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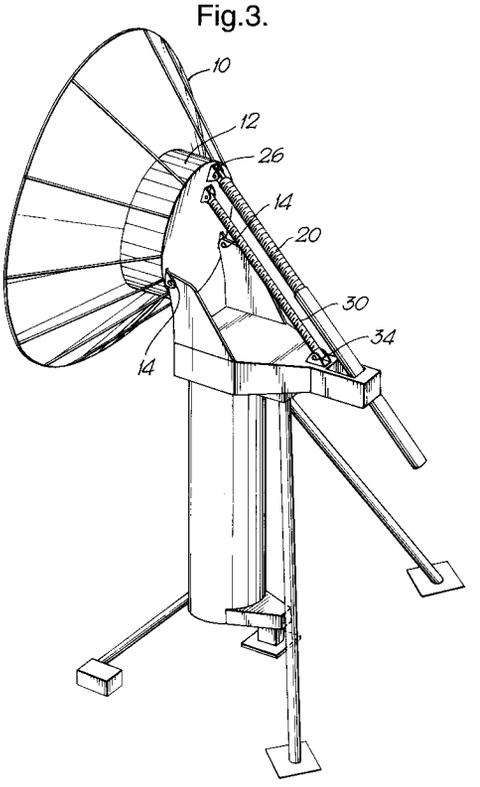
(54) Radio antenna.

(57) A radio antenna reflector assembly (10, 12) is provided with mounting points on a base structure and the reflector assembly upon which to mount jack means (20) to adjust the elevation of the relector assembly (10, 12). Means may also be provided for installing an auxiliary elevation jack (30) to enable the main jack (20) to be repaired or serviced. The use of the auxiliary jack enables the elevation of the antenna to be changed whilst the main jack is repaired or serviced.

Fig.3.



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This invention relates to radio antennas.

In order to transmit signals to and receive signals from satellites or even a distant antenna a large antenna is normally used. Large antennas in this context are those above about 3m in diameter. Large antennas normally need to be moveable in azimuth and elevation because the design of the antennas is such that they are highly focused and the best performance is achieved at maximum gain which occurs over a very narrow angular range. The angular range over which optimum gain occurs tends to be smaller than the motion of the remote device transmitting or receiving the signals.

The angular movement of the relevant satellites when viewed from the earth is very small but the gain profile of the antenna requires the satellite to be tracked to accuracies of within 0.001°. It will be appreciated therefore that the movement of the antenna needs to be controlled to a high degree of accuracy by a high precision means. In practice a screw jack is commonly used.

A moveable antenna may be mounted on a base structure securely fastened to the ground. The base structure which is secured to the ground may also have means to rotate either itself or the antenna in azimuth.

To ensure the reflecting surface of the antenna distorts as little as possible it may be mounted on a support frame. The support frame and reflector surface together generally form a reflector assembly. In the case of some large reflectors manufactured by a spinning process the structure is sufficiently rigid not to need a support frame. The reflector assembly may in turn be mounted pivotally on a base structure to enable the angle of elevation of the dish to be varied.

Normally a jack is connected between the base structure and the reflector assembly to provide means for changing as well as controlling the elevation of the antenna. Although the jack could be actuated by any known means, such as hydraulic power or pneumatic power the preferred means for this application is a screw jack. Screw jacks are used for a number of reasons. The reflector assemblies can be heavy, commonly the reflecting surface and supporting structure on large antennas can weigh many tons. The pivotal arrangements needed in non equatorial regions to point the antenna at a satellite and ensure the satellite is tracked coupled with the weight of the reflector assembly can result in the jack being a highly stressed component. Screw jacks are preferred because they can be accurately controlled and are capable of performing to the high levels of accuracy required whilst also providing a fail safe mechanism to maintain the position of the reflector assembly in the event of failure. Screw jacks are prone to wear, especially in the circumstances of frequent movement over only a very small length of their travel as would tend to be the case with these antenna jacks. Clearly there is a limit to the amount of wear that can be tolerated if the antenna is to be able to maintain the desired tracking accuracy. Whilst preventative steps can be taken to reduce the levels of wear they are not found to be very effective and merely delay the need either to replace the jack or to give it a major overhaul.

Replacement of the antenna jacks tends to be an expensive and time consuming process. It normally involves taking the antenna out of service whilst the repair is carried out. This lost revenue arising from the removal of the antenna from service adds to the cost of replacement. Known repair methods require the antenna to be parked and supported whilst the jack is removed and a replacement fitted. It is not uncommon for this process to take two days.

