June 9, 1925. 1,541,267

J. W. KITTREDGE

HOISTING BLOCK

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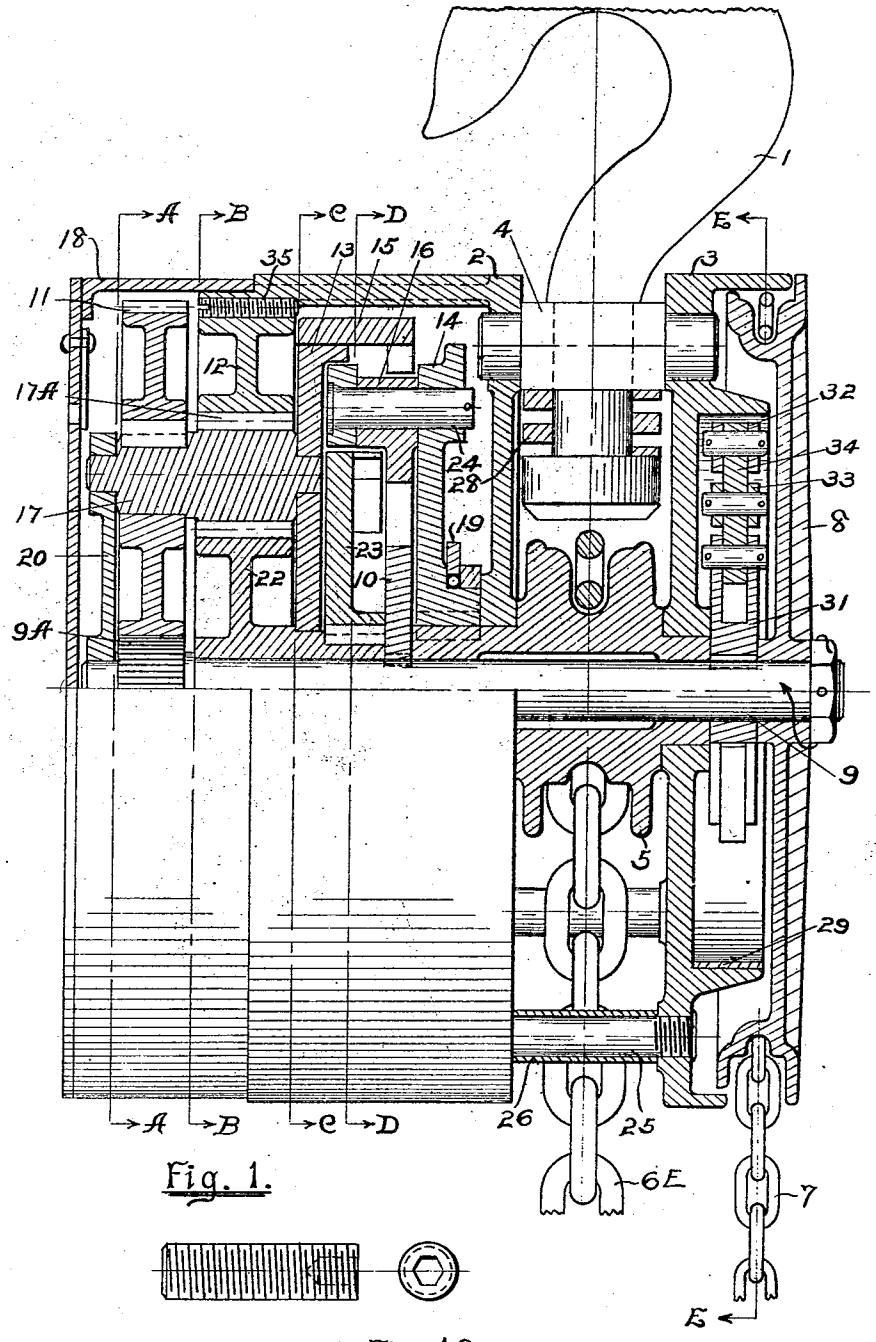


Fig. 1.

Fig. 10.

Witness.

Roy H. Brown.

Inventor:

John W. Kittredge

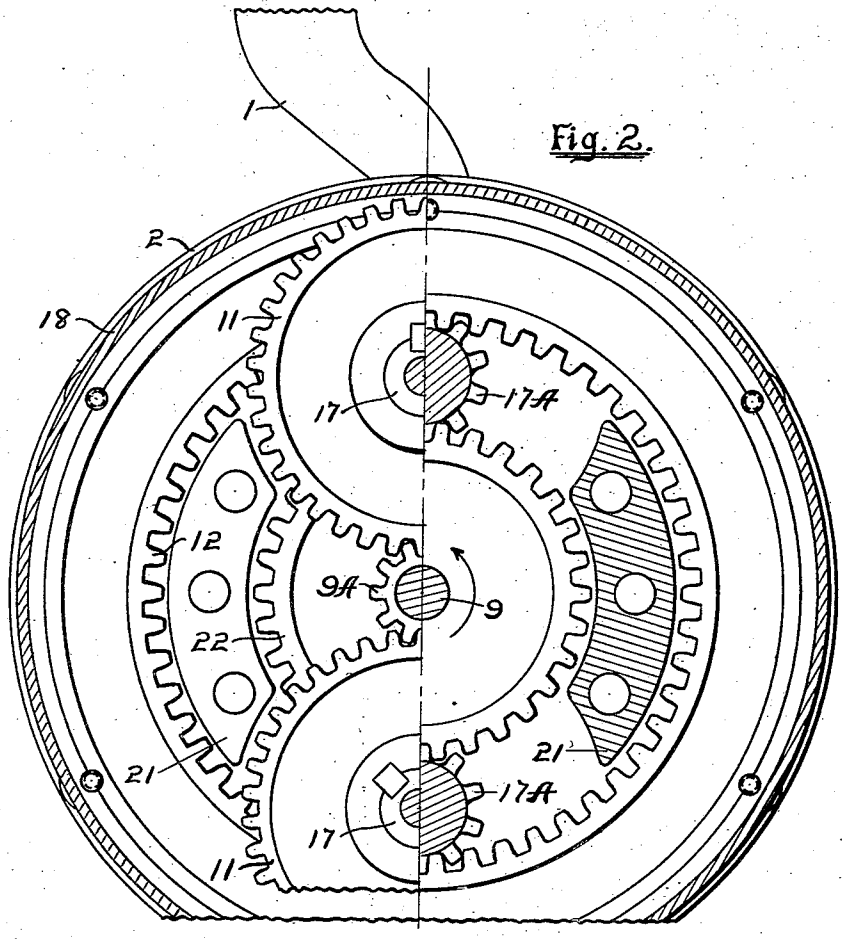
June 9, 1925. 1,541,267

J. W. KITTREDGE

HOISTING BLOCK

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Fig. 2.



