

Jan. 25, 1966

ICHINOSUKE NAITO
ROPE DRAWING APPARATUS

3,231,240

Filed Jan. 22, 1964

4 Sheets-Sheet 1

Fig. 2

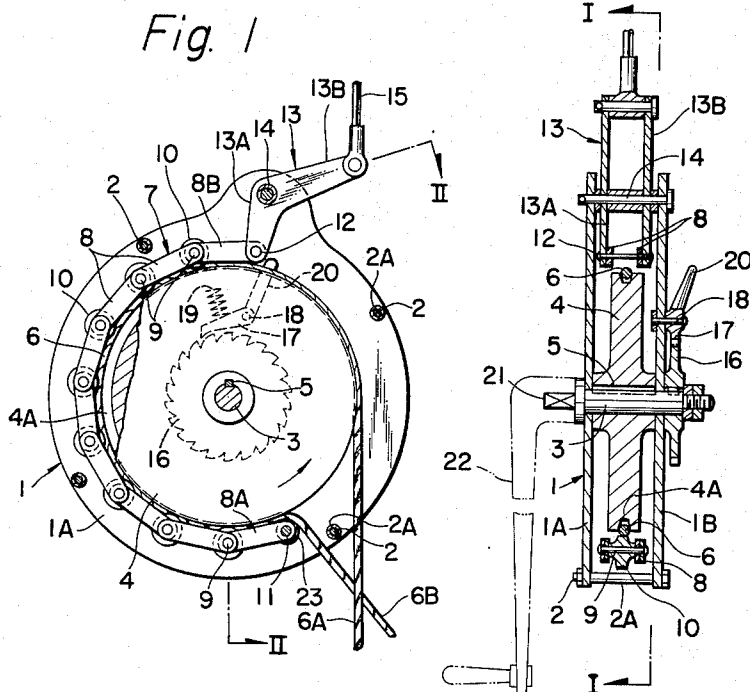
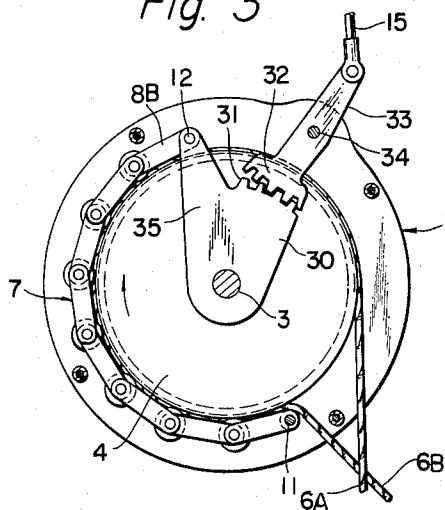


