

# MULTI- SERVOS

POWERFUL-DEPENDABLE  
R/C ACTUATORS

*The Heart of Your  
Radio Controlled Model!*

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INSTRUCTIONS FOR USE WITH  
MODEL 5PN, MCR AND  
MCE SERVOS

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DeBolt Model Engineering Co.  
WILLIAMSVILLE, N. Y.

**Your  
Introduction  
TO THE  
MODEL 5PN  
MULTI-SERVO**



## **YOUR INTRODUCTION TO THE MODEL 5PN MULTI-SERVO**

The model 5PN servo has been developed especially for use with electric motor powered model boats and vehicles. It provides selective steering plus forward, reverse and off motor speeds while using only a simple single channel radio.

Multi-Servos are powerful motor driven actuators for operating the controls of model airplanes, boats and vehicles through a radio receiver or any other device which provides a relay. They come in several different types to provide the special sorts of control action needed with the various models; the 5PN is particularly suited to boats and cars. These servos operate with any ordinary radio control equipment and require no special radio gear or accessories. They operate through a combination of electrical circuits and use both contacts of the radio receiver relay to switch their circuits. They may be used with other types of selectors when desired. All of the Multi-Servos provide more than ample power to move any model control or mechanism and will withstand all normal abuse while maintaining perfect operation. These servos require the very minimum of batteries to operate and yet provide exceptionally long battery life. No special mounting is required, they may be fastened to any part of the model. All Multi-Servos are unconditionally guaranteed

against defects in materials and workmanship for a period of 90 days, under normal use and conditions.

### DESCRIPTION OF THE MODEL 5PN MULTI-SERVO . . . .

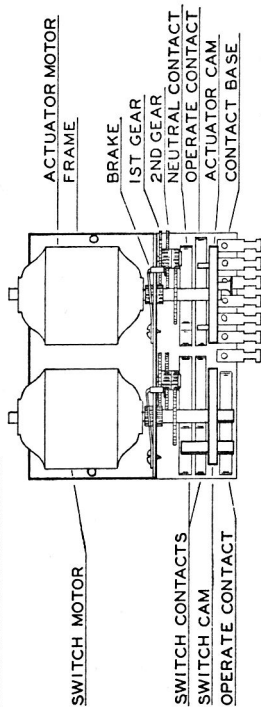
The parts of the 5PN servo are shown on Diagram No. 1. There are two sections to it, the actuator section and the switch section. Each has a separate motor and set of contacts. The actuator section operates the steering of the craft, it also operates the switching section when it is desired to change the motor speed. The switching section controls the motor used to power the craft.

On the actuator section the neutral contact controls a circuit which causes the servo to neutralize from any position. The motor also runs from position to position through this contact while you are pulsing for the position. The operate contact starts the servo and causes it to stop in the desired position. It also controls the 3rd circuit which causes the switching section to operate.

On the switch section the operate contact is the one which indexes the switch cam. When the 3rd circuit of the actuator section is closed momentarily it causes the switch motor to start, once it is started the switch operate contact closes and it will then run the motor until the next position comes up. At this point the operate switch opens and if the actuator has been allowed to return to neutral the switch motor will stop. The switch contacts

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DIAGRAM NO. 1. 5PN SERVO.



(5)

control the direction of the motor used for power. When both contacts are up the motor will run in one direction, when both contacts are down the motor will run in the opposite direction. When one switch contact is down and one is up the motor will stop.

The brake on the servo's motors is to maintain a constant speed for the servo. It keeps the cam from overrunning and controls the indexing of the cams. This indexing is also controlled by the timing of the contacts opening and closing.

All Multi-Servos come to you completely adjusted and tested, they should require no adjusting by you for at least several hundred thousand operations. If you think that the servo is not operating correctly the first thing to do is to **CHECK ALL BATTERIES** under a load before you touch anything! Then remember that the servo was operating correctly when it left the factory, recheck everything you have done since obtaining it and if the trouble should persist return it to the factory before anything serious can happen.

The factory provides a 24 hour service for your convenience. If you should return a servo for service inclose \$2.00 to cover the service charge and postage. If your trouble is covered by the warranty, your \$2 will be returned, if it has been damaged it will be returned in first class condition with an additional charge for all parts used C. O. D.

