Dec. 31, 1957 I. KAMEN ET AL 2,818,538

MOTOR CONTROL SYSTEM

Filed Nov. 30, 1955 2 Sheets-Sheet 1

FIG. 1.

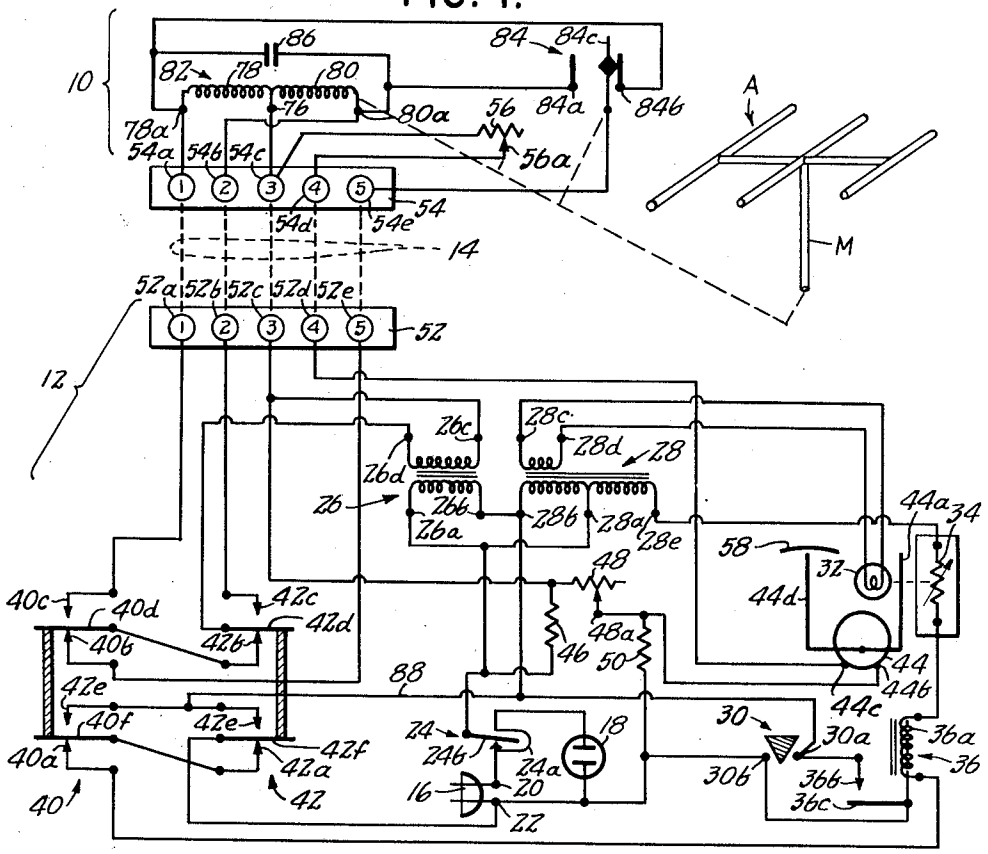
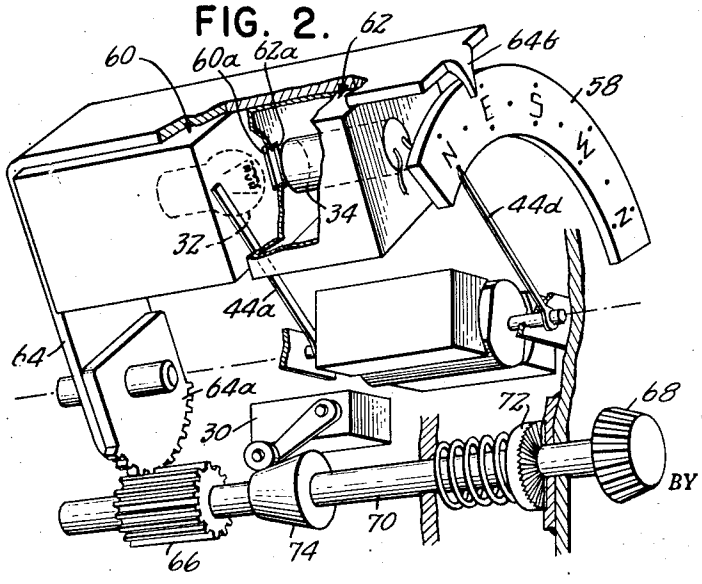


FIG. 2.



INVENTORS
IRA KAMEN
JOSEPH B. CEJKA

BY

Curtis Morris & Safford.
ATTORNEYS

Dec. 31, 1957 I. KAMEN ET AL 2,818,538

MOTOR CONTROL SYSTEM

Filed Nov. 30, 1955 2 Sheets-Sheet 2

FIG. 3.