Fig. 3



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Fig. 4

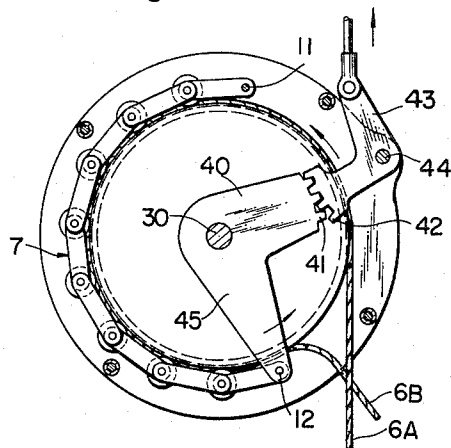


Fig. 6

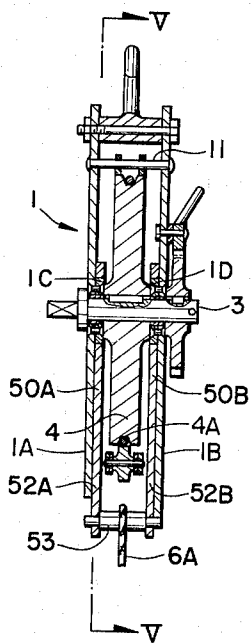
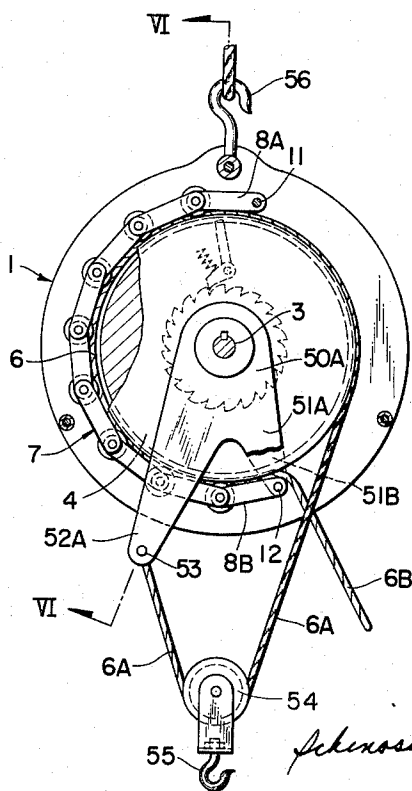


Fig. 5



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Fig. 7

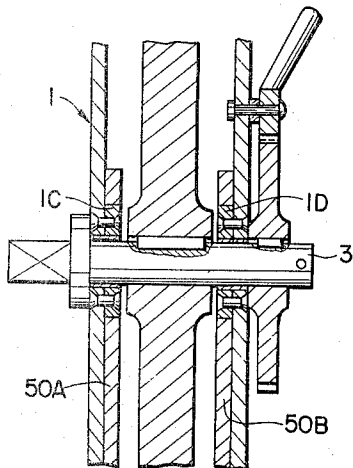
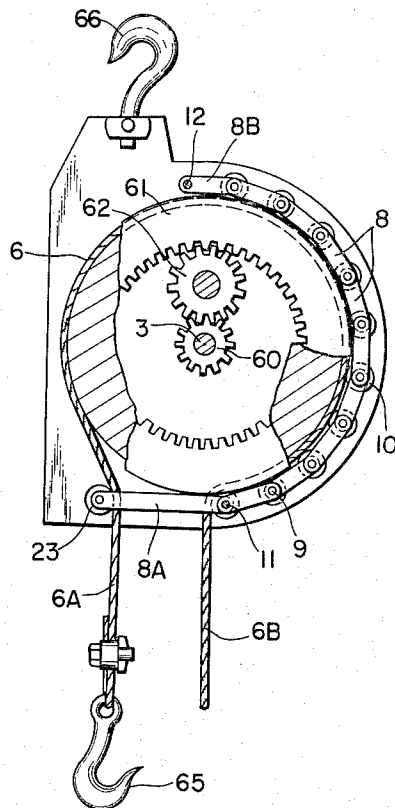


Fig. 8



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Fig. 9

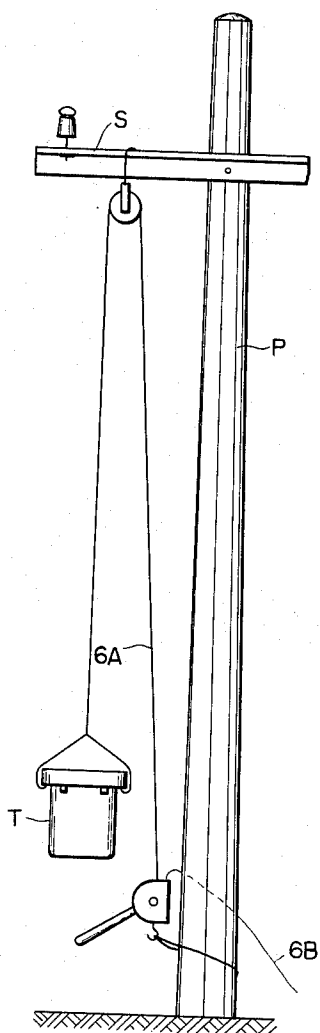
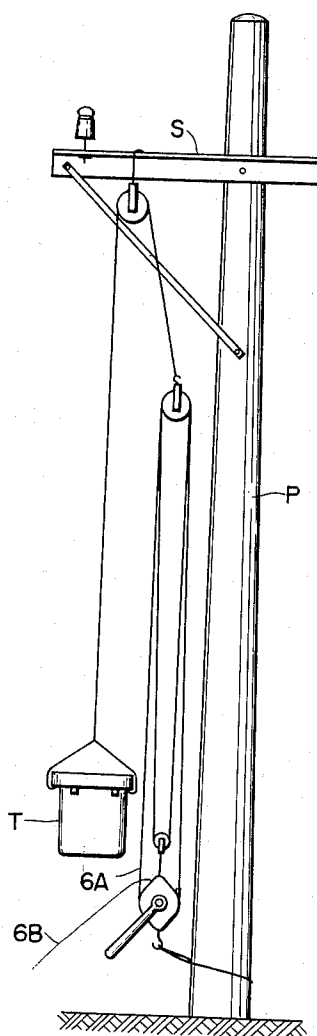


