June 21, 1955 E. L. BARRETT 2,711,527

DIRECTIONAL CONTROL MECHANISM FOR ANTENNAS

Filed June 7, 1951 3 Sheets-Sheet 1

Fig. 1

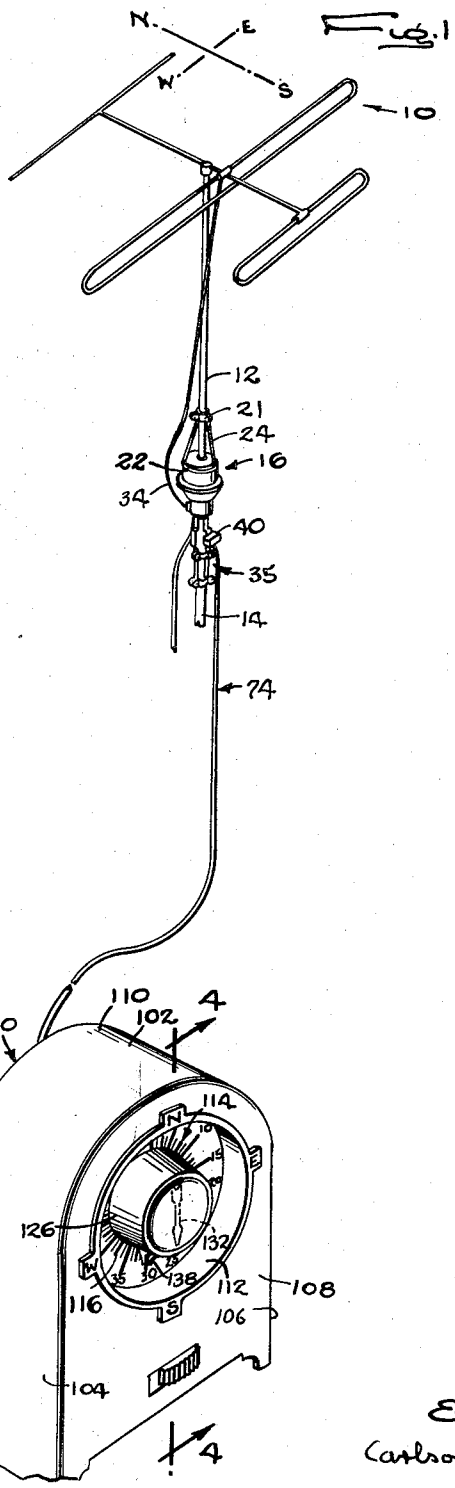
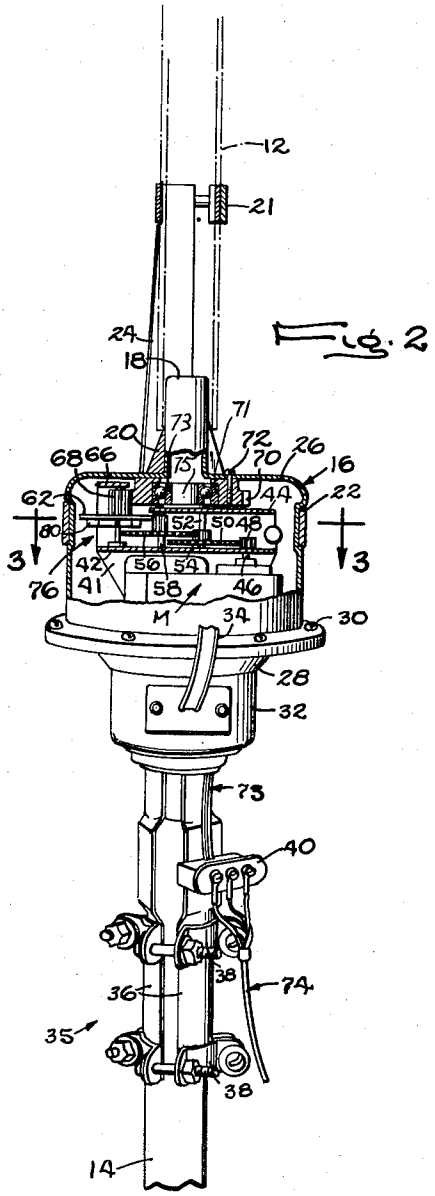


