May 28, 1957 H. R. PUTZ 2,794,091

REMOTE CONTROL RELAY

Filed March 15, 1952 2 Sheets-Sheet 1

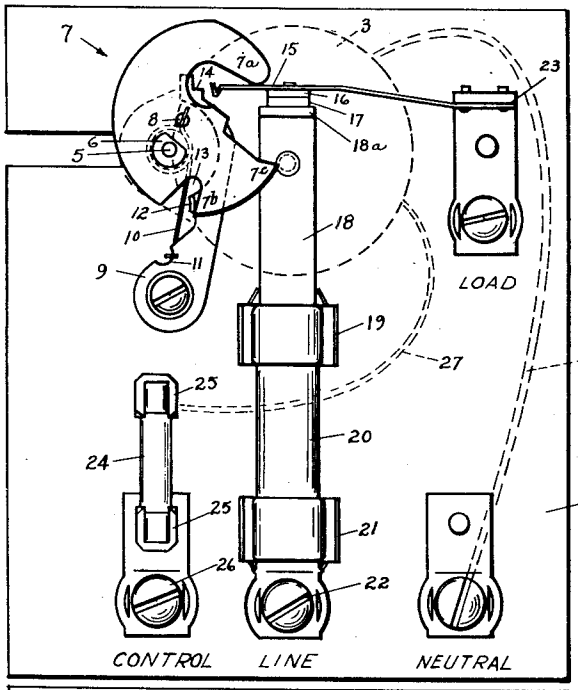

Fig. 1

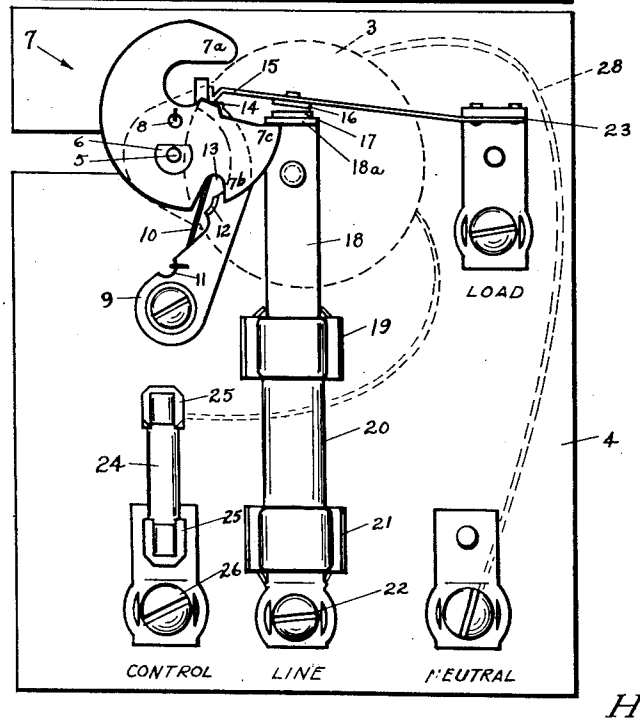

Fig. 2

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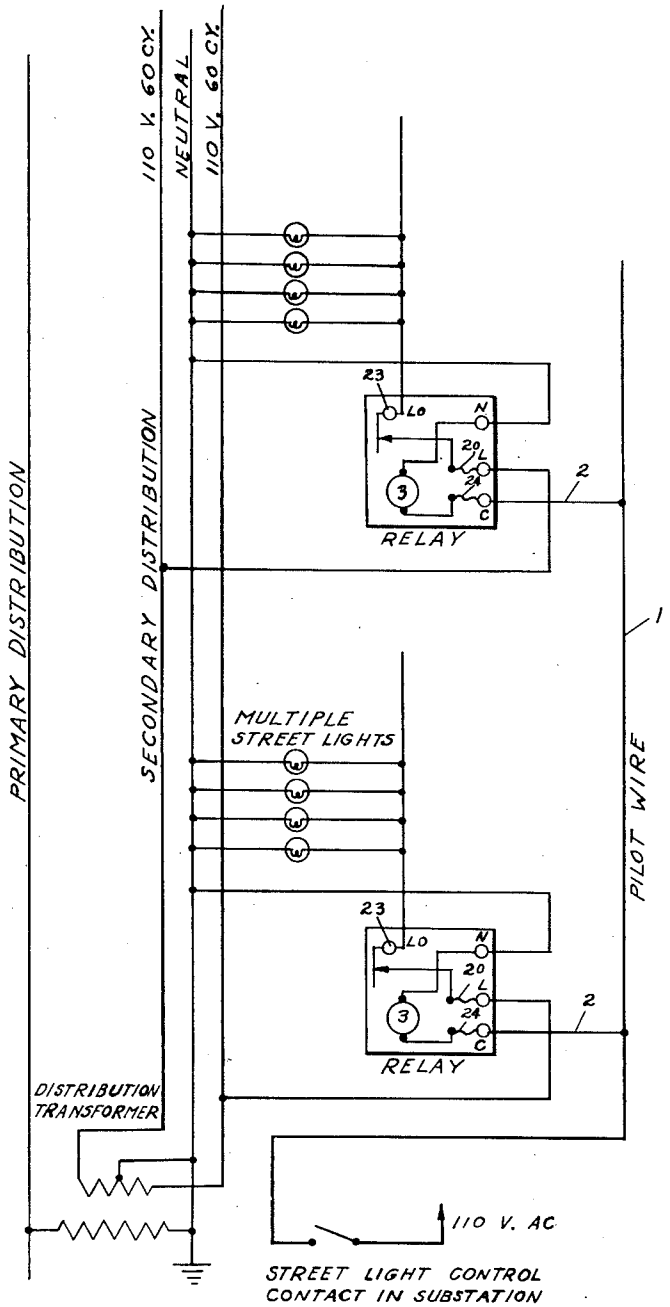

Fig. 3

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REMOTE CONTROL RELAY

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9 Claims. (Cl. 200—92)

This invention relates to an improvement in relays for a remote control of a plurality of switches on electrical power lines.

To facilitate efficient city management, it is very important to have the best possible method of street lighting, and the most reliable and efficient means of controlling it. It is also important to keep the operating power at a minimum, in order to have the greatest number of controls possible on a given line.

It is a great advantage to be able to turn "on" or "off" all the street lights of a city at one time. The existing means of achieving this involves complicated wiring devices. Since less complicated methods can be built of more rugged construction and therefore be more foolproof, it is desirable that a simple method be used.

To provide for this need, a control was developed that can be installed on the poles supporting the street lights. Or in underground systems, the control can be located inside a vault or inside the iron base of the street light standard. In either system each control switch is connected to the same pilot wire and this pilot wire is energized or de-energized from a street light control contact in a substation.

This relay was developed, utilizing the power of a small synchronous motor to actuate the contact mechanism. The torque produced by the motor is applied to the contacts over a relatively long period, and thus high operating forces can be derived from a lower power source. In actual practice the motor operated relay consumes approximately one half that of the normal magnetic contactor of a similar capacity.

