(12) UK Patent Application (19) GB (11) 2 114 376 A

(21) Application No **8300947**
(22) Date of filing **14 Jan 1983**
(30) Priority data
(31) **57/010957**
(32) **28 Jan 1982**
(33) **Japan (JP)**
(43) Application published
17 Aug 1983
(51) **INT CL³**
H01Q 3/02 1/12
(52) Domestic classification
H1Q FS KH
(56) Documents cited
None
(58) Field of search
H1Q

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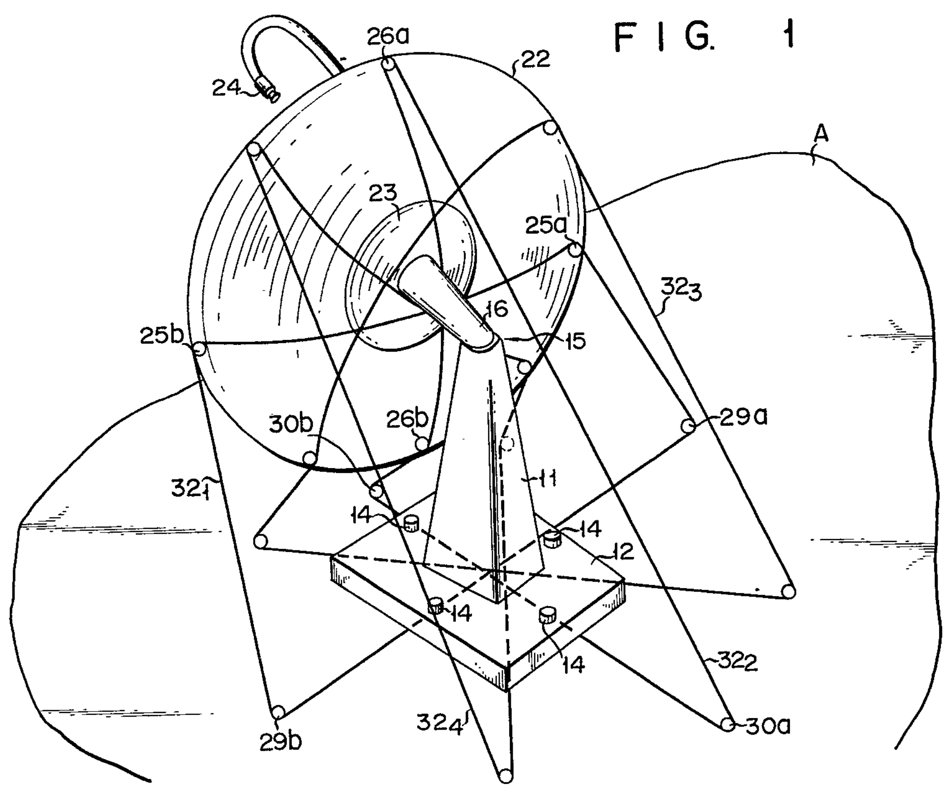
(54) **Antenna apparatus**

(57) An antenna apparatus has a support device (11, 12) to be fixed to a given installing body (A), an antenna body (22) e.g. a parabolic reflector having a given directivity, and a ball joint (15) mechanically coupling the support device (11) to the antenna body (22). Two different positions (25a, 25b) of the antenna body (22) are coupled via a wire or rope (32_1) so that the direction of the antenna body (22) with respect to a given axis is changed by the push-pull movement of the rope (32_1). Similarly other pairs of positions connected by wires 32_2, 32_3, 32_4 provide orientation about other axes. Once the apparatus has been installed and the direction adjusted, the wires are fixed so that the reflector cannot move. Details of fixings, pulleys, ball joints and clamps are disclosed. The arrangement is useful for domestic reception of Super High Frequency signals from a geostationary satellite.

FIG. 1



The drawing(s) originally filed were informal and the print here reproduced is taken from a later filed formal copy.

