No. 812,324. PATENTED FEB. 13, 1906.

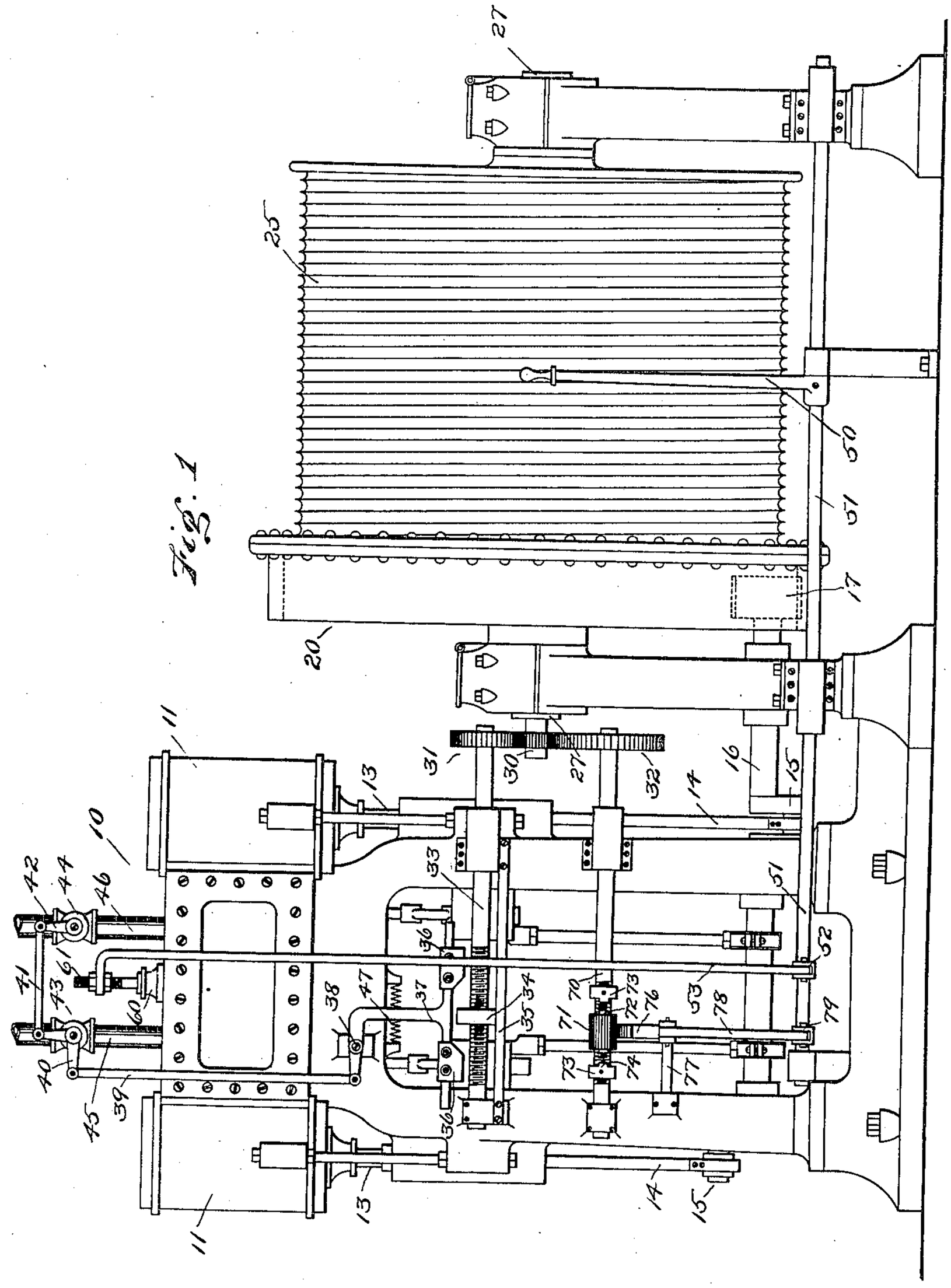
G. W. BOLLMAN.

STEAM HOISTING APPARATUS.

APPLICATION FILED OCT. 29, 1904.

4 SHEETS—SHEET 1.

Fig. 1.



