S. T. NELSON.

MINE HOIST.

APPLICATION FILED APR. 16, 1906.

999,841.

Patented Aug. 8, 1911.

4 SHEETS—SHEET 1.

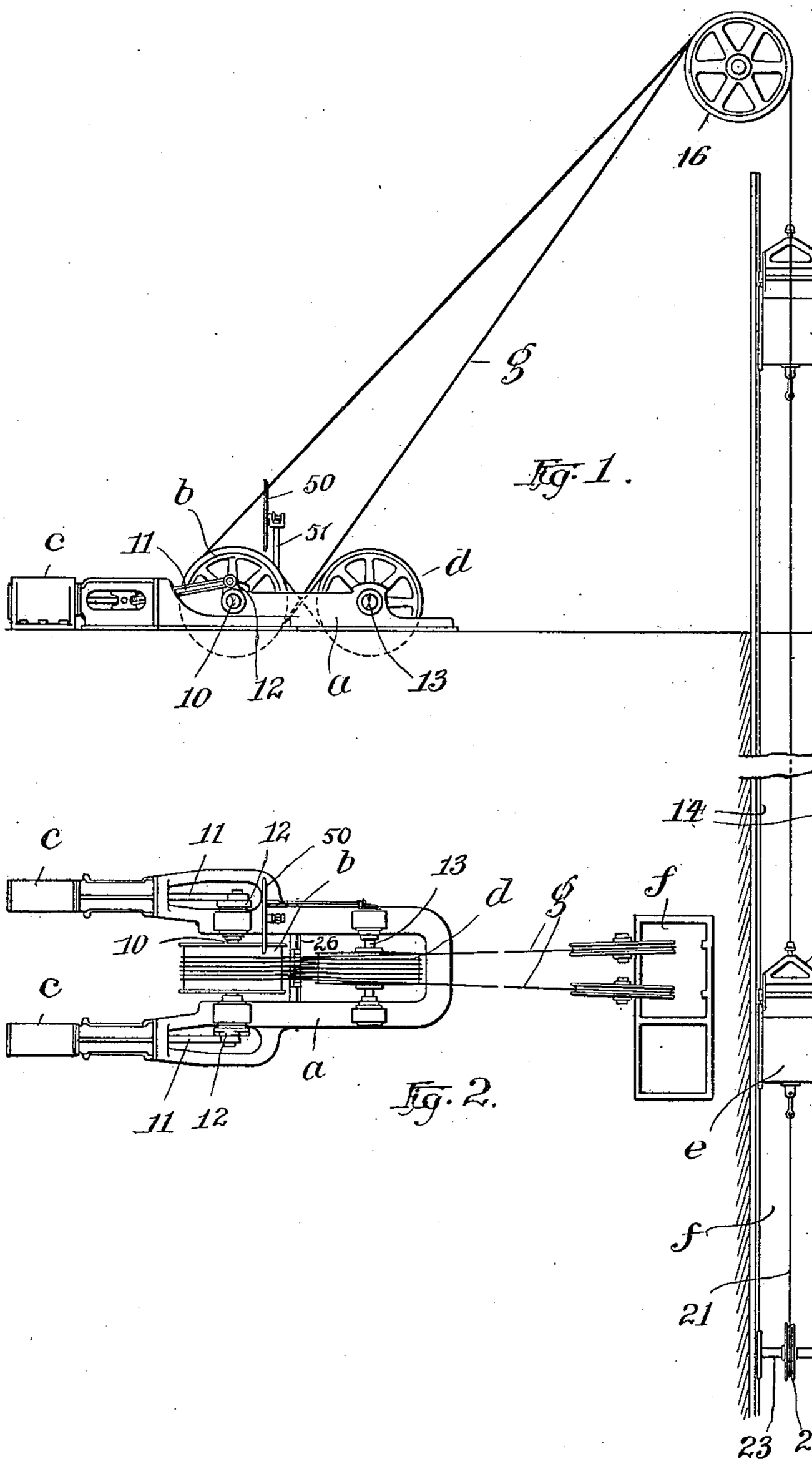

Fig. 1.

Fig. 3.

Fig. 2.

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4 SHEETS—SHEET 2.

