Feb. 24, 1953 W. M. CADY ET AL 2,629,828

SCANNING DEVICE

Filed March 5, 1946

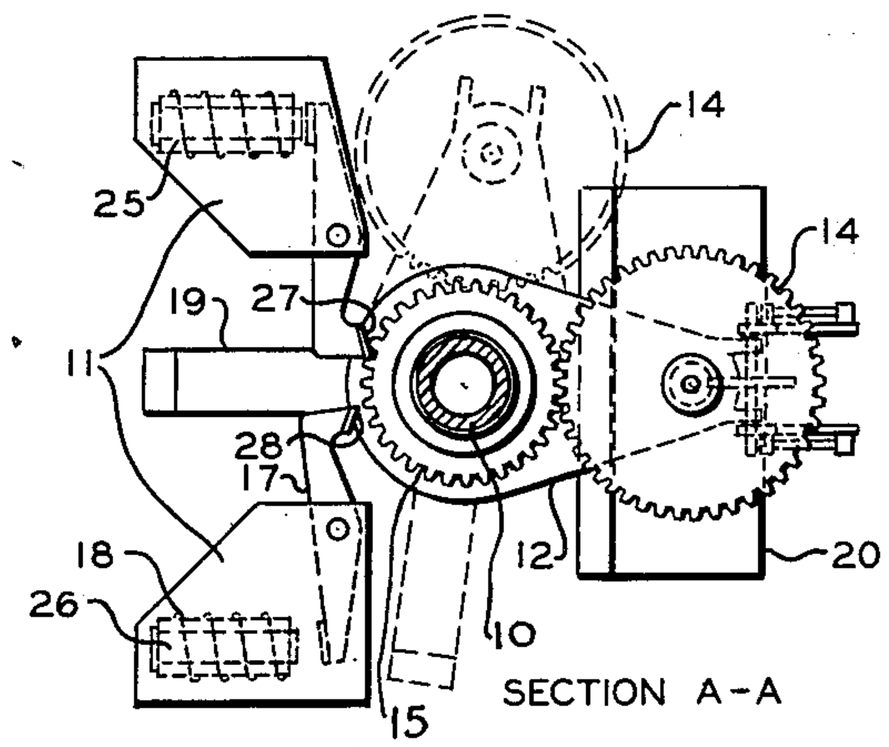


FIG. 1

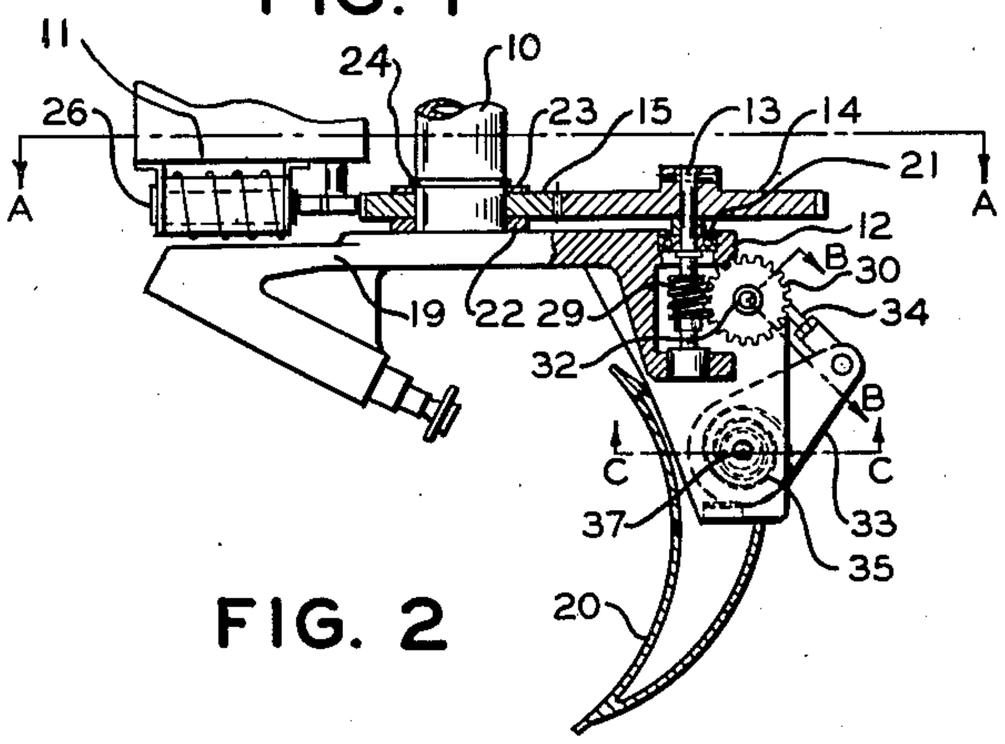
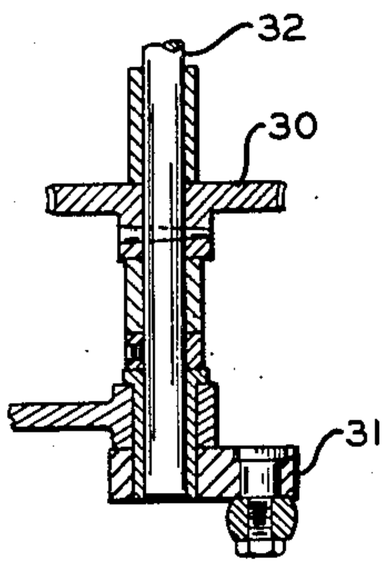
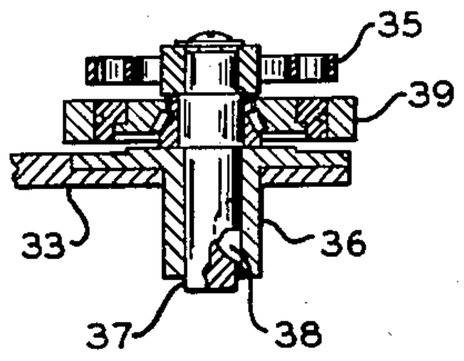