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FIG. 1

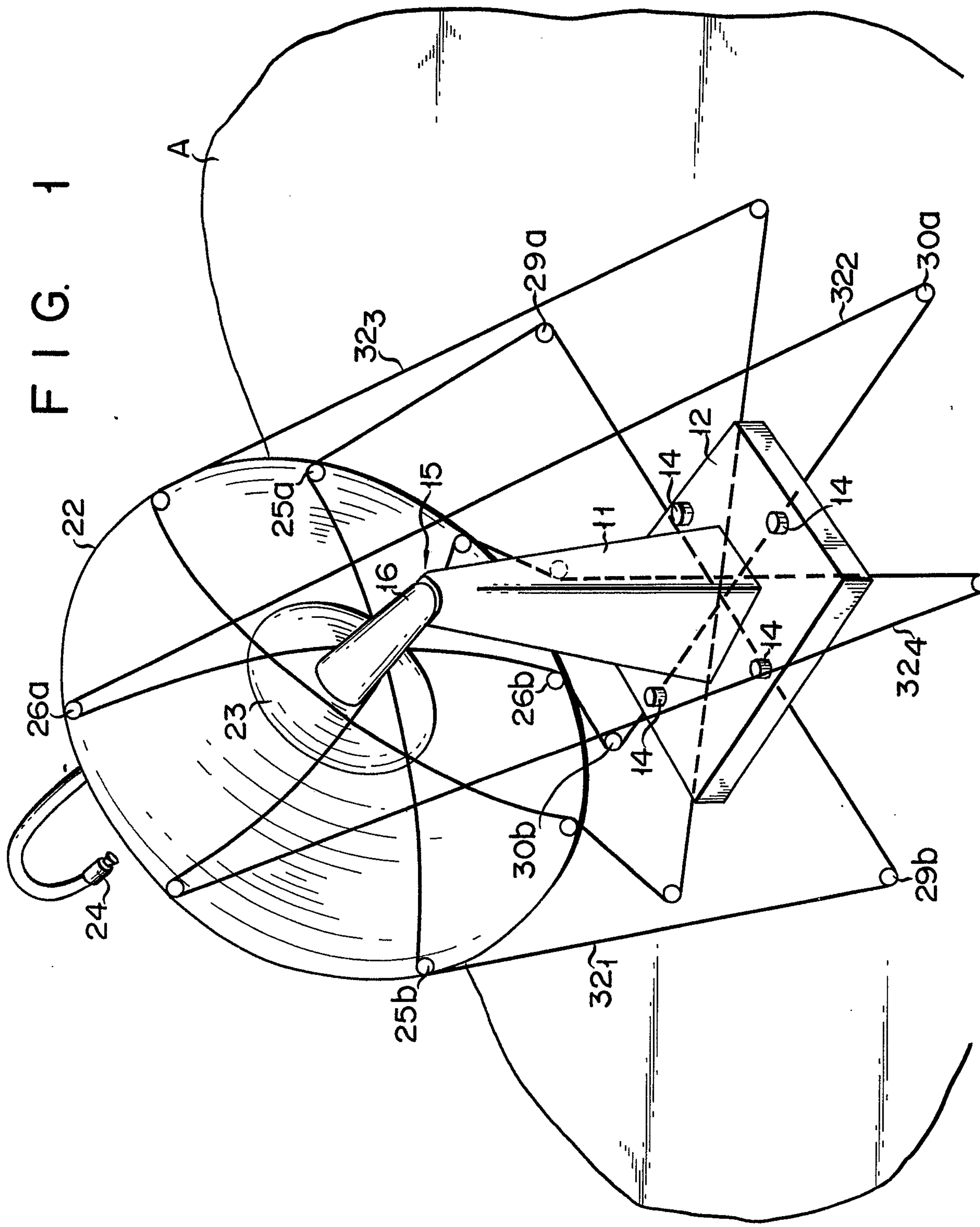

FIG. 2

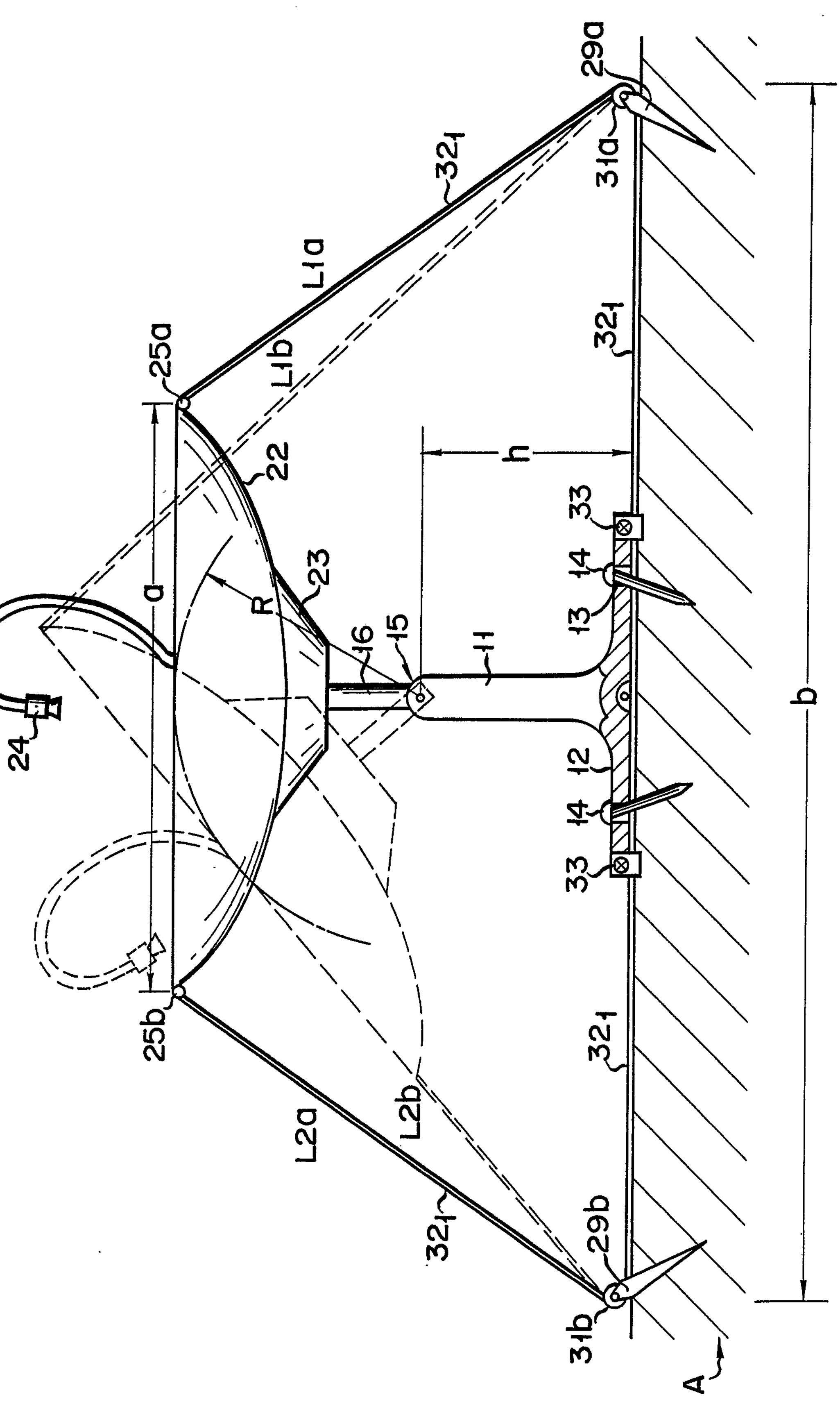
29a
31a
32₁
L1a
L1b
25a
22
23
R
a
h
33
14
13
15
16
11
12
14
33
24
b
25b
32₁
L2b
L2a
32₁
29b
31b
A

