July 20, 1965 M. E. SIMMONS 3,195,823

FLEXIBLE CABLE DRIVE

Filed March 12, 1963 2 Sheets-Sheet 1

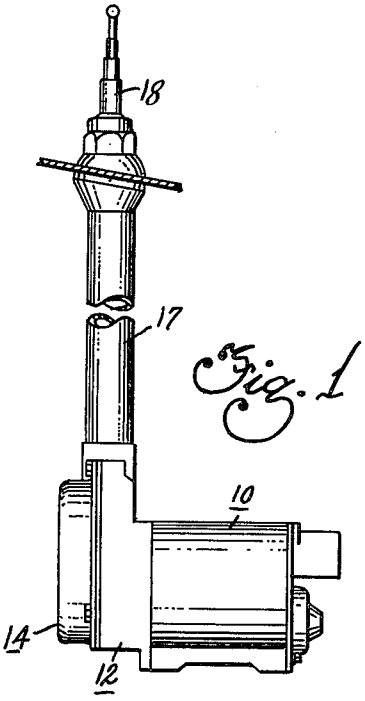


Fig. 1

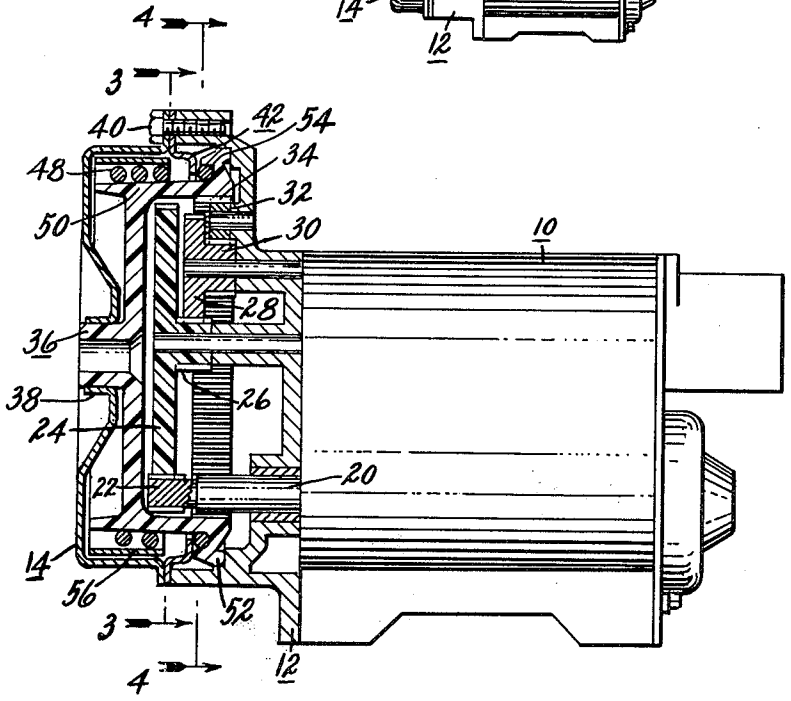


Fig. 2

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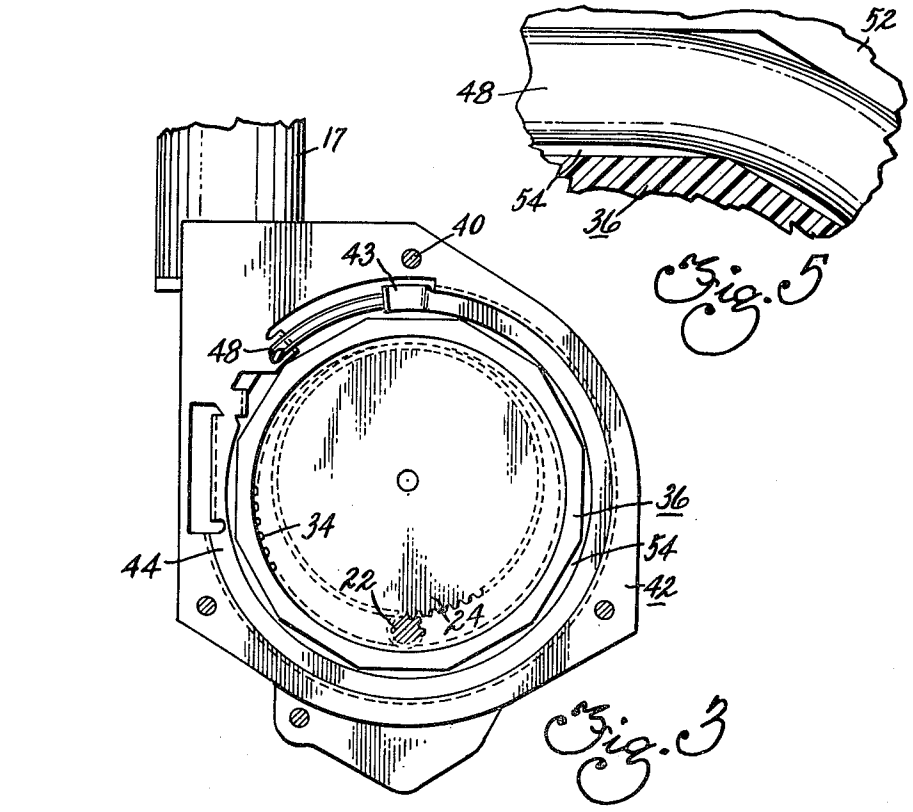