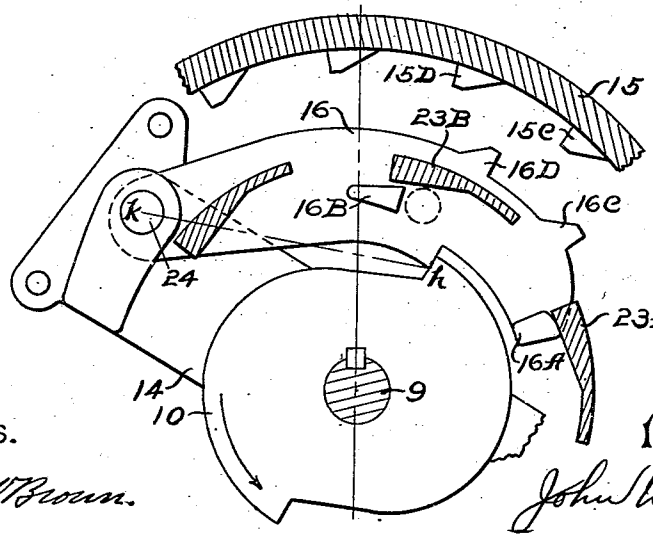


Fig. 7.

Witness.
Roy W. Brown.

Inventor.
John W. Kittredge

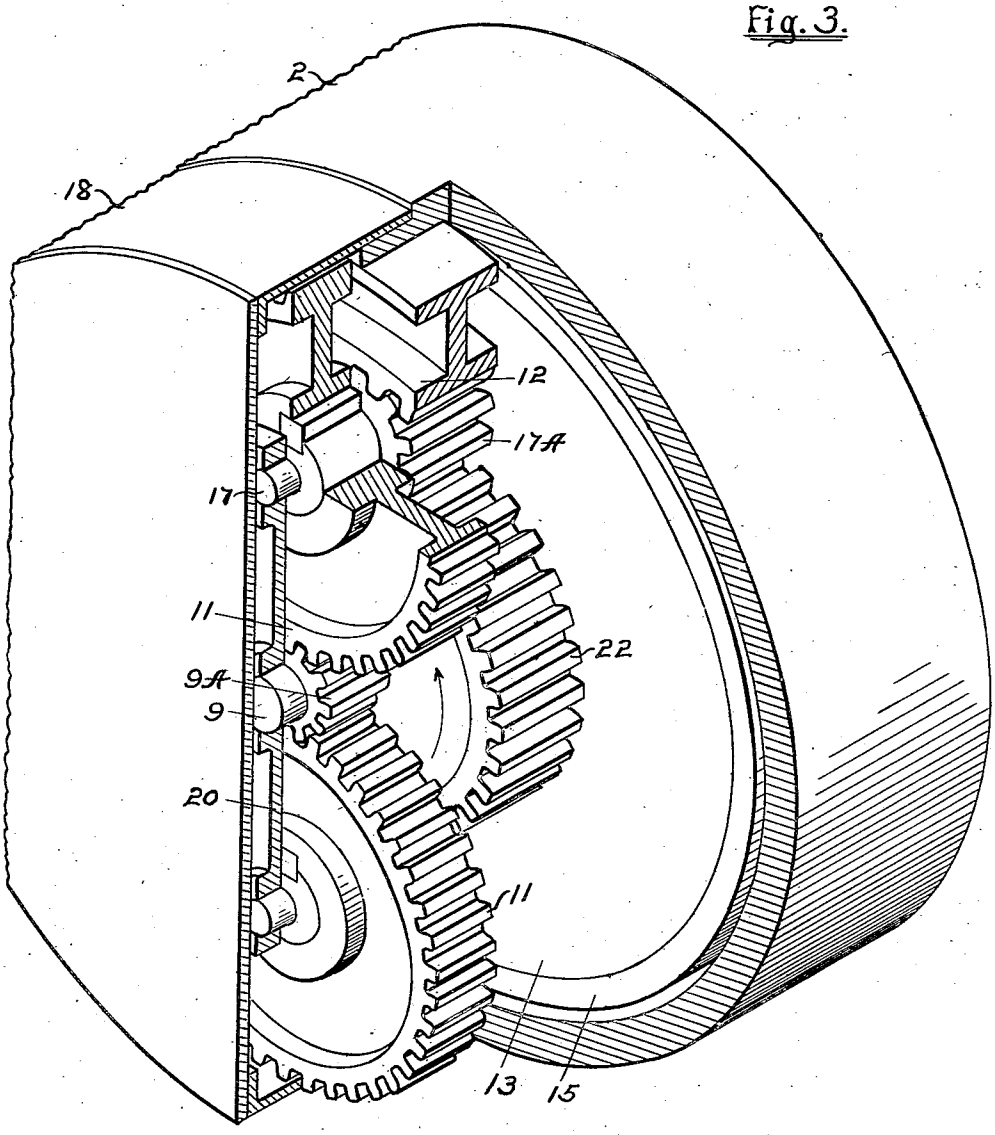
June 9, 1925. 1,541,267

J. W. KITTREDGE

HOISTING BLOCK

Filed Dec. 13, 1920 7 Sheets-Sheet 3

Fig. 3.



Witness.

Royd W. Brown.

Inventor.

John W. Kittredge.