FIG. 3

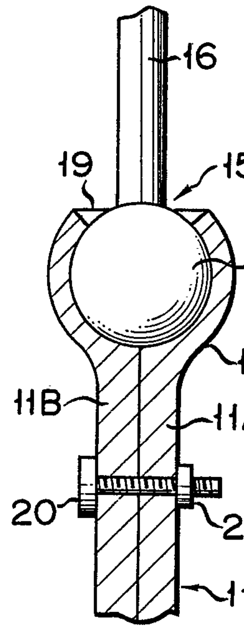

FIG. 4

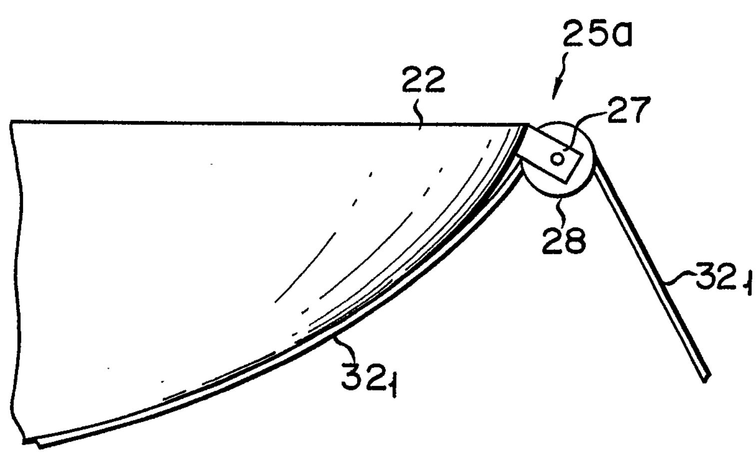

FIG. 5

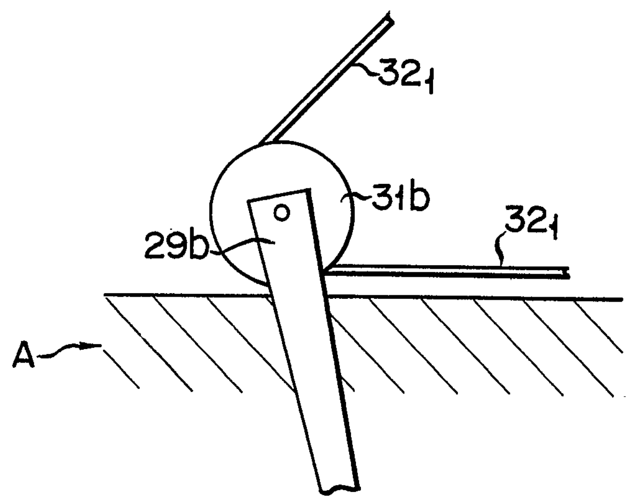

FIG. 6

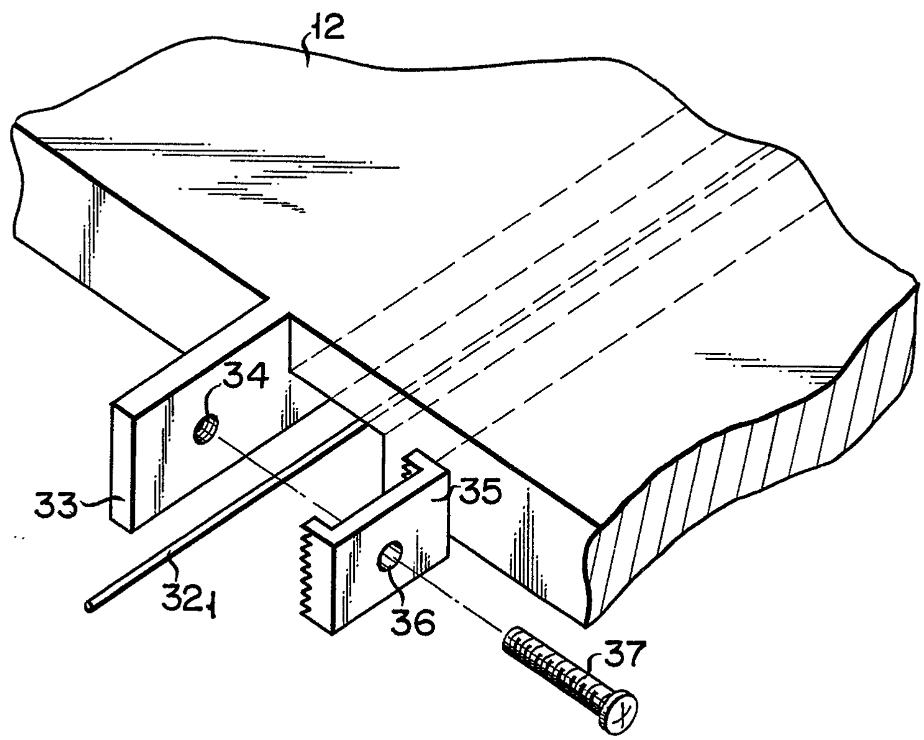

FIG. 7A

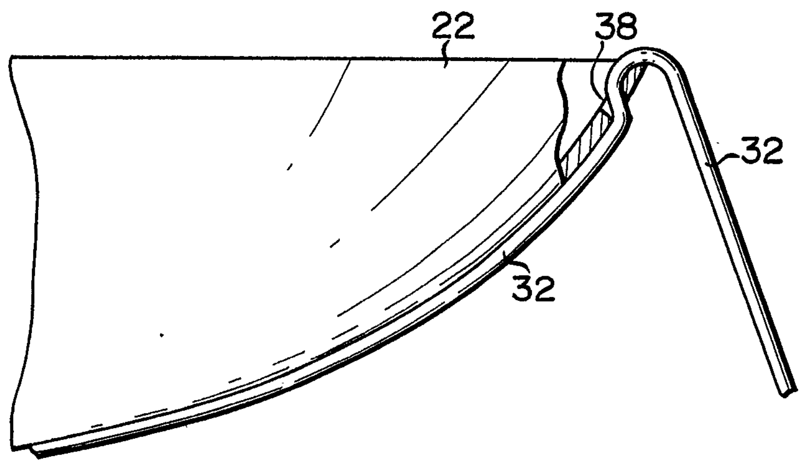

FIG. 7B

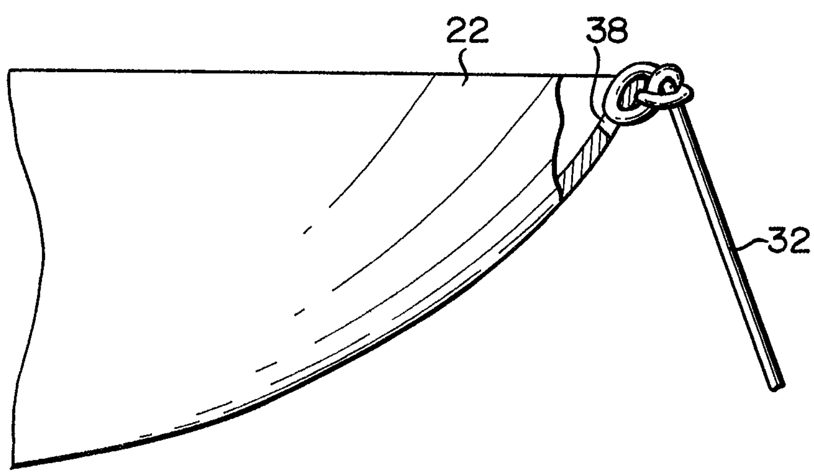

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FIG. 8

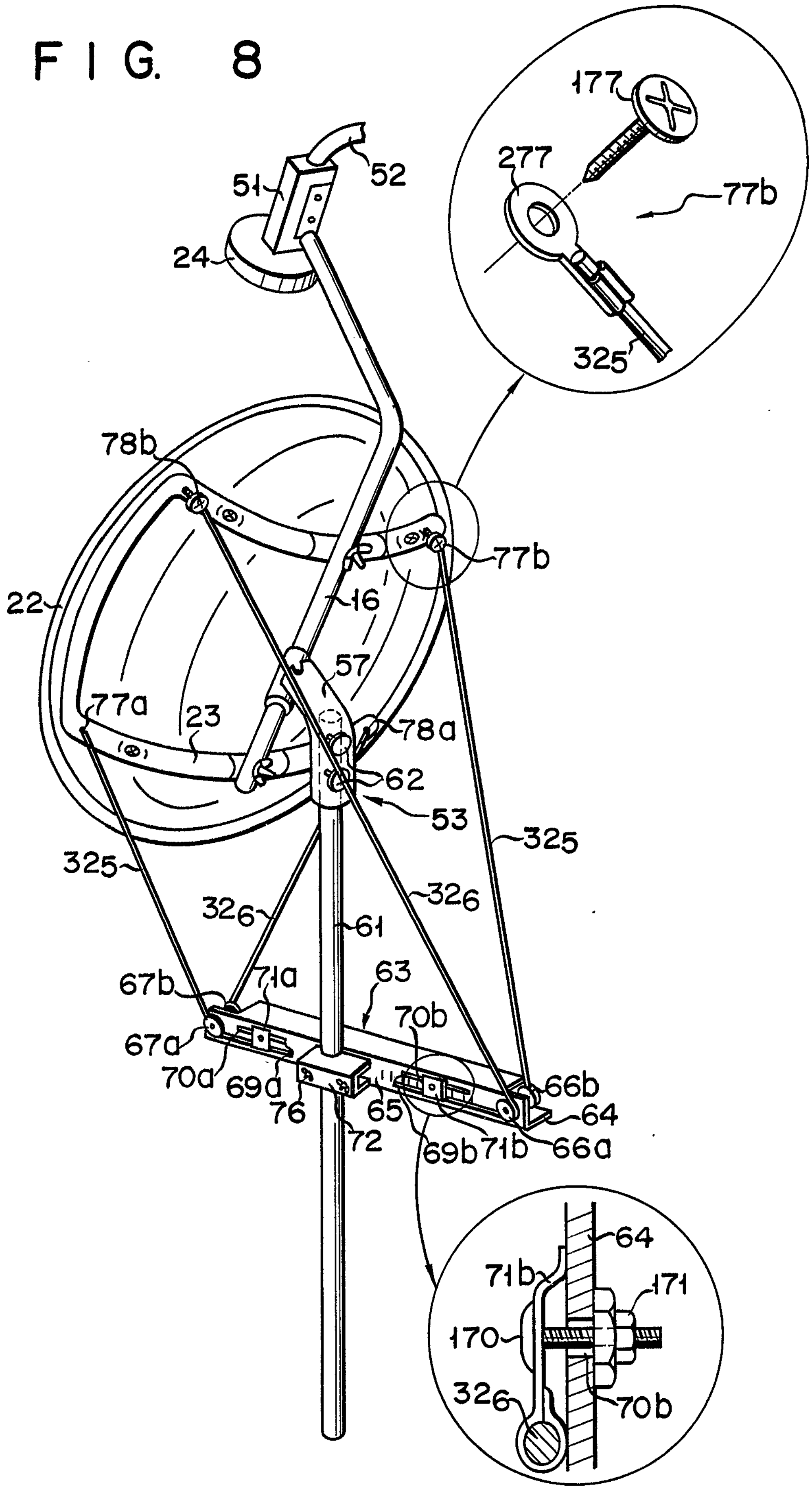


FIG. 9

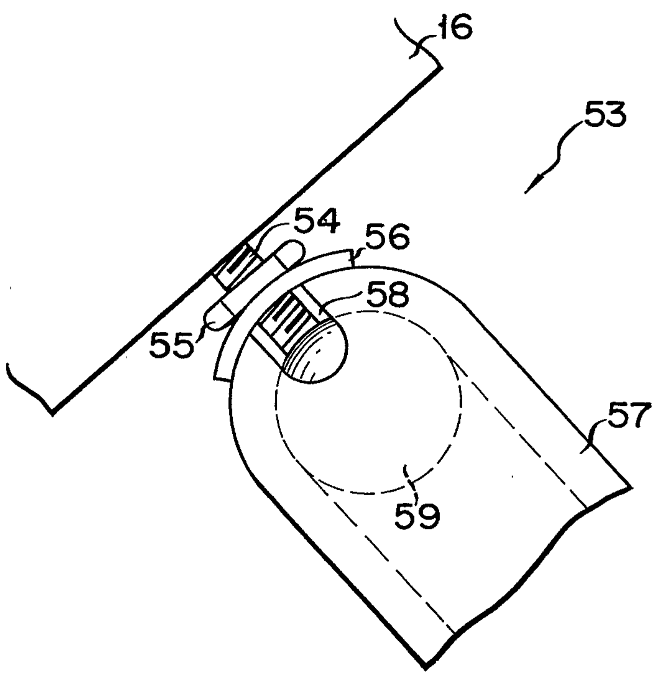
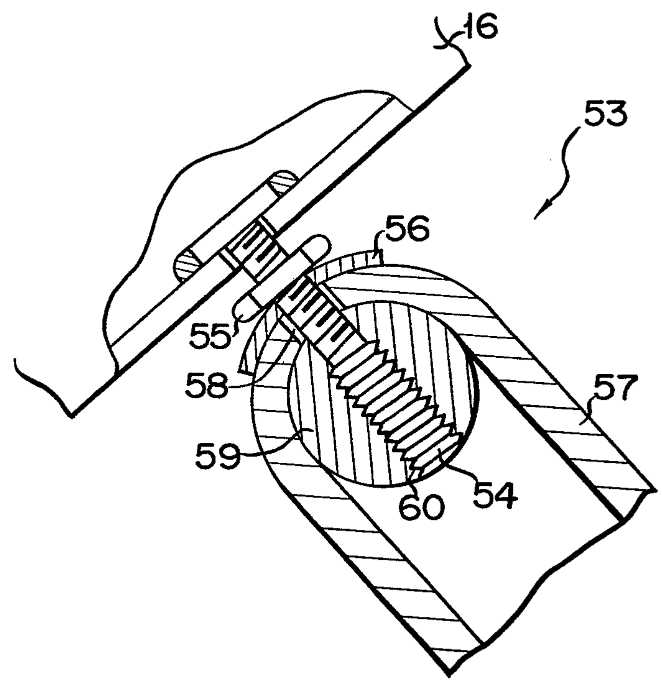
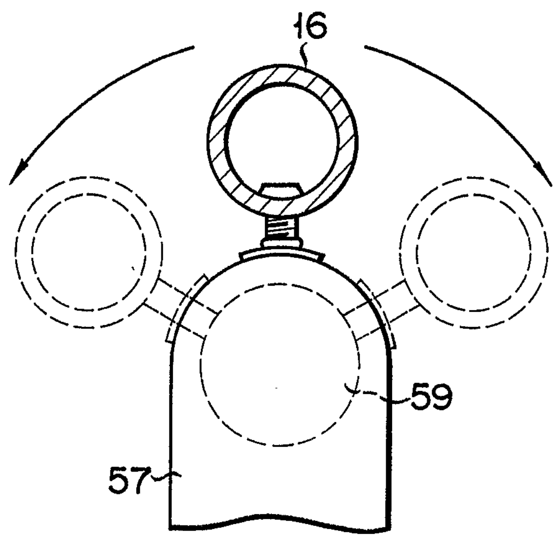


