Oct. 27, 1942. M. G. CLAY 2,300,343

HOISTING MECHANISM

Filed Jan. 24, 1941 2 Sheets-Sheet 1

FIG. 1

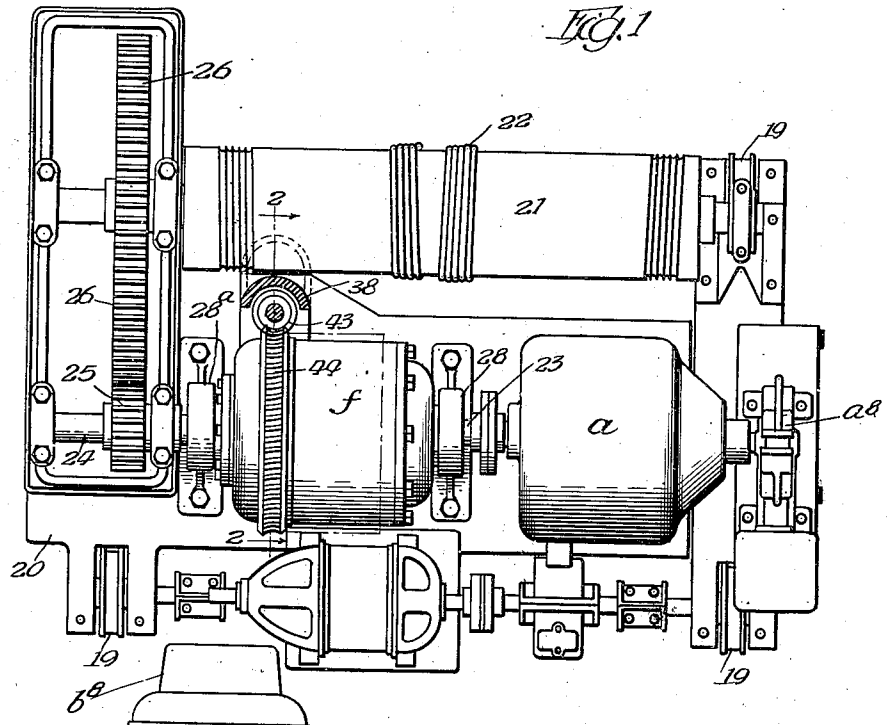
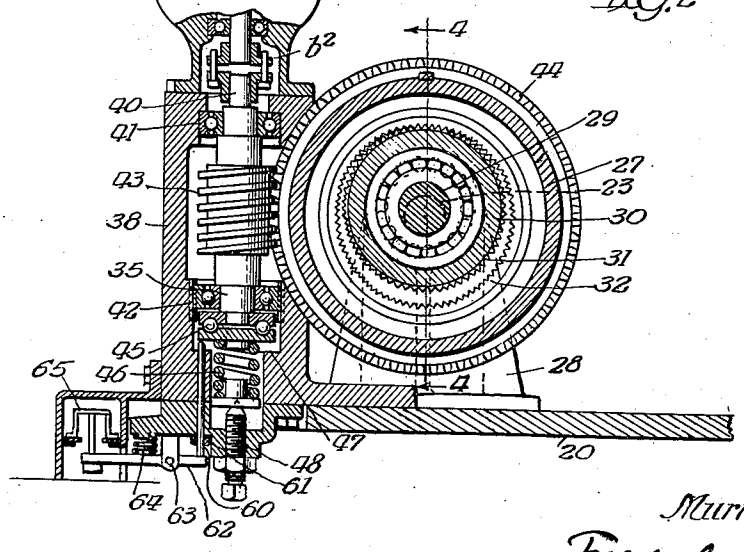