Fig. 2



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DIRECTIONAL CONTROL MECHANISM FOR ANTENNAS

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Fig. 3

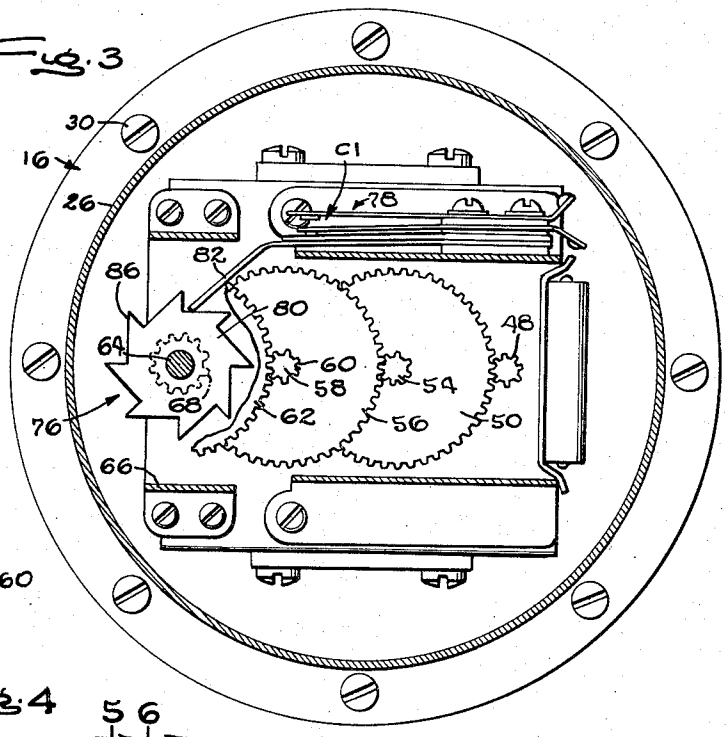


Fig. 6

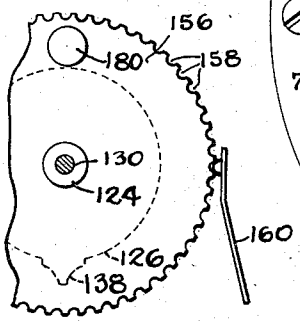


Fig. 4

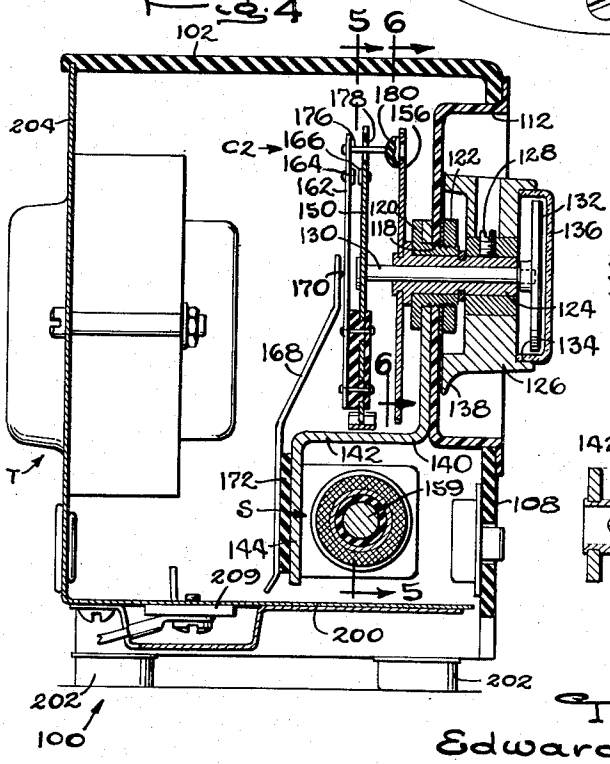
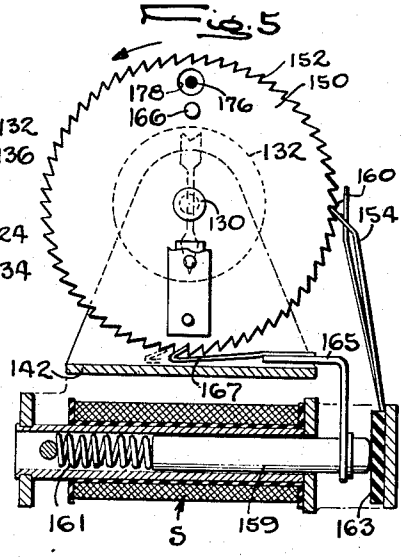


