June 26, 1962 H. W. RATHENAU 3,041,609

DIRECTIONAL-ANTENNA ROTATOR

Filed July 30, 1956 2 Sheets-Sheet 1

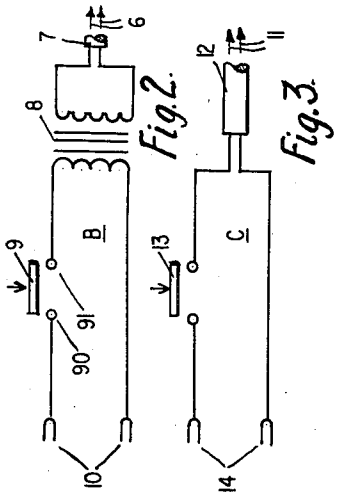


Fig. 2.

Fig. 3.

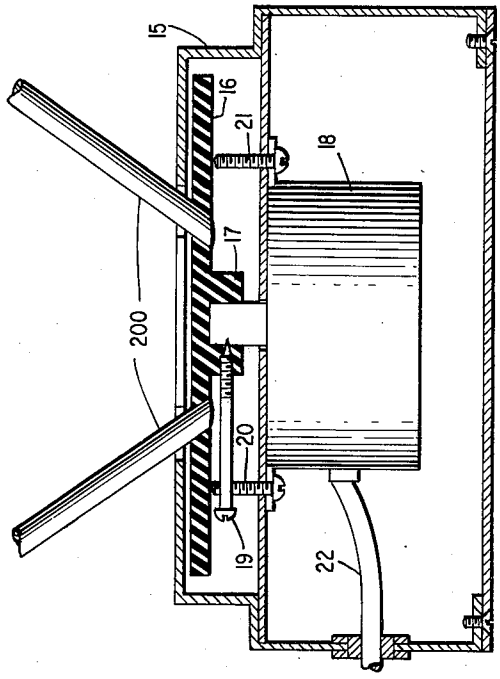


Fig. 4.

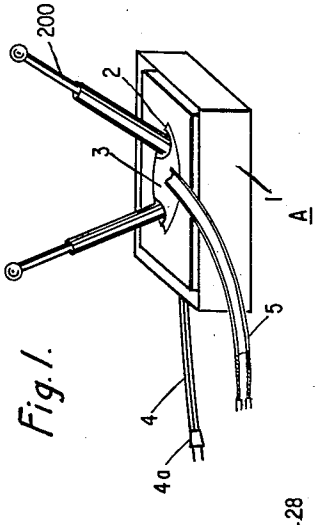


Fig. 1.

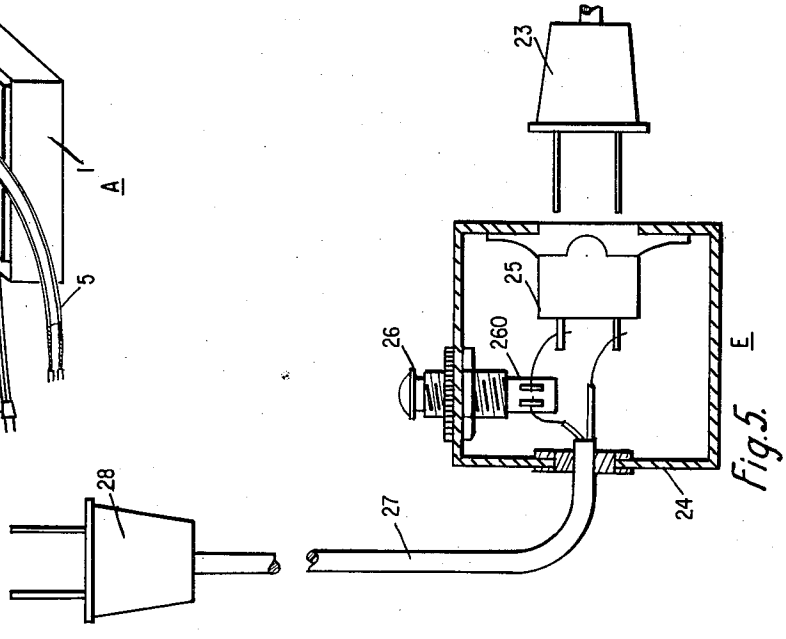


Fig. 5.