Fig. 10



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3,231,240

ROPE DRAWING APPARATUS

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38/8,725

8 Claims. (Cl. 254-167)

This invention relates to a rope drawing apparatus, i.e., to an apparatus for lifting and lowering or drawing a load secured to a rope by rotating a pulley.

According to the present invention there is provided a rope drawing apparatus comprising a driving pulley pivoted on a frame and a flexible belt fitted around the outer periphery of said pulley, one end of said flexible belt being fixed on said frame, the other end thereof being adapted to be tensioned by the rope being drawn, the tension in the belt being proportional to the load on the rope, the belt being adapted to press the rope into contact with the pulley.

The apparatus of this invention may be used in a number of applications, e.g., in the construction and maintenance of electric power transmission lines and distribution lines; in the construction and maintenance of trolley wires and aerial cableways; in the lifting and drawing operations in public works, mining works, building works, forestry, fishery, shipbuilding, shipping and transportation industries, as well as various factories; in the stretching of supporting lines and shelf or trellis lines in farms; in the leading in of power cables and cables for communication facilities; and in the lifting and lowering of heavy loads on mountains.

In order that the invention may more readily be understood, the following description is given of a number of examples of rope drawing apparatus according to the invention, reference being made to the accompanying drawings, in which:

FIGURE 1 is a front elevation taken in section on the line I—I of FIGURE 2 of a first embodiment of the invention;

FIGURE 2 is a side elevation taken in section on the line II—II of FIGURE 1;

FIGURE 3 is a front elevation of a second embodiment, a portion of the frame being removed;

FIGURE 4 is a view similar to FIGURE 3 of a third embodiment;

FIGURE 5 is an elevation on the line V—V of FIGURE 6 showing a fourth embodiment;

FIGURE 6 is a section on the line VI—VI of FIGURE 5;

FIGURE 7 is an enlarged view of a portion of FIGURE 6;

FIGURE 8 is a view, partly in section, of a fifth embodiment; and

FIGURES 9 and 10 show examples of the use of the apparatus of the invention.

In the drawings like parts in the various embodiments are indicated by the same reference numerals.

Referring to FIGURE 1 and FIGURE 2, a frame 1 consists of frame plates 1A and 1B fixed and supported in parallel by a number of bolts 2 and spacers 2A. A driving shaft 3 is mounted on the frame 1 and a pulley 4 is fixed by a key 5 on the shaft 3 between the frame plates 1A and 1B. On the outer periphery of the pulley 4 is provided a groove 4A whose cross-section is V-shaped to fit a load carrying rope 6. The rope may be a wire rope, a hemp rope, a cotton rope or ropes of other suitable materials. A flexible chain in the form of a link chain 7 has a plurality of links 8 connected by a plurality of pins 9, each of said pins freely supporting

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a roller 10. One end link 8A of the link chain 7 is mounted on the frame 1 by means of a pin 11, a guide roller 23 being fitted on the frame 1 with the pin 11 while the other end link 8B of the link chain 7 is pivoted on a shorter arm 13A of a bell crank 13 with a pin 12, so that each roller is in contact with the outer side of the rope 6 inserted in the V-shaped groove 4A.