FIG. 2



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HOISTING MECHANISM

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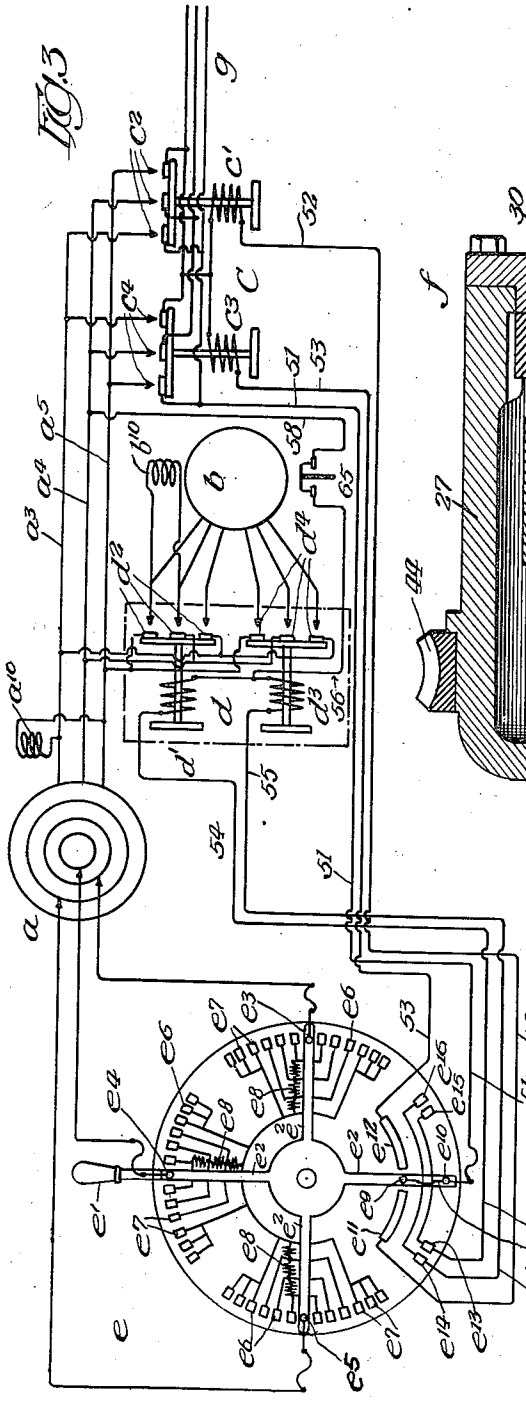


FIG. 3

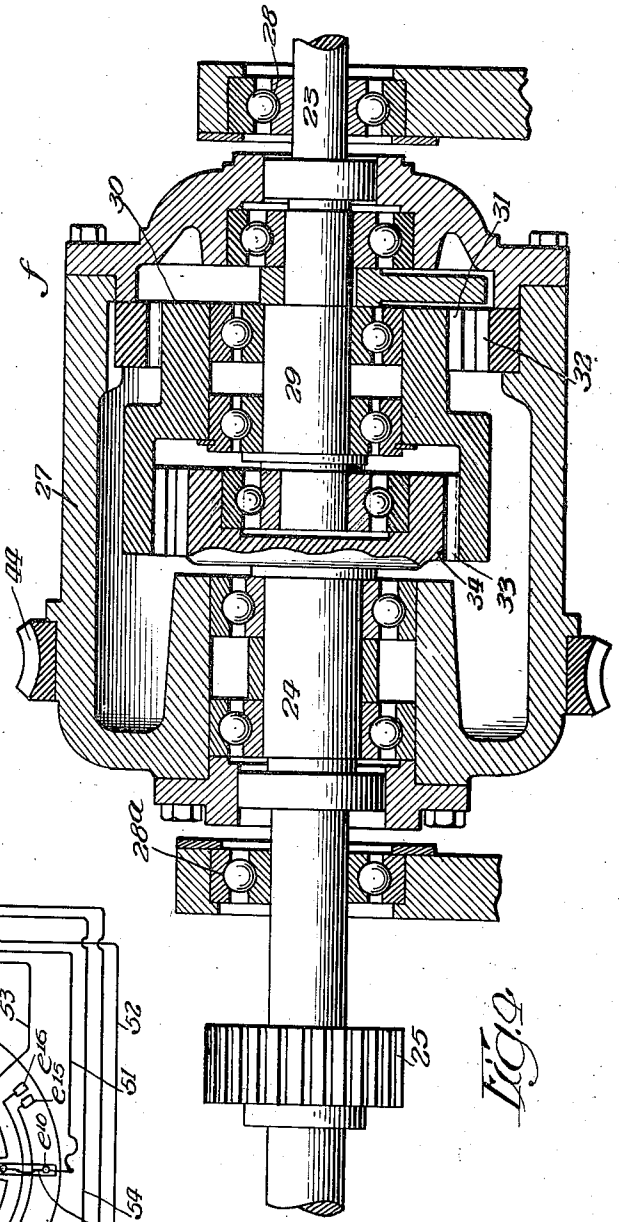


FIG. 2

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HOISTING MECHANISM

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Application January 24, 1941, Serial No. 375,819

7 Claims. (Cl. 254—173)

The invention relates to hoisting apparatus.

