

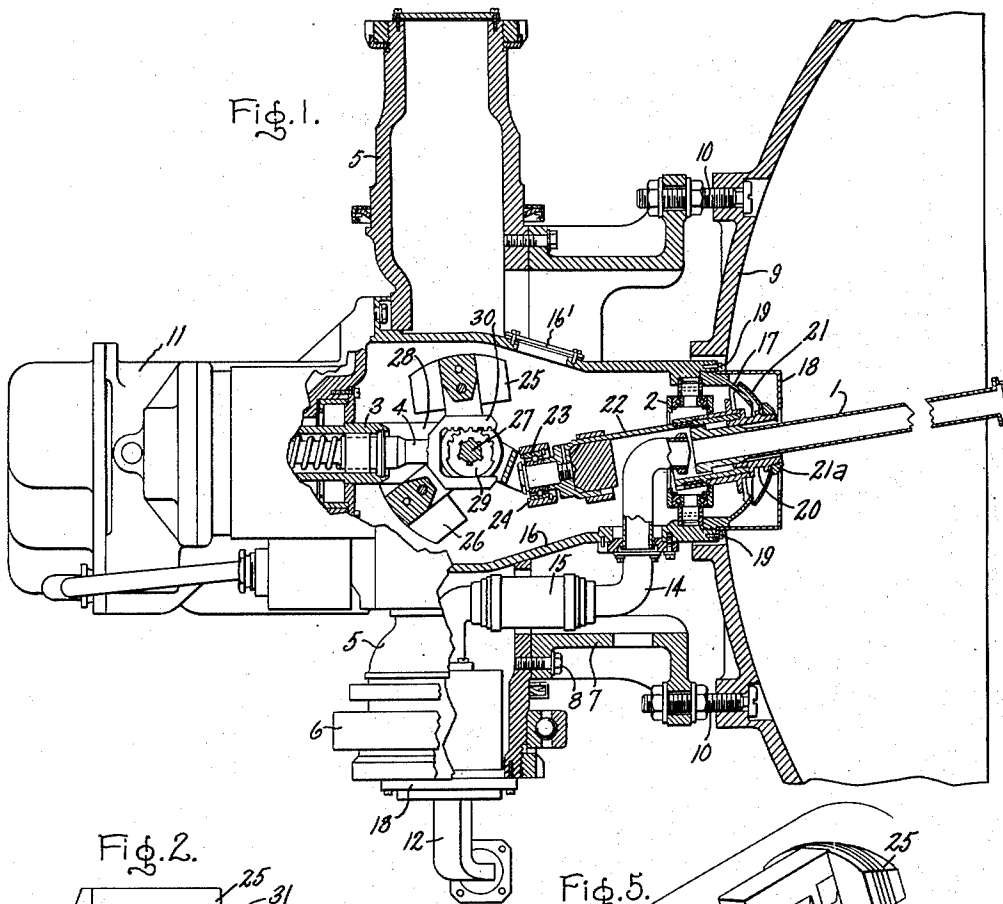
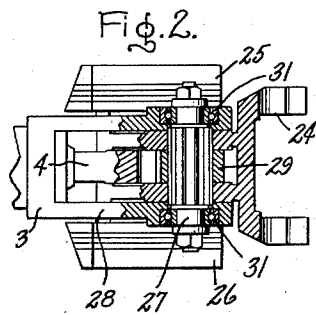
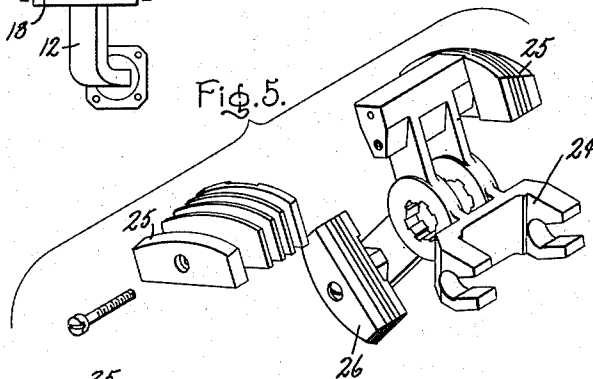
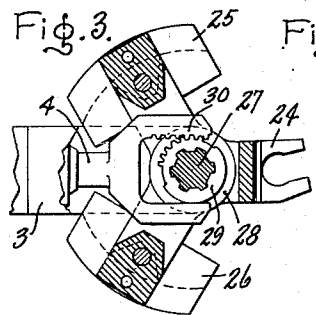
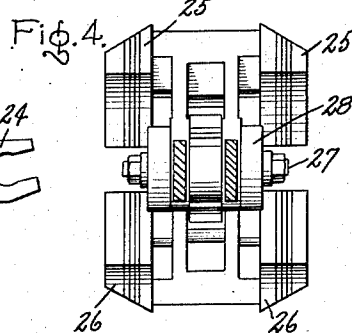
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ROTATING ANTENNA

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ROTATING ANTENNA

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The present invention relates to antenna systems and more particularly to such systems which, in conjunction with fixed or movable reflecting means, are used in radio directive or radar systems.