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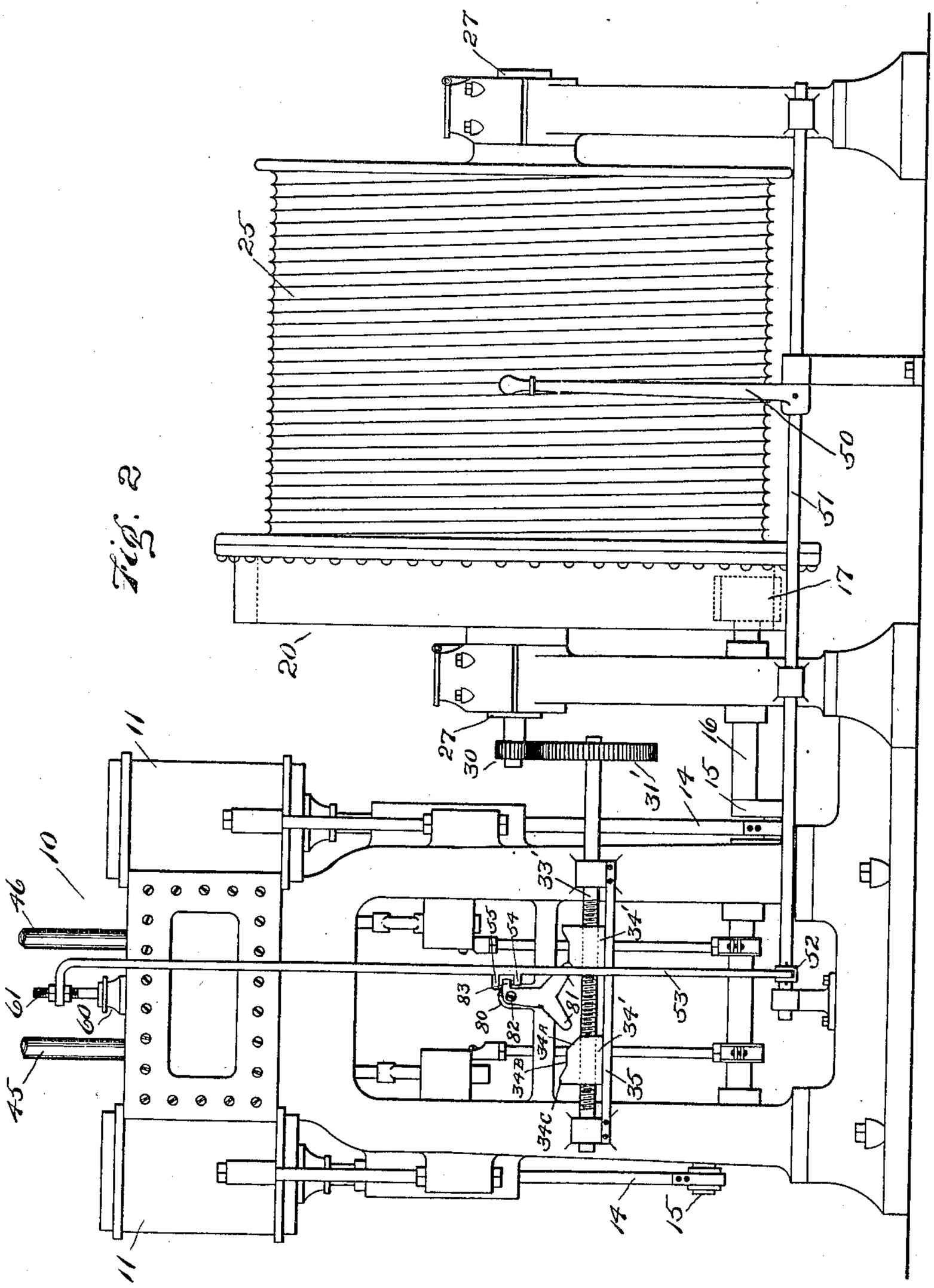
4 SHEETS—SHEET 2.

Fig. 2



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4 SHEETS—SHEET 3.

