H. SAWYER.

HOISTING APPARATUS.

APPLICATION FILED JULY 12, 1916.

1,395,735.

Patented Nov. 1, 1921.

6 SHEETS—SHEET 1.

Fig. 1

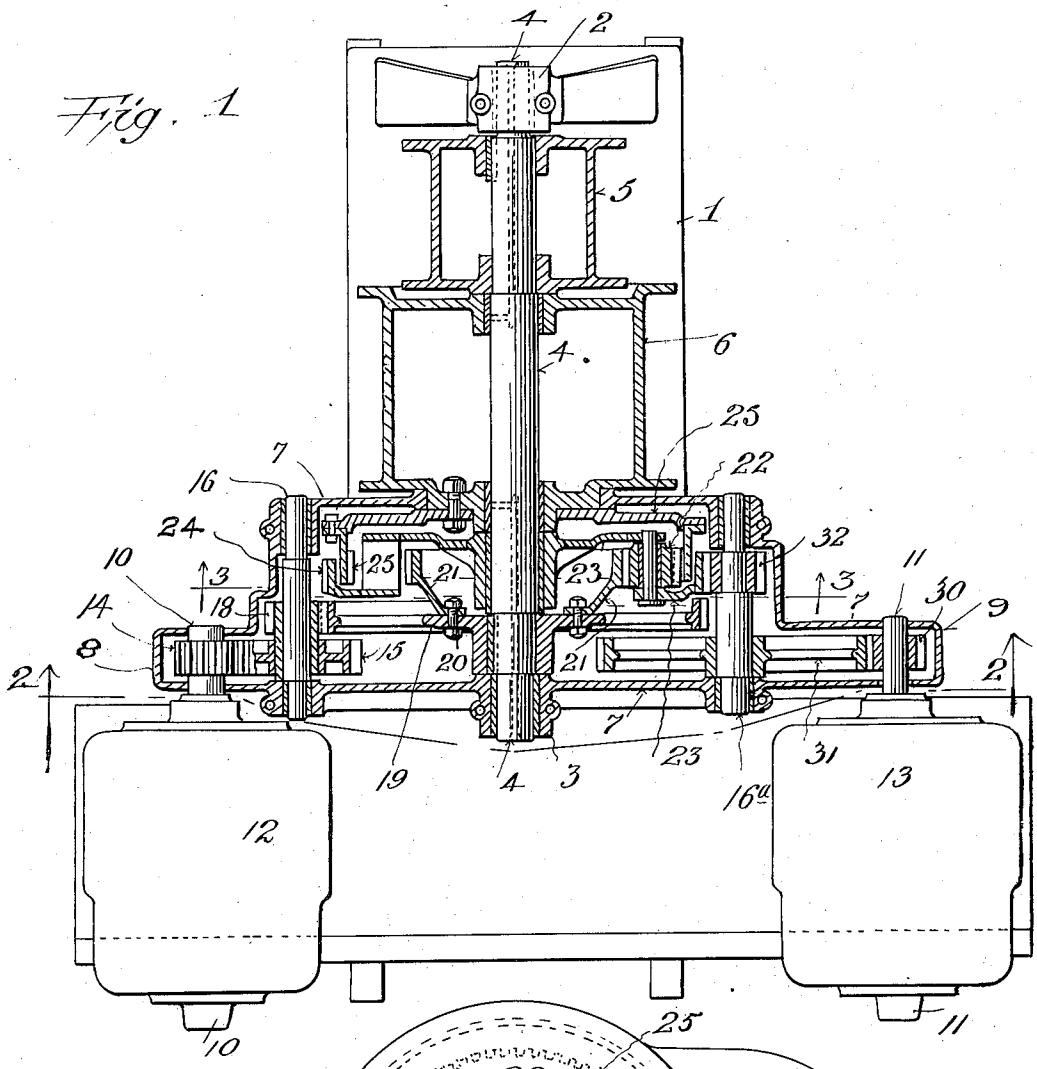
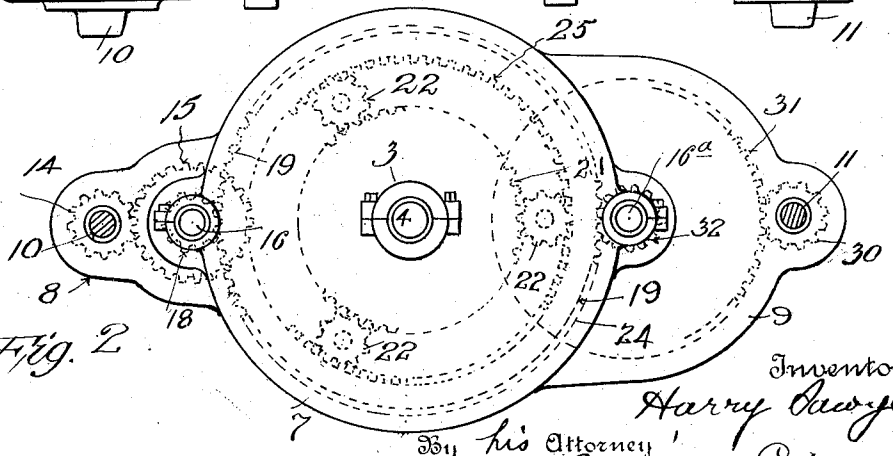


Fig. 2



Inventor

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By his Attorney

Samuel E. Darby

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6 SHEETS—SHEET 2.