Known methods of replacement can involve resting the reflector assembly on a prop to provide some support whilst the main jack is replaced. This process can risk distorting the reflecting surface and its reflector assembly, with a consequent loss of performance of the antenna.

The jacks are relatively expensive components of an antenna, representing historically between 10 and 15% of the cost of the antenna. Other solutions such as the use of two smaller main jacks, each of which could support and adjust the reflector assembly for a short time have not been considered economical because the difference in cost between each of the lighter jacks and one heavy one capable of operating on its own is not that great. It is quite common for there to be several antennas grouped on a site and for there to be one effectively held on standby for use when the repairs need to be undertaken.

According to the present invention there is provided an antenna which is capable of being moved in at least elevation, the movement in elevation being controllable by at least one main jack, a first mounting point of the main jack being connected to a reflector assembly, a second mounting point of the said jack being connected to an antenna base structure, and an auxiliary jack capable of moving the reflector assembly in elevation when the main jack is disconnected from at least one of its mounting points having a first mounting point attachable to the reflector assembly, and a second mounting point attachable to the base structure, the auxiliary jack being useable to move the reflector assembly with respect to the base structure.

An advantage of the present invention is that the provision of an auxiliary jack makes the replacement of main jack comparatively quick and simple. It also ensures the antenna can continue to transmit and receive signals whilst the main jack is

repaired, serviced or replaced.

The auxiliary jack may itself be removable so that only one set (either one or a pair) of auxiliary jacks are needed for the repairs rather than one per antenna. This method of repair enables jacks of lighter construction than the normal main jack to be installed temporarily whilst the main jack is replaced.

According to another aspect of the present invention there is provided a method of replacing a main antenna jack including the steps of

i) installing at least one auxiliary jack, by connecting a mounting point of said jack to a reflector assembly and a second end to an antenna base structure

ii) disconnecting the main antenna jack from its mountings

iii) removing said main jack

iv) refitting either a new, serviced or repaired main jack to its mountings

v) reconnecting the main jack as appropriate

vi) disconnecting or removing the auxiliary jack or jacks from at least one of their mounting points.

This invention has the advantage that it enables an auxiliary jack to be fitted so that the normal screw jack can be removed whilst the antenna remains in service. Additionally this means the replacement process itself can be quicker and cheaper because there is no need to take the antenna out of service, and park it before the main jack is replaced.

It is preferable that an auxiliary jack is mounted on a mounting structure built on the antenna base structure so that the auxiliary jacks may be mounted on the mounting structure. A corresponding mounting structure could be built on the reflector assembly. An advantage of the use of a mounting structure is that it enables the auxiliary jacks to be positioned such that they do not impede access to the main jack, which might make its removal and repair more difficult. The mounting structure could be something which is only installed at the time it is necessary to repair or replace the main jack, or it could be permanently installed on the antenna. In some instances it may be the mounting structure is no more than a set of brackets with pivot assemblies to which the jack pivots may be attached. The choice will depend upon the particular size and design of antenna and whether such an arrangement might make access to the main jack more difficult.

The invention will now be described in detail by way of example only, with reference to the accompanying drawings in which:

Figure 1 shows a view of one embodiment of the invention;

Figure 2 shows a view of an alternative embodiment to that shown in Figure 1 and employing two auxiliary jacks.

Figures 3, 4, 5 and 6 show alternative embodiments of the antenna arrangement with auxilliary jacks in place. In Figures 4 and 5 the auxiliary jack is placed below the axis of elevation and acts on points beneath it, and in Figure 6 a free standing antenna is shown in which the pivot points may be secured directly to ground anchors.

Referring now to Figure 1, a large antenna reflecting surface is supported by a support frame, which together form the reflector assembly 12. The function of the support frame is to provide support for the reflecting surface of the antenna and to ensure minimal distortion both as it is moved and as the environmental conditions such as wind and temperature change. The reflector assembly 12 also provides a mounting point for pivots 14, used to rotate the antenna in elevation. The reflector assembly is mounted on a base structure (not shown) which could be rotated to change the azimuth of the antenna.

Movement in elevation is controlled by a jack 20, attached at one end by a pivot 22 to a mounting beam 24 and at a second end by a pivot mechanism 26 to the reflector assembly 12. In normal operation the elevation of the antenna is controlled by the jack 20 driven by a motor and control means (not shown). An auxiliary jack 30 is mounted on a removable mounting frame 32 and connected to the reflector assembly 12 by pivot mechanism 34. The auxiliary jack also moves the antenna in elevation and once installed may be used to control the movement of the antenna whilst the jack 20 is replaced or serviced. Such activities normally involve disconnecting the jack from its mounting points (22, 26) on the antenna support frame 12 and the base structure respectively.

