

LOCATION AND USE OF PARTS OF GENERAL ELECTRIC PC-5 CONTROL.

*Boston Elevated Railway Instructions*

The motor controller is placed under the car body and contains the following parts:-

Switch Group  
Operating Engine  
Overload Trip  
Re-set  
Line Switch  
Reverser

Switch Group makes the necessary electrical connections to the motors.

Operating Engine turns the cam shaft and thereby operates the switch group.

Overload Trip protects the motors in case of an overload of current.

Re-set is for the purpose of closing the overload trip and is operated from control switch in cab. There is no way the motorman can close it by hand.

Line Switch is for the purpose of opening and closing the motor circuit.

Reverser is for the purpose of changing the direction of motor current. There is no way for the motorman to throw the reverser by hand.

Ribbon Fuse is located under left hand corner of No. 4 end, and is for the purpose of protecting the motors.

Motor Cut-out Switches are located under car and can be reached through trap in floor. This trap is in the floor at the end of the seat under main motor switch.

Master Controllers are located one in each cab and are used for operating the car. They are equipped with a reverse handle, operating handle, notching lever and emergency switch. The Reverse handle is removable.

There are three positions on Master Controller, viz:

Notching  
Series  
Parallel

Notching lever is the small lever on top of controller at the right and is used in notching up control when Automatic Relay fails to work.

Emergency Switch is a push button on top of controller at the left, and is for the purpose of disabling a train by blowing main battery fuses.

Control and Re-set Switch, located overhead, one in each cab. This switchbox contains a fuse to protect the control circuit. It is a five-ampere fuse. This switch has three positions.

Control, Off, Re-set.

When at "Control" position, it completes the control circuit.

When at "Off" position, it opens the control circuit.

When thrown to "Re-set", it closes the over-load trip.

Main Motor Switch, is located at the side of the door near the centre of the car and is for the purpose of opening or closing the motor circuits.

Roof Fuse, is located on roof of car to protect the main wiring between the trolley and the ribbon fuse.

Insulated Trolley Hooks, are located on roof of car to hold the idle trolley pole. Car cannot be started unless one pole is properly under the hook and the other on the wire.

Lightning Arrester is located on roof of car to protect car from discharge of lightning.

Grid Resistance, is located under car for the purpose of cutting down the flow of current to the motors, when starting.

Batteries, supply the power to the control circuit, door signals, brake magnet valves, single stroke bells, emergency lights and buzzers are located under the two end seats of No. 1 end of car.

Main Battery Fuse, is a 25-amp. fuse and is in a box under the same seat as batteries on the left-hand side.

A box located in centre compartment at end of seat contains the following fuses:

Top row:

Door Signals  
Electric Brake  
Single Stroke Bells  
Emergency Lights  
Buzzer

Lower Row:

Head and Tail Light  
Fuse and No. 1, 2, 3 & 4 Light Fuses

Main Light Fuse, Air Fuse and Main Heater Fuse, are located in box on panel over the door at the left.

Light Switch & Air Switch, are located under box which contains light and air fuses. The light switch is on the left and air switch on the right.

Heater Fuses and Switch Box, located on panel over door at right.

Conductor's Push Buttons, are located on fare box stand. The top button is for the buzzer and the bottom for the single stroke bell. The button on left-hand side of car rings bell in centre and rear of car and the button on the other side rings bell in centre and front of car. There is a buzzer button located in each cab.

Starting Light Signal, is located in box with the air gauge directly in front of Motorman. There are two lamps and if one fails the other can be used by operating snap switch at the bottom of box.

Head and Tail Lights, are controlled by reverse handle on controller.

Emergency Lights, five small lamps, three in body of the car and one in each tail light. These lights burn only when trolley leaves the wire, when the power is off line, or when there is trouble in the head and tail light circuit. The emergency lights will not burn if the main light switch is off.

Sand Lever, is located over top of Motorman's brake valve. Sand is applied by pressing lever down.

Control Reservoir, located under body of car, for the purpose of storing air for operating switch group and reverser, and is supplied direct from the main reservoir. There is a check valve on pipe which allows the air to go only in one direction. In case of a sudden loss of main reservoir pressure, the air in the control reservoir is retained so that reverser can be operated if necessary to stop car.

### OPERATION

As stated previously, there are three positions on Master Controller, viz:

Notching  
Series  
Parallel

On the first, or notching position, slow movement of car is obtained due to current passing through resistance. This is not a running point.

On second, or series position, all resistance is cut out. This is a running point.

On third, or parallel position, which is also a running point, the maximum speed is obtained.

The small Notching Lever is to be used in case Automatic Relay does not work due to an unusually heavy flow of current to the motors, which would be most likely to occur when starting a car on a heavy grade or in a sharp curve or when pushing a disabled car.