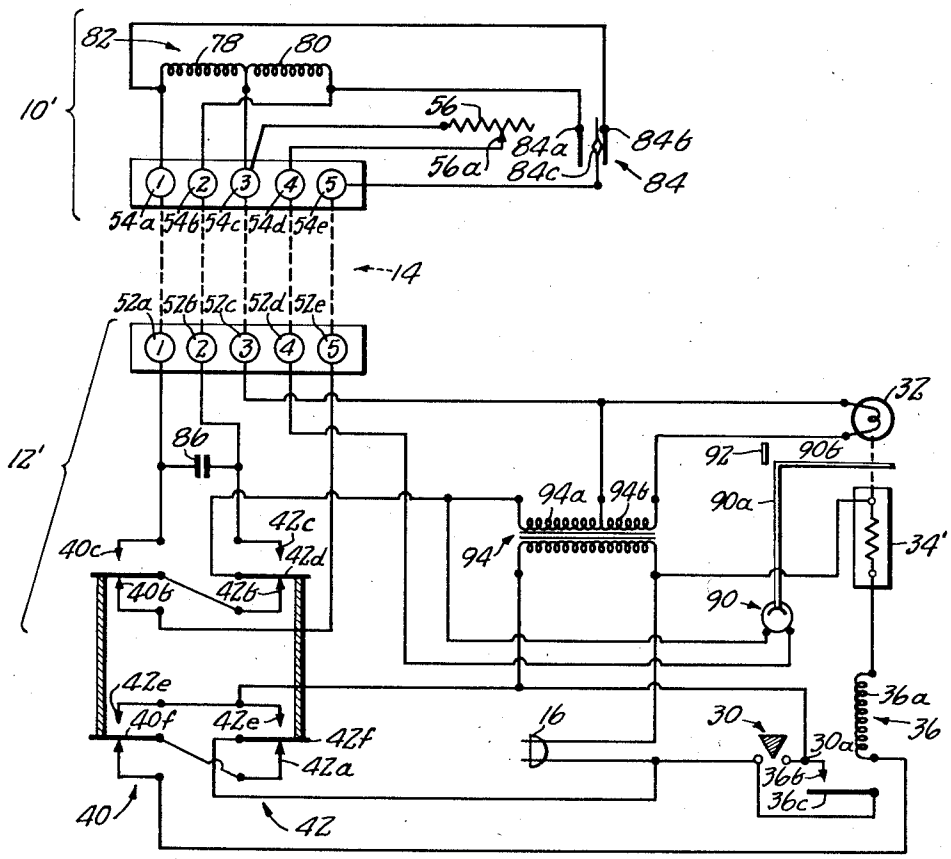
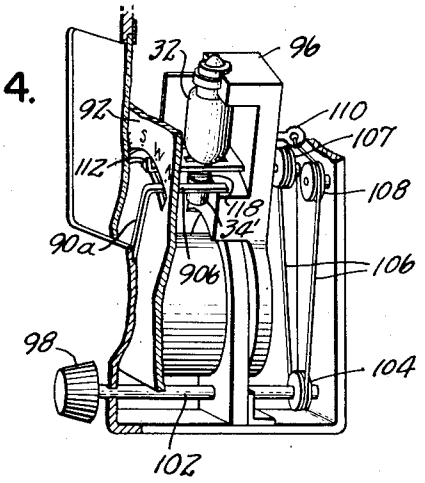


FIG. 4.



INVENTOR.
IRA KAMEN
JOSEPH B. CEJKA
BY
Curtis, Morris & Safford
ATTORNEYS

United States Patent Office 2,818,538 Patented Dec. 31, 1957

2,818,538

MOTOR CONTROL SYSTEM

Ira Kamen, New York, N. Y., and Joseph B. Cejka, Highland Park, N. J., assignors to General Bronze Corporation, Garden City, N. Y., a corporation of New York

Application November 30, 1955, Serial No. 549,909

13 Claims. (Cl. 318—31)

This invention relates to automatic control of electric motor-driven devices. The invention provides a driving means which may be manually preset for driving a movably mounted member to any desired position, and which, without further attention on the part of the operator, will automatically effect movement to the desired position and shut itself off.

This application is a continuation-in-part of our pending application Serial No. 505,879, filed May 4, 1955, now abandoned.

While the invention is shown and described herein as applied to a remotely controlled rotator for television receiving antennas, it will be readily understood that the invention is equally applicable to either locally or remotely controlled drive of any kind of member mounted for either rotational or translational movement.

In television reception, particularly in rural areas where the only television signals which are consistently received emanate from several different cities at considerable distances from the receiving location in widely divergent directions, it has become desirable or even necessary, in order to enable reception of signals on more than one television channel, to provide for rotation of the receiving antenna to the directions of the various television transmitters.

Most previous antenna rotators have been of the manually-controlled type, having, for example, two push-button switches for rotation of the antenna in one direction or the other as desired. Since such antenna rotators usually employ very inexpensive and low-powered electric motors which are geared down at a very high ratio in order to provide the power necessary to drive the antenna, they have been capable of rotating the antennas only at comparatively slow speeds of the order of one revolution per minute or even slower. Since the operator has had to hold the control switches in the actuated position during the entire time the antenna is rotating, he has had to waste considerable time in changing the direction of the antenna. Moreover, because of the human element involved, there was no assurance that the antenna would be rotated to the same position each time it was desired to receive signals from a certain television transmitting station. This has made reception unpredictable and often unsatisfactory. These various factors have created no little resistance to sales of manually-controlled rotators and a substantial demand for an automatically-controlled rotator.

There has been at least one type of automatically-controlled antenna rotator placed on the market. This rotator includes a multi-contact rotary switch which is preset in accordance with the desired rotational position of the antenna. One of the more obvious defects in the use of this type of automatic rotator is the fact that only a limited number of rotational positions is possible. Where multi-element "fringe area" television receiving antennas having narrow beam width field sensitivity patterns are employed, it is sometimes impossible to achieve

satisfactory reception unless a much finer control of the antenna position is possible.

