Feb. 23, 1960 R. H. WISE 2,925,743

MOTION CONVERSION DEVICE

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Fig. 2

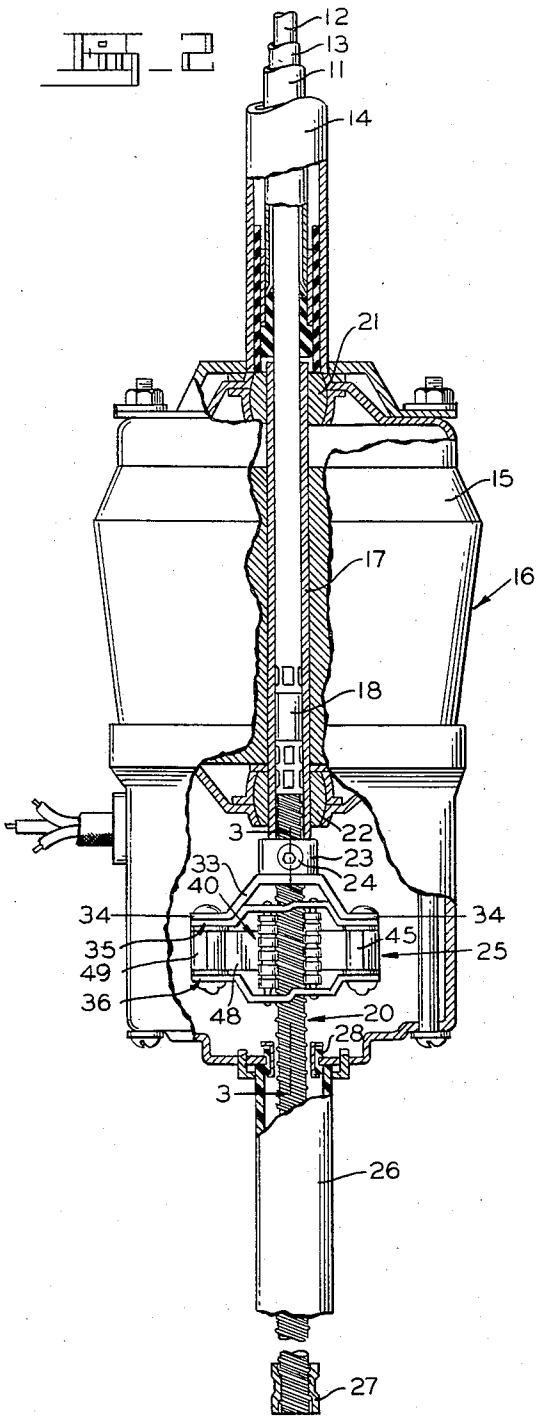
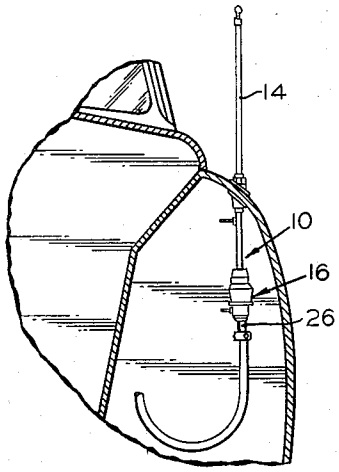


