Sept. 6, 1960 J. E. MARTENS ET AL 2,951,390

MOTION-TRANSMITTING DEVICE

Filed Sept. 21, 1959 2 Sheets-Sheet 1

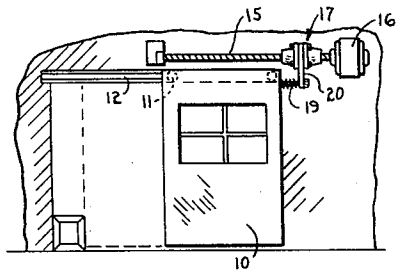


Fig. 1

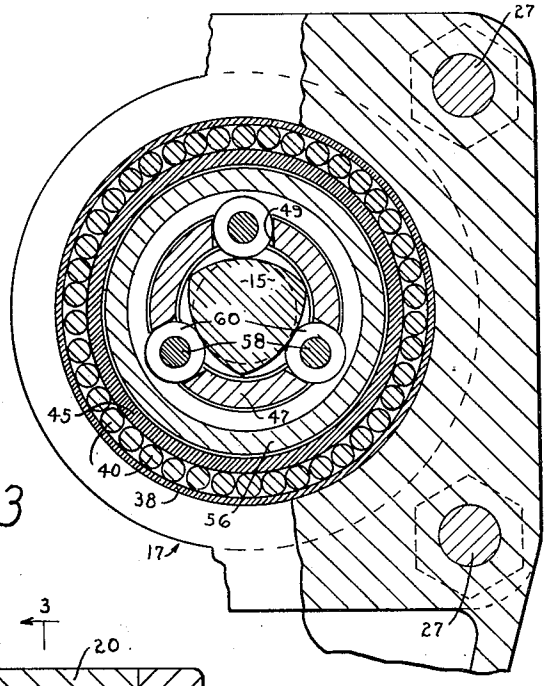


Fig. 3

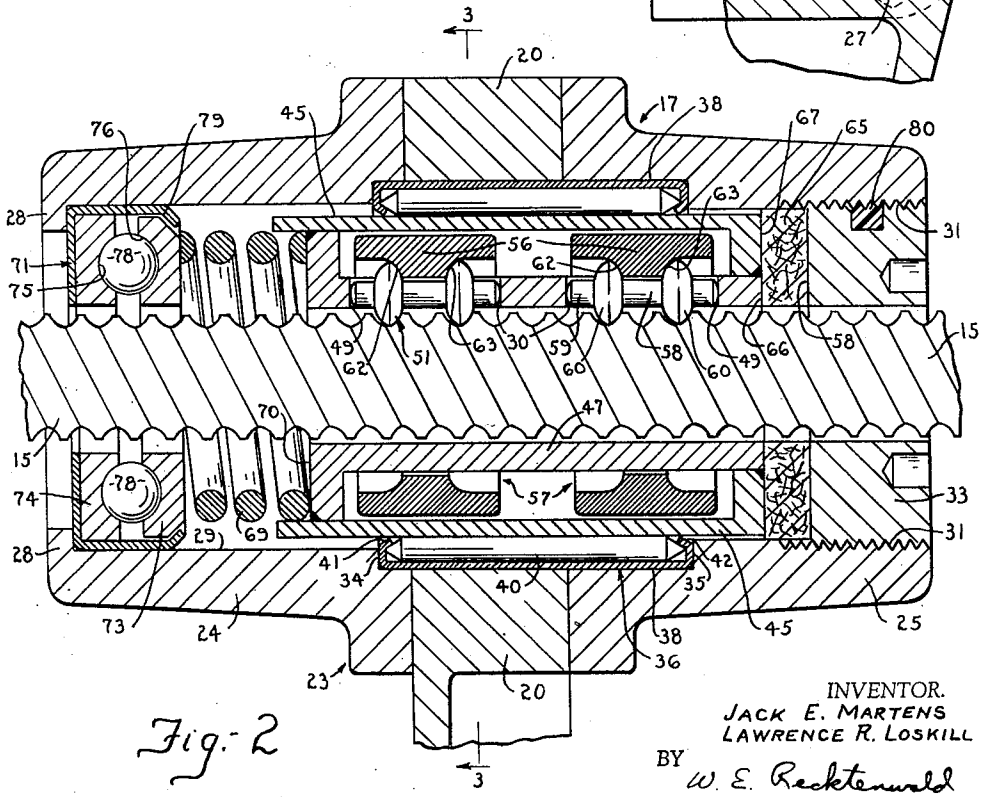


Fig. 2

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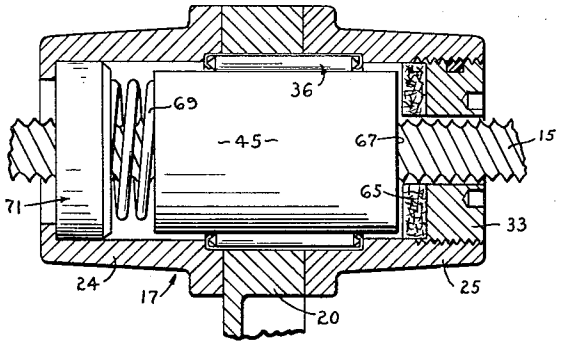


Fig.-4