Figure 2 shows an alternative embodiment in which the movement of the antenna 10 and reflector assembly 12 are controlled by a large screw jack 20. In this embodiment there are two auxiliary jacks used to control the antenna movement whilst the main jack 20 is disconnected from the pivot point 22, 26. If the support beam 24 is manufactured to be a 'V' frame type shape and the pivot point 22 is mounted at the apex of the V and the pivots 14 for pivoting the support frame 12 may be mounted at or near the ends of the limbs of the 'V' frame then it is advantageous to mount each of the removable mounting frames 32 on a limb of the V frame support beam 24. An advantage of using two jacks is that they may each be of smaller and lighter construction than the single jack they are temporarily replacing. A further advantage of using two auxiliary jacks is that they may be positioned

on the removable mounting frames spaced apart from each other on different limbs of the support beam 24 and from the main jack 20, this positioning enables easier access to the pivot points 22 and 26 and the jack 20 so facilitating its repair or replacement. Careful positioning of the removable mounting frames also enables the stresses on the support frame 12 to be more evenly distributed and thus reduce the risk of distortion of antenna.

Further alternative embodiments are shown in Figures 3-6. In these embodiments the detail of the construction is different but the principles remain unchanged.

Figure 3 shows a possible application in which there is only one auxiliary jack 30 used to replace the main jack 20.

Figure 4 shows another embodiment in which a single auxiliary jack is used to replace the main jack but in which both the main and auxiliary jacks are positioned below the axis of elevation 36 about which the antenna is rotated.

Figure 5 shows an arrangement similar to that of Figure 4, the main difference being in the use of two auxiliary jacks 30 instead of one.

Figure 6 shows a different arrangement in which the reflector assembly 12 is moved by use of jack 20 and rotates about pivots 38, 40, 42. The auxiliary jack 30 can be used to replace the main jack 20 and rotate the reflector assembly 12 on its pivots 38, 40, 42.

Pivots 40 and 42 may be anchored to the ground by suitable anchoring means, as can one end of the jack 20 and auxiliary jack 30.

This invention is suitable for use on large antenna, particularly those of 3m in diameter and more or where the jacks are necessarily large and heavy because of their need to support and move a structure generally weighing several tonnes.

Clearly the auxiliary jack need not be a screw jack but could be hydraulic or pneumatic. Such a jack could be left permanently installed, and when not in use the valving opened to allow relatively free movement.

By using this invention it is possible to maintain or service main jacks without incurring the loss of revenue implied by traditional methods. Thus it is worth considering both servicing the main jacks and even exercising them to spread the lubricants with a view to reducing the amount of wear and delaying the need for repair or replacement. With the auxiliary jack in place the main jack may be disconnected at one end from its mountings and cycled a number of time along its length to spread the lubricants.

Claims

1. An antenna which is capable of being moved in at least elevation, the movement in elevation being controllable by at least one main jack, a first mounting point of the main jack being connected to a reflector assembly, a second mounting point of the said jack being connected to an antenna base structure, and an auxiliary jack capable of moving the reflector assembly in elevation when the main jack is disconnected from at least one of its mounting points having a first mounting point attachable to the reflector assembly, and a second mounting point attachable to the base structure, the auxiliary jack being useable to move the reflector assembly with respect to the base structure.

2. A method of transmitting and receiving radio signals by means of an antenna dish of at least 3.0m in diameter, changing the elevation of the antenna from time to time using a main jack, and then from time to time whilst still transmitting or receiving signals, changing the elevation using an auxiliary jack and which is capable of substituting for the main jack whilst the main jack is repaired, serviced or replaced.

3. An antenna according to Claim 1 in which the auxiliary jack is of lighter construction than the main jack.

4. A method of replacing, servicing or replacing an antenna jack fitted to an antenna, whilst the antenna is still transmitting and receiving signals, including the steps of: -
   i) installing an auxiliary jack by connecting a first mounting point on the auxiliary jack to an antenna base structure, and a second mounting point on the auxiliary jack to an antenna support frame;
   ii) disconnecting the main jack from at least one of its mountings;
   iii) either removing, servicing or repairing the main jack whilst the auxiliary jack maintains or adjusts the elevation of the antenna;
   iv) refitting either a new or repaired main jack to the main jack mountings; and
   v) disconnecting the auxiliary jack.