The bell crank 13 is pivotally supported on the frame 1 about an axis 14, while a longer arm 13B of said crank is connected to a frame supporting rope 15 or a suitable hook. On the driving shaft 3 is fixed a ratchet wheel 16 and a pawl 17, engageable therewith, is pivotally supported on an axis 18 on the frame plate 1B. The pawl 17 is urged into contact with a tooth of the ratchet wheel by a spring 19 and disengaged by actuation of a rod 20. A square portion 21 is provided on the driving shaft 3 for securing a driving handle 22.

In operation of this apparatus the rope 15 is secured against movement and the load to be transferred or lifted is fixed to the end of the "drawn" side 6A of the rope 6. When tension is imparted to the drawn side 6A a similar tension occurs in the rope 15 and the link chain 7 is urged clockwise, in FIGURE 1, by the bell-crank 13. Accordingly, each roller 10 presses the rope 6 inwardly and urges the same into the V-shaped groove 4A by a pressure corresponding to the tension in rope 15. When the pulley 4 is subsequently rotated (counterclockwise in FIGURE 1) by operating the driving handle 22, the load is either drawn nearer or lifted by the drawn side 6A of the rope, the relaxed side 6B of the rope being guided outside of the apparatus by the guide roller 23. If the tension at the drawn side 6A is increased the rope 15 is drawn accordingly in a direction away from the apparatus (namely, upwardly in FIGURE 1), so that the bell-crank 13 rotates in such a way as to tension the link chain 7 so that the rollers 10 press the rope 6 more firmly into the V-shaped groove 4A. The friction force between the rope 6 and the V-shaped groove 4A increases, so that the rope 6 will not slide in the V-shaped groove 4A. If this apparatus is to be used only for small loads, it is possible to make the chain 7 as a flexible belt such as a series of rubber belts.

FIGURE 3 and FIGURE 4 show two modified embodiments of the pulley part for drawing the flexible belt (or link chain) of the above apparatus wherein the ratchet wheel is not shown. In the drawings, segments 30, 40 are respectively freely supported on the driving shaft 3. In FIGURE 3 a lever 33 is pivoted on a pin 34 on the frame 1, teeth 32 of the lever 33 engaging with teeth 31 of the segment 30 and the end of the lever 33 opposite the teeth 32 is connected to the rope 15. An arm 35 projects from the segment 30, the end of said arm being secured to the end link 8B of the link chain 7 by means of pin 12. In this structure, when a tension is imparted to the rope 15, the pin 12 draws the link chain clockwise.

FIGURE 4 shows another embodiment of this apparatus wherein an arm 45 of the segment 40 projects in a direction and to a side opposite from that of FIGURE 3, the end of said arm being connected pivotally with a pin 12 to one end of the link chain. The apparatus of FIGURE 4 is similar to that of FIGURE 3 except that lever 43 is cranked and pivoted on a pin 44 on the frame 1, teeth 42 therein engaging teeth 41 on the segment 40.

In operation, a rope is connected to the object to be lifted or dragged and is passed between the pulley and the link chain and the pulley is rotated in a direction to draw the rope. For example, a pole transformer T is shown being raised to a supporting arm S of an electric pole P in FIGURE 9.

