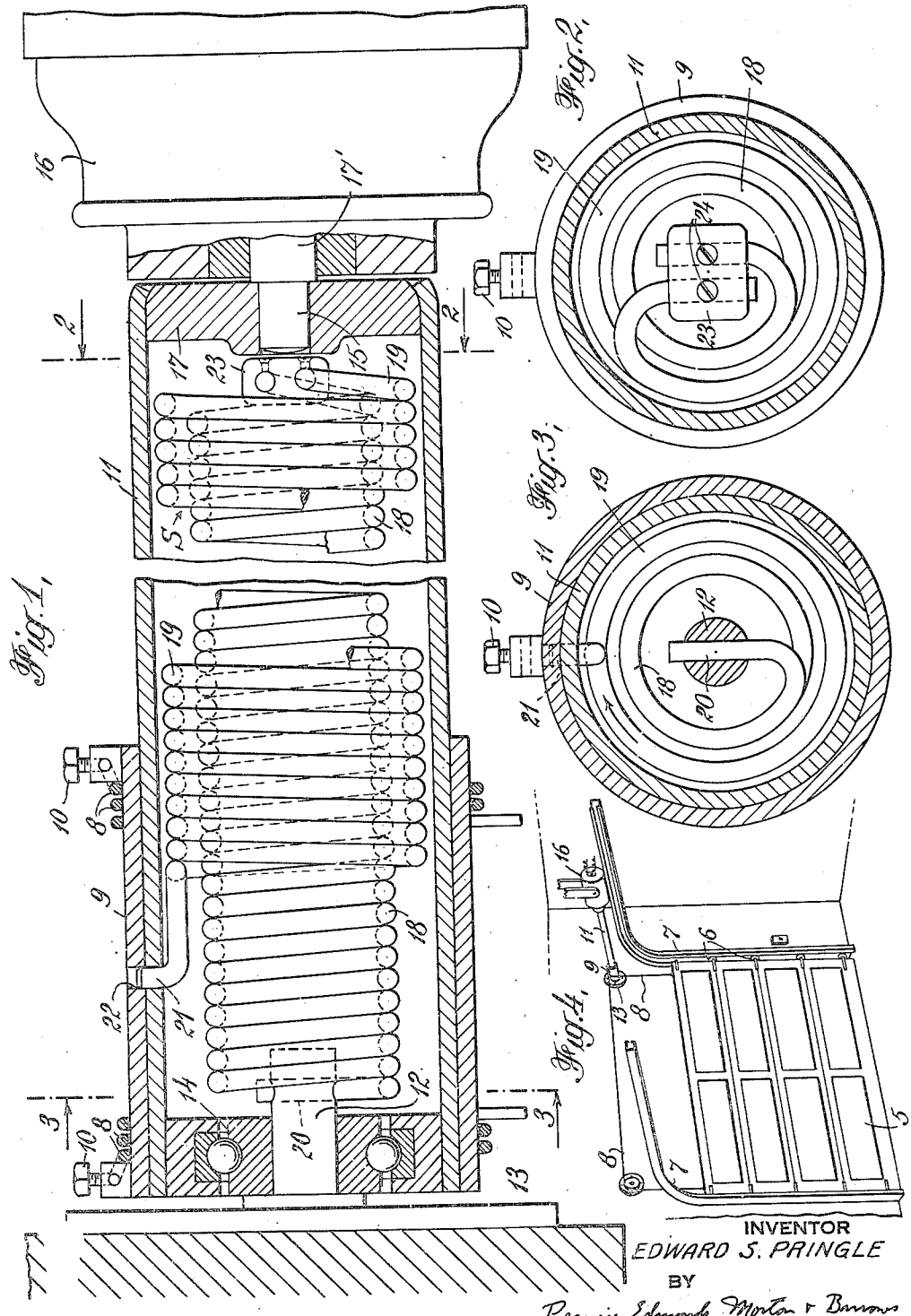
Sept. 6, 1949. E. S. PRINGLE 2,481,037

MULTIPLE TORSION SPRING

Filed Feb. 23, 1946 2 Sheets-Sheet 1



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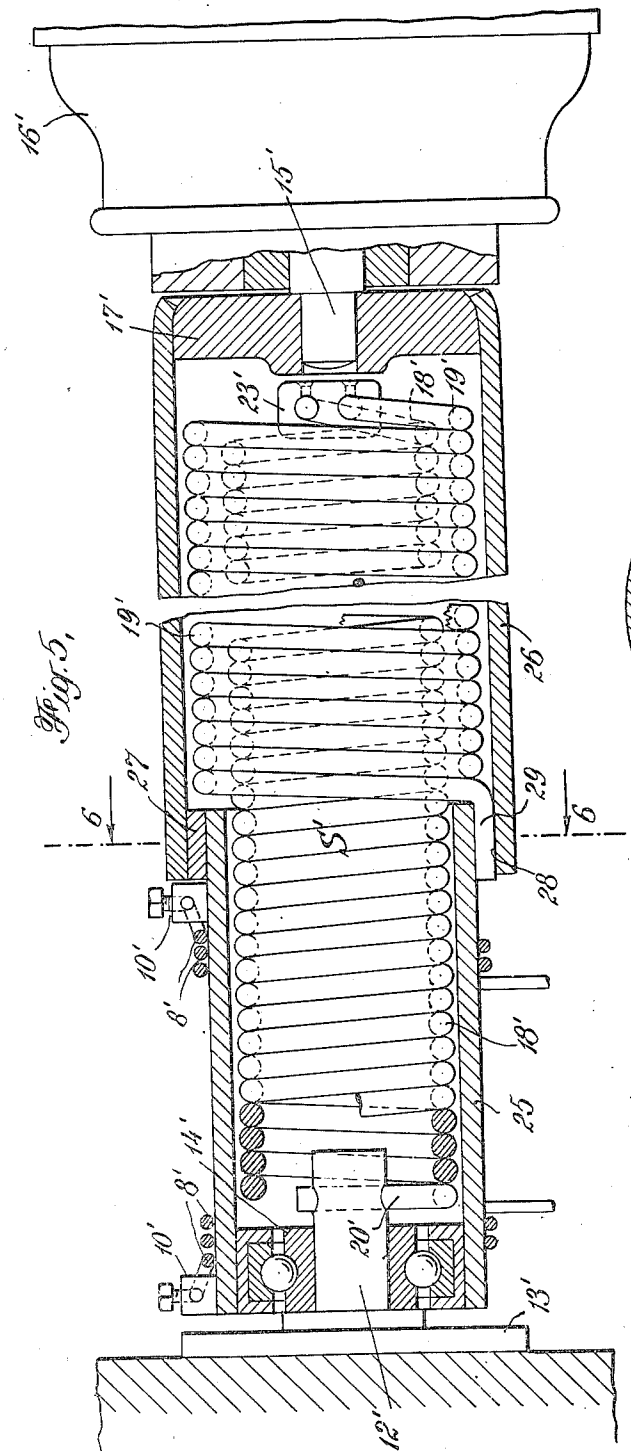


Fig. 5.

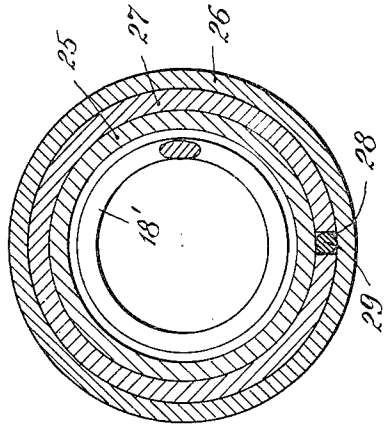


Fig. 6.

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MULTIPLE TORSION SPRING

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5 Claims. (Cl. 254—178)

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This invention relates to door operating apparatus and more particularly concerns an improved torsion spring and associated mechanism for use in operating a door.

