, but the grid inductance is a conventional wire coil. Crystal control is used, of course. The antenna circuit is fixed-tuned, but a ceramic trimmer is used to tune the plate tank. It may be reached through a grommet-protected hole in the top of the case.

A closed-circuit jack is provided for the use of a tuning meter; a 50 ma. meter is suggested. The socket for the key lead plug is electrically isolated from the transmitter circuit with an RF choke, to make it less "hot"—in other words, so that the transmitter output will not vary so much as the key lead is shifted around.

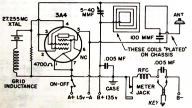
Since this transmitter case has a 5" x 9" side on the ground, the loading to ground will be quite good. The case is large enough to use three heavy duty 45 V. B batteries (Eveready 482 or equiv.), but if these are employed, the A supply must be smaller in size than the #6 dry cell listed on the specs. There is a sturdy metal folding handle on top of the case.

The antenna furnished with the transmitter is less than a quarter wavelength long, but will be adequate, considering the power output of the transmitter. Any antenna up to 9½ ft. long may be used; the lower end must be fitted with a 10-32 threaded bushing, to fit the antenna insulator.

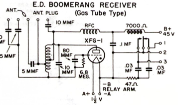
The instruction booklet covers both transmitter and receiver, gives installation and adjustment notes, a long list of possible battery combinations, list of F.C.C. offices, and considerable information on filling out the license form that accompanies the transmitter.



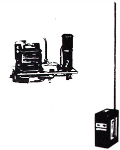
ARISTROL TRANSMITTER



E.D. BOOMERANG RECEIVER (Gas Tube Type)



SUPER AEROTROL



Because it is one of the few outfits that can be had in both kit and completely assembled form, there are doubtless more Super Aerotrols in use than any other commercial R/C equipment. Berkeley Model Supplies states over 5000 have been sold.

The transmitter is of the hand-held variety, with all batteries carried in the sheet steel case. While you can save considerable money by purchasing it in kit form, you actually get almost a completely assembled transmitter; all you have to do is wire it up. The chassis has tuning condenser, tube and crystal sockets, switches and lug strip already riveted to it. All necessary holes in chassis and case are punched and the case is finished in gray crackle. The chassis is held in case by four screws and may be removed quickly for servicing. Field tune-up is made easier if a ¼" hole is drilled in the top of the case directly over the slot in the tuning condenser. Under normal conditions retuning will seldom be required, unless the crystal or tube is changed.

The excellent plans sheet shows top and bottom views of the wired chassis with every lead clearly indicated. By close reference to this drawing and the step-by-step assembly instructions, the beginner in R/C should have little trouble in successfully wiring the unit. The plans also include all the circuit symbols used in the transmitter, to make the schematic diagram doubly clear.

In actual use, the transmitter should be held in both hands about waist high, with the antenna projecting vertically. The right thumb will then be near the On-Off switch, while the left thumb is used on the keying button.

The transmitter is crystal-controlled, as required for operation on the examination-free 27¼ mc. spot. The circuit utilizes a single 3A5 tube, with both sections connected in parallel. Rather loose coupling is used to the ⅝th wave antenna; this results in less adverse reaction when the transmitter is handled during use.

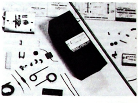
As a kit, the transmitter comes with crystal, but less tube and batteries. The tube and crystal are included with the finished unit; you get a finished antenna in either case.

The Super-Aerotrol receiver kit includes a drilled linen bakelite "chassis," which has six eyelets on it for connection purposes. The tube is held by a band around a long lug, and by threading the clipped leads through four "flea clips." The tuning coil is completely finished, as is the RF choke. You have only the simple job of mounting a few parts and wiring them. Flexible battery leads, potentiometer, and meter socket and two plugs (one for meter, one for a shorting plug) are part of this kit.

The relay is the moderately light and very sensitive Kurman, of 5000 ohms. Due to the compact assembly, this is probably the smallest and lightest commercial receiver available today for 27¼ mc. use.

The receiver plan sheet is just as complete as that for the transmitter and includes the same general drawings and data. In addition to these sheets, each kit features the 30 page Aerotrol Instruction Manual which gives full operating and service data for the equipment. The receiver is intended for either the RK61 or XFG-1 gas tubes; Berkeley normally supplies only the latter.

The equipment described here should not be confused with the earlier DE-Aerotrol transmitter and receiver, which are made for use on the amateur 50 mc. band, and which are sold only in kit form. The



Instruction Manual covers conversion of the De-Aerotrol receiver to 27¼ mc. operation; the transmitter can be converted to the amateur 27 or 28 mc. bands, but cannot be used on 27¼ mc., since it is not crystal-controlled.

Specifications

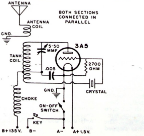
Receiver. Single gas tube type fitted with sensitizer for better range. Entire receiver mounts on base 1⅜x2⅜" and is about 1¾" high. Wt. with battery leads and tube—2¼ oz. On-off switch, meter jack and plug and potentiometer add about ½ oz. Relay in kit furnished fully adjusted, as it is in finished receiver.

Battery complement: A—two pencells in parallel (Eveready 915 or equivalent), 1½ V at 50 ma. B—two 22½ V. batteries in series (Eveready 412 or equiv.) Idling current about 1.4 ma.; with signal, current drops to around .2 ma. Lightest recommended battery supply, as above—3½ oz.

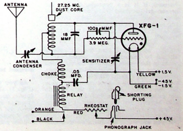
Adjustments: variable antenna coupling condenser. Screw core for setting frequency. Relay adjusted by bending components. Sensitizer.

Transmitter. Case size, 8½x4⅛x3", less antenna holder. Weight with batteries 4 lbs. Antenna projects about 4¾ ft. above case; it is two-section type, 2¾ ft. long when collapsed. Antenna attached by a single wing nut.

Batteries: Case holds two 67½ V. B batteries (Eveready 467 or eq.) and one 1½ V. A cell (Eveready 742 or eq.) A current—200 ma. B—135 V. at about 20 ma. (B current drawn only when key is depressed).



"SUPER AEROTROL" TRANSMITTER



"SUPER AEROTROL" RECEIVER

Primer on Power Loading

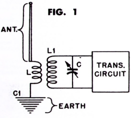
Having trouble tuning up that transmitter? Then you're sure to welcome this down-to-earth how-to-do-it dope

■ **Nope—we are not talking about the lead or old booster batteries you pile in your PAA-Load planes! The loading referred to here concerns R/C transmitters; a transmitter is said to be properly loaded when some circuit is coupled to the plate coil to take out the optimum amount of RF power. You can overload a transmitter—it will then usually stop oscillating—or underload it, in which case you don't get the amount of signal out into the air that you should.**

And there are still other penalties to improper loading; too much load can very easily ruin the tube, and will run down the B batteries very rapidly. If the circuit is not loaded enough, you can ruin your crystal. So you see, it pays in many ways to know the rudiments of transmitter loading and how it is accomplished.

First, let's see what loading is. You know that a flashlight cell has a certain amount of power in it; if you hook too heavy a

FIG. 1



load to it—a glow plug, for example—it will simply refuse to work. You can consider the tube of your transmitter as a battery, too, but this one does not produce direct current like your dry cell—it puts out radio frequency power, or RF. In order to do this, the tube is made to "oscillate," by connection to certain circuit elements, such as the crystal and tuned plate circuit. If you overload it, it too refuses to work; it stops oscillating, and the plate current goes up much higher than the tube can handle. If you do not load it enough, the tube (if it is a triode) wil not be harmed; if it is a pentode, though, the screen grid current will rise to overload proportions. Also, the RF that is circulating in the circuit builds up to a high value in the crystal—and there goes your costly "rock"!

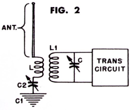
O.K., we'll agree that the transmitter should be loaded to the correct value; what is this value and how do we reach it? If you have a commercial transmitter, or make one from a kit, the instructions will undoubtedly give an operating value for the current. Make sure that you do not exceed this value, and if the current goes higher, turn the rig off till you can collect your composure and find out why.