FIG. 2



SECTION B-B

FIG. 3



SECTION C-C

FIG. 4

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SCANNING DEVICE

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This invention relates to a means for controlling the tilt motion of rotating or oscillating antennas. More particularly it relates to an electromagnetic ratchet means for controlling the tilt mechanism of the antenna without the use of slip rings, push-tubes, or a secondary power source.

In the mechanical control of parabolic and other antennas a necessary feature is a means of controlling the tilt of the antenna. Tilt control has been mechanized by (1) a motor and gear train on the scanner base which slides a thrust bearing along the scanner axis, thus actuating a linkage mounted on the moving portion of the scanner and thereby causing the reflector to tilt; or (2) feeding power through slip rings to a small electric motor which drives a gear train and linkage mounted on the moving portion of the scanner. The present invention avoids both of these complex methods.

Accordingly, it is an object of this invention to provide a tilt control for moving antennas.

Another object of this invention is to provide a tilt control which will have a small number of parts on the moving portion of the antenna mount.

Another object of this invention is to provide a tilt control which will operate from the primary power source used to rotate the antenna.

These and further objects will become more readily apparent upon consideration of the following description and the accompanying drawings, of which:

Fig. 1 is a sectional plan view of an embodiment of the invention taken at A—A;

Fig. 2 is a front elevation view of this embodiment;

Fig. 3 is a sectional view taken at B—B;

Fig. 4 is a sectional view taken at C—C.