The smooth rotational power obtained from the motor does not transmit to the contact mechanism vibrations at the supply frequency. This is very important when dealing with incandescent lamp load, wherein the inrush current may be as high as fourteen times the steady state current.

The comparatively slow break of the contacts does not draw out the arc, but rather quenches it at a critical distance during a zero portion of the cycle. Furthermore, the latch action during the closure allows the contacts to approach each other, but not actually to make contact until released by the latch. The final closure is effected over a minimum distance, and thus contact bounce or chatter is eliminated.

In the closed position, the contact blade is held by virtue of the motor return spring and the friction of a portion of the gear train. Conversely, in the open position the full motor force is applied to the contact blade, and it follows therefore, that in either the open or closed position the switch mechanism is locked in. This is a distinct advantage in connection with pole mounted equipment subject to extreme vibration.

Contact chatter is the most frequent cause of contact welding or freezing when used on street lighting equipment. Should welding occur due to causes such as overload, the proposed switch arrangement is such that the returning cam strikes the switch blade tending

to break the weld, whereas the usual magnetic contactor has the pressure of the return spring or gravity only.

On large control systems trouble is sometimes caused by the effect of direct current voltages induced into the pilot wire from street railway power supplies. These voltages are often of sufficient magnitude to hold the armature in, in the usual type of magnetic relay, unless an isolating transformer is interposed between the source and the relay coil of each relay. In the present case the motor operated relay is of the synchronous type and is unaffected by direct current voltages of any magnitude.

One of the objects of this invention is to provide an interrupting means for a plurality of lamp loads controlled by one pilot wire.

