

[54] WINCH

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[58] Field of Search 254/154, 155, 157, 159, 167,
254/168, 169, 170, 175.5, 175.7, 188; 182/142;
212/145

[56]

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[57]

ABSTRACT

This winch is of a type driven by a prime mover, and comprises a mechanism wherein the rope is wound around two driving pulleys in the shape of the letter "Z", providing tractive force without coiling of the rope. Also included are an automatic safety device for preventing possible accidents in the course of lowering of the load, and a mechanism for changing over to manual operation in case of emergency.

12 Claims, 8 Drawing Figures

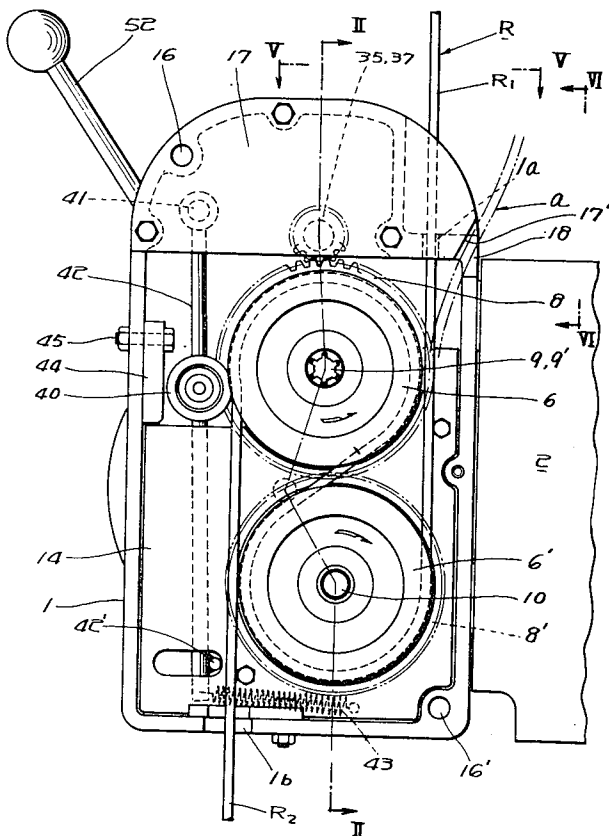


FIG. 1

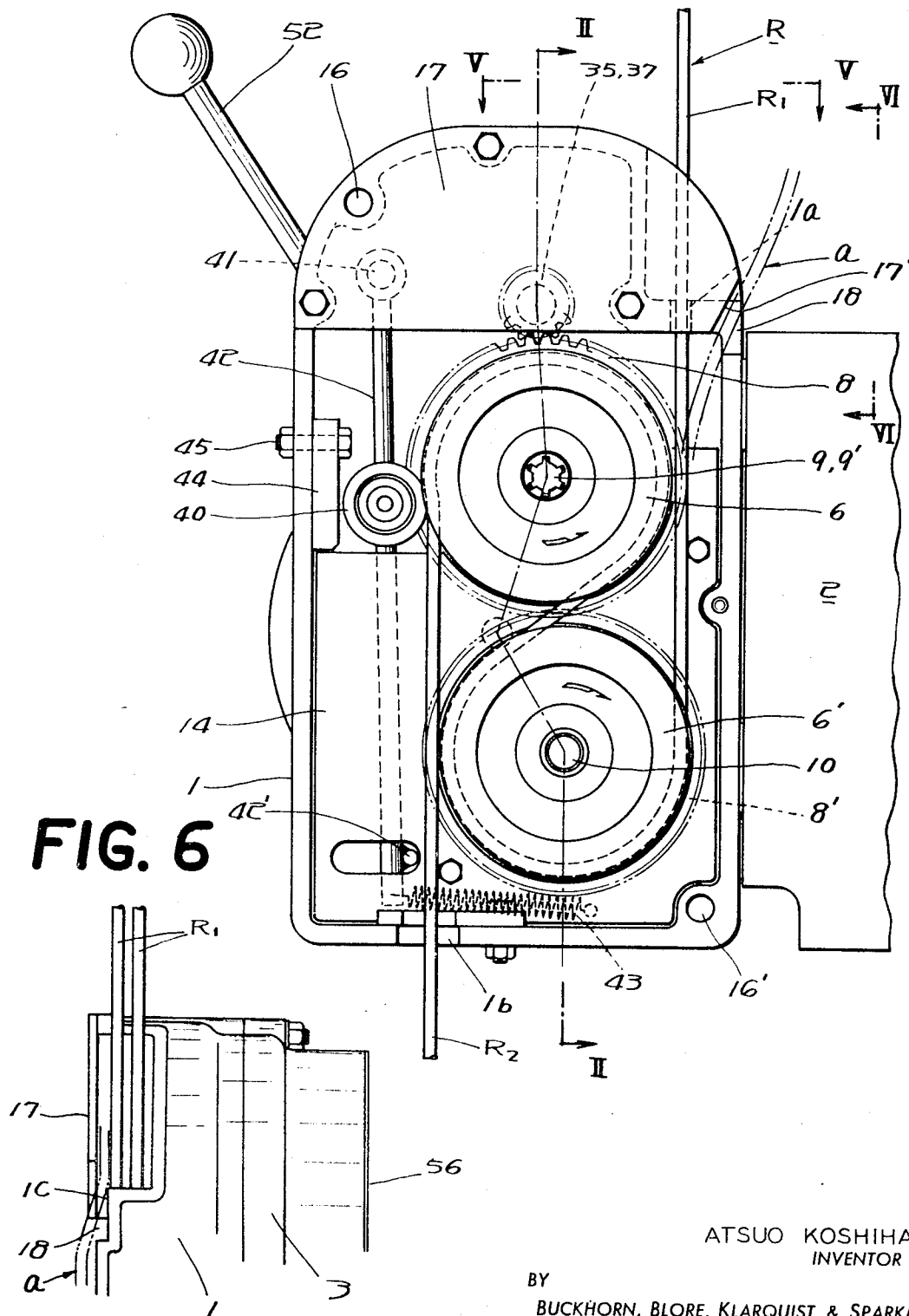


FIG. 6

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FIG. 2

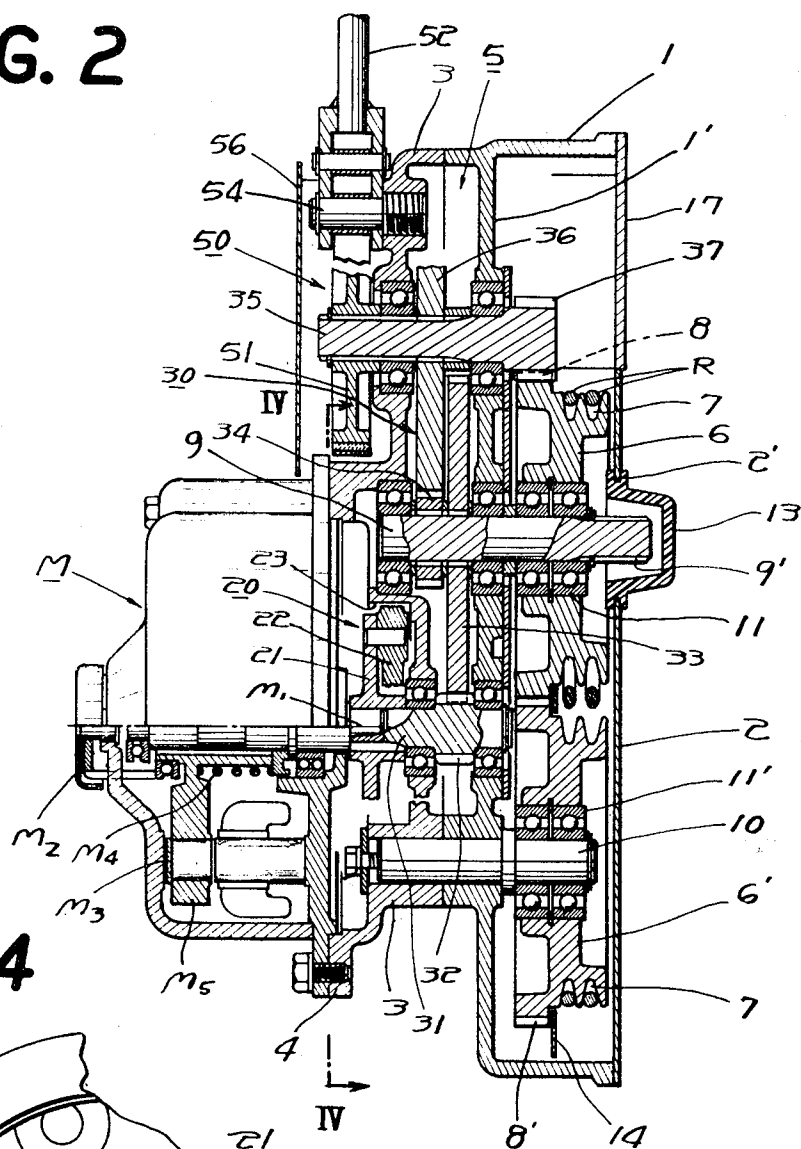
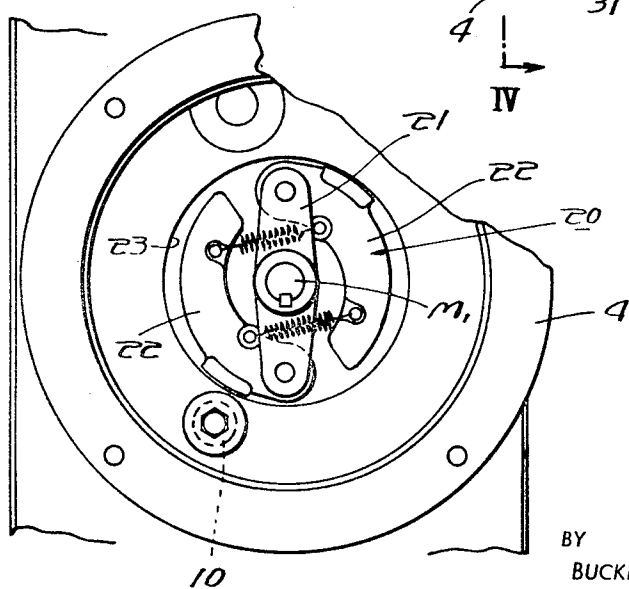