If you are using a homemade transmitter, better check with someone who owns a well-known make, which uses the same tube and B battery voltage as yours, and do not exceed his current values. As a very rough guide, the common battery transmitter tubes such as 1S4, 3S4, 3V4 should not be used at higher plate current than 12 ma. The 3A4 can go up to about 17 ma., as can the 3D6. If the tubes are used as triodes (with screen grid hooked to plate), you can run the current up another 20%. The 3A5 will stand 15 ma. per section, or a total of 30 ma. for the tube. Heater type tubes that work on 6 V. will generally take quite a lot more plate current safely.

Now, what about the "how" of loading? Remember that the tube is an "RF battery"—it will produce a lot of RF power; you have to get it out and into the air. This is done simply by coupling an output circuit to the tube, tuned to the same frequency. All transmitter antenna systems must be tuned, to operate correctly. You can't consider the *antenna* simply as "that rod you attach to the top of transmitter case"; it is this rod, *plus* the coupling coil, the antenna tuning condenser, if any, and the capacity between the transmitter case and ground. Also to be added in here is the capacity between the key lead and ground—and you yourself are involved in this. That is why the meter may wiggle a bit as you move the key lead.

The simplest coupling systems utilize just the antenna rod, and a coupling coil, as in Fig. 1. Because the antenna is cut to a carefully chosen length, it will be tuned (very broadly to be sure) to the transmitter frequency. For 27¼ mc., we use an antenna about 9½' long; this is known as a "quarter wave antenna," because it is about one quarter as long as the frequency (27¼ is roughly 11 meters, or 37 feet). Some transmitters, especially the hand-held jobs, have shorter antennas than this, but they have other tricks incorporated that allow good operation with these undersized rods.

FIG. 2



As you turn the plates of condenser C (Fig. 1) slowly from minimum capacity (plates open) toward full capacity (plates closed or meshed) the current should drop down to a minimum, then rather suddenly jump up quite high. See Fig. 3. The sudden jump shows the tube has stopped oscillating—get that condenser back to lower capacity in a hurry! If your transmitter uses a pentode connected 3A4, for example, and the current dips down lower than about 15 ma. (with 135 V. B supply) it's a sign you need closer coupling; in other words, you are not loading the tube enough. So you just shove L closer to L1, and retune C. The current dip should not now be as low. Continue till you get the current up around 15 or 16 ma. If it won't go up this high, then you may have to add a turn or two to the coil L.

Suppose you increase L till it has about half the number of turns of L1 and the current still won't go up to 16 ma? Then you will have to check C1, which is the capacity between the transmitter circuits (including case, key lead, etc.) and actual ground, or earth. Try setting the transmitter on the hood of your car, or on a yard square piece of hardware cloth or even metal. You will doubtless now have to back L away from L1, to get the proper plate current.

And if this *still* fails to raise the plate current—brother, you've got real troubles, and we can't diagnose them from this distance!

Now take the same 3A4 pentode circuit, but with the circuit of Fig. 2. It's the same as Fig. 1, but we have added another condenser, C2. This makes it much easier to properly load the transmitter, especially when it is to be operated on different types of surfaces (and more about *this* a little later). In this case, the ant., L, C2 and C1 are all chosen to add up to approximately the transmitter frequency, or 27¼ mc. Actually, we make L, C2 and C1 all larger than necessary; then in the field, all we have to do is to reduce C2, till the plate current is normal. This is the system that was used in the Mac II transmitter, and is mainly responsible for the exceptional range of this unit. It can be applied to most any other transmitter just as well.

We suggest that the reader refer back to the circuit of the Mac II (and the tuning instructions on A. T. Plan 553) to see just how this tuning system is applied to a representative transmitter.

With a correctly designed system as in Fig. 2, you don't need to have the antenna exactly 9½' long, for good results. It can be as much as a foot shorter, and you can still get pretty good output. It can also be longer, but little or nothing is gained in the way of power output, and the antenna just gets that much more ungainly.

Now a word about those "different types of surfaces" we mentioned a while ago. The reason we have stressed capacity to ground—which is represented by C1 in Figs. 1 and 2—is that the earth plays a vital part in the operation of the quarter wave ant.; without going into the technical reasons why, just take our word that a *half-wave* antenna is the ideal simple radiator.

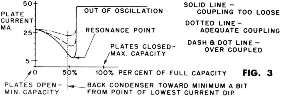


FIG. 3

Sure, we specify a *quarter* wave for our whips—the ground actually acts as the missing quarter. That is why it is so important to have good capacity to ground —C1, you'll remember—in our output circuits.

If you doubt this, just tune up the transmitter sitting on the ground, then raise it up four or five feet on a wooden table. Right! The tuning goes all haywire, and you can't load the transmitter. Ground varies quite a bit in conductivity—and hence in its inability to be capacity-coupled to your transmitter case. That is why it is a good idea to use a large metal case, or to put an extra plate on the bottom of the case as was done on the Mac II. It allows you to get good loading, even if you are over very dry ground. Moist ground, lush grass, metal surfaces like a

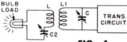


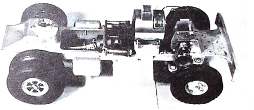
FIG. 4

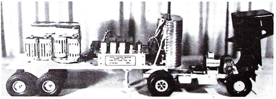
car hood, all allow easy coupling and loading. On the other hand, very dry ground, sand, concrete runways, and macadam surfaces are poor ones from a loading standpoint.

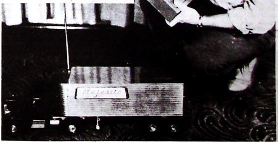
We have often mentioned the use of a pilot lamp, to show power output, when you are tuning up a transmitter. If one is connected as in Fig. 4, it serves as an ideal means of adjusting the transmitter, when you are first getting it set up. After this, the pilot lamp is of little use; you can connect one in series with the antenna and it might light up, but it will not prove a lot about transmitter output. Also, all the power that is required to light it is just subtracted from that going out in the air to your plane. Hook the bulb as in Fig. 4 for test purposes only—or to impress your friends with mighty power capabilities of your transmitter—but take it entirely out of the circuit for actual radio control operation.

The final word on how your transmitter "puts out" can only be had with a field strength meter. Build one like that in the new Air Trails Model Annual, or purchase one of the many low cost units on the market, and you can quickly check what is coming out of that whip atop your transmitter box. You just can't fool the FSM; if your buddy has a peanut-whistle half watt transmitter, and he can make the FSM read higher at the same distance than you can with your "5 watter" . . . well, just read the foregoing paragraphs once more!

R/C TRUCK

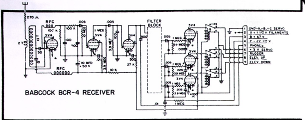




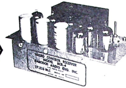


Indiana Fan Operates Radio-Controlled Tractor-Trailer

"This is my second radio-controlled tractor-trailer combination," says T. A. Kelley of Huntington, Ind. "Both were originally toys purchased at a store, disassembled and equipped with R/C units. The first contained a 465 radio but complexity of controls made it difficult to memorize the sequence. The present one, shown here, utilizes the Babcock three-channel outfit which greatly simplifies the operation. Whenever I run the model it attracts a lot of attention. I also build R/C planes, but find that precision pattern is easier to achieve with the trailer-truck; with it, my spot landings are always perfect."



BABCOCK BCR-4 RECEIVER



■ Following the lines of their successful BCR-3 single-channel receiver, Babcock Radio Engineering offers a reliable system to have three control operations instantaneously and at will. The new BCR-4 receiver has but one adjustment—that for tuning to resonance with the transmitter. There is no sensitivity control, no plate circuit variable resistor, and there are no adjustments on the relays. While a 3-channel outfit is not usually recommended for the beginner to R/C, this one will certainly confront him with a minimum of problems.

Babcock's 3 CHANNEL R/C

All of the tubes are the same; in the unlikely event of a tube failure, a single spare takes care of any position in the receiver. On all tubes, only one-half of the filament is in use, a measure intended to reduce "A" current consumption.

Tuning is very broad, and antenna length is not at all critical; a couple of feet of wire will suffice. There is no need to do any audio tuning, since the filters, which are contained in a sealed metal box, are set at the factory and should never require change.