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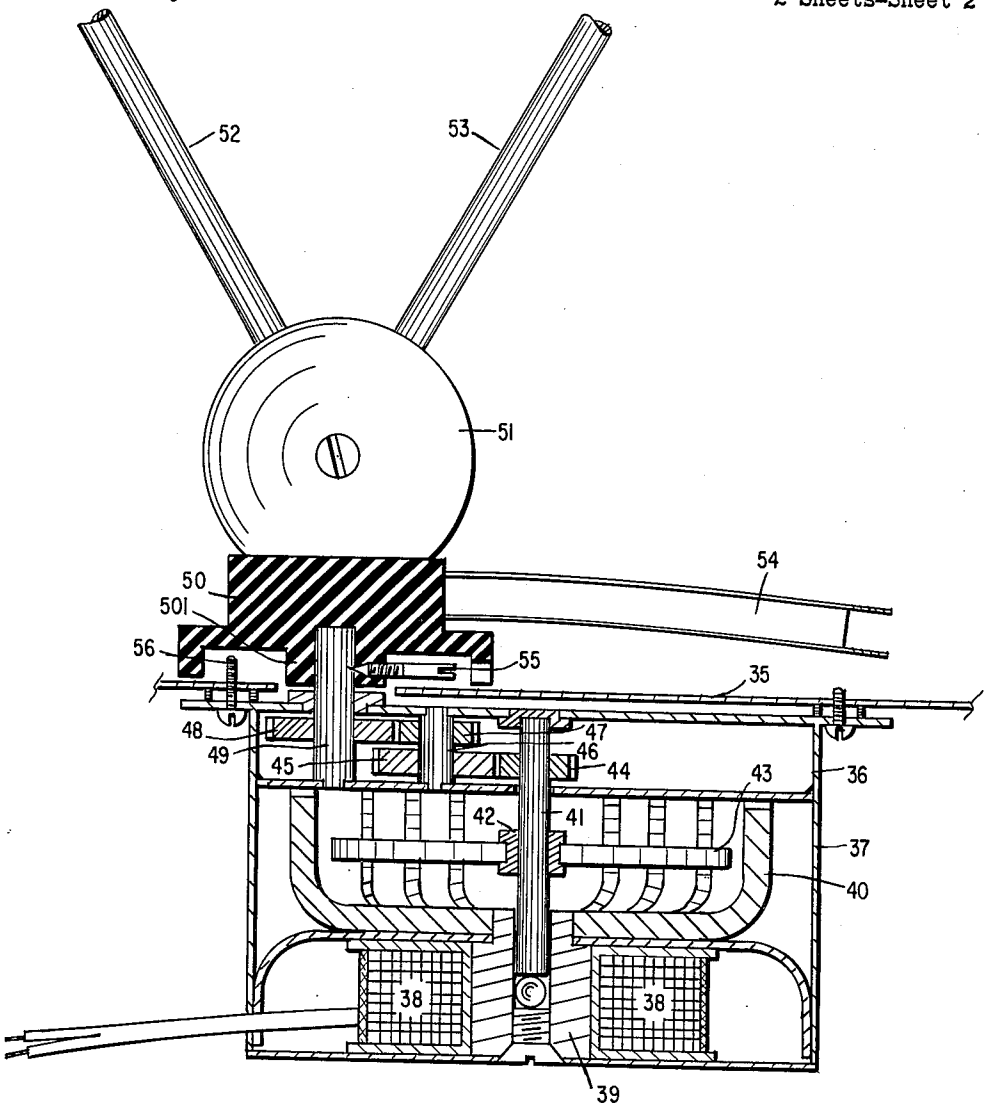


Fig. 6.

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United States Patent Office 3,041,609 Patented June 26, 1962

3,041,609

DIRECTIONAL-ANTENNA ROTATOR

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Filed July 30, 1956, Ser. No. 600,831
5 Claims. (Cl. 343—766)

This invention relates to antenna rotating or oscillating devices, particularly for use with television or frequency-modulated radio receivers.

It is desired, as a rule, that a television, or F-M radio, antenna installation be equally well suited for reception of all available channels. This may require the use of multiple dipoles or antenna rotators for adjustment to signals arriving from different respective directions. Aggravated conditions are generally encountered in cities, or wherever the antennas are mounted near reflecting surfaces such as building walls, because the antenna receives reflected energy from such surfaces. This often results in cancellation, weakening, distortion, phase inversion and echoes of the signals, with the effect of causing "ghosts" and other disturbances. Since such effects are often observed on more than one channel, best reception of all available channels would also require the use of separate antennas or of an antenna rotator to be selectively used or adjusted for the particular channel to be received at a time.