FIG. 4



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FIG. 3

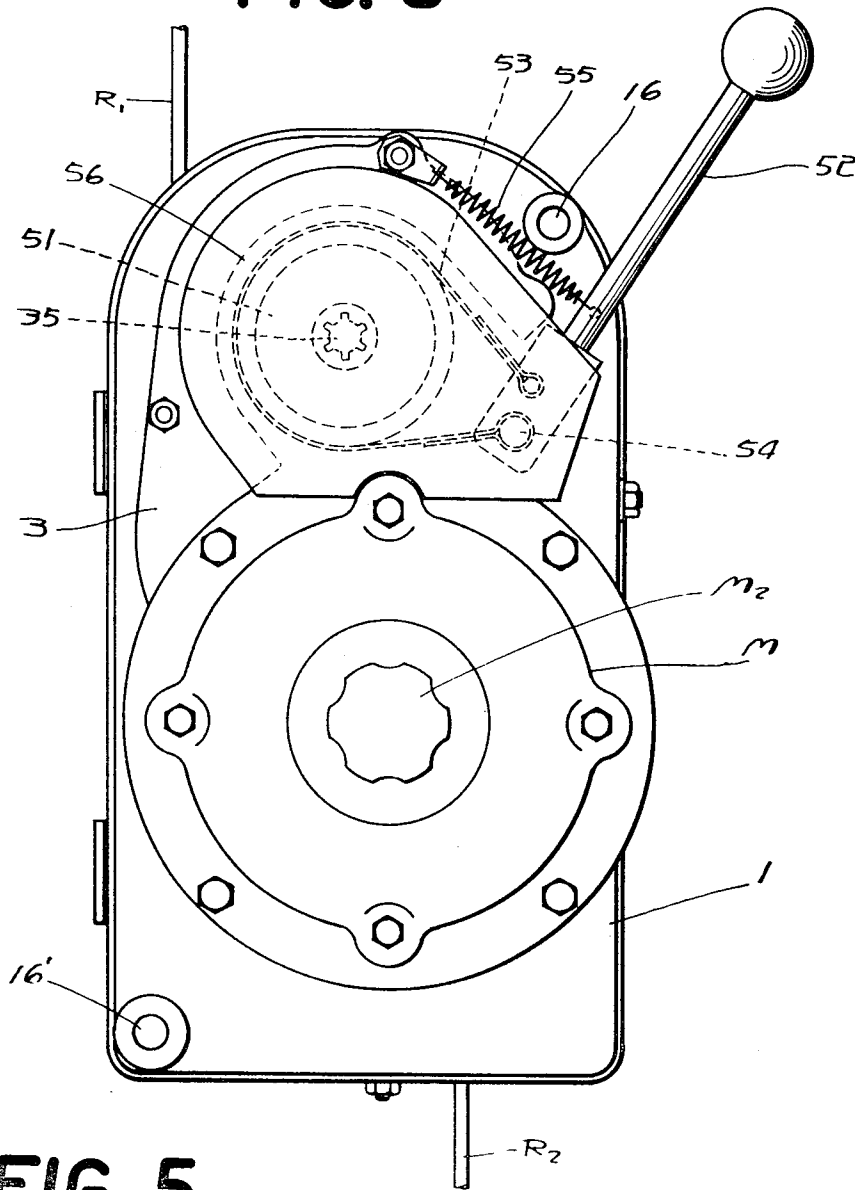
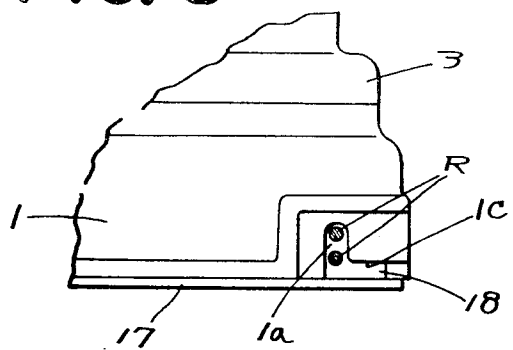