The present invention provides a practical automatic rotator which is capable of accurately rotating an antenna to any preselected direction. This is accomplished by the use of an electrical meter movement connected in series with a potentiometer mechanically coupled to the antenna so that the meter needle moves in accordance with the position of the antenna. The path of the needle passes between a small incandescent lamp and a photosensitive cell which are mounted for movement to various positions corresponding to the desired rotational positions of the antenna. The photocell is connected in circuit with a relay which controls the supply of current to the rotator motor. When the device is turned on and preset, the antenna will rotate until the needle intercepts the light rays passing from the lamp to the photocell, deenergizing the relay and stopping the motor with the antenna in the desired position.

In one embodiment, a second needle on the same meter movement cooperates with a graduated scale on the front panel of the control box to visually indicate the position of the antenna at all times during operation. In another embodiment, a single-needle meter movement is employed, but the needle is bent at right angles to provide two portions one of which cooperates with the graduated scale and the other of which intercepts the light beam to the photosensitive cell.

A reversing switch, arranged to be actuated by the antenna at either extreme of its approximately 360 degrees of rotation automatically reverses the connections to the motor when the antenna reaches the end of its travel in either direction. A separate manual switch is provided so that the rotator may be controlled manually if desired. The power for the television receiving set may be drawn through the antenna rotator control box and a thermostatic switch provided to turn on the antenna rotator whenever the television set is turned on and to turn it off automatically when the television set is not in use.

In the drawings:

Figure 1 is a schematic diagram of the electrical circuit of an antenna rotator embodying features of the present invention.

Figure 2 is a somewhat diagrammatic perspective view of the arrangement of the meter needles and of the lamp and photocell, with certain parts broken away to reveal their internal construction.

Figure 3 is a schematic diagram of the electrical circuit of an antenna rotator constituting a modified embodiment of the invention.

Figure 4 is a somewhat diagrammatic vertical sectional view of the modified rotator, the circuit of which is shown in Figure 3.

Each of the two types of rotator shown in the drawings is divided into two separate units: a motor unit, generally indicated **10** (see Figure 1), which is mounted at the base of the mast *m* which supports the antenna *a*; and a control box, generally indicated **12**, which is mounted in a remote location, for example adjacent the television receiver, the two units being interconnected by means of a five-conductor cable generally indicated **14**.

The motor unit **10** suitably may be of the type disclosed in the copending application Serial No. 506,847, filed May 9, 1955, although it is equally useful with many other types of motor units presently in commercial sale. The motor unit shown in said copending application includes an elongated housing having at its upper and lower ends bearings for rotatably supporting a hollow torque tube. This torque tube is coupled to the driven by an electric motor contained in the housing through a speed-reducing gear train which preferably includes

a worm gear and worm wheel so that the torque tube cannot be rotated by external forces. The torque tube receives the lower end of the antenna mast and at its upper and lower ends is provided with inwardly projecting bolts for securing the mast.

In the rotator shown in Figures 1 and 2, the control box **12** is provided with a conventional two-prong male plug **16** for connection to a source of alternating current power, for example at 115 volts, 60 cycles. The control box is also provided with a two-prong female receptacle **18** into which the power cord of the television reeciver may be plugged. The two contact members of this receptacle **18** are respectively connected to the two terminals **20** and **22** of the power source, one of these connections being through a bi-metallic element **24***a* of a thermostatic switch generally indicated **24**. When the television set is turned on, it draws current through the bi-metallic element **24***a*, healing and distorting it and causing it to move into engagement with a fixed contact **24***b*, which is thereby connected to the terminal **20** of the power source.

This fixed contact **24***b* is connected to one terminal **26***a* of the primary winding of a motor transformer generally indicated **26** and to one terminal **28***a* of the primary winding of a lamp transformer generally indicated **28**. The other primary terminals **26***b* and **28***b* of these two transformers **26** and **28** are connected to each other and to one contact **30***a* of a momentary contact, single-pole, single-throw, push-button switch **30**, the other contact **30***b* of which is connected to the other terminal **22** of the power source. Thus, whenever the television set is operating, and when the switch **30** is closed, power is supplied to the primary windings of the transformers **26** and **28**.

The secondary winding of the transformer **28** is adapted to provide an alternating current voltage of approximately 6.3 volts and the two terminals **28***c* and **28***d* of this winding are connected across a miniature incandescent lamp **32**, for example a bulb having a two-candle-power filament in a self-focusing lenticular envelope.

The primary winding of the transformer **28** is in effect an auto transformer, being provided with a third terminal **28***e* which is connected to one terminal of a photosensitive cell **34**. The other terminal of the photocell **34** is connected through the winding **36***a* of a relay generally indicated **36** (which suitably is of the sensitive A. C. type having a winding impedance of approximately 50,000 ohms) and through a pair of normally closed fixed contacts **40***a* and **42***a*, respectively, of a pair of manually-operable switches generally indicated **40** and **42**, to the terminal **22** of the power source. The ratio of turns in the primary of the transformer **28** is such that across the terminals **28***b* and **28***e* there is developed an alternating current voltage of the order of 150 volts R. M. S.

The photocell **34** may suitably be one of the miniature cadmium sulfide cells now commercially available. These cells have a static resistance of the order of several hundred megohms, but when light impinges upon them, their resistance drops to a value less than 100,000 ohms. Thus, when light from the lamp **32** strikes the photocell **34**, the resistance of the cell drops to such value as to permit a minimum of approximately one milliampere of alternating current to flow through the cell **34** and through the winding **36***a* of the relay **36**.