It is an object of this invention to provide means for imparting a desired motion to antennas in the above-mentioned type of system about a fixed pivot point.

It is a further object of this invention to cause such antennas to describe a fixed cone or a spiral cone about such a pivot point.

A still further object of this invention is to provide counter-balancing means in such systems, whereby the system is at all times balanced for all angular and linear displacements of the antenna.

Yet another object of this invention is to provide such a system wherein vibrations due to the motion of the antenna and the antenna actuating means are reduced to a minimum.

The features of this invention which are believed to be new are set forth with particularity in the appended claims. The invention itself, however, together with further objects and advantages thereof may best be understood by reference to the following description when taken in conjunction with the accompanying drawing wherein:

Fig. 1 shows a view partly in section of an antenna system utilizing the present invention.

Fig. 2 shows a view, partly in section of the linkage mechanism between the driving shafts and the antenna of the system shown in Fig. 1.

Figs. 3 and 4 show respectively side and end views of the mechanism of Fig. 2.

Fig. 5 shows, partly exploded, a perspective view of the counter-balance weight mechanism of the system of Fig. 1.

Radio detection systems have been designed in which the antenna is directed towards a certain object or group of objects by the usual scanning mechanism. When the antenna is so directed, a further mechanism may be used to cause the antenna to "wobble" and hence explore the object or group and in this manner the characteristics thereof may be indicated. The present invention is concerned with such "wobbling" mechanism and comprises a means whereby the antenna is made to describe a cone of variable or fixed conical angle. Hence, as mentioned above any objects or group to which the antenna is directed may be explored and the characteristics of the particular object or group thereby determined.

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It is contemplated in accordance with the present invention to mount an antenna, which may be of the cavity, di-pole or such types, in such a manner that upon rotation it describes a fixed cone or a spiral cone as so desired. This may be accomplished by mounting the antenna in a gimbal or similar pivot point and causing the antenna to rotate about this point. Mechanism is provided for causing the cone angle to be increased or decreased as desired. This mechanism may be mechanically adjustable so that the antenna may be caused to scribe a fixed cone with any desired cone angle, or the mechanism may be coupled to the rotating means in such a manner that the cone angle is made gradually to increase or decrease as the antenna is rotated, thus causing the antenna to scribe a spiral cone. It is further contemplated to so design the system that the reactions at the pivoting point are substantially zero and hence the vibration of the system is maintained at a minimum for any cone angle that the antenna may describe. This is accomplished by the proper placement of weights, proper selection of materials, proper location of the center of gravity and proper location of the center of percussion.

Although the foregoing discussion and the subsequent description are directed to antenna systems it is not intended that the invention be limited thereto, as many applications may be found wherein a mechanism is required to transmit the aforescribed motion.

Referring now to Fig. 1 which shows an antenna system incorporating the present invention, an antenna which may be any of the aforementioned types is designated at 1. This antenna is pivoted in a gimbal 2 and coupled to a shaft 3 by suitable linkage mechanism, to be described in detail hereinafter. Shaft 3 may be rotated by any suitable means and rotation of this shaft causes antenna 1 to scribe the desired conical motion. The conical action described by antenna 1 may be increased or decreased by a longitudinal reciprocating motion of shaft 4, shaft 4 being mounted concentrically in shaft 3. Any of the known types of manual or mechanical adjusting means may be utilized to adjust longitudinally the shaft 4 and hence make the angle of the cone described by antenna 1 any desired fixed value. When desired, reciprocating motion may be given to shaft 4 by links, cams, gears or like devices coupling this shaft to the rotating mechanism of shaft 3 whereby the antenna 1 may be made to describe a spiral cone.

The above-described antenna system is mount-

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ed in a yoke 5. This yoke is suitably supported on bearings such as 6 and may be rotated about its vertical axis so that antenna 1 may be oriented in any desired horizontal direction. Yoke 5 carries a cylindrical shaped bracket 7 fixed thereto by means of screws 8, and the bracket 7 carries a parabolic shaped reflector 9 fastened by screws 10. Screws 10 are made adjustable so that reflector 9 may be adjusted with respect to the yoke 5 and antenna 1.