(6)

## INSTRUCTIONS FOR USING THE MODEL 5PN MULTI-SERVO . . . .

### Mounting the Servo . . . .

#### Diagram No. 2

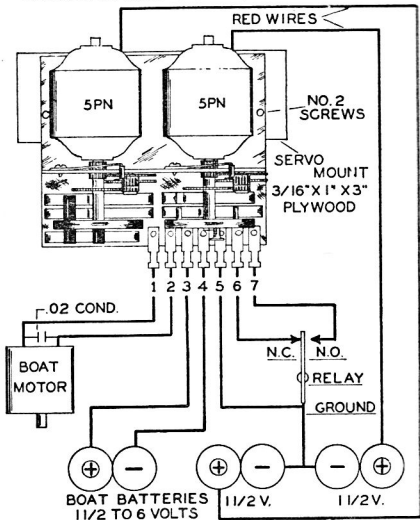
The servo should be mounted on a piece of  $\frac{3}{8}$ "x1"x3" plywood or hardwood using two No. 2"x $\frac{1}{4}$ " wood screws. When mounting be sure that the contact base of the servo does not touch any part of the model which could exert pressure on it. The wooden mount may then be cemented to the most convenient part of the model. With boats particular attention should be used to be sure that the servo is well insulated from water or water spray, moisture can cause malfunctioning of the servo. The actuator cam of the servo is connected to the rudder or wheels through  $\frac{1}{8}$ " wire push rods and a compensator as shown in Diagram No. 3.

### BATTERY REQUIREMENTS FOR THE 5PN MULTI-SERVO . . . .

The 5PN servo operates on  $1\frac{1}{2}$  volts, never more. It requires two sets of batteries for its operation at  $1\frac{1}{2}$  volts each. The batteries should be changed when the voltage has dropped to minimum of  $1\frac{1}{4}$  volts for either set, the minimum battery supply will give approximately 5000 operations of the servo. The minimum battery supply is 2 sets of 2 pen cells, total 4 pen cells. The servo is divided into two sections, the actuator section and the switching section. One set of batteries is required for each section. If long periods of

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## DIAGRAM NO. 2 5PN SERVO WIRING

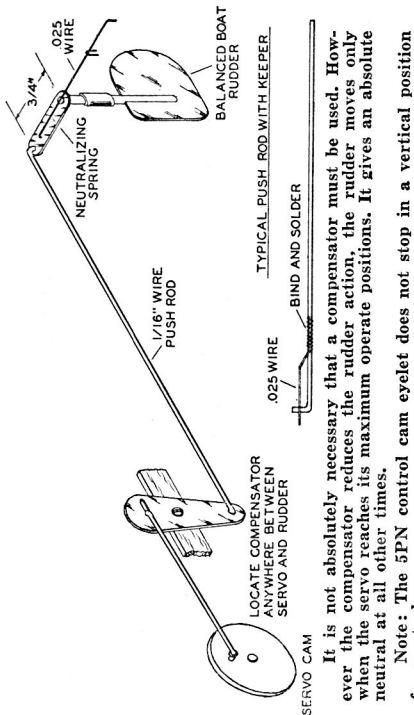


- SERVO TERMINAL CONNECTIONS**
1. Boat Motor terminal.
  2. Boat Motor terminal.
  3. Boat Motor battery.
  4. Boat Motor battery.
  5. Receiver relay ground or common terminal.
  6. Receiver relay normally closed contact.
  7. Receiver relay normally open contact.

One red wire goes to one set of servo batteries positive.

The other red wire goes to the 2nd set of servo batteries positive.

## DIAGRAM NO. 3 5PN CONTROL HOOK-UP



It is not absolutely necessary that a compensator must be used. However the compensator reduces the rudder action, the rudder moves only when the servo reaches its maximum operate positions. It gives an absolute neutral at all other times.

**Note:** The 5PN control cam eyelet does not stop in a vertical position for neutral.

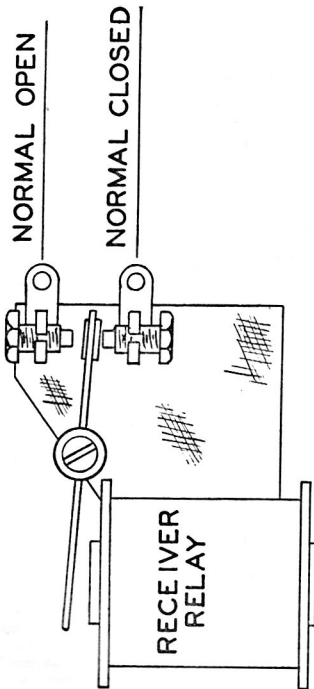
operation are desired heavier batteries may be used of course, the more batteries you use the longer the life and the better will be your servos operation.