The antenna rotators heretofore available are primarily designed for outdoor antennas and their remote directional control requires the provision of multi-conductor cables in conjunction with multi-pole switches or automatic limit switches and other automatic switching devices. Accordingly, such rotators require rather voluminous equipment, are subject to trouble and rather expensive. For these reasons, although such remotely controlled rotators would afford the same receptional advantages when used indoors, they have not found acceptance by the public for use with indoor antennas.

For indoor service, various kinds of aerials have been designed, using either loop selection devices graduated into rather coarse steps of adjustment or necessitating orientation of the antenna by hand, a difficult operation on account of the fact that slight deviation from the most suitable orientation may result in poor reception.

It is an object of my invention to devise a turnable or rotatably reciprocated antenna device, generally for the above-mentioned purposes, that operates under remote control with the aid of devices much smaller and less intricate than the known antenna rotators and that, by virtue of its simplicity and low cost, is eminently suitable as an indoor or household device, for instance, with the conventional rabbits-ear dipoles, although it is likewise applicable in designs for outdoor use.

It is another object of my invention, to provide a directional-antenna rotator that operates to vary the orientation of the antenna through a desired angular range without requiring any electric limit switches, position selector switches and multiconductor cables, nor the use of slip rings, contact brushes or other contact devices in the high-frequency leads of the antenna.

Another object, akin to those mentioned, is to provide a simple appliance that permits a precise directional control of an indoor or outdoor antenna for optimum receiving condition or any selected channel without the necessity for a person watching television or listening to

F-M radio to leave the seat, bed or other location then occupied, or without requiring the person to directly manipulate the antenna device which may be inconvenient to reach or may be located at a place from which the effect of rotary antenna displacement upon the picture quality of television reception may not be well observable.

To achieve these objects, and in accordance with my invention, I mount the rotatably adjustable member of the directional antenna, such as a dipole of the rabbit's ear type, on a base structure and provide the rotatable antenna member and the base with respective positive stops that are abuttable against one another and limit the rotary antenna adjustment to a fixed angular range of less than 360°, a range of 180° being sufficient and preferable for most indoor purposes; and I drivingly connect with the rotatable antenna member a small self-starting single-phase motor of indeterminate starting direction, the connection including a speed-reducing transmission for imparting to the antenna member a rotating speed of a few, preferably less than ten, rotations per minute. I further provide the motor with a current supply circuit to be energized from an alternating-current source preferably through a plug and cord, and control the current supply to the motor by a normally open switch, preferably of the push-button type.

The particular fractional-horsepower motor to be used is preferably of the type having a field excited by a stationary coil and a permanent-magnet armature mounted on the motor shaft that drives the antenna member through a reduction gear; however, other small motors of the same starting and reversing characteristic are also applicable. For the purpose of the invention, it is essential that this type of motor, unless purposely modified for asymmetrical starting torque, does not have a fixed or predetermined starting direction. The motor will start running in one or the other direction depending upon such matters of chance as the instantaneous polarity of the field poles and the relative position of the armature thereto at the moment the energizing circuit is closed. When such motors are employed as drive for clocks and other instruments the inherently indefinite running direction is detrimental. In known devices it has been eliminated by resort to elements introducing mechanical asymmetry, such as by means of ratched-type mechanisms and unidirectionally operative gear transmission, to make the motor always run in the desired direction. It is a characteristic of my invention that no such asymmetrical modifying means need be used, the motor as well as the speed reducing transmission remaining symmetrically operative and indeterminate as regards the running directions, with the result that the antenna member may start rotating in either direction, which is not subject to prediction or control.

Under these conditions, when the motor has started running and turns the antenna member to the point where further movement is prevented by the stop means, the motor immediately reverses its motion and turns the antenna in the opposite direction to the point where the reverse motion is positively blocked by the stop means, whereupon the motor reverses. This sequence continues as long as the motor remains energized.

The motor may either be wound for normal line voltage, such as 110 or 220 volts, or for low voltage, for ex-

ample within the range between 6 and 24 volts. For low-voltage operation, I mount a step-down transformer in or on the base of the antenna rotator, or, preferably, in a separate control box which also contains a low-voltage push-button switch and is connected with the antenna base structure by a flexible cord for remote control.