One object of the invention is to provide hoisting mechanism which includes an electric motor for hoisting heavy loads through a speed-reducing unit and an auxiliary motor for operating the unit at higher speeds for quickly shifting light loads.

Another object of the invention is to provide hoisting mechanism of this type with unitary control means whereby both motors may be controlled for hoisting heavy and light loads at relatively low and high speeds.

Other objects of the invention will appear from the detailed description.

The invention consists in the several novel features which are hereinafter set forth and are more particularly defined by claims at the conclusion hereof.

In the drawings: Fig. 1 is a plan view of hoisting mechanism embodying the invention. Fig. 2 is a section taken on line 2—2 of Fig. 1. Fig. 3 is a diagrammatic view illustrating the hoisting mechanism and the electrical connections for controlling the operation of the motors. Fig. 4 is a longitudinal section of the speed-reducing unit which is adapted to be operated by the motor for lifting heavy loads at low speeds and by both of the motors for lifting light loads at high speeds.

The invention is exemplified in hoisting mechanism which comprises a trolley-frame **20** provided with wheels **19** adapted to run on the overhead tracks of a crane; a drum **21** for winding and unwinding a cable **22** for raising and lowering loads; a reversible variable speed three-phase electric motor *a* which is adapted to develop sufficient horse power to operate the drum **21** for lifting and lowering heavy loads; a speed-reducing unit *f* of the helio-centric type; a power input shaft **23** fixedly connected to the rotor of motor *a* and journaled in a bearing **28**; a power output shaft **24** journaled in a bearing **28a** and coaxial with shaft **23**; a pinion **25** on and driven by the output shaft; and a gear **26** fixed to drum **21** and meshing with pinion **25**. The speed-reducing gearing *f* comprises a gear-case **27**; an eccentric **29** integral with the input shaft **23**; a ring **30** journaled on eccentric **29**; an externally toothed gear **31** integral with ring **30**; an internally toothed ring gear **32** fixed to gear-case **27**, and with which eccentric gear **31** meshes; an internally toothed eccentric gear **33** integral with ring **30**; and an externally toothed gear **34** which is fixed to or integral with the output shaft **24**. When gear-case **27** is stationary, motor *a* will drive eccentric **29** to rotate ring **30** by reason of the engagement of the internal gear **32** and gear **31**, and ring **30** will drive gear **33** to rotate gear **34** and the output shaft **24** at a low ratio for moving heavy loads. Motor *a* is adapted for operation at different predetermined speeds for driving the helio-centric speed-reducing gearing to operate the shifting cable **22** through drum **21** for moving heavy loads at corresponding predetermined speeds. For example, motor *a* may be of 35 horse-power and adapted for operation at 225, 450, 900 and 1800 R. P. M. to drive the input shaft **23** at corresponding speeds for lifting heavy loads, such as 15 tons, and the shaft **23** will drive the output shaft **24** through the gearing in the case **27** while the case is stationary, at corresponding low speeds. This motor *a* and gearing are designed, for example, for lifting maximum loads of 15 tons so that when motor *a* is driven at its lowest speed of 225 R. P. M. it will develop approximately 4⅜ horse-power and drive the output shaft **24** at 3¼ R. P. M. to operate the cable **22** at the rate of 3¾ feet per minute; when driven at the second speed of 450 R. P. M., the motor will develop 8¾ horse-power to drive the output shaft **24** at 6½ R. P. M. to operate the cable **22** at the rate of 7½ feet per minute; when driven at its third speed of 900 R. P. M. the motor *a* will develop approximately 17½ horse-power and drive the output shaft **24** at 13 R. P. M. to operate the cable **22** at the rate of 15 feet per minute; and when driven at its maximum speed of 1800 R. P. M., motor *a* will develop approximately 35 horse-power and drive output shaft **24** at 26 R. P. M. to operate the cable **22** at the rate of 30 feet per minute. This exemplifies gearing for lifting heavy loads at relatively slow speeds. A spring-set magnetically releasable brake a^8, which is released whenever the stator of motor *a* is energized, is provided for shaft **23** of said motor. This brake, as well understood in the art, is set to hold the load when current is cut off from said motor.