### WIRING THE MODEL 5PN MULTI-SERVO, DIAGRAM NO. 2 . . . .

In figure No. 4, a typical receiver relay is shown. The servo is wired to it for operation. In wiring the servo we will consider the relay points to be normally open and normally closed, as labeled. With your radio the normally closed relay point is the one which is closed with the receiver turned on and while no signal is being sent by the transmitter. The normally open point is the one which closes when you signal with the transmitter. You may refer to diagram No. 2 for the servo wiring.

1. Take 2 pen cells and connect them together, positive to positive and negative to negative, you will have  $1\frac{1}{2}$  volts. A second set of batteries exactly the same is also needed.
2. Connect the negative side of both sets of batteries together.
3. Connect this common negative to the ground or armature connection of your relay.
4. Connect the red wire from the motor on the actuator section of the servo to one set of batteries positive.
5. Connect the red wire from the motor on the switch section of the servo to the remaining set of batteries positive.

(10)



(11)

FIGURE NO. 4

6. Connect terminal No. 5 on the servo contact base to the ground or armature terminal of your relay, same terminal as in step No. 3.
7. Connect terminal No. 6 on the servo contact base to the normally closed relay contact.
8. Connect terminal No. 7 on the servo contact base to the normally open relay contact.

### **BABCOCK MODEL BCR-3 SINGLE CHANNEL RECEIVER . . .**

These are special instructions for using the model 5PN Multi-Servo with the Babcock BCR-3 receiver. These instructions have been furnished by Babcock Radio Engineering.

Remove the case of the receiver. A wire is then soldered to terminal No. 5 of the relay socket and brought out of the receiver through a new hole with a grommet to prevent chafe. This wire is then the normally closed contact of the relay. Pin No. 6 of the CONNECTOR PLUG is the normally open contact of the relay. Pin No. 7 of the CONNECTOR PLUG is the armature of the relay or relay ground. With this information the regular servo wiring instructions may be followed.

The servo is now ready to operate. Terminals 1 thru 4 on the servo contact base are the boat motor and its battery connections.

9. A .02 ceramic condenser should be used across the brush terminals of your boat motor to reduce radio interference.

10. Connect the two wires coming from your boat motor to terminals No. 1 and 2 on the servo contact base, it makes no difference which wire goes to which terminal.
11. Connect the positive boat battery wire to terminal No. 3 on the servo contact base.
12. Connect the negative boat battery wire to terminal No. 4 on the servo contact base.

When you have operated the servo and checked the switching, if your boat motor should run in reverse when you switch from off to forward speed the battery connections at terminals No. 3 and 4 must be reversed to obtain the proper polarity for your particular motor.

A good quality No. 22 insulated stranded hook up wire should be used for all servo connections. Be sure to check all wiring carefully, improper wiring may damage your servo! Under no circumstances should you turn the servo's cams by hand! You may damage the cam or the servo contacts causing the servo to malfunction!

### **OPERATING THE MODEL 5PN MULTI-SERVO . . .**

Multi-Servos operate by keying the transmitter with a series of pulses. When no pulses are being sent, the servo automatically neutralizes itself. To hold the control position selected, it is only necessary to keep the transmitter key depressed.



The servo uses no battery current while in any control position, it uses current only while running from position to position. It is possible to key the transmitter **too fast** but almost impossible to key it too slowly, hence, it is advisable to key slowly until you have become familiar with the pulse pace required. You will find this pace to be normal to your physical reactions and very simple to follow.

To control the direction of the craft you depress the transmitter key once and hold it depressed. Upon release the servo will neutralize the control. Anytime that you key once and hold you will get the same action. To get the opposite control direction you depress the key once, release and depress it again holding it down this time. Thus anytime that you key or pulse twice holding the key down on the second pulse you will get this same control direction.