And another object of this invention is to provide a contactor with a slow break and a firm and fast make for a remote relay control.

Other objects will appear from time to time in the course of the specification and claims.

An embodiment of this invention is illustrated on the accompanying drawings in which:

Fig. 1 is an elevation of the switch panel in the closed position.

Fig. 2 is an elevation of the switch panel in the open position.

Fig. 3 is a schematic wiring diagram.

Like reference characters indicate like parts throughout.

The schematic wiring diagram of Fig. 3 shows the manner in which this device can be used. There is nothing novel in the method of connecting the relay but the diagram is included for the sake of clarity. A pilot wire **1**, operating from a substation has take off wires **2** which energize a coil in a simple synchronous motor **3**. In Figs. 1 and 2 it can be seen that the motor **3** is mounted on the rear of a switch panel **4** made of some suitable insulating material. The motor **3** is of the self-starting synchronous type disclosed in U. S. Patent 2,334,040 to Schellens wherein the armature carries a pinion or equivalent driving member and is axially shiftable by the magnetization of the motor or its field from an idle initial position to an active position where the pinion is coupled to a driven gear train. Such a driving motor, wherein the magnetic pull of its energized field is operative to axially shift the rotor to couple it to the output shaft, is well known in the art and does not constitute a part of the present invention, and for simplicity, the details thereof have been omitted from the drawing.

A cam **7** is solidly affixed to the end of the output shaft **6** of the driving motor **3** and is shown in Figs. 1 and 2. The cam **7** is shaped with several lobe portions, portion *7a* to lock the switch blade with the contacts closed, lobe portion *7b* to trip a latch which holds the movable contact open, and lobe portion *7c* to stall the motor. A latch **9** pivoted near its lower end upon a bearing affixed to the panel **4** is resiliently urged to rotate in a clockwise direction by a torsion spring **10** coiled around the shaft **6** and having one end extending through an aperture **8** in the cam **7** and the opposite end hooked in a notch **11** in the latch **9**. The torque exerted by the coil spring **10** urging clockwise rotation of the cam **7** is approximately one half of the torque of the motor **3** produced at the shaft **6** tending to rotate the cam **7** in the counterclockwise direction when the motor **3** is energized. Upon rotation of the cam **7** a flat surface thereon bears against the end of and gradually raises the switch blade **15**.

The latch **9** has a slightly curved portion **12** extending at right angles to the flat face of the latch **9**. In Fig. 1, it can be seen how the position of the cam holds the

latch 9 by means of an opening 13 in the cam 7 on which the right angle portion 12 rests. The upper portion of the latch 9 is shaped with a step arrangement 14 which locks a switch blade 15 in its operated position when the cam rotates counter-clockwise and releases the latch 9.

The switch blade 15 has one of the electric contacts 16 attached to its lower surface. The second electric contact 17 is attached to the upper end of a contact bracket 18.

The contact bracket 18 has a pair of spring arms 19 which hold the upper end of a load fuse 20. Another pair of spring arms 21 on a lower contact bracket holds the lower end of the load fuse 20. This fuse load serves to protect the street light from overload. A conductor to the line is attached to the lower contact bracket at 22, and the current is carried from the line up through the load fuse 20 and contact brackets to the contacts 17 and 16 and by means of the contact strip 15 to the load contactor 23. The street lights are on the line leading out from the load contactor 23.

Another fuse 24 is held in similar manner by brackets 25 and serves to protect the motor 3 from fault or overload. The take-off line 2 to the pilot wire 1 is attached at 26. A conductor 27 forms a connection between the upper part of the fuse 24 and the motor 3. Another conductor 28 completes the circuit from the motor 3 to a neutral line.

The use and operation of my invention are as follows:

This switch is designed principally to be used to turn "off" or "on" groups of street lights. However, it could be adapted to other uses such as water heaters or air conditioning equipment or wherever certain equipment can be hooked up to one line. This control, consisting of a cam operated switch and a small motor to move the cam, is connected to each street light between the lights and the supply line and is so constructed that it can interrupt the flow of current from the line to the street lights. The control boxes are all connected to one pilot line which is operated from a central point.

From this central point by pushing "on" or "off," the pilot line will energize or de-energize every control box motor connected to it. When the motor coil is energized, the motor armature is coupled to the gear train, locking the shaft to the motor.