Vertically movable doors of the type used for residential garages and like building entrances may be conveniently operated by power mechanism. One form of such mechanism that I have devised includes a torsion spring which is charged or wound up as the door is lowered and which unwinds and exerts a lifting force on the door when the door is released from its lowered closed position. This spring is preferably housed in a rotary drum connected to the door by flexible means such as cables, and an electric motor is provided to turn the drum in a direction to wind up or charge the spring and so to permit the door to close by gravity.

It is desirable that the torsion spring employed in the above described and like door operating mechanisms have sufficient strength to lift the door or to counterbalance its weight, and it is further desirable that the spring mechanism be relatively small and compact.

The present invention has for its object the provision of an improved torsion spring mechanism useful for the above described and like purposes, which combines high strength with relatively small overall dimensions. A further object of the invention is the provision of a spring and drum mechanism including the improved spring structure for use in operating a vertically movable door or like closure. Other specific objects and advantages of the invention will become apparent from the appended description of a typical embodiment thereof.

In describing the invention in detail, reference will be made to the accompanying drawing in which an embodiment of the invention is illustrated. In the drawings;

Fig. 1 is a sectional elevation of a torsion spring and associated mechanism embodying my invention;

Figs. 2 and 3 are respectively sectional views taken along the lines 2—2 and 3—3 of Fig. 1 and viewed in the direction of the arrows;

Fig. 4 is a simplified perspective view of a torsion spring mechanism embodying the invention and connected to a vertically movable sectional door;

Fig. 5 is a sectional elevation, similar to Fig. 1, showing a modified form of torsion spring and associated door operating mechanism embodying my invention; and

Fig. 6 is a sectional view taken along the line 6—6 of Fig. 5 and viewed in the direction of the arrows.

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Referring to the drawings, a sectional, vertically movable door 5 of known construction is illustrated in Fig. 4. The door is mounted and guided by rollers 6 running in guide tracks 7 which extend vertically along opposite sides of the door opening and curve back to extend substantially horizontally along the ceiling of the building. The door moves from the closed position shown upwardly and rearwardly along the tracks 7 to its open position. Cables 8 are secured to the bottom section of the door 5 and are disposed to be wound on a rotary drum 9 to which the cable ends may be suitably secured as by the set screws 10.

Referring to the drum 9 which is illustrated in detail in Figs. 1, 2 and 3, it is fixed to a rotary tube 11, one end of which is journalled on a post 12 fixed to a wall bracket 13, a bearing 14 being disposed between the post and the tube. The opposite end of the tube 11 is fixed to the shaft 15 of an electric motor 16 by an end plug 17 and the motor is suitably secured to the ceiling or any other fixed support as illustrated in Fig. 4. With this arrangement, the motor bearing 17' serves as the outer journal bearing for rotatably supporting the tube 11 and drum 9. A coiled torsion spring unit S is disposed within the tube 11. In accordance with my invention, this spring unit is made up of two elongated cylindrical helically coiled torsion springs 18 and 19 which are telescopically nested together, the spring 18 being inside of the spring 19. The springs 18 and 19 are of substantially equal length and are nearly coextensive with the tube 11, although in the disclosed embodiment the outer spring 19 terminates short of the lefthand end of the tube 11 and of the inner spring 18. As shown in Figs. 1 and 2, both of the springs 18 and 19 are wound in the same direction circumferentially thereof, that is, their successive turns progressing from left to right as viewed in Fig. 1 are wound clockwise as viewed from the right end, as in Fig. 2, but whereas the successive turns of the inner spring 18 progress toward the right, as viewed in Fig. 1, the successive turns of the outer spring 19 progress in the opposite direction, that is, toward the left as viewed in the same figure.