Fig. 3

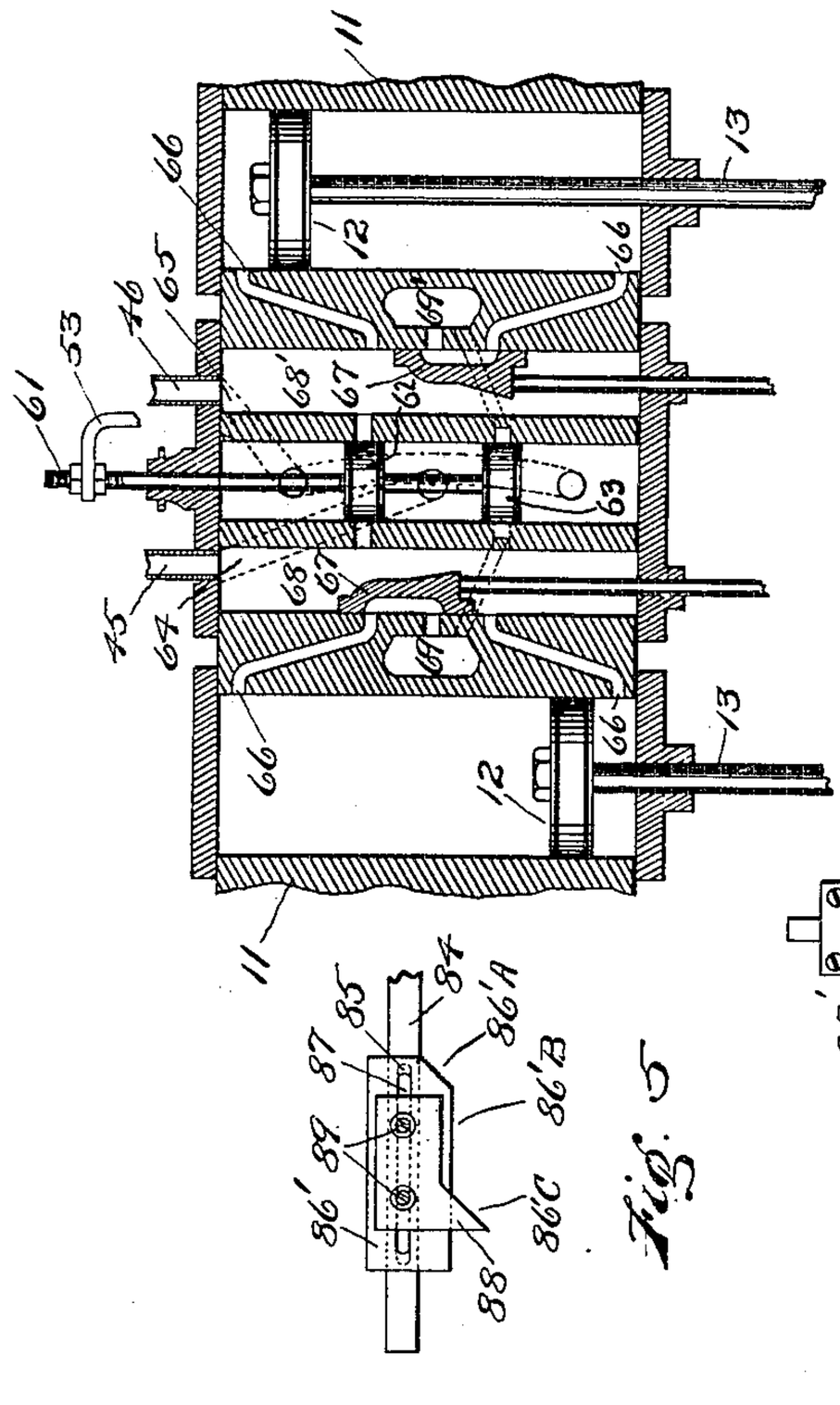

Fig. 5

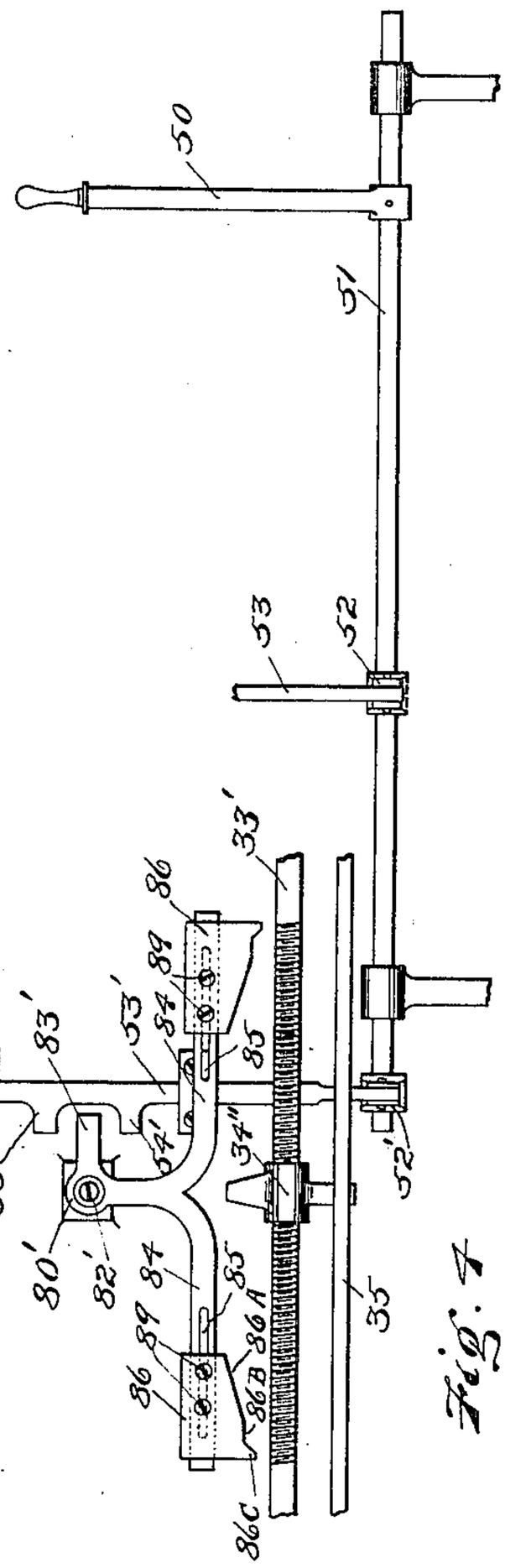

Fig. 4

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4 SHEETS—SHEET 4.