When an empty hook or light loads, for example a load weighing one ton, is suspended from cable **22**, it is desirable to expedite the motion of the hook. The gear-case **27**, to which internal gear **32** is fixed, is rotatable for lowering the speed-reduction between the input shaft **23** and output shaft **24**, so that the internally toothed gear ring **32** is rotated and ring **30** will be rotated thereby around eccentric **29** while the latter is being driven by the input shaft **23** from motor *a*. This will increase the speed-ratio of the output shaft **24** relatively to the speed of the

input shaft 23 when the gear-case is rotated. A reversible variable speed auxiliary electric motor *b* is provided for rotating the gear-case 27 when it is desired to move the loads at high speeds. This motor *b* may, for example, be of 5 horsepower and adapted to be driven at 900 and 1800 R. P. M. Motor *b* may be vertical and its case is supported by a standard 38 which is secured to frame 20 of the trolley. The rotor of motor *b* is connected by a sliding coupling b^2 to a shaft 40 which is journaled in bearings 41 and 42 which are mounted in standard 38. A worm 43 is keyed to shaft 40 and meshes with a gear 44 which is keyed on the outside of gear-case 27 for driving said gear-case from motor *b*. When lifting heavy loads, motor *b* will be idle and gear-case 27 will be held stationary by worm 43 and gear 44. When auxiliary motor *b* is operated while motor *a* is operated, it will rotate the gear-case 27 and the internal gear 32 and thereby increase the speed-ratio of gear-ring 30 relatively to the input shaft 23. For example, when motor *a* is operated at its maximum speed of 1800 R. P. M. and auxiliary motor *b* is operated at a speed of 900 R. P. M., the speed of the output shaft 24 will be increased to approximately 75 R. P. M. to operate the cable 22 at the rate of 90 feet per minute. When motor *a* is driven at its maximum speed of 1800 R. P. M. and the motor *b* is driven at its maximum speed of 1800 R. P. M., the output shaft 24 will be driven at 150 R. P. M. and cause the cable 22 to travel at the rate of approximately 150 feet per minute. Motor *b* is provided with a spring-set releasable brake b^8 of a construction well understood in the art, which is released whenever the stator of said motor is energized, and holds the load thereon when current is cut off from the motor.

The outer members of ball-bearings 41, 42 for worm-shaft 35 are slidable in the support 38. A thrust-bearing 45 is provided at the lower end of shaft 35. The stationary member of thrust-bearing 45 is engaged by a spring 46 and is adapted to engage an abutment 47 on support 38 when the worm 43 is subjected to downward thrust of sufficient magnitude to overcome said spring caused by the load on the gear-case 27. The force of spring 46 is adjustable by means of a screw 48. The spring 46 resists the downward thrust on worm 43 and shaft 35 which results from the load on the gear-case 27 and worm-gear 44 until bearing 45 engages the abutment 47. An over-load switch 65 is provided for interrupting the circuit through motor *b*, in the event that a load in excess of a predetermined maximum is applied to the gear-case 27 while said motor is being operated. A pin 60 is slidably mounted in the housing or support 38 and is shiftable by thrust-bearing 45. Pin 60 is adapted to shift a switch-lever 62 which is fulcrumed at 63 and carries contacts for opening and closing switch 65 which is included in the circuit for motor *b*. Switch 65 is held normally closed by a spring 64 applied to lever 62. When the load on gear-case 27 is sufficient to force worm 43 and thrust-bearing 45 downwardly against the force of spring 46, bearing 45 will shift pin 60 and automatically open switch 65 to open the circuit for motor *b* and cause it to stop. When the load on gear-case 27 is reduced sufficiently to permit spring 46 to lift bearing 45, spring 64 will automatically shift lever 62 to close switch 65 and close the circuit for motor *b* at said switch.

Electrical equipment, illustrated in Fig. 3, is provided for controlling the operation of motors *a* and *b* for handling heavy and light loads at different speeds and for operating the motors in opposite directions for lifting and lowering. This equipment includes a relay *c* for controlling the direction of motors *a* and *b*; a relay *d* for controlling the starting and the operation at two speeds of auxiliary motor *b*; and a manually operable switch-mechanism *e* for controlling the circuits for relay *c* and the circuits for the relay *d*.