Fig. 5



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DIRECTIONAL CONTROL MECHANISM FOR ANTENNAS

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Fig. 7

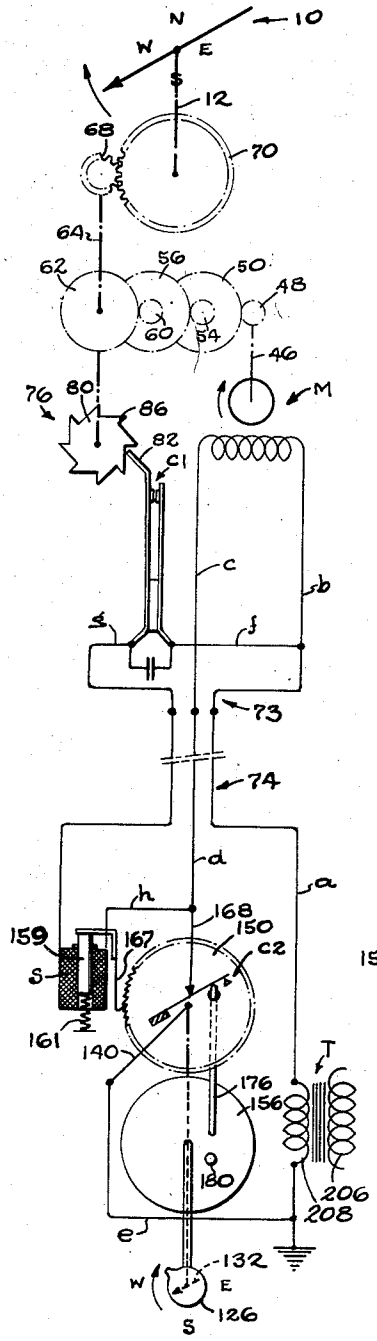


Fig. 8

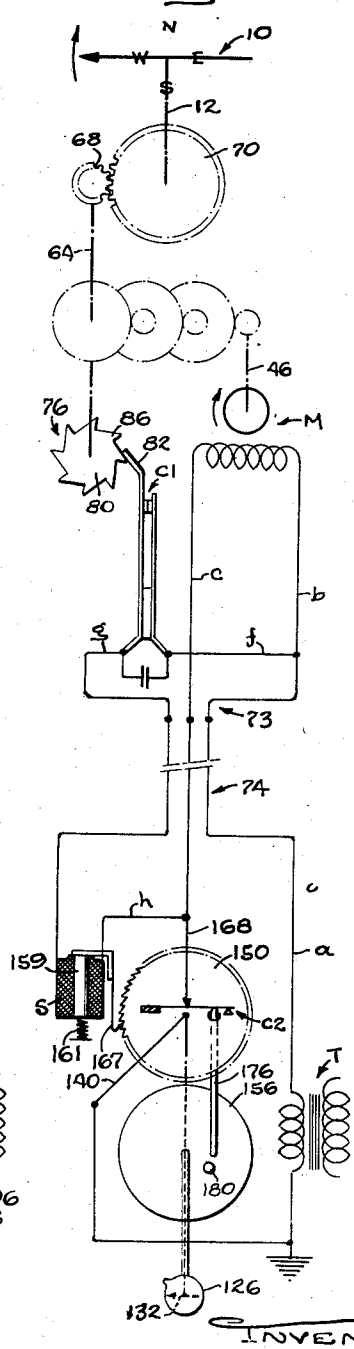
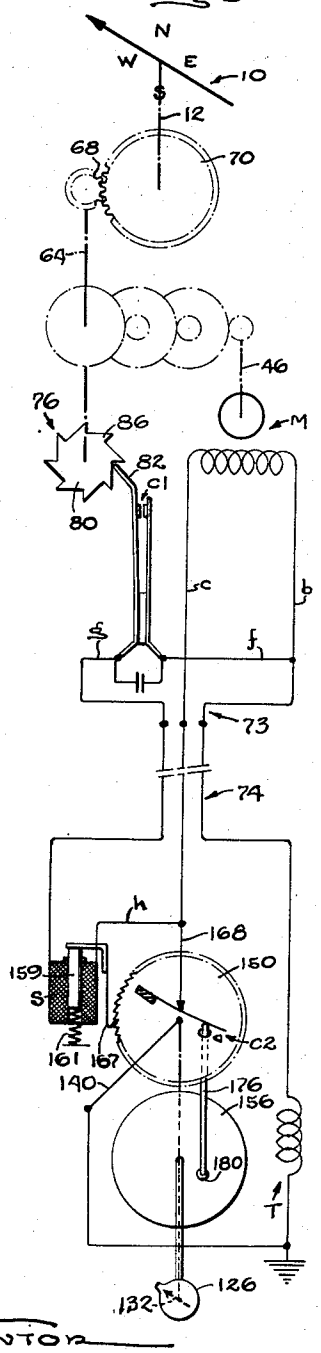


Fig. 9



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United States Patent Office 2,711,527 Patented June 21, 1955

2,711,527

DIRECTIONAL CONTROL MECHANISM FOR ANTENNAS

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Application June 7, 1951, Serial No. 230,266

8 Claims. (Cl. 340—226)

The present invention relates to a directional control system for signal receiving antennas whereby the antenna mast may be selectively rotated to bring the antenna to a predetermined position of orientation conducive toward the reception of maximum signal strength from any selected transmitting station.

The present invention has been designed for use and illustrated herein in connection with television receiving antenna but it will be understood that the principles of the invention are applicable to use in the control of the position of other types of antenna structures, whether the same be employed for transmitting or receiving signals, and whether the signals be of relatively high or low frequency.

Because of the relatively high frequencies employed in connection with the transmission of television signals, the signals are directional and are possessed of a limited range. In order to increase the possibility of signal reception such antennas are ordinarily mounted as high as practicable above the earth's surface, and in order to attain maximum signal strength from the different transmitting stations, the receiving antennas are frequently mounted for rotation about a vertical axis so that they may be readily oriented in the direction of the particular transmitting station whose signal is to be received.

It is among the principal objects of the present invention to provide a remote control means for rotating an antenna on its support, together with indicating means for indicating the directional position of the antenna at the remote control location or station. For convenience, in carrying out the above mentioned object, the remote control station will ordinarily be situated in the vicinity of the television receiver in order that the person or persons in attendance at the receiver may control the rotation of the antenna and at all times be apprised of the directional position of the antenna under control.

A more specific object of the invention is to provide a remote control system for regulating the directional position of an antenna which is, in the main, of an electrical nature and which includes a driving motor operatively geared to the antenna supporting mast, a direction indicator located at the control station, and a telemetering sysem operatively connecting the motor and indicator whereby the indicator is caused to follow the directional movements of the antenna so that the position of the former will at times render an indication of the position of the latter.

Another object of the invention is to provide a system of this character including a movable control member which may be set to a predetermined directional position and which, when so set, will effect energization of the antenna driving motor and maintain such energization of the motor until such time as the indicator, in following the movements of the rotatable antenna, moves into a position of register or coincidence with the control member.

In carrying out this last mentioned object, the invention contemplates the provision of a stepping magnet for the indicator which is so designed that upon initial energization thereof the stepping impulse will be stored for subsequent use and released only when deenergization of the magnet takes place. A circuit maker and breaker is arranged in the magnet circuit and, additionally, a pair of normally closed contacts which remain open when the indicator and control member are in coincidence are disposed in the circuit in series with the magnet. Thus, if the antenna structure comes to rest when the contacts of the circuit maker and breaker are open, no further impulse is received by the stepping magnet. If, on the other hand, the antenna structure overruns its position before coming to rest so that the contacts of the circuit maker and breaker become closed when the antenna structure comes to rest, the open contacts in the magnet circuit existing by virtue of coincidence between the indicator and control knob, prevent a current impulse from reaching the magnet. Thus, the indicator can at no time overrun the control knob by virtue of a stored impulse in the circuit. By the same token, when the antenna structure comes to rest with the contacts of the circuit maker and breaker closed, manual setting of the control member to a new position out of coincidence with the indicator will merely serve to initiate an impulse in the stepping magnet, and this impulse will be stored until such time as movement of the antenna structure brings the latter into coincidence with the indicator.

Another object of the invention is to provide a follow-up system of the character briefly outlined above in which the antenna rotating motor is of the unidirectional type so that the follow-up movements of the motor, and consequenly of the antenna, in seeking a position commensurate with the adjusted position of the control member, will always be in the same direction regardless of whether large or small increments of position change are involved.

A further object of the invention is to provide a follow-up system of this sort in which any tendency for a hunting action between the antenna driving motor and the control member are eliminated.