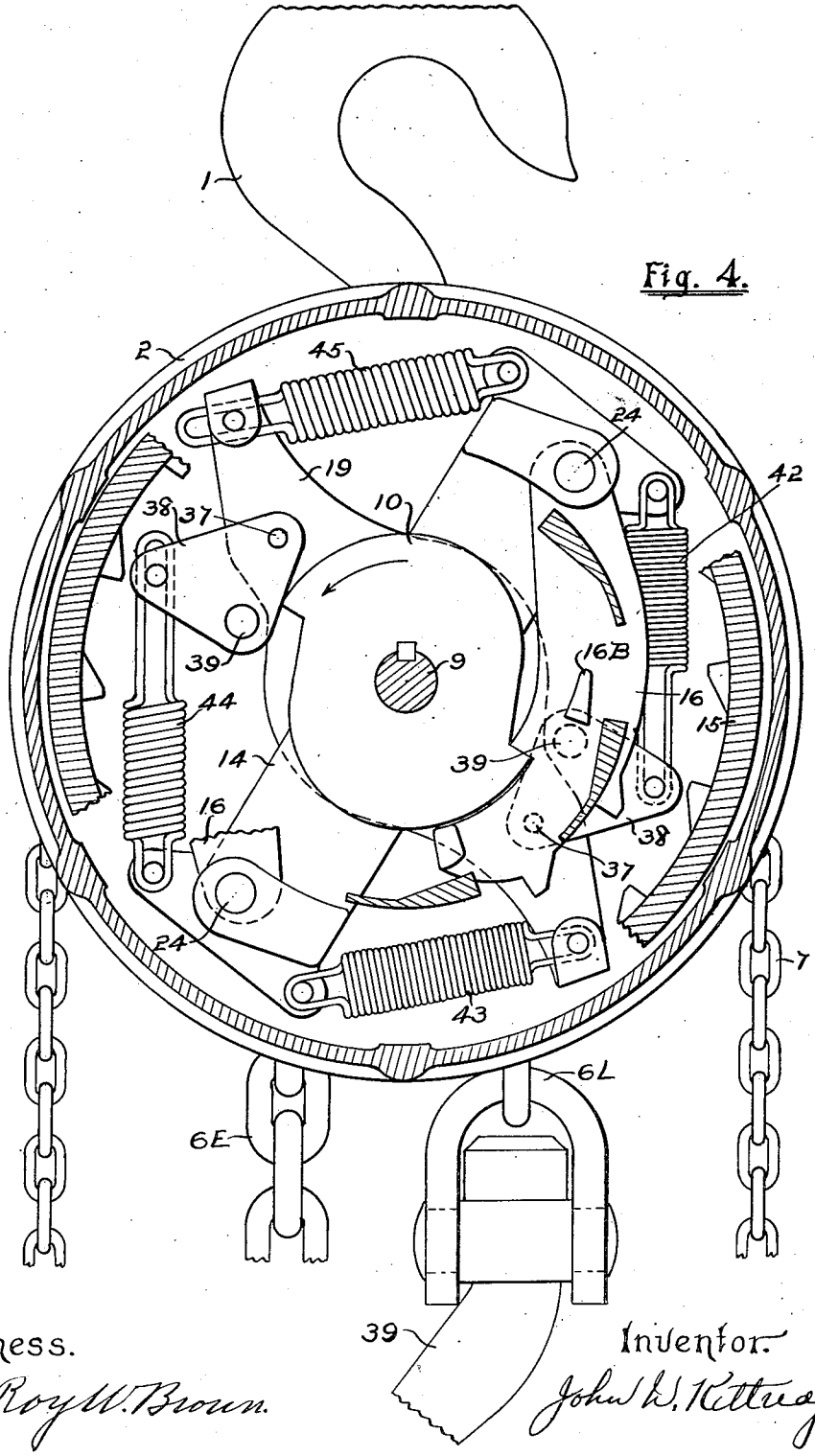
June 9, 1925. 1,541,267

J. W. KITTREDGE

HOISTING BLOCK

Filed Dec. 13, 1920 7 Sheets-Sheet 4

Fig. 4.



Witness.

Roy W. Brown.

Inventor.

John W. Kittredge

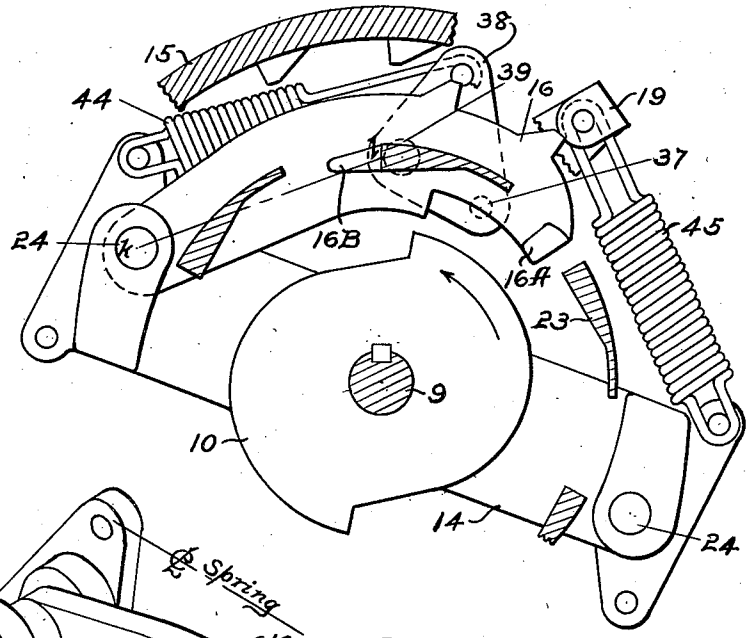
June 9, 1925. 1,541,267

J. W. KITTREDGE

HOISTING BLOCK

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Fig. 6.



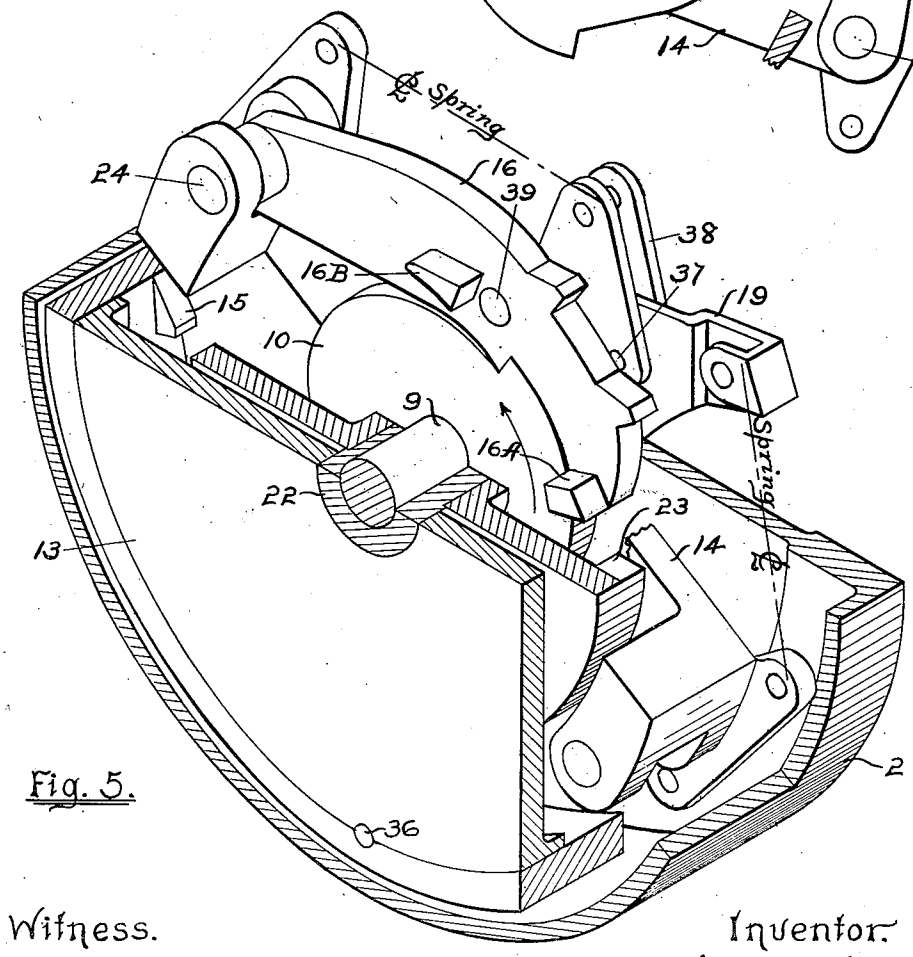


Fig. 5.

Witness.
Roy H. Brown.