This current flow is sufficient to energize the relay **36** and close its normally open contacts **36***b* and **36***c*. These contacts **36***b* and **36***c* are connected across the contacts **30***a* and **30***b* of the switch **30** and accordingly serve as holding contacts to maintain the supply of current to the primaries of the transformers **26** and **28** even after the momentary contact switch **30** is opened, so long as light from the bulb **32** reaches the photocell **34**, assuming, of course, that the television set remains "on" and that the manually-operable switches **40** and **42** are not actuated to open their normally-closed contacts **40***a* and **42***a*.

The lamp **32** and the photocell **34** are mounted on opposite sides of the path of one of the two needles **44***a* of a special double needle meter movement **44**. One terminal **44***b* of the meter coil is connected to the junction of a fixed resistor **46** and a potentiometer **48** in a voltage divider circuit which also includes a fixed resistor **50** and which is connected in series with the thermostatic switch **24** across the terminals **20** and **22** of the power source. The other terminal **44***c* of the coil of the meter movement **44** is connected through one terminal **52***d* of a terminal board **52** on the control box, one of the conductors in the cable **14** and one of the terminals **54***d* on a similar terminal board **54** on the motor unit to the rotary contact **56***a* of a potentiometer **56** mounted within the motor unit. One end of the resistive winding of this poentiometer **56** is connected through terminals **54***c* and **52***c* with the junction point of the resistor **46** and the potentiometer **48** in the voltage divider network previously described. It will thus be seen that an A. C. voltage whose amplitude depends on the setting of the potentiometer **48** is impressed across the coil of the meter **44** and the potentiometer **56** in series.

The potentiometer **56** is mechanically coupled to the antenna (for example, by means of the torque tube previously referred to) so that its rotary contact **56***a* is moved along the resistance winding of the potentiometer in accordance with the rotational position of the antenna.

The second needle **44***d* of the meter movement cooperates with a graduated scale **58** which is visible from the front panel of the control box and which is graduated to indicate compass direction.

The circuit constants are so chosen and the potentiometer **48** in the voltage divider circuit is adjusted so that the voltage impressed across the meter **44** and the potentiometer **56** in series is such that when the antenna is at one extreme of its rotation, the meter needle **44***d* is at one end of the scale **58** and when the antenna is at the other extreme of its rotation, the needle **44***d* is at the other end of the scale. The potentiometer **56** has a special logarithmic taper which makes the calibration of the scale **58** substantially linear.

As shown in Figure 2, the lamp **32** and photocell **34** are mounted respectively in housings **60** and **62** spaced apart a short distance to permit the needle **44***a* of the meter **44** to pass between the two housings. At their proximate faces, the housings **60** and **62** are respectively provided with narrow slits **60***a* and **62***a* which are centered on the optical axis of the lamp **32** and photocell **34** and which are radial with respect to the axis of the meter movement **44** so that they are parallel with the needle **44***a* when the needle is between the slits. The slits are narrower than the needle (e. g., .025" wide) so that when the needle is aligned with the slits, it cuts off all of the light passing from the lamp **32** to the photocell **34**.

The two housings **60** and **62** are secured at the upper end of a bracket **64** which is mounted for rotation about an axis which coincides with the axis of rotation of the needles **44***a* and **44***d*. This bracket **64** has at its lower end a sector gear **64***a* which meshes with a pinion **66** fixed on the rear end of a shaft **70** which projects through the front panel of the control box and carries at its outer end a control knob **68**. By rotation of the knob **68**, the lamp **32** and photocell **34** may thus be moved to any rotational position within the range of the needle **44***a*. The bracket **64** has mounted at its forward end an indicator needle **64***b* which also cooperates with the meter scale **58** to indicate the rotational position for which the control circuit has been set by the knob **68**.

The shaft **70** of the control knob **68** includes a spring loaded friction brake **72**, so that the knob **68** must be depressed before it may be rotated. The shaft **70** also has

mounted on it a cam **74** which cooperates with the actuating push-button of the aforementioned momentary contact switch **30**, so that the switch **30** is automatically closed each time the control knob **68** is rotated.

One terminal **26***a* of the secondary winding of the motor transformer **26** is connected through a terminal **52***c* on the terminal board **52**, one of the conductors of the cable **14**, and a terminal **54***c* on the terminal board **54** to a common terminal **76** of the two windings **78** and **80** of the antenna driving motor **82**. The remaining terminals **78***a* and **80***a* of these two motor windings are respectively connected to the two fixed contacts **84***a* and **84***b* of a single-pole, double-throw reversing switch generally indicated **84** which is mounted within the motor unit. The movable contact **84***c* of the reversing switch **84** is actuated by movement of the antenna (for example by a lug mounted on the aforementioned torque tube), the switch being actuated in one direction at one end of the rotation of the antenna and in the opposite direction at the opposite end of the rotation of the antenna, and being arranged so that the antenna is permitted rotation through an angle slightly in excess of 360 degrees, for example 365 degrees. The movable contact **84***c* of the reversing switch **84** is electrically connected through a terminal **54***e* on the terminal board **54**, one of the conductors of the cable **14**, a terminal **52***e* on the terminal board **52** and through a pair of normally closed contacts **40***b* and **42***b* of the aforementioned manually-operable switches **40** and **42** with the other terminal **26***d* of the motor transformer **26**.

Thus, assuming the manually-operable switches **40** and **42** are in their normal position, as shown, energization of the primary of the motor transformer **26** will cause one or the other of the motor windings **78** or **80** to be energized depending upon which of the contacts **84***a* or **84***b* of the reversing switch **84** is closed. When the winding **78** is energized, the motor will rotate the antenna in one direction, and when the winding **80** is energized the motor will rotate the antenna in the opposite direction. A capacitor **86** is connected across the motor windings **78** and **80** in conventional fashion.