Another object is to provide a directional control system for antennas including a telemetering circuit between the movable member or antenna and the indicating member so that the latter will at all times indicate the position of the former and in which movement of the indicator is effected intermittently under the control of a stepping magnet which, in turn, receives impulses under the control of a circuit maker and breaker actuated by the antenna driving motor. A similar and related object is to provide a telemetering system of this character in which the impulses received by the stepping magnet are initiated upon closing of the telemetering circuit by the circuit maker and breaker and are subsequently released for actual stepping of the indicator when the circuit is opened. By such an arrangement limited overrunning of the antenna will not cause overrunning of the indicator to an extent sufficient to effect an out-of-phase condition between the indicator and antenna during the next succeeding cycle of antenna adjustment.

A further object of the invention is to provide a directional control system for antenna masts in which the control mechanism at the control station is portable and, toward this end, extremely compact.

Another object is to provide such a system in which the driving and control mechanism at the antenna location is likewise extremely compact and is entirely enclosed and shielded against the ingress of moisture and dirt.

Still another object is to provide a device of this nature which may be readily marketable as an attachment for existing antenna installations.

Other objects and advantages of the invention, not at this time enumerated, will become more readily apparent as the nature of the invention is better understood.

In the accompanying three sheets of drawings forming

a part of this specification, one embodiment of the invention has been shown.

In these drawings:

Figure 1 is a perspective view, somewhat schematic in its illustration, of an erected antenna system showing the improved control mechanism of the present invention applied thereto.

Fig. 2 is a side elevational view of the mast supporting structure in Fig. 1. In this view, certain parts have been broken away to more clearly reveal the nature of the control instrumentalities associated with the mast supporting structure.

Fig. 3 is a sectional view taken substantially along the line 3—3 of Fig. 2.

Fig. 4 is a sectional view taken substantially along the line 4—4 of Fig. 1.

Fig. 5 is a sectional view taken substantially along the line 5—5 of Fig. 4.

Fig. 6 is a sectional view taken substantially along the line 6—6 of Fig. 4.

Fig. 7 is a circuit diagram of the directional antenna control system showing the control knob thereof set for a predetermined adjustment of the directional position of the antenna and prior to initial movement of the latter.

Fig. 8 is a diagrammatic view similar to Fig. 7 showing the antenna and follow-up indicator in the course of their respective movements toward the predetermined angular position, and

Fig. 9 is a diagrammatic view similar to Figs. 7 and 8 showing the relative positions of the various mechanical and electrical parts employed after adjustment of the antenna to the predetermined angular position has been attained.

While the invention is susceptible of various modifications and alternative constructions, there is shown in the drawings and will herein be described in detail the preferred embodiment, but it is to be understood that it is not thereby intended to limit the invention to the form disclosed, but it is intended to cover all modifications and alternative constructions falling within the spirit and scope of the invention as expressed in the appended claims.

Briefly, the present invention contemplates the provision of an antenna mast supporting structure for maintaining in upright coaxial relation, fixed and rotatable mast sections and embodying means for gripping the mast sections which is capable of accommodating a relatively wide range of mast sizes. The control mechanism for actuating the rotatable mast section includes one set of instrumentalities located at the outlying antenna location, and another set of instrumentalities located at the control station which may be in the vicinity of the television receiver. Among the control instrumentalities located at the outlying station are a driving motor which is operatively geared to the rotatable mast section for driving the same in one direction. The control instrumentalities at the control station include a fixed reference indicator and a rotatable control knob which may be manually adjusted to any desired position with respect to the fixed reference indicator. The control instrumentalities at the control station also include a movable follow-up direction indicator which is adapted at all times to indicate the true directional position of the rotatable antenna mast. A circuit maker and breaker at the outlying station and operable under the control of the antenna driving motor is adapted to control the stepping movements of the direction indicator at the control location.

Two electric circuits are involved, one for controlling the energization of the driving motor and the other for controlling the energization of the stepping magnet. The circuit arrangement is such that when the control knob and direction indicator at the control station are in coincidence, the circuit through the electric driving motor and the circuit through the stepping magnet are both open. When the control knob is moved out of coincidence with the direction indicator, as for example, when it is set to a predetermined position with respect to the fixed direction indicator, to which position it is desired that the antenna shall be rotated, the circuit through the driving motor is closed and the driving motor commences its operation of driving the rotatable antenna mast in one direction toward its ultimate destination. As soon as the driving motor has commenced its rotation, the circuit maker and breaker which now exists in a potentially closed circuit including the stepping magnet for the direction indicator, commences a series of periodic opening and closing movements. These movements serve to periodically energize the stepping magnet which in turn causes a periodic stepping or indexing of the direction indicator which then operates to "follow-up" the previously adjusted control knob. Such stepping operations take place until such time as the movable direction indicator moves into coincidence with the previously adjusted control knob and at this time the circuit through the driving motor as well as the circuit through the stepping magnet and circuit maker and breaker is opened thus rendering the entire set of control instrumentalities inoperative until such time as the control knob is again moved to a new position out of coincidence with the direction indicator.

Referring now to Figs. 1 and 2 of the drawings, the antenna installation includes the usual assembly of antenna elements designated in their entirety at **10** and which are suitably mounted upon a rotatable antenna mast section **12**. A fixed mast section **14** is disposed in coaxial alinement with the rotatable mast section **10**, and the two sections are coupled together for rotation of the section **12** with respect to the section **14** by means of a control assembly including a housing **16** in which is disposed all of the control elements and instrumentalities at the outlying station.

The housing **16** is provided with a coaxially disposed, upwardly projecting post **18** which is adapted to be inserted in the lower end of the rotatable mast section **12**. In order to accommodate masts of various internal diameters, the post **18** is provided with a split conical bushing **20** therearound having an axial bore therein for reception of the post. It will be apparent that masts of relatively small internal diameters will engage the bushing **20** adjacent the upper region thereof, while masts of larger internal diameters will move further downwardly on the bushing.