FIG. 5



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FIG. 7

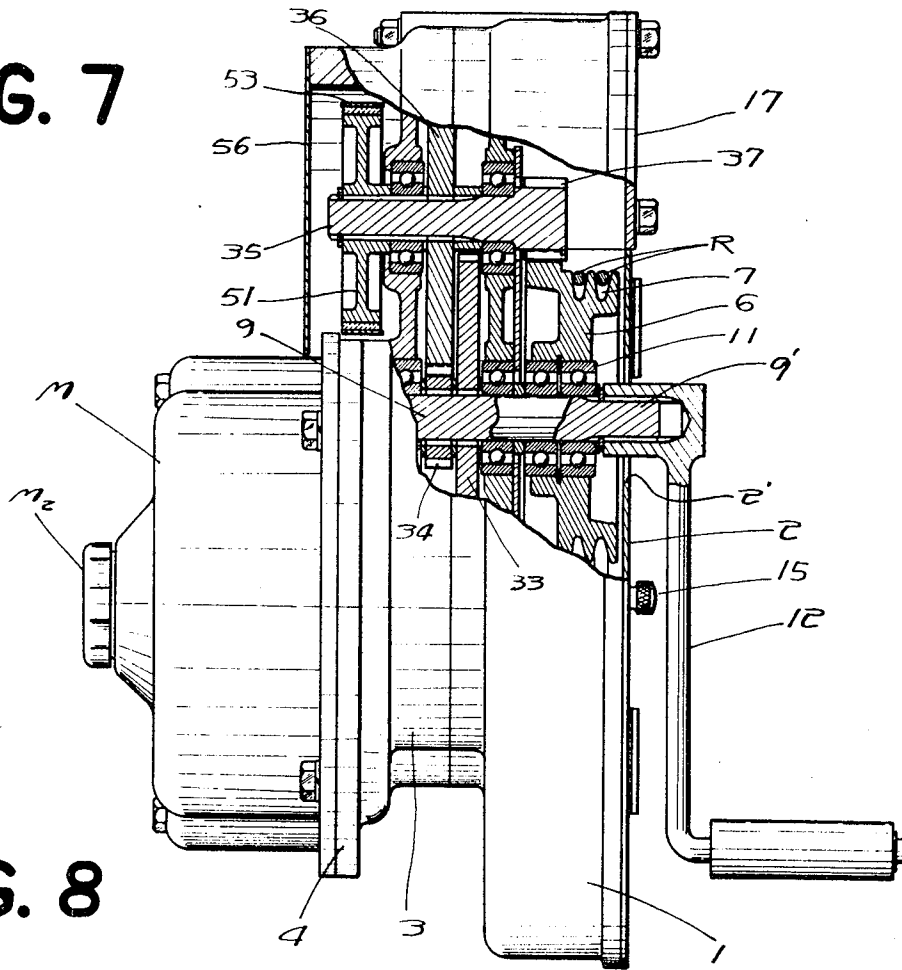
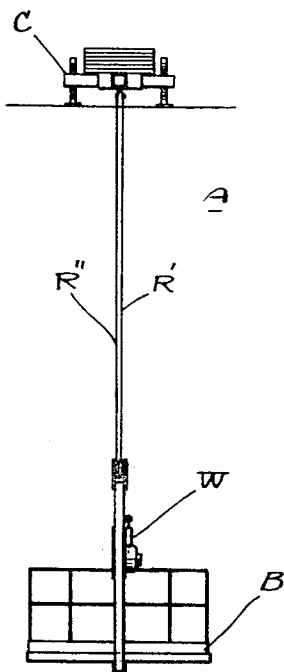


FIG. 8



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WINCH

The present invention relates to a power-operated winch, and more particularly to a winch of simple construction employing no rope coiling drums, wherein the rope is wound around two driving pulleys having V-shaped grooves. The rope is automatically braked in case rope speed exceeds a prescribed limit in the course of lowering a hung load, thus allowing hoisting and tractive operations to be performed safely and positively.

Various types of small winches have been suggested or actually used for hoisting light loads without coiling rope on a take-up drum. Examples are hanging of scaffolds used in construction work sites or for maintenance of structures, as well as in erection of communication lines, transmission lines and other applications where it is necessary to perform such operations without any restriction in the length of the supporting rope. However, these winches are complicated in construction, and are not only expensive but also inconvenient to handle. In order to eliminate slipping of the rope on the rope-driving pulley — that is, in order to increase tractive force — the rope is wound around many driving pulleys and pressed against by many rollers from the outside, so that undue external force has to be applied to said rope, resulting in shorter rope life. Further, in order to wind the rope around a driving pulley, it must be ordinarily drawn into the pulley, starting from one end of the rope. Thus, prior devices have a number of disadvantages from the point of view of function and handling procedures.