Fig. 1



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2 Sheets-Sheet 2

Fig. 3

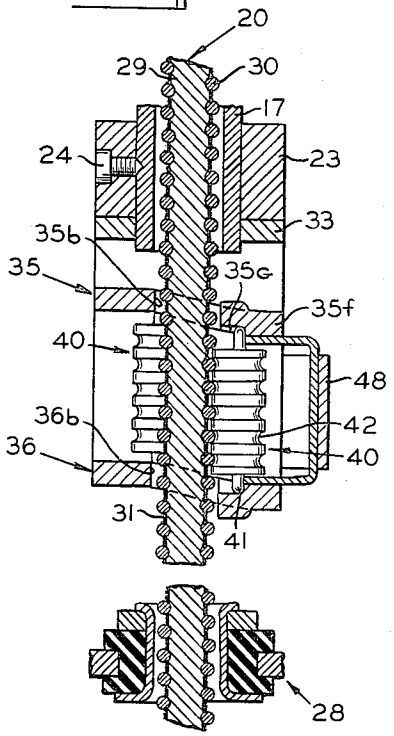


Fig. 4

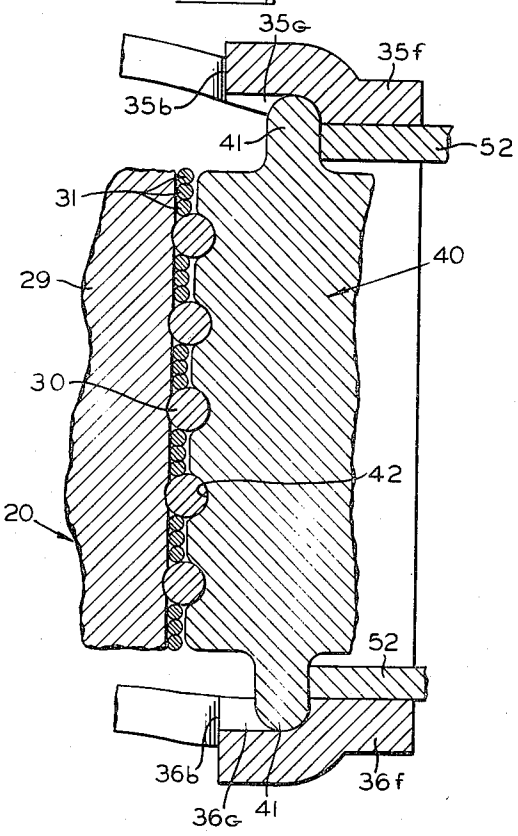
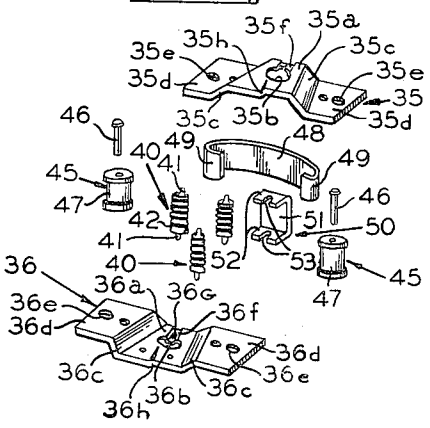


Fig. 5



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2,925,743

MOTION CONVERSION DEVICE

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Application December 13, 1955, Serial No. 552,786

6 Claims. (Cl. 74—424.8)

The present invention relates to a motion-conversion device and more particularly to a device for converting rotary motion to linear motion, or vice versa.

In my earlier filed application entitled "Power Operated Radio Antenna," Serial No. 503,891, filed April 26, 1955, I have disclosed a vehicular radio antenna wherein rotary motion from a power source, such as an electric motor, is converted to linear motion for advancing and retracting a telescopic antenna structure. The motion-converting unit disclosed in this earlier application includes a carrier driven by a motor and supporting a plurality of individually rotatable elements having toroidal surfaces engaging a threaded member attached to a telescopic antenna mast section. The threaded member is flexible and comprises a central, flexible core having spirally wound thereabout a wire which provides a helical peripheral screw surface which is engaged by the toroidal surfaces of the rotatable elements.

The present invention utilizes a similar threaded member but a different type of rotatably thread-engaging element. The thread-engaging element of the present invention is provided with a plurality of individual, axially spaced peripheral grooves which lie in parallel planes normal to the axis of the element and which are spaced apart through a distance equivalent to the lead of the helical thread. These grooves are concave and of an arcuate contour accurately and snugly receiving the spirally wound wire which provides the screw surface.

The provision of the plurality of grooves distributes the driving load imposed upon the spirally wound wire upon a number of different portions of the wire, equal in number to the number of grooves in each element, so that no one portion of the wire is subjected to the entire thrust load. This distribution of the load makes possible the actuation of relatively heavy loads through the use of a flexible cable, and adapts the use of the motion-converting mechanism to a great number of purposes in addition ot the actuation of relatively light loads, such as an antenna.