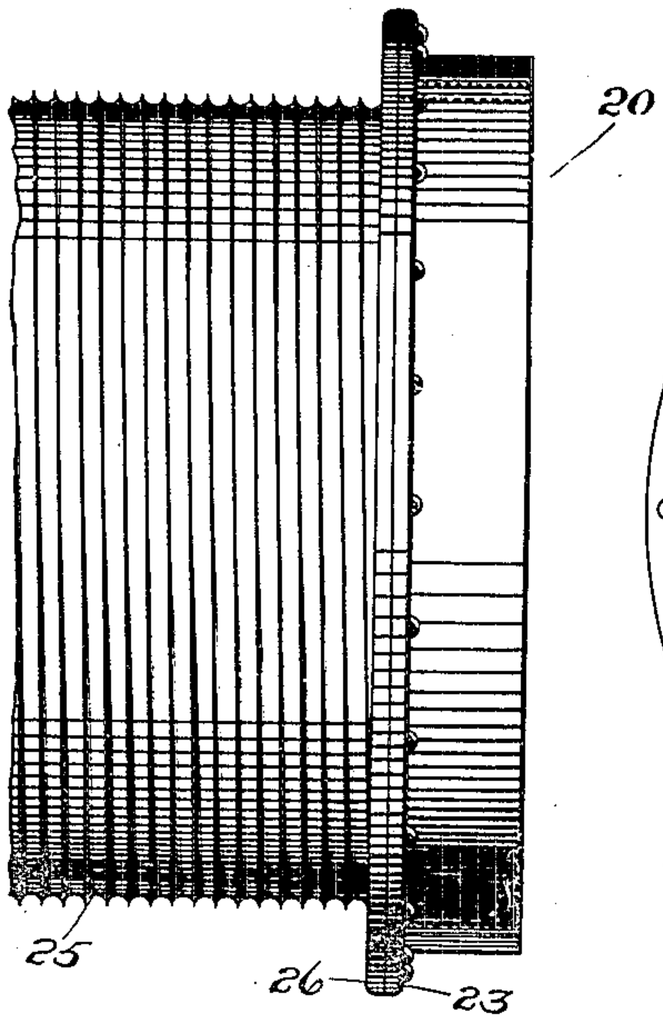

Fig. 8

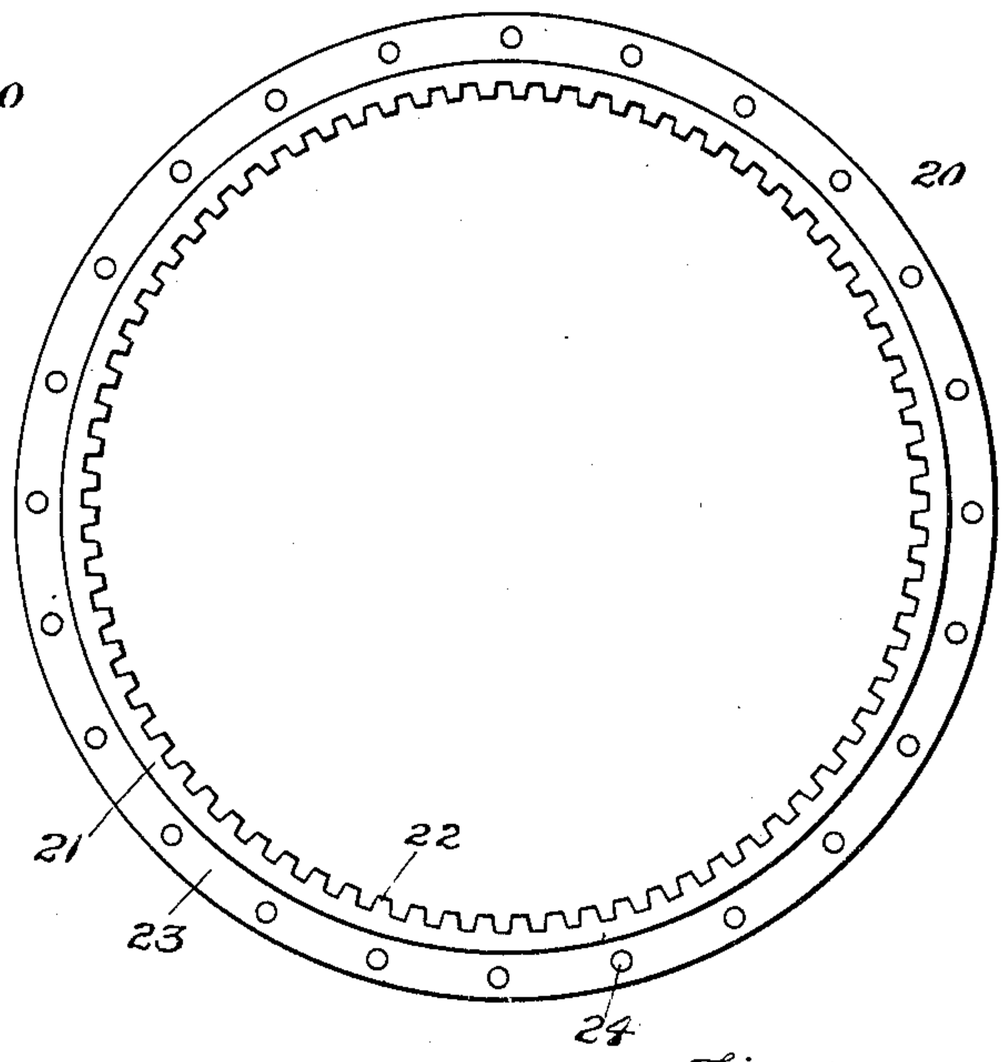

Fig. 9

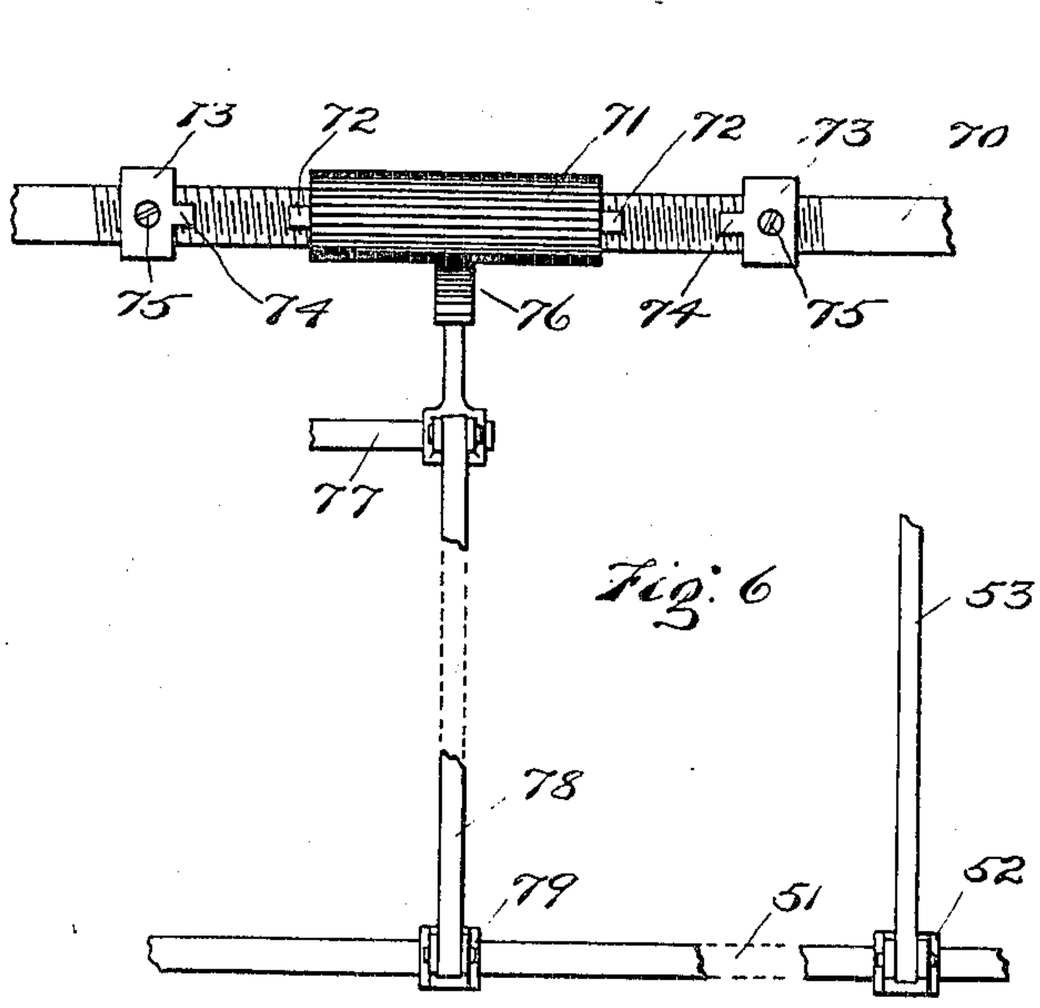

Fig. 6

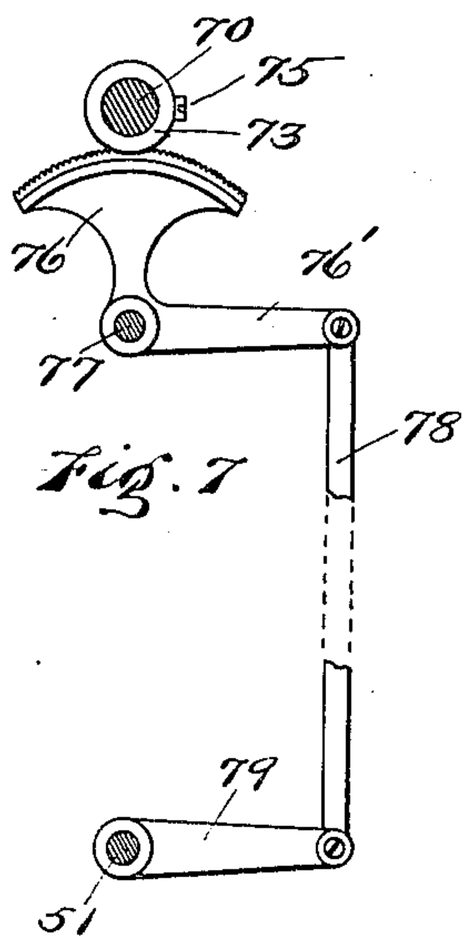

Fig. 7

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UNITED STATES PATENT OFFICE.

GEORGE W. BOLLMAN, OF PITTSBURG, PENNSYLVANIA, ASSIGNOR TO OTIS ELEVATOR COMPANY, OF JERSEY CITY, NEW JERSEY, A CORPORATION OF NEW JERSEY.

STEAM HOISTING APPARATUS.

No. 812,324. Specification of Letters Patent. Patented Feb. 13, 1906.

Application filed October 29, 1904. Serial No. 230,469.

To all whom it may concern:

Be it known that I, GEORGE W. BOLLMAN, a citizen of the United States, and a resident of Pittsburg, Allegheny county, Pennsylvania, have invented certain Improvements in Steam Hoisting Apparatus, of which the following is a specification.

My invention relates to steam hoisting apparatus, and has for its object to increase the efficiency and safety of operation of such apparatus and to improve its construction. I will describe a hoist made according to my invention and point out the novel features thereof in claims.

Referring now to the drawings, Figure 1 shows in side elevation a steam hoisting machine which embodies my invention. Fig. 2 is a side elevation of a similar machine with another form of my invention embodied in it. Fig. 3 is a sectional view of steam cylinders, valves, and some of their connected parts, showing them diagrammatically to illustrate the operation of my invention. Fig. 4 shows certain parts of the mechanism in detail. Fig. 5 is another detail showing a modification of one of the parts shown in Fig. 4. Figs. 6 and 7 are respectively side and end elevations of details of certain parts. Figs. 8 and 9 are side and end elevations of an improved construction of gear. In Fig. 8 a part of the winding-drum is also shown.

Like reference characters designate corresponding parts in all of the figures.