Though there are a lot of tubes in the receiver, and current drain is naturally heavier than in receivers with only one or two, this particular unit is very tolerant of voltage drop in the power supply; for example, a 67½ V. battery can be used till its voltage has dropped to 52 V., while a 60 V. battery can be used all the way down to 40 V., before replacement is necessary.

All receiver components are attached to an insulating base housed in an aluminum case; three sealed Babcock relays plug into the same kind of sockets as the tubes. The set is a bit too heavy to mount by means of rubber bands; sponge rubber shock absorbers are suggested. All connections to the receiver, except the antenna lead, are by a miniature 9-pin plug. As with the BCR-3, the makers offer a low-cost installation kit, containing flexible wire in several colors, battery and receiver plugs, switches, phone plug, etc.

For use in model planes, Babcock recommends a Bonner compound escapement for rudder, and Bonner motor control escapement for two-speed engine. A non-self-centering motor-driven servo is utilized for the elevator. For boats, this servo is used on the rudder, with the third channel for motor speed control.

The BCT-4 transmitter externally looks much like the single-channel Babcock BCT-2; it is the same size and is housed in a similar gray hammertone-finished case. All parts are attached to the front panel, which is removable for access to the batteries. Tuning (which should be seldom) is through a front panel hole; a lamp bulb indicates proper operation and aids tuning. Major external difference is that the new unit has a little control stick projecting from panel; marked Up, Down, Left, Right, and Motor.

Transmitter is crystal controlled for use on 27¼ mc. Three audio tones, 300, 720, and 1620 cycles, are non-adjustable, since the audio oscillator circuit is also controlled by tuned filters set at the factory; filters are sealed in a metal case.

The transmitter is supplied with crystal, tubes and whip antenna, less batts.

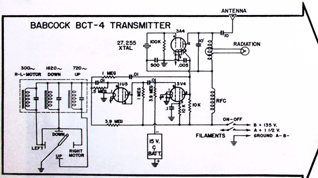
Transmitter: Type BCT-4. Case size, less panel projections—4¾" x 3½" x 8" high. On-off toggle switch for batteries. "Control stick" for sending any of three audio tones at will. Radiation indicator bulb allows continuous check of operation. Single-section 3/32" dia. rod antenna projects from top of case about 35"; plug-in type. All batteries held under single mounting clamp, except C batt., which fits in its own clips.

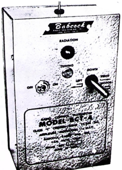
Battery Requirements: One 15 V. C battery (Eveready #411 or equiv.); indefinite life, as there is no drain on it. Two 67½ V. batteries (Eveready #467 or equiv.), 135 V. at 16½ ma. (carrier only), and 20 ma. with control stick depressed. "A" supply is two large flashlight cells; 1.5 V. at 350 ma.

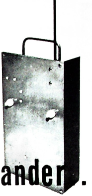
Receiver: Type BCR-4. Overall size including mounting flanges—6" long x 2⅞" wide x 3" high. Weight 17½ oz., with all tubes and relays. Relays are SPDT, sealed, plug-in. Single adjustment only—for tuning. Non-sensitive to antenna length, hand-capacity, etc. High sensitivity, but will not overload close to transmitter. Responds only to three audio tones of associated transmitter. Only one type tube used throughout.

Battery Complement: Lightest recommended battery supply, 10½ oz. (including cells for servo and escapements, and battery boxes). "A" battery drain is 1.5 V. at 350 ma. "B" battery drain is 1.8 ma. idle and 7 ma. on signal, with 60 V. "C" battery for 60 V. use is 15. V., with no current drain. Lightest set of batteries consists of 8 pencells, two 30 V. batteries in series (Burgess U20E or equiv.) and one "C" battery (Eveready 504E or equiv.).

BABCOCK BCT-4 TRANSMITTER







ECC Telecommander...

features

MOPA Xmtr, Hard Tube Rcvr

Available only in finished form, the ECC line of R/C apparatus was designed in England, but is intended for use in this country. The transmitter is crystal controlled—a feature not required in England, and not very generally used there.

Designed to be held in the hands while in use, this transmitter has quite a few unusual features. In the first place it uses a master oscillator-power amplifier circuit with separate oscillator and amplifier tube. Actually, both tubes are in one envelope, since a standard 3A5 tube is utilized.

The circuit is further unusual in that the final amplifier is not neutralized, generally thought a necessity when the oscillator and amplifier operate on the same frequency, as they do in this unit. The oscillator employs a tapped-coil circuit, quite common in R/C transmitters; power output of the first half of the 3A5 tube is capacity coupled to the grid of the amplifier section. The plate circuit of the latter has the usual inductance and air tuning condenser. Antenna coupling consists of a single turn around the "cold" end of the plate inductance.

In a circuit of this sort, tuning the plate circuit of the amplifier results in considerable reaction on the oscillator tuning. For this reason, the tuning acts very much like a plain crystal oscillator transmitter. As the amplifier plate condenser is rotated, there is the same sharp cessation of output to one side of the point of maximum output, and a much more gradual drop off, with rotation to the other side. The circuit is very easy on the crystal, and power output is ample for normal R/C purposes.

Another novel feature of the transmitter is that there is no filament on-off switch. Instead, there is a button to close the filament circuit, and another to close the high voltage circuit and send out a signal. Since an escapement-equipped model requires a signal only a small percentage of the time, this arrangement is quite adequate, and it saves filament battery power. For this latter reason, the filament battery can be smaller than usually seen in such transmitters.

The transmitter is mounted on a gray hammertone finished aluminum panel, all parts being attached to this panel, including the batteries, for which clips are furnished. A molded bakelite case covers all the parts, and a metal handle is fitted for ease in carrying.

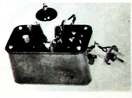
ECC's single hard tube receiver is mounted on a molded bakelite plate, which also includes integral coil forms. There are two iron slug cores that may be reached from the top of the plate, or panel. The tube is mounted in a socket spaced considerably below the panel, so that only about half is outside the case.

The battery connections are made through a three-wire cable which terminates in a small plug. All three relay contact connections are made to solder pins on the panel.

An instruction sheet for the receiver carries a chart of plate current readings and relay settings; the receiver may be used at from 60 to 90 V., and on the latter, the idling current will be around 5 ma. Our tests were made at 67½ V., and results tallied exactly with the Test Card packed with each receiver.

SPECIFICATIONS

Transmitter: No. 1061. Case size, less handle and antenna—10" x 6¼" x 2¼". Two operating buttons project about ⅝". Weight with all batteries, about 3 lbs. 7 ozs. Panel has filament pushbutton and plate pushbutton (both must be held down at once to send out a signal). No provision for tuning meter. Antenna plugs in through hole in top of case; it is



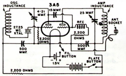
a 4-section unit about 48" long, and folds up to about 11½".

Battery complement: A—one 1½ V. cell fitted with socket. (Eveready No. 960P or equiv.) 1½ V. at 200 ma. B—two 67½ V. batteries (Eveready No. 467 or equiv.). 135 V. at about 18 ma.

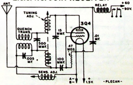
Receiver: No. 951A. Single hard-tube type. Separate screw controls for tuning and sensitivity. Receiver size with bottom cover in place, 2½" x 1½" x 1⅜". Tube projects about 1⅛" above top of panel. Receiver weight with tube—2.85 oz. Relay tension screw adjustment may be set from top panel. Molded case-bottom held on with four corner screws which also carry small lugs to be used for rubber shock suspension. Suggested antenna length—3'; use of 5-30 mmf. variable antenna series condenser may be necessary in some installations.

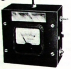
Battery requirements: A—1½ V. at 100 ma. B—voltage from 60 to 90. Idling current 2.8 to 5 ma. Current with good signal, about .5 ma., regardless of battery voltage. Lightest possible battery complement (two pencells and two 30 V. batteries)—4 oz.

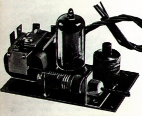
E.C.C. NO. 1061 TRANSMITTER



E.C.C. NO. 951A RECEIVER







Control Master

27X and 27RH Equipment

■ Control Master's single hard tube receiver has a few tricks all its own. For one thing, it has no separate sensitivity control; there is only a single adjustment—that for tuning. Indirectly this sets the sensitivity as well.