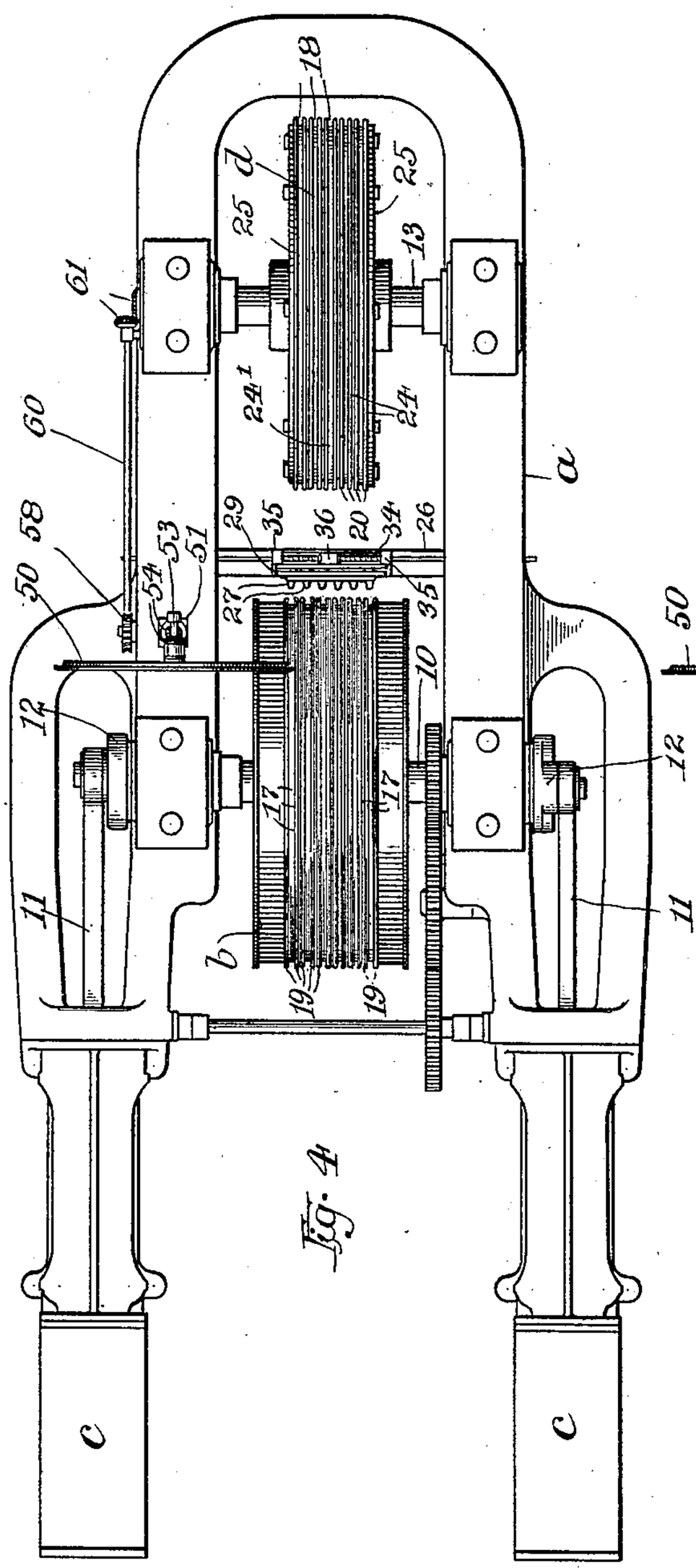

Fig. 4

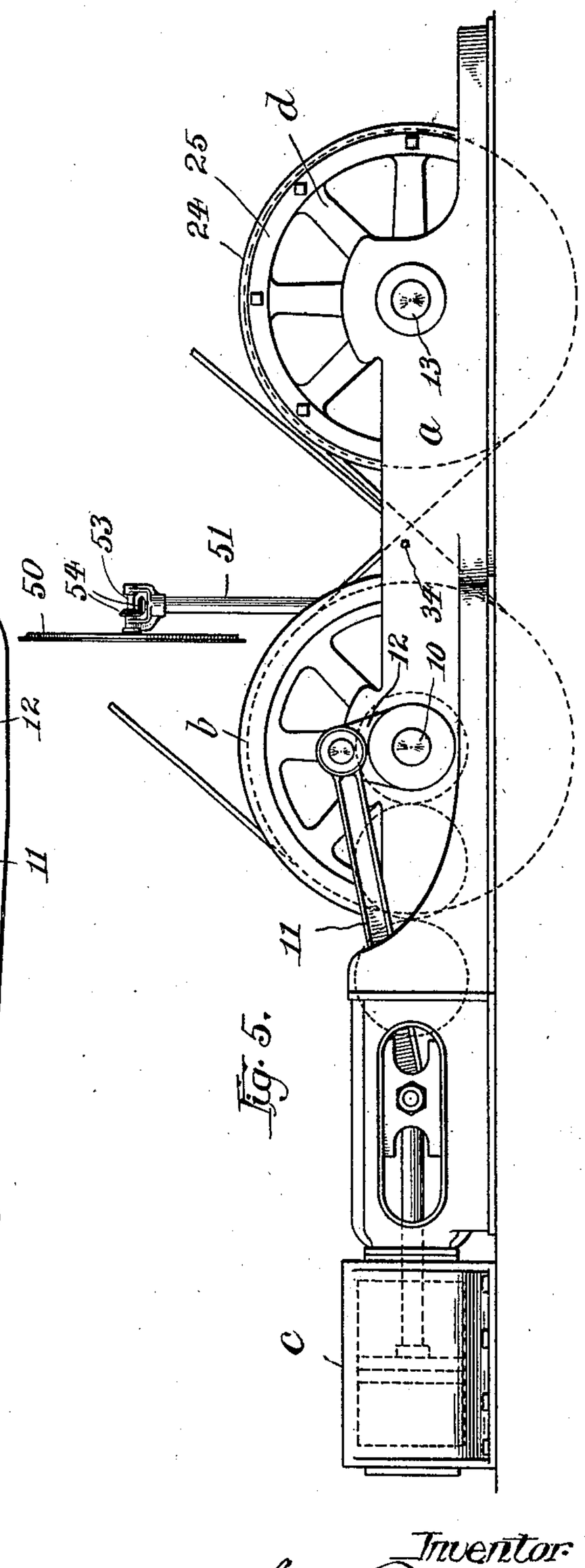

Fig. 5.