The windings **78** and **80** may also be energized by actuation of the manual switches **40** and **42**, respectively. The common terminal **76** of these two windings is always connected to one terminal **26***c* of the secondary of the motor transformer **26**. The other terminal **78***a* of the winding **78** is connected through a terminal **54***a* on the terminal board **54**, one of the conductors of the cable **14**, and a terminal **52***a* on the terminal board **52** to a fixed contact **40***c* in the switch **40**. The switch **40** is a double-pole, double-throw switch wherein the contacts **40***b* and **40***c* cooperate with a movable contact **40***d* which is connected to the aforementioned fixed contact **42***b* in the switch **42**. The switch **42** is a similar double-pole, double-throw switch wherein the fixed contact **42***b* as well as another fixed contact **42***c* cooperate with a movable contact **42***d* which is connected to the aforementioned terminal **26***b* of the motor transformer **26**. The fixed contact **42***c* is connected through a terminal **52***b* on the terminal board **52**, a conductor in the cable **14**, and a terminal **54***b* on the terminal board **54** to the aforementioned terminal **80***a* of the winding **80**. It will thus be seen that actuation of the switch **40** to throw the movable contact **40***d* into engagement with the fixed contact **40***c* will energize the winding **78** through the contacts **40***c* and **40***d* of switch **40** and the contacts **42***b* and **42***d* of switch **42**. It will also be seen that actuation of the switch **42** will energize the winding **80** through the contacts **42***c* and **42***d* of the switch **42**.

Actuation of either of the switches **40** or **42** also connects the primaries of both the motor transformer **26** and the lamp transformer **28** with the power source through the following circuit: The terminals **26***b* and **28***b* of these two transformers are connected by means of a conductor **88** with a fixed contact **40***e* in the switch **40** and a fixed contact **42***e* in the switch **42**. The fixed contact **40***e*, along with the aforementioned fixed contact **40***a*, cooperates with a movable contact **40***f* of this single-pole, double-throw section of the switch **40**. The fixed contact **42***e*, along with the aforementioned fixed contact **42***a* of the switch **42**, similarly cooperates with a movable contact **42***f* of the switch **42**. Actuation of the switch **40** thus connects the terminals **26***b* and **28***b* of the transformers **26** and **28** to the terminal **22** of the power source through contacts **40***e* and **40***f* of switch **40**, and contacts **42***a* and **42***f* of switch **42**. Actuation of switch **42** connects these transformer terminals **26***b* and **28***b* to the terminal **22** of the power source through contacts **42***e* and **42***f* of switch **42**. The other terminals **26***a* and **28***a* of these transformers are connected to the other terminal **20** of the power source through the thermostatic switch **24**, as previously described. Thus, actuation of either of the switches **40** or **42** performs the following functions: (1) it energizes the primaries of both the motor transformer **26** and the lamp transformer **28**; (2) it connects the secondary of the motor transformer **26** to one or the other windings of the motor **82** to cause the antenna to rotate in the desired direction; and (3) it opens the circuit to the winding of the relay **36** and renders the automatic control circuit inoperative.

The switches **40** and **42** advantageously may be respectively arranged for actuation by rocking in opposite directions of a single, centrally-pivoted bar mounted at an accessible location on the control box.

The operation of this apparatus may be summarized as follows: With the plug **16** plugged into the outlet of a source of A. C. electrical power, and with the television receiver plugged into the receptacle **18**, whenever the television receiver is turned on, the thermostatic switch **24** will be closed. If the operator desires to rotate the antenna under a manual control, he may depress the switch **40** for rotation in one direction and the switch **42** for rotation in the opposite direction. The antenna will rotate in the desired direction until the end of its permissible travel is reached when a lug on the torque tube comes into engagement with a stop on the housing of the motor unit. The motor is of the type which draws only slightly more current when stalled than when rotating so that cutout switches to disconnect the motor at each end of its rotational movement are unnecessary.

As the antenna rotates, the movable arm **56***a* is moved along the resistive winding of the potentiometer **56**, causing the needles **44***a* and **44***d* of the meter **44** to move in accordance with the changing position of the antenna. The operator may either observe the antenna itself and rotate it until the desired direction is achieved, or he may observe the screen of the television set and rotate the antenna until the best reception is obtained. After a brief initial period of experimentation, the operator will determine the best rotational position for each of the television stations whose signals are regularly received in his location, and he may make notations of the antenna headings, as indicated on the scale **58** by the needle **44***d* of the meter **44**, or may merely mark these locations directly on the scale **58**.

Once the optimum rotational position has been ascertained for each transmitting station, the operator will probably prefer to use automatic control. In order to set the control box for automatic rotation to a desired position, the operator depresses the knob **68**, releasing the brake **72** and closing the switch **30**. This energizes the primaries of the transformers **26** and **28** and illuminates the lamp **32**. It also impresses a voltage across the photocell **34** and the relay **36** in series. As light from the lamp **32** impinges upon the photocell **34**, the winding of the relay **36** will be energized, closing its contacts **36***b* and **36***c*. The operator then rotates the knob **68** to place the pointer **64***b* in the position on the scale **58** corresponding to the desired rotational position of the antenna. When the operator releases the knob **68**, opening the switch **30**, the

primaries of the transformers **26** and **28** will continue to be energized by virtue of the closure of the holding relay **36**.