The current for the control circuit is supplied by storage batteries which are charged by the compressor.

#### TO PREPARE CARS FOR SERVICE

1. See that rear trolley is under hook and forward trolley on wire.
2. Close compressor switch to start compressor.
3. Test hand brakes, sand boxes and gongs.
4. When full air pressure (75-lbs.) has been obtained, test brakes by making electric and pneumatic applications and note pressure on gauge.
5. See that brakes release properly.
6. Reset circuit breaker and close control switch.
7. Before closing main motor switch, test reverser.
8. Close main motor switch.

If slow movement of car is desired, advance handle to first or nothing position. If maximum speed is desired, the handle should be advanced to full parallel position at once, as the notching of controller is taken care of by the Automatic Relay.

To reverse car, pull reverse handle to reverse position and apply power. After reverser has been thrown, shut off power and allow car to come to a full stop before applying power in the forward direction again, to avoid damage to reverser and motors.

When car will not start, due to relay not operating, the Notching Lever is for the purpose of notching the controller. This is done in the following manner.

But the controller handle to full series position, pull lever back and hold it for at least one second. If car does not start, repeat the operation until it does start and full series is obtained. The controller handle must be kept on full series all the time that notching lever is being used.

Emergency switch, is operated by holding button down with controller at "off" and reverse handle in the reverse position. It is used in case power cannot be shut off on rear cars of train.

Car is to be started in light signals. When all doors are closed the signal is lighted in the air gauge box in motorman's cab. The signal stroke bell is to be used for starting, when the starting signal light is out of order. The buzzer is to be used as a signal to stop by conductor as well as passengers.

Hand brakes in cabs are applied by working lever backward and forward and can be released by stepping upon pedal at end of brake base.

In the centre compartment there is a hand brake and a conductor's Emergency Valve. The emergency valve is under the fare box and is operated by pushing plunger down, thereby setting brake. This brake is released by pulling plunger up, with motorman's brake valve handle in service position. Brakes in centre compartment are for emergency only.

Two pieces of canvas are carried in box with spare fuses, and are to be used between the drawbars when there is trouble in the control circuit.

#### DEFECTS

If car fails to start, it may be due to one or more of the following causes:

- Defective Motors
- Low Air Pressure
- Main Battery Fuse Blown
- Control Fuse Blown
- Idle Trolley Pole not under hook.

#### QUESTIONS AND ANSWERS

Questions and answers regarding the operation of cars equipped with General Electric PC-5 Control.

No. 1: When about to take a car out for service what would you do?

Answer: Close compressor switch to start compressor. Test hand brakes, sand boxes and gongs. Place brake valve handle on brake valve and put same in release position. When full air pressure has been obtained, test brakes by making an electric and pneumatic service application of the brakes and note pressure on gauge. See that brakes release properly. Close control switch on operating end of car. Before closing Main Motor Switch, test reverser.

No. 2: What are the probable causes of contactors not operating if these switches are closed?

Answer to No. 2: Main battery fuse blown. Central Switch Fuse blown. Low air pressure.

No. 3: If contactors operated all right, but car did not move, what is most likely to be the cause?

Answer: Main motor switch not closed, Circuit Breaker not closed, Ribbon Fuse blown, Roof fuse blown.

No. 4: What means are provided for bringing the car to a stop?

Answer: Cars can be stopped with hand brakes, air brakes or by reversing.

No. 5: What would you do to prevent a collision if the brakes were not effective?

Answer: Stop car by reversing.

No. 6: If a four-motor car became disabled, is it possible to pull the car in the opposite direction from that in which it was going without having the reverser in the forward position or cutting out one pair of motors?

Answer: No, any attempt at moving it without reverser being in forward position or cutting out a pair of motors will result in a severe braking effect.

No. 7: How would you reverse a car?

Answer: Pull reverse handle to reverse position and apply one notch of power. When reverser, which is under car, is thrown, shut power off.

No. 8: On a four-motor car if the reverser is thrown to reverse position while car is moving, what is the result?

Answer: The motors will operate as generators and have a powerful braking effect on car.

No. 9: If car is reversed why should it be brought to a full stop before applying power in the forward direction again?

Answer: To avoid damage to reverser and motors.

No. 10: Can reverser be thrown if line current is loose or trolley is off wire?

Answer: Yes: the reverser is operated by current supplied by batteries.

No. 11: In ordinary operation how should power be applied?

Answer: Advance controller handle to full multiple position at once.

No. 12: When using power to operate an electric switch, how many points on controller should be used?

Answer: One; first point on controller.

No. 13: What is the use of the small notching lever on controller? How is it used?

Answer: For notching controller under car in case automatic relay does not work. Put controller handle to full series position, pull lever back and hold it for at least one second. If car does not start repeat the operation until car starts and full series is obtained. Controller handle must be kept on full series all the time that notching lever is being used.