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4 SHEETS—SHEET 3.

Fig. 6.

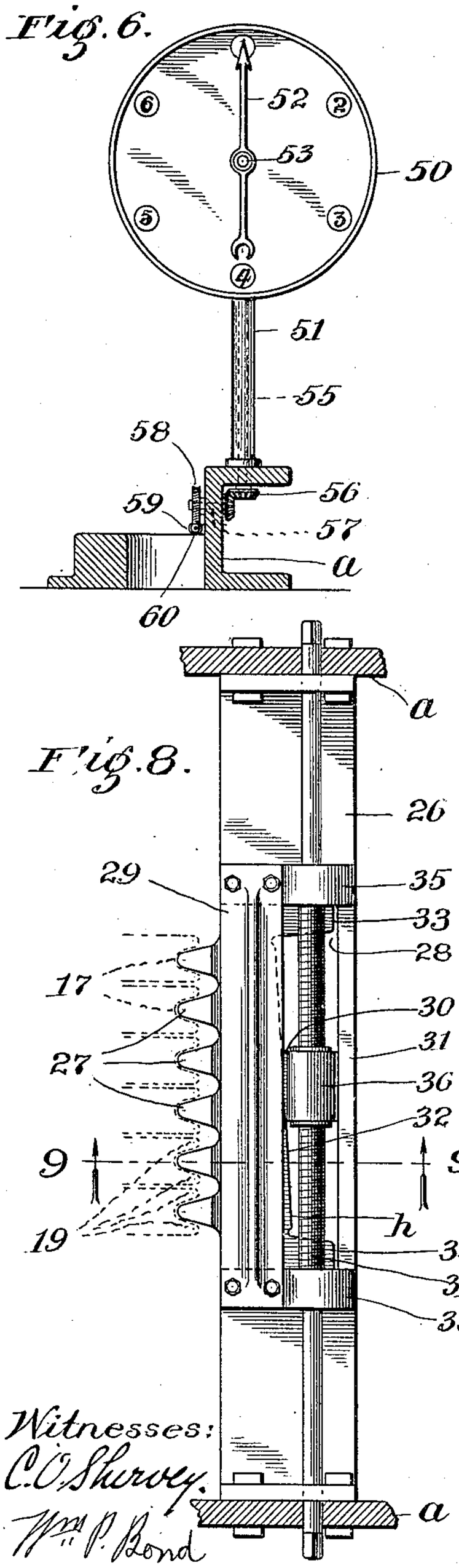

Fig. 8.

Fig. 7.