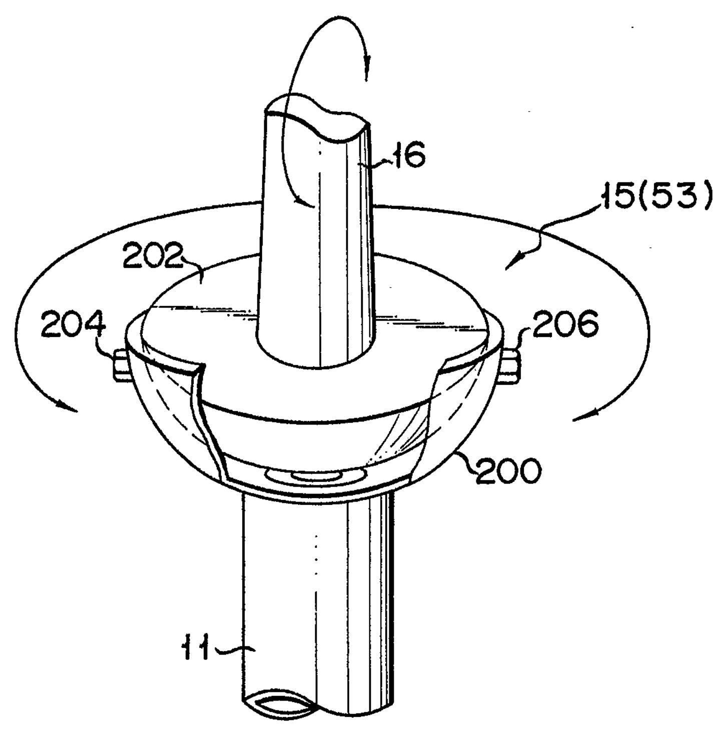
FIG. 10



F I G. 11



F I G. 13



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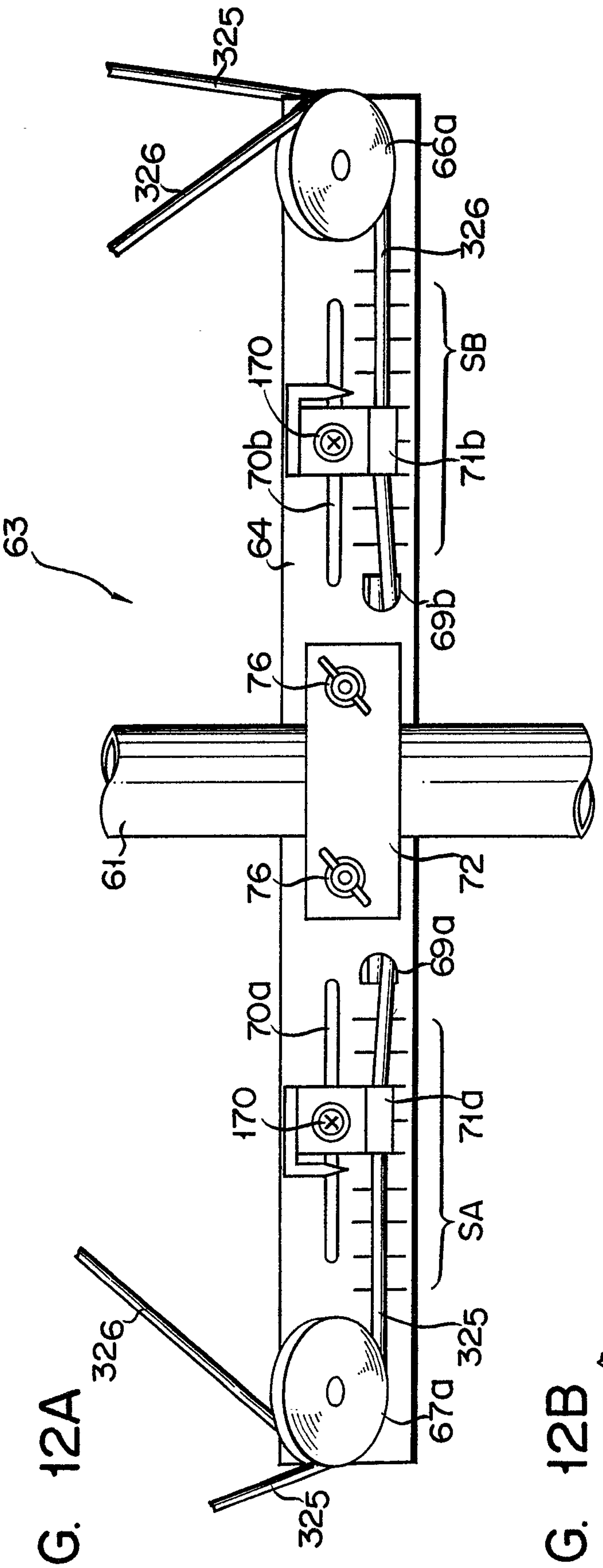


FIG. 12A

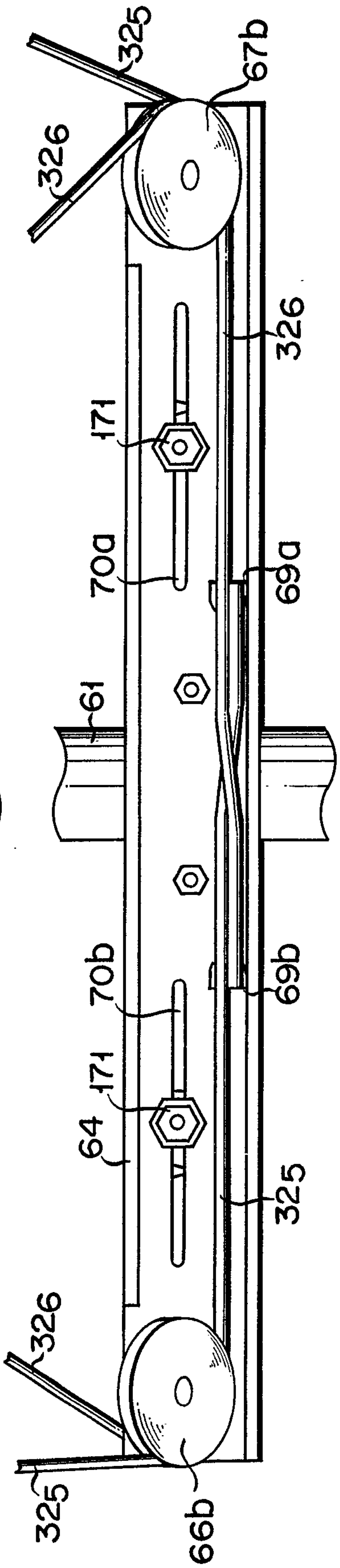
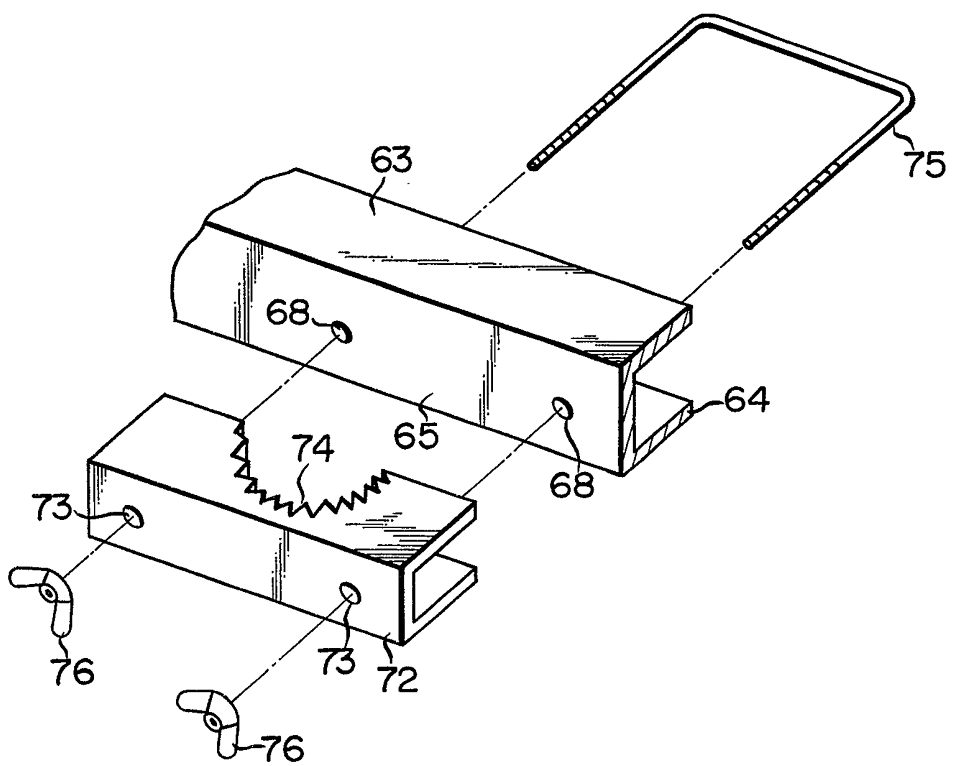