The yoke 5 also carries a housing 11 which encloses the aforementioned rotating mechanism for concentric shaft 3, and the actuating mechanism for reciprocating shaft 4. It is noted that shaft 3 is free only to rotate and may be so supported in housing 11 by thrust bearings, bearings and the like.

The high frequency radiant energy is fed to the system by way of waveguide 12. Waveguide 12 is joined to yoke 5 by a joint 13 which allows free rotation of the yoke. The high frequency energy is then passed to antenna 1 by way of channel 14 which includes a flexible coupling 15, as shown.

The yoke 5 also supports a housing 16 enclosing the linkage mechanism which may be examined through a port hole 16'. One end of housing 16 is inserted into an aperture in the reflector 9, as shown. The gimbal 2 which pivots the antenna 1 is mounted in this end of housing 16 and the housing additionally carries a spherical bearing plate 17 threaded thereto, and a cover 18 fixed to the housing by screws 19. The antenna 1 is mounted concentrically in antenna holder 22 by a clamping nut 20. The clamping nut 20 carries at one end a spherical shield 21, the shield 21 being fixed to clamping nut 20 by means of a nut 21a. The other end of clamping nut 20 is threaded to the antenna holder 22 as shown, and this holder is pivoted to the gimbal 2, and hence allows mutation of antenna 1 about a pivot point. The holder 22 carries at its end a bearing 23 which is held in a yoke 24.

By placing a bearing and yoke at the end of holder 22, means for transmitting motion to the antenna have been therefore provided. The forces due to the antenna and the associated holder may be resolved into a weight which may be considered as acting at the end of holder 22 remote from the antenna. Hence by taking this weight and placing equal weights at equal lever arms and spacing the lever arms a certain angular distance apart the system may be balanced. This is accomplished in the linkage system by providing weights 25 and 26 with associated lever arms, which with the weights representing the antenna and the lever arm associated with this weight, representing three equal weights at equal lever arms and having the arms spaced substantially 120° apart.

The above-mentioned weights and lever arms are carried by a spline shaft 27, and this shaft is turned about the axis of shaft 3 by the rotation of shaft 3, which carries the spline shaft 27 in a yoke 28. Shaft 27 has a pinion 29 splined thereto, and this shaft is rotated about its longitudinal axis by means of a rack arrangement 30, as shown, as the shaft 4 is reciprocated. The rack and pinion drive 29-30 is shown by way of example only, as the reciprocating action transmitted to the above-described weights from the shaft 4 may be similarly accomplished by means of levers, links, hydraulic mechanism, and the like.

It can therefore be seen that when the shaft 3

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rotates, the antenna 1 is made to scribe a conical motion about the pivot 2, and the conical angle of the described cone may be varied by varying the longitudinal adjustment of shaft 4. When the values of weights 25 and 26 and the lengths of the respective lever arms are adjusted so that the summation of the forces and moments about the axis of shaft 3 are equal to zero, a fixed cone angle may be chosen to be described by antenna 1 and when the weight members are given a rotating motion by the rotation of shaft 3, the system will be in balance. The values of the weights 25 and 26 and the lengths of their associated lever arms may be made such that the summation of the moments and of the forces about the longitudinal axis of shaft 3 and shaft 27 are both equal to zero. Now by the rotation of shaft 3 and the reciprocation of shaft 4, the antenna may be made to describe a variable cone or spiral motion, and the system will then be in complete balance for both dimensions.

When the mechanism has been brought up to a desired operating speed by the rotation of shaft 3, the load on the prime mover does not vary as a constant load is maintained for any angular position of this shaft. In other words, the linkage member may be likened to a fly-wheel, the centrifugal force being constant and hence the angular momentum similarly remaining constant. In addition when reciprocating motion is given to shaft 4 and hence to the weights 25, 26, the only loads on the shaft 4 are those due to friction and any slight unbalance that has been built into the mechanism. There is no appreciable load because the angular displacement caused by the axial movement of shaft 4 does not cause any unbalance in the system.

Referring now to Fig. 2 which shows the linkage mechanism in greater detail, the spline shaft 27 is shown carried by the yoke 28 and mounted therein by bearings 31. The pinion 29 is splined to shaft 27 and driven by rack 30, rack 30 being integral with the reciprocating shaft 4, and the complete mechanism being rotated by shaft 3. Weights 25 and 26 are shown in this figure, and also yoke 24 which carries the bearing 23 of Fig. 1 as previously described.

Figs. 3 and 4 as previously mentioned are respectively side and end views of the mechanism of Fig. 2 and further description thereof is believed to be unnecessary.

Fig. 5 is a perspective view of the counter-balancing mechanism and clearly shows the manner in which the weights 25 and 26 and the yoke 24 are mounted about the shaft 27 whereby the various lever arms associated therewith are mutually at substantially 120°.