The receiver is on a linen bakelite base, with four corner holes for attachment of hooks (if mounting is to be by rubber bands). Due to the high resistance relay, and rather high plate current, the relay can be adjusted with plenty of tension. In most installations, the set could doubtless be mounted on sponge rubber with entire satisfaction.

The 1S4 tube used may be had at most radio shops, since it is used in portable BC receivers.

CM's set comes with a 6" five-wire cord, terminating in a small five-prong plug. Also furnished are a socket for this plug, a test meter socket with two plugs, and two SPST slide switches for A battery and escapement circuits. For use with this receiver either a 3 or a 5 ma. meter will fill the bill; the latter is probably best.

Both transmitter and receiver are in finished form; replacement parts may be obtained. Xmtr is in a husky steel, black-crackle-finish case. This case is rather large, since the transmitter takes 180 V., which means four 45 V. batteries. There is plenty of room for them.

Xmtr circuit is the familiar tapped-coil type, tuning being accomplished with a screw-operated capacitor. This adjustment is at the rear of the chassis, not reachable from outside, unless a small hole is drilled in the rear cover (the batteries do not obstruct it).

Antenna coupling is the untuned type; the coupling coil is non-adjustable. For lower power, or close range work, the transmitter may be operated with only one or two antenna sections; for full output, three are used.

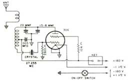
With the transmitter you get the tube, crystal, snap action key button with long cord, and the antenna.

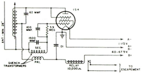
TRANSMITTER: Type 27X. Case size, less top handle and protuberances—6" x 7" x 12" high. One slide switch for A circuit. Two-pin jack for attaching key lead or meter (both plate and screen grid current will be shown at this jack). Weight with all batteries installed—about 14 lbs. Antenna held on two screws by wing nuts; it is three-section type 8' 9" assembled; 3' long when taken apart; aluminum tubing.

BATTERY COMPLEMENT: One 1½ V. A cell (Eveready 742 or equiv.), current drain, 220 ma. B supply, four batteries (Eveready 482 and several other types and makes will fit); drain when properly tuned, 20-25 ma.

RECEIVER: Type 27RH. Single hard tube circuit, with a single control only. Size overall—2⅞" x 1⅞" x 2⅜" high, with tube in socket. Weight with tube, cord and plug—4 oz. Relay adjustments are made by bending parts. Suggested antenna length—30". Relay connections made through cord and plug. Relay is SPST type.

BATTERY REQUIREMENTS: A—1½ V. at 100 ma. (Can be two pencells in parallel). B voltage may be from 60-67½ V. At 67½ V., idling current is about 2.8 ma., dropping to 1.5 ma. with strong signal. Relay is set to operate at 2.1 ma. and open at 1.4 ma. Lightest possible suggested battery complement—two pencells and two 30 V batteries—4 oz. Heavier batteries strongly recommended, if model can carry them.





ESCAPEMENT TRICKS

■ With all the talk and action these days on trimmable elevators, dual proportional control, and so on, a newcomer to R/C might think that escapements are on the way out. Well, they aren't, and we show here a few escapement tricks that will enable the thousands of users to get even more out of these universal gadgets.

In Fig. 1 is an arrangement used by Kenton H. Brenegan (16 Louise Rd., New Castle, Del.), whereby he can have the normal rudder action, plus engine two speed, all with a single two-arm escapement. Latter is mounted on a bulkhead, with rudder driven by a torque rod and loop over the escapement wheel drive pin. A second loop is placed over the pin, with a hinge fastened to side of fuselage; wire on other side of hinge has-

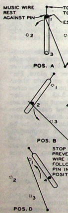


Fig. 2

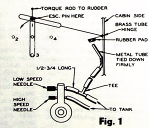


Fig. 1

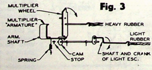
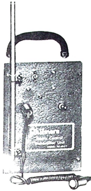
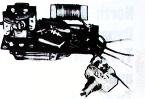


Fig. 3



PHILMORE



▪ Kit equipment intended for use on Citizen's Radio control frequency of 27.255 mc; F.C.C. blank for station license is included with kit. Transmitter is housed in gray hammertone finished case, with folding handle on top. Antenna held by two ceramic insulators on front panel. Circuit is similar to that of 1952 A.T. Annual transmitter, but a 13,627.5 crystal is utilized. Antenna coupling is fixed, and rather light; antenna is usual quarter-wave style. The single transmitter adjustment is very broad. As with most harmonic crystal oscillator circuits, it is possible to obtain output at higher than crystal frequency, when the tuning condenser is set at minimum; it is wise to follow instruction sheet recommendation to have frequency checked before putting transmitter into use.

There is plenty of room in the case for all batteries, and also room for a meter on the front panel, in case you wish to add one. All necessary holes are drilled in case and panel, as well as in tube bracket.

The key jack is of the closed circuit type; the unit will put out a signal with the key plug out of the jack, and the filament switch on. A O-50 ma. meter may be plugged into the jack to measure plate current.

The kit contains everything needed to finish the transmitter; you even get shaped wood blocks to hold the batteries in position. The antenna is a chrome-plated job that looks like an extra-long auto type. Parts are included for 5 ft. key cable.

The receiver is a standard gas tube unit, with Kurman relay attached to the chassis. Latter comes ready-drilled, is of 1/16" thick linen Bakelite. Tube is inserted in miniature socket, and held to chassis with rubber band. Circuit is intended for use with either RK61 or XFG-1 tubes.

Besides parts for receiver itself, kit includes toggle switch for A circuit, a miniature metal-cased rheostat, and a phono jack and two plugs (one for meter, one for shorting jack).

Wiring is made easy and neat, since chassis comes fitted with ten metal grommets that are used for interconnection, and for battery leads.

Separate instruction folders for each unit comprise four pages, with written general data, step-by-step assembly, and information on adjustment and operation. The receiver sheet includes several paragraphs on relay adjustment. There are also circuit diagrams, mounting drawings with actual wiring indicated, and in the case of the receiver, a drawing of connections to receiver accessories and escapement circuit.

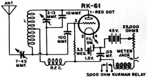
For those who require it, Philmore has available the rugged Super-Aerotrol escapement (Philmore part No. RCEU). There is a separate instruction sheet for the escapement, and another sheet carrying general information on R/C operation. If the kit builder has trouble getting his units to work properly, they may be returned to the Philmore Service Dept. for inspection and repair, provided units are constructed according to instructions. A charge of $3.00 is made for this service, plus cost of any new parts that may be required.

Specifications

Receiver #RC222R. Overall size about 2⅞" x 1⅞" x 1⅝" high. Weight with tube and built-in relay—2¼ oz. On-off switch and rheostat add another oz. Kit with tube, relay, $26.50.

Batteries: A—Two pencells (or larger) 1½ V. at 50 ma. B—Two 22½ V. units. Lightest recommended total—3½ oz. Idling current—1.6 ma.; with signal, about .1 ma.

PHILMORE RECEIVER

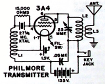


Adjustments: tuning condenser, antenna condenser. Plate series rheostat and meter jack mounted on model. On-off switch. Relay adjusted by bending parts.

Transmitter #RC222T. Size 5" x 6" x 9" high. Antenna is 4-section collapsible type 9'10" long (3½' long folded). Weight with batteries and ant.—11½ lb. Kit with tube, crystal, key button & lead, case, $33.50.

Batteries: A—one 1½ V. at 200 ma. (Burgess 4F or equiv.) and three 45 V. at 20 ma. (Burgess M30 or equiv.).

Controls: On-off filament switch, key jack on panel; latter also used to plug in test meter. Plate tank variable condenser shaft, & lock nut, panel screwdriver slot.



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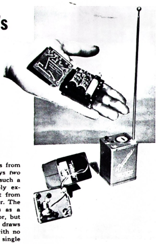
a rubber pad on the end, pad being adjusted to cover end of a tube, also attached to fuse side. The engine is fitted with dual needle valves, the high-speed valve attached direct to tank, low-speed valve with a Tee as shown.