10 designates a steam-engine of a type commonly employed for elevators and other hoisting apparatus. 11 11 are its cylinders, in which the pistons 12 12 work. These pistons are connected to the cranks 15 on a shaft 16 by means of piston-rods 13 and connecting-rods 14. On the other end of shaft 16 is attached a pinion 17, which meshes with a gear 20. This gear is made in a special manner, which I will now describe. It comprises a ring 21, on the inner surface of which the teeth 22 are formed, and a flange 23. The flange 23 is provided with holes 24. The drum 25 of the hoisting-machine is also provided with a flange 26 of the same diameter as the flange 23. The two flanges are turned off, so that they fit each other, and then the ring 20 is attached to the drum 25 by means of bolts or rivets through the holes 24. By making the gear on a separate ring as just described it may be made of better metal than the ordinary cast gears, and the teeth may be cut through by an ordinary machine-tool. The bolts being on the outside of the ring if broken cannot fall into the teeth.

The rest of the hoisting mechanism is of ordinary construction and need not be described in this specification.

The drum 25 is supported on a shaft 27, on one end of which is attached a pinion 30, which meshes with gears 31 and 32 in the arrangement shown in Fig. 1 or with a gear 31′ in the modification shown in Fig. 2. The gears 31 or 31′ are securely attached to threaded shafts 33 or 33′. A nut 34 is on the shaft 33, and a guide 35 is provided to keep this nut from rotating when the shaft 33 is revolved. In Fig. 2 two of these nuts are shown on the threaded shaft and are designated as 34′. It will be seen that the threaded shaft will rotate in one direction or the other whenever the hoisting-drum is rotated in one direction or the other. Consequently the nut on the threaded shaft will travel from side to side as the hoisting-drum rotates and as the car or hoist is connected to the drum in the usual manner, and as the drum is connected to the traveling nut by the gearing just described the travel of the nut will be proportional to the travel of the car.