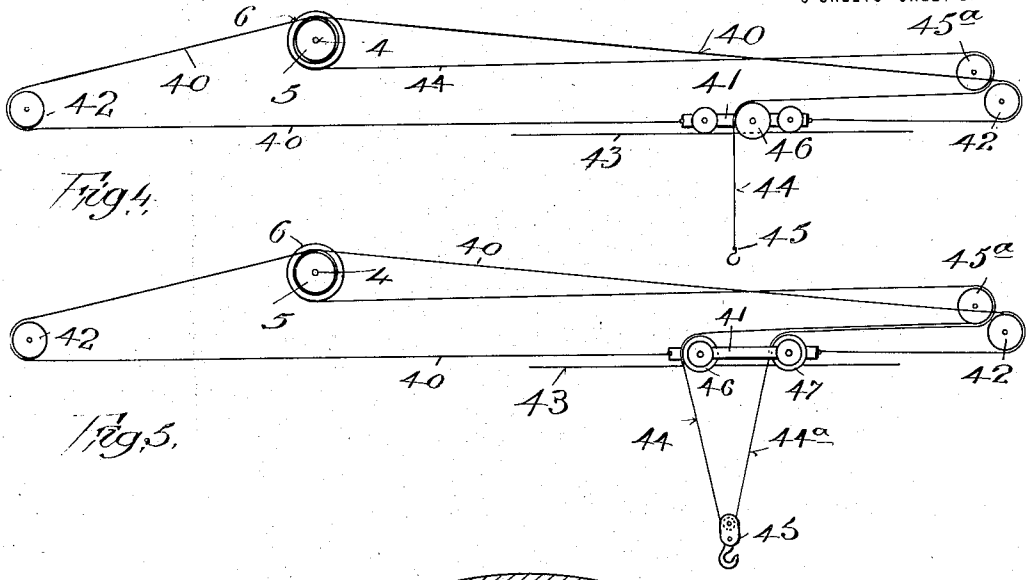

Fig. 4.

Fig. 5.

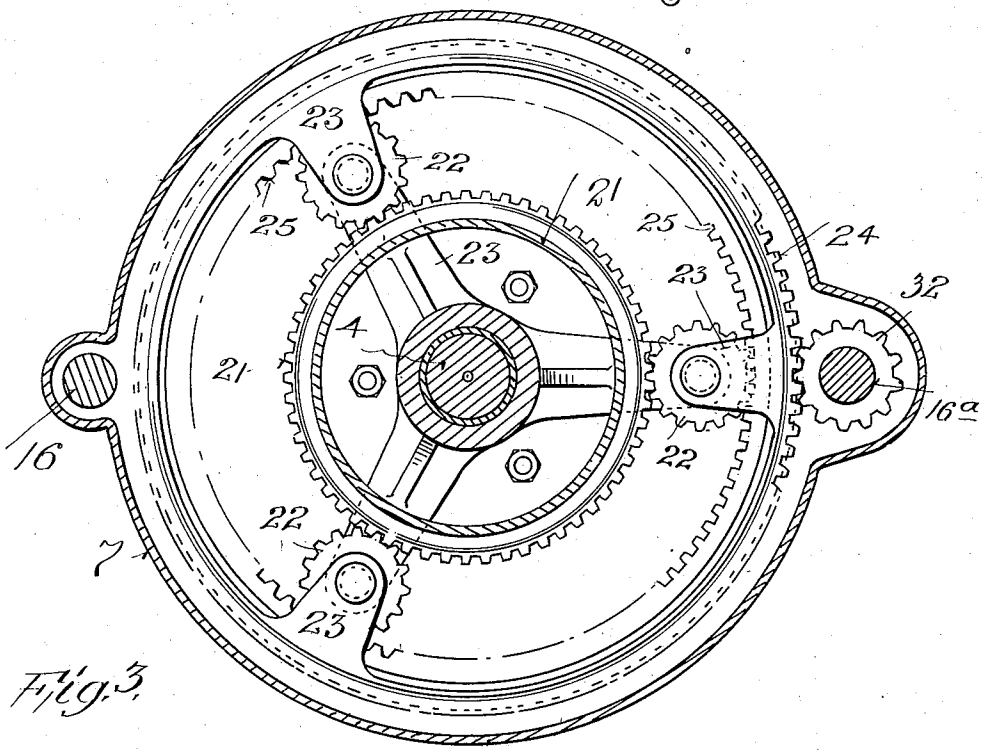

Fig. 3.

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6 SHEETS—SHEET 3.