One of the objects of the present invention is to eliminate such drawbacks and provide a small-size winch of improved type, convenient in handling and simple in construction, that does not affect the life of the rope adversely.

For this purpose, the winch according to this invention is provided with two rope-driving pulleys having V-shaped grooves, around which pulleys the rope is wound from one pulley to the other in the shape of the letter "Z," said rope being driven by a prime mover so interlocked with a brake via a simple speed reduction gear that the moment driving stops, the brake operates.

Another object of the present invention is to simplify handling — especially the procedures of winding rope around the pulleys. For this purpose, a notch is formed in one part of the winch casing to take in the rope, and the side portion of the rope-driving pulleys are so constructed that they can be uncovered.

Still another object of this invention is to enable a winch to be used safely and positively as a driving machine for hoisting hanging scaffolds and the like. In order to increase safety and efficiency, the winch according to this invention is so designed that, with winding at least two ropes around the rope-driving pulleys, they can be driven simultaneously, and a speed reduction device is provided with a speed limiting mechanism and a manual brake, each of which has a portion for attaching a handle for manual operation to be used in case of emergency.

Now, I will describe this invention, referring to drawings that illustrate an example of this winch in detail:

FIG. 1 is the front view of the winch of this invention in a condition wherein its door is opened.

FIG. 2 is a longitudinal sectional view of this winch taken at line II — II in FIG. 1, with part of the manual brake added thereto, — particularly in the condition wherein a plurality of ropes are wound around the pulleys simultaneously.

FIG. 3 is a side view of the device viewed from the left in FIG. 2.

FIG. 4 is the view taken at the position indicated by line IV — IV in FIG. 2.

FIG. 5 is the view taken at the position indicated by line V — V in FIG. 1.

FIG. 6 is a view taken at the position indicated by line VI — VI in FIG. 1.

FIG. 7 is a partial longitudinal sectional side view showing the winch with the manual handle attached thereto.

FIG. 8 is an explanatory drawing showing the winch of this invention when used as a hoisting driving machine for a hanging scaffold.

In FIG. 1 through FIG. 3, 1 is a casing with the door 2 hinged on its front, and having a reduction gear chamber 5, which is formed by the cover 3 having the motor-mounting seat 4, and partitioned by a wall 1'. Inside the case are located rope-driving pulleys 6 and 6' each having a V-shaped groove 7 around its periphery, and carrying annular gears 8 and 8'. The gears 8 and 8' are respectively of unitary construction with pulleys 6 and 6'. The two gears, which mesh with each other, are supported rotatably by rotating shaft 9 and fixed shaft 10 carrying bearings 11 and 11' respectively, these elements also being housed in the casing 1. In FIG. 2, M is a motor equipped with a brake, and is fixed to mounting seat 4. On the motor shaft M₁ are provided brake shoes 22 with a holder 21 interposed between. This holder is housed concentrically within the inner wall 23 for braking. Centrifugal brake 20 formed thereby is provided as a speed limiter. Reduction gear mechanism 30 is housed within gear chamber 5, the input shaft 31 for which is connected to motor shaft M₁ with the holder 21 of said brake as a joint. Drive is transmitted from pinion 32 on said input shaft 31, through gears 33 and 34 mounted side by side on the rotating shaft 9, to gear 36 on the output shaft 35. Shaft 9 also serves as the support shaft for rope-driving pulley 6. The pinion 37 at the end of output shaft 35 projects into the casing 1 and is formed in one piece with said output shaft 35. Pinion 37 meshes with gear 8, causing the rope-driving pulleys 6 and 6' to rotate at a prescribed speed. The rope R, as shown in FIG. 1, is fitted in the V-shaped rope grooves 7 of the rope-driving pulleys 6 and 6', being wound around them in the shape of the letter Z. The part of the rope shown in the upper part of FIG. 1, hereinafter referred to as the load side R₁, comes out of the casing through the guide slot 1a formed in the upper corner of the casing 1, and the part of the rope shown in the lower part of FIG. 1, hereinafter referred to as the drawn-out side R₂, comes out of the casing through the notch 1b at the lower part thereof. The rope used for this winch is usually a wire rope, but in this description it is referred to simply as "rope."

40 is a rope-pressing roller, which, as shown in FIG. 1, is mounted in the middle portion of the rod 42, whose base end is held with a pin 41 to the partition wall 1' of the casing 1, and is normally pushed toward the rope-driving pulley 6 by the pressure of the spring 43 provided at the lower end of said rod, pressing the drawn-out side R₂ of the rope. 44 is a piece for preventing said roller from coming off, and is pinned rotatably to the side wall of 1 with the pin 45. Normally, it is positioned as shown in FIG. 1. The extension on the pulley side of the rotating shaft 9 that supports the rope-driving pulley 6 forms the spline shaft 9', and on this spline shaft the manual handle 12 (See FIG. 7) can be easily attached and detached. The hole 2' bored in the door, through which said shaft end 9' projects out, is covered with a cap 13 made of elastic material, which can be attached and detached. 14 is the cover plate for the gear of the rope-driving pulley, 15 is the fixing screw for said cover that serves also as a knob for the door, 42' is the knob for the rod 42 that supports the rope-pressing roller, M₂ is a knob for controlling the motor brake, M₃ is the brake plate for the motor, M₄ is the brake-operating spring, M₅ is a roller, and 16 and 16' are holes for the bolts for securing the casing.