The rotatable mast section **12** is mounted in coaxial relationship on the housing **16** by means of a supporting structure including an expansible and contractible clamping band **21** adapted to engage the mast section **12** at a region spaced upwardly above the housing **16** and a similar contractible band **22** adapted to engage the housing **16**. A series of struts or supports **24** serves to connect the two bands **21** and **22** and maintain the rotatable mast structure or section **12** upright.

The housing **16** is formed in two sections including an upper section **26** and a lower section **28**, the two sections being suitably secured together as by means of attachment screws **30**. Means are provided whereby a rotary connection is obtained between the housing **16** and the fixed mast section **14**. This means forms no part of the present invention, and for a full disclosure thereof reference may be had to my copending application, Serial No. 243,108, filed August 22, 1951, for an Antenna Rotator, now Patent No. 2,668,920. It is deemed sufficient to state, for purposes of illustration that this connecting means includes a lower well or extension **32** formed on the lower casing section **28** and in which there is disposed a slip ring construction by means of which the rotatable and non-rotatable ends of the antenna lead-in wire tape or strap **34** may be electrically joined together as well as through which the circuit wires employed in connection with the present control system may pass. A sealing gasket **35** serves to seal the well **32** and clamping mechanism **35** against

ingress of moisture or other foreign material. The slip ring construction forms no part of the present invention, and reference may be had to another copending application, Serial No. 230,267, filed June 7, 1951, for a Lead-In System for Rotatable Antennas for a full disclosure of this device.

Referring now to Fig. 2, the upper end of the non-rotatable mast section **14** is adapted to be received within a clamping mechanism **35** including axially extending clamping arms **36** and sectional clamping bands **38**. One of these clamping arms **36** serves to support thereon a terminal block **40** by means of which the circuit wires leading from the control station are connected to the antenna rotating assembly. The nature of the clamping assembly **35** may be determined by reference to my copending application, Serial No. 230,268, filed June 7, 1951, for an Antenna Mast Clamp, now Patent No. 2,692,745.

The upper ends of the clamping arms **36** project through the lower section **28** of the casing **16** and carry at their upper ends a stationary cage or framework **41** within which there is supported the driving motor M for the rotatable mast section **12**. Thus when the mast section **12** is fixedly secured to the upper housing section **26**, rotation of the mast section **12** is obtained by rotating the entire housing **16** under the driving influence of the motor M.

The cage **41** is provided with a top wall **42** to which there is secured an inverted U-shaped bracket **44**. The motor M is provided with a motor shaft **46** on which there is mounted a gear **48** (Figs. 2 and 3) which meshes with a larger gear **50** mounted on a shaft **52** journaled between the top wall **42** of the cage and the bracket **44**. A small gear **54**, which may be integrally formed with the gear **50**, meshes with a larger gear **56** carried on a shaft **58** likewise journaled between the top wall **42** of the cage **41** and the bracket **44**. A small gear **60**, which may be integrally formed with the gear **56**, meshes with a gear **62** mounted on a shaft **64** rotatably journaled between the top wall **42** of the cage **41** and the upper portion of a second inverted U-shaped bracket **66** suitably secured to the cage **41**. A gear **68** is secured to the shaft **64** and is in constant mesh with a ring gear **70** which is centrally disposed within the upper casing section **42** and is secured in position by means of a series of radially spaced anchoring bolts **72**. The ring gear **70** is recessed centrally to provide a socket **71** therein for reception of a thrust bearing **73** rotatively mounted on a post **75** carried on the bracket **44**. The bearing **73** absorbs substantially all of the downward vertical thrust of the antenna installation, and relieves the resilient sealing gasket **35** provided on the lower portion of the well **32**. From the above description of parts, it will be seen upon energization of the motor M and consequent rotation of the motor shaft **46** a direct drive will exist through the train of gears including the gears **48, 50, 54, 60, 62, 68** and **70** to the housing **16** on which the rotatable mast section **12** is mounted. Since the motor M is of the unidirectional type, any change in the directional position of the antenna will, of course, occur by rotation of the mast section **12** in a clockwise direction as viewed in Figs. 7, 8 and 9.

As will be more fully explained in connection with the wiring diagrams of Figs. 7, 8 and 9, the electrical connections for the motor include lead in wires collectively designated at **73** in Fig. 2 which extend from the terminal block **40** and pass through the slip ring construction **32** and are connected to the binding posts (not shown) of the motor M. The wires **73** are connected to respective wires **74** leading to the outlying antenna location from the control station.

Referring now to Fig. 3, the motor M has associated therewith an impulse transmitter mechanism designated in its entirety at **76** and including a contact assembly **79** and a rotary transmitter wheel **80** mounted on the shaft **64**. The contact assembly **78** includes a pair of normally open contacts C1 and an operating finger **82** therefor, the end of which projects into the path of movement of a series of peripheral teeth **86** provided on the transmitter wheel **80**. It will be seen that upon energization of the motor M and consequent rotation of the shaft **64** and transmitter wheel **80**, the normally open contacts C1 will be periodically closed in order to send electrical impulses to the control station for purposes that will be made presently. The contacts C1 are also connected to the wires **73** which in turn are connected through the binding posts to the wires **74**, respectively.