Means have thus been provided for transmitting a variable cone angle of motion at relatively high speeds in which the system is inherently balanced in all angular positions. In such a system the conical motion may be transmitted at any reasonable speed and the conical angle varied at will, with no variable and excessive torques and forces being impressed upon the structural members. This condition is realized due to the fact that the loads are balanced and the angular momentums are constant.

It is obvious that the three weights balanced means for transmitting a fixed or variable cone angle is not limited to the above-described arrangement. For example, the two weights and the unbalanced force of the antenna system representing the third weight may be located at any

point along the axis of the antenna system, including the pivot point.

The above-described system is not limited to radio directive antennas but may find many uses. For example, when a single pivot point is utilized in conjunction with the three weights, a straight line motion either vertical or horizontal may be given to a point on the structure equivalent to the antenna 1 of Fig. 1. Because of this fact, the device is applicable to various rotating systems where high speed unbalance is detrimental to the desired operation.

The above-described device may also be applied to any high speed automatic machine that must be in balance at all positions of angular displacement. Thus it may find particular application in the paper, textile and converting industries. This device is applicable likewise to heavy machines where the relatively high or low speed motions of heavy parts requires excessive power to overcome unbalances, and makes possible the utilization of less power and lighter structure in such machines.

Therefore, while certain specific embodiments have been shown and described, it will, of course, be understood that various modifications may be made without departing from the invention. The appended claims are, therefore, intended to cover all such modifications within the true spirit and scope of the invention.

What we claim as new and desire to secure by Letters Patent of the United States is:

1. In a mechanism for translating motion, a rotatable shaft member, linkage means mounted on said shaft member and rotated thereby about the axis of said member, said linkage means including a plurality of weight members having lever arms spacing said weight members from a point on said linkage means in line with the axis of rotation of said shaft member, means for coupling said linkage means to a further member spaced from said point to impart a desired motion thereto, and means for rotating said weight members and said coupling means about said point and normal to said axis of rotation of said shaft member, said weight members and coupling means being angularly displaced about said point whereby, the combined moments thereof including said further member about said axis of rotation are substantially zero.

2. In a mechanism for translating motion, a rotatable shaft member, linkage means mounted on said shaft member and rotated thereby about the axis of said member, said linkage means including a plurality of weight members having lever arms associated therewith and a second shaft member having its axis normal to the axis of said rotatable shaft member, means for imparting motion to said second shaft member about its axis, and means for coupling said linkage means to a further member to impart a desired motion thereto, said weight members and said further member being so arranged that the combined moments thereof about the axes of said rotatable shaft member and said second shaft member are substantially zero.

3. In a mechanism for translating conical motion, a rotatable shaft member, linkage means mounted on said shaft member and rotated thereby about the axis of said member, said linkage means including a plurality of weight members having lever members spacing said weight mem-

bers from a point on said linkage means in line with the axis of rotation of said shaft member, means for coupling said linkage means to a pivoted member spaced from said point to impart said conical motion thereto, means for rotating said weight members and said coupling means about said point and normal to said axis of rotation, said weight members and coupling means being angularly displaced about said point whereby the combined moments thereof including said pivoted member about said axis of shaft member rotation are substantially zero.

4. In a mechanism for translating conical motion, a rotatable shaft member, linkage means mounted on said shaft member and rotated thereby about the axis of said member, said linkage means including a plurality of weight members having lever arms associated therewith and a second shaft member having its axis normal to the axis of said rotatable shaft member, means for coupling said linkage means to a pivoted member to impart said conical motion thereto, and reciprocating means for imparting rotatable motion to said second shaft member about its axis to vary the conical angle of the cone of motion described by said pivoted member, said weight members and said pivoted member being so arranged that the combined moments thereof about the axes of said rotatable shaft member and said second shaft member are substantially zero.

5. In a radio directive antenna system of the type having a pivoted antenna, means for imparting a conical motion to the antenna and for varying the conical angle of the cone of motion described by the antenna, comprising a rotatable shaft member, a reciprocating shaft member mounted within said rotatable shaft member and concentric thereto, linkage means mounted on said rotatable shaft member and rotated thereby about the axis of said rotatable shaft member, said linkage means including a plurality of weight members having lever arms associated therewith and a supporting shaft member having its axis normal to the axis of said rotatable shaft member, means for coupling said linkage means to the pivoted antenna to impart said conical motion thereto, and means including said reciprocating shaft member for imparting rotating motion to said supporting shaft member about its axis thereby to vary the conical angle of the cone of motion described by the antenna, said weight members and said antenna being so arranged that the combined moments thereof about the axes of said rotatable shaft member and said supporting shaft member are substantially zero.

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