To start the craft's motor or to change it, you use a similar pulse sequence, but with a 3rd pulse added. Thus if you key once, release, key again and hold momentarily and follow this 2nd release with a short pulse, the switch will change. In other words you should pulse twice, hold, then release and pulse quickly again without holding.

Considering that the motor is in the off position, the first time that you signal for a change, the motor will start in a forward direction and run until you signal for a change. The next change will be to the reverse direction where it will continue

to run as before. The next change is to the off motor position. The motor will not change from the position it is in unless you definitely signal for it with the series of 3 pulses as described.

It is of course advisable that you should practise the pulsing of the servo at home before actually operating your craft, a little bit of familiarity with the system can be a great help and of course make your sport that much more enjoyable.

### MODEL 5PN MULTI-SERVO PARTS AND PRICE LIST

| Part No. | Description                                       | Price  |
|----------|---|--------|
| MS-1     | —Servo motor with condenser and pinion gear ..... | \$2.75 |
| MS-2     | —Servo motor condenser .....                      | .50    |
| MS-4     | —First gear and pinion .....                      | .25    |
| MS-5     | —2nd gear and pinion .....                        | .25    |
| MS-6     | —First pinion shaft .....                         | .25    |
| MS-7     | —2nd pinion shaft .....                           | .25    |
| MS-9     | —Actuator cam and main shaft with gear .....      | 4.00   |
| MS-20    | —Switch cam and main shaft with gear .....        | 4.00   |
| MS-12    | —Main inner cam shaft .....                       | .35    |
| MS-13    | —Brake assembly .....                             | .25    |
| MS-21    | —Set of servo screws .....                        | .50    |
| MS-22    | —Servo frame .....                                | 4.00   |
| MS-23    | —Contact base with contacts and terminals .....   | 9.75   |
| MS-24    | —Servo instruction booklet .....                  | .75    |

**Your Introduction to  
THE MODEL MC  
MULTI-SERVOS**

**IMPORTANT**

There is an error in the following instructions for the Model MC-Servos.

To correct it, do this: Wherever the instructions or a diagram mentions the normally CLOSED relay contact, change the wording so as to read normally OPEN.

Next, change the wording to normally CLOSED wherever the instructions now read normally OPEN.

The instructions will then be correct.

**Your  
Introduction  
TO THE  
MODEL MC  
MULTI-SERVOS**

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## YOUR INTRODUCTION TO THE MODEL MC MULTI-SERVOS . . . .

The Model MC Multi-Servos have been developed to fill the need for an extremely reliable servo to use with multi-channel type radio equipment. In as much as they are for use with multi-channel equipment they require two relays to operate each servo. The advantage being that you have instantaneous action in any direction that is both fast and extremely powerful.

The Model MC Multi-Servos come in two models, the MCR and the MCE. Both models are basically the same except for operation. The model MCR servo provides two control positions and self-neutralizes from any position to an absolute neutral. This servo may also be pulsed in either direction to obtain a proportional type turn. The model MCR is intended for use as a rudder control servo.

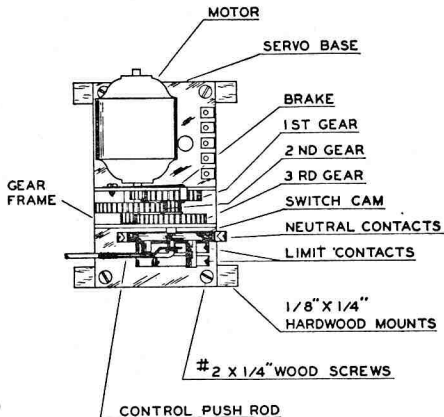
The Model MCE servo differs from the MCR in that it self-centers and can be trimmed through an arc 5 degrees each side of dead neutral. This servo is intended for use as an elevator control servo as it provides full control in both directions, self-centers and yet it is trimmable.