Fig. 5

Fig. 3

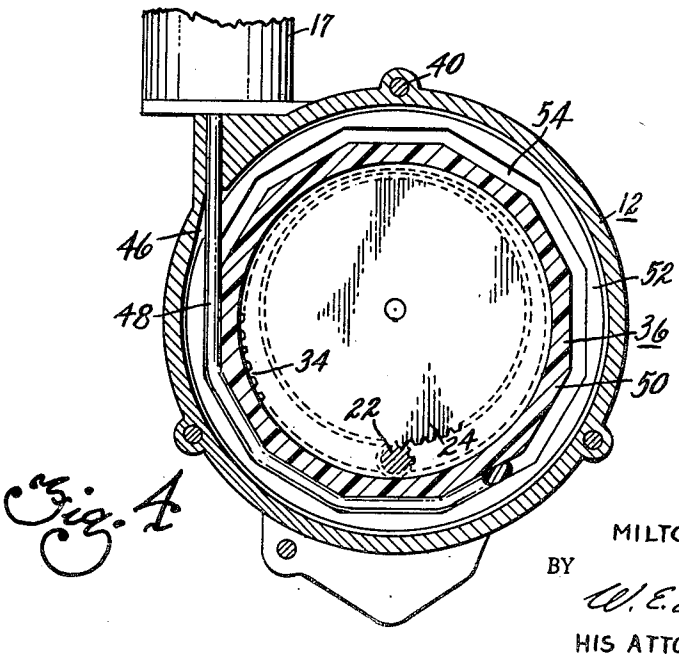


Fig. 4

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FLEXIBLE CABLE DRIVE

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6 Claims. (Cl. 242—54)

This invention pertains to flexible cable drive, and particularly to an improved mechanism for extending and retracting an elongate flexible actuating member which is coiled for storage within the mechanism.

Heretofore, various types of reeling and unreeling mechanisms for elongate flexible driving members have been devised for extending and retracting vehicle radio antennas having a plurality of relatively movable, telescopically arranged sections. For the most part the prior art drive mechanisms embody means to frictionally grip the flexible member, such as a cable, for reeling and unreeling the same to and from a storage chamber wherein a cable is coiled so as to adjust the antenna with which it is drivingly connected. The present invention relates to an improved flexible cable drive wherein the driving forces for reeling and unreeling the same are obtained through deformation of the cable.

Accordingly, among my objects are the provision of an improved reversible driving means for extending and retracting a flexible cable; the further provision of driving means for extending and retracting an elongate flexible cable through deformation thereof; and the still further provision of an antenna actuator including a flexible cable drive embodying a chordal groove for reeling and unreeling the cable to and from its coil storage chamber.

The aforementioned and other objects are accomplished in the present invention by utilizing a drum having a substantially cylindrical portion upon which the cable is coiled, when retracted, the drum having an upstanding flange with a chordal or polygonal groove therein through which the cable extends and is deformed for reeling and unreeling the same from the cylindrical portion of the drum. Specifically, in the exemplary embodiment disclosed the improved cable driving mechanism is driven by a reversible electric motor, one end of the cable being attached to the innermost section of the antenna structure. The cable is composed of a flexible plastic, such as nylon, and when the antenna is fully retracted, the major portion thereof is coiled on the drum within a storage chamber. Conversely, when the antenna is fully extended, the cable is uncoiled with the end portion thereof being situated in the chordal groove.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings wherein a preferred embodiment of the present invention is clearly shown.

In the drawings:

FIGURE 1 depicts an electric motor driven radio antenna embodying the improved drive mechanism of this invention;

FIGURE 2 is a side view, partly in section and partly in elevation, of the improved antenna actuator;

FIGURE 3 is a view, partly in section and partly in elevation, taken along line 3—3 of FIGURE 2;

FIGURE 4 is a sectional view taken along line 4—4 of FIGURE 2; and

FIGURE 5 is an enlarged fragmentary view depicting the deformation of the cable within the chordal groove of the drum.

With particular reference to FIGURES 1 and 2, the improved flexible cable drive means are depicted in combination with a vehicle antenna actuator comprising reversible direct-current motor **10** having a gear reduction housing **12** and a storage housing **14** attached thereto. The gear reduction housing **12** and the storage housing **14** are connected to an outer support **17** of the antenna structure which includes a plurality of telescopically arranged adjustable sections **18**. As seen more particularly in FIGURE 2, the motor **10** includes a rotary output shaft **20** having a pinion gear **22** on the end thereof in engagement with a spur gear **24** constituting the first gear reduction stage. The spur gear **24** has an integral pinion gear **26** meshing with a spur gear **28** constituting the second reduction stage. The spur gear **28**, in turn, has a gear **30** engaging an idler gear **32**, the idler gear **32** engaging an internal gear **34** formed on a plastic drum **36**.