So far the various modifications illustrated are similar. I will now describe the rest of the apparatus shown in Fig. 1. In this case when the nut 34 reaches the desired points of its travel it will strike against adjustable cams 36 on a tilting arm 37, which is pivoted to a stationary support at 38. The tilting arm 37 is connected to a bell-crank lever 40 by a connecting-rod 39. The bell-crank lever is connected to another lever 42 by another connecting-rod 41. 45 designates the steam or inlet pipe to the engine 10. 46 designates the exhaust or outlet pipe from the engine 10. 43 is a valve in the steam-pipe 45, and 44 is a valve in the exhaust-pipe 46. These valves are open when the upright arms of the bell-crank lever 40 and the lever 42 are in vertical position. When these arms are moved to one side or the other by means of the traveling nut 34 and the cams 36, these valves will both be partly closed. The cams 36 are so shaped that the valves 43 44 are not fully closed, but are only closed partially to a

certain desired extent. Centering-springs 47 are provided to bring the tilting arm 37 and its connected parts back to central position and to open the valves 43 and 44 as soon as the traveling nut 34 has moved away from either of the cams.

50 designates an operating-lever. It is securely attached to a shaft 51. At another point on the shaft 51 a lever 52 is attached, and this lever is connected to the stem 61 of the change or reversing valve 60 by a connecting-rod 53. The shaft 51 may be moved from a distance by means of ropes or other connections—as, for example, when the hoisting mechanism is used to run an elevator and it is desired to control the machine from the car. The change-valve 60 is for the purpose of starting, stopping, and reversing the engine. This valve is shown more in detail in Fig. 3. It comprises two pistons 62 and 63, which are connected to the stem 61, so that they may be moved by hand through the train of mechanism above described. The steam-pipe 45 leads the steam to the space between the pistons 62 and 63 through the passage 64. The exhaust-pipe connects with the space outside of the pistons by means of the passage 65. The steam-cylinders 11 11 have passages 66 leading from either end, which are controlled by slide-valves 67 of ordinary construction and which are operated from eccentrics on the crank-shaft in the well-known manner. The chambers 68 69 and 68′ 69′ are for either steam or exhaust. When the pistons 62 and 63 of the change-valve are moved up, they uncover ports which make 68 and 68′ steam-chambers by connecting them with the steam-pipe 45 and make 69 and 69′ exhaust-chambers by connecting them with the exhaust-pipe 46. When the pistons 62 and 63 are moved down, the chambers 68 and 68′ are connected with the exhaust-pipe 46 and the chambers 69 and 69′ are connected with the steam-pipe 45. Therefore when the operator raises the valve-stem 61, to which the pistons 62 and 63 are attached, he causes the engine to start in one direction, and when he lowers the valve-stem 61 he causes the engine to start in the opposite direction. He may start the engine slowly or quickly by raising the valve-stem slightly until its pistons but partially open the ports to the chambers 68, 69, 68′, and 69′ or by raising the valve-stem a greater distance until the ports are fully opened. When the operator desires to stop the engine, he may do so by moving the pistons 62 and 63 back to their central position, when they close the ports leading from the steam and the exhaust to the chambers 68, 69, 68′, and 69′. He can slow down the machine by partly closing these ports, which will partly shut off both the supply and the exhaust. I have described how this change-valve may be moved by hand. I will now describe an arrangement whereby it may be moved automatically by the movement of the machine itself. I have already shown that a pinion 30 on the end of the drum-shaft 27 meshes with a gear 32 and rotates the latter whenever the hoisting-drum rotates. The gear 32 is attached to a threaded shaft 70, similar to the shaft 33. A traveling nut 71 is placed on the shaft 70 and arranged to move back and forth on the shaft when the latter is rotated in one direction or the other. These parts are shown more clearly in Figs. 6 and 7. The outer surface of this traveling nut has teeth cut in it longitudinally, so that it forms an elongated pinion. Lugs 72 72 project from its ends, and these are adapted to engage with similar projecting lugs 74 on adjustable collars 73. These collars are secured to the shaft 70 at desired points by means of set-screws 75. A gear-segment 76 on a shaft 77 is in mesh with the traveling nut or pinion 71. This gear-segment 76 has an extension-arm 76′, which is connected by a rod 78 to an arm 79, which is securely attached to the shaft 51. The friction on these various parts is sufficient to keep the traveling nut or pinion from rotating with the threaded shaft 70 under ordinary conditions, so that it will move back and forth on the shaft, and its teeth will slide through the teeth of the gear-segment. When, however, it has moved along on the threaded shaft until one of its projecting lugs 72 engages with a corresponding projecting lug 74 on one of the adjustable collars 73, the lug 74, which always moves with the threaded shaft 70, will push the traveling nut or pinion 71 around with itself. The traveling nut or pinion, which is in mesh with the gear-segment 76, will cause the latter to move, and the gear-segment, through its connection with the shaft 51, will move the shaft 51. It has been shown that the shaft 51 has been moved in one direction to open the change-valve and to start the engine. It is so arranged that the action of the parts just described will move the shaft 51 back until it causes the change-valve 60 to be closed, when the engine will stop, and consequently the movement of the threaded shaft 70 will stop and the whole mechanism come to rest. The adjustable collars 73 may be set at any desired point on the threaded shaft 70, which point corresponds to some definite point along the travel of the hoist or car, so that this automatic action may be brought into play to stop the hoist or car at any desired point.