The relay *c* comprises an electromagnet *c'*, which controls a set of three contacts c^2 and an electromagnet c^3 which controls a set of contacts c^4. Conductors a^3, a^4 and a^5 are connected to the stator of motor *a* and, when connected to the three conductors of input line *g* through contacts c^2, will supply current to said motor for operating it in one direction and, when connected to line *g* through contacts c^4, will supply current to the stator of motor *a* for the operation of said motor in the reverse direction.

Relay *d* comprises an electromagnet *d'* for controlling a set of three contacts d^2 and an electromagnet d^3 for controlling a set of contacts d^4. Contacts d^2 and d^4 are adapted to close circuits for supplying current from conductors a^3, a^4 and a^5, respectively, to the stator of motor *b* for operating said motor at predetermined low and high speeds. When contacts d^2 are closed and contacts d^4 are open, current will be supplied for the operation of motor *b* at a predetermined low speed. When contacts d^4 are closed and contcasts d^2 are open, current will be supplied to the stator of motor *b* for the operation of said motor at a high predetermined speed. Contacts d^2 and d^4 are connected to conductors a^3, a^4 and a^5, which are controlled by the contacts c^2, c^4 of relay *c*, so that auxiliary motor *b* will, at all times, be operated in a corresponding direction to motor *a* for the conjoint operation of gear-unit *f* by both motors. The switching mechanism *e* comprises a four-armed rotatable switch-lever e^2, which is provided with a handle *e'*, whereby it may be manually rotated. One of the arms is adapted to control the operation of magnets *c'*, c^3 to control the stator-circuits for operating motor *a* in one direction for lifting and in the opposite direction for lowering loads. Three of the arms of lever e^2 are provided with contacts e^3, e^4 and e^5, respectively, which are connected by suitable conductors to the rotor of motor *a* for establishing circuits for controlling the speed of motor *a*.

One arm of lever e^2 is provided with a contact e^9, which is connected by conductors 50, 51 to one of the conductors of the input line *g*, for controlling the circuits through magnet *c'*, c^3 for starting motor *a* and controlling the direction of its operation for lifting or lowering. Contact e^9 on lever e^2 is connected by conductor 51 to one of the conductors of the input line *g*. Contact e^9 is engageable with an arcuate contact e^{11} when the lever is shifted to any of its six lifting stations and engageable with an arcuate contact e^{12} when lever e^2 is in any of its six lowering stations. A conductor 52 connects contact e^{11} to the helix of magnet *c'* for establishing a circuit to energize said magnet to control the contacts for operating the motor *a* for lifting. A conductor 53 is connected to the helix of magnet c^3 for energizing said magnet to control the cir-

cuits to motor a for operation in the reverse direction or for lowering.

Contacts e^3, e^4, e^5 on lever e^2 are engageable, respectively, with three sets of contacts e^6 at six lifting stations for controlling the rotor-circuits and the speed of motor a in lifting when the lever is shifted in clockwise direction from its normal position, illustrated in Fig. 3, and are also engageable, respectively, with three sets of contacts e^7 for controlling the speed and reverse operation of the motor a at six lowering stations when lever e^2 is shifted from its normal position in anti-clockwise direction.

Resistors e^8 are included in the conductors which are connected to contacts e^6, e^7 at the first three lifting and the first three lowering stations of levers e^2. When lever e^2 is shifted to the first station, either for raising or lowering, all three of the resistors will be included in the rotor-circuits for motor a, so that the motor a will be operated at its lowest predetermined speed. When lever e^2 is shifted to either lowering or raising station two, one of the resistors e^8 will be excluded from the rotor-circuits for motor a and the motor will be operated at the second predetermined speed. When lever e^2 is shifted to either raising or lowering station three, two of the resistors will be excluded and the motor a will be operated at the third predetermined speed. When lever e^4 is shifted to either raising or lowering station four, all of the resistors will be excluded and the motor a will be operated at its maximum speed. The maximum speed will be retained at lifting and lowering stations five and six.