The motor **82** will thus rotate in a direction depending upon the position of the reversing switch **84**. If the antenna happens to be rotating in the direction of the desired rotational position, its rotation will bring the needle **44***a* of the meter directly into line with the slits **60***a* and **62***a* and shut off the light from the lamp **32** to the photocell **34**. This will increase the resistance of the photocell **34** and cause deenergization of the relay **36**, opening its contacts **36***b*, **36***c* and deenergizing the primaries of the transformers **26** and **28**. This will extinguish the lamp **32** and stop the motor **82** with the antenna in the desired position.

In case the reversing switch is in such position that the antenna is initially rotated in the direction opposite to that of the desired rotational position, the antenna will continue to rotate until it reaches the limit of its rotation in this direction, at which time the reversing switch **84** will be actuated to reverse the contacts to the motor **82** and cause rotation of the antenna in the opposite direction until the desired rotational position is reached, whereupon the device will be turned off.

The modified form of antenna rotator shown in Figures 3 and 4 is similar in construction and operation to that shown in Figures 1 and 2, except in the following respects:

(1) It employs a meter movement **90** having a single needle which is bent at right angles to provide two portions, **90***a* and **90***b*, the portion **90***a* being arranged to cooperate with a graduated scale **92** to indicate the position of the antenna, and the portion **90***b* being arranged to intercept the beam of light between the incandescent lamp **32** and the photocell **34'**.

(2) An improved type of photoelectric cell **34'** is employed having, when illuminated by the lamp **32**, resistance low enough to allow the series-connected relay **36** to be energized at a voltage not greater than the conventional domestic service line voltage of 115 volts R. M. S. This eliminates the necessity of the auto transformer connection on the primary winding of the transformer **28** (Figure 1) and makes it possible, as shown in Figure 3, to connect the photocell **34'** and relay **36** directly across the terminals of the power plug **16**. When the lamp **32** is not illuminated, the resistance of the photocell **34'** is so high that the amount of current drain is of the order of only a microampere or less, and is therefore negligible.

(3) A single transformer **94** is employed in lieu of the two transformers **26** and **28** in the circuit of Figure 1. The secondary of this transformer is tapped to provide a winding portion **94***a* which supplies 29 volts R. M. S. for the operation of the motor **82** and a winding portion **94***b* which supplies 6 volts for the illumination of the lamp **32**. The coil **90***b* of the meter **90** is connected in series with the potentiometer **56** across the secondary portion **94***a* of the transformer **94**. Thus, the meter **90** indicates only when the transformer **94** is energized—i. e. when the motor is actually running, either under manual control or under automatic control. This eliminates the necessity of the voltage dividing network **46**, **48**, **50** (Figure 1).

(4) The thermal switch **24** and the receptacle **18** for the television receiver (Figure 1) have been eliminated. Since the static current drain of the modified unit is negligible, it becomes unnecessary to turn the unit off when the television set is not operating.

(5) The motor capacitor **86** has been moved from the motor unit **10'** to the control unit **12'** where it is connected across the terminals **52***a* and **52***b* which are connected through the five-conductor cable **14** with the terminals **54***a* and **54***b* of the motor unit and thus across the motor windings **78** and **80**. The electrical circuit of the capacitor and motor therefore remains the same and only the physical location of the capacitor has been changed.

(6) The physical arrangement of the meter **90**, lamp **32** and photocell **34'** in the modified rotator, which is shown in Figure 4, is somewhat different. As may be seen in that figure, the horizontal portion **90***b* of the needle of the meter **90** is positioned so that its path intersects the light rays between the bulb **32** and the photocell **34'**. The lamp **32** and photocell **34'** are mounted on a molded plastic support **96** which is pivotally supported at its lower end on an axis coincident with that of the meter needle.

The support **96** may be rotated by means of a control knob **98** which is mounted at the front panel of the housing **100** of the control unit on a shaft **102** which also has fixed on it a pulley **104** about which is trained a dial cord **106**. This dial cord **106** is also trained about a pair of idler pulleys **107** and **108** which are rotatably supported at opposite sides of the housing **100** and extends inwardly from these pulleys to opposite sides of an eye **110** which is secured to the support **96**. Rotation of the knob **98** thus actuates the dial cord **106** to rotate the support **96** to various positions in accordance with the desired antenna position.

Projecting forwardly from the support **96** is a pointer **112** which extends through an opening **114***a* in a translucent screen **114** and cooperates with a graduated scale **92** printed on the translucent screen to indicate the rotational position to which the lamp **32** and photocell **34'** have been set. The vertical portion **90***b* of the meter needle also cooperates with this scale **92** to indicate the actual position of the antenna.

The face of the photocell **34'** directed toward the lamp **32** is painted except for a narrow slit **118** which is parallel to the horizontal portion **90***b* of the meter needle and which is narrower than the needle so that when the needle is in line with the unpainted slit, it will cut off all of the light from the lamp **32** to the photocell **34'**. This eliminates the necessity of the apertured housing shown in Figure 2.

As will be understood, the rotator shown in Figures 3 and 4 is simpler and therefore less expensive in construction than the embodiment of Figures 1 and 2, although the two units function in substantially the same manner.

From the foregoing description, it will be understood that the present invention provides a fully practical rotator apparatus capable of either manual or automatic remotely-controlled rotation to any selected position. It will therefore be understood that the aforementioned and other desirable objectives have been achieved. However, it should be emphasized that the particular embodiments of the invention which are shown and described herein are intended as merely illustrative and not as restrictive of the invention.