Inventor:
John W. Kittredge

June 9, 1925. 1,541,267

J. W. KITTREDGE

HOISTING BLOCK

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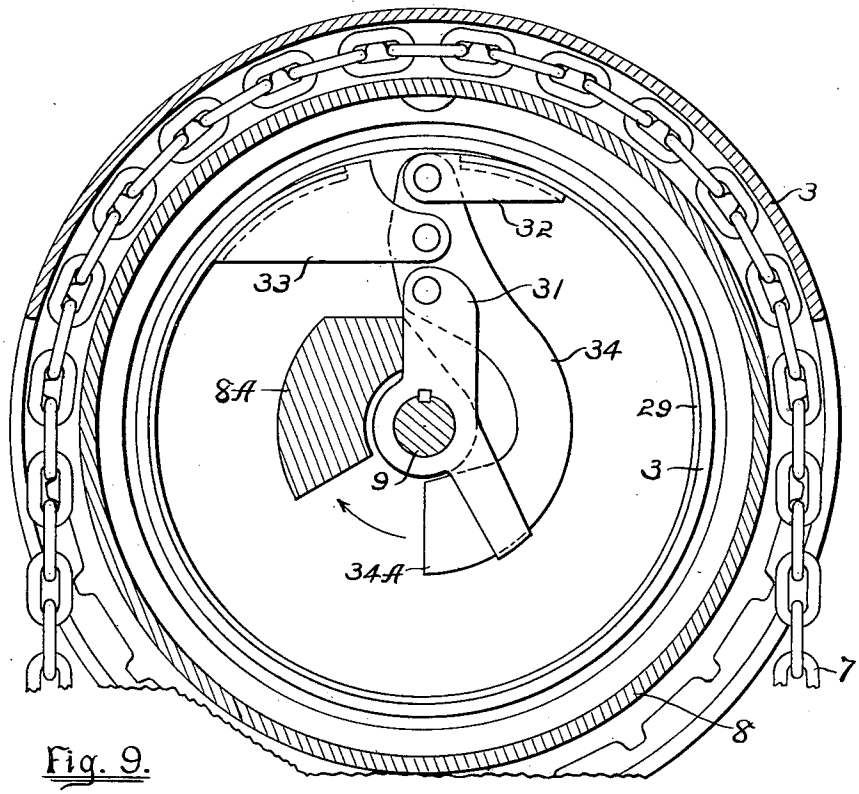


Fig. 9.

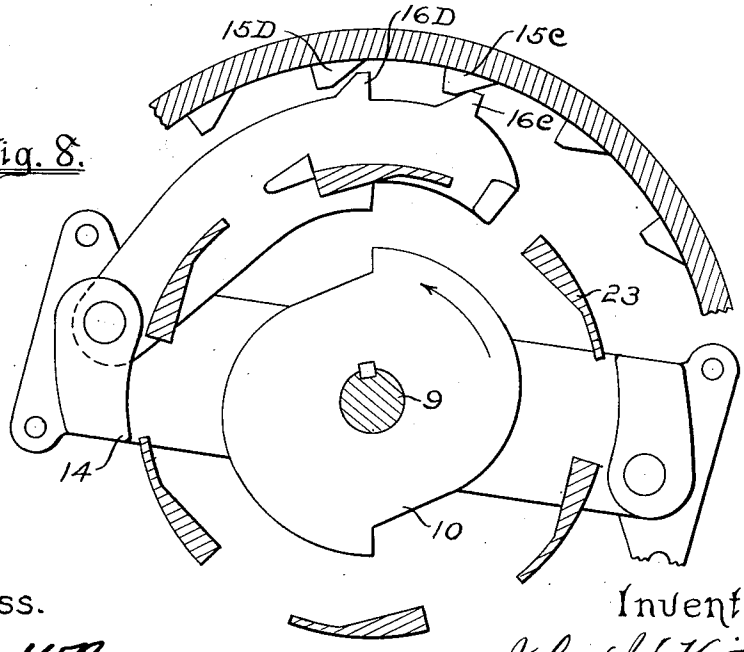


Fig. 8.

Witness.
Royll. Brown.

Inventor.
John W. Kittredge.

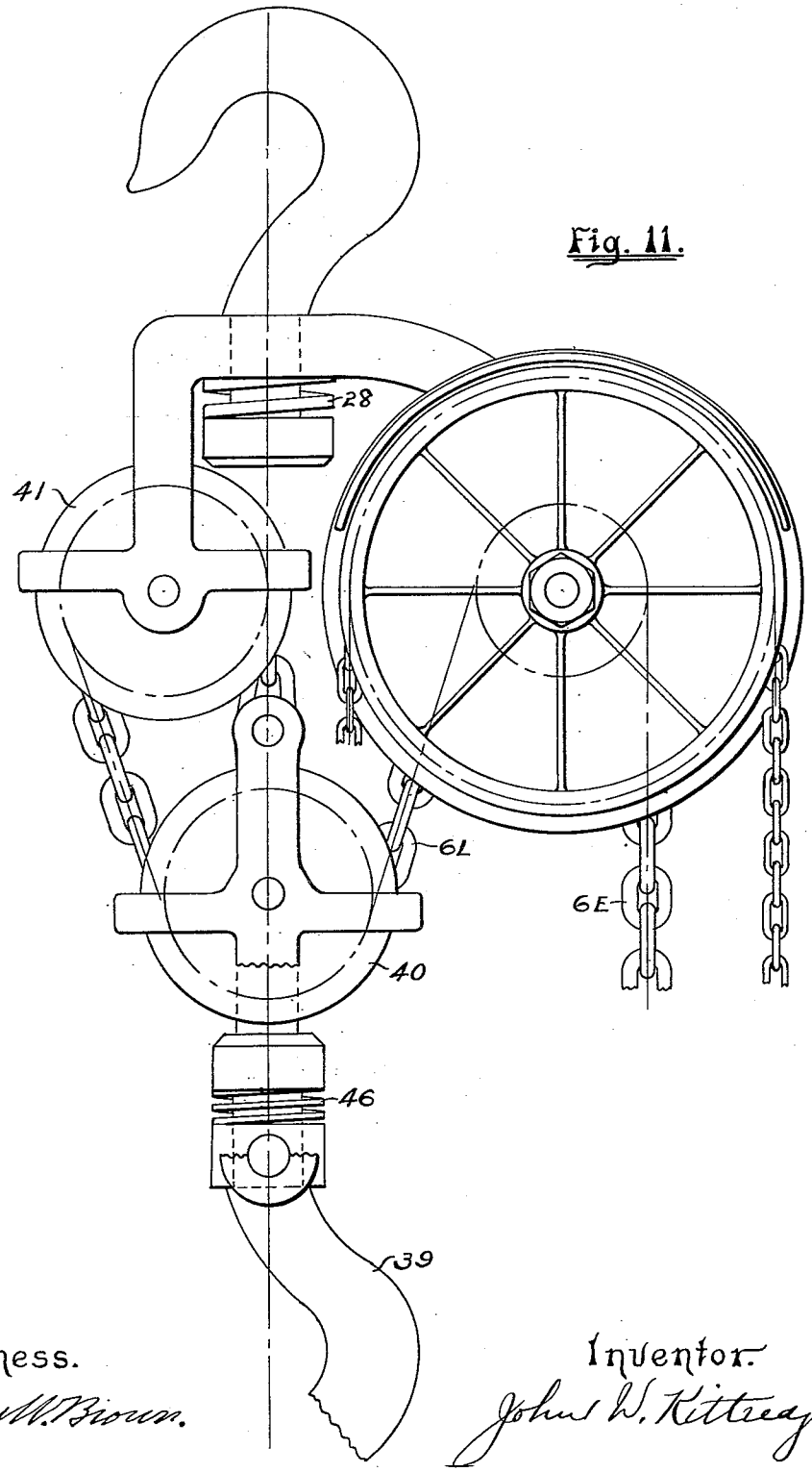
June 9, 1925. 1,541,267

J. W. KITTREDGE

HOISTING BLOCK

Filed Dec. 13, 1920 7 Sheets-Sheet 7

Fig. 11.