Escapement positions are: 1—(as in drawing) neutral rudder-high speed; 2—right rudder-high speed; 3—neutral with low speed; 4—left rudder-high speed. Rubber pad is adjusted to close tube only in position 3. Kenton's sketch showed only a single needle valve on the engine; system would look just the same with this, but there would have to be a valve somewhere in the bleed line to control the amount of air bleed for the three high-speed positions. He would like to hear from readers who try this arrangement, and compare notes.

Fig. 2 is somewhat on the same lines, but is used by Keith A. Barrigar (1518 E. Caro Rd., Caro, Mich.) to work an elevator from his rudder escapement. Again, the rudder is operated by the usual torque rod and loop over escapement wheel pin; Keith wanted only up-elevator, so the torque rod for this surface has only a wire at the forward end—not a loop. Positions are: A—neutral rudder and elevator; B—right rudder with up-elevator; C—(not shown) neutral rudder with up-elevator; D—left rudder with neutral elevator. As seen in sketch for position B, the pin holds the elevator wire down the same amount for right rudder and the lower neutral. The elevator has a light wire spring bearing on the upper surface to push it downward, and a stop below to hold it in neutral. If you want up only in the lower neutral, you can get this action by moving the elevator torque rod pivot somewhat higher.

Many modelers have found that normal escapements have insufficient power to operate elevators (or even rudders) on large fast planes. Heavier rubber and more escapement voltage and spring tension help, but tend to hasten wear on the escapement parts. Frank Doty (Route 2, Chardon, Ohio) offers the scheme in Fig. 3 to take care of this. He calls it an "escapement multiplier." The primary escapement is at right, and we show only the shaft and crank arm of this one; it can be any (*Continued on page 75*) one that you may want to use, and requires only light rubber. Linked to the crank is another shaft with a small two-lobe cam on the end. This controls an "armature" for a second escapement wheel, and you can pile the rubber on this shaft. The multiplier would be useful also for boats and even in cars, since you can put all the power you want on it.

North American's Dynatrol Transmitter and Twin Tube Receiver



■ The Twin Tube receiver differs from most gas tubers in that it employs *two* such tubes, and utilizes them in such a way that their life is considerably extended over what you can expect from the normal single gas tube receiver. The first tube in the circuit operates as a regular super-regenerative oscillator, but the circuit values are such that it draws only about .5 ma. plate current with no signal, compared to 1.5 ma. in the single gas tubers.

The life of these tubes is dependent directly upon the plate current. The second tube acts solely as a relay tube. It runs at zero plate current except when a signal comes in, so it, too, may be expected to have very good life.

All components of the receiver, aside from the relay and current adjusting rheostat, are mounted on both sides of a printed-circuit plate. Five pins project from the underside, and make contact with five socket eyelets which are attached to a base plate. The latter is fastened into your model permanently; should the receiver need adjustment, you just pull it loose from the base plate—no leads need be unsoldered or broken.

The base plate has a variable resistor for setting the operating point of the oscillator tube, and thus adjusting overall operation of the receiver.

Tube leads are held in flea clips, with rubber bands to secure the bulbs. Tuning is by means of an iron-core inductance.

Receiver is sold less relay, but the range of current change is such that a wide variety of relays may be used, provided they are of proper resistance (5000-8000 ohms). The makers recommend the ½ oz. Neomatic relay, and sell one adjusted properly for the Twin Tube receiver. Shock mounting is not required for the receiver, though many users cement the base plate to sponge rubber, which in turn is cemented to the plane.

Receiver is also sold in kit form, and is extremely easy to assemble, since all "wiring" is already done for you, on the printed-circuit plate. All you have to do is solder the resistors, condensers, etc., into eyelets.

The kit is beautifully packaged, with all the small parts individually identified, to make things easy for the beginner. All parts, including the printed-circuit plate, may be purchased separately.

This type of receiver is very sensitive, not particularly fussy to adjust, nor critical as to antenna length.

Dynatrol transmitter also makes use of the printed-circuit principle, and by doing so, can be put into a very small case. The circuit is of the usual regenerative crystal-oscillator type, with a single pentode tube. All parts of the transmitter are attached to the top cover of the case, including meter, antenna insulator and key button. A regular single circuit jack is connected in parallel with the key, so that the user may employ a key on a long cord, if he wishes.

Even the tuning inductance is printed, being in the form of a flat spiral; capacitive coupling to the antenna is employed. Tuning is accomplished by means of a small screwdriver poked through a rubber grommet in the cover of the case; it is not necessary to use an insulated screwdriver.

All battery connections are made by snap fasteners. The transmitter comes with antenna, tube and crystal. If purchased in kit form, you get the printed circuit plate, case with all holes punched, antenna, meter, etc. Here again, wiring is simply a matter of inserting resistor and condenser leads through eyelets, and attaching the battery cable leads.

As with the receiver, parts are identified so that the builder does not have to know the radio color codes, to do the job correctly.

Instructions for both kit and assembled units are very complete, the former including many drawings and photos to show assembly steps and part location.

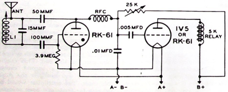
Specifications

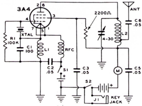
Transmitter: Dynatrol. Case size, less panel projections—4" x 3 5/16" x 5½" high. On-off slide switch for power, push-button to control signal. 3-section antenna, 16" long when collapsed, 40" when open. Uses single 3A4 tube and overtone-type crystal. Single tuning adjustment. B battery current meter on panel. Total weight, 3 lb.

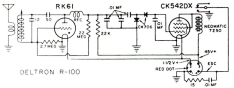
Battery requirements: One 1½ V. battery (Eveready #720 or equiv.), A current drain—200 ma. Two 67½ V. batteries (Eveready #457 or equiv.), B drain with antenna installed—22 ma.

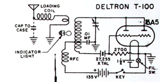
Receiver: Twin Tube. Overall size, including tubes and mounting plate; 2" x 2" x 1¼" high. Requires two RK61's. Adjustments for tuning and for oscillator plate current. Antenna length not critical. Weight including both tubes and the base plate, but less relay—1½ oz.

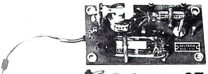
Battery requirements: Minimum sizes recommended; A—two pencells in parallel, 1½ V. at 100 ma. B—two 22½ V. batteries in series (Eveready 412 or equiv.), current drain with no signal—about .5 ma. With signal—2-2½ ma. Higher battery voltage may be used to keep older tubes in use longer.

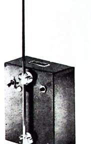












Deltron 27.255mc.

T-100 Transmitter and R-100 Receiver

An unusual two-tube lineup is utilized in the Deltron receiver, which, with the special coupling system between the tubes, assures very positive relay operation. It will be seen that a gas tube is in the first position, but the method of coupling it to the second tube is rather unusual. Unlike the normal two-tube receiver, where the second-position tube is fed an audio signal through a coupling condenser, here the output of the gas tube is rectified by a pair of diodes, and the second tube receives just a DC voltage on its grid. Resultant action is so positive that it is possible to eliminate the variable resistor always associated with gas tubes, the only control being for tuning.

A 27" length of flexible wire is supplied with the receiver, and the full length should always be used. If the builder prefers, a vertical music wire whip may be substituted, but the total length from set to antenna tip should be 27".

The makers do not show a milliammeter in the circuit, and suggest that tuning be accomplished with a pair of earphones; there are two terminals on the set for phone connections, and when the set is working correctly a strong steady hiss will be heard. If the hiss is unsteady or sputters, correction may be made by adjustment of the antenna coupling. Note that inductive coupling is used, and the antenna coil may be slid over quite a range.

The receiver was found to be extremely sensitive to weak signals, yet did not appear to overload on strong sigs.

The relay tube is a sub-miniature type drawing a filament current of only 15 ma. Both tubes are soldered to the chassis, and both have wire loops to hold them and take any strain off the leads. There are many little refinements to be found in the receiver. For example, the base is 3/32" thick linen bakelite; four corner holes are provided for mounting, with a smoothly-rolled eyelet in each. The power cable is tied firmly to the chassis, and terminates in a 4-prong plug; a matching socket is included. All components are firmly anchored, either to lugs on other receiver parts, or to eyelets in the base.