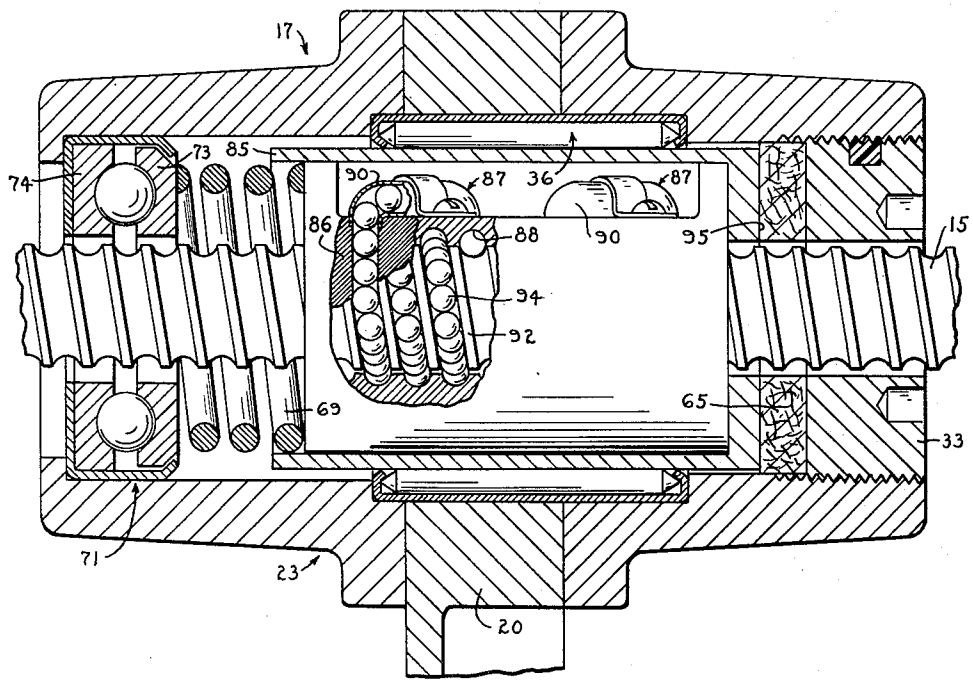


Fig.-5

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# MOTION-TRANSMITTING DEVICE

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7 Claims. (Cl. 74—424.8)

This invention relates generally to motion-transmitting devices and more particularly is directed to a motion-transmitting device having an overload release mechanism.