It is, therefore, an important object of the present invention to provide an improved motion-conversion mechanism for converting rotary motion to linear motion, or vice versa.

Another important object of this invention is the provision of an improved motion-conversion mechanism wherein a flexible cable having a spirally wound wire defining a helical thread is engaged by a rotatable element in snugly mating relationship and at a number of spaced portions to distribute a load imposed on the cable to the several wire portions engaged by the element.

It is a further important object of this invention to provide an improved motion-conversion device wherein a threaded element is engaged by a plurality of individually rotatable rollers having a plurality of concave grooves receiving an equivalent number of portions of the thread to distribute an actuating load to the various portions of the thread.

Yet another object is the provision of a thrust unit wherein a linearly movable driven element having a threaded periphery is engaged by a nut assembly composed of a plurality of individually rotatable driving elements having spaced grooves engageable with the threaded periphery and spaced from one another through a distance equivalent to the lead of the thread to distribute to the engaged portions of the thread a thrust load imposed on the driven member.

Other and further important objects of the present invention will become apparent from a study of the detailed description appended hereto and the attached sheets of drawings.

On the drawings:

Figure 1 is a fragmentary sectional view, with parts shown in elevation, illustrating an antenna mounted upon an automobile and provided with a motion-conversion unit of the present invention;

Figure 2 is an elevational view, with parts broken away and in section, illustrating a motion-conversion unit of the prevent invention;

Figure 3 is an enlarged sectional view taken along the plane 3—3 of Figure 2;

Figure 4 is a greatly enlarged, fragmentary view of a portion of the motion-conversion unit illustrating the engagement of the driving and driven members; and

Figure 5 is an exploded perspective view of a portion of the motion-conversion unit.

As shown on the drawings:

In Figure 1, reference numeral 10 refers generally to an antenna such as that disclosed in my earlier filed, copending application, Serial No. 503,891, but provided with an actuating mechanism of the present invention.

More particularly, the antenna 10 comprises a generally tubular, elongate outer mast section 11 and a cylindrical or rodlike inner mast section 12 which is axially telescopical within the outer mast 11. Interposed between the inner and outer masts is an insulating sleeve 13 formed of an electrical insulating material, such as nylon or the like, and the lower portion of the outer mast section is enclosed within an exterior casing 14. This exterior casing 14 is secured to the housing 15 of an actuating motor indicated generally at 16 and having a hollow armature shaft 17 through which the inner mast section 12 extends, the lower end of which is connected through an insulated connector 18 with a flexible cable 20 which forms one component of the motion-conversion unit of the present invention. The insulating connector 18 is staked or otherwise suitably connected to both the inner mast section 12 and to the cable 20. The hollow motor shaft 17 is journaled in the housing 15 by suitable means, as by thrust bearings 21 and 22, the lower projecting end of the motor shaft being connected, as through a drive collar 23 secured by a set screw 24, to a rotatable nut assembly 25 which forms the driving unit of the conversion unit of the present invention.

The cable 20 has its lower or free end disposed within a flexible tubular casing 26, the free end of the cable carrying a stop collar 27 which is abuttable against a fixed resilient stop 28.

The flexible cable 20, as best illustrated in Figures 3 and 4, comprises a central flexible core 29 of braided or wrapped construction and which has spirally wound thereabout a peripheral wire 30. The spirally wound wire 30 defines a peripheral helical thread of appreciable axial lead, since the wire 30 is wound so tightly on the core 20 as to be partially imbedded in the core to resist axial displacement of the wire 30. Thus, the core 20, plus the spirally wound wire 30, provides a flexible screwlike thrust element which is capable of transmitting an appreciable thrust load, while being sufficiently

flexible to be easily distortable for storage within a vehicular component or the like, as illustrated in Figure 1. To aid in preventing axial displacement of the peripherally wound wire **30**, relatively smaller, peripherally wound wires **31** (Figure 4) are interposed between the larger, thread-defining wires **30**.