The relay is the tiny but rugged Neomatic, and on our set was found to be adjusted to close at .9 ma., and open at .5 ma. Thus a moderate signal will produce three times as much current as required to close the relay. The relay, incidentally, is a special model with spiral armature spring, rather than the flat spring as is found on the standard Neomatic relays.

Contained in a metallic blue finished case, the transmitter features an antenna loading system, to make sure that power *output* will be high. Plate tuning adjustment may be reached through a hole in the front panel, and was not found to be critical. A pilot bulb—located under the antenna for protection against breakage — glows every time key button is depressed. If you don't see the glow, you know attention is required, since it will shine only if the batteries are in good condition and the tube is oscillating. The transmitter was not put out of operation when the antenna was touched while the key was down, though output naturally dropped considerably.

Batteries sit in a row at the bottom of the case, and the latter is of such size that they are held snugly and require no clamps to keep them from rattling around. Connections are by snap fastener and plug, and the back of the case is removable by taking out four screws.

The Deltron equipment is sold only in finished form and cannot be had in make-it-yourself kits.

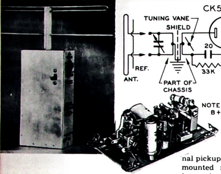
Specifications

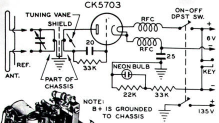
Transmitter: Model T-100, using single 3A5 tube (elements connected in parallel) and Petersen Z9A crystal. Case size, less projections—3x5x7". Toggle switch for A power, and snap-type push button for controlling signal. 4-section collapsible antenna projects 8¾" above case when folded, and 40" when open. Single tuning adjustment reached through hole under removable button on front panel. 60 ma. pilot bulb used as radiation indicator. Weight with all batteries—4 lbs., 4 oz.

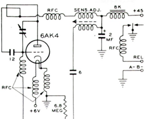
Battery requirements: One 1½ V battery for filaments (Eveready 742 or equivalent)—220 ma. drain. Two B bats. (Everyready 457 or equivalent), total of 135 V—drain with antenna extended, about 25 ma.

Receiver: Model R-100. Requires one Raytheon RK61 and one CK542-DX. Base size, 3x1⅝", about 2" thick over all projections. Weight with tubes, power cable and plug, 2.1 oz. Screw adjustment for tuning. Antenna coil may be moved, if operation is not satisfactory. 27" antenna has clip-on end. Relay has screw spring tension adjustment. Escapement connections made through power cable.

Battery requirements: Minimum sizes recommended, A—two pencells in parallel—1.5 V at 65 ma. B—two 22½ V units (Eveready 412 or equivalent) connected in series, 45 V. First tube idles at .5-.75 ma., drops to .1 ma. on signal. Second tube idles at zero, draws about 2.7 ma. on moderate signal. Batteries should be discarded when A drops to 1.3 V with the set on, and B drops to 40 V, with set turned on and signal tuned in.







CITIZEN-SHIP 465 MC. "CC" Transmitter & "AR" Receiver

■ This equipment is unique in the radio-controlled field, since it is the only line made for use in the "Citizen's" 465 mc. R/C spot. While operation in the field on this frequency is just about as easy as on 27¼, manufacture of the equipment is another matter—as is the fact that the transmitter has to pass strict F.C.C. regulations, especially as to frequency stability. Because of this requirement, the user is not allowed to do *any* maintenance work on the transmitter—not even to the extent of replacing a bad tube. He can, however, renew batteries as needed.

Since the Model AR receiver is the newest thing in this field, we will cover it here; note, however, that the older and larger Model CR is still being made, and is often preferred by those who don't object to its larger size and wish to operate their models at the greatest possible range.

Circuitwise, the two receivers are very much alike, the main difference being that the Model AR does not have the attached loop antenna. Because of this it is much more compact, and has, in fact, been fitted nicely in Half-A planes. No external antenna is needed with the AR, since the associated wiring to batteries and actuator or escapement provides all signal pickup needed. The AR may be mounted nicely by cementing a layer of sponge rubber to the bottom of the bakelite chassis, then cementing the other face of the rubber to a thin piece of plywood. It can also be suspended from the four corners by rubber bands; a small spring-type contact clip for battery and relay connections is mounted at each corner of the base.

The second main difference between the AR and CR receivers is that the former is equipped with a variable capacitor which makes it simple to touch up tuning at the field.

This type of receiver requires considerably more A battery power than those used in 27¼ mc., due to the fact that an entirely different sort of tube is necessary. Even so, it has been found practical to use various combinations or four or five 1.5 V. cells, as explained at length in the instruction booklet. To balance the higher A drain, the receiver is extremely economical on B batteries, and the smallest hearing aid units will give very good life.

The plate current change of both Citizen-Ship 465 mc. receivers is about the same, regardless of signal strength, so it is not necessary to make repeated long distance range checks. The transmitter puts out very little signal when the antenna is removed, and therefore makes an excellent test signal source for tuning the receiver. Detailed steps on such tuning are included in the accompanying instructions.

While it is illegal to tamper with the transmitter in any way, we give the circuit here, since it is of real interest to the electronically-minded modelers. Because of the stringent stability requirements, the Model CC transmitter has features not seen in any other R/C transmitters. It utilizes a "faraday shield" between the tuning inductance and the antenna loop to reduce detuning effect, should the antenna be held too near a conducting surface. Also, there is a built-in temperature compensator. Both the tuned circuit and antenna loop are formed by punching out part of the metal chassis, and because of this, the tuned circuit—and B plus—are grounded to case.

The neon lamp on the case is a valuable check on the condition of the B batteries; it will light as long as they are strong enough to work the transmitter reliably.

It should be noted that 465 mc. equipment is increasingly useful nowadays, when every day sees more and more modelers beginning operation on the 27¼ mc. R/C spot; there is no interference between the two, incidentally, and receivers on the two R/C spot frequencies may be operated in the same model simultaneously.

Transmitter: Model CC. Case size 9 x 4 x 2¾". Antenna projects 4" from top of case and is 12¼" wide; must be pointed at the model to get maximum range. On-off toggle switch for batteries, snap-type push-button for signal. Neon indicator pilot lamp. Batteries fit snugly in own compartment, attach by plug and snap clips. Unit takes about one min. to warm up ready for use. Weight with batts. and antenna—4 lbs. Battery complement: B battery—two 67½ V. units (Eveready 467 or equiv.), 135 V. at about 20 ma. with signal on. A battery—one 6 V. unit (Eveready 744 or equiv.), 200 ma. at 6 V.

Receiver: Model AR. Overall size about 4 x 1¾ x 2⅛" wide. Weighs about 4.1 oz., has Sigma 4F relay. Tube soldered in place. Adjustments for RF tuning and quench frequency; latter controls sensitivity. No antenna of any sort required. Relay set to operate at about .5 ma. and open at .4 ma. Heater-type tube takes half minute or so to warm up thoroughly. Battery complement: lightest recommended batteries are four penlite cells for A supply, 6 V. at 150 ma. Five pencells in series will give considerably longer service—will not harm tube. B battery—two 22½ V. units (Eveready 412 or equiv.), 45 V., idling current is .25-3 ma. With signal, current is .9-1.3 ma. Lightest set of batteries weighs 5¾ oz.

R/C Combo Meter

(Continued from pg. 6)

R2. The resistors R1 and R2 in the FSM shown are the ordinary ½ W. carbon variety, but they were carefully picked for correct value. If you don't have access to a quantity of these resistors, you can purchase what are known as "carbon film" resistors, which come in 1% tolerance, and are inexpensive. Ohmite Carbofilm type CP-½ will do nicely.

The milliampere shunt resistors R3 and R4 must be home made, since you can't purchase resistors close enough for this purpose. The approximate values are given on the diagram, but the only way to get them accurate is to connect the unit up to a meter of known accuracy, and calibrate by clipping the resistance wire to exact length. The sketch shows how this is done. Always disconnect the battery before adjusting the resistor. When the proper length of resistance wire has been found, it may be soldered to a couple of lugs or clamped in small binding posts. If a different make of meter from that specified in the parts list is used, these resistors may have to be of considerably different value. Resistance wire for them can be taken from old radio wire wound rheostats.