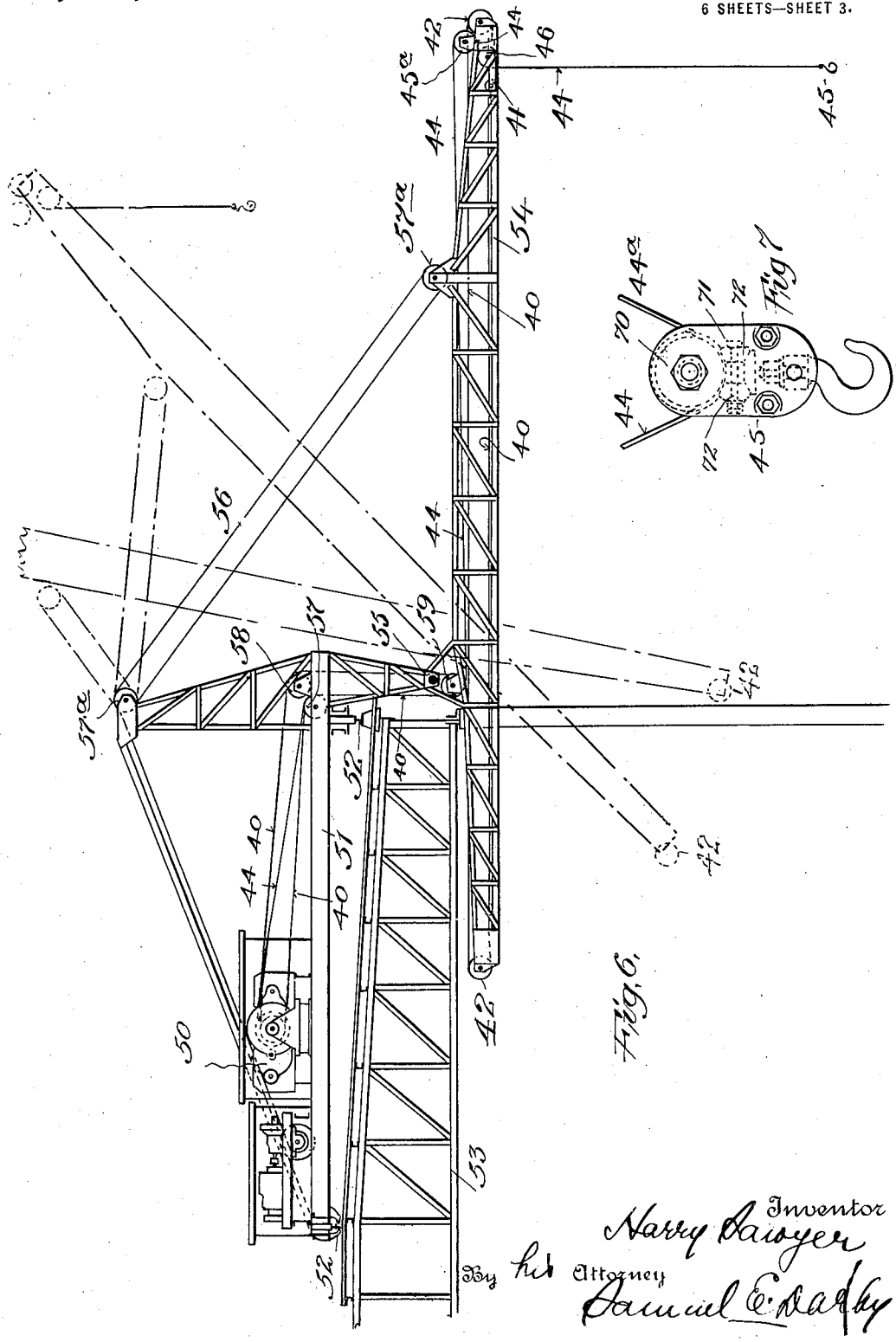

Fig. 6.

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6 SHEETS—SHEET 4.

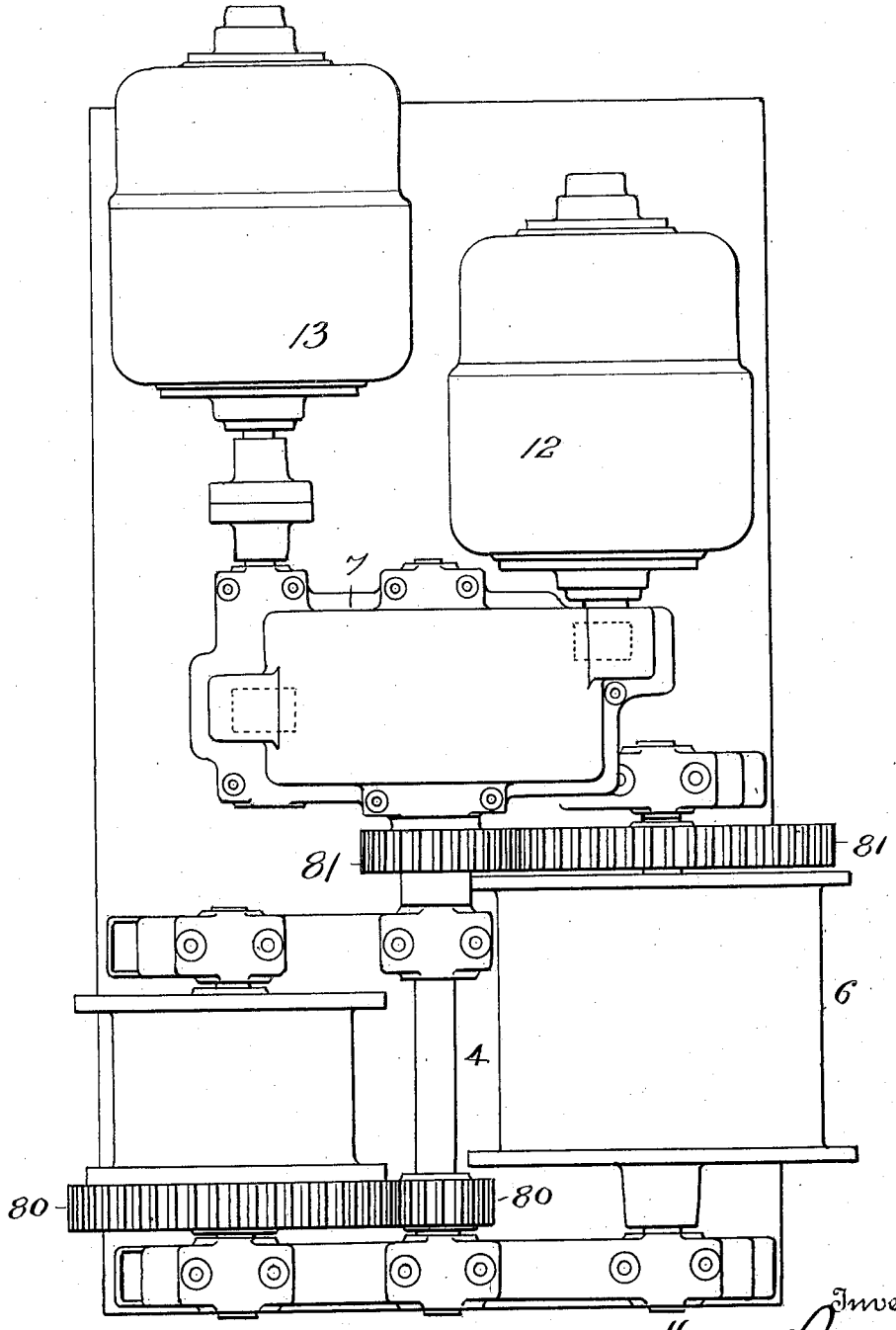

Fig. 8.

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6 SHEETS—SHEET 5.

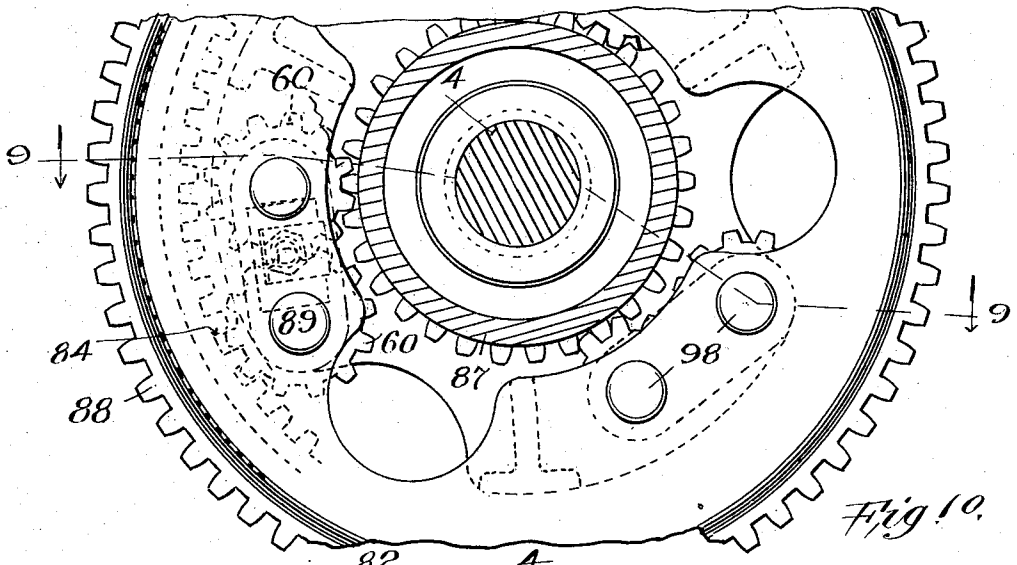

Fig 10.