FIGURE 5, FIGURE 6 and FIGURE 7 show a further embodiment of the structure of this invention fitted

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on a conventional pulley block provided with an extra pulley. On the frame plates 1A and 1B, discs 1C and 1D are mounted concentrically on the driving shaft 3 while bell-cranks 50A and 50B of the same shape are rotatably supported on the discs 1C and 1D between the frame plates 1A, 1B and the pulley 4. The ends of the shorter arms 51A and 51B of the bellcranks 50A and 50B, respectively, and the end link 8B of the link chain 7 are connected by a pin 12. Similarly, the ends of the longer arms 52A and 52B of the bell-cranks are connected to the drawn side 6A of the rope 6 by a pin 53. The rope supports a movable pulley 54 and is pressed against the pulley 4 by the link chain 7, which is secured to frame plates 1A and 1B by pin 11. To support the apparatus the latter is provided with a load supporting hook 56, the load being hung on a load supporting hook 55 secured to the movable pulley 54. When the pulley 4 is rotated, because the rope is pressed by the link chain into the V-shaped groove of the pulley, the load is lifted without allowing any slip of the rope. As one example of use of this apparatus, a pole transformer T is shown being lifted to a supporting arm S of an electric pole P in FIGURE 10.

FIGURE 8 shows still another embodiment of this invention, a front frame plate being shown removed for clarity. A pulley 61 having a peripheral groove is provided with teeth around the internal periphery thereof meshing with an idler gear 62 driven by a pinion 60 concentrically fitted on the driving shaft 3. At one end of the end link 8A of the link chain 7, a guide roller 23 is provided, such roller being movable in the extended direction of the end link 8A along a guide slot (not shown) provided on the frame plate; one end of the other end link 8B is fixed to the frame plate by a pin 12 as in the previous embodiments. Hooks 65 and 66 are provided respectively on the end of the drawn side 6A of the rope 6 and at the upper end of the frame plate of this apparatus. When an object to be lifted is fitted on the hook 65 the pulley 61 is rotated and the tension in the portion 6A of the rope draws the guide roller 23 to the left in the drawings, thus tensioning the link chain, the rope 6 thereby being pressed into the groove of the pulley by the rollers 10. When the link chain is fitted around a greater part of the periphery of the pulley, the rope can be pressed onto the groove of the pulley more effectively, so that therefore the tension in the rope (and thus the load lifted) can be increased.

With the apparatus of the invention the tension produced in the flexible belt is such that a friction force is produced between the rope and the pulley which is somewhat greater than the tension in the rope. However, the tension in the flexible belt is chosen so that there is no fear of damaging the rope as a result of pressing the same onto the pulley more than necessary. Also, the flexible belt can extend around most of the outer periphery of the pulley and the number of rollers can be increased accordingly, so that the pressing force of each roller becomes relatively small and the rope is less likely to be damaged.

Also, it should be noted that the apparatus of this invention needs no winding drum for the rope so that the drawing or lifting distance is not limited by the size of the apparatus. Thus, the apparatus of this invention can drag or lift an object over any distance provided the rope is sufficiently long.

Further, because the apparatus of this invention needs no winding drum for the rope, the apparatus is very small and light and handy to carry, so that it is suitable for use in inaccessible places such as on an electric pole, on a tree, and on a mountain.

Furthermore, the apparatus of this invention has parts which can be easily replaced, the apparatus being simple in use and inexpensive in construction.

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Although the apparatus whose driving shafts 3 are directly rotated by hand are shown in the embodiments, it is also possible to form a gear on the inner periphery of the pulley 4 with a pinion mounted on the frame engaging therewith, the pulley being rotated by turning the pinion. It is also possible to provide a gear fitted concentrically on the driving shaft 3 of the pulley 4 and mount a pinion on the frame to engage therewith, the pulley being rotated by turning the pinion. Further, the pulley 4 or the pinion may be driven by a motor or a chain wheel provided on the side of the frame. Moreover, the surface of the V-shaped groove of the pulley 4 may be formed in a rough surface to increase the friction as occasion demands and it is possible to provide a means to restrain the pulley upon rewinding the rope.