Referring now to Figs. 1, 4, 5 and 6, the mechanism at the control station, which may be located in the vicinity of the television receiver, is in the form of a small, unitary, contact control box or cabinet designated in its entirety at **100** and including an outer casing **102** having side walls **104** and **106**, a front or panel wall **108**, and a domelike top wall **110**. The front wall **108** is provided with a circulr opening **112** therein in which there is nested a cup-shaped dial unit **114** which may be calibrated with a series of radially spaced indicia marks **116**, the space between adjacent indicia marks representing 6° of angular turning movement of the antenna **10**. The cup-shaped dial unit **114** is provided with a central opening **118** therein in which there is secured a bushing **120**. A nut **122** serves to secure the bushing **120** in position within the opening **118**. A sleeve **124** projects completely through the bushing **120** and the forward end of the sleeve is adapted to receive thereon a control knob **126** which is secured in position by means of a set screw **128**. A shaft **130** extends through the sleeve **124** and the forward end thereof frictionally receives thereon an indicator or pointer **132** which is disposed within a recess **134** formed in the front face of the knob **126** and which is adapted to be covered by means of a transparent cover **136**, the rim portion of which is seated within the recess **134**. The control knob **126** is provided with a pointer **138** designed for cooperation with the various indicia marks **116** provided on the face of the dial member **114**.

Supported solely by the sleeve **124** is a bracket **140** having a laterally extending portion **142** and a downwardly extending portion **144** to which latter portion there is secured a solenoid assembly S.

According to the present invention, the indicator **132** is adapted to render an indication of the position of the antenna **10** whenever the antenna is at rest in a predetermined position. The control knob **126** is provided for the purpose of selecting a new antenna position, and when the pointer **138** thereof is swung to a position representing the desired antenna position, mechanism is set into motion for energizing the motor M and causing the antenna **10** to rotate toward the desired new position. As soon as such rotation of the antenna commences, the previously described transmitter **76**, at the outlying location, is set into operation and impulses are forwarded to the solenoid S, and by means of this solenoid the indicator **132** is caused to follow the positions of the antenna as the same moves toward its predetermined, selected new location, at which time the indicator **132** moves into register with the pointer **138**, and at this time current for energizing the motor M is interrupted so that the antenna comes to rest.

In order to effect closing of the motor circuit, when the control knob **126** is moved to a new location representing a desired angular position of the antenna **10**, and in order to effect follow-up movement of the indicator **132** as briefly outlined above, the inner end of the shaft **130** has mounted thereon a disk **150** (Figs. 4 and 5) having a series of ratchet teeth **152** thereon. A holding pawl **154** cooperates with the teeth **152** in preventing reverse movement thereof. The disk **150** is adapted for rotational stepping or indexing movements

in a counterclockwise direction as indicated by the arrow in Fig. 5.

In order to step or index the disk **150**, the solenoid S is provided with a movable core **159** which is spring pressed as at **161** to an extended position wherein it bears against a resilient limit stop **163**. The core **159** carries an angle piece **165** to which there is secured a pawl **167** which cooperates with the teeth **152** provided on the disk **150**. It will be seen, therefore, that upon energization of the solenoid S, the core **159** will be retracted against the action of the spring **161** thus causing the pawl **167** to move over one of the teeth **152** on the disk **150** and assume a retracted position so that upon de-energization of the solenoid S the spring **161** will move the core **159** to its advanced position, thus carrying with it the pawl **167** and advancing the disk **150** throughout one increment of motion representing 6° of rotation of the indicator **132**.

The rear end of the sleeve **124** carries a second disk **156** thereon having a series of detent teeth **158** formed on the periphery thereof. The teeth **158** cooperate with a retaining pawl **160** which permits rotation of the disk **156** in either direction but restrains the same against such movement and serves to locate the disk **156** in any one of the sixty positions of angularity of which the disk **156** is capable of assuming.

Secured to for rotation therewith but spaced and insulated from the disk **150**, is a contact arm **162** carrying a movable contact element **164** designed for cooperation with a fixed contact element **166** which is secured to and rotatable with the disk **150**. The contact elements **164** and **166** cooperate to make up the pair of normally closed contacts designated in their entirety at **C2**. An electrical take-off arm **168** bears as at **170** against the contact arm **162** and is secured to an insulating block **172** mounted on the bracket **140**. Reference to Fig. 4 will reveal the fact that the contact **166** is electrically connected to the metal bracket **140** through the metal path leading through the disk **150**, shaft **130**, sleeve **124** to the bracket **140**. Thus, when the normally insulated contact arm **162** is moved in such a direction as to close the pair of contacts **C2**, the take-off arm **168** becomes electrically connected or "grounded" to the bracket **140**.

The free end of the contact arm **162** is provided with a laterally projecting finger **176** which projects through an opening **178** provided in the disk **150**. The free end of the finger **176** is designed for cooperation with a cam protuberance or button **180** formed of insulated material and carried on the disk **156** adjacent the periphery thereof. The contacts **C2** are adapted to remain closed during all relative positions of the two disks **150** and **156** except the one relative position between these two disks which exists when the cam protuberance **180** is in engagement with the finger **176**. Thus, as one or the other of the two disks rotates relative to its counterpart disk, a position of coincidence between the finger **176** and cam protuberance **180** will occur when a similar position of coincidence occurs between the indicator **132** and the control knob pointer **138**. At such a time the normally closed contacts **C2** will become opened.

A base member **200** extends across the open bottom end of the cabinet or casing **102** and is provided with a series of supporting feet **202** thereon. The base member **200** is provided with an upwardly extending portion **204** which constitutes a rear wall for the casing **102**. The upstanding portion **204** of the base member **200** serves to support thereon a transformer T (see also Figs. 7, 8 and 9), having a primary winding **206** and a secondary winding **208**. The base member **200** is provided with a terminal binding post assembly **209** by means of which the circuit wires **74** leading from the control cabinet **102** will be secured in position and operatively connected to the various electrical instrumentalities associated therewith in the manner illustrated in Figs. 7, 8 and 9.

In Fig. 7, the antenna is shown as occupying a directional position which may generally be referred to as southwest, and the control knob **126** is shown as having been moved to a position which may generally be referred to as northwest and which indicates that it is the desire of the operator to swing the antenna **10** to this northwest position. As soon as the control knob **126** assumes its new position and is moved away from its original position, the insulated cam protuberance or button **180** moves out of register with the finger **176** as shown in Fig. 4 and the contacts **C2** become closed, thus electrically connecting the frame or bracket **140** to one terminal of the transformer secondary winding **208**.