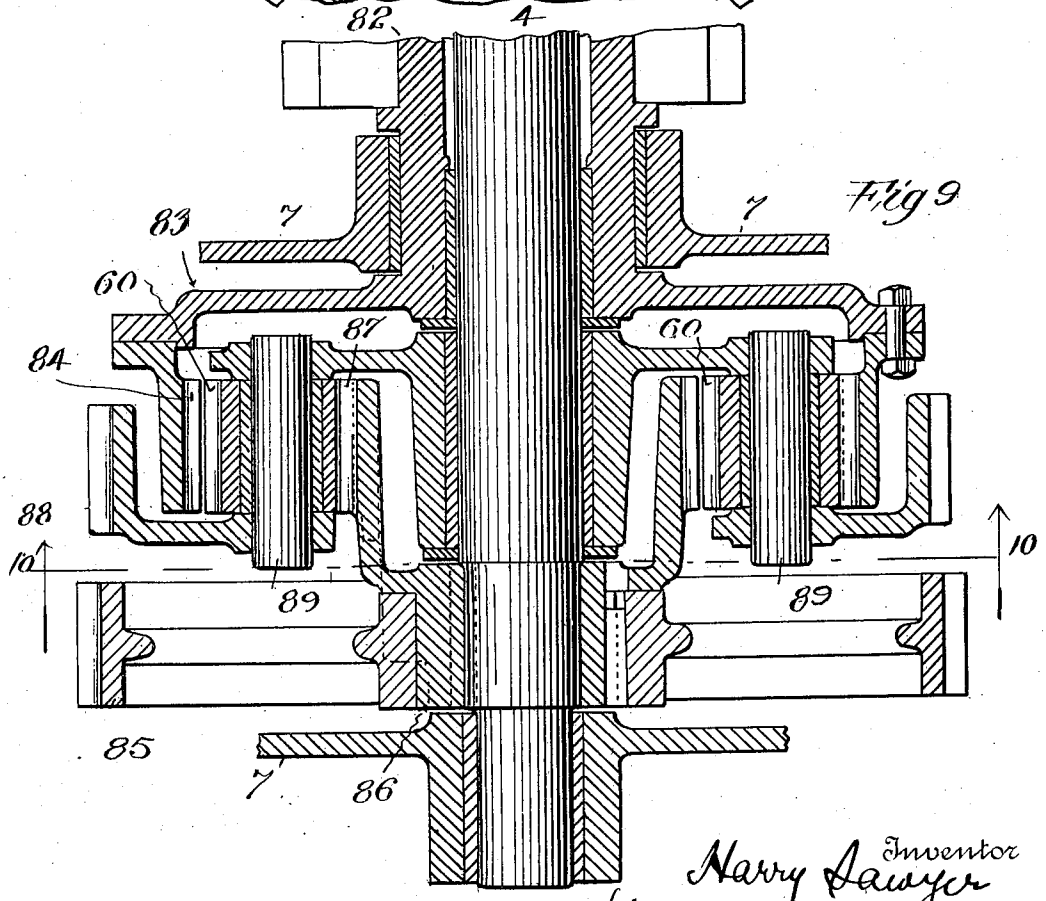

Fig 9

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6 SHEETS—SHEET 6.