5. A method of replacing an antenna jack fitted to an antenna used in accordance with claim 2, whilst the antenna is still transmitting and receiving signals, including the steps of: -
   i) connecting a second free end of said auxiliary jack to either the base structure or support frame;

ii) disconnecting the main jack from at least one of its mountings;
iii) either removing or repairing the main jack whilst the auxiliary jack maintains or adjusts the elevation of the antenna;
iv) refitting either a new or repaired main jack to the main jack mountings; and
v) disconnecting the auxiliary jack.

6. A method of replacing an antenna jack according to claim 4 or 5 in which the auxiliary jack is mounted on a mounting structure, the mounting structure being mounted on the base structure of the antenna.

7. A method of replacing an antenna jack according to claim 4 or 5 in which the auxiliary jack is mounted on a mounting structure, the mounting structure being mounted on the reflector assembly.

8. A method of replacing an antenna jack according to claim 4 in which mounting structure is installed before and removed after the repair or replacement of the main jack.

Fig.1.

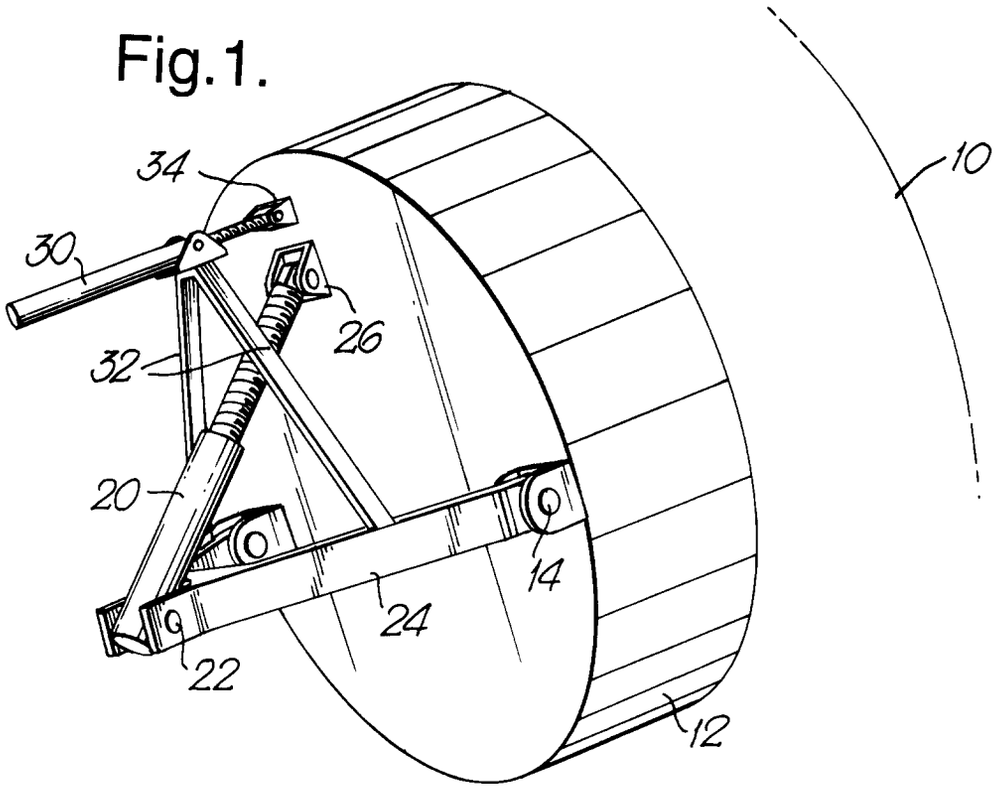


Fig.2.