### DESCRIPTION OF THE MODEL MC MULTI-SERVOS . . . .

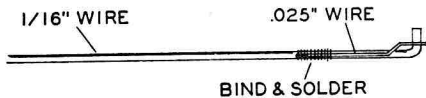
The parts of the MC servos are shown in diagram No. 6. It is composed of three units, the servo base, the gear train and the motor. The motor runs both to the

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DIAGRAM NO. 6 MCR and MCE SERVOS



PUSH ROD END WITH KEEPER



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right and to the left as commanded so you have two sets of neutralizing contacts and two sets of limit switches. When one of the receiver relays is closed it completes a circuit through the corresponding limit switch causing the servo to run in that direction until the cam opens the limit switch; the servo will stay in that position as long as the relay is held closed. When the cam moved from neutral it closed the corresponding neutralizing switch which is wired through the opposite contact of the relay, this contact opened and broke the circuit when the command was sent to move the servo from neutral. If the relay is allowed to open (release the command) it closes the contact through which the neutral circuit is wired and the servo will run back to neutral where the neutralizing switch opens and causes the motor to stop. This same action occurs whenever the 2nd relay is used except that the servo moves in an opposite direction.

To obtain the specific type of action provided by the model MCR or the Model MCE a difference is made in the adjusting of the switches. Adjusted one way you have a MCR type servo, adjusted another way you have the MCE type servo. The only difference in the two is the way they operate. The brake on the servo motor keeps the servo from overrunning and at the same time it maintains a constant servo speed over a wide range of battery voltages.

All Multi-Servos come to you completely adjusted and tested, they should require no adjusting by you for at least several hundred thousand operations. If

you think that the servo is not operating correctly the first thing to do is to CHECK ALL BATTERIES under a load before you touch anything! Then remember that the servo was operating correctly when it left the factory, recheck everything that you have done since obtaining it and if the trouble should persist return it to the factory before anything serious can happen.

The factory provides a 24 hour service for your convenience. If you should return a servo for service inclose \$2.00 to cover the service charge and postage. If your trouble is covered by the warranty your \$2 will be returned, if it has been damaged it will be returned in first class condition with an additional charge for all parts used C.O.D.

### INSTRUCTIONS FOR USING THE MODEL MC MULTI-SERVOS . . .

The mounting for the MC type servos is shown in diagram No. 6. The mounts are two pieces of  $\frac{1}{8} \times \frac{1}{4}$  hardwood to which the servo is fastened with 4—No.  $2 \times \frac{1}{4}$ " wood screws. These hardwood strips may be cemented to any portion of the model. When fastening the servos to these strips be sure that the pressure does not spring the base and that the bottom side of the base does not touch any other part of the model. You will note that the servo must be mounted so that the push rod extends from the side of the switch cam which has the short cam pin. If not the long cam pin will jam the push rod as the servo oscillates.

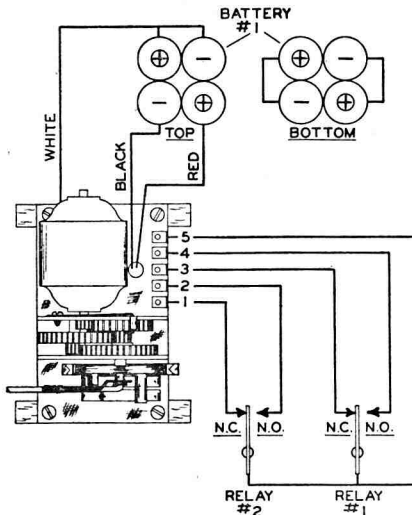
**BATTERY REQUIREMENTS FOR THE MODEL  
MC MULTI-SERVOS . . . .**

The model MC servos operate on 3 volts, never more. The servo requires two sets of batteries for its operation at 3 volts each. The batteries should be changed when either set has dropped to a minimum of 2 volts under load. The minimum battery supply will give at least 5000 operations of the servo. The minimum battery supply is 2 sets of 2 pen cells for a total of 4 pen cells. Each set provides the power for one direction of servo movement. If longer periods of operation are desired heavier batteries may be used of course, the heavier the batteries you use the longer will be the life and the better will be the servos' operation.

**WIRING THE MODEL MC MULTI-SERVOS,  
DIAGRAM No. 5 . . . .**

Both the model MCR and the model MCE are wired in the same manner, hence these instructions will apply to either model.

In figure No. 4, a typical receiver relay is shown, 2 of these are used for each MC servo. The servo is wired to both of them for its operation. In wiring the servo we will consider the relay points to be normally open an normally closed as labeled. With your radio the normally closed relay point is the one which is closed with the receiver turned on and while no signal is being sent by the transmitter. The normally open point is the one



**SERVO TERMINAL CONNECTIONS**

1. No. 1 relay normally closed point.
  2. No. 1 relay normally open point.
  3. No. 2 relay normally closed point.
  4. No. 2 relay normally open point.
  5. Common ground from both relays.
- White wire: Battery common connection.  
Red wire: Battery positive terminal.  
Black wire: Battery negative terminal.

which closes when you signal with the transmitter. You may refer to diagram No. 5 for the servo wiring.