Witness.
Roy W. Brown.

Inventor.
John W. Kittredge

Patented June 9, 1925. 1,541,267

UNITED STATES PATENT OFFICE.

JOHN W. KITTREDGE, OF AKRON, OHIO.

HOISTING BLOCK.

Application filed December 13, 1920. Serial No. 430,406.

To all whom it may concern:

Be it known that I, JOHN W. KITTREDGE, a citizen of the United States, residing at Akron, in the county of Summit and State of Ohio, have invented a new and useful Hoisting Block, of which the following is a full, clear, and exact description.

My invention is a further development of the hoist shown in my Patent Number 1,311,236, issued July 29th, 1919. It relates particularly to "chain blocks" operated by hand, but it may be power driven, may have cables instead of chains and have many other modifications. It may be combined with other parts and form a member of a larger machine. The brake is shown in my Patent, Number 1,496,273, issued June 3, 1924.

The objects of my invention are:—

1st. To provide a hoisting mechanism of interlocking parts, insuring positive action and absolute safety.

2nd. To have all mechanism enclosed and thereby protected from dirt and accidental injury, further inuring to safety.

3rd. To provide a hoisting block in which different loads upon the lifting line automatically put different trains of mechanism into operation, giving different speeds of the lifting line from a constant speed of the driving wheel, the greatest load on the lifting line producing in it the least speed, and the least load on the lifting line producing in it the greatest speed.

4th. To provide for ample lubrication; to eliminate lateral pressure on the bearings and transmit to the revolving parts, so far as possible, a turning moment only, thereby securing efficiency and economy of power.

I attain these objects by the mechanism shown in the accompanying drawings, in which,—

Fig. 1 is a longitudinal cross-section. The left half of Fig. 2 is a transverse section on line A—A of Fig. 1, and the right half of Fig. 2 is a transverse section on line B—B of Fig. 1; Fig. 2 entire showing the arrangement of the reducing gears. Fig. 3 is an isometric section of the gears and gear case, cut on line C—C of Fig. 1. Fig. 4 is a transverse section on line D—D of Fig. 1, showing the shifting mechanism, and Fig. 5 is an isometric section further illustrating said shifting mechanism. Figs. 6, 7 and 8 are also transverse sections on line D—D of Fig. 1, showing different positions of the shifting mechanism. Fig. 9 is a transverse section on line E—E of Fig. 1, showing the brake mechanism. Fig. 10 is a detail of the threaded keys. Fig. 11 is an end view of the block with the chain reeved over auxiliary sprockets to further reduce the speed and increase the lift.

For clearness of description, a given part is designated by a numeral as 16, and different edges or faces of that part by that numeral with letters, as 16^A, 16^B, etc. A given piece carries the same number throughout the several views. Both in the gearing and the shifting mechanism, similar mechanisms exist on opposite sides of the drive shaft. The machine can be made with triplicate mechanisms or other multiple.

The block is hung from an overhead support by the hook 1, which is attached to the gear case 2 and the brake case 3 by the swivel bar 4. Bolts 25 and spacers 26 bind the cases firmly together. A sprocket wheel 5 is journaled in bearings in the cases 2 and 3, and it carries a lifting chain 6. The loaded end of the chain is 6^L and the empty end is 6^E. The arrows, in every case, indicate the parts running in the direction to raise the load. The drive shaft 9 passes centrally through the lifting sprocket 5, and is journaled in bearings therein. A hand chain 7 actuates a sprocket wheel 8, which, in turn, actuates the drive shaft 9, through the brake mechanism hereinafter described.

Integral with the shaft 9, or rigidly attached to it, is a pinion 9^A. It meshes with the planetary gears 11. Gears 11 are mounted on shafts 17 and keyed rigidly thereto. The shafts 17 are journaled in the carrier plates 13 and 20. These carrier plates are bolted rigidly together with the spacers 21 between them, and the plates and spacers then revolve as a single rigid piece about the central axis of the machine. Integral with the shafts 17 are the pinions 17^A meshing with the annular gear 12, which is keyed fast in the gear case 2, by the threaded keys 35.

As the shaft 9 and the pinion 9^A revolve, the gears 11 and pinions 17^A revolve on their own axes and also revolve around the shaft 9, as the pinions 17^A follow around the annular surface of the stationary gear 12. The shafts 17 actuate the carrier plates 13 and 20, moving them around the shaft 9 in the same direction as its rotation, but much more slowly, depending on the ra-

tios of the reducing gears. The system forms a plentary gear train.

The gear 22 runs loose on the shaft 9 and meshes with the pinions 17^A. As the pinion 9^A actuates the gears 11 and the pinions 17^A, the said pinions 17^A actuate the gear 22, and turn it in the same direction as the pinion 9^A. It will be apparent that the gear 22 turns more slowly than the shaft 9, but faster than the carrier plates 13 and 20. The three members 9, 22 and 13 run in the same direction and actuate the lifting sprocket 5 at three different speeds, through pawl and ratchet connections now to be described.