In the operation of a scanning antenna, a reflector is rapidly oscillated about a torque tube axis, and tilt adjustment of the reflector is desirable during operation. Half-wave rectification of this oscillatory moton with a coil-actuated ratchet as explained hereinafter presents a rapid intermittent motion which is satisfactory for tilt adjustment. Introduction of a second such ratchet permits the choice in direction of the adjustment. In operation a gear on the torque tube is fixed in motion every alternate half cycle relative to the mount, and this causes movement of the tilt gearing and consequent tilting of the reflector. The operation may be further explained by reference to the accompanying drawings. Torque tube or shaft of rotation 10 is rotatably mounted in a suitable bearing on the scanner base 11 in any conventional manner. Turntable 19 supports reflector 20 and is mounted on torque tube 10. Arm 12 of turntable 19 holds shaft 13 in bearing 21. Spur gear 14 is rigidly attached to shaft 13. Spur gear 15 engages spur gear 14, is mounted on friction plate 22, and is held by friction ring 23. Friction ring 23 in turn is held to torque tube 10 by retaining ring 24. Electromagnetic relay ratchets 25 and 26 are mounted on scanner base 11 and engage gear 15 with shoes 27 and 28 respectively. Shoes 27 and 28 are made of wear-resistant metal and are so inclined relative to the spur gear teeth that they will lock the spur gear in one direction and will slide on the gear teeth in the other direction. The diametral pitch of spur gear 15 must be great enough that the narrowest sector of antenna oscillation will still include a sufficient number of teeth to give tilt motion when either shoe 27 or 28 engages gear 15. Gear 14 transmits motion through shaft 13 to worm 29. Worm 29 moves worm gear 30 in response to motion of gear 14. Section B—B given in Fig. 3 shows that tilt crank 31 is attached to shaft 32 which bears worm gear 30. Tilt crank 31 connects to tilt pivot plate 33 through lever arm 34. Section C—C given in Fig. 4 shows the structure by which the motion of plate 33 is transmitted to reflector 20. Tilt pivot plate 33 is attached to tilt pivot flange 36 which is keyed to shaft 37 by Woodruff key 38. Spring 35 prevents any backlash in antenna motion. Bearing 39 is attached to turntable 19 by means not shown and carries shaft 37 and its associated components. By the mechanical system disclosed motion of gear 14 is transmitted to reflector 20. For purposes of demonstration, torque tube 10 will be assumed to oscillate through approximately 90°. A phantom view of a position near the limit of oscillation has been shown in dotted lines in Fig. 1. In the condition when actuating coil 18 is de-energized ratchet arm 17 is pushed out by clockwise rotation of gear 15 which will revolve with torque tube 10 due to the friction established by ring 23 and plate 22. In this case, it is readily evident that no relative motion will occur between gears 14 and 15 since they both revolve with torque tube 10. When actuating coil 18 is energized however, ratchet arm 17 causes shoe 28 to engage gear 15 and during the counterclockwise motion of torque tube 10, gear 15 will revolve with respect to torque tube 10, since gear 15 is now fixed in motion relative to scanner base 11. Since gear 14 is mounted on arm 12 and must assume the phan-

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tom position, relative motion occurs between gears 14 and 15. This motion is then translated via shaft 13 to the aforementioned linkage for tilting the reflector 20 which is undergoing the same angular motion as arm 12 which houses shaft 13 since both reflector 20 and arm 12 are on turntable 19. On the clockwise return motion ratchet arm 17 is pushed out by the rotation of gear 15 which results from the friction established by ring 23 and plate 22. In this manner, a rapid intermittent motion is provided which is entirely satisfactory for tilt adjustment. It is readily seen that a slow sinusoidal tilt motion will result if one ratchet is continually engaged. This is due to the fact that tilt crank 31 is essentially a point on the circumference of a disc of motion. Consequently as this point is rotated its incremental linear displacement relative to a plane tangent to the circle will be less for a given angular displacement as the point falls closer to the tangent plane. It is obvious that return tilt motion of the reflector is provided by the action of electromagnetic ratchet 25 which causes shoe 27 to engage gear 15. Thus two-directional tilt control is established.

The foregoing description has presented an explanation of this invention in the particular application of an electromagnetic ratchet for tilt control, but the principles of this invention are of broader application in ways which will be apparent to those skilled in the art. It will be understood that the above-disclosed embodiment is primarily illustrative and that the invention includes such embodiments as fairly come with the spirit and scope of the appended claims.

What is claimed is:

1. A mechanical structure for tilt control of moving antennas including, two electromagnetically controlled ratchets, driving means, a shaft of rotation actuated by said driving means, an antenna turntable mounted on said shaft of rotation, an antenna reflector mounted on said turntable, a first gear freely mounted on said shaft of rotation and which may be locked against rotation with said shaft by said ratchets, a second gear mounted on said turntable and engaging said first gear, a mechanical linkage connecting said second gear and said antenna reflector, wherein said structure utilizes the power source of azimuth movement of said antenna turntable to yield tilt motion of said reflector upon locking of said first gear against rotation.

2. An electromagnetic ratchet antenna tilt control structure comprising, a torque tube, a turntable mounted on the end of said torque tube, a scanner base, an antenna reflector mounted on said turntable, a first spur gear freely mounted on said torque tube, a friction plate and a friction ring so mounted around said gear on said torque tube that said gear will rotate with said torque tube unless subject to external force, a second spur gear which engages said first gear, a shaft mounted in a suitable bearing in said turntable wherein said shaft has pinned to it said second gear, a worm mounted on said turntable and driven by said shaft, a worm gear mounted on said turntable and driven by said worm, a second shaft which is pinned to said worm gear, a crank arm attached to said second shaft, a lever arm connected to said crank arm, a third shaft used as tilt axis for said reflector connected to said reflector and mounted in a suitable bearing on said turntable, a tilt pivot plate connected to said third shaft and to said lever arm, first and second electromagnetically controlled ratchets mounted on said scanner base so that the lever arm of said first ratchet engages said first gear in one direction of rotation and the lever arm at said second ratchet engages said first gear in the opposite direction of rotation wherein said structure provides a tilt control for said reflector which utilizes the power source of antenna oscillation and which is electromagnetically controlled.