Synchronous permanent-magnet type motors are especially suitable for antenna rotors according to the invention. Such a motor, available at low cost, reaches synchronous speed after only 2 to 3 cycles, at 60 c.p.s., and stops positively within one cycle (1/60 second) after being deenergized. Consequently the self-reversing operation caused exclusively by the positive stop engagement is virtually instantaneous and release of the push-button switch effects virtually instantaneous stopping of the antenna rotation so that the antenna will remain in the most favorable adjustment reached.

It will be recognized that the device causes slow reciprocation of the directional antenna through the desired angle of motion without requiring any limit switches, selector contacts or multiple wire control circuits. Furthermore, since the rotary antenna motion is limited to less than one full turn, preferably no more than 180°, no slip rings or slide contacts of any kind are required in the antenna-signal circuit. It is sufficient if the antenna twin-wire feed line be kept somewhat slack.

In cases where a rabbit-ear antenna is inconvenient, a reflector type antenna with a fixed dipole may be used, and only the reflector need then be rotatably reciprocated by the above-described synchronous motor.

The foregoing and other features of my invention will be apparent from the preferred embodiments illustrated in the drawings and the following detailed description. In the drawings:

FIG. 1 is a perspective view of an indoor antenna and oscillator;

FIGS. 2 and 3 illustrate two alternative circuit diagrams of a control box designed as a component separable from the antenna oscillating component of the device;

FIG. 4 is a cross section through a rotator;

FIG. 5 is a cross section of the appertaining control box wired in accordance with FIG. 3; and

FIG. 6 illustrates a portion of another antenna oscillator, the synchronous motor and reduction gear being shown in axial section.

The device illustrated in FIG. 1 comprises a base structure **1** consisting of a housing made of sheet metal, plastic or any other suitable material. Mounted on top of the structure **1** is a rotatable disk **2** which is supported and driven by a single-phase motor located within the structure **1**. In the illustrated embodiment the disk **2** carries an aerial **200** of the conventional rabbit-ear type. A two-wire power supply cord **4** extends from the base structure **1** and is provided with a power plug **4***a* for connection to any suitable outlet of a home installation or other supply line. A standard flexible, flat two-conductor TV transmission line **5** extends from the disk **2**, one end being connected to the two poles of the aerial whereas the other end is provided with terminals for connection to the TV or FM set, that is, the receiver. Since the rotation of the aerial-carrying disk **2** is limited to 180°, as will appear from the following, the twin transmission line **5** requires only little slack.

The control-box wiring diagram illustrated in FIG. 2 shows a step-down transformer **8** for operation of the rotator motor at low voltage. The control box circuit is provided with power leads **6** for connection to a standard alternating-current 115 or 220 volt wall outlet and is connected by a power supply cord **7** with the primary winding of transformer **8**. The secondary voltage of transformer **8**, for example within the range between 6 and 24 volts, is supplied to the rotator motor through a quick-acting single-pole button switch **9** the contacts **90** and **91** of which are normally open. When switch **9** is closed it connects the secondary winding of transformer

8 across the two poles **10** of a power receptacle which is designed to receive the plug **4***a* on the power supply cord **4** of the rotator. If desired, a push button may also be located in the primary circuit of transformer **8** instead of that shown in the secondary circuit.

In the modified circuit diagram of FIG. 3, the transformer is omitted. The power leads **11** for connection to a wall outlet are connected in series, through a power supply cord **12**, with a normally open-quick-acting single-pole push button switch **13** and with a pole power receptacle **14** to receive the plug **4***a* on the power supply cord **4** of the rotator.

In the form shown in FIG. 4, the base structure of the antenna rotator comprises a housing **15** of sheet metal, plastic or other material. The disk or carrier plate **16** for the antenna proper is mounted within housing extension **150** and is driven by a speed-reducer type synchronous motor **18**. The carrier plate **16** has attached thereto a hub **17** which is seated upon the output shaft of the speed-reducer mechanism and which is fastened to the shaft by means of a bolt **19**. The bolt extends in the radial direction of the shaft and is made sufficiently long to serve as a stop arm. The rotary movement of arm **19** is limited by two stop pins **20** and **21**. These two pins, in the illustrated embodiment, limit the rotation of the carrier plate **16** to 180°. The pins also serve as fastening screws for securing the motor and speed-reducer unit **18** to the top plate of the housing **15**. When, during operation of motor **18**, the arm **19** hits against pin **20**, the rotary motion of the motor and of the carrier plate **16** is positively stopped and, as explained, the motor then revolves in the opposite direction until the stop arm **19** hits against the stop in **21**, whereupon the motion of the motor and carrier disk is again reversed, and so forth, as long as the motor remains energized. A power cord **22** and a power plug **23** (FIG. 5) connect the motor with teh control box shown in FIG. 5.