FIG. 12B

F I G. 14



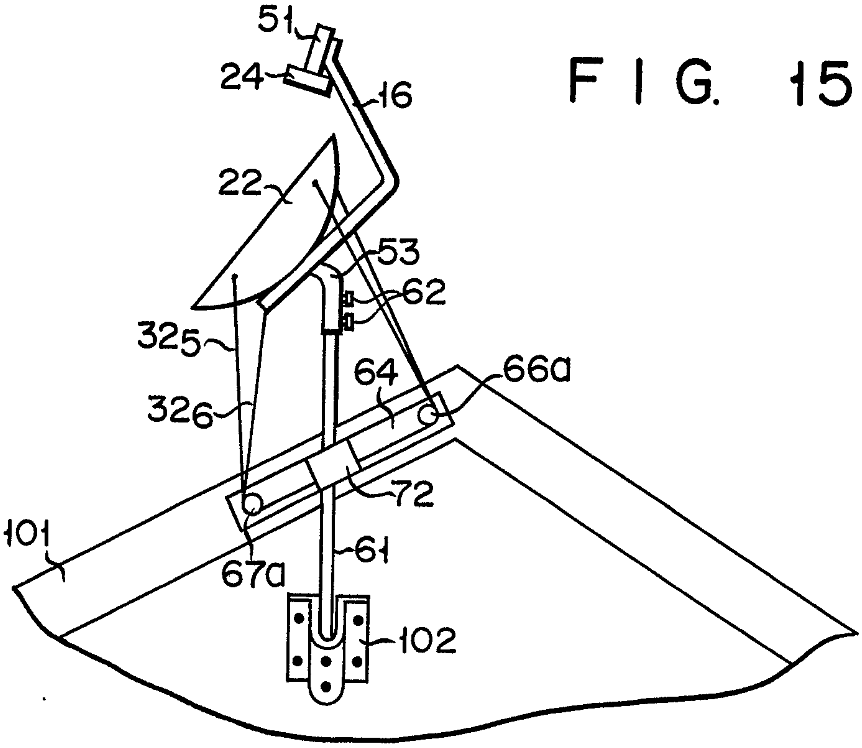
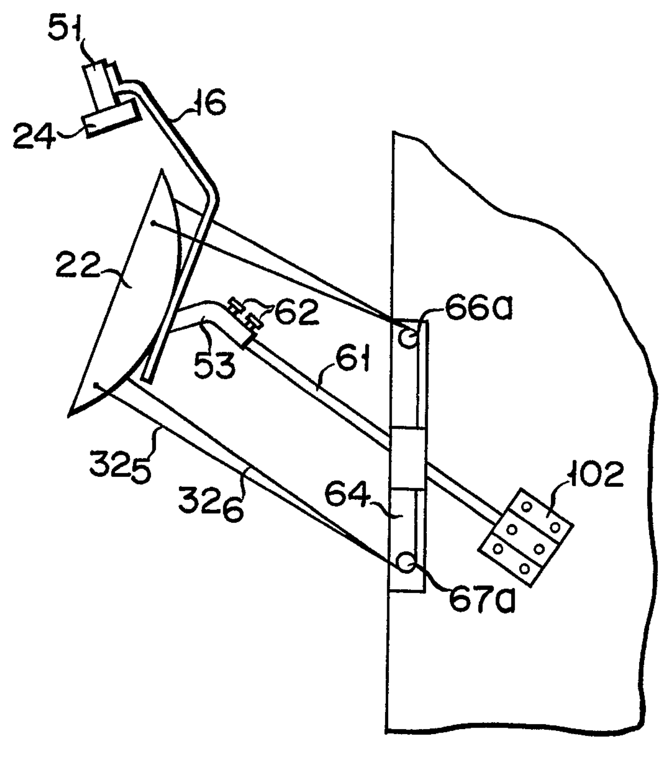

51
24
16
22
53
62
325
326
64
66a
72
101
67a
61
102

FIG. 15

FIG. 16


51
16
24
22
62
66a
53
61
325
326
64
102
67a

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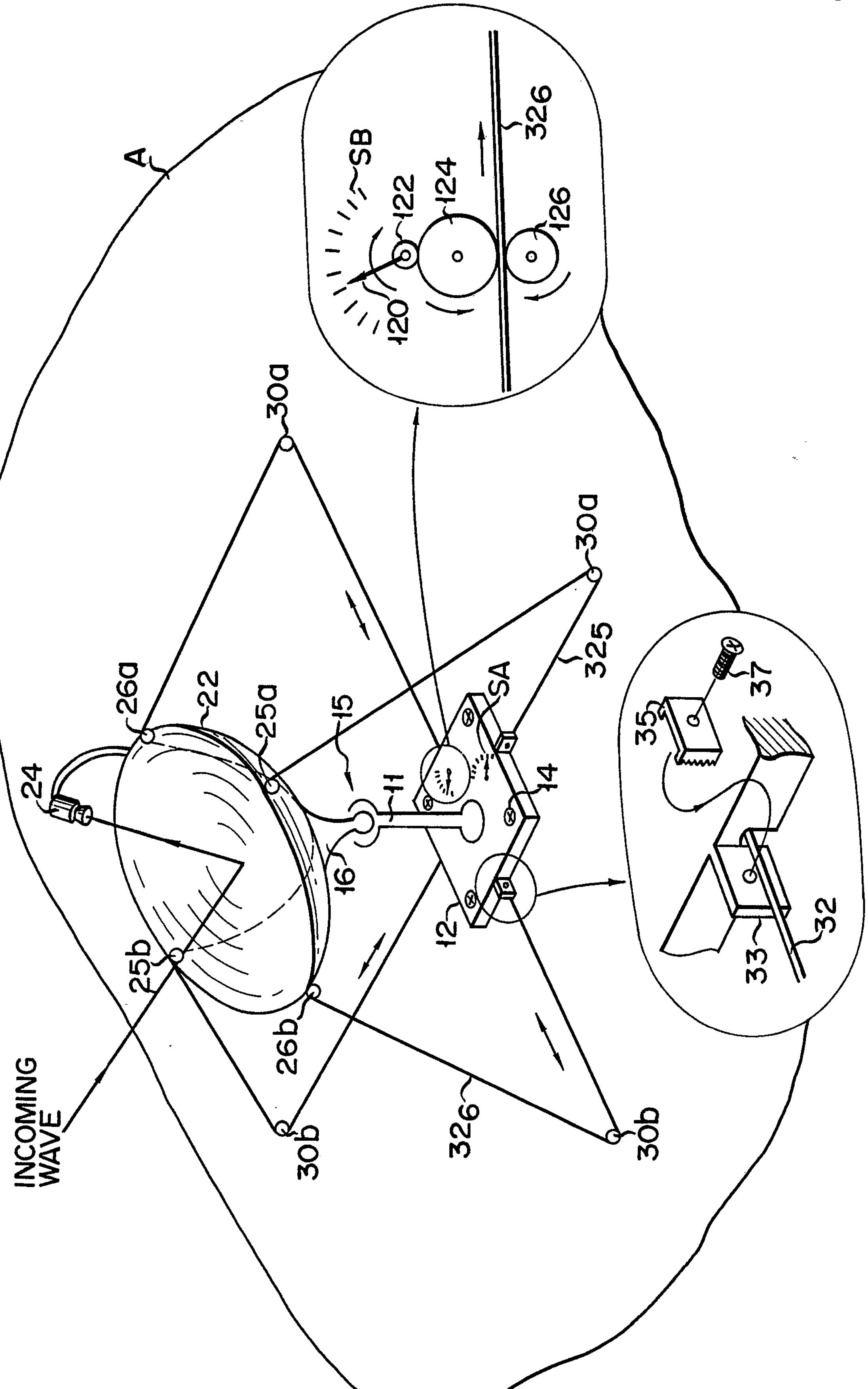
F I G. 17



SPECIFICATION

Antenna apparatus

The present invention relates to an antenna apparatus and, more particularly, to an antenna apparatus which allows easy setting or changing of the directivity of a parabolic antenna or the angle of tilt of the parabolic antenna.

In addition to television broadcasting services utilizing the VHF and UHF bands, attempts are being made to realize television broadcasting in the SHF (Super High Frequency) band of 3 to 30 GHz, which is higher than the UHF band. Conventional reception antennas such as Yagi antennas or loop antennas may not be used for reception of SHF waves. A parabolic antenna is used for this purpose.

UHF broadcasting is used for local service areas, whereas VHF broadcasting is used for wide service areas. With an increase in the number of high buildings, the problem of broadcasting interference is becoming more pronounced. A community reception system has been proposed to solve this problem, which is useful for a service area of great population density. However, in the case of a service area wherein the population is sparse, cost factors prevent the actual adoption of the community reception system. Another problem of radio interference, such as ghosting which is caused by waves reflected by a mountain, a building or the like, is also becoming more pronounced. A good solution to this problem has not yet been proposed. Although studies are being made on the use of CATV (community antenna television) and on the incorporation of a ghost canceler circuit in each TV set with a view to solving this problem, no successful practical measure has yet been reported.

According to the SHF broadcasting system, TV waves are radiated toward a geostationary satellite orbiting the equator, and the satellite retansmits the waves to the service area. The wave frequency in the SHF band is over 100 times that in the VHF band, so that the wavelength becomes as short as 25 cm and the waves propagate in the same manner as light rays, that is, in accordance with the line-of-sight theory. However, since a geostationary satellite is used for a relay station, the waves are not subject to the influence of mountains or buildings, and uniform transmission of the TV waves in a wide or even national area is thereby achieved. For reception of such SHF waves, the current type of TV set should be modified so as to be adapted to the new frequency. The reception antenna of the set must first be considered; use of a parabolic antenna is feasible. SHF waves received by the parabolic antenna are supplied to an SHF-UHF converter (hereinafter referred to as an S/U converter for brevity's sake) and are further supplied, if necessary, to a UHF-VHF converter before they are applied to the TV set. The S/U converter is often directly mounted on the parabolic antenna which is generally installed in outdoors. SHF waves may be received by a current type of TV set without any modification thereto if S/U converter or S/U and U/V converters are independently prepared as external adapters. A parabolic antenna for receiving SHF waves may be installed on a roof top or in the yard around the house, and the parabolic antenna is coupled via a cable to the TV set. In addition to the requirement of compactness, the parabolic antenna must satisfy the requirements of easy installation, light weight, and easy antenna pointing due to the fact that parabolic antennas are sold over a wide area and installed on various places. Since parabolic antennas are not currently generally used in general households, development of simple parabolic antennas is desired.