For field strength use (which simply means measuring the power your transmitter puts out into the air) a small antenna is required. Two feet of 3/64" music wire was used here, soldered into a banana plug from the BC-366. The longer the antenna, the higher the meter will read. However, there isn't much use in making it more than four feet long, and even two will give good readings from a properly adjusted transmitter, at a distance of 10 feet. As an example, the meter went to midscale, when placed on the ground about 12 ft. from the Mac-II transmitter; the same distance from a 3A4 triode job gave about a quarter scale reading. It is, however, much more reliable to use an antenna long enough to get a good reading ten feet or so away, rather than a very short one, with the FSM placed right next to the transmitter.

The meter will read higher if it is setting upon some metallic surface, such as a car hood. If you make it a practice to put it on the car, you can check the transmitter each time you set it up, noting if the FSM meter reads about the same. If it doesn't (and the meter is the same distance away), the transmitter might not be loaded up correctly, the batteries a bit low, etc.

To get a fairly close check on the transmitter frequency, always use the same length of antenna in the FSM, and put it in the same location; it is probably best to hold it in your hand for this test, since you will want to turn the tuning knob anyhow. Different locations (on a car hood, for example) and different antenna lengths will change the tuning a bit.

When you first put the FSM into operation, it will be necessary to adjust the coil core to the right spot. Set the condenser knob to mid-scale, and move the core till your transmitter signal shows maximum reading. With the components given, the tuning range is actually about 2 mc.; you could calibrate the condenser to cover the ham 10 and 11 meter bands, as well as the 27.255 mc. spot, if you want.

Just a note on testing dry cells; it proves very little to check them with a meter as sensitive as this one, unless they are loaded. The best way is to test them with the transmitter or receiver turned on; you then can see what the voltage is, under the actual operating conditions. Sometimes this is not convenient, though. It is quite practical to install "built-in loads" for the voltage ranges. The connections are shown dotted in the diagram.

The load resistors, R5 and R6, must be compromise values, since many different types of cells and batteries will be checked. The values shown for these resistors will give a full-scale drain of about 500 ma. on the 5V. range, and 50 ma. on the high range; thus, you would have a drain of around 150 ma. on a 1½ V. cell, and 45 ma. on a 45 V. battery. This will serve quite well for all the normally used sizes of batteries. A switch could be installed to cut out the "load resistors," if desired. Ordinary 2 W. carbon resistors will do the job.

When using this instrument to check the plate current of a receiver mounted in a plane, the meter should be off the ground (put it on the plane itself, if possible) and the shortest possible leads employed. Long leads, and capacity of the meter case to ground, might upset the tuning and loading of the receiver; you could thus get an entirely different action when the meter and its leads were removed from the plane. Connection arrangements are up to the individual. One neat way to solve the above problem is to put a plug on the meter case, and hang the whole meter on the plane test jack. This won't do for Half-A jobs, of course! For battery testing, an ordinary plug with a couple of leads ending in test clips are handy.

You will doubtless find more uses for this handy gadget as you use it. Since the switch that comes in the BC366 has only five positions, we are limited to that number of meter ranges. It is possible to shift the unused contacts around (or you could buy another switch) to get other combinations, if you feel they are needed.

Parts List

Case—surplus BC-366, Electronic Specialty Supply Co. M-500 microampere 2" square meter, Electronic Specialty Supply Co. L—slug tuned coil, Electronic Specialty Supply Co. C1—15 mmf. midget variable condenser, Bud LC-2706 or equiv. C2—30 mmf. mica or ceramic. C3—500 mmf. mica or ceramic. SW1—5 position, two circuit rotary switch, comes in BC-366. J—single circuit jack, comes in BC-366. R1—Precision carbon resistor, 10,000 ohms. R2—precision carbon resistor, 100,000 ohms. R3, R4—must be home made. R5—1000 ohm 2 W. carbon. R6—10 ohm 2 W. carbon. SW2—single pole, single throw slide type. RECT.—Raytheon CK705 germanium rectifier. Two knobs, material for desired test leads.

Motor and Auxiliary Controls

(Continued from pg. 11)

like the "battery-condenser" system used to fire flashbulbs. In the normal position shown, the relay connects a large condenser C in series with a battery, and the condenser charges up to full battery voltage. When the relay operates, the full charge is applied to the escapement, which really bangs closed; it just gets a pulse, though, and will not stay in the closed position. The values shown worked well with an E.D. Compact escapement, which has a coil of about 10.5 ohms. The escapement was set so it required 8½ V. of D.C. to work it, when loaded with a fully wound loop of ⅛" flat rubber.

Advantages of the condenser-discharge system are that it is very easy on relay contacts, closes the escapement with a real bang (so fast that it is often unnecessary to have two stops on the escapement armature—the latter closes and opens so fast that only a single stop is needed) for reliable operation against heavy spring tension, and a very light battery will do the job. R limits the charging current to the condenser; the larger it is, the slower is the charging and the longer you have to wait between operations, but the lower the battery drain.

Now, how about extra controls from a proportional rudder system? One way, which can be added to an existing setup without having to change the pulser, is to add a pair of contacts to the actuator, set so that when the arm is in either extreme position the points *do not* close. Reason for the latter is that we do not want the auxiliary circuit to be tripped, when the plane is being held in a tight turn, with rudder full over. It will be found that most proportional control actuators "overtravel" at each extreme of movement, provided the stops are set correctly to allow this.

When the control stick is moved rapidly from one extreme to the other, the arm will pass the normal full turn position each way, and the contacts are set to utilize this overtravel. They only close when the rudder is flapped from one extreme to the other. A relay circuit like that in Fig. 8 is then connected to the contacts, and the relay will close when the control lever has been given a sufficient number of full-limit movements. Since this is done quickly, the plane will not respond, but will continue on a straight course. If the actuator and linkage are very light, it may be necessary to add a little weight so that they will swing wider, when the rudder is thrown from one side to the other.

Some actuators, such as the Trammel described in the January, 1954, issue of A.T. swing practically a full 180 degrees from one limit to the other, and the contacts would necessarily close whenever a full limit turn to either side was made. This necessitates a different contact arrangement, so the auxiliary circuit will not be closed on continuous sharp turns, but only when the rudder is "flapped." In this case, the contact that the actuator arm hits should be rather heavy and stiff, and will act as the normal stop for the arm. The contacts only close—and then just for a pulse—when the arm swings fast from side to side; if these pulses come rapidly enough, the relay will operate.

Proportional control offers a fine means of getting another control function, through "rate control." This means simply that the pulses are speeded up or slowed down, but the proportion of on-to-off remains constant, so the rudder position does not shift. It is usually necessary to at least double the speed of the pulses, to be able to work the auxiliary circuit, and it is safer to triple the speed. The circuit of Fig. 13 is needed to close the second relay, and functions only on the pulses it receives as the actuator circuit is opened and closed; no current flows in Ry 2 when the actuator circuit is passive. Pulses from the actuator are stepped up through the transformer and put through the rectifier. The resultant DC is then applied to C and the relay.

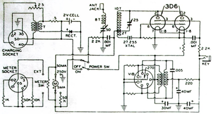
This circuit requires a good relay, since there is always some current flowing, produced by the continuous pulsing of the rudder actuator (current stops only when rudder movement stops) and the higher pulse rate simply increases this current. In other words, the relay has to be set up to a close "differential"—the values of current that operate it and allow it to open are very close together. This is another reason why the pulse rate should preferably be tripled, for auxiliary control operation.

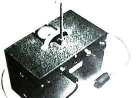
If you can't get the amount of current from Fig. 13 that you would like, to work the relay, try Fig. 14. Here a transistor is used as a current "booster," and will produce up to about ten times the current through the relay that can be had without it. Fig. 14 has been used with a midget relay of 1200 ohms, but the 4 ma. current available for the relay is ample for reliable operation, even under conditions of heavy vibration.

We won't go into means to get the pulse rate variation here, but the list of references gives several ways this can be done. The list also will bring to the attention of the reader other items on this subject of auxiliary controls, in past issues of A.T. And when we speak of such control, remember that we don't mean just motor speed change; most of the systems can be adapted to elevator operation, bomb dropping, flaps, or whatever else you want to work on the plane, while sticking to single channel rudder actuation.