The nut assembly **25** is disposed on a bracket **33** secured to the attaching collar **23** and having radially outturned terminal legs **34**. A nut carrier is provided by plates **35** and **36** which are axially spaced with relation to the cable **20** and which are best illustrated in Figure 5. The plates **35** and **36** being identical, only one need be described in detail. The plate **35** comprises a raised central portion **35***a* having a central aperture **35***b* for freely receiving the cable **20** therethrough. The raised central portion **35***a* is joined through outwardly and downwardly sloping side portions **35***c* to laterally extending attaching portions **35***d* which are apertured at **35***e* for purposes to be hereinafter more fully described. The central raised portion **35***a* is provided with a downwardly offset portion **35***f* which has, on its undersurface, an elongate dimple **35***g* (Figures 3 and 4). The other side of the portion **35***a* is offset, as at **35***h*, to provide portions lying in different radial planes spaced axially of the cable **20** when the nut assembly is installed in the structure shown in Figure 2. The undersurface of the offset portions are provided with circular dimples for a purpose to be hereinafter more fully described.

The plate **36** is identical to the plate **35**, and is merely turned upside down with respect to the plate **35**, the numerals **36***a* through **36***h* referring to portions of the plate **36** identical with the cooperating portions of the plate **35**.

Interposed between the plates are a plurality of rotatable cable-engaging elements indicated generally at **40** and best illustrated in Figures 3 and 4. These elements **40** are identical and may be best defined as being generally cylindrical rollers having axial projections **41** at the axial extremities thereof defining trunnions about which the rollers are rotatable. The trunnions **41** fit into the dimples **35***g*, **36***g* and the other dimples formed in the undersurfaces of the central portion **35***a*, **36***a* of the plates. The dimples are vertically aligned respectively so that the axes of rotation of the rollers defined by the trunnions are substantially parallel to the axis of the cable **20**.

The rollers **40** are each provided with a plurality of concave grooves **42** which extend peripherally about the roller and each of which lies in a plane normal to the plane of rotation of the roller. The grooves **42** are arcuate in contour and snugly mate with an exposed portion of the exterior periphery of the wire **30**. The axial spacing of the grooves **42** corresponds to the axial lead of the cable thread provided by the wire **30**. It will be noted that the exterior periphery of the roller is diminished so that the nongrooved portions thereof lie in radially spaced relation to the smaller helically wound wires **31**.

The rollers are retained between the plates **35** and **36** by the engagement of the trunnions **41** of the rollers in the plate dimples, and the plates are held in their proper spaced relation by tubular spacer elements **45** interposed therebetween and retained by suitable means, as by rivets **46**. One of the rotatable rollers **40**, specifically that roller which has its trunnions **41** extending into the elongate dimples **35***g* and **36***g* is movable in the dimple radially of the cable **20**. The other rollers **40** are held in radially spaced relation with respect to the cable by the simple concave dimples within which their trunnions **41** are seated.

The movable roller **40** is urged radially into engagement with the wire **30** by means of a leaf spring **48** having arcuate ends **49** engaging the tubular spacers **45** to retain the spring in position. The central portions of the spacers **45** are reduced, as at **47**, so that the enlarged ends of the spool-like spacers prevent spring displacement. The pressure of spring **48** is transmitted to the movable roller **40** by a saddle **50**. This saddle **50** comprises a central or web portion **51** abutting the spring **48** and radially inwardly extending legs **52** which straddle the roller proper and which engage only the terminal pintless or trunnions **41** of the roller. To aid in preventing displacement of the saddle **50**, the legs are provided with notches **53**.

Operation

The operation of the motion-converting mechanism of the present invention is quite simple, since energization of the motor **16** will cause rotation of the armature shaft **17** to rotate the nut assembly **25**. Rotation of the nut assembly **25** will cause the rollers to engage the helical screw surface provided by the spirally wound wire **30**, and the axial lead of the screw surface will cause the cable **20** to be advanced in an axial direction, the direction of movement depending upon the direction of rotation of the armature shaft **17**. Of course, the cable **20** must be retained against rotation in order that it may be axially advanced, one system of retaining the cable against such rotation being by a slot-and-key interconnection of the inner and outer mast sections **11** and **12**, as shown in my earlier filed application, Serial No. 503,891.