Various structures have been proposed to allow antenna pointing of the conventional parabolic antennas as per Japanese Utility Model Publication Application No. 55-28004. According to the prior art technique in this publication (Figure 1), an antenna is mounted on a frame through a pivot mechanism. The frame is supported on a reference plane such as the ground surface by a plurality of jacks. Individual jacks are adjusted so as to adjust the direction and angle of tilt of the antenna. In this prior art, in order to support the total weight of the antenna and the frame with the jacks, the ruggedness or hardness of the jacks must be increased, resulting in a heavy structure and a great jack operating force. An improvement to this prior art is proposed in this publication (Figures 2 and 3) wherein a frame is mounted on a reference plane such as the ground surface and an antenna is mounted on the frame through a level adjustment mechanism. A support column is fixed to the frame, and a cylinder fixed to the antenna is fitted around the support column. The cylinder and the support column engage with each other through a spherical body and a bearing. Therefore, the cylinder is rotatable to a desired angle relative to the support column, so that the antenna may freely rotate relative to the frame. However, when the antenna is left unsupported in this state, it is inclined due to its own weight. In order to prevent this, tapping holes are formed on the cylinder at angular intervals of about 120°. Screws are screwed into these tapping holes such that the distal ends of the screws may contact the support column. Therefore, individual adjustment of the three screws allows desired inclination of the cylinder (and hence the antenna with respect to the support column), and allows fixing of the antenna. Thus, the antenna may be kept at a selected angle of tilt by appropriate tightening of the screws.

In an antenna apparatus of this publication, the angle of tilt is adjusted through the spherical body and the bearing disposed between the cylinder and the support column. Therefore, although such an antenna apparatus may be conveniently used for a radar, it is too complex in structure for a home TV set. Furthermore, this antenna apparatus only allows adjustment of the angle of tilt within a narrow angular range. In home-installations, an antenna apparatus may not be installed in a flat location; it may be installed in a yard, indoors, or on a roof top. Conventional apparatuses do not allow such wide selection of installation locations and therefore prevent actual home use.

It is accordingly an object of the present invention to provide an antenna apparatus which may be easily home-installed, which allows easy antenna pointing, and which is simple in construction and light in weight.

According to an aspect of the present invention, there is provided an antenna apparatus wherein a parabolic antenna is pivotally supported on a support, and tying members such as wire ropes are suspended between the antenna and a stationary object such that the ropes may be selectively pulled. According to the antenna apparatus of the present invention, even if a rope is pulled to turn the parabolic antenna, the overall length of each rope is kept constant. This simplifies installation and construction of the apparatus and allows reduction of its weight. Pointing of the parabolic antenna may be freely performed.

This invention can be more fully understood from the following detailed description when taken in conjunction with the accompanying drawings, in which:

Figure 1 is a schematic perspective view showing an antenna apparatus according to the first embodiment of the present invention;

Figure 2 is a view showing the installed state of the apparatus shown in Figure 1;

Figure 3 is a view showing the configuration of a link mechanism of the antenna apparatus of Figure 1;

Figure 4 shows a pulley mechanism for a rope, which is provided at the edge of reflector of the antenna apparatus of Figure 1;

Figure 5 shows a fixing member for a pulley, which is driven into a mounting plane and the pulley is used for guiding the rope of Figure 1;

Figure 6 is a view showing a clamping mechanism for the rope shown in Figure 1;

Figures 7A and *7B* are modifications of the mechanism of Figure 4;

Figure 8 is a perspective view of an antenna apparatus according to the second embodiment of the present invention;

Figure 9 shows details of the link mechanism of the antenna apparatus of Figure 8;

Figure 10 is a sectional view of the link mechanism of Figure 9;

Figure 11 is a side view of Figure 9 and illustrates the operation of the link mechanism of Figure 9;

Figure 12A shows details of a support arm of the antenna apparatus of Figure 8;

Figure 12B is a rear view of the support arm of Figure 12A;

Figure 13 is a modification of the link mechanism of Figure 3 or the free joint of Figures 9 to 11;

Figure 14 is a perspective view showing a clamp mechanism for the support arm shown in Figure 8;

Figure 15 shows an installed state of the antenna apparatus of Figure 8;

Figure 16 shows another installed state of the antenna apparatus of Figure 8; and

Figure 17 shows a modification of the antenna apparatus of Figure 1.

The antenna apparatus of the preferred embodiment according to the present invention will now be described with reference to the accompanying drawings.

Figures 1 and 2 schematically show an antenna apparatus according to the first embodiment of the present invention. A columnar or cylindrical support 11 of a metal, reinforced synthetic resin or the like is formed integrally with the upper surface of a mounting plate 12. The integration of support 11 and mounting plate 12 may be made by means of welding, screws or the like. Through holes 13 (Figure 2) are formed at predetermined locations in mounting plate 12 and respectively receive fastening members 14. Fastening members 14 are driven into a mounting plane A such as the ground or a beam of a building so as to fix mounting plate 12 thereto. A link mechanism 15 is mounted at the top of support 11. Link mechanism 15 serves to pivotally link a holding arm 16 to support 11 as a configuration as shown in Figure 3.

In Figure 3, a ball 17 is fixed to one end of holding arm 16. A hollow socket 18 at the top end of support 11 receives ball 17 therein. A loose space is provided between an opening 19 of socket 18 and the root of holding arm 16 so as to allow pivotal movement of holding arm 16 within a prescribed range of this space.

In the embodiment of Figure 3, support 11 comprises two halves 11A and 11B; after ball 17 is inserted into socket 18, two halves 11A and 11B of support 11 are fastened to each other with a bolt 20 and a nut 21. The configuration of link mechanism 15 is not limited to this arrangement, and many other types of mechanism may alternatively be adopted. The other end of holding arm 16 which may be pivotal in this manner is coupled to an armature 23 fixed to the rear surface of a reflector 22 (Figure 1). The front surface of reflector 22 which does not have an armature fixed thereto is concave (paraboloid). The concave surface or the parabolic receiving surface of reflector 22 is directed toward a geostationary satellite (not shown). A primary feed 24 opposes the concave surface. An S/U (SHF/UHF) converter (not shown) may be mounted behind primary feed 24 as needed.

A plurality of pairs of pulley mechanisms 25a and 25b, 26a and 26b, and so on are mounted on the periphery of reflector 22. The arrangement of these pulley mechanisms are, for example, symmetrical about the center axis of reflector 22. As shown in Figure 4, each of these pulley mechanisms 25a, 25b, 26a, 26b and so on is provided with a pulley support 27 mounted on the outer surface at the perimeter of reflector 22, and with a pulley 28 rotatably supported by each associated pulley support 27. A plurality of pairs of fixing members 29a, 29b, 30a and 30b, and so on are mounted on mounting plane A so as to be symmetrical about the central axis of support 11 (Figure 1 or 2). One end of each of these fixing members 29a, 29b, 30a, 30b and so on pivotally supports a pulley 31 (31b) and the other end thereof is thrust or driven into mounting plane A (Figure 5).

Tying members 32 (32_1 - 32_4) such as stainless steel wire ropes are braced around each pair of pulley 28 and corresponding pulley 31. A large tensile strength and a small thermal expansion coefficient are important characteristics of members 32. "Stainless steel" is a typical material suitable for members 32. The bracing method of ropes 32 will be described with reference to Figure 2. Clamping or fastening portions 33 are formed at the sides of mounting plate 12. More particularly, referring to Figure 6, clamping portion 33 with a tapping hole 34 is formed at the side of mounting plate 12. A U-shaped fixture 35 is arranged such that its both sides of sawtooth-like shape may contact the clamping portion 33. A through hole 36 is formed in fixture 35 in alignment with tapping hole 34. After rope 32 (32_1) is placed next to clamping portion 33 and fixture 35 is placed thereover, a screw 37 is screwed into tapping hole 34 of clamping portion 33 via through hole 36 of fixture 35. After one end of rope 32_1 is fixed to clamping portion 33 in this manner, rope 32_1 is braced around pulley 31a of fixing member 29a (Figure 2). After rope 32_1 is passed over pulley mechanism 25a of reflector 22, it is braced over pulley mechanism 25b along the rear surface of reflector 22 (Figures 2 and 4). Rope 32_1 is then passed via pulley 31b of fixing member 29b to clamping portion 33, and is fixed to clamping portion 33 with a proper tension in a similar manner as described above. Reflector 22 is held by bracing a suitable number of ropes 32 (32_1 to 32_4) in this manner.