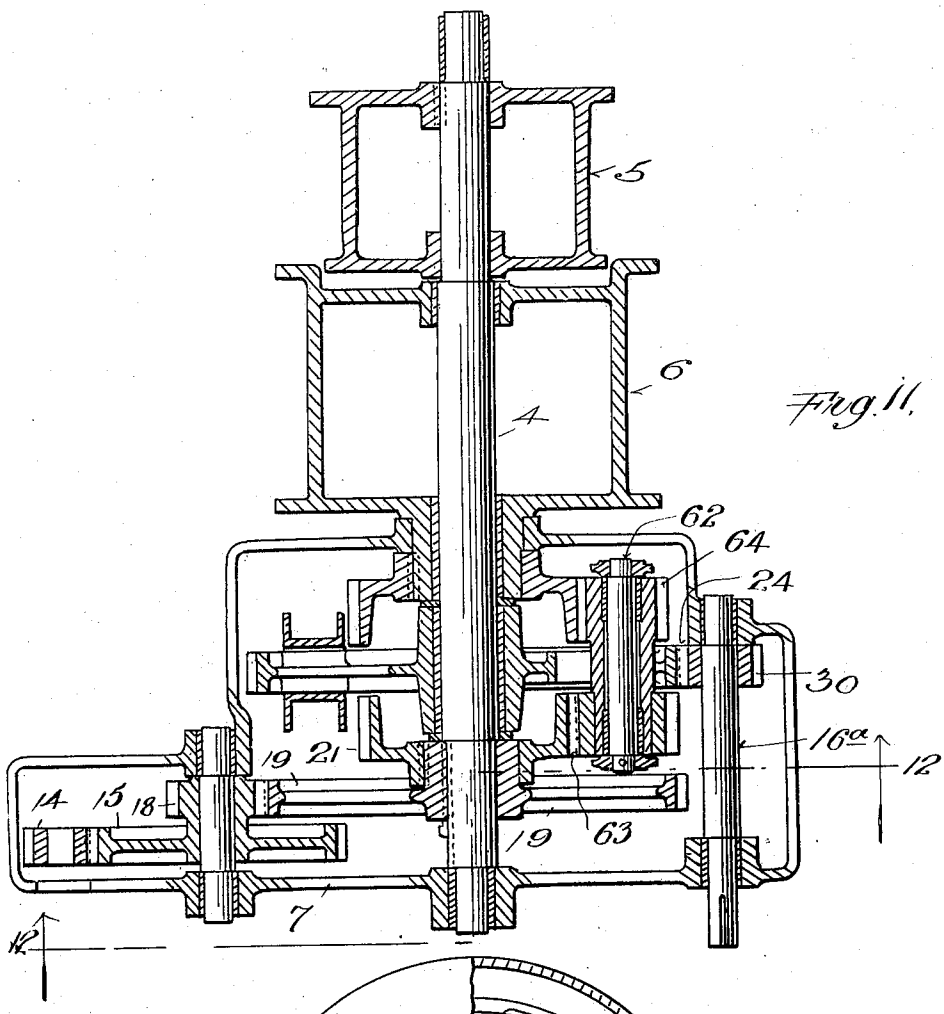

Fig. 11.

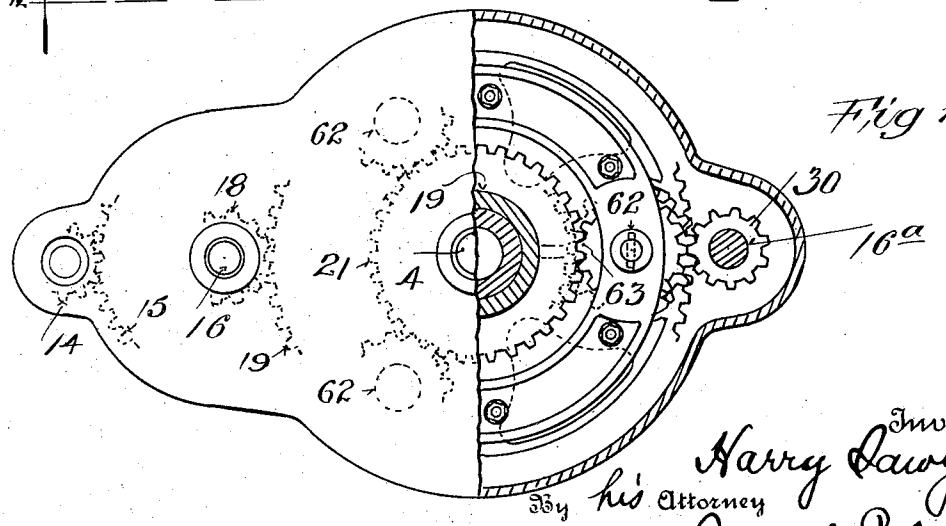

Fig 12.

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UNITED STATES PATENT OFFICE.

HARRY SAWYER, OF MUSKEGON, MICHIGAN, ASSIGNOR TO SHAW ELECTRIC CRANE COMPANY, OF MUSKEGON, MICHIGAN, A CORPORATION OF MICHIGAN.

HOISTING APPARATUS.

1,395,735. Specification of Letters Patent. Patented Nov. 1, 1921.

Application filed July 12, 1916. Serial No. 108,830.

To all whom it may concern:

Be it known that I, HARRY SAWYER, a citizen of the United States, residing at Muskegon, county of Muskegon, State of Michigan, have made a certain new and useful Invention in Hoisting Apparatus, of which the following is a specification.

This invention relates to hoisting apparatus.

The object of the invention is to provide apparatus for use in hoisting and carrying loads, which is simple in structure, efficient in operation, and economical of manufacture.

A further object of the invention is to provide a hoisting apparatus which is simple in construction and efficient in operation, employing a hoisting drum and a racking drum, with separate motors to operate said drums, irrespective of whether the drums are of the same or of different diameters, whether mounted on the same or different shafts, and whether operating in the same or relatively reverse directions.

Further objects of the invention will appear more fully hereinafter.

The invention consists substantially in the construction, combination, location and relative arrangement of parts, all as will be more fully hereinafter set forth, as shown by the accompanying drawings, and finally pointed out in the appended claims.

Referring to the drawings:—

Figure 1 is a plan view, partly in central horizontal section, of a combined hoisting and racking gear and drum mechanism embodying one form of my invention and wherein the said drums are of unequal diameters and are driven in opposite directions, in racking the load.

Fig. 2 is a sectional view of the same, taken on the line 2, 2, Fig. 1, and looking in the direction of the arrows.

Fig. 3 is a similar view taken on the line 3, 3, Fig. 1, and looking in the direction of the arrows.

Fig. 4 is a diagrammatic view of a hoist and trolley system using a single hoisting rope, in accordance with my invention.

Fig. 5 is a similar view of a hoist and trolley system using two hoisting ropes.

Fig. 6 is a view in side elevation of a traveling crane structure showing the application thereto of hoist and racking mechanism embodying my invention.

Fig. 7 is a detail view showing a form of load engaging device suitable for use in connection with the arrangement shown in Fig. 5.

Fig. 8 is a view in top plan of another form of combined hoisting and racking mechanism embodying my invention, wherein the hoisting and racking drums are driven in the same direction, in racking the load, and where the structure is such as to give a considerable gear ratio between the motor and drum.

Fig. 9 is a view in section of the same taken longitudinally of the main operating shaft.

Fig. 10 is a broken view in transverse section on the line 10, 10, Fig. 9, looking in the direction of the arrows.

Fig. 11 is a view similar to Fig. 9, showing another form of structure embodying the principles of my invention and wherein the hoist and rack drums are mounted on the same shaft and are driven in the same direction in racking the load.

Fig. 12 is a view partly in end elevation and partly in section on the line 12, 12, Fig. 11, looking in the direction of the arrows.

The same part is designated by the same reference numerals wherever it occurs throughout the several views.