1. It will be necessary for you to label your relays No. 1 and No. 2 so that you can quickly determine which is which one.
2. Take two pen cells and connect them together positive to negative, you will then have 3 volts. A second set of batteries exactly the same is also needed.
3. Each set of batteries will now have a positive and a negative terminal. Connect the positive terminal of one set to the negative terminal of the other set, this will be a common connection. In addition you will now have one positive and one negative terminal left.
4. Connect the white wire from the servo motor to the common connection of the batteries.
5. Connect the red wire coming out of the servo base to the positive terminal of the batteries.
6. Connect the black wire coming out of the servo base to the negative terminal of the batteries.
7. Connect the ground terminals or armatures of your relays together. Connect this common ground to terminal No. 5 on the servo base.
8. Connect the normally open contact of relay No. 1 to terminal No. 4 on the servo base.

9. Connect the normally closed contact of relay No. 1 to terminal No. 3 on the servo base.
10. Connect the normally open contact of relay No. 2 to terminal No. 2 on the servo base.
11. Connect the normally closed contact of relay No. 2 to terminal No. 1 on the servo base.

### **SPECIAL WIRING INSTRUCTIONS . . .**

#### **For using model MC servos with Schmidt "Multi-Channel" equipment.**

The Schmidt "Multi-Channel" receiver comes with built in sockets to connect the servos to the receiver with. These sockets are already wired to the relays so that it is not necessary to connect the servos to the relays in any other manner. As a result the model MC servos may be wired directly to a plug which matches these sockets.

1. Follow steps No. 2 thru 6 of the regular wiring instructions to connect the batteries to your MC servo. When the model MCE and model MCR are used at the same time they may both be wired to the same set of batteries.
2. The Schmidt plug is a 6 prong type, the sixth prong is provided as a connection for the 5th relay, only 5 of the prongs are used to connect a MC servo.
3. Connect prong No. 1 to terminal No. 1 on the servo base.

4. Connect prong No. 2 to terminal No. 2 on the servo base.
5. Connect prong No. 3 to terminal No. 3 on the servo base.
6. Connect prong No. 4 to terminal No. 4 on the servo base.
7. Connect prong No. 6 to terminal No. 5 on the servo base.

Prong No. 5 of the Schmidt plug is the connection to the 5th relay on the Schmidt receiver.

After completing your wiring if you find that the control movement is opposite to what you would like, reverse the tones on your Schmidt control box rather than change your servo wiring.

### **BABCOCK BCR-4 3 CHANNEL RECEIVER . . . .**

These are special suggested instructions for altering your model BCR-4 Babcock 3 channel receiver to use a model MC Multi-Servo with it. It is expected that you may want to use one channel and relay to operate a rudder actuator such as the Model 3PN Multi-Servo. The other 2 channels and relays will be required to operate the model MCE or MCR Multi-Servo.

Remove the case of the receiver and determine which are the 3 relay sockets, do not confuse them with tubes. Remove all wires from terminals No. 4, 5 and 6 on each of the relay sockets. Do not touch the wires on the remaining terminals. On each of these sockets terminal No. 4 is the normally open contact of the relay. Ter-

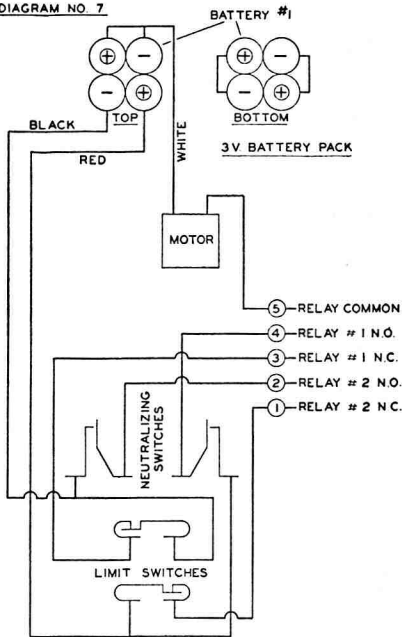
minal No. 5 is the normally closed contact of the relay. Terminal No. 6 is the armature or ground terminal of the relay. With this knowledge you may then treat the socket terminals as your relay connections and proceed to wire your servos following the regular servo wiring instructions. It is advisable to twist the new wires used for the servos into a cable and bring them out through a new hole in the case using a grommet to prevent chafe. In wiring your receiver to the connector plug you may now ignore pins No. 6, 7, 8, and 9. These were actuator connections which you will no longer need to use.