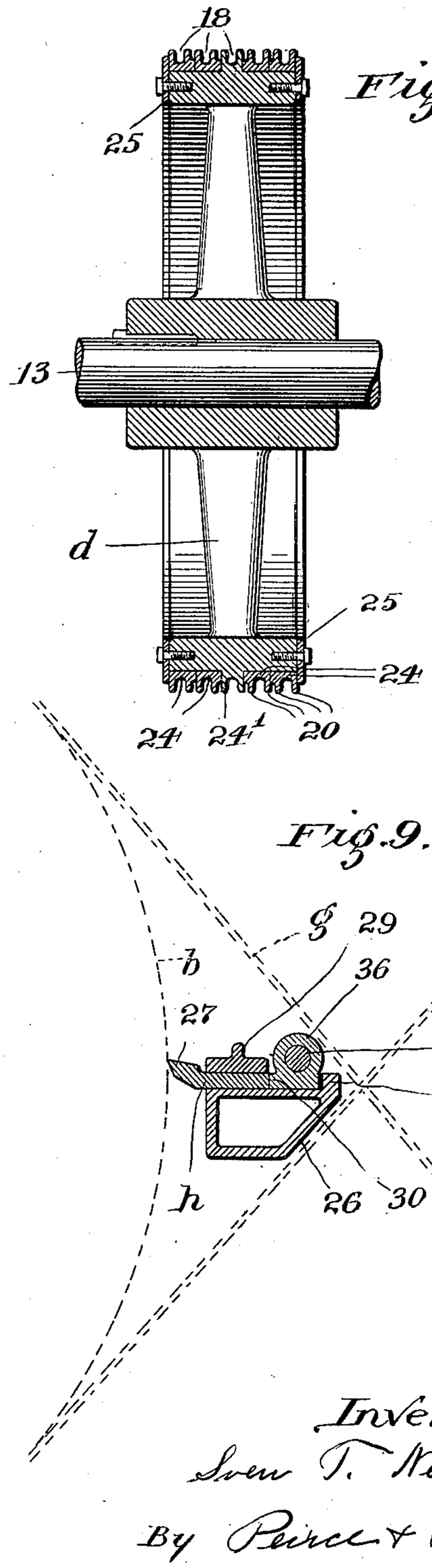

Fig. 9.

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4 SHEETS—SHEET 4.

Fig. 10.

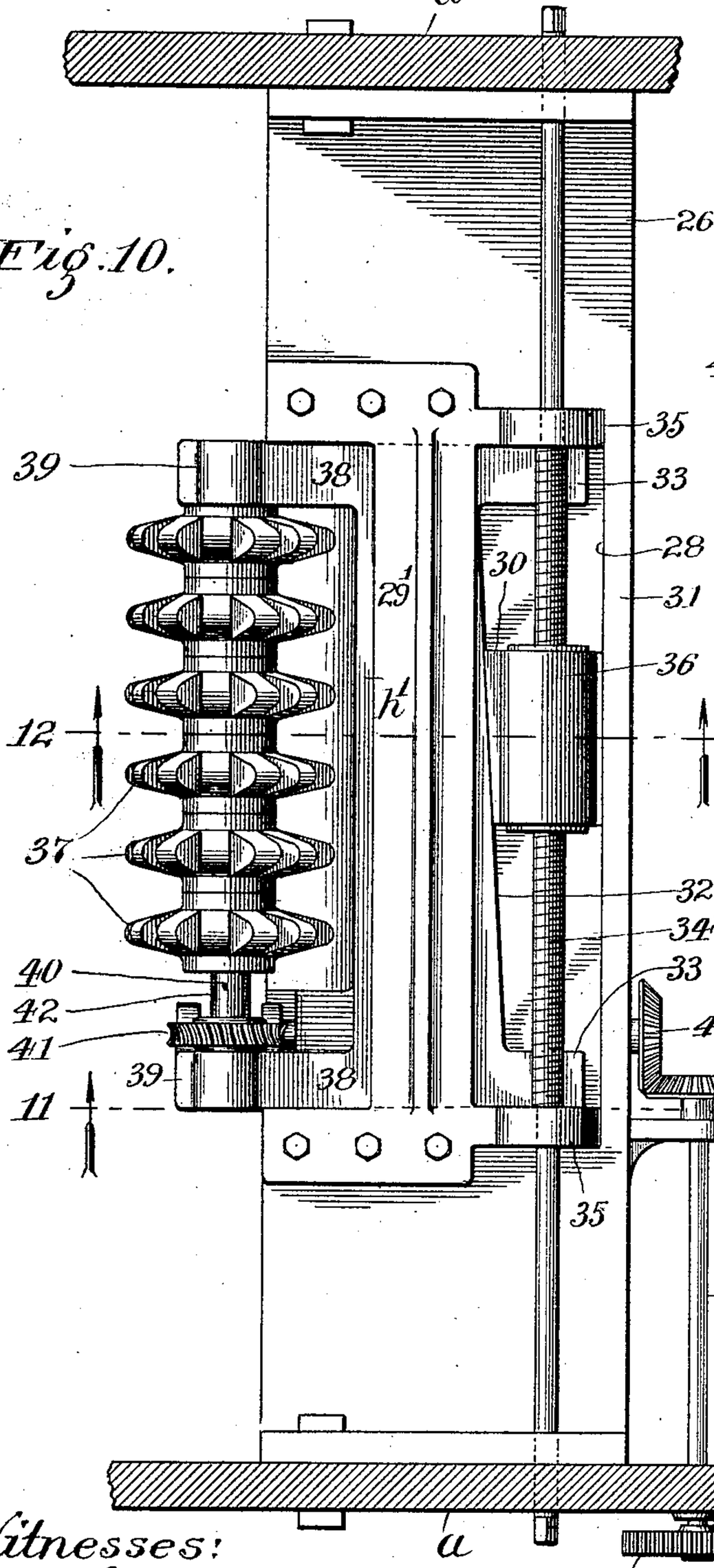


Fig. 11.