References: (all in past issues of A.T., mostly in R/C Column): Sept. 1951 p. 12—Motor and rudder from single receiver relay. Dec. 1951, p. 9—Escapement operation booster. Feb. 1952, p. 10—Delay relay and bomb dropper. July 1952, p. 38—Desc. of all sorts of escapements. Sept. 1952, p. 10—Relay pulsers, showing means for pulse rate change. Oct. 1952, p. 47—Thermal delay unit. Dec. 1952, p. 60—Getting added control from proportional control system. Feb. 1953, p. 10—Getting added control from proportional control system. May 1953, p. 10—Second control with 3-arm escapement. June 1953, p. 8—Dual control with proportional system. Nov. 1953, p. 50—3-arm escapement for rudder and motor.

TRANSMITTER





ESSCO'S "27¼"

■ The Model DHT two tube receiver of this combination utilizes a first tube circuit identical to that of the Mini-Mac, but with the relay shifted to the second tube plate circuit. The first tube is tuned up exactly as is the Mini-Mac or Simple-Single receiver, and it *must* be operating properly before a check is made of the second tube current; when adjusted correctly, V1 will idle at about .7 to .8 ma., and this will drop to around .4 ma. with signal. The two tubes are arranged in what is known as a "direct-coupled" circuit, and a variable resistor is used to adjust the operating point of the second tube, after the oscillator is working properly. This resistor is simply set so that V2 draws zero plate current, when the V1 is idling. Depending upon relay and battery voltage, V-2 will draw from 2-3 ma.; as a typical case, fitted with the Kurman 5000 ohm relay, seen in the illustration, and with 22½ V. B batteries, V2 will go from zero to about 2.5 ma. on signal.

This circuit, a development by Paul Runge, gives very positive action, and has the advantage that the two hard tubes will have an almost indefinite life. MPC-1 or 1AG4 tubes may be used in either position, while a CK526 will also work well as V1, and give a little lower A and B battery drains.

Once the variable resistor is set it will seldom have to be touched again. The sensitivity control is a variable trimmer condenser while tuning is accomplished by a slug-tuned coil. These two controls do not interlock noticeably. Since the circuit is based upon a single hard-tuber, some care must be taken in making the sensitivity adjustment. Also the antenna length specified in the instructions—20-24"—should not be exceeded. The receiver gives the usual advantages of the single hard-tuber, plus the added advantage of extremely positive relay action; any of a number of different relays may be used, running from 5,000 to 10,000 ohms. 30 V. may be used at B2, if higher relay current is desired.

It will be noticed that a very unusual connection is needed for B1 and B2, which are *not* simply hooked in series. Actually, B1 and B2 are both used for V1, while B2 supplies only V2. A good 3 or 5 ma. meter will suffice for making checks on both tubes.

Though not shown in the photo, the set is supplied with a second bakelite plate of the same size as the chassis; the two are fastened together with spacers and screws, and the lower plate may be cemented to sponge rubber, if this type of mounting is desired. Otherwise, the usual wire hook and rubber band suspension may be used, without the second plate.

The Model DHT may be had finished and tested, with any of several different relays, finished but less relay, or in kit form.

The ESSCO Model RCX HP II transmitter is a most complete storage cell operated transmitter, contained in a black crackle-finish case. The basic transmitter and power supply circuits are very much like those of the Mac II, and the maximum power input is about the same—very close to 5 watts. All RF parts of the transmitter are on a small chassis, with holes in the front of the case to reach the two variable condensers. The single 2 V. storage cell is strapped down at one end of the case, and there are openings to reach the filling hole of the cell, and to observe the built-in hydrometer—the latter serving, of course, to show how much charge is in the cell.

Charging of the cell is made easy, by the inclusion in the case of two separate charging systems. Both are reached by making connections to the 6-prong charging socket on the rear of the case. When the 110 V. charging lead is inserted in this socket, it makes connections to transformer T, while the other charging lead allows use of a 6 V. storage battery for charging. Power for heating glow plugs may also be obtained from this socket; some plugs can take only 1.5 V., and 1 and 3 will supply this. If you want the full two volts, connect to 5 and 3.

Another feature of this transmitter is the metering circuit, basis of which is a high grade 5 ma. meter. When the meter switch is in the position shown on the diagram, the meter is connected as a 50 ma. unit, to measure the transmitter plate current. In the left position, the meter is entirely disconnected from the transmitter, and by connecting to the proper terminals of the meter socket, can be used as a 0-5 V. meter (terms. 1 & 2), 0-50 V. (1 & 8), 0-250 V. (1 & 4), or a 0-5 ma. meter (1 & 5). In the right hand position the meter switch allows checking the high voltage of the transmitter power supply, with a scale range of 0-250 V.

This transmitter is available only as a finished and tested unit, although the RF unit may be had separately in kit or finished form. The outfit is complete, with storage cell, crystal and tubes, antenna, snap-action key on 8' cord, and 110 V. and 6 V. charging cables.

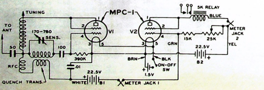
Transmitter Specifications: Model RCX HP II, using two 3D6 tubes and Petersen Z9A crystal. Case size less projections, 5 x 6 x 9". Toggle switch for power ON-OFF, jack for key plug, 3-position rotary switch for meter. 3-section screw-together antenna is 9½' long, 38" long when taken apart. Tuned antenna coupling allows proper loading on all sorts of surfaces. Built-in chargers for 110 V. AC or 6 V.

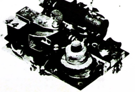
DC. Meter may be used for checking external circuits (or transmitter). At maximum loading, transmitter runs at 30 ma. and 160 V., or 4.8 W. Weight less antenna—13 lbs.

Receiver Specifications: Model DHT; supplied with two MPC-1 tubes. Base size 2½x1¾", overall height (including second base) 1⅝". Weight with tubes and Kurman relay—2.9 oz. Screw adjustments for tuning and sensitivity, variable resistor to set second tube plate current. 6-lead power cable does not include relay contact connections. 20-24" ant. recom.

Battery Requirements **(using two MPC-1 tubes): A—two pencells in parallel—1.5 V at 80 ma. B—two 22½ V. batteries (Eveready 412 or equiv.), *not* series connected. See text for current drains.**

RECEIVER





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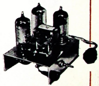
Group 454A...... 50¢

"WAG" Dr. Walter A. Good's sensational new and long-awaited radio control high-wing monoplane for rudder or rudder-elevator-engine control. Spans 5 feet, has 4.5 sq. ft. wing area. Wing loading 1 lb./sq. ft. Fuselage 43 inch overall. Power is Forster .29 or equivalent.



WALT GOOD'S RECEIVER

Group 554A...... 35¢

WALT GOOD'S Non-Selective 3-tube 27 mc. audio receiver for radio control use. Dr. Good's latest effort in the R/C field. Full-size patterns and helpful photos plus circuits.

MAC II Hi-Power 5-Watt Transmitter by Howard McEntee. Full size chassis drawings and all data for duplicating Mac's famous top-power xmtr.

MINI-MAC Hard-Tuber by Howard McEntee. Simplest thing in non-gas type receivers by the old master himself. Utilizes sub-miniature CK526AX tube.

OBEE

Group 654A...... 50¢

OBEE is ultra simple, very appealing sea-sled type of cabin cruiser for powering with the new glow plug outboard motor, or by inboard electric, ignition, diesel or glow plug power plant. Especially good for radio control. Easiest possible construction. Length, 18½"; beam, 7"; height, 5½".

GOOD'S XTAL XMTR is 27.255 tone transmitter by Dr. Walter A. Good for use with this noted authority's non-selective audio receiver. Plans give full size chassis pattern, etc., plus the designer's comments and technical notes.

OVER AND UNDER

Group 754A...... 50¢

OVER AND UNDER - Harold deBolt's amazing symmetrical wing stunt radio control plane. Uses .19 to .23 engines; spans 65½ inches; has 45" fuselage. Was a sensation at the last National meet with its full stunt pattern.

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