The shaft 6 and the cam 7 are solidly affixed so that when the shaft 6 rotates counter-clockwise, the cam 7 moves with it. As the cam moves, it gradually raises the end of the switch blade 15 to provide a slow break of the contacts 16 and 17 and upon further rotation releases the latch 9 which rested on the lobe portion 7*b* by means of the right angle extension 12. The gradual separation of the contacts does not draw out the arc but rather extinguishes it after the contacts have separated and during the portion of the cycle when the current wave passes through zero. The spring 10 rotates the latch in a clockwise direction until the step 14 moves under the end of the switch blade 15 to lock the contacts 16 and 17 in open position. By this time, the cam has rotated counter-clockwise until the lobe portion 7*c* strikes the protruding ledge 18*a* of the contact bracket 18. This causes the motor to stall which is not harmful to the motor or gear train.

To reclose the switch, power is removed along the pilot line which de-energizes the motor 3. This allows the shaft and cam under the pressure of the spring 10 to rotate in clockwise direction. The contact blade 15 is prevented from closing by the position of the latching lever 9 until the lobe portion 7*b* forces the latch from under the blade at 14 thus allowing the contact 16 to snap into closed position next to contact 17. The cam follows on until the lobe portion 7*a* stops against the upper side of the blade 15 adding further pressure to the contacts and locking them together. The switch is then back in the position shown in Fig. 1.

If a normally open type of switch is required instead of the closed type shown, a motor with the opposite rotation can be used and the return spring thrust reversed. In this embodiment the contact blade 15 is held away from the stationary contact by both the torque of the coil spring and the friction of the gear train, and the contacts are locked closed by the full torque exerted by the motor through the shaft 6.

With incandescent lamp loads, the cold resistance is $\frac{1}{10}$ to $\frac{1}{15}$ of the heat resistance, thus causing a momentary inrush current of 10 to 15 times the steady state current. This characteristic demands that the contacts close rapidly and firmly without bounce or chatter. A contactor with a slow break and a firm and fast make is ideally suited for this type of duty. By opening slowly, the switch will not draw a long arc which would burn the contacts. A small arc will be extinguished on the first zero of the cycle. On the make, the switch contact blade is released by the movement of the latch 9 and closes rapidly under the blade pressure. The cam follows through and the lobe portion 7*a* locks the switch blade in the closed position.

With this device, vibration much in excess of that found in pole mounted equipment cannot possibly cause the contacts to vibrate. The latch guards against a slow returning motor under low voltage conditions. It also maintains the same snap action with the normally open type of relay in which the motor force closes the switch blade. Thus, it can be seen that this invention fills a great need for better and more efficient street lighting control.

I claim:

1. A relay for remote control of an electrical circuit comprising contact means having an open position and a closed position and including a movable contact member resiliently biased toward closed position, a reversibly rotatable actuating member adapted when rotated in one direction to directly engage said movable contact member and hold said contact means in closed position and having means, when rotated in the opposite direction, to directly engage said movable contact member and actuate said contact means to open position, means for biasing said actuating member for rotation in one of said directions, means for driving said actuating member in the other of said directions, means for engaging and disengaging said driving means and said actuating member at will, and means including a spring-biased latch controlled by said actuating member for locking said contact means in its circuit-opening position.

2. A relay comprising contact means having an open position and a closed position for controlling an electrical circuit, a rotatable contact actuating member having a portion directly engaging said contact means and normally biased to hold said contact means in closed position, driving means, means for engaging and disengaging said driving means and said actuating member at will, a latch engageable with said contact means to hold said contact means in circuit-opening position, and spring means urging said latch to contact-locking position, said actuating member having another portion adapted to engage and operate said latch after said contact means has opened said electrical circuit and to release said latch from its contact-locking position when actuated in a direction to move said contact means to circuit-closing position.

3. A relay for remote control of an electrical circuit comprising contact means having an open and a closed position for controlling said electrical circuit and including a movable contact member resiliently biased toward closed position, a latch engageable with said movable contact member to lock said contact means in open position and being biased toward contact locking position, a rotatable cam having a first surface engageable with said movable contact member to hold said contact means closed when said cam is rotated in one direction, hav-

ing a second surface engageable with said movable contact member to slowly separate said contacts when said cam is rotated in the opposite direction, and having a third surface adapted to operate said latch from contact locking position when said cam is rotated in said one direction, spring means biasing said cam to rotate in said one direction, driving means for rotating said cam in said opposite direction, and means operative upon energization of said driving means for engaging said cam and said driving means and for disengaging said members upon de-energization of said driving means.