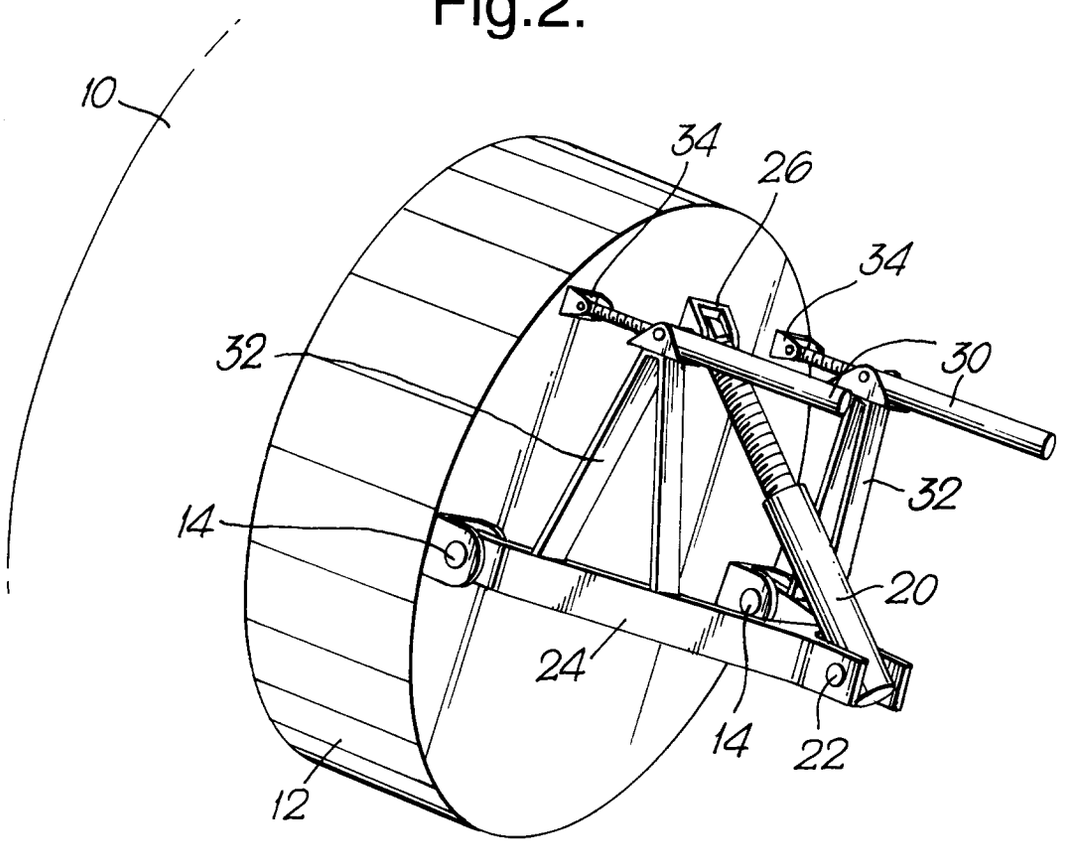


Fig.3.