In the winch embodying this invention, as described above, when the load is applied to the load side R₁ of the rope, and the motor M is rotated in the proper direction, the pinion 37 mounted on the output shaft 35 of the speed reduction gear mechanism 30 rotates at a speed reduced to specified r.p.m., and with it the gears 8 and 8' are rotated. Consequently the rope-driving pulleys 6 and 6' rotate in the direction indicated by the arrows. Thereupon, the rope R is driven from the load side R₁ over the rope driving pulley 6' shown in the lower part of FIG. 1 and around the upper rope-driving pulley 6. The drawn-out side R₂ of the rope leaves the casing through the notch 1b. As the rope is wound around the rope-driving pulleys in the shape of "Z," as shown in FIG. 1, the area of contact of the rope with the rope-driving pulleys is the maximum allowable, and when tension acts on the rope thus wound around the pulleys, the force acting on the rope is at equilibri-

um in the part of the rope between the pulleys, since said rope is wound around them in opposite directions. Therefore, the part of the rope that is wound around a ropediving pulley is drawn toward the center of the pulley, so that, the greater the load, the harder the rope is pressed against the surface of the rope groove 7. Thus, by the wedge effect of the V-shaped groove, frictional force is increased progressively without applying any external force additionally. Hence, only one turn of the rope around the rope-driving pulleys produces powerful tractive force, and makes safe and positive hoisting and drawing operations possible. When running of the motor M is stopped, the brake attached to said motor operates and brakes operation immediately, and as the rope-driving pulleys 6 and 6' are connected with the motor M by the speed reduction gear mechanism via the gears 8 and 8' incorporated respectively with said pulleys, reverse rotation thereof is absolutely prevented. Further, as the drawn-out side R₂ of the rope is normally pressed against the rope-groove of the rope-driving pulley 6 by the roller 40, tension of the rope is always maintained, without difficulty.

Of course, when using this winch, it should be fixed to a proper place, making use of the mounting holes 16 and 16', or attaching proper legs or hooks or the like, (not shown in this drawing) to the casing. It is usually vertically mounted.

Lowering of the hung load is accomplished by letting the winch go through the above-mentioned procedures in the reverse order, rotating the motor in the reverse direction, and drawing out the rope's load side R₁. In this case, if the speed of the rope exceeds the specified speed due to the hung load, centrifugal force greater than normal acts on the brake shoes 22 attached to the holder 21 on the motor shaft M₁, and said brake shoes are pressed against the inner wall 23 for braking. Then, by the braking force of this centrifugal mechanism, lowering of the rope is either stopped or its speed is reduced. For the above-mentioned reason, drawing operation by the rope can be performed both in a first direction and in the reverse direction, quickly, safely and positively.

When applying the rope to this winch, the door 2 is opened, and as shown by the broken line a in FIG. 1 and FIG. 6, the load side R₁ of the rope is located through the rope take-in opening 18 formed by the notch portion 1C on the upper part of the wall of the casing 1 and the inclined notch 17' formed in the lower corner of the fixed cover 17. The rope is then fit into the guide groove 1a formed in the upper portion of the casing, and thereafter the rope is wound around the rope-driving pulleys in the open casing in the shape of the letter "Z," i.e., in such a way that the load side R₁ of the rope contacts the driving pulley 6' while the drawn-out side R₂ of the rope is pressed against the driving pulley 6, shown in the upper part of FIG. 1, by the roller 40. The drawn-out side of the rope is pulled through the notch 1b. When detaching the rope from the driving pulley, the above-mentioned procedure is followed in the reverse order. Thus, as is evident from the above description, the rope can be attached or detached much more easily than it would be with conventional winches. Especially, the present winch has a great advantage in that the rope can be wound around the rope-driving pulleys along any part of the rope.

Attaching or detaching the rope R onto or from the rope-driving pulley 6 can be easily done by turning the piece 44 with its fixing pin 45 as the center, moving the roller 40 outwardly and then moving the rod 42 outwardly. In normal position, the piece 44 prevents the roller from shifting substantially outwardly. Therefore, tension on the drawn-out side R₂ of the rope is maintained.