Switch-mechanism e also includes means for controlling the operation of auxiliary motor b through lever e^2 and handle e', so that the operator may manually control the operation and speed of motor b and the operation and speed of motor a. The circuits for the operation of auxiliary motor b are controlled by the arm of lever e^2 which carries contacts e^9. An additional contact e^{10} on said arm and connected to contact e^9 by conductor **50**, is provided for establishing circuits for energizing magnets d', d^3 of relay d. When lever e^2 is at lifting station five, lever-contact e^{10} engages a stationary contact e^{13} which is connected by a conductor **54** to the helix of magnet d', for closing contacts d^2 to establish circuits for the low-speed operation of motor b when lifting loads. When lever e^2 is at lifting station six, contact e^{10} engages a stationary contact e^{14} which is connected by a conductor **55** to the helix of magnet d^3 for establishing circuits for the high-speed operation of motor b during lifting operations. At lowering station five, lever-contact e^{10} engages a stationary contact e^{15} for closing a circuit for energizing magnet d' for the low-speed operation of motor b when lowering loads. At lowering station six, contact e^{10} engages a stationary contact e^{16} to close a circuit for energizing magnet d^3 to close contacts d^4 for the high-speed operation of motor b when lowering loads. A conductor **56** connects the helices of magnets d' and d^3 to the conductor a^4. Overload switch **65** is included in conductor **56** so that when said switch is opened by an excessive load on the gear-case **27**, the circuits through the helices of magnets d', d^3 will be interrupted to open contacts d^2 and d^4 in the circuits for motor b and cause the latter to stop. The helix a^{10} for the brake a^8 is connected to conductors a^3, a^5. The helix b^{10} of the magnetic brake b^8 for auxiliary motor b is connected to two of the contacts d^2.

The operation will be as follows: When lever e^2 is in its neutral position, as illustrated in Fig. 3, the circuits for motors a and b will be open and motors a and b will be idle. When a heavy load is to be lifted, lever e^2 will be shifted to engage the contacts at stations one, two, three or four, according to the speed of travel of the cable **22** desired in lifting the load. At any of said stations, commencing with lifting station one, a circuit will be established from one of the line conductors g through conductor **51**, contacts e^9, e^{11}, conductor **52** and the helix of magnet c'. Said magnet will then shift contacts c^2 to close circuits from the conductors of the input lines g to the stator of motor a and cause it to be started and operated for lifting. The speed will progressively increase as lever e^2 is shifted from stations one to four, as the resistors e^8 are short-circuited, as hereinbefore described. The drum **21** will be driven entirely by motor a through the speed-reducing gearing f while motor b and the gear-case **27** remain stationary. The speed of motor a is progressively increased to increase the lifting rate of travel of the cable **22** from 3¾ to 7½ to 15 to 30 feet per minute.

When the lever e^2 is moved to engage any of the contacts e^7 at the first four lowering stations, contacts e^9 on lever e^2 will engage contact e^{12} and establish a circuit through conductor **51**, contacts e^9, e^{12}, conductor **53**, the helix of magnet c^3, and one of the conductors g. Said magnet will be energized and shift contacts c^4 to close circuits through conductors a^3, a^4 and a^5 between the stator of motor a and the power input conductors g for the reverse rotation of the motor a for lowering heavy loads. The speed will be progressively increased between stations one and four, the same as in lifting. At fifth and sixth lifting and lowering stations, the circuits for the operation of motor a at its maximum speed will remain the same as at station four.

When light loads are being lifted, it is desirable to shift them at a greater speed than those at which the input shaft **24** is driven solely by motor a at its maximum speed (1800 R. P. M.) and the speed reduction gearing f. Lever e^2 will then be moved onto the fifth lifting station to cause the auxiliary motor b to be operated so it will rotate the gear-case **27** while motor a is running at its maximum speed. On the fifth lifting station, contact e^{10} on lever e^2 will engage contact e^{13} and establish a circuit through conductor **51**, contacts e^{10}, e^{13}, conductor **54**, the helix of magnet d', and conductor **56**. Magnet d' will shift contacts d^2 to connect the low speed winding of motor b to the conductors a^3, a^4, a^5 and cause said motor to operate at the lowest of its predetermined speeds, for example 900 R. P. M. This will cause the cable to travel in lifting at an increased speed of approximately 90 feet per minute, by driving the gear-case **27** of the unit f to correspondingly increase the speed of the output shaft **24**. If it is desired to further increase the rate of travel of the lifting cable, lever e^2 will be moved to the sixth lifting station and a circuit will be established through conductor **51**, contacts e^{10}, e^{14}, conductor **55** and the helix of magnet d^3 and conductor **56**. Magnet d^3 will then close contacts d^4 of the relay d to connect the high speed winding of motor b to the input line for the high speed operation, for example 1800 R. P. M., of said motor. The cable speed will then be 150 feet per minute. At the