A circuit then exists from the secondary winding **208** of the transformer T through leads *a*, *b*, winding of the motor M, leads *c*, *d*, take-off arm **168**, contacts **C2**, and lead *e* back to the secondary winding **208**. Closure of the contacts **C2** thus establishes a circuit through the motor M to energize the same and upon rotation of the motor shaft **46** in the direction indicated by the arrow in Fig. 7 the train of gearing previously described and including the gears **48**, **50**, **54**, **56**, **60**, **62**, **68** and **70** serves to rotate the housing **16** of Fig. 2, and consequently the rotatable, mast section **12** and antenna **10** in a clockwise direction, as viewed in Fig. 7. Rotation of the antenna structure continues until such time as the insulated protuberance or button **180**, in its follow-up action, again engages the finger **176** thus opening the contacts **C2** and discontinuing the motor circuit.

Immediately upon energization of the motor M and consequent rotation of its shaft **46**, the impulse transmitter assembly **76** is set into operation. The gear ratio existing from the motor shaft **46**, through the train of gearing leading up to the transmitter wheel **80**, is so designed according to engineering exigencies that the transmitting wheel **80** will make one complete revolution while the antenna **10**, and consequently the indicator **132**, moves throughout an angle of 48°. In other words, inasmuch as there are eight teeth **86** on the wheel **80**, successive impulses created by the transmitter by virtue of the closing of the contacts **C1** will represent 6° increments of motion of the antenna and indicator. The impulse circuit leading through the contacts **C1** extends from the secondary winding **208** of the transformer T through leads *a*, *f*, contacts **C1**, lead *g*, the winding of the solenoiid S, leads *h*, *d*, take-off arm **168**, contacts **C2** (closed when the finger **176** and protuberance **180** are out of register) and lead *e* back to the secondary winding **208**. As each successive impulse is created by closure of the contacts **C1**, the solenoid S receives an impulse thereby advancing the pawl **167**, which after 6° of rotational movement of the antenna, is released to advance the disk **150**. The impulses are repetitive until such time as the finger **176** and button or protuberance **180** come into register, at which time the contacts **C2** become open, thus opening the impulse circuit just described as well as opening the motor circuit.

The arrangement of the solenoid S whereby impulses received thereby upon closure of the contacts **C1** are stored for subsequent release upon opening of the contacts **C1**, will preclude the possibility of the indicator **132** and the antenna **10** getting out-of-phase with each other due to overrunning of the motor M after a prolonged period of rotational sweep of the antenna, possibly augmented by a high wind. In such an event, even though the transmitter wheel **80** may overrun its normal position so as to cause closure of the contacts **C1**, the fact that the contacts **C2** are open as soon as the indicator **132** and pointer **138** come into register will prevent an impulse from being received by the solenoid S. Even though the contacts **C1** may remain closed after a particular angular setting of the antenna **10** has been effected, and even though these contacts will remain closed when the control knob **126** is again moved to a new setting, the impulse applied to the solenoid S through both contacts **C1** and

C2 will merely be the normal impulse that would ordinarily be applied when the antenna **10** arrived at its overrun position. In other words, any overrunning of the antenna throughout a few degrees of rotation will not be reflected by the indicator at the end of a particular cycle of operations but this reflection will immediately take place at the beginning of the next cycle of operations so that the antenna and indicator will at all times be in phase with each other during stepping operations.

To state the above in still another way, overrunning of the antenna to a slight degree will have no effect upon the indicator **132** during a particular cycle of operations. However, during the next cycle, such overrunning of the antenna will instantly be accounted for by a corresponding movement of the indicator and thereafter the indicator and antenna will move in unison.

In Fig. 8, the antenna **10** and transmitting wheel **80** are shown in a position wherein the contacts C1 are closed. In this view the solenoid S is energized and its core or armature **159** is retracted. The pawl **167** is also retracted and the spring **161** is compressed. Preparatory to opening of either the contacts C1 or C2, the antenna **10** has moved to substantially its west position and stepping operations are in progress. The indicator **132** is shown as assuming its west position and the contacts C2 are closed inasmuch as the indicator **132** is out of register with the pointer **138**.

In Fig. 9, the indicator **132** has moved into register with the pointer **138** and both these elements as well as the antenna **10** have assumed the northwest setting to which the control knob **126** has been adjusted. The contacts C2 are therefore open and the circuit through the motor is discontinued. Since there has been no overrunning of the antenna, the contacts C1 are also open but even if there had been overrunning of the antenna and closing of the contacts C1, the fact that the contacts C2 are open would preclude the possibility of an impulse of current being directed to the solenoid S.

I claim as my invention:

1. In a control device for a rotatable directional antenna, a motor adapted to be operatively connected thereto for rotating the same, a normally closed circuit for said motor, a movable indicator for indicating the directional position of the antenna, a settable control member movable into and out of register with the indicator, a stepping magnet for indexing the indicator throughout predetermined increments of motion, said magnet being operable upon energization thereof to become preset and operable upon de-energization to initiate the indexing operation of the indicator, a circuit for the magnet, an impulse emitter operable under the control of said motor for intermittently interrupting the magnet circuit, and means operable when the control member and indicator are in register for opening both of said circuits.

2. In a control device for a rotatable, directional antenna, a motor adapted to be operatively connected to the antenna in driving relationship, control means for operating said motor from a remote location, indicating means at said remote location for rendering a visual indication of the directional position of the antenna, said control means comprising an electric circuit for the motor including a source of current supply and a movable, settable control member, said indicating means including a movable indicator, said indicator and control member being relatively movable into and out of register with each other, a stepping magnet operable upon application of successive impulses thereto to index said indicator through predetermined increments of motion, an electric circuit for said stepping magnet, an impulse emitter operable under the control of said motor for successively energizing said stepping magnet, a pair of normally closed contacts common to said circuits and operable when closed to energize the magnet circuit and potentially close the magnet circuit for subsequent energization by said emitter, and means operable when said indicator and control member are in register for opening said contacts, said impulse emitter being effective when said control member is moved out of register with said indicator to effect repeated energization of said stepping magnet a number of times sufficient to advance the indicator into register with said control member.