The ratchet 10 is keyed rigidly to the shaft 9; the ratchet 23 is keyed rigidly to the hub of the gear 22; and the ratchet 15 is keyed rigidly to the carrier plate 13 by means of the threaded keys 36. The pawl holder 14 is keyed rigidly on the hub of the lifting sprocket 5. On each end of 14 is a fork which carries a pawl 16 by means of the pin 24. The pawls are in the same plane with the ratchets 10 and 15 and may engage and release them. The ratchet 23 is in a parallel plane and the projecting tooth 16^B on the pawl 16 may engage and release it. The pawl shifter 19 turns freely on the hub of the pawl holder 14 through a partial revolution, preferably on a ball bearing. The links 38 are attached to the pawl shifter 19 by the pins 37, and to the pawls by the pins 39. The pawl holder 14, the pawls 16, the pawl shifter 19 and the links 38 form two similar link motions permitting the pawls to move in and out about their pivots 24, but holding them at all times equidistant from the shaft 9. The light spring 42 is attached to the pawl holder 14 and to the links 38 by pins. Similarly, the light spring 43 is attached to the pawl holder 14 and to the pawl shifter 19 by pins. The tension of these springs tends to throw the pawls inward about their pivots 24, the two pawls moving simultaneously as just described. These springs 42 and 43 are of such length that they exert tension when the pawls are in their innermost positions in engagement with the ratchet 10 as shown in Fig. 4. The heavy springs 44 and 45 are attached similar to the springs 42 and 43, except that when the pawls are in their innermost position. the springs 44 and 45 have clearance and do not exert tension, as also shown in Fig. 4. Fig. 6 shows these parts with the pawls in mid-position, in engagement with the ratchet 23. In this position, the parts have taken up the clearance and any further outward movement expands the heavy springs 44 and 45. As the two pawls must always move in and out together, as previously explained, it will be apparent that when the heavy springs are inactive as in Fig. 4, the two light springs exert their tension on both pawls; and when the heavy springs come into action as in Fig. 6, they also exert their heavy tension on both pawls.

The planes of the ratchet teeth in contact with the pawls are inclined to the lines of force which pass through the pivots 24; as line *kh* in Fig. 7, and line *kl* in Fig. 6. In consequence, the pawls slip outward and release the ratchet 10 when the outward force due to the pressure on the inclined planes exceeds the inward force due to the light springs 42 and 43. And they slip farther out and release the ratchet 23, when the outward force due to the pressure on the inclined planes exceeds the inward force due to all four springs. The teeth are so spaced radially that the pawls cannot release ratchet 10 until they are in position to engage ratchet 23; and they cannot release ratchet 23 until they are in position to engage ratchet 15; so they must be in engagement with one ratchet or another at all times. The teeth are so spaced circumferentially that when the pawls release ratchet 10, said ratchet 10 holds them out in approximate mid-position until they come into contact with teeth on ratchet 23; and when the pawls release ratchet 23, said ratchet 23 holds them out in approximate outermost position until they come into contact with teeth on ratchet 15. If ratchet 10 has 2 teeth, ratchet 23 has 6 teeth and ratchet 15 has 16 teeth as shown in the drawings, they accomplish this result. This arrangement of teeth radially and circumferentially makes it impossible for a load to run back except as it is controlled by shaft 9 and the gearing.

While this arrangement is desirable and necessary to insure a positive grip on the load at all times, it will be evident that sometimes the pawls will take the position shown in Fig. 7. That is where the load is sufficient to drive the pawl outward, but where the tooth 16^B would antagonize the tooth 23^B before the pawl would release the ratchet 10. If it should so antagonize, then the pawl would have to move slightly inward as the ratchet 10 turned in the direction of the arrow, until the tooth 16^B passed the tooth 23^B and could pass out into proper engagement with it. But in such case, the inward pressure of the tooth 23^B would have a component tending to increase the pressure on the ratchet 10, and thereby increase the friction at *h*, and prevent such inward movement of the pawl 16. To overcome these difficulties, I provide another projecting tooth 16^A which antagonizes the tooth 23^A and causes 16^B to clear 23^B, as shown in Fig. 7. The inward pressure of 23^A has a component tending to lessen the pressure at *h* and thereby lessen the friction there. This arrangement causes the pawl to move slightly

inward until it can pass out into the position shown in Fig. 6. Similarly, a guide tooth 16^C antagonizes tooth 15^C and causes lifting tooth 16^D to clear tooth 15^D until the pawl can pass out into proper engagement with the ratchet 15, as shown in Fig. 8.

If, now, the gear 9^A has 10 teeth, gear 11 has 38 teeth, gear 17^A has 10 teeth, gear 22 has 30 teeth and gear 12 has 50 teeth; if sprocket 5 has a pitch diameter of 4.437 inches and sprocket 8 has a pitch diameter of 13.925 inches; then on fast speed, the operator passes 3.14 feet of hand chain through his hands to raise the lifting chain 6^L one foot; on intermediate speed, he passes 23.54 feet of hand chain to raise the lifting chain one foot; and on slow speed, he passes 62.76 feet of the hand chain to raise the lifting chain one foot. On fast speed, 70.8 lbs. pull on the hand chain lifts 200 lbs. on the lifting chain, if 10 per cent of the energy is consumed in friction. The springs 42 and 43 should then yield under a load of 200 lbs. on the lifting chain. On intermediate speed, a pull of 102.4 lbs. on the hand chain lifts 1 ton on the lifting chain if 17 per cent of the energy is consumed in friction. The four springs 42, 43, 44 and 45 should then yield under a load of 1 ton on the lifting chain. On slow speed, a pull of 106.2 lbs. on the hand chain lifts 2.5 tons on the lifting chain if 25 per cent of the energy is consumed in friction.

Suppose the lifting chain 6^L tightens on a 2.5 ton load when the pawls are in the position shown in Fig. 8. To lift the load on intermediate speed a fraction of an inch until they could pass out into engagement would require a pull of some 256 lbs. on the hand chain, which would be objectionable, even for a very short interval. To overcome this difficulty, I provide a spring 28 which yields at a little more than 1 ton. Then, with a pull of 110 lbs. or thereabouts on the hand chain, the operator compresses the spring 28 with the load stationary, until the pawl can shift to proper engagement with the ratchet 15, and then he raises the load on the proper speed ratio. The spring 28 can be anywhere in the line of pull, but I prefer to put it on the upper hook as shown.

A cover 18 is bolted over the end of the gear case 2. This entirely encloses the gears and shifting mechanism and protects them from the operator as well as from dirt and accidental injury. The shifting mechanism is therefore actuated by tension on the lifting chain only. So long as there is a medium or heavy tension on that chain, the load must necessarily run on intermediate or slow speed. So long as there is a light tension on that chain, it must necessarily run on high speed. The lifting chain can be run either up or down on fast, intermediate or slow speed, depending on its tension. The operator has absolutely no means of changing the speed ratio except by changing the load.

The joints in the gear case 2 may be sealed and the case half filled with oil. The gears and shifting parts then run in an oil bath.

In order that the block shall hold its load securely, a brake is provided. This consists of an expanding band 29 seated on the interior surface of the brake case 3. The band 29 has shoes 32 and 33 securely fastened to its ends. The lever 31 is keyed to the shaft 9, while the hand sprocket 8 turns freely on the said shaft through a partial revolution. The lever 34 is attached to the lever 31 and to the brake shoes 32 and 33 by pin connections as shown. The lug 8^A projects from the face of the sprocket 8 and is integral therewith. Normally, the spring 29 expands against its enclosing walls. The load tends to turn the shaft 9 opposite to the direction of the arrow, and acting through levers 31 and 34 and shoes 32 and 33, it expands the band still more firmly against the walls. The greater the torque on the shaft, the more tightly does the band grip. When, however, the operator turns the sprocket 8 arrow-wise, or in the direction of lift, the lug 8^A engages the lever 31; the lever 31 actuates the lever 34, and it contracts the band and allows it to turn freely. When he turns the sprocket 8 in the opposite direction, or in the direction of lowering, the lug 8^A engages the end 34^A of the lever 34, and it again contracts the band and allows it to turn freely.