The first turn at the left end of the inner spring 18 is suitably secured to the fixed post 12 as by passing a diametrically bent end 20 of the spring turn through a transverse opening in the post (see Fig. 3). The last turn at the

left end of the outer spring 19 is suitably secured to the tube 11 and to the drum 9 as by inserting an outwardly bent end 21 of the last turn into aligned openings 22 in the tube and the drum. These left ends of the two springs which are respectively connected to the fixed post and to the rotary tube and drum structure may for convenience be referred to as the fixed ends of the springs 18 and 19. The last turn at the right or free end of the inner spring 18 is directly secured to the first turn at the right or free end of the outer spring 19 by any suitable means. In the disclosed embodiment, a block 23 receives the two spring ends in transverse openings therein, and set screws 24 hold the spring ends in the block openings.

With the described arrangement, the two springs 18 and 19 are connected in series to form a single compact torsion spring unit which may be charged or wound up by turning the tube 11 clockwise as viewed in Figs. 2 and 3. This spring winding rotation may be imparted to the tube 11 by operation of the motor 6, and in the disclosed embodiment this rotation results in a lowering of the door 5 by gravity since during such rotation the cables 8 are payed out from the drum 9. When it is desired to raise the door 5, a suitable latch mechanism on the door may be released, whereupon the spring unit S exerts a torsional force which acts to turn the tube 11 and drum 9 and so wind the cables 8 on the drum and raise the door.

The described arrangement incorporates a multiple spring unit wherein one spring is connected at one end to a fixed support and at the other end directly to one end of the other spring, the other end of which is attached to the rotary drum. This construction permits the two springs to be nested together telescopically within the drum tube to produce a spring unit of small dimensions and large power output.

In the modified form of my invention illustrated in Figs. 5 and 6, the tubular member which encloses the torsion spring unit S' comprises a relatively short cable drum portion 25 of reduced diameter secured co-axially to one end of a relatively long portion 26 of larger diameter. The door lifting cables 8' are secured to the cable drum portion 25 by suitable means such as the set screws 10'. The inner coiled torsion spring 18' is longer than the outer spring 19'. As shown, the right hand ends of the two springs 18' and 19' which are interconnected by the block 23' are substantially aligned, whereas the left hand end of the outer spring 19' terminates short of the left hand end of the inner spring 18' by an interval substantially equal to the length of the reduced diameter drum portion 25 of the tubular spring housing member. The difference in length between the springs 18' and 19' is preferably small in proportion to their total lengths, and may comprise a few inches as compared to a total spring length of several feet. The reduced drum portion 25 is just large enough to enclose the relatively small diameter inner spring 18', and the larger diameter tubular portion 26 is of sufficient diameter to enclose the outer spring 19'.

The two portions 25 and 26 of the tubular member may be connected by any suitable means, and as shown, a sleeve or ring 27 is employed for this purpose. The outer surface of the sleeve 27 engages the inner wall of the left end of the tubular portion 26, and the inner surface of the sleeve engages the outer wall of the tubular drum portion 25. The sleeve 27 may be secured to the respective tubular portions 26 and 27 by a press fit, by welding or in any other suitable manner. The sleeve 27 is preferably split as shown in Fig. 6 to provide an opening 28 into which an axial extension 29 at the left end of the outer spring 19 is inserted. This forms a driving connection between the left end of the outer spring 19' and the tubular member.

The parts of the modification of Figs. 5 and 6 not specifically described are substantially identical with the corresponding parts of the modification of Figs. 1 to 4, and are designated by like reference characters bearing distinctive exponents.

The modification of Figs. 5 and 6 operates in the same manner as has been described above in connection with the previously described embodiment. The stepped diameter of the tubular member enclosing the spring unit in combination with the arrangement of the outer spring terminating short of the reduced cable drum portion permits the use of an outer spring of relatively large diameter while employing a small diameter cable drum with a resultant reduction in the torque load on the torsion spring.

A particular advantage of the disclosed multiple torsional spring structures is that they permit the use of a relatively small diameter cable drum with a resultant reduction in the torque load on the spring, while at the same time keeping the spring relatively short. A small cable drum diameter is desirable in that by reducing the torque load, it permits the use of a smaller wire size in the spring. At the same time, however, the small cable drum diameter makes necessary a greater number of turns of the drum in moving the door a given distance, and hence a greater number of turns of the torsional spring which rotates the drum. With the improved construction of the invention, a large number of spring turns is provided in a relatively short structure whereby the advantages of a small cable drum can be achieved in a spring structure of moderate length. By employing the described stepped construction of the tubular member, a further reduction in the torque load on the spring is obtained.