3. A mechanical structure for the tilt control of an antenna comprising a driven torque tube, electromagnetically controlled ratchets, an antenna turntable mounted on said torque tube, an antenna reflector mounted on said turntable, a gear freely mounted on said torque tube and fixable against rotation with said torque tube by said ratchets, and a mechanical linkage connecting said gear and said antenna reflector for providing tilt control of said antenna reflector in response to said ratchets.

4. An antenna orientation control structure comprising, a turntable for supporting said antenna, a driven torque member fixedly attached to said turntable for causing said antenna to scan in a horizontal plane, means attached to said turntable for causing said antenna to scan in a vertical plane, a first gear freely mounted on said torque member, friction means for locking said first gear to said torque member, a second gear in mesh with said first gear and carried by said turntable, means connecting said second gear to said vertical scanning means, and means for intermittently locking said first gear against rotation with said torque member, whereby said vertical scanning means is actuated in response to rotation of said turntable.

5. An antenna orientation control structure comprising, a turntable for supporting said antenna, a driven torque member fixedly attached to said turntable for rotating said turntable to cause said antenna to scan in a horizontal plane, a first gear freely mounted on said torque member, a friction ring disposed between said torque member and said first gear for retaining said first gear in rotation with said torque member, ratchets for periodically engaging and locking said first gear against rotation with said torque member, means attached to said turntable for causing said antenna to scan in a vertical plane, a second gear in mesh with said first gear and connected to said last-mentioned means, locking of said first gear by said ratchets causing rotation of said second gear relative thereto during rotation of said turntable, said second gear actuating said last-mentioned means during periods of locking of said first gear.

6. An antenna orientation control structure comprising, a turntable for supporting said antenna, a driven torque member fixedly attached to said turntable for rotating said turntable to cause said antenna to scan in a horizontal plane, a first gear freely mounted on said torque member, a friction ring disposed between said torque member and said first gear for retaining said first gear in rotation with said torque member, ratchets for periodically engaging and locking said first gear against rotation with said torque member, a second gear in mesh with said first gear and carried on said turntable, locking of said first gear causing rotation of said second gear relative thereto during rotation of said turntable, a shaft attached to said second gear and rotatable therewith, a worm mounted on said shaft, a worm gear driven by said worm, and a bell crank driven by said worm gear and at-

tached to said antenna to cause vertical scanning thereof.

7. An antenna orientation control structure comprising, a turntable for supporting said antenna, a driven torque member fixedly attached to said turntable for rotating said turntable to cause said antenna to scan in a horizontal plane, a first gear freely mounted on said torque member, a friction ring disposed between said torque member and said first gear for retaining said first gear in rotation with said torque member, a first electromagnetically controlled ratchet for arresting motion of said gear in one direction and locking of said first gear against continued rotation with said torque member, a second electromagnetically controlled ratchet for arresting motion of said first gear in a second direction and locking said first gear against continued rotation with said torque member, a shaft mounted on said turntable, a second gear carried by said shaft and in mesh with said first gear, said second gear being rotatable in response to rotation of said turntable only during periods of locking of said first gear, and a gear train and crank arm driven by said second gear for causing vertical scanning of said antenna.

8. An antenna orientation control structure comprising a turntable for supporting said antenna, a driven torque tube fixedly attached to said turntable for causing said antenna to scan

in a horizontal plane, means attached to said turntable for causing said antenna to scan in a vertical plane, means mounted on said torque tube and connected to said vertical scanning means, and means for locking said last-mentioned means to impart power to said vertical scanning means from said torque tube.

9. An antenna orientation control structure comprising a turntable for supporting said antenna, a driven torque tube fixedly attached to said turntable for causing said antenna to scan in a horizontal plane, means attached to said turntable for causing said antenna to scan in a vertical plane, power transmitting means mounted on said torque tube and connected to said vertical scanning means, and means for locking said power transmitting means to impart power to said vertical scanning means from said torque tube.

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