Heretofore many different systems have been devised for use in applying linear force to a member for moving it from one position to another, for instance in opening a door on a subway train. Such systems include air or hydraulically driven linear actuators and provide for means for reversing the movement of the door in the event of an overload. These devices are expensive in that they require motors and pumps, together with expensive valving, to produce the desired result. Other types of actuators convert rotary motion to linear motion, but these devices generally are positively driven so that there are no means for stopping movement of the member short of burning out the motor or blowing a fuse in the electrical circuit.

It is, therefore, a principal object of this invention to overcome the above-noted disadvantages of the prior art and to provide an improved motion-transmitting device for moving a member from one position to another.

Another object of this invention is to provide an improved motion-transmitting device having a safety or overload release mechanism which serves to limit the maximum force delivered to an output member.

It is another object of this invention to provide an improved motion-transmitting device that is readily reversible at either end of its stroke or at any intermediate points along its path of travel.

And still another object of this invention is to provide an improved motion-transmitting device employing readily available drive means which in no way affects the overload characteristics of the device.

A further object of this invention is to provide an improved motion-transmitting device having positively driven means for effecting movement of the output member in a highly efficient manner.

A still further object of this invention is to provide an improved motion-transmitting device that is relatively simple in operation, readily serviceable in use and comparatively inexpensive to manufacture and maintain.

These and other objects and advantages of the invention will become apparent after the description hereinafter set forth is considered in conjunction with the drawing annexed hereto.

Figure 1 is a schematic view showing a motion-transmitting device incorporating our invention as applied to operating a sliding door;

Figure 2 is an enlarged lengthwise cross-sectional view through the motion-transmitting device showing the details of one form of our invention;

Figure 3 is a cross-sectional view taken along the line 3—3 of Figure 2;

Figure 4 is a view similar to Figure 2 with a portion of the housing cut away to show a disengaging position of the drive assembly; and



Figure 5 is a view corresponding to Figure 2 showing a modified form of our invention.

Referring to the drawings and more particularly to Figures 1–4, a door 10 is illustrated as being horizontally movable on rollers 11 which engage in a track 12 carried by a structure such as the wall of a railway car. A drive mechanism is operatively positioned along one edge of the door 10 and is comprised of a threaded shaft or screw 15 rotatably driven in opposite directions about its longitudinal axis by a reversible motor 16. A composite drive assembly 17 is engaged with the threaded shaft and with one edge of the door so that movement of the assembly 17 along the axis of the screw moves the door from one position to another. A spring means 19 is mounted between one end portion of a supporting bracket 20 of the drive assembly 17 and the adjoining edge of the door so as to absorb a small amount of the inertia loads of the door in the starting and stopping movement of the door.

The drive assembly 17, as best illustrated in Figures 2 and 3, is comprised of an elongate casing or housing 23 through the inside of which passes the screw 15. The housing 23 is composed of two cylindrically shaped parts 24 and 25 sandwiched together against the opposite sides of the hollow supporting bracket 20 by means of bolts 27. The outer end portion or part 24 is formed inwardly a short distance so as to provide a shoulder 28 relative to the inner surface 29 of said part 24. The outer end portion of part 25 is internally threaded at 31 for receiving a threaded cap or stop 33.

In the general vicinity of the central portion of the casing or housing 23, there is provided an elongate radially directed undercut section on the inner surface thereof which produces a pair of opposed shoulders 34, 35. An elongate cylindrical bearing structure 36 is seated in the undercut portion of the housing 23 with the ends of the bearing jacket 38 seated against the shoulders 34, 35. A plurality of elongate needle bearings 40 are retained within said jacket by the inwardly struck edges 41 and 42 of the jacket 38. The longitudinal axes of the needle bearings 40 and the threaded shaft 15 are disposed in a substantially parallel relationship.