We claim:

1. A driving device for a movable member, comprising an electric motor connected to drive said movable member, a variable circuit element mechanically coupled to said movable member and adapted to vary the amplitude of an electrical current in accordance with the position of said movable member, a meter having a needle movable in accordance with the amplitude of said electrical current, a photo-sensitive cell and light source positioned adjacent the path of said needle whereby said needle will intercept the light rays traveling from said light source to said cell, said cell and said light source being movable relative to said meter to a position corresponding to a desired position of said movable member, said cell being connected to control the supply of electrical current to said motor, whereby said motor will drive said movable member until said needle reaches a position corresponding to said desired rotational position of said movable member and intercepts said light rays.

2. A remotely controlled driving device for a movable member, comprising an electric motor connected to drive said movable member, a variable circuit element mechanically coupled to said movable member and

adapted to vary the amplitude of an electrical current in accordance with the position of said movable member, a meter having a needle movable in accordance with amplitude of said electrical current, a scale mounted adjacent the path of said needle and being graduated to indicate the various compass directions of said movable member, a photo-sensitive cell and a light source positioned adjacent the path of said needle whereby said needle will intercept the light rays traveling from said source to said cell, said cell and said light source being movable relative to said meter to a position corresponding to a desired position of said movable member, said cell being connected to control the supply of electrical current to said motor, whereby said motor will rotate said movable member until said needle reaches a position corresponding to said desired position of said movable member and intercepts said light rays.

3. A remotely controlled driving device for a movable member, comprising an electric motor connected to drive said movable member, a variable circuit element mechanically coupled to said movable member and adapted to vary the amplitude of an electrical current in accordance with the position of said movable member, a meter having two needles movable in accordance with amplitude of said electrical current, a scale mounted adjacent the path of one of said needles and being graduated to indicate the various compass directions of said movable member, a photo-sensitive cell and a light source positioned adjacent the path of the other of said needles whereby said other needle will intercept the light rays traveling from said source to said cell, said cell and said light source being movable relative to said meter to a position corresponding to a desired position of said movable member, said cell being connected to control the supply of electrical current to said motor, whereby said motor will rotate said movable member until said other needle reaches a position corresponding to said desired position of said movable member and intercepts said light rays.

4. A rotator for a rotatable member, comprising an electric motor geared to rotate said rotatable member, a variable circuit element mechanically coupled to said rotatable member and adapted to vary the amplitude of an electrical current in accordance with the rotational position of said rotatable member, a meter having a needle rotatable to various positions in accordance with amplitude of said electrical current, a scale mounted adjacent the path of said needle and being graduated to indicate the various compass directions of said rotatable member, a photo-sensitive cell and a light source positioned at opposite sides of the path of said needle whereby said needle will intercept the light rays traveling from said source to said cell, said cell and said light source being secured on a supporting member which is mounted for rotation about an axis approximately coincident with the axis of rotation of said needle, said supporting member carrying a pointer cooperating with said scale for indicating the position of said cell and said light source and facilitating their rotation to a position corresponding to the desired rotational position of said rotatable member, and said cell being connected to control the supply of electrical current to said motor, whereby said motor will rotate said rotatable member until said needle reaches a position corresponding to said desired rotational position of said rotatable member and intercepts said light rays.

5. A rotator for a rotatable member, comprising an electric motor geared to rotate said rotatable member, a variable circuit element mechanically coupled to said rotatable member and adapted to vary the amplitude of an electrical current in accordance with the rotational position of said rotatable member, a meter having a single needle bent to provide two portions at right angles rotatable about a pivot at the end of said needle to various positions in accordance with amplitude of said electrical current, a scale mounted opposite the path of the portion of said needle adjacent said pivot and being graduated to indicate the various compass directions of said rotatable member, a photo-sensitive cell and a light source positioned at opposite sides of the path of the other portion of said needle whereby said needle will intercept the light rays traveling from said source to said cell, said cell and said light source being secured on a supporting member which is mounted for rotation about an axis approximately coincident with the axis of rotation of said needle, said supporting member carrying a pointer cooperating with said scale for indicating the position of said cell and said light source and facilitating their rotation to a position corresponding to the desired rotational position of said rotatable member, and said cell being connected to control the supply of electrical current to said motor, whereby said motor will rotate said rotatable member until said needle reaches a position corresponding to said desired rotational position of said rotatable member and intercepts said light rays.

6. A rotator for a rotatable member, comprising an electric motor geared to rotate said rotatable member, a variable circuit element mechanically coupled to said rotatable member and adapted to vary the amplitude of an electrical current in accordance with the rotational position of said rotatable member, a meter having two needles rotatable on a common axis in accordance with amplitude of said electrical current, a scale mounted adjacent the path of one of said needles and being graduated to indicate the various compass directions of said rotatable member, a photo-sensitive cell and a light source positioned adjacent the path of the other of said needles whereby said other needle will intercept the light rays traveling from said source to said cell, said cell and said light source being secured on a supporting member which is mounted for rotation about an axis approximately aligned with the axis of rotation of said needles, said supporting member carrying a pointer cooperating with said scale for indicating the position of said cell and said light source and facilitate their rotation to a position corresponding to the desired rotational position of said rotatable member, and said cell being connected to control the supply of electrical current to said motor, whereby said motor will rotate said rotatable member until said needle reaches a position corresponding to said desired rotational position of said rotatable member and intercepts said light rays.