I claim:

1. In a spring operated device, in combination, a rotary tubular member, a fixed post extending into one end of said tubular member, a bearing connecting one end of said tubular member to said post, an electric motor directly connected to the other end of said tubular member to rotate the same, an inner helically coiled torsion spring within and substantially coextensive with said tubular member and having a fixed end secured to said post and a free end adjacent the opposite end of said tubular member, and an outer helically coiled torsion spring in said tubular member surrounding and substantially coextensive with said inner spring and having a free end directly connected with the free end of said inner spring independently of said tubular member and a fixed end secured to said tubular member adjacent the fixed end of said inner spring, the successive turns of said springs being wound in the same direction circumferentially thereof but progressing in opposite directions longitudinally thereof.

2. In a spring operated device, in combination, a fixed member, a tubular member rotatably supported adjacent said fixed member and having a drum portion of reduced diameter adjacent one end thereof, a pair of helically coiled elongated torsion springs nested telescopically one within

the other and disposed within said tubular member, the inner of said nested springs extending substantially throughout the length of said tubular member and the outer of said nested springs terminating short of said end portion of reduced diameter, means for connecting the end of said inner spring within said tubular end portion of reduced diameter to said fixed member, means for connecting the adjacent end of said outer spring to said tubular member and means for connecting the other ends of said springs together independently of said tubular member.

3. In a spring operated device, in combination with a fixed support and an elongated tubular member having a cable drum portion of reduced diameter at one end thereof and rotatably connected at said end to said support, an inner helically coiled torsion spring within and substantially co-extensive with the entire length of said tubular member, means for connecting one end of said inner spring to said fixed support, an outer helically coiled torsion spring surrounding said inner spring, said outer spring being of a diameter larger than the inner diameter of said cable drum portion and terminating adjacent the inner end of said cable drum portion, means for connecting the end of said outer spring that is adjacent said cable drum portion to said tubular member and means for interconnecting the ends of said inner and outer springs that are remote from said cable drum portion.

4. In a spring operated device, in combination with a fixed support and an elongated tubular member having a tubular cable drum portion of reduced diameter at one end thereof, means for rotatably connecting the cable drum end of said tubular member to said fixed support, an inner helically coiled torsion spring within said tubular member and extending substantially from end to end thereof and having a fixed end within said cable drum portion connected to said fixed support and a free end adjacent the opposite end of said tubular member, an outer helically coiled torsion spring within said tubular member surrounding said inner spring and extending from the inner end of said reduced cable drum portion substantially to the free end of said inner spring, means for connecting the end of said outer spring that is adjacent said cable drum portion to said

tubular member and means for connecting the other end of said outer spring to the free end of said inner spring independently of said tubular member.

5. In a spring operated device, in combination, a rotary hollow tubular member comprising a body portion and a co-axial drum end portion of smaller diameter than said body portion having its inner end extending within the end of said body portion, a sleeve surrounding and secured to said inner end of said drum end portion and engaging and secured to the inner surface of the surrounding end of said body portion, a fixed post extending into the outer end of said drum end portion, means for rotatably connecting said drum end portion to said post, an inner helically coiled torsion spring within and co-extensive with said connected portions of said tubular member and having a fixed end secured to said post and a free end adjacent the opposite end of said tubular member, said inner spring having an outer diameter less than the inner diameter of said drum end portion, and an outer helically coiled torsion spring within the body portion of said tubular member surrounding said inner spring in said body portion and having a free end remote from said drum end portion and directly connected to the free end of said inner spring independently of said tubular member and a fixed end adjacent the inner end of said drum end portion and secured to said sleeve.

EDWARD S. PRINGLE.

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