The control box illustrated in FIG. 5 comprises a housing **24** of sheet metal, plastic or other suitable material. Mounted in the housing is a power receptacle **25** which feeds electric power into the power plug **23**, power cord **22** and motor **18**. The control box is further equipped with a snap-action push-button switch **26** with normally open contacts **260**. When the push button is depressed, it energizes the motor **18** through a power cord from a power plug **28** which is to be inserted into a standard alternating-current 115 or 220 volt wall outlet. When the push button **26** is released, the motor **18** stops instantaneously.

The operation of the system of FIGS. 4 and 5 is as follows. After plug **23** is inserted into receptacle **25** and plug **28** into the wall outlet, the operator depresses the push button switch **26**, thus energizing the motor **18** which turns the carrier plate **2** and the aerial **200** mounted thereon. As soon as the television picture being received is free of "ghost" images, or the FM signal found satisfactory, the operator releases the push button switch **26**. This may occur before the stop arm **19** hits against stop pin **20** or **21**, otherwise the aerial will reverse its rotation to perform another 180° revolution, and continue to do so.

As mentioned, instead of the illustrated rabbit-ear type aerial, any other directional aerial may be used, such as a fixed horizontal or vertical dipole and a rotatable reflector. In the latter case only the reflector is connected with the carrier disk **16** to rotate together therewith. The system can also be used for the drive of a roof antenna rotator. In this case, the low-voltage circuit design of FIG. 2 is preferable. The enclosure of the rotator assembly should then be made hermetically tight and is preferably provided with a thrust bearing to support the weight of the antenna.

In the embodiment illustrated in FIG. 6 the top plate **35** of a housing structure (not shown) which forms the base of the device, serves as a carrier for a reduction-gear housing **36** which is rigidly joined with the housing **37** of

the synchronous single-phase motor of the permanent-magnet type. The motor comprises a field coil **38** surrounding a magnetizable core **39** on which a magnetizable field-pole system **40** is mounted and attached. When the coil **38** is energized by alternating current, an alternating magnetic field is produced between the poles of the field system **40**. The shaft **41** of the motor carries a hub **42** on which the armature **43** of the motor is firmly mounted. This armature consists of a permanent magnet. During excitation of the field coil **38** the permanent-magnet armature **43** is caused to rotate in synchronism with the alternating field current. However, as explained, the direction of rotation is a matter of chance, and not definite.

Mounted on shaft **41** is a pinion gear **44** which forms part of the reduction gear located within housing **36**. Pinion **44** is in meshing engagement with a spur gear **45** on an intermediate shaft **46** which carries a pinion **47** meshing with a spur gear **48** on the output shaft **49**. The output shaft is attached in and carries the rotatably reciprocating member **50** on which the carrier **51** of a rabbit-ear dipole **52, 53** is fixedly mounted. The dipole is connected with a flexible two-wire antenna lead **54** preferably through members **50** and **51**.

The hub portion **501** of member **50** is provided with a set screw **55** which forms a stop arm. Arm **55** cooperates with two stop pins **56** (only one is shown) spaced 180° from each other. One of these stop pins, or both, also serve as a fastening screw for attaching the reduction-gear housing **36** to the top wall **35** of the encloure.

The device operates in the same manner as described with reference to FIGS. 1 to 4.

Further details of the motor structure may be found in U.S. Patents No. 2,436,231, 2,492,197, and British Patent No. 489,246 of 1938, the motor being used herein without the corrective means employed by the patentees to establish and initiate rotation in one desired and predetermined direction, preferably.

When alternating current is not available a convertor is additional required equipment.

Other types of oscillators may be used provided that an equivalent control is effected.

The carrier **51** (FIG. 6) need not be permanently fixed upon member **50**. If desired provision may be made for rotating **51** manually and independently of member **50**, by employing conventional adjustable friction couplings or fastenings between the two, or by using a readily removable screw fastening (not shown).