No. 14: What is emergency switch on controller for and how is it used?

Answer: It is for the purpose of disabling train by blowing main battery fuses. It is operated by holding button down with controller at "off" and reverse handle in reverse position.

No. 15: Should car be started on bell signals?

Answer: Car should not be started on bell signals unless starting light signals are defective.

No. 16: Where are motor cut-out switches located?

Answer: Under car and can be reached by raising trap in floor, which is at the end of seat under the main motor switch.

No. 17: What should be done before coupling to a car that has a grounded control circuit?

Answer: Fasten canvas on each side of drawbar over control plugs. Canvas will be found in spare fuse box.

No. 18: If a two-car train is disabled on account of a ground in the control circuit, what should be done?

Answer: Use following car or train to separate cars of disabled train. If the following car or train is of same type, before coupling on to disabled train, place canvas over control plugs in drawbar. If this is not done the battery fuses on all cars attached will be blown.

After separating car from its disabled train, replace battery fuse and examine fuse in control switch box. If trouble is found in this car, replace fuses in front car of train.

If front car will operate, connect car detached. Before doing so, place canvas over control plugs in drawbar.

If trouble is found in control circuit of front car, connect car detached to disabled car, using canvas between drawbars. In such a case train will be operated from second car with conductor in front end of train. Passengers of disabled train must be transferred to cars following when convenient.

No. 19: Can a car be cut off a train if the main motor switch is closed?

Answer: No. Main Motor Switch must be open. If Main Motor Switch is not open, car will be operated by its own power.

No. 20: Why is it necessary to have air pressure to start car?

Answer: The switch group and reverser are operated by air.

No. 21: How much pressure is necessary?

Answer: Forty pounds.

No. 22: If air gauge showed no reservoir pressure, could car be started?

Answer: Yes; if control reservoir contained 40 lbs. of air.

### TRAIN OPERATION

In making up a train, brake must be set on car to be attached and drawbars must be placed so that tongues will enter opposite pockets squarely. Ford shackler must be used when necessary to raise drawbars. After cars have been coupled together w test coupling (In order to test coupling the brake must be set or the main motor switch open on car attached). The cocks in emergency and brake pipes must be opened on the ends of all cars where coupling is made. The cocks on emergency and brake pipes on front and rear end of train must be closed. These cocks are closed when they are parallel with pipe, and open when they are at right angles with pipe.

When train is made up test brakes by making electric and pneumatic applications and see that brakes operate on each car of train. See that forward trolley of each car is on wire and rear trolley under hook; remove reverse, sand, and air brake handles of all cars except the first in train and place same in holder in box containing jack and couplers. All control switches on train should be "off" except control switch on operating end of train.

Starting signal lights must be tested by having reverse

handle of operating car in the forward position and all doors of train closed. If no starting light signal is obtained, it may be due to one or more of the following causes:

Cocks in brake pipe not open

Door fuse in box in centre compartment blown

Doors of the train not closed

Cocks in brake pipe must be open between all cars.

If this is not done the starting light signal will be obtained on forward car with the doors of rear cars open.

When ready to start, close Main Motor Switches on all cars. Trains must be started on light signals. If starting light signals are out of order, train may be started by bell signals relayed by conductor of rear car to conductor of forward car. The bells given by rear conductor ring in the centre compartment of the car ahead.

Trains are stopped by buzzer signal. The buzzer rings in all cars of train and the motorman's cab so that conductors need not relay the buzzer signal.

Arbitrary stops. At Railroad Crossings and at places where stop signs are installed, train will be started on bell signal only.

In cutting cars off train, close cocks in brake and emergency pipes and open main motor switches on cars to be cut off.

When brakes are applied in emergency a considerable time must elapse before they will release as the emergency pipe is recharged through the brake pipe and brake valve handle in service position.

When the rail is slippery motormen should avoid making an emergency application of the brakes, as it skids wheels and he would lose control of train.

The Emergency switch on top of controller is for the purpose of disabling train in case power cannot be shut off on rear cars of train due to controller being on a drawbar short circuited. After train comes to a stop open main motor switches and then proceed to locate the trouble. See that controllers on all cars are at "off". If controllers are at "off" the trouble must be in the drawbars. If trouble is in the drawbars, cut this car from train and use canvas between the drawbars.

There are three cut-out cocks under the right front corner of car. The cock on brake pipe and one of the cocks on emergency pipe connect the brake and emergency pipes in the train. The Third cock, which is on the emergency pipe and further under the car, is for the purpose of allowing brakes to be set in emergency in case car is derailed or splits a switch. This

emergency application is made by drawbar swinging to one side and opening the emergency line. In such a case brakes cannot be released until this inside cock is closed.

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