A sleeve member 45 is rotatably disposed within the bearing structure 36 and is fastened at its opposite end portions to the opposite end portions of a cage or carrier member 47 which is concentrically disposed within said sleeve 45. The sleeve 45 and carrier 47 are fastened together in any suitable fashion, as by welding, keying or any other positive means, such that the sleeve and carrier are disposed to move together as a unit. The carrier 47 has a plurality of elongate openings 49 formed therein in both radially and axially spaced relation to each other. Each opening 49 receives an elongate bearing member 51, which is adapted to operatively engage with the threads on the threaded shaft 15. A pair of axially spaced-apart ring members 56 are positioned concentrically between the sleeve 45 and the carrier 47 in operative engagement with the bearing members 51. The ring members 56 are free to rotate relative to the carrier 47 and the sleeve 45 and are not directly or indirectly connected to either said carrier or said sleeve. Each ring member 56, set of cooperating bearings 51, carrier 47 and screw 15 combine to form a nut member 57. As shown, two nut members 57 are employed to act together to positively drive the carrier 47 and sleeve 45 in an axial direction.

The bearing members 51 are comprised of a cylindrically shaped base portion 58 forming trunnionlike end portions 49. A pair of radially enlarged bearing surfaces 60 are axially spaced apart along said base portion 58 and are adapted to engage with the threads on the shaft 15 and with the raceways 62 and 63 in the ring members 56. Any number of bearing surfaces 60 may be formed

on each bearing member 51 depending on the loads and speed of operation of the mechanism.

Disposed on the inner face 58 of the cap 33 is a clutch plate 65 which has its clutching surface 66 facing the end face 67 of the combined carrier 47 and sleeve 45. A compression spring 69 encircles a portion of the threaded shaft 15 within the housing 23 and is disposed between the end face 70 of the carrier 47 and one face of a bearing 71. Said spring 69 urges the bearing 71 against the shoulder 28 of the housing 23 and also urges the end face 67 of the carrier and sleeve against the clutching surface 66 of the plate 65.

The bearing 71 has two race members 73, 74 providing raceways 75, 76, respectively, for operatively receiving a plurality of ball bearings 78. The race members 73, 74 are held assembled with the balls 78 by an appropriately formed retainer 79. The spring 69 in the assembled condition of the drive assembly 17 bears against the exposed face of the one race member 73 of the bearing 71. The other end of the spring 69 is held in position by an overhanging extension of the sleeve 45.

Rotation by the motor of the screw 15 in, for instance, a clockwise direction moves the drive assembly 17 to the left. The movement of the assembly 17 is accomplished by the threads on the screw 15 urging the bearing members 51 to rotate about their own axis and planetate about the axis of the screw. Simultaneous with the rotation of the screw the ring members 56, which serve as reaction members, are caused to rotate in a direction opposite to the direction of rotation of the screw. The carrier 47 and sleeve 45, which are restrained from rotational movement by the spring 69 and the clutch plate 65 which lock the carrier 47 and sleeve 45 to the nonrotating casing 23, are moved to the left as shown in Figure 2 along the axis of the screw by the rotation of the screw.

Should the nut assembly or the member being moved by the drive assembly meet an obstruction in its path, further advance of the drive assembly to the left is stopped. Within the drive assembly the carrier 47 and sleeve 45 continue to be moved to the left, and since the casing 23 is stopped from movement the carrier and sleeve slide axially within the needle bearings 40 to compress the spring 69. After only a short axial movement of the carrier and sleeve relative to the casing 23, the end face 67 of the carrier and sleeve disengage from the clutch surface 66 on the clutch plate 65, as is best illustrated in Figure 4, wherein the clutch 65 is disengaged. The carrier 47 and sleeve 45, the spring 69 and the one raceway 73, once clutch 65 is disengaged, rotate together as a unit with the rotating screw 15. The needle bearings 40 provide the bearing surface for the relative rotation between the sleeve 45 and the casing 23. The race member 73 rotates with the sleeve 45 relative to the fixed race member 74 on the ball bearings 78. The result is that, even though the motor 16 continues to rotatably drive the screw 15, the drive assembly does not exert a force on the obstruction to its linear movement beyond a predetermined amount. That is, whatever force it takes to compress spring 69 an amount sufficient to disengage the clutch 65 is the amount of force that is exerted by the nut assembly against any obstruction to the nut assembly. When the force obstructing movement of the nut assembly falls below the predetermined force, the spring urges the carrier and sleeve against the clutch 65 whereupon the nut assembly once again moves to the left (Figure 2).