fifth and sixth lowering stations, lever e^2 and contact e^{10} will similarly establish circuits through magnets d', d^3, respectively, to shift contacts d^2, d^4, respectively, for operating the motor b in the reverse direction at corresponding predetermined speeds to operate the cable **22** at 90 and 150 feet per minute, respectively, when lowering the loads. Contacts d^2 and d^4 for controlling motor b are connected to conductors a^3, a^4 and a^5. The current in said conductors for operating the motor a in opposite directions, is controlled by the relay c so that the current supplied to motor b from said conductors will operate auxiliary motor b for raising or lowering correspondingly to the direction of the operation of motor a.

In the event that the operator attempts to lift or lower a load which is too heavy to be handled by the auxiliary motor b, sufficient torque will be applied to gear-case **27** to cause worm-gear **44** to force worm **43** axially downward against the force of spring **46**, until thrust-bearing **45** engages abutment **47**. Thrust-bearing **45** will then hold pin **60** in position to open switch **65**. The magnets d', d^3 will not then be energized, and contacts d^2, d^4 will remain open, so that motor b will fail to start. The magnetic brake b^8 will remain applied to, and lock motor b. When the controller-lever e^2 is at the fifth or sixth stations, the hoist will be operated at the high speed resulting from the operation of both motors a and b only if the load is within the capacity of the auxiliary motor and when the load is excessive it will be handled by motor a at its maximum speed, which will operate the hoist at a lower speed than when motor b is operated. If, at any time, the load decreases sufficiently so that the capacity of motor b is sufficient for the load, switch **65** will be automatically closed and the load will be shifted at the higher rate of travel effected by the operation of both motors a and b. By adjustment of the screw **48**, the overload at which switch **65** is opened to render motor b inoperative, may be regulated as desired.

The invention exemplifies hoisting mechanism which comprises a main reversible variable speed motor for operating the gear-unit for lifting heavy loads and an auxiliary electric motor for operating the gear-unit while it is also being operated by the main motor, to increase the speed of travel of the hoisting cable above the maximum at which it may be operated by the main motor. The invention also exemplifies hoisting mechanism embodying a speed reduction gear-unit and a pair of motors for operating heavy loads at low speeds and an auxiliary motor for hoisting the loads at comparatively higher speeds, and means for automatically preventing high-speed operation or the operation of the auxiliary motor, in the event that the load is excessive for hoisting at the higher speeds effected by the use of both motors. The invention also exemplifies a unitary control mechanism for both motors, by which the lifting and lowering of varying loads may be effected at high or low speeds. The invention also exemplifies a hoisting mechanism which is efficient in operation, is adapted for handling heavy and light loads at a wide range of speeds and is economical in operation.

The invention is not to be understood as restricted to the details set forth, since these may be modified within the scope of the appended claims, without departing from the spirit and scope of the invention.

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

1. The combination with a hoisting drum and a cable which is adapted to be coupled to varying loads, of a gearing unit comprising an output shaft connected to drive the drum, an input shaft, helio-centric gearing between the shafts for driving the output shaft from the input shaft at reduced speed, and a rotatable element connected to drive the output shaft at a substantially higher speed than it can be driven by the reducing gearing, a variable speed electric motor connected to drive the input shaft and the output shaft and drum through the helio-centric gearing and of sufficient and suitable horse-power for hoisting heavy loads at suitable low speeds, a second electric motor connected to drive the rotatable element and output shaft of sustantially less horse-power than the other electric motor and suitable for hoisting light loads at a higher speed than the speed used for heavy loads, and means for controlling the operation of the motors respectively for hoisting heavy and light loads on the cable.

2. The combination with a hoisting drum and a cable which is free, adapted to be coupled to varying loads of a gearing unit comprising an output shaft connected to drive the drum, an input shaft, reversible helio-centric gearing between the shafts for driving the output shaft from the input shaft at reduced speed, and a rotatable element connected to drive the output shaft at a substantially higher speed than it is driven by the reducing gearing, a variable speed reversible electric motor connected to drive the input shaft and the output shaft and drum through the helio-centric gearing and of sufficient horse-power for hoisting heavy loads at suitable low speeds, a reversible second electric motor connected to drive the rotatable element and output shaft, of substantially less horse-power than the other electric motor and suitable for hoisting light loads at a higher speed than the speed used for heavy loads, and means for controlling the operation of the motors respectively for raising and lowering heavy and light loads on the cable.