When hoisting machinery is in a fixed position, and not on a traveling trolley, it is the present practice to run the hoisting rope from the hoisting drum over a sheave at one end of the trolley track, then around a sheave in the trolley, a similar sheave in the hook or lower block, a second sheave in the trolley, and thence to the opposite end of the trolley track where it is anchored. It is obvious that this arrangement requires at least one running sheave in the hook or lower block and requires the hoisting rope which sustains the load to run through the sheaves in the trolley and in the hook block as the trolley travels back and forth on its track. It is obvious, therefore, that this arrangement is objectionable in that the friction between the rope and the sheaves quickly wears the rope and the other parts. Further, for certain classes of work, where it is desirable to handle light loads at high speed, it is desirable to avoid the use of running sheaves in the hook or lower block, and to do so requires some arrangement of hoisting and racking or trolley operating mechanism

that will pay out the hoisting rope as the trolley is traveled or racked in one direction, and, likewise, will take in the hoisting rope as the trolley is racked in the other direction so that the trolley may be racked without simultaneously hoisting or lowering the load, and also so that the weight of the load itself will not cause the trolley to travel in one direction or the other.

It is among the special purposes of my present invention to provide a hoisting and racking mechanism which will entirely eliminate the necessity of a running sheave in the hook or lower block, and which will permit the racking of the trolley without hoisting or lowering the load, and which will also allow the load to be hoisted without racking the trolley either by power mechanism or by the load itself, and in addition thereto, to provide means to prevent the swaying of the load during the travel of the trolley.

In accordance with my invention, in one form of embodiment thereof, I provide a suitable motor bed or frame 1 provided with suitable brackets forming journals 2, 3, for a shaft 4, to which is secured the rack drum 5, for example, keyed thereto, as shown, and also the hoisting drum 6, loosely mounted thereon. The shaft 4, extends through the drums 5 and 6, and into a gear case 7, which is provided with side flange portions 8 and 9, in which are housed pinions carried on shafts 10 and 11, respectively, of motors 12 and 13, which, in the present case, are respectively, the rack operating motor and the hoist controlling motor.

Mounted on the shaft 10, of the rack operating motor 12 is a pinion 14, which meshes with and drives a similar gear 15, mounted on the shaft 16, suitably journaled in the casing 7, as shown. Also mounted on the shaft 16, is a pinion 18, which meshes with and drives a large spur gear 19, which is suitably secured to the shaft 4, for example, keyed thereto, as shown. Suitably secured to the spur gear 19, for example, bolted thereto by bolts 20, is a smaller spur gear 21, which meshes with three equally spaced pinions 22, carried by suitable arms 23, which also carry a gear wheel 24. The arms 23 are formed on a sleeve which is loosely mounted on the shaft 4, as clearly shown. Thus it will be seen that the combined pinions 22, and gear 24, in effect, form a planetary gearing, that is, the pinions 22, may be rotated on their individual axes, and the gear wheel 24, may be rotated about the shaft 4, therefore, when the gear 24, rotates about the shaft 4, the pinions 22 will be carried around the same shaft 4, and will at the same time be rotated about their own axes.

The teeth of the pinions 22, mesh with the teeth of an internal gear wheel 25, which is suitably secured to the hoist drum 6, for example, bolted thereto, as shown, and which drum, as above stated, is loosely mounted on the shaft 4. Thus it will be seen that when the motor 12 and shaft 10 thereof, are rotated, the gear 14 drives gear 15, shaft 16, gear 18, gear 19, and consequently shaft 4, and rack drum 5. This may be in either direction according to the direction of rotation of the motor. Coincidently therewith, the spur gear 21, secured to the gear 19, rotates the pinions 22, about their individual axes, which are held fixed by means preventing rotation of gear 24, as will be more clearly hereinafter described, and which pinions 22, in turn, drive the internal gear 25, which, being secured to the drum 6, rotates the hoisting drum as will be clearly understood, in a direction, in this case, opposite to the direction of rotation of the rack drum 5. By suitably proportioning the ratios of gears 21, 22 and 25, and the ratio of the respective drum diameters, the peripheral speeds of the drums will be the same, and in opposite directions, and will therefore wind up or unwind the hoisting and racking ropes at the same rate of speed.

Therefore, the hoisting drum 6 will take up or pay out the hoisting rope at the same rate of speed that the rack rope is operated by the drum 5. This means that the load will travel in a rectilinear and horizontal line during the racking operation of the trolley, and without the objectionable reeving of the hoisting rope above referred to.

Mounted on the shaft 11 of the hoist motor 13 is a gear wheel 30, which meshes with and drives a comparatively larger gear 31, mounted on shaft 16^a, which is parallel with and similar to the shaft 16, on the rack side of the gear case, and which likewise is journaled in the casing as shown. Mounted on the shaft 16^a, is a gear 32, which meshes with the teeth of the external annular gear 24, which gear is carried by the arms which also form bearings for the pinions 22, as hereinbefore described. Thus it will be seen that when the hoist motor 13 and consequently the shaft 16^a is operated in one direction or the other, the gear 24, is rotated about the shaft 4, carrying the pinions 22, with it, thereby causing the pinions 22, to roll over the spur gear 21, which, in this case, is held stationary, and the pinions rolling over the spur gear 21, and meshing with the teeth of the internal annular gear 25, drives the gear 25, and consequently the hoist drum 6, without rotating the shaft 4, and drum 5. From this it will be seen that the rack motor 12, will rotate both the rack drum 5 and the hoist drum 6, at equal peripheral speeds and in opposite directions, while the hoist motor 13 will operate only the hoist drum 6, when the rack motor is stationary.

In the arrangement above described the hoisting and racking drums are of relatively different diameters and are operated

in reverse directions with relation to each other. These characteristics, however, are not essential in carrying out the broad scope and intent of my invention. In Figs. 8, 9, and 10, I have shown another form of embodiment of my invention wherein the hoisting drums 6 and the rack drum 5, while shown of relatively different diameters are not required to be, and wherein these drums are rotated in the same direction. In this arrangement instead of mounting the drums 5, 6, on the main shaft, said drums are mounted on separate shafts. The rack drum shaft is driven from main shaft 4, through intermeshing gears 80, while the hoist drum shaft is driven through intermeshing gears 81, one member of which is carried by the hub sleeve 82 of the carrying wheel 83, having an annular, internally toothed gear 84. The rack motor 12, drives a large spur gear 85, which is mounted to rotate with main shaft 4, and corresponds in purpose and function to gear 19, above described with reference to Fig. 1. Instead of gear 85 being keyed directly to shaft 4, it is connected to the hub 86, of a spur gear 87, said hub 86, being keyed to shaft 4. A large spur gear 88 driven by the hoist motor 13 is mounted loosely to rotate upon the main shaft 4, and it carries studs 89, upon which are journaled pinions 60. These pinions are arranged in pairs, the members of which intermesh with each other, one member of each pair meshing with the internal annular gear 84, and the other with the spur gear 87, thus constituting a planetary gear system.