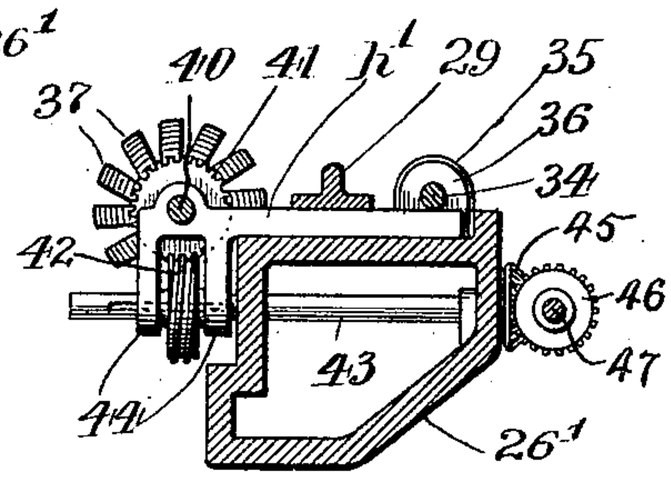
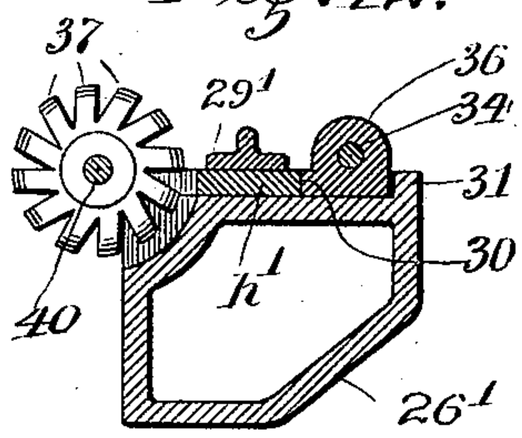


Fig. 12.



Witnesses:

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UNITED STATES PATENT OFFICE.

SVEN T. NELSON, OF CHICAGO, ILLINOIS, ASSIGNOR TO SULLIVAN MACHINERY COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION.

MINE-HOIST.

999,841. Specification of Letters Patent. **Patented Aug. 8, 1911.**

Application filed April 16, 1906. Serial No. 311,879.

To all whom it may concern:

Be it known that I, SVEN T. NELSON, a citizen of the United States, and a resident of Chicago, county of Cook, and State of Illinois, have invented certain new and useful Improvements in Mine-Hoists, of which the following is declared to be a full, clear, and exact description.

The invention relates to hoists for the cars, cages or "skips" employed in shafts of mines and seeks to provide an improved arrangement of the parts of the hoist, for operating two cars "in balance", *i. e.* so connected that when one car is raised the other is lowered.

The object of the invention is to provide an arrangement of parts in which the cable connected to the cars need only be wound a few times around the drum of the hoisting engine so that the size and weight of the hoisting drum and its driving engine may be considerably less than that usually employed. Moreover, with the present improved construction, the length of the cable necessary and the cost of the entire construction is considerably reduced.

A further object of the invention is to provide an idler drum in connection with the drum of the hoisting engine over which drums the cable is passed several times, and to further provide suitable means for compensating for the differential wear upon the grooves of the driving and idler drums.

With these objects in view the invention consists in the features of construction, combinations and arrangements of parts hereinafter set forth, illustrated in the accompanying drawings and more particularly pointed out in the appended claims.

Figure 1 is a view in side elevation showing the arrangement of parts of the improved hoist. Fig. 2 is a plan view thereof. Fig. 3 is a view in end elevation. Fig. 4 is a plan view of the hoisting engine and drums. Fig. 5 is a view in side elevation thereof. Fig. 6 is a view in elevation of the indicator mechanism. Fig. 7 is a detail view in section of the idler drum. Fig. 8 is a detail plan view of the tool member for truing up the grooves of the driving drum, the frame being shown in section and the drum in dotted lines. Fig. 9 is a detail view of the tool member with parts shown in section on line 9—9 of Fig. 8. Fig. 10 is a plan view of a modified form of tool. Fig. 11 is a cross section on a reduced scale on line 11—11 of Fig. 10 and Fig. 12 is a similar cross section on line 12—12 of Fig. 10.

In ordinary practice, when a single drum is employed in a mine hoist for operating two cars or cages "in balance" the drum is of such size that a cable equal in length to twice the depth of the mine can be wound thereon. In a double drum hoist, with the ordinary practice each drum is of such size to hold a length of cable equal to the depth of the mine. In either case, the length of the cable employed must be equal to twice the depth of the mine shaft. Where the mine shaft is of any considerable depth, this necessitates the use of drums of great size and weight and correspondingly increases the size and cost of the engines employed. In accordance with the present invention, the hoisting cable at all times is only wrapped a few times around the drum of the hoisting engine and around an idler drum, so that the size, weight and cost of the parts may be considerably reduced and so that the hoist may be operated at much less expense. Moreover, the length of the hoisting cable need only be slightly greater than the depth of the mine and can be renewed when worn out at less expense than with hoists such as are now usually employed.