It is therefore possible to adjust the direction and angle of tilt of reflector 22. When the concave surface of reflector 22 is directed straight upward, reflector 22 is arranged as shown by the solid line in Figure 2. In order to readjust the reflector 22, it is moved by hands or the like to a desired direction. Although both ends of each rope 32 are fixed to clamping portion 33, reflector 22 is free to pivot and each rope 32 is free to move. Therefore, reflector 22 may be relatively easily pointed. The broken line in Figure 2 represents the reflector 22 which is pointed in this manner. Let *a* stand for the diameter of reflector 22 (distance between pulley mechanisms 25a and 25b); *b*, the distance between fixing members 29a and 29b; *h*, the distance (height) between mounting plane A and link mechanism 15; R, the radius of gyration of reflector 22 around link mechanism 15; L1a, the length of rope 32_1 from pulley 31a of member 29a to pulley mechanism 25a in the initial state (state indicated by the solid line); and L2a, the length of rope 32_1 from pulley 31b of member 29b to pulley mechanism 25b in the initial state. Even if L1a and L2a respectively change to L1b and L2b after antenna pointing (state indicated by the broken line), a relation $L1a + L2a \approx L1b + L2b$ is established. This relation indicates that the total length of rope 32_1 between mounting plane A and reflector 22 can be kept substantially constant during antenna installation and after antenna pointing. In other words, the direction and angle of tilt of reflector 22 may be freely changed within such a range that the above relation is established. After reflector 22 is pointed in this manner, reflector 22 and ropes 32 must be fixed in position so that reflector 22 may not accidentally move due to wind, etc. This may be accomplished by adhering or fixing pulley mechanism 25 and rope 32 with an adhesive or wire, or by clamping pulley mechanism 25 with metal fixtures which are mounted by caulking or the like to the portions of rope 32 at both sides of pulley mechanism 25.

In the above description, reflector 22, ropes 32, pulley mechanisms 25a to 26b and so on are combined. However, reflector 22 and ropes 32 may engage with each other in the manner as shown in Figure 7A or 7B. Referring to Figure 7A, a through hole 38 is formed in the periphery of reflector 22. Rope 32 is passed from fixing member 29 over the rim of reflector 22 and further passed through the through hole 38 to the rear surface side of reflector 22. Alternatively, both ends of rope 32 may be fastened to reflector 22 as shown in Figure 7B, while its intermediate portion is braced bwetween fixing members 29a and 29b through clamping portion 33 (cf. Figure 2). In this case, rope 32 is fixed in position by utilizing clamping portion 33 after antenna pointing. With this arrangement, since reflector 22 need not have pulley mechanisms 25a to 26b and so on on its rear surface, it becomes simpler in construction and lighter in weight.

In accordance with the first embodiment of the present invention described above, the direction and angle of tilt of the reflector may be freely adjusted with a simple construction. Since tying members such as wire ropes are used to perform such adjustment, the antenna apparatus becomes simpler in construction and lighter in weight. The present invention can thus be applied to antennas of home TV receivers or the like.

The present invention is not limited to the embodiment described above, and various other changes and modifications may be made. The second embodiment of the present invention will now be described with reference to Figure 8. The antenna apparatus shown in Figure 8 is specifically characterized in its installation structure. The same reference numerals as in the first embodiment denote the same parts in the second embodiment, and a detailed description thereof will be omitted.

A U-shaped armature 23 is fixed to the rear surface of a reflector 22. Armature 23 comprises a cylindrical metal pipe and is fixed to reflector 22 by welding or with screws or the like. A holding arm 16 is arranged across two sides of armature 23. The top of holding arm 16 is extended to lightly bend toward the concave surface side of reflector 22, and carries a primary feed 24 and an S/U converter 51. A coaxial cable 52 is connected to S/U converter 51 for transmitting signals therefrom to electric equipment (e.g. UHF tuner) inside a house (not shown). A free joint 53 is mounted on holding arm 16 such that reflector 22 is pivotal with respect to free joint 53. More specifically, as shown in Figures 9 to 11, one end of a bolt 54 is fixed to holding arm 16 while its other end projects outward. Bolt 54 is screwed into a nut 55 and a washer 56. A slit 58 is formed in the bottom of a cylindrically-shaped body 57 of free joint 53. The other end of bolt 54 is inserted into the interior of joint body 57 and threadably engages with a tapping hole 60 formed in a globe 59 inside the joint body 57. Globe 59 serves as a nut for bolt 54. After adjusting the angle of tilt of reflector 22, nut 55 is tightened toward the side of globe 59 to clamp joint body 57 between globe 59 and nut 55. Thus, reflector 22 can be fixed with respect to free joint 53.

Free joint 53 may be bent to a suitable angle within slit 58. This angle corresponds to the angle of tilt of a geostationary satellite (not shown) with espect to the ground surface of, for example, Japan. In a country such as Japan wherein the angle does not significantly change throughout the country, the angle may be set to an epitomized value for all antennas. However, free joints 53 of different bent angles may be prepared for individual adjustment in countries such as the U.S.A. or England.

As shown in Figure 8, the other end of free joint body 57 is cylindrical and is fitted over the top end of an installation pole 61. Clamping screws 62 are screwed to given portions of free joint 53. In this manner, reflector 22 is rotatable about pole 61 by means of free joint 53. When reflector 22 is set at a predetermined direction and clamping screws 62 are fastened, screws 62 abut against pole 61 to thereby fix free joint 53. The lower end of pole 61 is fixed to a stationary plate (not shown) as will be described later. A support arm 63 is mounted to an intermediate portion of pole 61 so that support arm 63 is perpendicularly fixed to pole 61. However, the angle of support arm 63 with respect to pole 61 may be adjustable. Support arm 63 has a U-shaped arm body 64. A pair of pulleys 66a and 66b and another pair of pulleys 67a and 67b, one pair being provided at each end of arm body 64, are pivotally supported to oppose each other with an arm body proximal portion 65 interposed therebetween. A pair of through holes 69a and 69b for passing ropes 32_5 and 32_6 therethrough are respectively formed in those portions of proximal portion 65. These through holes 69a and 69b are respectively provided between the center of arm body 64 and the pair of pulleys 66a and 66b, and between the center of arm body 64 and the pair of pulleys 67a and 67b. Latitude and longitude scales are provided on the sides of arm body 64 along its longitudinal direction. Elongated slits 70a and 70b are formed in correspondence with these scales, and rope clamping members 71a and 71b are mounted therein. Bolts 170 are fixed to rope clamping members 71a and 71b and are inserted into slits 70a and 70b. A nut 171 threadably engages with each of bolts 170 projecting into the inner side of arm portion 64. Alternatively, through holes may be formed in the clamping members 71a and 71b so as to allow fastening with bolts and nuts.

A pair of through holes 68 are formed in arm body proximal portion 65 as shown in Figure 14. Arm body 64 is fixed by a U-shaped fixture 72 such that the bottom of the U-shape may be brought into contact with arm body 64. A pair of through holes 73 are formed to correspond to through holes 68. Semicircular notches 74 are formed in a center portion of fixture 72. Notches 74 lie between through holes 68. The edges of these notches 74 fit around pole 61 (Figure 8) and are brought into contact with pole 61. Notches 74 need not precisely correspond to the outer shape of pole 61 but may be slightly larger than that. Support arm 63 may be fixed to pole 61 by clamping a U-shaped threaded rod rixture 75 with fly nuts (thumbscrews) 76. So that pole 61 is interposed between fixture 72 and arm body 64. This may alternatively be accomplished with a combination of bolts and nuts without requiring threaded rod fixture 75 and fly nuts 76.

A pair of rope stoppers 77a and 77b and another pair of rope stoppers 78a and 78b are mounted on armature 23 of reflector 22 to be symmetrical about its center (Figure 8). Each of rope stoppers 77a to 78b may comprise, for example, a screw 177 screwed into armature 23 via a through hole of a lug 277 which is fixed by soldering or caulking to the end of rope 32 (32_5). The tension of rope 32 may be rendered adjustable in the following manner. One of each pair of rope stoppers, that is, stoppers 77a and 78a, comprises either a through hole to which rope 32 is directly wound or a fixing portion such as a soldered or welded portion. The other of each pair of rope stoppers, that is, stoppers 77b and 78b, comprises a screw. Two ropes 32_5 and 32_6 such as stainless steel wire ropes may be braced around these stoppers 77a to 78b. One end of rope 32_5, for example, is fixed to the stopper 77a, while its other end is passed through pulley 67a, through hole 69a of support arm 63 and pulley 66b and is fixed by stopper 77b (Figures 12A and 12B). Rope 32_5 is clamped by clamping member 71a. Similarly, one end of the other rope 32_6 is fixed by stopper 78a, while its other end is passed through pulley 67b and through hole 69b of support arm 63 to the opposite side of support arm 63. The other end of rope 32_6 further engages with pulley 66a and is fixed by stopper 78b. Therefore, the tension on ropes 32_5 and 32_6 may be adjusted by adjusting screw 177 of each of stoppers 77b and 78b.