7. A rotator for a rotatable member, comprising a reversible electric motor geared to rotate said antenna, a variable circuit element mechanically coupled to said rotatable member and adapted to vary the amplitude of an electrical current in accordance with the rotational position of said rotatable member, a meter having a needle movable in accordance with the amplitude of said electrical current, a photo-sensitive cell and light source positioned adjacent the path of said needle whereby said needle will intercept the light rays traveling from said light source to said cell, said cell and said light source being movable relative to said meter to a position corresponding to a desired rotational position of said rotatable member, said cell being connected to control the supply of electrical current to said motor, a reversing switch connected to change the connections to said motor and control the direction of rotation of said rotatable member, said reversing switch being arranged to be actuated when said rotatable member reaches opposite extremes of its full rotational travel of approximately 360°, whereby said motor will rotate said rotatable member until said needle reaches a position corresponding to said desired rotational position of said rotatable member and intercepts said light rays.

8. A rotator for a rotatable member, comprising a reversible electric motor geared to rotate said antenna,

a variable circuit element mechanically coupled to said rotatable member and adapted to vary the amplitude of an electrical current in accordance with the rotational position of said rotatable member, a meter having a needle movable in accordance with the amplitude of said electrical current, a photo-sensitive cell and light source positioned adjacent the path of said needle whereby said needle will intercept the light rays traveling from said light source to said cell, said cell and said light source being movable relative to said meter to a position corresponding to a desired rotational position of said rotatable member, said cell being connected to control the supply of electrical current to said motor whereby said motor will rotate said rotatable member until said needle reaches a position corresponding to said desired rotational position of said rotatable member and intercepts said light rays, and a manually-operable switch arranged so as to permit electrical current to be supplied to said motor independently of said cell and cause rotation of said rotatable member in either direction as desired.

9. A rotator as claimed in claim 8 wherein said manually operable switch includes normally closed contacts connected in the circuit of said cell whereby said cell becomes inoperative to supply current to said motor during the time said manually-operable switch is being manually operated.

10. A rotator for a rotatable member, comprising an electric motor geared to rotate said rotatable member, a variable circuit element mechanically coupled to said rotatable member and adapted to vary the amplitude of an electrical current in accordance with the rotational position of said rotatable member, a meter having a needle movable in accordance with the amplitude of said electrical current, a photo-sensitive cell and electric lamp positioned adjacent the path of said needle whereby said needle will intercept the light rays traveling from said electric lamp to said cell, said cell and said lamp being movable relative to said meter to a position corresponding to a desired rotational position of said rotatable member, said cell being connected in circuit with the winding of a relay whose contacts are connected to control the supply of current to the winding of said motor and to said lamp, and a normally-open, momentary contact manually-operable switch connected across said relay contacts whereby actuation of said manually-operable switch will illuminate said lamp and start said motor, and said motor will continue to rotate said rotatable member until said needle reaches a position corresponding to the desired rotational position of said rotatable member and intercepts said light rays.

11. A rotator for a rotatable member, comprising an electric motor geared to rotate said rotatable member, a variable circuit element mechanically coupled to said rotatable member and adapted to vary the amplitude of an electrical current in accordance with the rotational position of said rotatable member, a meter having a needle movable in accordance with the amplitude of said electrical current, a scale mounted adjacent the path of one of said needles and being graduated to indicate the various

compass directions of said rotatable member, a photo-sensitive cell and an electric lamp positioned adjacent the path of the other of said needles whereby said other needle will intercept the light rays traveling from said source to said cell, said cell and said lamp being secured on a supporting member which is mounted for rotation about an axis approximately aligned with the axis of rotation of said needles, said supporting member carrying a pointer cooperating with said scale for indicating the position of said cell and said lamp and facilitate their rotation to a position corresponding to the desired rotational position of said rotatable member, said cell being connected in circuit with the winding of a relay whose contacts are connected to control the supply of current to the winding of said motor and to said lamp, a normally-open, momentary contact, manually-operable switch connected across said relay contacts, a single control member adapted to cause rotation of said support and to cause actuation of said switch whereby movement of said control member to set said pointer will illuminate said lamp and start said motor, and said motor will continue to rotate said rotatable member until said needle reaches a position corresponding to the desired rotational position of said rotatable member and intercepts said light rays.

12. A rotator for a rotatable member, comprising an electric motor geared to rotate said rotatable member, a variable circuit element mechanically coupled to said rotatable member and adapted to vary the amplitude of an electrical current in accordance with the rotational position of said rotatable member, a meter having a needle movable in accordance with the amplitude of said electrical current, a photo-sensitive cell and light source positioned adjacent the path of said needle whereby said needle will intercept the light rays traveling from said light source to said cell, said cell and said light source being movable relative to said meter to a position corresponding to a desired rotational position of said rotatable member, said cell being connected to control the supply of electrical current to said motor, whereby said motor will rotate said rotatable member until said needle reaches a position corresponding to said desired rotational position of said rotatable member and intercepts said light rays, and a manually-operable switch arranged to connect said motor to said source of electrical current whereby said motor may be controlled either manually or automatically.

13. A rotator as claimed in claim 12 in which said manually-operable switch includes normally closed contacts in the circuit of said photocell to render said photocell ineffective to cause rotation of said motor when said manually-operable switch is actuated.

References Cited in the file of this patent

UNITED STATES PATENTS

1,957,240	Young	May 1, 1934
2,289,242	Chance et al.	July 7, 1942
2,361,973	Smith	Nov. 7, 1944
2,377,698	Kettering et al.	June 5, 1945