What I claim is:

1. A rope driving apparatus for lifting loads by means of a rope, comprising a frame, a grooved driving pulley rotatably mounted on said frame and adapted to have a load carrying rope member therearound, a flexible band extending around at least a portion of the periphery of the driving pulley, said band having one end fixed to said frame and being adapted to bear on the load carrying rope member and press it into the groove in the pulley, a frame supporting member adapted to support said apparatus from a fixed support, and coupling means secured to the free end of said band and adapted to be coupled to one of said members for transmitting the tension in said one of said members due to a load on said load carrying rope member to said band, said tension being proportional to the load and causing the band to press the rope member against the pulley groove with a force proportional to the load, said frame supporting member being coupled to said frame when said coupling means is coupled to said rope member and being coupled directly only to said coupling means when said coupling means is coupled between the band and said frame supporting member.

2. A rope driving apparatus for lifting loads by means of a rope, comprising a frame, a grooved driving pulley rotatably mounted on said frame and adapted to have a load carrying rope therearound, a flexible band extending around at least a portion of the periphery of said driving pulley, said band having one end fixed to said frame and being adapted to bear on said load carrying rope and press it into the groove in the pulley, a frame supporting member secured to said frame for supporting the frame from a fixed support, and coupling means secured to the free end of said band and being adapted to be coupled to the rope for transmitting the tension in the rope due to a load on the rope to said band, said tension being proportional to the load and causing the band to press the rope against the pulley groove with a force proportional to the load.

3. An apparatus as claimed in claim 2 in which said coupling means comprises a bell crank having the elbow thereof pivoted to said frame and having one end connected to said free end of said band and having the other end adapted to be connected to one end of said rope with said rope being adapted to extend to the load and then around said pulley and tending to pivot said bell crank in a direction to exert a tensioning force on said band.

4. An apparatus as claimed in claim 2 in which said coupling means comprises a roller on the free end of said band mounted on said band with the periphery of the roller spaced from the end of the band, the rope being adapted to extend over said roller from the periphery of said pulley in the space between the end of the band and the roller and extend away from the apparatus in a direction for exerting a force on the free end of the band when a load tensions the rope.

5. A rope driving apparatus for lifting loads by means of a rope, comprising a frame, a grooved driving pulley

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rotatably mounted on said frame and adapted to have a load carrying rope therearound, a flexible band member extending around at least a portion of the periphery of the driving pulley, said band having one end fixed to said frame and being adapted to bear on the load carrying rope and press it into the groove in the pulley, a frame supporting member adapted to support said apparatus from a fixed support, and coupling means secured between the free end of the band and said frame supporting member for suspending the apparatus from the frame supporting member and transmitting the tension in said frame supporting member due to a load on the load carrying rope to said band, said tension being proportional to the load and causing the band to press the rope against the pulley groove with a force proportional to the load.

6. An apparatus as claimed in claim 5 in which said coupling means comprises a bell crank pivoted on said frame at the elbow thereof and having one end connected to said band and the other end connected to said frame supporting member, said bell crank being pivoted in a direction to exert tension on the band when a load is supported on said rope and a resulting tension is produced in said frame supporting member.

7. An apparatus as claimed in claim 5 in which said coupling means comprises a bell crank pivoted on said frame at an elbow thereof and having one end connected to said band and having a gear segment at the other end, a lever pivoted on said frame with one end connected to said frame supporting member and the other end having a gear segment thereon meshed with the gear segment on said bell crank, said bell crank and lever being pivoted in a direction to exert tension on the

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band when a load is supported on said rope and resulting tension is produced in said frame supporting member.

8. A rope driving apparatus for lifting loads by means of a rope, comprising a frame, a grooved driving pulley rotatably mounted on said frame, a load carrying rope member around said pulley, a flexible band extending around at least a portion of the periphery of the driving pulley, said band having one end fixed to said frame and bearing on the load carrying rope member and pressing it into the groove in the pulley, a frame supporting member adapted to support said apparatus from a fixed support, and coupling means secured to the free end of said band and coupled to one of said members for transmitting the tension in said one of said members due to a load on said load carrying rope member to said band, said tension being proportional to the load and causing the band to press the rope member against the pulley groove with a force proportional to the load, said frame supporting member being coupled to said frame when said coupling means is coupled to said rope member and being coupled directly only to said coupling means when said coupling means is coupled between the band and said frame supporting member.

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