The frame *a* of the hoisting engine is mounted upon a suitable foundation at the surface of the mine. The driving drum *b* is fixed upon the engine shaft 10 that is journaled in suitable bearings in the sides of the engine frame. As usual, two engines *c* are employed and are coupled by their connecting rods 11 to the cranks 12 on the opposite ends of the drum supporting crank shaft 10. An idler drum *d* is mounted upon a shaft 13 journaled in suitable bearings at the forward end of the engine frame *a*.

The cars, cages or "skips" *e* of any suitable construction, are arranged within the mine shaft *f* and are mounted to slide upon suitable guides or ways 14 fixed to the sides of the mine shaft and projecting from the upper end thereof. The upper portions of the frames of the two cars or cages are provided with yokes 15 to which the opposite ends of a single hoisting cable *g* are respectively connected. The cable *g* passes up from the mine shaft over a pair of grooved guide pulleys 16 mounted in any suitable manner above the upper end thereof. The

cable passes downwardly from the guide pulley 16 and is reeved several times over the driving and idler drums *b* and *d* in opposite directions, or in the so-called "figure-eight" fashion. The drums are provided with suitable guide grooves 17 and 18 for the cable, preferably formed between ribs 19 and 20 on the respective drums, and the cable is wrapped around the drums a sufficient number of times to develop the proper amount of friction between the cable and the driving drum. By reeving the cable in a figure-eight, it engages the driving drum throughout the greater portion of the periphery thereof so that sufficient friction may be developed between it and the driving drum with a fewer number of wraps than with any other method of winding the cable.

The guide pulleys 16 may be supported in any suitable manner above the mine shaft *f* and are preferably slightly inclined to each other or diverged outwardly, as shown in Fig. 2, so as to properly receive and guide the cable as it passes to and from the driving drum *b*. The cars or cages are also preferably connected by a second cable 21 (see Fig. 3) that is fixed at its opposite ends to the lower portions of the frames of the cars or cages and extends downwardly over a grooved guide pulley 22 mounted on the shaft 23 at the bottom of the mine shaft.

The engine is provided with any suitable sort of reverse gear so that it may be driven in opposite directions to alternately lift one of the cars or cages and lower the other. With this arrangement, it will be noted that the amount of hoisting cable necessary is only a little more than equals the depth of the mine, so that it may be easily replaced when worn out at comparatively small cost. Moreover, the driving drum and, in consequence, the operating engines therefor, may be of small size and weight and the cost of equipment and of operation thereby considerably reduced as compared with the usual practice. As the engine is driven in opposite directions, the cable first passes on to one of the outer grooves of the drums and such outer grooves will wear more and tend to become less in diameter than the central or intermediate grooves. In an ordinary construction, in which the cable is wound on the groove of the drum and remains there until it is unwound, this differential wear of the separate grooves is immaterial. But in the present construction, in which any section of the cable is wound first upon one of the outer grooves and passes through each of the other grooves until it finally leaves the drum, such a differential wear will place a very heavy strain upon the cable since, if the outer groove upon which the cable first passes is smaller in diameter than the others, it will not take up a sufficient length of cable to properly extend around the other grooves. In the present construction, means are provided for compensating for this differential strain upon the cable, and for this purpose the grooves 18 of the idler drum *d* are formed on separate, relatively movable sections thereof. Preferably, these grooves are formed in separate rings 24 (see Fig. 7) mounted upon the rim of the drum. The central ring 24′ is preferably fixed to or formed in piece with the pulley, while the others are held in place between the central ring and removable flanges 25 at the outer edges of the rim of the drum. Each grooved section or ring therefore of the idler drum *d* and the wraps of cable therein, are movable relatively to one another and will so move to relieve at once any strain put upon the cable because of the excessive wear of the outer grooves. Such an arrangement of loose, free movable rings would be impracticable for the driving drum, since if only one of the rings were fixed, the entire driving strain would have to be transmitted through a single wrap or coil of the cable. In order that the pull of the engine shall be properly transmitted to all of the coils or wraps of the cable thereon, the flanges 19 or other parts wherein the grooves 17 of the driving drum are located, are fixed to or formed in piece with the rim of the drum and a suitable tool member is provided for maintaining all of the grooves of the same diameter and for preventing any differential strain on the cable because of the excessive wear of the outer grooves.