Obviously, part or all of the structures and mechanisms described above can be made an integral part of a TV or FM or other receiver.

It will be obvious to those skilled in the art upon a study of my disclosure, that the invention permits of various modifications with respect to the details and arrangement of its individual components and may be embodied in devices other than those particularly illustrated and described, without departing from the essence of my invention and within the scope of the claims annexed hereto.

I claim:

1. A directional-antenna oscillator, comprising a base structure, a rotatably reciprocable antenna support means, flexible leads for connection to a receiver, said leads having a slack end attached to said antenna support means so as to be free to reciprocate together with said support means, a first rigid stop means rigidly mounted on said base structure, a second rigid stop means turning with said antenna support means, said two stop means being abuttable against one another to limit the rotary motion of said assembly to less than 360°, a self-starting synchronous motor of dual directional type carried by said base structure and drivingly connected with said antenna support means to turn it, and an alternating-current supply circuit connected to said motor and comprising a normally open switch with manually controllable switch-closing means, whereby said antenna means, as long as said switch is kept closed, is caused to rotatably reciprocate between fixed limits determined by said two stop means and can be stopped in any position between said limits by permitting said switch to open.

2. A directional-antenna device for TV and FM home receivers, comprising a structure forming a base, a rotatable antenna support member, a dipole antenna carried on said support member to rotate together therewith, an antenna feed line having a slack end attached to said support member to rotate together therewith, a stop element turning with said support member, rigid stop means rigidly mounted on said structure in the path of said stop element and abuttable against said stop element for limiting the rotary motion of said support and antenna to less than 360°, a self-reversible synchronous motor mounted on said base, a reduction gear drivingly connecting said motor with said antenna support, and an alternating-current supply circuit connected to said motor and comprising a normally open manually closable switch, whereby said antenna, as long as said switch is kept closed, is caused to rotatably reciprocate between limits determined by said stop means and can be stopped in any position between said limits by permitting said switch to open.

3. A directional-antenna device, comprising a base structure, rotatable antenna means carried by and rotatably journalled in said structure, a stop arm rigidly joined with said antenna means and extending radially to the axis of antenna rotation, two stop pins mounted on said base structure in the path of rotation of said stop arm so as to be hit upon by said arm, said two stop pins being angularly spaced from each other for limiting said rotation to an angular range of about 180°, an antenna feed line having a slack end attached to said antenna means to freely move together therewith, a drive comprising a self-starting single-phase motor of indeterminate starting direction mounted on said base structure and a reduction gear connecting said motor with said antenna means, said drive having an output speed less than about 10 antenna rotations per minute, and alternating-current supply means connected to said motor and comprising a normally open manual push-button switch for causing, when closed, said antenna means to rotatably reciprocate through said range and to be stopped by release of said switch in any position within said range.

4. A directional-antenna oscillator, comprising a base structure, an antenna assembly rotatably carried by said base structure and comprising directional antenna means, flexible leads having a slack end attached to said antenna means for connection to a receiver, said base structure and said antenna assembly having respective stop means abuttable against one another for limiting the rotary motion of said assembly, a self-starting synchronous motor of dual directional type mounted on said base structure and drivingly connected with said antenna assembly, alternating-current supply means for said motor comprising a line-voltage connector, a step-down transformer having a primary circuit connected to said connector and a secondary circuit connected to said motor, and a normally open manual push-button switch connected in said secondary circuit, whereby closing of said switch causes said antenna assembly to be continually reversed by abutting action of said stop means exclusively and to be stopped by release of said switch in any position of travel.

5. A directional-antenna oscillator, comprising a base structure, an antenna assembly rotatably mounted on said base structure and comprising directional antenna means, flexible leads having a slack end attached to said antenna means for connection to a receiver, said base structure and said antenna assembly having respective stop means abuttable against one another for limiting the rotary motion of said assembly, a self-starting synchronous motor of dual directional type mounted on said base structure and drivingly connected with said antenna assembly, and alternating-current supply means connected to said motor and

comprising a control box having a normally open manual push-button switch mounted therein for causing said antenna assembly to rotatably reciprocate when said switch is manually closed and to stop in any position of travel when said switch is released, and a flexible two-wire cord connecting said box with said base structure to permit carrying and moving said control box to different locations remote from said base structure.

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