3. A combination with a drum and a cable which is adapted to be coupled to varying loads, of a gearing unit comprising an output shaft connected to drive the drum, an input shaft, speed-reducing gearing between the shafts for driving the output shaft from the input shaft at reduced speed, and a rotatable element connected to drive the output shaft at a higher speed than it is driven by reducing gearing, a variable speed electric motor connected to drive the input shaft and the output shaft and drum through the reducing gearing and of sufficient and suitable horse-power for hoisting heavy loads at suitable low speeds, a second electric motor connected to drive the output shaft through the rotatable element at a higher speed than used for heavy loads, of substantially less horse-power than the other motor and suitable for hoisting light loads at high speed, torque responsive means for stopping the second motor when the load on the cable is excessive for light loads, and means for controlling the operation of the motors respectively for hoisting heavy and light loads on the cable.

4. A combination with a drum and a cable which is adapted to be coupled to varying loads, of a gearing unit comprising an output shaft

connected to drive the drum, an input shaft, helio-centric gearing between the shafts for driving the output shaft from the input shaft at reduced speed, and a rotatable element connected to drive the output shaft at a substantially higher speed than it is driven from the input shaft, a variable speed electric motor connected to drive the input shaft and the output shaft and drum through the helio-centric gearing and of sufficient and suitable horse-power for hoisting heavy loads at suitable low speeds, a second electric motor connected to drive the rotatable element and output shaft, of substantially less horse-power than the other motor and suitable for hoisting light loads at a higher speed than that used for heavy loads, torque controlled means for stopping the second motor when the load on the cable is excessive for light loads, and means for controlling the operation of the motors respectively for hoisting heavy and light loads on the cable.

5. A combination with a hoisting drum and cable which is adapted to be coupled to varying loads, of a gearing unit comprising an output shaft connected to drive the drum, an input shaft, helio-centric gearing between the shafts for driving the output shaft at low speeds, and a rotatable gear-case connected to drive the output shaft without substantial speed reduction, a variable speed electric motor connected to drive the input shaft and the output shaft and drum through the helio-centric gearing and of sufficient and suitable horse-power for hoisting heavy loads at suitable low speeds, a second electric motor, a worm and gear-drive between the second motor and the gear-case, said second motor being of substantially less horse-power than the other motor and suitable for lifting light loads at a higher speed than that used for heavy loads, and means for controlling the operation of the motors respectively for hoisting heavy and light loads on the cable.

6. A combination with a hoisting drum and cable which is adapted to be coupled to varying loads, of a gearing unit comprising an output shaft connected to drive the drum, an input shaft, speed-reducing gearing between the shafts for driving the output shaft at low speeds, and a rotatable gear-case connected to drive the output shaft without substantial speed reduction, a variable speed electric motor connected to drive the input shaft and the output shaft and drum through the reducing gearing and of sufficient and suitable horse-power for hoisting heavy loads at suitable low speeds, a second electric motor, a worm and gear-drive between the second motor and the gear-case, said second motor being of substantially less horse-power than the other motor and suitable for lifting light loads at a higher speed than that used for heavy loads, torque responsive means for stopping the second motor when the load on the cable is excessive, and means for controlling the operation of the motors respectively for hoisting heavy and light loads on the cable.

7. A combination with a hoisting drum and cable which is adapted to be coupled to varying loads, of a gearing unit comprising an output shaft connected to drive the drum, an input shaft, helio-centric gearing between the shafts for driving the output shaft at low speeds, and a rotatable gear-case connected to drive the output shaft without substantial speed reduction, a variable speed electric motor connected to drive the input shaft and the output shaft and drum through the helio-centric gearing and of sufficient and suitable horse-power for hoisting heavy loads at suitable low speeds, a second electric motor, a worm and gear-drive between the second motor and the gear-case, said second motor being of substantially less horse-power than the other motor and suitable for lifting light loads at a higher speed than that used for heavy loads, torque responsive means for stopping the second motor when the load on the cable is excessive, and means for controlling the operation of the motors respectively for hoisting heavy and light loads on the cable.

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