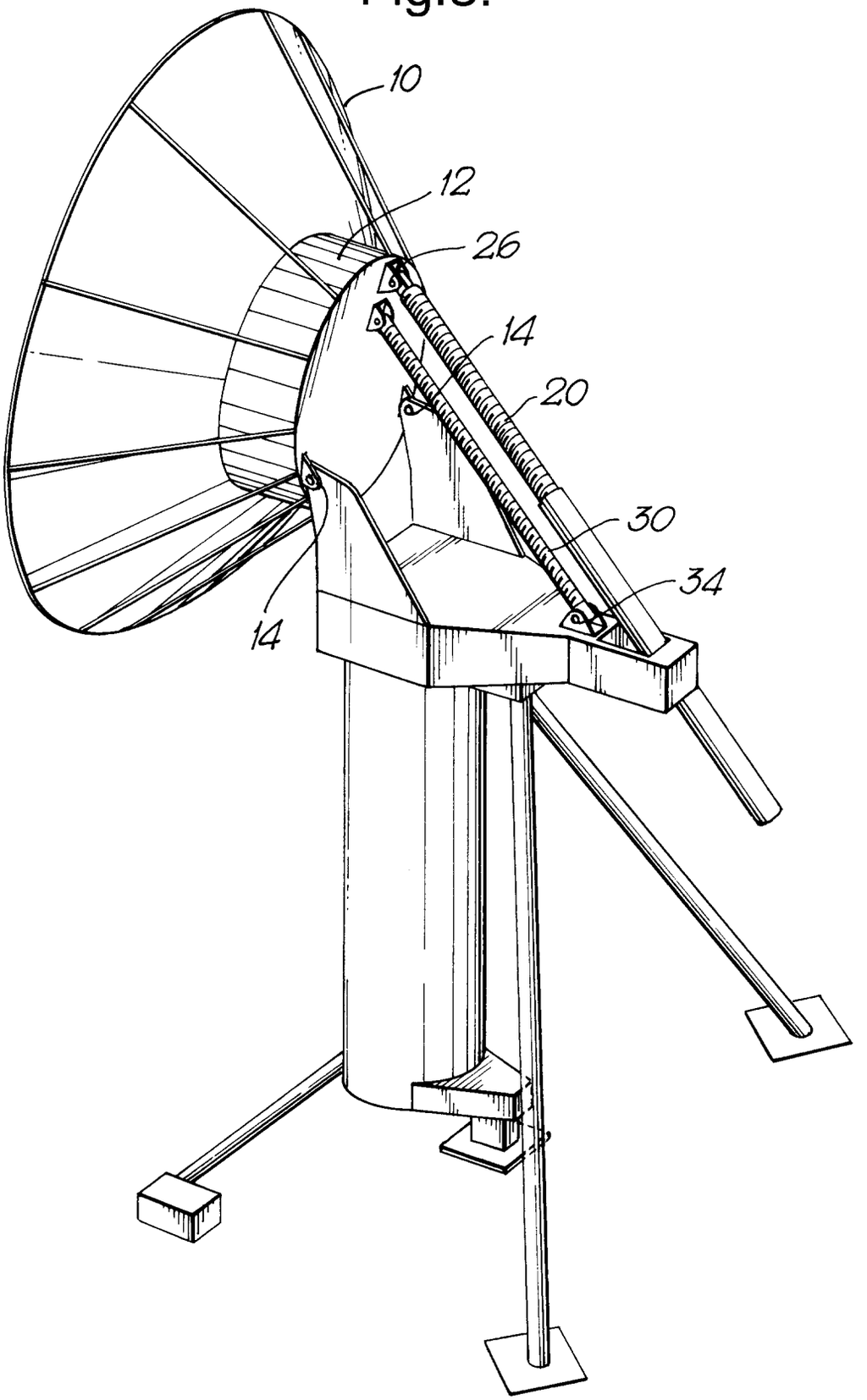


Fig.4.