The tool member *h* (shown in detail in Figs. 8 and 9) is mounted upon a cross bar or support 26 extending between the sides of the frame *a* and arranged between the driving drum *b* and the crossed portions of the cable *g*. The tool member *h* is in the form of a flat plate constructed of suitable tool steel and is provided with a series of cutting teeth 27 corresponding in shape to the grooves 17 of the drum. The tool member rests in a recess or guide way 28 formed in the upper surface of the cross bar 26 and is held securely in place by a brace bar 29 extending over and resting upon the upper surface of the tool member and bolted at its ends to the cross bar 26 on opposite sides of the recess or guide way 28. By this arrangement the tool member is securely held in a position parallel to the axis of the driving drum with the cutting teeth thereof in line with the grooves of the drum, and so that it may be fed in a direction at right angles to the axis of the drum to bring the cutting teeth into engagement with the grooves at a point just above the center of the drum, as shown in Fig. 9.

Suitable means for feeding the tool member comprises a wedge plate 30 arranged in

the recess or guide way 28 behind the tool member and in front of a ledge or shoulder 31. This wedge is provided with an inclined face engaging the correspondingly inclined face 32 upon the rear edge of the tool member between the side portions 33 thereof. A feed screw 34 mounted in suitable bearings 35 upon the transverse bar 26, is threaded through an upwardly extending lug or abutment 36 upon the wedge 30. The end of this shaft projects through the engine frame and is provided with square ends for receiving a crank handle or other suitable device, by which it may be turned to force the tool member against the drum. It is obvious that by means of such a tool the various grooves of the drum may be turned up from time to time and thus maintained at uniform diameter to avoid any differential strain upon the cable due to excessive wear of the outer grooves. When the tool member is used to true up the groove of the driving drum, the latter is preferably not rotated by the steam engines, but steam is shut off and the drum slowly rotated by loading one of the cages.

The modified form of tool is shown in Figs. 10 and 11, in which a series of rotary milling cutters 37 are employed. A slide *h'* similar in shape to the slide tool member *h* previously described, is mounted in a similar manner upon the cross bar 26' and beneath a brace bar 29'. This slide is provided with feeding mechanism similar to that previously described and is also provided with a pair of forwardly extending arms 38, the forward ends of which have suitable bearings 39 for a shaft 40 upon which the milling cutters 37 are mounted. These cutters are suitably shaped to engage the grooves of the driving drum and may be fed forwardly with the slide *h'* to properly engage the same. A worm wheel 41 is fixed to one end of the shaft 40 and is arranged to engage a worm 42 upon a shaft 43 that is journaled in the supporting cross bar 26' below the upper portion thereof. The worm 42 is arranged between a pair of lugs 44 fixed to and depending from the slide *h'*, and through which lugs the end of the shaft 43 extends. The worm 42 is keyed to rotate with the shaft 43 but is longitudinally shiftable thereon and moves with the slide *h'*. The opposite end of the shaft 43 is provided with a beveled gear 45 meshing with a gear 46 on the inner end of a shaft 47 that is journaled in a lug 48 on the cross bar 26' and in the side of the engine frame *a*. The outer end of the shaft 47 is provided with a gear 49 or with a pulley by which it may be driven from any suitable source of power.

An indicator dial 50 is carried upon an upright 51 that is mounted on one side of the engine frame. A pointer 52 is movable over the face of the dial for indicating the position of the cars or cages that are operated by the hoist with reference to the different levels in the mine shaft. This pointer is carried on a shaft 53, journaled on the upper end of the post 51 and is driven by a pair of beveled gears 54 from the upright shaft 55 that extends through the upright or post 51. A pair of beveled gears 56 connect the lower end of the shaft 55 with a short shaft 57 journaled in the side of the engine frame *a*. A worm wheel 58 on the outer end of the shaft 57 meshes with the worm 59 upon a longitudinally extending shaft 60 that is journaled in suitable bearings on the side of the engine frame. The opposite end of the shaft 60 is connected by a pair of beveled gears 61 with the shaft 13 of the idler pulley. The idler pulley is keyed to the shaft, and as above stated, the central ring 24' is fixed to or formed in piece with the same so that the pulley shaft 13 is rotated to properly move the pointer 52 over the indicator dial 50. Such indicator dials are usually driven from the hoisting drum but can be more accurately driven from the idler drum of the construction set forth, since the rings of the idler drum are freely and relatively rotatable and there is no tendency for the cable to slip thereon. Any slippage that may occur will be between the cable and the driving drum through which the pull on the cable is applied.

It is obvious that numerous changes may be made in the details of construction without departure from the essentials of the invention.

Having described my invention, what I claim as new and desire to secure by Letters Patent is:—

1. In a mine hoist for operating two cars or cages in balance, the combination with two cars or cages and a reversible hoisting engine therefor, of a grooved driving drum mounted on the engine shaft, a coöperating grooved idler drum journaled on the engine frame, and a hoisting cable connected at its opposite ends to said cars or cages and reeved several times in opposite directions about said driving and idler drums, the grooves of said driving drum being formed in portions fixed thereto and the grooves of said idler drum being formed in separate relatively movable sections thereof and the central one of said sections being fixed to the shaft of the idler drum, substantially as described.