For heavier loads than the block can lift direct, as above described, the hook 39, instead of being attached directly to the lifting chain 6^L, is attached to an auxiliary sprocket 40, and the chain 6^L is reeved over one or more such sprockets as 40 and 41 in Fig. 11. The gears and shifting mechanism may then be exactly the same as above described for the smaller loads. The reeving multiplies the lifting power. In such case, it will be convenient to have a light spring 46, yielding at slightly greater load than that required to shift the pawls from ratchet 10 to ratchet 23, and a heavy spring 28, yielding at slightly greater load than that required to shift the pawls from ratchet 23 to ratchet 15.

It will be understood that the figures hereinbefore given for loads, number of teeth, etc., are for illustration only, and do not in any way limit the claims, as the block can be made in many sizes and styles.

With excessive friction resulting from wear, dirt or other cause, the springs may fail to throw in the fast motion. The heavy pull of the load cannot fail to throw in the slower motions until the mechanism is injured beyond the possibility of use. If the

springs break, that simply eliminates the fast motion. So if, at any time, the block fails to function, it must fail on the side of safety.

Having thus described my invention, I claim:

1. In a hoisting block, a combination of driving elements so co-acting as to form a planetary gear drive, a second combination of driving elements co-acting in a different manner from the first combination so as to form a different planetary gear drive, and the said driving elements comprising a planetary gear train; said planetary gear train in combination with a frame, a driven wheel, a lifting line, a winding connection between the driven wheel and the lifting line, and means controlled by the load on the lifting line which shift the drive from one planetary gear drive to the other.

2. In a hoisting block, a combination of driving elements so co-acting as to form a planetary gear drive, a second combination of driving elements co-acting in a different manner from the first combination so as to form a different planetary gear drive, and the said driving elements comprising a planetary gear train; a drive shaft in the said planetary gear train; said planetary gear train in combination with a frame, a driven wheel, a lifting line, a winding connection between the driven wheel and the lifting line, and means controlled by the load on the lifting line whereby the said drive shaft drives the driven wheel direct or drives it through one or another of the said planetary gear drives.

3. In a hoisting block, a planetary gear drive, a gear adapted to co-act with the said planetary gear drive and thereby form a different planetary gear drive, the elements aforesaid comprising a planetary gear train; and in combination with the said planetary gear train, a frame, a driven wheel, a lifting line, a winding connection between the driven wheel and the lifting line, and means controlled by the load on the lifting line which shift the drive from one of the said planetary gear drives to the other one.

4. In a hoisting block, a planetary gear drive, a drive shaft therein, a gear adapted to co-act with the said planetary gear drive and thereby form a different planetary gear drive, the elements aforesaid comprising a planetary gear train; and in combination with the said planetary gear train, a frame, a driven wheel, a lifting line, a winding connection between the driven wheel and the lifting line, and means controlled by the load on the lifting line whereby the drive shaft drives the driven wheel direct or drives it through one or another of the said planetary gear drives.

5. In a hoisting block, the combination of a supporting member, a frame, a drive shaft, a driven wheel, a lifting line, a winding connection between the lifting line and the driven wheel, gearing, a plurality of ratchets, a pawl, the said pawl adapted to engage one of the ratchets and thereby lock the driven wheel to the drive shaft whereby the said driven wheel and the drive shaft revolve at the same speed, the said pawl adapted to engage another of the ratchets and thereby connect the driven wheel to the drive shaft through the gearing whereby the said driven wheel and the drive shaft revolve at different speeds, and means whereby different loads on the lifting line put the pawl in engagement with the different ratchets consecutively.

6. In a hoisting block, the combination of a frame, a drive shaft, a driven wheel, a plurality of toothed members adapted to interlock and release and thereby form a plurality of drive connections from the drive shaft to the driven wheel, beveled teeth on the said toothed members adapted to shift them under change of load from one drive connection to another, springs adapted to exert force on the said toothed members in opposition to the beveled teeth, a lifting line, and a winding connection between the lifting line and the driven wheel.

7. In a hoisting block, the combination of a frame, a drive shaft, a driven wheel, a plurality of ratchets, a pawl, said pawl adapted to engage the said ratchets consecutively and thereby form a drive connection from the drive shaft to the driven wheel through each engaged ratchet, the ratchet teeth bearing obliquely on the said pawl and thereby adapted under change of load to shift the pawl from engagement with one ratchet to engagement with another one, a spring, said spring adapted to exert force on the said pawl and to thereby resist the oblique pressure of the ratchet teeth, a lifting line, and a winding connection between the lifting line and the driven wheel.

8. In a hoisting block, the combination of a frame, a drive shaft, a driven wheel, a lifting line, a winding connection between the lifting line and the driven wheel, a plurality of drive connections from the drive shaft to the driven wheel, a ratchet in each of the said drive connections, a pawl, said pawl being a thrust member, and means solely dependent upon different thrusts in the said pawl to put it in engagement with one or another of the said ratchets and thereby shift from one of the said drive connections to another.

9. In a hoisting block, the combination of a supporting member, a frame, a drive shaft, a driven wheel, a lifting line, a winding connection between the lifting line and the driven wheel, an inner ratchet, an outer ratchet, a pawl, a spring adapted to exert inward pressure upon the pawl, the said

pawl adapted to engage the inner ratchet and thereby form a drive connection from the drive shaft to the driven wheel, the said ratchet bearing obliquely upon the pawl and thereby adapted to exert outward pressure upon the said pawl, and the said pawl adapted under increased outward pressure of the said ratchet to throw outward from the said inner ratchet into engagement with the said outer ratchet and thereby form a different drive connection from the drive shaft to the driven wheel.

10. In a hoisting block, the combination of a supporting member, a frame, a drive shaft, a driven wheel, a lifting line, a winding connection between the lifting line and the driven wheel, a plurality of ratchets each ratchet having a different number of teeth from every other ratchet, a pawl, said pawl adapted to engage the said ratchets consecutively and thereby form a drive connection from the drive shaft to the driven wheel through each engaged ratchet, the ratchet teeth adapted to bear obliquely on the said pawl and thereby shift it under change of load from engagement with one ratchet to engagement with another one, a spring adapted to bear on the said pawl in opposition to the oblique tooth pressure, and the ratchets so spaced that the pawl must engage one ratchet before it releases another one.

11. In a hoisting block, the combination of a supporting member, a frame, a drive shaft, a plurality of ratchets, a positive drive connection to each ratchet from the drive shaft, a driven wheel, a lifting line, a winding connection between the driven wheel and the lifting line, a pawl, a pivot rigid with the driven wheel and having the pawl pivoted thereon, a spring, a connection between the spring and the pawl whereby the spring tends to turn the pawl on its pivot, the pawl positioned to engage the ratchets consecutively as it turns on its pivot and thereby connect the engaged ratchet to the driven wheel, and the pawl engaging the ratchet teeth at angles oblique to the direction of its pressure.