In the illustrated form of the invention, it is believed to be obvious that the overload release mechanism is only operative in one direction of movement of the nut assembly; namely, only during movement to the left as viewed in Figure 2. The force needed to compress the spring 69 can be varied to some extent by threading the cap or plug 33 in or out of the casing 23. A composition-type material 80 is provided in a segment of the



threaded cap or plug 33 for locking the plug or cap against creeping under load relative to the casing 23.

Figure 5 shows a modification of our invention wherein the housing 23, the bearing 71, the spring 69, the plug or cap 33, the needle bearing 36, the screw 15, and the clutch 65 are substantially identical with, and function the same as, the corresponding parts shown in Figures 1–4. Concentrically disposed within the needle bearing 36 is a cylindrical sleeve 85 which is secured to the outside of a race block 86. The race block 86 has two axially spaced-apart units 87. Each unit comprises a spirally shaped continuous groove 88 formed around the inner surface of the block and terminating at each end in aligned relation with a tubular return member 90. The return members 90 are seated in a cavity formed between the sleeve 85 and the block 86. The spiral shape of the groove 88 substantially coincides with the cooperating groove or thread 92 formed on the shaft or screw 15. A plurality of ball bearings 94 are nested in the cooperating groove 88 and thread 92, as well as in the tubular member 90. The units 87 are commonly known as recirculating ball-type motion-transmitting nuts.

The spring 69 bearing against the race member 73 of the bearing 71 urges the sleeve 85 to the right so as to engage the clutching surface 95 of the sleeve with the clutch plate 65. The drive assembly 17 functions when the screw is rotated to move a member carried thereby from one position to another. In the form illustrated, counterclockwise rotation of the screw moves the drive assembly 17 to the right; clockwise rotation of the screw moves the drive assembly to the left. During movement of the drive assembly to the left, if an obstruction to the movement of the drive assembly is encountered the sleeve 85 and block 86 under the force created by the units 87 compress the spring to disengage the sleeve and block from the clutch 65. The race member 73, spring 69, block 86, sleeve 85 and units 87 rotate together with the screw 15 relative to the obstructed casing 23. Release of the pressure on the drive assembly causes the spring 69 to urge the sleeve 85 and block 86 into clutching relation with the clutch plate 65 whereupon the drive assembly is driven to the left the desired amount. Movement of the drive assembly to the right is from the units 87 through the clutch plate 65 directly and positively to the casing 23 such that no overload release feature is available in this direction.

Having thus described our invention, it is obvious that various modifications may be made in the same without departing from the spirit of the invention; and, therefore, we do not wish to be understood as limiting ourselves to the exact forms, constructions, arrangements, and combinations of parts herein shown and described.

We claim:

1. Means for traversing reciprocably mounted objects, such as doors, windows and the like, comprising a screw operatively mounted along the path of movement of said object, a drive assembly translatable along said screw and connectible to said object, said assembly comprising a tubular housing, a sleeve member rotatably and slidably mounted in said housing for receiving said screw, a carrier within and fixed to said sleeve member, thread-engaging elements disposed in openings formed in said cage and adapted to engage with the threads on said screw, a freely rotatable ring member disposed between said carrier and said sleeve in operative engagement with said thread-engaging elements, bearing means fixed in one end of said housing, clutch means fixed in the other end of said housing, resilient means positioned between said bearing means and the adjacent end of said combined carrier and sleeve member biasing the opposite end of said combined carrier and sleeve against said clutch means whereby rotatable movement of the screw moves said drive assembly along the screw.