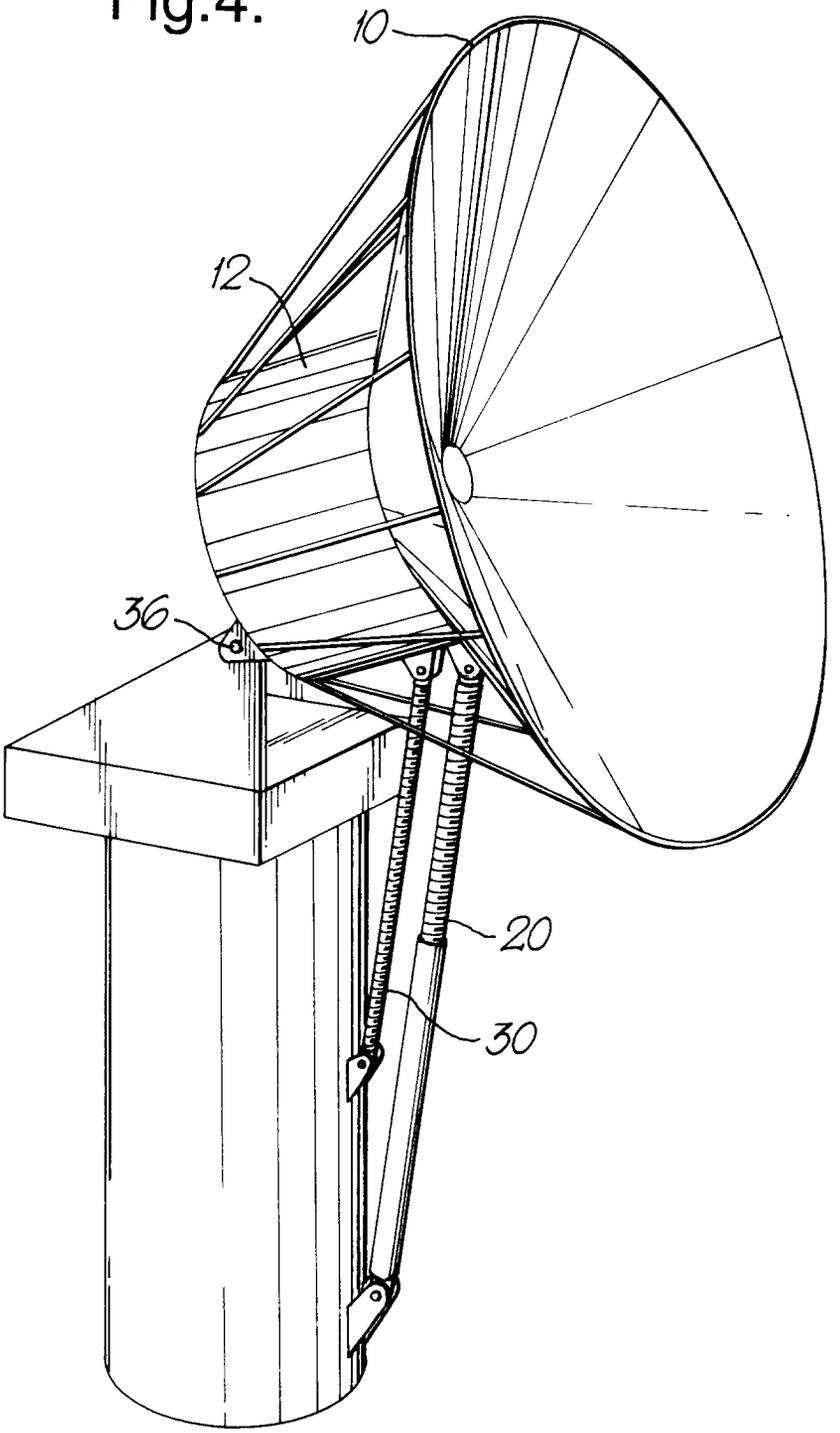


Fig.5.

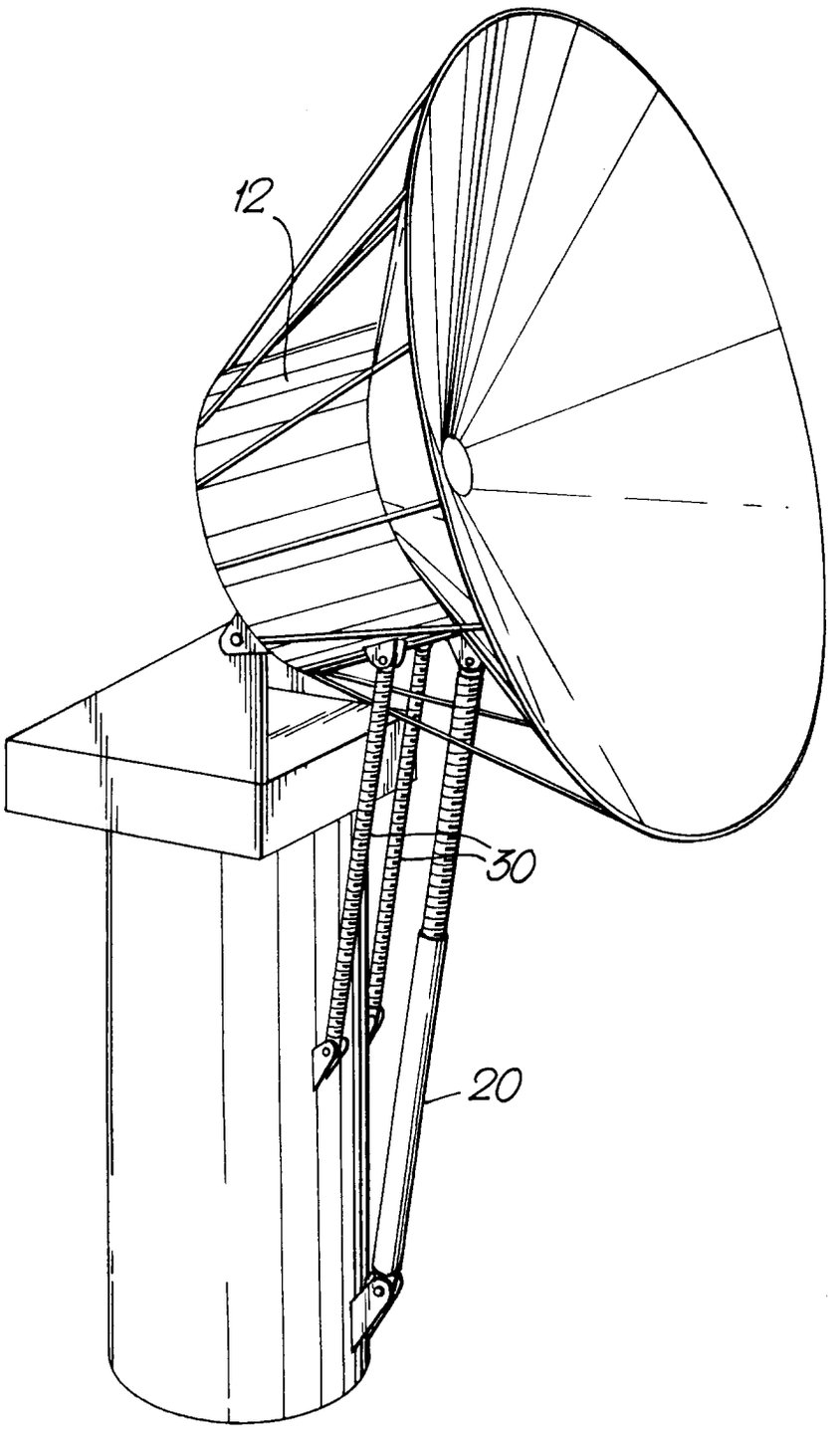
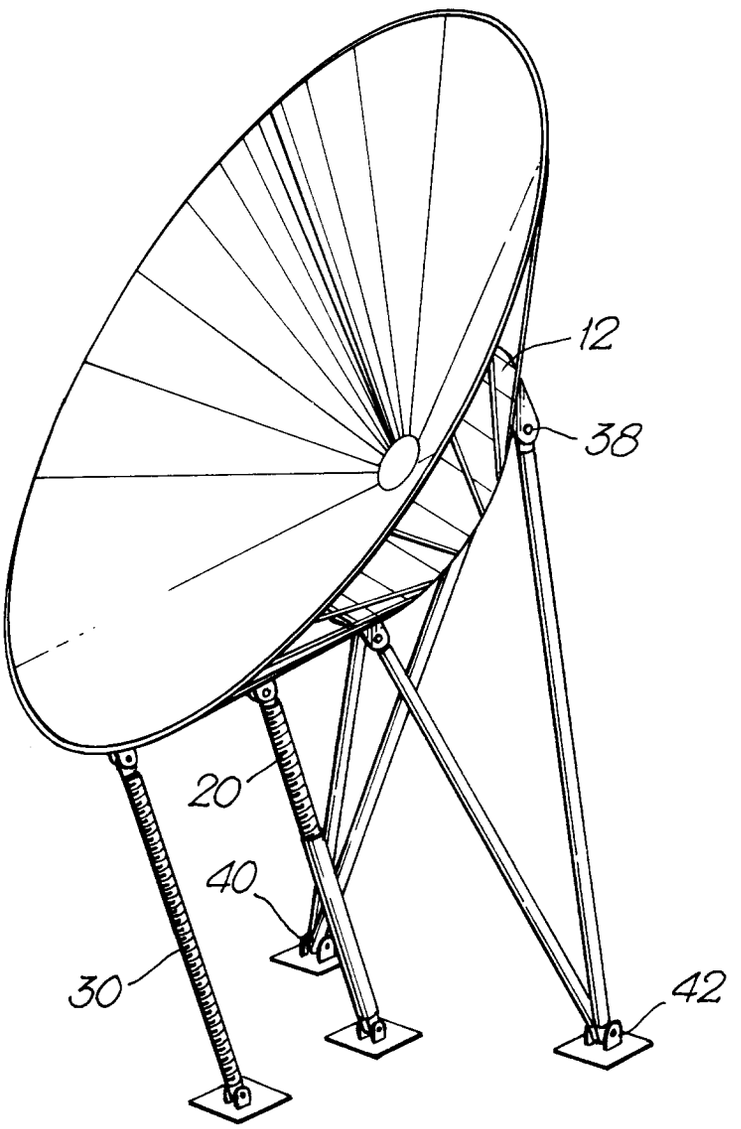


Fig.6.



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EUROPEAN SEARCH REPORT

Application Number
EP 94 30 2757

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
A	DE-U-92 15 224 (PFAFF-SILBERBLAU HEBEZEUGFABRIK) * page 5, line 15 - line 27; claims 1-3; figures 1-3 *	1,2,4	H01Q1/12
A	PATENT ABSTRACTS OF JAPAN vol. 6, no. 72 (E-105) (950) 7 May 1982 & JP-A-57 011 501 (NIPPON DENKI) 21 January 1982 * abstract *	1,2,4	
A	PATENT ABSTRACTS OF JAPAN vol. 4, no. 40 (E-004) 28 March 1980 & JP-A-55 013 544 (MITSUBISHI ELECTRIC) 30 January 1980 * abstract *	1,2,4	
A	PATENT ABSTRACTS OF JAPAN vol. 17, no. 128 (E-1333) 18 March 1993 & JP-A-04 304 005 (TOSHIBA) 27 October 1992 * abstract *	1,2,4	

TECHNICAL FIELDS SEARCHED (Int.Cl.6)
H01Q

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	15 September 1994	Angrabeit, F

CATEGORY OF CITED DOCUMENTS

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