12. In a hoisting block, the combination of a supporting member, a frame, a drive shaft, a driven wheel, a plurality of ratchets, a pawl, a guide tooth on the said pawl, lifting teeth on the said pawl, the pawl adapted to engage the ratchets consecutively and thereby form a drive connection from the drive shaft to the driven wheel through each engaged ratchet, the said lifting teeth and the ratchet teeth beveled forming inclined planes and exerting outward pressure upon the said pawl, a spring exerting inward pressure upon the said pawl, a lifting line, and a winding connection between the lifting line and the driven wheel.

13. In a hoisting block, the combination of a supporting member, a frame, a driving wheel, a drive shaft, a connection between the driving wheel and the drive shaft, a driven wheel, a lifting line, a winding connection between the driven wheel and the lifting line, a pawl, springs, some of the said springs stronger than the others, constant connections between the pawl and the weaker springs, intermittent connections between the pawl and the stronger springs, a pivot connection between the pawl and the driven wheel, a plurality of ratchets, each ratchet having a different number of teeth from every other ratchet, drive connections from the drive shaft to the ratchets, each drive connection driving its ratchet at a different speed ratio from the others, the said pawl adapted to engage the said ratchets consecutively, the said ratchets so spaced that the pawl must engage one ratchet before it releases another one, and the engaging surfaces of the pawl and ratchets slanting whereby the torque of the driven wheel exerts force on the pawl opposite to the force of the springs.

14. In a hoisting block, the combination of a supporting member, a frame, a drive shaft, a driven wheel, a plurality of ratchets, teeth on the said ratchets, a pawl adapted to engage the said ratchets consecutively and thereby form a drive connection from the drive shaft to the driven wheel through each engaged ratchet and the pawl bearing obliquely on the said ratchet teeth, a spring adapted to exert pressure on the said pawl opposite to the reaction of the oblique bearing pressures, a lifting line, a winding connection between the lifting line and the driven wheel, and an auxiliary spring connected between the supporting member and the load adapted to yield at a given load on the lifting line whereby the said pawl may easily pass from a position of interference to a position of shift.

15. In a hoisting block, the combination of a supporting member, a frame, a drive shaft, a plurality of ratchets, a plurality of driving planetary gear connections from the drive shaft to the ratchets, the one driving gear connection comprising a central pinion rigid with the drive shaft, a plurality of planet gears coaxial with each other one of them meshing with the said pinion, a stationary annular gear meshing with one of the planet gears, said annular gear concentric with the drive shaft, and a carrier adapted to carry the planet gears around the drive shaft; the other driving gear connection comprising the gears and carrier hereinbefore described and in addition a gear co-axial with the drive shaft and meshing with one of the planet gears; one of the said ratchets rigid with the said carrier, another of the said ratchets rigid with the gear last described, a driven wheel, a lifting

line, a winding connection between the driven wheel and the lifting line, a pawl, a pivot connection between the pawl and the driven wheel, a spring adapted to turn the pawl on its pivot connection, the pawl adapted to engage any one of the ratchets and thereby form a drive connection from the engaged ratchet to the driven wheel, and the ratchet teeth bearing obliquely on the said pawl.

16. In a hoisting block, the combination of a supporting member, a frame, a drive shaft, a plurality of ratchets, a plurality of driving planetary gear connections from the drive shaft to the ratchets, the one driving gear connection comprising a central pinion rigid with the drive shaft, a plurality of planet gears co-axial with each other one of them meshing with the said pinion, a stationary annular gear meshing with one of the planet gears, said annular gear concentric with the drive shaft, and a carrier adapted to carry the planet gears around the drive shaft; the other driving gear connection comprising the gears and carrier hereinbefore described and in addition a gear co-axial with the drive shaft and meshing with one of the planet gears; one of the said ratchets rigid with the said carrier, another of the said ratchets rigid with the gear last described, and another of the said ratchets rigid with the drive shaft, a driven wheel, a lifting line, a winding connection between the driven wheel and the lifting line, a pawl, a pivot connection between the pawl and the driven wheel, a spring adapted to turn the pawl on its pivot connection, the pawl adapted to engage any one of the said ratchets and thereby form a drive connection from the engaged ratchet to the driven wheel, and the ratchet teeth bearing obliquely on the said pawl.

17. In a hoisting block, a planetary gear train comprising a drive shaft, a plurality of planet gears, a plurality of gears co-axial with the drive shaft and one of them rigid therewith, said co-axial gears in mesh with the planet gears, and a carrier adapted to carry the planet gears around the drive shaft; this gear train in combination with a supporting member, a frame, a plurality of ratchets rigidly connected to different members of the planetary gear train whereby the said planetary gear train drives the said ratchets at different speeds, a driven wheel, a lifting line, a winding connection between the driven wheel and the lifting line, pawls, pivot connections between the pawls and the driven wheel, springs adapted to turn the said pawls on their pivot connections, the pawls adapted to engage any one of the ratchets and thereby form a drive connection from the engaged ratchet to the driven wheel, and the ratchet teeth bearing obliquely upon the said pawls.

18. In a hoisting block, a planetary gear train comprising a drive shaft, a plurality of planet gears, a plurality of gears co-axial with the drive shaft and one of them rigid therewith, said co-axial gears in mesh with the planet gears, and a carrier adapted to carry the planet gears around the drive shaft; this gear train in combination with a frame, a plurality of ratchets rigidly connected to different members of the planetary gear train, a driven wheel, a lifting line, a winding connection between the driven wheel and the lifting line, a pawl, the said pawl adapted to engage any one of the said ratchets and thereby form a drive connection from the drive shaft to the driven wheel through the engaged ratchet, the ratchet teeth bearing obliquely on the said pawl and thereby adapted under change of load to shift the pawl from engagement with one ratchet to engagement with another one, and a spring adapted to exert force on the said pawl in opposition to the oblique tooth pressure.

19. In a hoisting block, the combination of a frame, a drive shaft, a lifting line, a plurality of power transmissions from the drive shaft to the lifting line, ratchets on elements of the said power transmissions and each power transmission adapted to drive through a given ratchet, a pawl, a pivot connection between the pawl and an element of the said power transmissions, the pawl adapted to engage the said ratchets consecutively and to thereby form a direct driving member between the engaged ratchet tooth and the said pivot, the pawl also adapted to engage the ratchet teeth obliquely to the said line of drive, the width of the pawl acting on consecutive ratchets being greater than the distance between the said ratchets, and the pawl thereby adapted under variable oblique pressure of the said ratchet teeth to pass directly from engagement with one ratchet to engagement with another one, and a spring adapted to exert transverse pressure on the said pawl.

In testimony whereof, I have signed my name to this specification in the presence of two subscribing witnesses, this 26th day of November, 1920.

JOHN W. KITTREDGE.

Witnesses:
ROY W. BROWN,
JOHN HOUSTON.