Thus, as is evident from the description of the above example, the winch according to this invention provides a positive drawing force by winding the rope around two rope-driving pulleys in a single turn in the shape of the letter "Z," so that, unlike conventional winches, it is possible to wind not only one rope, but also two or more ropes in parallel on a rope-driving pulley having two or more rope grooves. Thus, this winch can be used for applications where greater safety is required than for one-rope winches. To give an example, this

winch may be used as a hoisting machine for a hanging scaffold, as shown in FIG. 8, with the winch W installed on the scaffold B, and hung with load-side rope ends connected to support means C provided on the top of the structure. The scaffold B may be hung by at least two ropes R' and R''. In such case these ropes will serve respectively as a driving rope and as a safety rope, and provide a very high degree of safety. The motor M for the winch is connected with a power source, and the motor is operated by an electric controller provided on the scaffold B.

If under this condition the motor M should stop running due to unexpected power failure or the like, cap 13 on the door 2 can be removed, the manual handle 12 is attached on the exposed spline shaft 9', the knob M₂ for controlling the brake of the motor M is controlled to release the braking force of the motor brake, and the handle 12 is turned in the proper direction. The pinion 34 on the shaft 9 will rotate, and via the large gear 36 meshing therewith, will turn the pinion 37 on the output shaft. Then the gears 8 and 8' will be driven, causing the rope-driving pulleys 6 and 6' to rotate, for drawing in the rope and lifting the scaffold. Since the rope-driving pulley 6 is rotatably supported by the shaft 9 via the bearing 11, there is no difficulty in operating the apparatus. Furthermore, as this manual operation operates the shaft 9 of the speed reduction mechanism 3, it is possible to drive with a high reduction ratio, and therefore with small power. To stop driving, operating lever 52 of the manual brake 5 is pulled. Manual brake 5 is provided on the outside of the cover of the gear chamber, by which braking force is applied via the brake band 53 to the braking drum 51 on the output shaft 35 of the reduction gear mechanism, whereby rotation can be stopped. Knob M₂ for adjusting the brake of the motor is returned to the original position and the brake of the motor is returned to normal. The rope can be stopped at the desired position. 54 is the fulcrum pin of the manual brake operating lever, 55 is the return spring of the operating lever, and 56 is the cover.

When it is desired to lower the load under a condition wherein the motor cannot be used, braking force is first applied to the output shaft 35 by operating the manual brake 50, braking force of the motor M is released by loosening its brake, and the braking force is then reduced by controlling the operating lever 51 of the manual brake 50. Then, as there is nothing to stop rotation, the rope-driving pulleys will rotate reversely because of the load acting on the rope, and the load will be lowered. In this case, if the drawn-out speed of the rope exceeds a prescribed value, the centrifugal brake 20 connected with the input shaft 31 of the reduction gear mechanism operates and applies the brake automatically to halt lowering of the load or to reduce the speed to a safe speed. Of course, if the manual brake is also employed then, operation will be safer. In this example of winch operation, even if the manual brake should fail to operate, when speed rises to about 1.3 times the safety speed, the above-mentioned centrifugal brake will operate and undue acceleration of the load will be prevented. Ordinarily, or when lowering the load by manual operation, the manual handle 12 should be detached for the sake of safety.

The above is only an example of the application of this winch, and of course it is not necessary to adhere absolutely to the above-mentioned method. It can be used for applications similar to those mentioned above or other applications, changing over to manual operation in the case of emergency.

Thus, the winch of this invention has a unique function not to be found in conventional winches. It has a number of advantages, such as simple construction, easy handling and provision of a safely operating device in case of emergency, etc., all of which combine to make it possible to perform hoisting and drawing operations with high efficiency. Furthermore, with this machine the rope is not subjected to undue force, so as an additional advantage the rope can withstand long use without losing its durability. It is technically possible to use this winch installed in a framework, instead of housing it in the casing, and if desired, to use an internal combustion engine in-

stead of an electric motor. As for the mode of winding the rope around the rope-driving pulleys, the rope need not necessarily be wound around them in the shape of the letter "Z," but the same effect may be obtained by winding it in the shape of the letter "S", if the related mechanism is reversed to that of the example given above. The letter "Z" as used in the claims is intended to have either meaning.

While I have shown and described a preferred embodiment of my invention, it will be apparent to those skilled in the art that many other changes and modifications may be made without departing from my invention in its broader aspects. I therefore intend the appended claims to cover all such changes and modifications as fall within the true spirit and scope of my invention.

What is claimed is:

1. A winch comprising:

a casing having a front compartment provided with a door and a rear compartment separated from a front compartment by a partition wall,

a pair of rope driving pulleys located adjacent one another in said front compartment and having V-shaped peripheral grooves around which a rope may be located, with the door to said front compartment open, for passing said rope around the peripheral grooves of said pulleys in reverse directions, said casing being provided with openings, also accessible by opening of said door, for guiding the load side and drawn side of said rope whereby the rope leaving each pulley passes adjacent the periphery of the opposite pulley before leaving said casing via a said opening,

each of said pulleys being provided with a gear unitary therewith wherein said gears are disposed in meshing relation to turn one of said pulleys in a first direction when the other of said pulleys is turned in a second direction,

a gear reduction mechanism within said rear compartment provided with an output shaft rotated thereby extending into the said front compartment and having a pinion affixed thereto for engaging said gear unitary with one of said pulleys,

and a prime mover attached to said casing for driving said gear reduction mechanism and for rotating said pulleys as a consequence thereof.