In this arrangement when the rack motor is operated the rack drum is driven through gear 85, shaft 4, and gears 80, while at the same time the hoist drum is driven in the same direction through gear 85, gear 87, pinions 60, annular gear 84, wheel 83, and gears 81, assuming that the hoist motor is not in operation, and therefore, that gear 88 is held stationary. When the hoist motor is operated and the rack motor is stationary the gear 88 is rotated, thereby carrying the pinions 60 around with it. Through the intermeshing of one member of each pair of gears 60, with the now stationary spur gear 87, said pinions are also axially rotated, thereby imparting rotation to annular gear 84, and hence to the hoisting drum.

This structure attains a higher speed of the planetary gear system than in the arrangement shown in Fig. 1, because of the elimination of the gear reduction intermediate the motor shafts and the drum operating gears. This change, however, necessitates the introduction of the gearing 80, 81, intermediate the main shaft and the drum shafts. The arrangement of planetary gearing shown in Figs. 8, 9 and 10, however, not only enables the hoist and rack drums to rotate in the same direction but also secures a considerable gear ratio between the hoist motor and drum; that is to say, the gear 84 rotates fewer revolutions per unit of time than the gear 88 which carries the planetary gears. In order to attain the same peripheral speeds of the hoist and rack drums the diameters of the drums and the gear ratios between the drums and the main shaft must be taken into account. By suitably selecting the gear ratios of gearing 80, 81, the drums may be of the same diameters and made to rotate at the same peripheral speeds. Ordinarily, however, it may be found desirable to make the hoist drum of larger diameter than that of the rack drum because, usually, it is required to handle a greater length of rope or cable. Since the hoist drum is driven by the rack motor as well as by the hoist motor, it must be so constructed as to wind rope for the total hoist as well as for the total rack movements, while the rack drum winds rope only for the rack movements.

In Figs. 11 and 12, I have shown another form of embodiment of my invention wherein the rack and hoist drums are designed to be mounted on the same shaft and driven in the same direction by means of a somewhat simplified planetary gearing wherein gear reduction between the hoist motor and the planetary gearing is reduced and the desired gear ratio attained in the planetary system itself.

In this arrangement the rack motor drives the gear 19, through gears 14, 15, 18, as above described with reference to Fig. 1. The gear 19 is mounted on to rotate with the shaft 4, and carries a spur gear 21. A spur gear 61 is connected to rotate with the hoist drum 6. The rack drum 5 rotates with shaft 4, while the hoist drum rotates upon shaft 4. The gear wheel 24 is journaled to rotate upon shaft 4, and carries studs 62, upon which are carried pinions 63, 64, which mesh, respectively with the spur gears 21, 61. The operation is simple. With the hoist motor idle and the rack motor operating, the gear 24 is stationary while the spur gear 21, and shaft 4, are driven. The gear 21, drives pinions 63 and 64, and the latter drives gear 61, and the hoist drum, thereby causing both drums to rotate in the same direction. With the rack motor idle and the hoist motor in operation the gear 21 and shaft 4 are stationary, while gear 24 is rotated carrying the studs 62 with it. Through the intermeshing of pinion 63, and the stationary spur gear 21, the pinion 63 is axially rotated thereby rotating pinion 64, and driving gear 61 and the hoist drum.

The principles of my invention may be embodied in still other forms of apparatus but the various forms above described are sufficient to indicate the broad and generic character of my invention.

In Fig. 4, I show a combined rack and hoist mechanism embodying my invention applied to a system using a single hoist rope wherein the hoist drum is designated at 6, and the rack drum is designated at 5. The rack or trolley ropes 40, are connected to opposite ends of the drum 5 and pass over stationary sheaves 42, to the rack or trolley 41, which travels along the track 43. The hoist rope 44, leads from the hoist drum 6, and operates over the stationary sheave 45[a] and the sheave 46, carried by the trolley 41, and thence to the load hook 45. In this arrangement, it is obvious that when the rack motor is operated to travel the trolley toward the left from the position shown, the rack motor will be operated to drive the rack drum clockwise which will wind up that run of the rope 40 to the left from the trolley to the rack drum, and will pay out the rope 40, from the drum to the right side of the trolley. As above explained, the hoisting drum is also operated simultaneously by the rack motor, at equal peripheral speed, if hoist motor is not in operation. Therefore, when the trolley is traveled to the left the hoist rope 44 is at the same speed paid out from drum 6, therefore the load carried by the load attaching device 45, will remain at the same level throughout the travel of the trolley in either direction. It is also obvious that by operating the hoist motor alone, the hoist rope 44, may be operated independently of the trolley movement. It is also obvious, that if desired, both motors may be operated at the same time to cause both the hoisting rope and the racking rope to operate in such manner as to secure a diagonal line of travel of the load carried by the load engaging device.

It is frequently desirable, in carrying loads at particularly high speeds to provide means to prevent swaying of the load. In such case it is desirable to employ two hoist ropes to operate over sheaves spaced apart on the trolley. In Fig. 5, I show an arrangement for accomplishing this wherein two hoist ropes 44, and 44[a] operate over the hoist drum 6, and the fixed sheaves 45[a] and the respective sheaves 46, 47, carried by the trolley 41, and are secured to the load engaging device 45. A convenient arrangement of load engaging device 45 for use in this case is shown in Fig. 7, wherein a small sheave 70, is mounted in the lower block 71, over which the ropes 44, 44[a] operate and with reference to which the same ropes are adjusted so as to assume about an equal angle to the vertical. If the trolley track is always in a horizontal position or always at a fixed angle when in service, this adjustment, once made, need not be changed, but if the boom carrying the trolley track is a swinging boom, and arranged to work at different angles, it is necessary after the boom is fixed in the desired angle at which it is to work that the sheave 70 and ropes 44, 44[a] be so relatively adjusted as to secure substantially equal angles to the vertical of said ropes. When adjusted for any particular working position of the boom the ropes and sheave are clamped and held against movement in any suitable manner, as, for example, by means of clamp devices 72.