The thrust load imposed upon the cable **20**, as by resistance of movement of the inner mast element **12**, will be transmitted from the cable to the rollers **40** and hence to the carrier comprising the plates **35** and **36**. This load will then be distributed by the bracket **34** to the armature shaft and the shaft bearings. The contact of the rollers **40** with the several portions of the spirally wound wire **30** will distribute this thrust load among several turns of the wire **30** so that the wire will not be subjected to a thrust load sufficient to displace it from the core **29**.

In the illustrated embodiment of the invention, the driving element of the nut-and-screw combination is the nut, with the screw formed by the cable **20** being the driven component. Obviously, if desired, the unit may be operated by driving the cable **20** and having the nut form the driven member. Also, the illustrated embodiment shows the conversion of rotary motion to linear motion. It is also obvious that the device may be utilized for converting linear motion to rotary motion.

Various details of construction may be changed through a wide range without departing from the principles of this invention, and it is, therefore, not the purpose to limit the patent granted hereon otherwise than necessitated by the scope of the appended claims.

I claim:

1. A motion-conversion unit comprising driving and driven elements, one of said elements comprising a flexible cable having an exterior spirally wound peripheral wire defining a helical thread of appreciable axial lead, and the other of said elements comprising a carrier surrounding a portion of said one element and a plurality of individually rotatable thread-engaging rollers journalled on said carrier for rotation about axes generally parallel to the axis of said cable, said rollers having a plurality of individual peripheral grooves therein spaced from one another axially of the rollers through distances equal to the axial lead of the cable thread, the grooves respectively receiving portions of the thread-defining wire and serving to distribute the driving load over a large area of said wire.

2. A device for converting rotary motion to linear motion comprising driving and driven members, one of said members being flexible and having an exterior thread of appreciable axial lead, and the other of said members including a carrier embracing a portion of said thread and thread-engaging elements mounted on said carrier for rotation about individual axes, each of said elements having a plurality of separate peripheral grooves therein mating with the thread, the individual grooves of

each of said elements being spaced from one another a distance equivalent to the axial lead of the thread.

3. A device for converting rotary motion to linear motion comprising driving and driven members, one of said members being flexible and having an exterior thread of appreciable axial lead, and the other of said members including a carrier embracing a portion of said thread, thread-engaging elements mounted on said carrier for rotation about individual axes and each having a plurality of separate peripheral grooves therein mating with the thread, the individual grooves of each of said elements being spaced from one another a distance equivalent to the axial lead of the thread, said elements lying in different radial planes of said one member in spaced relation along the axis thereof to insure accurate engagement of said elements with adjacent portions of the thread.

4. A motion-conversion unit comprising driving and driven elements, one of said elements comprising a flexible cable having a spirally wound exterior element defining a helical thread of appreciable axial lead, and the other of said elements comprising a carrier embracing a portion of said cable and a plurality of individually rotatable thread-engaging members journalled on the carrier for rotation about individual axes, each of said members having a plurality of separate peripheral grooves therein lying in planes parallel to one another and spaced axially of the member through distances equivalent to the axial lead of the thread.

5. In a motion-conversion unit having driving and driven elements, one of the elements being flexible and threaded and the other of the elements being juxtapositioned to the thread, a rotatable member forming an operative portion of said other element and comprising

a roller having a plurality of individual grooves engageable with the thread of the one element, the grooves being mutually parallel and of an arcuate configuration to closely conform to the thread of the one element.

6. A motion-conversion unit comprising driving and driven elements, one of said elements comprising a flexible cable having secured thereto as a part thereof an exterior spirally wound peripheral elongate member defining a helical thread of appreciable axial lead, and the other of said elements comprising a carrier surrounding a portion of said one element and carrying a plurality of individually rotatable thread-engaging rollers journaled on said carrier for rotation about axes generally parallel to the axis of said cable, each of said rollers having a plurality of individual peripheral grooves therein spaced from one another axially of the rollers through distances substantially equal to the axial lead of the thread, the grooves respectively receiving portions of the thread-defining wire and having wall portions serving to distribute driving thrust to or receive driving thrust from said member at a plurality of points along said thread-defining wire.

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