I will now describe the operation of my invention as illustrated in that part of the mechanism which has already been described. When it is desired to start the hoisting mechanism in one direction or the other, the operator does so by rotating the shaft 51 to the right or left. He may also stop the apparatus at will by moving the shaft 51 and its con-

nected parts back to their original position. These operations he may make quickly or slowly, so that the machine is entirely within his control. Now if he starts the apparatus in one direction and then leaves it the engine will continue to rotate the hoisting-drum at practically the same speed at which the operator had started it until the traveling nut 34 on the threaded shaft 33 comes into contact with one of the adjustable cams 36. It will then move the tilting arm 37 and its connected parts and through them partially close the valves in both the supply and exhaust pipes 45 and 46. This slows down the engine, but allows it to continue to run at reduced speed. The fact that the exhaust, as well as the supply, is partially closed causes the engine to run under more complete restraint at its reduced speed than it would if only the supply were throttled. The cams 36 are of such shape that they allow the engine to continue to run and the traveling nut to continue to move without further affecting the valves 43 and 44 in the supply and exhaust pipes. The adjustable collars 73 are so set on the threaded shaft 70 that their projecting lugs 74 engage the lugs 72 on the traveling nut or pinion 71 only after the above operation has taken place. When the lugs 74 and 72 do engage, however, the motion of the drum-shaft 27 will be transmitted to the shaft 51 and will cause the latter to be brought back to its original position, which in turn will cause the change-valve 60 to be brought back to its central or stop position and to stop the engine. Thus it may be seen that by means of the various parts which have been fully described I have provided an effective adjustable device for automatically slowing down a steam hoisting apparatus by partially closing both the supply and exhaust ports for the engine, and another independent device which is independently adjustable for automatically stopping the apparatus by closing or shutting off both the supply and exhaust ports of the engine. After these automatic actions have taken place the operator can start the engine only in the opposite direction of rotation. It will have an easy gradual start until the valves 43 and 44 have been opened by the centering-springs 47 when the traveling nut 34 has moved away from the cam 36.

I will now describe the modification which is illustrated in Fig. 2. In this case I use but one threaded shaft 33′, driven from the drum-shaft 27 by means of a pinion 30 and gear 31′. On this threaded shaft 33′ are two traveling nuts 34′ 34′, the upper surfaces of which are cam-shaped, as shown. On one of these traveling nuts I have designated the three parts of its cam-face as 34^A, 34^B, and 34^C in order to later explain its operation more fully. These traveling nuts are prevented from turning by a guide 35, as in the arrangement which has already been described. They therefore move from side to side along the threaded shaft 33′ when the latter is rotated in one direction or the other. The cam-faces of the traveling nuts 34′ 34′ are arranged to engage with the projecting points 81 of a peculiarly-shaped bell-crank lever 80, which is pivoted at 82 and the other arm 83 of which extends into the space between two stationary lugs 54 and 55, which in this case are provided on the connecting-rod 53. The connecting-rod 53 is otherwise arranged, as before described.

The modifications just described operates in the following manner: The operator may start, stop, or reverse the engine and the hoisting apparatus by manipulating the change-valve 60 by means of the shaft 51 and its various connections. When he has moved the stem 61 of the change-valve up or down, the projecting lug 54 or the projecting lug 55 on the connecting-rod 53 will be moved to the projecting arm 83 of the bell-crank lever 80. Now when one of the traveling nuts 34′ 34′ is moved along until its cam-face 34^A strikes one of the projecting points 81 it will move the bell-crank lever and the connecting-rod 53 partly back toward its central position. This will partly close the steam and exhaust ports of the change-valve (see Fig. 3) and cause the engine to slow down. It will continue to run at this slow speed as long as the projecting point 81 runs along the horizontal portion 34^B of the cam-face of the traveling nut 34′; but as soon as it strikes the raised portion 34^C it will be pushed up a little more and through its connected parts will bring the valve-stem 61 back to its central position, when the pistons 62 and 63 will fully close the steam and exhaust ports and stop the engine, and consequently the whole hoisting apparatus. The traveling nuts 34′ 34′ may be placed at any desired point on the threaded shaft 33′, so that this automatic slowing down and stopping of the engine may be made to occur at the desired part of the car travel. The space between the lugs 54 and 55 on the connecting-rod 53 provides sufficient lost motion, so that after this automatic action has taken place the operator is free to start the apparatus in the opposite direction from that in which it has been running by moving the change-valve the other way.

In Fig. 4 I have shown another construction and arrangement of parts. In this case there is but one traveling nut 34″ on the threaded shaft 33′. The bell-crank lever 80′, with its projecting arm 83′, is pivoted at 82′ in a manner similar to that before described in connection with Fig. 2. In this case, however, its lower arms, which are numbered 84, are carried out over the threaded shaft and are arranged to carry cams 86 86. Slots 85 are provided in the arms 84, so that these

cams may be adjustably secured to the arms. On one of these cams I have designated the three parts of its face as 86^A, 86^B, and 86^C, which correspond to the three parts 34^A, 34^B and 34^C of the cam-face of the traveling nut 34′. In operation this arrangement is similar to the one described in connection with Fig. 2. The traveling nut 34″ comes in contact with one of the cams 86 86, and thereby causes the projecting arm 83′ to move up or down, as the case may be. This arm may engage with lugs 54 and 55 on the connecting-rod 53 and the operation be the same as that previously described, or it may engage with lugs 54′ and 55′ on an auxiliary sliding rod 53′, such as is shown in Fig. 4. In this case the sliding rod 53′ is connected to the operating-shaft 51 by a lever 52′, so that its motion is transmitted to the connecting-rod 53 and to the stem 61 of the change-valve and its operation will be the same as if the projecting arm 83′ engaged directly with lugs on the connecting-rod 53. The cam-faces 86^A, 86^B, and 86^C are arranged to first slow down the engine by partially closing both the supply and exhaust ports, allowing it to run at slow speed and then stopping it by closing the supply and exhaust ports in the same way as before described.