2. In a motion-transmitting mechanism comprising a

rotatably mounted screw, a drive assembly translatable along said screw, said drive assembly comprising motion-converting means for changing the rotatable movement of the screw to longitudinal movement of the drive assembly, a sleeve member rotatably and slidably mounted in said drive assembly and operatively connected with said motion-converting means, two-sided bearing means in said drive assembly having one side abutting said drive assembly, resilient means between the other side of the bearing means and said sleeve member normally biasing said sleeve member axially against a friction element to restrain relative rotation between said drive assembly and said motion-converting means, whereby an excessive resistance in the path of movement of said drive assembly compresses said resilient means so that the resilient means, one side of said bearing means and said motion-converting means rotate together with the screw for delivering no addiitonal driving force to the output of the drive assembly.

3. A screw-driven drive assembly comprising a tubular housing having oppositely disposed end portions, bearing means seated in one end portion of said housing, a clutch plate seated in the other end portion of said housing, a motion-converting means operatively engaging with the rotatable screw and being rotatably and axially slidable in said housing, and spring means between one side of said bearing means and the motion-converting means for biasing the latter against said clutch plate whereby an excessive load encountered by said drive assembly causes said motion-converting means to compress the spring means and disconnect the clutch so that the bearing means, spring means and motion-converting means rotate together with the screw for limiting the amount of driving force transmitted to the drive assembly.

4. Means for traversing a reciprocably mounted object comprising a screw mounted along the path of movement of said object, a drive assembly translatable along said screw and connectible to said object, said drive assembly comprising a two-part antifriction thrust bearing and a clutch plate spaced therefrom, motion-transmitting means rotatably and slidably mounted in said drive assembly between said bearing and said clutch plate, a spring between said bearing and said motion-transmitting means biasing said means against said clutch plate whereby an obstruction in the path of said object compresses said spring freeing said means for rotation with said screw.



5. A screw-driven member comprising a tubular housing encompassing a portion of said screw for movement therealong, a bearing member seated in one end portion of said housing, clutch means seated in the other end portion of said housing, motion-transmitting means rotatably and slidably mounted in said tubular housing and operatively connected with said screw, and means positioned between said bearing member and said motion-transmitting means for biasing the latter against said clutch means.

6. A screw-driven member comprising a tubular housing encompassing a portion of said screw for movement therealong, a bearing member seated in one end portion of said housing, a clutch plate seated in the other end portion of said housing, an annular bearing seated within said housing, motion-transmitting means rotatably and slidably mounted in said annular bearing, and a spring positioned between said bearing member and said motion-transmitting means for biasing the latter against said clutch plate.

7. A mechanical actuator comprising a screw, a housing encompassing a portion of the screw for movement therealong, a bearing member seated in one end portion of said housing, a clutch member seated in the other end portion of said housing, motion-transmitting means rotatably and slidably mounted in said housing and operatively connected with said screw, and biasing means positioned between said bearing member and said motion-transmitting means for urging the latter against said clutch member whereby rotation of the screw drives said motion-transmitting means and housing along the screw.

**References Cited** in the file of this patent

UNITED STATES PATENTS

| | | |
|---|---|---|
| 1,024,582 | Jones | Apr. 30, 1912 |
| 1,215,573 | Otis | Feb. 13, 1917 |
| 1,411,039 | Lacey | Mar. 28, 1922 |
| 2,768,532 | Russell | Oct. 30, 1956 |
| 2,857,776 | Williams et al. | Oct. 28, 1958 |
| 2,860,521 | Sierant | Nov. 18, 1958 |
| 2,875,630 | Gill et al. | Mar. 3, 1959 |
| 2,875,631 | Syring | Mar. 3, 1959 |
| 2,893,258 | Meyer | July 7, 1959 |