In the arrangements above described, it will be noted that I am enabled to eliminate a running sheave in the lower or load block of the system, but at the same time, I am enabled to automatically pay out or take in the hoist rope as the trolley is racked which heretofore it has been impossible to do without the use of a running sheave in the load block.

In Fig. 6 I have shown my invention as applied to a traveling crane structure, wherein the rack and hoist motors and drums, generally designated at 50, are mounted on a frame 51, which travels along tracks 52 of any structure, such, for example, on the top of a warehouse 53. The boom 54 is pivotally carried by the frame 51, at 55, and can be raised or lowered as indicated by dotted lines by any suitable means such as by the rope and sheaves 56, 57[a] in the usual or well known manner. The two ends of the trolley racking rope 40 run over the respective sheaves 57, 58, respectively carried by frame 51, and over sheaves 59, carried by the boom 54, and sheaves 42, carried at the ends of the boom, and are secured to the trolley 41, in the usual manner. The hoist rope 44 travels over a sheave mounted concentric with sheave 59, over the fixed sheave 45[a] also carried by the boom, the sheave 46, carried by the trolley 41, and has at its end the usual, or any desired form of load engaging device 45.

From the foregoing it will be seen that I have provided a simple, compact, and highly efficient combined rack and hoist apparatus which will allow complete control of the vertical and horizontal movement of loads to be handled either independently or coincidently.

From the foregoing description it will be seen that in each illustrative form of my invention the rack drum is located beyond, but in close proximiity to the hoist drum, and that the latter is disposed between the hoist drum and the planetary gear system which drives both drums. An important advantage results from this disposition by reason of the fact that the runs of the ropes are maintained more nearly in parallelism thereby preventing unevenness in the strains or pulls exerted by them and enabling them to be wound upon or unreeled from the drums in more regular order.

I do not claim herein specifically the struc-

tures shown in Figs. 8, 9, 10, 11, and 12, as the specific subjects matter thereof are embodied and claimed in separate applications executed and filed of even date herewith.

While I have shown and described various specific structures embodying my invention, it will be understood that my invention may be carried out in various other forms, and that many modifications and changes in detail will readily occur to those skilled in the art without departing from the broad scope of my invention, as defined in the claims. Therefore, what I claim as new and useful, and of my own invention, and desire to secure by Letters Patent, is—

1. In a combined rack and hoist mechanism, the combination with a motor, a hoist drum and a rack drum, said drums located adjacent each other, of a planetary gear system located at one side of said drums and between said drums and motor and actuated by said motor for simultaneously driving said drums.

2. In a combined rack and hoist mechanism, the combination with a motor, a hoist drum and a rack drum, said drums located adjacent each other, of a planetary gear system located at one side of said drums and between said drums and motor and actuated by said motor for simultaneously driving said drums, and a second motor also connected to said gear system to operate the same to drive the hoist drum without driving the rack drum.

3. In a combined rack and hoist mechanism, the combination with a shaft, a hoist drum, and a rack drum, said drums located adjacent each other and associated with said shaft, of a drive gear member mounted on said shaft beyond both of said drums, and operating to drive one of said drums, gear devices intermediate said drive gear member an the other of said drums to drive the latter, and a motor connected to said drive gear member to actuate the same.

4. In a combined rack and hoist mechanism, the combination with a shaft, a hoist drum and a rack drum, said drums located adjacent each other and associated with said shaft, of a drive gear member mounted on said shaft beyond both of said drums, and operating to drive one of said drums, gear devices intermediate said drive gear member and the other of said drums to drive the latter, a motor connected to said drive gear member to actuate the same, and an independent motor connected to said gear devices to actuate the drum associated therewith without actuating the other drum.

5. In a combined rack and hoist mechanism, the combination with a shaft, a hoist drum and a rack drum, said drums located adjacent each other and associated with said shaft, of a drive gear member mounted on said shaft beyond both of said drums, and operating to drive said rack drum, a planetary gear system connected to said hoist drum and actuated by said drive gear member, and a motor connected to said drive gear member to actuate the same.

6. In a combined rack and hoist mechanism, the combination with a shaft, a hoist drum and a rack drum, said drums located adjacent each other and associated with said shaft, of a drive gear member mounted on said shaft beyond both of said drums, and operating to drive said rack drum, a planetary gear system also located beyond both of said drums connected to said hoist drum and actuated by said drive gear member, a motor located beyond said gearing and connected to said drive gear member to actuate the same, and a second motor connected to said planetary gear system to actuate the hoist drum therethrough without actuating the rack drum.

7. In a combined rack and hoist mechanism, the combination with a driving motor, a hoist drum and a rack drum located adjacent and in proximity to each other, of gearing actuated by said motor for simultaneously and positively driving both of said drums, said motor being disposed at one side of both of said gearing and said drums disposed at the other side of said gearing.

8. In a combined rack and hoist mechanism, the combination with a driving motor, a hoist drum and a rack drum located adjacent and in proximity to each other, of gearing actuated by said motor for simultaneously and positively driving both of said drums, said motor located at one side of said gearing, and both of said drums being located at the other side of said gearing, and an independent motor connected to said gearing for actuating said hoist drum without actuating said rack drum.

9. In a combined rack and hoist mechanism, the combination with a driving motor, a hoist drum and a rack drum, said drums located adjacent and in proximity to each other, of gearing actuated by said motor and operating to positively rotate both of said drums simultaneously and at the same peripheral speed, both of said drums being located at one side of said gearing, and said motor located at the other side of said gearing.

10. In a combined rack and hoist apparatus, a rack drum and a hoist drum, said drums being of unequal diameters, and means for simultaneously and positively rotating both of said drums and at equal peripheral speeds, both of said drums being located at the same side of said rotating means.

11. In a combined rack and hoist apparatus, a rack drum and a hoist drum, said drums being of unequal diameters, and

means for simultaneously and positively rotating both of said drums and at equal peripheral speeds, both of said drums being located at the same side of said rotating means, and means for rotating said hoist drum independently of the rack drum.

In testimony whereof I have hereunto set my hand in the presence of the subscribing witnesses, on this 29th day of June, A. D. 1916.

HARRY SAWYER.

Witnesses:
P. J. KNIPERS,
T. C. AKIN.