It is sometimes desirable to independently adjust the slowing down and the stopping of the apparatus or, in other words, to be able to vary the interval during which the engine runs at its reduced speed. In Fig. 5 I have shown a simple way of doing this. In this case the cam which is adjustably attached to the arm 84 is made in two pieces 86′ and 88. 86′ has the surfaces $86'^A$ and $86'^B$, corresponding to the surfaces 86^A and 86^B. It is also provided with a slot 87. A separate piece 88 has the cam-surface $86'^C$. These two pieces 86′ and 88 may be attached to the arm 84 by means of screws or bolts 89, and it is obvious that they may be adjusted both as to their position on the arm 84 and as to their own relative position and that consequently the time between the slowing down and the stopping of the engine by the automatic devices may be varied at will.

Many other modifications of the constructions hereinbefore described, and shown in the accompanying drawings, may be made without departing from the spirit of the invention and will readily occur to the skilled mechanic without a definite statement thereof herein. The plan or system of this invention enables a steam hoisting apparatus to be controlled with a great degree of nicety, so that great speeds can be attained with safety under any conditions of load and for varying conditions of load or speed a hoist or car can be gradually and accurately stopped at the ends of its run, whereby the safety and efficiency of the apparatus is largely increased.

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

1. In a hoisting apparatus the combination with an engine having supply and exhaust ports, of automatic means for partially closing both supply and exhaust ports.

2. In a hoisting apparatus the combination with an engine having supply and exhaust ports, of adjustable means for partially and automatically closing both supply and exhaust ports.

3. In a hoisting apparatus the combination with an engine having supply and exhaust ports, of automatic means for partially closing both supply and exhaust ports and then fully closing said ports.

4. In a hoisting apparatus the combination with an engine having supply and exhaust ports, of adjustable means for automatically partially closing both supply and exhaust ports and then fully closing said ports.

5. In a hoisting apparatus, the combination with an engine having supply and exhaust ports, of means for partially closing both supply and exhaust ports, and independent means for thereafter fully closing said ports.

6. In a hoisting apparatus, the combination with an engine having supply and exhaust ports, of adjustable means for partially closing both supply and exhaust ports, and independent means for thereafter fully closing said ports.

7. In a hoisting apparatus, the combination with an engine having supply and exhaust ports, of adjustable means for partially and automatically closing both supply and exhaust ports, and independent automatic means for then fully closing said ports.

8. In combination with hoisting apparatus, of a threaded shaft connected thereto, a traveling pinion on said threaded shaft, limit-stops for said pinion, a gear in mesh with said pinion, and means connected to said gear and operated thereby for slowing down or stopping the hoisting apparatus.

9. In a hoisting apparatus the combination with an engine having supply and exhaust ports, of adjustable means for partially closing both supply and exhaust ports automatically after the engine has made a desired number of revolutions, and independently-adjustable means for fully closing the ports and stopping the engine after the partial closing of said ports.

10. In a hoisting apparatus the combination with an engine having supply and exhaust ports, of an automatic device operated by some moving part of the machine for first partially closing both supply and exhaust ports and then fully closing the ports.

11. In a hoisting apparatus the combination with an engine having supply and exhaust ports, a winding-drum driven by such

engine, adjustable means actuated by the movement of the winding-drum for partially closing both supply and exhaust ports automatically after the winding-drum has made a desired movement and independently-adjustable means also driven by the movement of the winding-drum for stopping the engine after such partial closing of said ports.

12. In combination with hoisting apparatus, of a screw-threaded shaft connected to rotate in harmony therewith, a traveling pinion on said shaft and moved along the same longitudinally, limit-stops for changing the longitudinal movement of said pinion to a rotative motion, a gear continually in mesh with said pinion, and means connected with said gear to be operated thereby to slow down or stop the hoisting apparatus upon rotation of said pinion.

13. In hoisting apparatus, the combination with a hoisting-drum, a threaded shaft geared to move with the hoisting-drum, a traveling nut having gear-teeth on its exterior surface, limit-stops for said nut, a segmental gear in mesh with said nut, and means connected with said segmental gear for slowing down or stopping the hoisting-drum when the nut engages a limit-stop.

14. In combination with hoisting apparatus, of controlling means therefor, a threaded shaft, a traveler on said shaft, a lever connected to the controlling means, and a cam on said lever in the path of said nut.

15. In combination with hoisting apparatus, of controlling means therefor, a threaded shaft connected to rotate in harmony with the movement of the hoisting apparatus, a traveling nut on said threaded shaft, means for restricting said nut to a longitudinal movement, a lever connected to said controlling means, and cams at predetermined points in the path of travel of said nut to effect the operation of said controlling apparatus at corresponding positions of the hoisting apparatus.

16. In combination with hoisting apparatus, of controlling means therefor, a threaded shaft connected to said hoisting apparatus, a longitudinally-traveling nut on said shaft, a pivoted lever, cams on two of the arms of said lever and in the path of travel of said nut to be engaged by said nut at the limits of movement of said hoisting apparatus, and means coacting with a third arm of said lever for operating said controlling apparatus to slow down or stop said hoisting apparatus.

17. In combination with hoisting apparatus, of means for controlling same, a threaded shaft rotatively connected to said hoisting apparatus, nuts having cam-faces and carried by said shaft to be moved longitudinally, a pivoted lever having arms in the path of travel of said nuts to be engaged by said cam-faces at predetermined times, and means coacting with said lever for operating said controlling means for slowing down or stopping said hoisting apparatus when a cam engages said lever.

In witness whereof I have signed my name in the presence of two subscribing witnesses.

GEORGE W. BOLLMAN.

Witnesses:
ERNEST W. MARSHALL,
HENRY E. KIRBY.