4. A relay, comprising, in combination, contact means having an open position and a closed position including a movable contact member, a reversibly rotatable contact actuating member adapted when rotated in one direction to directly engage said movable contact member and hold said contact means in closed position and when rotated in the opposite direction having means to directly engage said movable contact member and slowly actuate said contact means to open position, means for resiliently biasing said actuating member to rotate in one of said directions, a motor for rotating said actuating member in the other of said directions, means for engaging said actuating member and said motor upon energization of said motor and for disengaging these elements upon de-energization of said motor, and a stop in the path of movement of said actuating member for removing the influence of said motor after a predetermined rotation of said actuating member.

5. An electrical relay comprising, in combination, contact means having an open position and a closed position and including a movable contact member, a reversible rotatable cam directly engageable with said movable contact member when rotated in one direction to hold said contact means in closed position and having means, when rotated in the opposite direction, to directly engage said movable contact member and actuate said contact means to open position, means for resiliently biasing said cam to rotate in one of said directions, a motor for driving said rotatable cam in the other of said directions, means for engaging said cam and said motor upon energization of said motor and for disengaging these members upon deenergization of said motor, a latch engageable with said movable contact member to lock said contact means in open position and being resiliently biased toward contact locking position, said rotatable cam having means to operate said latch out of its contact locking position when said cam is rotated in a direction to actuate said movable contact member to closed position.

6. An electrical relay comprising, in combination, contact means having an open position and a closed position and including a movable contact member, a reversibly rotatable actuating member directly engageable with said movable contact member to hold said contact means in one of said positions when said actuating member is moved in one direction and adapted to directly engage said movable contact member to actuate said contact means to the other of said positions when moved in the opposite direction, means for driving said actuating member in one of said directions, means for engaging and disengaging said driving means and said actuating means at will, a latch engageable with said movable contact member to lock said contact means in open position, a spring resiliently urging said actuating member in the other of said directions and also urging said latch towards contact locking position, said actuating member having means to operate said latch out of its contact locking position after said actuating member is disengaged from said movable contact member.

7. An electrical relay comprising, in combination, contact means having an open position and a closed position and including a movable contact member resiliently biased toward closed position, an actuating member having a portion engageable with said movable contact member and being biased for movement in one direction to hold said contact means in one of said positions and being adapted, when moved in the opposite direction, to actuate said contact means to the other of said positions, means for driving said actuating member in said opposite direction, means for engaging and disengaging said driving means and said actuating member at will, a latch engageable with said movable contact member to lock said contact means in open position and being biased toward contact locking position, said actuating member having another portion adapted to engage and operate said latch out of contact locking position after said actuating member is disengaged from said movable contact member, whereby said movable contact member snaps to closed position.

8. An electrical relay comprising, in combination, contact means having an open position and a closed position and including a movable contact member resiliently biased toward closed position, an actuating member having a portion engageable with said movable contact member, spring means resiliently urging said actuating member in a direction to hold said contact member in one of said positions, means for driving said actuating member in a direction against the force of said spring means, means for engaging and disengaging said driving means and said actuating member at will, a latch engageable with said movable contact member to lock said contact means in open position, and spring means urging said latch to its contact locking position, said actuating member having another portion adapted to engage and operate said latch out of contact locking position when said actuating member is moving in a direction to actuate said contact means to closed position.

9. An electrical relay comprising, in combination, contact means having an open and a closed position and including a movable contact member, an actuating member having a portion engageable with said movable contact member and being biased in a direction to hold said movable contact member in one of said positions and being adapted when moved in the direction opposed to said bias to actuate said movable contact member to the other of said positions, means for driving said actuating member in the direction opposed to said bias, means for engaging and disengaging said driving means and said actuating member at will, a latch engageable with said movable contact member to lock said contact means in open position and being resiliently urged toward contact locking position, said actuating member having another portion adapted to engage and operate said latch out of contact locking position when said actuating member is moved in a direction to actuate said contact means to closed position, and a stop in the path of movement of said actuating member in the direction opposed to said bias to remove the influence of said driving means after a predetermined rotation of said actuating member.

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