3. In a control device for a rotatable, directional antenna, a motor adapted to be operatively connected to the antenna for rotating the same, a normally closed circuit for said motor, a movable indicator at a remote location for indicating the directional position of the antenna, a settable control member movable into and out of register with the indicator, a stepping magnet for indexing the indicator throughout predetermined increments of motion, a circuit for said magnet, an impulse emitter operable under the control of said motor for successively closing and opening the magnet circuit, a pair of normally closed contacts common to said motor and magnet circuits, and means operable when said control member and indicator are in register to open said pair of contacts.

4. In a control device for a rotatable, directional antenna, a motor operatively connected to the antenna for driving the same from one position of adjustment to another selected position of adjustment, a normally closed circuit for the motor, a rotatable settable position selector at a remote location, a rotatable indicator, said position selector and indicator being relatively movable into and out of register with each other, a stepping magnet for indexing the position indicator throughout predetermined increments of motion, a circuit for the magnet, a pair of emitter contacts disposed in said magnet circuit, means operable upon energization of said motor for intermittently opening and closing said emitter contacts, and means operable when said position selector and indicator are in register for opening both of said circuits to render said emitter ineffective.

5. In a control device for a rotatable, directional antenna, a unidirectional motor adapted to be operatively connected to the antenna for driving the same in one direction from one position of adjustment to another selected position of adjustment, a normally closed circuit for the motor, control mechanism for operating said motor from a remote location, said control mechanism comprising a rotatable settable position selector at said remote location, a rotatable indicator, said position selector and indicator being relatively movable into and out of register with each other, a solenoid for indexing the position indicator, said solenoid being operable upon initial energization thereof to become preset and being operable upon de-energization thereof to effect indexing of the position indicator, a circuit for the solenoid, an impulse emitter in said circuit and operable under the control of said motor for successively energizing said solenoid, and means operable when said position selector and indicator are in register for opening both of said circuits to render said emitter ineffective.

6. In a control device for a directional antenna, a motor adapted to be operatively connected thereto for rotating the same, a normally closed circuit for the motor, means at a remote location for controlling the movements of the motor and consequently of the antenna and for indicating the position of the latter, said means comprising an indicator disk mounted for rotation about an axis, direction indicating means on said disk establishing the position thereof relative to a fixed point, a manually operable settable selector disk spaced from said indicator disk and mounted for rotation about the axis of the latter, a direction pointer on said selector disk to facilitate setting of the latter relative to a fixed point, said pointer and direction indicating means being movable into and out of register with each other upon relative rotational movement between said disks, a stepping magnet for indexing the indicator disk throughout predetermined increments of rotation, a circuit for the magnet, an impulse emitter operable under the control of said motor for intermit-

tently interrupting said magnet circuit, a pair of normally closed contacts mounted on and rotatable with one of said disks, said contacts being common to both the magnet and the motor circuits, and means carried on the other disk and engageable with said pair of contacts when said indicating means and pointer are in register for opening said contacts to de-energize said motor and to render said emitter ineffective.

7. In a control device for a rotatable, directional antenna, a motor adapted to be operatively connected thereto for rotating the same, an electric circuit for the motor, means at a remote location for controlling the movements of the motor and consequently of the antenna and for indicating the position of the latter, said means comprising an indicator disk mounted for rotation about an axis, direction indicating means on said disk establishing the position thereof relative to a fixed point, a manually operable settable selector disk spaced from said indicator disk and mounted for rotation about the axis of the latter, a direction pointer on said selector disk to facilitate setting of the latter relative to a fixed point, said pointer and direction indicating means being movable into and out of register with each other upon relative rotational movement between said disks, a stepping magnet for indexing the indicator disk throughout predetermined increments of rotation, a circuit for said magnet, an impulse emitter operable under the control of said motor for intermittently interrupting the magnet circuit, a source of current for energizing said circuits, a pair of normally closed contacts mounted on one of said disks and rotatable in unison therewith, one contact of said pair being electrically connected in both of said circuits, the other contact of said pair being electrically connected to said source of current supply, and cam means carried by the other disk and engageable with said pair of contacts when said indicating means and pointer are in register for opening said contacts to de-energize said motor and to render said emitter ineffective.

8. In a control device for a rotatable, directional antenna, a motor adapted to be operatively connected thereto for rotating the same, an electric circuit for the motor, means at a remote location for controlling the movements of the motor and consequently of the antenna and for indicating the position of the latter, said means comprising an indicator disk mounted for rotation about an axis, direction indicating means on said disk establishing the position thereof relative to a fixed point, a manually operable settable selector disk spaced from said indicator disk and mounted for rotation about the axis of the latter, a direction pointer on said selector disk to facilitate setting of the latter relative to a fixed point, said pointer and direction indicating means being movable into and out of register with each other upon relative rotational movement between said disks, a stepping magnet for indexing the indicator disk throughout predetermined increments of rotation, a circuit for said magnet, an impulse emitter operable under the control of said motor for intermittently interrupting the magnet circuit, an electrical contact mounted on one of said disks and fixed relative thereto, said contact being electrically disposed in both the motor and magnet circuits, a relatively movable contact also carried by said latter disk and movable into and out of contact with said relatively fixed contact, means normally maintaining said contacts in engagement, and means carried by said other disk and engageable with said movable contact when said indicating means and pointer are in register for moving said relatively movable contact out of engagement with said fixed contact, a source of energizing current common to said circuits, and means electrically connecting said relatively movable contact to said source.

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