2. In a mine hoist for operating two cars or cages in balance, the combination with two cars or cages and a reversible hoisting engine therefor, of a grooved driving drum mounted on the engine shaft, a coöperating, grooved idler drum journaled on the engine frame, and a hoisting cable connected at its opposite ends to said cars or cages and reeved several times in opposite directions

about said driving and idler drums, the grooves of said idler drum being formed in separate, relatively movable rings mounted on its rim, the central one of said rings being fixed to said drum, substantially as described.

3. In a mine hoist for operating two cars or cages in balance, the combination with two cars or cages and a reversible hoisting engine therefor, of a grooved driving drum mounted on the engine shaft, a coöperating, grooved idler drum journaled in the engine frame, and a hoisting cable connected at its opposite ends to said cars or cages and reeved several times in opposite directions about said driving and idler drums, said idler drum having flanges removably secured to the opposite edges of its rim, a fixed central grooved ring formed in piece with its rim and a series of separate grooved rings mounted on its rims between said central ring and said flanges, substantially as described.

4. In a mine hoist for operating two cars or cages, the combination with a grooved driving drum, of a coöperating, grooved idler drum, a cable connected to said cars or cages and reeved several times about said driving and idler drums, the grooves of said idler drum being formed in separate, relatively movable sections, and a car indicator driven from one of said idler drum sections, substantially as described.

5. In a mine hoist for operating two cars or cages, the combination with a grooved driving drum, of a coöperating, grooved idler drum, a cable connected to said cars or cages and reeved several times about said driving and idler drums, the grooves of said idler drum being formed in separate relatively movable sections thereof, one of which sections is fixed to the shaft of said idler drum, and a car indicator driven from the shaft of the idler drum, substantially as described.

6. In a mine hoist for operating two cars or cages, the combination with two cars or cages and a reversible hoisting engine therefor, of a grooved driving drum mounted on the engine shaft, a coöperating grooved idler drum journaled on the engine frame, a hoisting cable connected to said cars or cages and reeved several times about said driving and idler drums, the grooves of said idler drum being formed in separate relatively movable rings mounted on the rim, the central ring being fixed to said drum, and a car indicator driven from the shaft of said drum, substantially as described.

7. In a hoist, the combination with a suitable frame, of a driving drum journaled on said frame, a coöperating idler drum, a cable reeved several times around said drums, said driving drum having guide grooves formed in a rim portion fixed thereto, and a tool member mounted on said frame and having a series of suitably shaped cutters for engaging the grooves of said driving drum and maintaining them of uniform diameter, substantially as described.

8. In a hoist, the combination with a suitable frame, of a driving drum journaled on said frame, a coöperating idler drum, a cable reeved several times around said drums, each of said drums having guide grooves for said cable, the guide grooves of said idler drum being formed in separate, relatively movable sections and the guide grooves of said driving drum being formed in a rim portion fixed thereto, and a tool member mounted on said frame and having a series of suitably shaped cutters for engaging the grooves of said driving drum and maintaining them of uniform diameter, substantially as described.

9. In a hoist, the combination with a suitable frame, of a driving drum journaled on said frame, a coöperating idler drum, a cable reeved several times around said drums, each of said drums having guide grooves for said cable, and a tool member mounted on said frame parallel to the axis of said driving drum and guided to shift at right angles thereto, said tool member having a series of suitably shaped cutters for engaging the grooves of said driving drum, and means for feeding said tool member toward said drum, substantially as described.

10. In a mine hoist for operating two cars or cages, the combination with two cars or cages and a hoisting engine therefor, of coöperating, grooved driving and idler drums mounted on the engine frame, said driving drum being connected to the engine shaft, a hoisting cable connected to said cars or cages and reeved several times about said drums, the grooves of said idler drum being formed in separate, relatively rotatable sections and the grooves of said driving drum being formed in a rim portion fixed thereto, and a tool member mounted on the engine frame and having a series of suitably shaped cutters for engaging the grooves of said driving drum and maintaining them of uniform diameter, substantially as described.

11. In a mine hoist for operating two cars or cages in balance, the combination with the cars or cages and a hoisting engine therefor, of a grooved driving drum mounted on the engine shaft, a coöperating. grooved idler drum journaled on the engine frame, a hoisting cable connected at its opposite ends to said cars or cages and reeved several times in opposite directions about said driving and idler drums, the grooves of said idler drum being formed in separate, relatively movable sections thereof and the grooves of said driving drum being

formed in a rim portion fixed thereto, a transverse support fixed to the engine frame between said driving drum and the crossed portions of said cable, and a tool member adjustably mounted on said support and having a series of suitably shaped cutters for engaging the grooves of said driving drum and maintaining them of uniform diameter, substantially as described.

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