A good quality #24 insulated stranded hookup wire should be used for all servo connections, twist the wires into a cable for convenience and protection. Be sure to check all wiring carefully, improper wiring may damage your servo! Under no circumstances should you turn the servos cam by hand! You may damage the cam or the servo contacts causing the servo to malfunction!

### **OPERATING THE MODEL MCR MULTI-SERVO . . . .**

With this servo each control direction is on a separate channel, hence they are completely separate and instantly available. No sequence of any sort is required with the result that any time you close the switch for one channel the servo will move in the corresponding direction. Holding the switch closed will keep the servo in the position. While in position the servo uses no battery current.

DIAGRAM NO. 7



SCHEMATIC OF MODEL MCR & MCE MULTI-SERVOS

Anytime that the switch is not closed the servo will move to an absolute neutral position.

Closing the switch on the second channel will give movement in the opposite direction from the first channel.

A proportional control action can be had when desired by pulsing the switch on either channel. This causes the servo to start to move towards the control position and return to neutral each time the circuit is broken. The amount of control action is determined by the length of the pulses, the longer the switch is held down the greater will be the amount of control. It is not advisable to use this proportional action for all flying as it will tend to materially reduce the life span of all the radio equipment and the servo.

### OPERATING THE MODEL MCE MULTI-SERVO . . .

The model MCE operates in the same manner as the model MCR. The difference is that you may also trim the control thru an arc of 10 degrees at neutral. Any time that you close one channel switch and hold it closed the servo will move to a full control position. Upon releasing the signal the servo will move to a position that is close to neutral but slightly towards the opposite side of neutral. To trim the control you use short beeps of the switch, short beeps will move the servo a few degrees for each beep towards the direction corresponding to the channel you are beep-



ing on. Too long a beep will cause the servo to move out of this trim area and return to a trim in the opposite direction.

In operation the model is launched with a neutral elevator, short beeps of control are used to trim the model for the type of flight desired. You will only use full control for doing maneuvers, full up control will cause a loop or stall, when recovering from this loop or stall the model will have built up excessive speed and you will need a trim in the opposite direction to the control used for a level recovery. The servo automatically returns to the correct trim for this level recovery when you release the control. Once the model has leveled off and lost its excessive speed you may then beep the trim out and arrive back at the neutral position.

When it comes to using elevators with your model it should be done within your experience. Naturally any sort of elevator control which returns to an absolute neutral position is the safest to use. With this type any time that you get into trouble all that is necessary is to release the control and it will neutralize allowing the model to recover by itself. Therefore if it is your first attempt at elevators you may wish to use a model MCR for actuating them, it provides an absolute neutral. On the other hand if you have had considerable experience flying you will quickly realize the value of the trimmable feature provided by the model MCE and understand that it requires only a bit of practise to be able to obtain the full value from this servo's action.

## MODEL MC MULTI-SERVO PARTS AND PRICE LIST

| Part No. | Description                                       | Price  |
|----------|---|--------|
| MC-1     | —Servo motor with condenser and pinion gear ..... | \$2.75 |
| MC-2     | —Servo motor condenser .....                      | .50    |
| MC-3     | —Gear train frame .....                           | 2.50   |
| MC-4     | —1st gear and pinion .....                        | .75    |
| MC-5     | —2nd gear and pinion .....                        | .90    |
| MC-6     | —3rd gear and shaft .....                         | .90    |
| MC-7     | —2nd gear pinion shaft .....                      | .35    |
| MC-8     | —Main cam shaft .....                             | .35    |
| MC-9     | —Cam disc .....                                   | 3.00   |
| MC-10    | —Servo base with contacts and terminals .....     | 8.50   |
| MC-11    | —Brake Assembly .....                             | .25    |
| MC-12    | —Set of servo screws .....                        | .50    |
| MC-13    | —Instruction booklet .....                        | .75    |

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