Figure 13 shows another type of link mechanism 15 or another type of free joint 53. A cup like bearing 200 is rotatably mounted on the top end portion of support 11. A hemispheroid 202 is received by the concave surface of bearing 200, and it is pivotally suspended by a pair of strongly built bearings 204 and 206 so that hemispheroid 202 is smoothly rotate within the concave. The center of the plane of hemispheroid 202 is provided with holding arm 16. Thus, holding arm 16 can freely move within a space of 2π (hemispheric space).

A case will be described with reference to Figure 15 wherein an antenna apparatus of the configuration as described above is fixed to a house. In Figure 15, an antenna apparatus is installed on a beam of a house. A support arm body 64 is mounted on an end beam 101 of a roof with screws or the like. Thereafter, one end of an installation pole 61 is fixed to the gable wall surface of the house with a fixture 102 such that pole 61 is perpendicular to the ground surface (not shown). Since beam 101 is inclined with respect to the ground surface, pole 61 is not perpendicular to support arm body 64. However, this angular deviation may be canceled out by notches 74 (Figure 14) formed in fixture 72. Pole 61 may be securely fixed by fixture 72 with fly nuts or the like. A reflector 22 is directed to a desired direction utilizing a free joint 53 mounted at the top end of pole 61. Thereafter, pole 61 and free joint 53 are fixed by clamping screws 62. Even if the angular deviation is produced between reflector 22 and support arm body 64, it may be corrected since ropes 32 (32_5, 32_6) may be freely moved. After coarse adjustment, ropes 32 are moved for fine adjustment. The adjustment of the angle of tilt of reflector 22 is performed by means of reflector 22 itself and free joint 53. Since the angle of tilt of free joint 53 is set in advance as described above, setting the direction of reflector 22 will automatically roughly set its angle of tilt. Then, ropes 32 are manually moved to correctly set the direction and the angle of tilt of reflector 22. Scales SA and SB (Figure 12A) for calibrating longitude and latitude may be made to correspond to ropes 32_5 and 32_6, respectively. These scales SA and SB may then be used to determine successful adjustment with reference to rope clamping members 71a and 71b. The adjustment may be performed individually or simultaneously for the ropes 32_5 and 32_6. After completing required fine adjustment, rope clamping members 71a and 71b are fixed to support arm body 64 to stop ropes 32_5 and 32_6, and nut 55 (Figure 10) at the top end of free joint 53 is clamped to fix reflector 22 in position. The antenna apparatus has the configuration as described above. However, the installation method is not limited to that shown in Figure 15. The antenna apparatus may be installed on a wall surface of the house as shown in Figure 16. Since the adjustment method is the same as that described above in this case, a detailed description thereof will be omitted.

Figure 17 shows a modification of the antenna apparatus of Figure 1. In Figure 17, a mounting plate 12 is provided with a longitude scale SA coupled to a first rope 32_5 and a latitude scale SB coupled to a second robe 32_6. A needle 120 of scale SB is coupled via a roller 122 to a rubber or elastic roller 124. Rope 32_6 is sandwiched between roller 124 and a pinch roller 126 with a certain pressure. When rope 32_6 is pulled toward the right side, roller 124 rotates in counterclockwise direction, and roller 122 rotates in clockwise direction. Then, needle 120 moves toward right. When the movement of rope 32_6 corresponds to the latitude angle of tilt of reflector 22, scale SB indicates the degree of latitude angle. Scale SA may have the same configuration as scale SB, and scale SA indicates the degree of longitude angle.

In the above description, two ropes 32_5 and 32_6 cross at the intermediate portion of support arm 63 so as to prevent their inadvertently falling off (Figure 12B). However, the ropes need not cross each other if the grooves of pulleys 66a, 66b, 67a and 67b for receiving them are deep enough. In this case, the ropes may be simply braced around pulleys 66a to 67b, and through holes 69a and 69b may be omitted. Armature 23 is arranged on the rear surface of reflector 22 for reinforcing it, since it is of light weight; armature 23 serves to make the overall structure lighter in weight and stronger. Primary feed 24 or the like is mounted utilizing holding arm 16 which also serves as part of armature 23. However, primary feed 24 may be separately mounted; it may be mounted on an arm projecting from reflector 22. Moreover, various parameters B to P are set to hold predetermined relations where B is the distance between the upper support points of reflector 22, C is the distance between its lower support points of reflector 22, H is the height of pole 61, R is the radius of gyration of reflector 22, D is the length of the arm of free joint 53, S is the deviation in positions of support arm body 64 and pole 61, and P is the winding diameter of pulleys 66a to 67b. When the values of parameters B to P are properly selected, reflector 22 may be moved vertically within the range of ±40° and angularly or horizontally through 360° about free joint 53, and the linear distance of rope 32 remains substantially constant. Although these conditions are generally difficult to satisfy, they may be relatively easily satisfied by setting the moving range of reflector 22 to fall within ±40°. The actual range of movement required is 10° to 80°, which is within the range of ±40°. In the embodiment described above, free joint 53 is inclined by 45° with respect to pole 61, and reflector 22 is vertically movable within the range of ±40° with respect to free joint 53. This configuration allows easy adjustment of the angle of tilt since reflector 22 may be moved within such a range by adjustment of the length of ropes 32. If one of two ropes 32_5 and 32_6 is held stationary and the other is held movable, the direction corresponding to the angle of tilt moves obliquely, and the tilt angle changes proportionally. Such a change in the angle of tilt with oblique movement is similar to the change in the optimum direction and in the angle of tilt of a service area with respect to latitude and longitude, due to the difference in latitudes of the geostationary satellite and the service area. By utilizing the deviation in the lengths of ropes 32_5 and 32_6, support arm 63 or arm body 64 may be set to a particular direction. In this case, the direction and the angle of tilt of reflector 22 may be adjusted by providing displacement and deviation of two ropes 32_5 and 32_6 corresponding to the latitude and longitude at an installation location of the antenna apparatus. Free joint 53 may be held stationary in the transverse direction but movable in the vertical direction relative to reflector 22. In this case, the angle of tilt (direction) of reflector 22 coincides with the axial direction of free joint 53 (axial direction of the bent portion at the side of reflector 22), resulting in stable reception. In each of the first and second embodiments of the present invention, a plurality (e.g., two) of ropes, wires, chains, etc. may be used. The installation positions of the ropes are preferably equally spaced apart and constant length for easy adjustment.

According to the antenna apparatus of the present invention described above, adjustment of the reflector is easy. The apparatus may be easily and reliably fixed by stopping the ropes, resulting in light weight, simple construction and low manufacturing cost. If an installation pole is used, the installation location of the apparatus may be more freely selected. Use of a free joint allows easy setting of the direction and angle of tilt of the antenna apparatus, providing better operability.

Although the present invention is described with reference to the particular embodiments, various changes and modifications may be made within the scope of the present invention. The present invention is not limited to a parabolic antenna but may be extended to a flat or loop antenna. Furthermore, the present invention is not limited to small antennas for general home use but may be extended to relatively large antennas.

CLAIMS

1. An antenna apparatus comprising:

a support device to be fixed to a given installing body;

an antenna body having a given directivity; and coupling device for mechanically coupling said support means to said antenna body,

characterized in that said coupling device includes a free joint which permits to move said antenna body around the free joint,

and that two different portions of said antenna body are connected via a wire or rope so that the direction of said antenna body is changed by the push-pull movement of said rope.

2. The antenna apparatus of claim 1, characterized by further comprising means for clamping said rope at a given position of said support device.

3. The antenna apparatus of claim 2, wherein said two different portions are disposed at two opposite points of said antenna body.

4. The antenna apparatus of claim 3, wherein second two different portions of said antenna body are connected via second wire or rope so that the direction of said antenna body is changed by the push-pull movement of said second rope.

5. The antenna apparatus of claim 4, wherein said second different portions are disposed at second two opposite points of said antenna body, said two different portions being separated from said second two different portions.

6. The antenna apparatus of claim 4 or 5, characterized by further comprising second means for clamping said second rope at a second given position of said support device.

7. The antenna apparatus of any one of claims 4 to 6, wherein said second rope crosses over said first rope or vice versa with a certain tension.

8. The antenna apparatus of any one of claims 1 to 7, wherein said free joint includes:

a holding member coupled at its one end to said antenna body and having at the other end a ball member; and

a shell bearing for partly encapsulating said ball member and supporting said ball member such that said holding member is movable around said shell bearing.

9. The antenna apparatus of any one of claims 1 to 8, wherein the two different portions of said antenna body are provided with means for movably retaining said rope.

10. The antenna apparatus of any one of claims 1 to 9, characterized by further comprising scale means coupled to said rope for indicating the amount of said push-pull movement.

11. The antenna apparatus of any one of claims 1 to 8, wherein said support device includes:

a pole member coupled at its one side with said free joint; and

a support arm rotatably coupled to said pole member for movably hooking said rope, said push-pull movement of said rope being made by rotating said support arm around said pole member.

12. The antenna apparatus of claim 11, wherein said support arm is provided with scale means for indicating the amount of said push-pull movement.

13. An antenna apparatus, substantially hereinbefore described with reference to the accompanying drawings.

Printed for Her Majesty's Stationery Office, by Croydon Printing Company Limited, Croydon, Surrey, 1983.
Published by The Patent Office, 25 Southampton Buildings, London. WC2A 1AY, from which copies may be obtained.