The drum **36** is rotatably journalled by a flanged portion **38** of the storage housing **14**, the storage housing **14** being attached to the gear reduction housing **12** by a plurality of bolts **40**. A partition plate **42** is clamped between the storage housing **14** and the gear reduction housing **12**, the partition plate **42**, as seen more particularly in FIGURE 3, having entrance and exit ramp portions **43** and **44**, respectively, in the form of helically inclined grooves spaced substantially 270° apart. As seen in FIGURE 4, the gear reduction housing **12** is formed with a substantially tangential passage **46** through which a flexible nylon cable **48** extends for attachment to the innermost antenna section.

The drum **36**, as seen in FIGURES 2 and 4 is formed with a slightly tapered cylindrical portion **50** and an upstanding flange **52** having a chordal groove **54** therein. The cylindrical drum portion **50** is separated from the flange **52** by the partition plate **42** as clearly depicted in FIGURE 2. In the specifically disclosed embodiment the chordal groove is formed by twelve equiangular flats, the width of the groove **54** being greater than the diameter of cable **48**. For example, when a .125 inch diameter nylon cable is used, the width of the chordal groove **54** may vary between .135 and .138 inches. It is to be understood that the number of flats can be varied and that the specific disclosure of twelve flats is only exemplary.

A portion of the cable is always situated within an angle of more than 180° and less than 270° of the chordal groove **54**. The cable **48**, when situated in the chordal groove **54**, is deformed in the manner depicted in FIGURE 5. This deformation of the cable is sufficient to obtain the requisite thrust to both extend and retract the movable load device with which it is drivingly connected. It will be apparent to those skilled in the art that by increasing the number of flats for a given drum the thrust, or the driving force, will be increased, and vice versa. The end of the cable which is not attached to the movable load device is not attached to the drum **36**, but when the cable is fully extended, this end portion must be situated within the chordal groove **54** or coiled within the storage chamber.

When the cable **48** is substantially fully retracted, the major portion thereof is coiled, or reeled, on the tapered cylindrical portion **50** of the drum in a helical fashion. A floating ring, or band, **56** is disposed within the storage chamber thus forming an outer bearing surface against which the convolutions of the coiled cable **48** come into contact. The ring **56** is free to float axially as well as radially within the storage chamber, and thus serves to guide the cable **48** as it is being reeled or unreeled from this storage chamber to prevent buckling or misalignment of the convolutions.

Operation of the improved cable drive mechanism is believed to be self-evident in that upon rotation of the motor shaft **20** in one direction to extend the cable **48**, the drum **36** will rotate so as to unreel the cable **48** from the storage chamber and extend it through the exit opening **46** in the gear reduction housing **12**. Conversely, to

retract the cable 48, the motor driven shaft 20 is rotated in the opposite direction thereby reeling, or coiling, the cable 48 on the drum portion 50 within the storage chamber.

While the embodiment of the present invention as herein disclosed constitutes a preferred form, it is to be understood that other forms might be adopted.

What is claimed is as follows:

1. A flexible cable drive including, a coil storage chamber, an elongate flexible cable having one end connected with an object to be moved and the other end portion coiled within said chamber, a rotatable deformation element adjacent said chamber having a polygonal surface in driving engagement with said cable for coiling and uncoiling said cable in said chamber, means separating said storage chamber from said rotatable element having helical ramp means therethrough for guiding said cable in its movement in either direction to and from said storage chamber; and means operable to rotate said deformation element.

2. A drive element for an elongate flexible cable comprising a drum having an upstanding flange with a polygonal groove therein, said cable being seated within said groove for an angle of more than 180° but less than 360° with the entrance and exit portions of said cable extending helically from said groove.

3. A drive element for an elongate flexible cable comprising a drum having an upstanding flange with a chordal groove therein, said cable being situated in said groove throughout an angle of more than 180° but less than 360° with the entrance and exit portions of said cable extending helically therefrom.

4. The drive element set forth in claim 3 wherein the cable is deformed in said chordal groove, and wherein the width of the chordal groove exceeds the thickness of said cable.

5. A flexible cable drive including, a coil storage chamber, an elongate flexible cable having one end connected with an object to be moved and the other end portion coiled within said chamber, a drum having a substantially cylindrical portion disposed within said chamber upon which said cable is coiled and an upstanding flange with a polygonal groove adjacent said chamber for receiving and deforming said cable to coil and uncoil said cable in said chamber, means separating said storage chamber from said polygonal groove having helical ramp means therethrough for guiding said cable in its movement in either direction to and from said storage chamber, and means operable to rotate said drum.

6. A flexible cable drive including, a coil storage chamber, an elongate flexible cable having one end portion connected with an object to be moved and the other end portion coiled within said chamber, a drive element adjacent said chamber having a chordal groove for receiving and deforming said cable to coil and uncoil said cable in said chamber, means separating said storage chamber from said rotatable element having helical ramp means therethrough for guiding said cable in its movement in either direction to and from said storage chamber, and means operable to rotate said drive element.

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