2. The winch according to claim 1 wherein said gear reduction mechanism is provided with a centrifugal brake, and wherein said prime mover is also provided with a brake normally functioning when said prime mover is not rotating said reduction gear mechanism.

3. The apparatus according to claim 1 wherein the said output shaft of said gear reduction mechanism is provided with a manual brake mechanism.

4. The winch according to claim 1 wherein said gear reduction mechanism is provided with a shaft projecting outwardly therefrom adapted to receive a handle for manual operation of said winch.

5. The winch according to claim 1 further including a pressing roller urged against the periphery of the pulley from which the drawn side of the rope passes, and means for normally preventing said roller from leaving its position.

6. The winch according to claim 1 wherein each of said pulleys is provided with an additional V-shaped groove for engaging an additional rope in a similar manner.

7. A winch to hoist a scaffold or other similar load which comprises:

a casing,

a pair of V-grooved pulleys with same diameter fixed in said casing in a vertically adjacent relation to each other,

a wire rope coming into and out of said casing vertically and passing around said pulleys by a single pass in a "Z" course,

access means providing access for lateral movement of said rope into said casing and onto said pulleys,

a gear train,

a motor mounted on said casing to drive one of said pulleys clockwise and the other counterclockwise through said gear train,

a frictional centrifugal brake coupled to said gear train,

a control handle attachable to said gear train to drive said pulleys manually through a part of said gear train in case said motor fails to run to drive said pulleys,

a hand brake attached to said gear train,

and means to fix said casing to the load,

one end of said rope being connected to a fixed point in space out of said casing and the other end of same being left free out of said casing, said rope passing around one of said pulleys clockwise and the other counterclockwise by a single pass so as to embrace substantially more than half of each pulley in a frictional relation to the V-groove thereof,

pressing means pressing said rope against one of said pulleys so as to provide the rope with sufficient tension to support the load,

said motor including brake means operable automatically when the motor is stopped.

8. A winch to hoist a scaffold or other similar load in accordance with claim 7 wherein said pressing means comprises a roller in contact with said rope at the point where said rope leaves said one pulley in the counter-load side naturally by its own gravity,

a rod pivotally supported on an inner wall of said casing to support said roller thereon,

spring means to urge said rod pivotally into a position to hold said roller to exert the required compression to said rope at said contact point,

and a plate pivotally supported on an inner wall of said casing to be in a position substantially near to said pressing roller oppositely to said counter-load side pulley thereby preventing said roller from getting out of said contact point during service and to be out of said position when desired for detachment of said roller from said contact point.

9. A winch to hoist a scaffold or other similar load in accordance with claim 7 wherein said access means comprises:

a substantially large door to be opened freely in front of said casing,

an opening indented from the front edge of a top part of said casing to guide said rope through,

and an opening indented from the front edge of a bottom part of said casing to guide said rope through.

10. A winch to hoist a scaffold or other similar load in accordance with claim 7 wherein each of said pulleys is provided with a plurality of parallel V-grooves in independent relation with each other so as to permit a plurality of wire ropes to pass around said pulleys in a "Z" course by a single pass in parallel relation with each other.

11. In a winch,

a pair of V-grooved pulleys,

a gear casing,

a gear train in the casing including a first input shaft extending out of one side of the casing,

a second input shaft extending out of the other side of the casing,

a motor coupled to the first input shaft,

a hand crank attachable to the second shaft,

means mounting one of the pulleys rotatably on said second input shaft at said other side of the casing,

means mounting the other pulley rotatably at said other side of the casing,

and output means coupling the gear train to the pulleys.

12. In a winch,

casing means having a pulley compartment,

a V-grooved upper pulley,

a grooved lower pulley,

mounting means mounting the pulleys in the pulley compartment with the pulleys in the same plane and the upper pulley above the lower pulley,

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drive means for rotating the pulleys in opposite directions at the same peripheral speed, and a rope, the pulley compartment having an upper load opening therein through which the rope extends substantially vertically into the pulley compartment, past the upper pulley and into tangential engagement with the lower pulley, the pulley compartment also having a lower opening through which the rope extends out of the pulley com-

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partment from the tangential engagement with the upper pulley, the rope extending substantially completely around the lower peripheral portion of the lower pulley, partially around the upper peripheral portion of the lower pulley, partially around the lower peripheral portion of the upper pulley and substantially completely around the upper peripheral portion of the upper pulley.

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