No. 873,312. PATENTED DEC. 10, 1907.

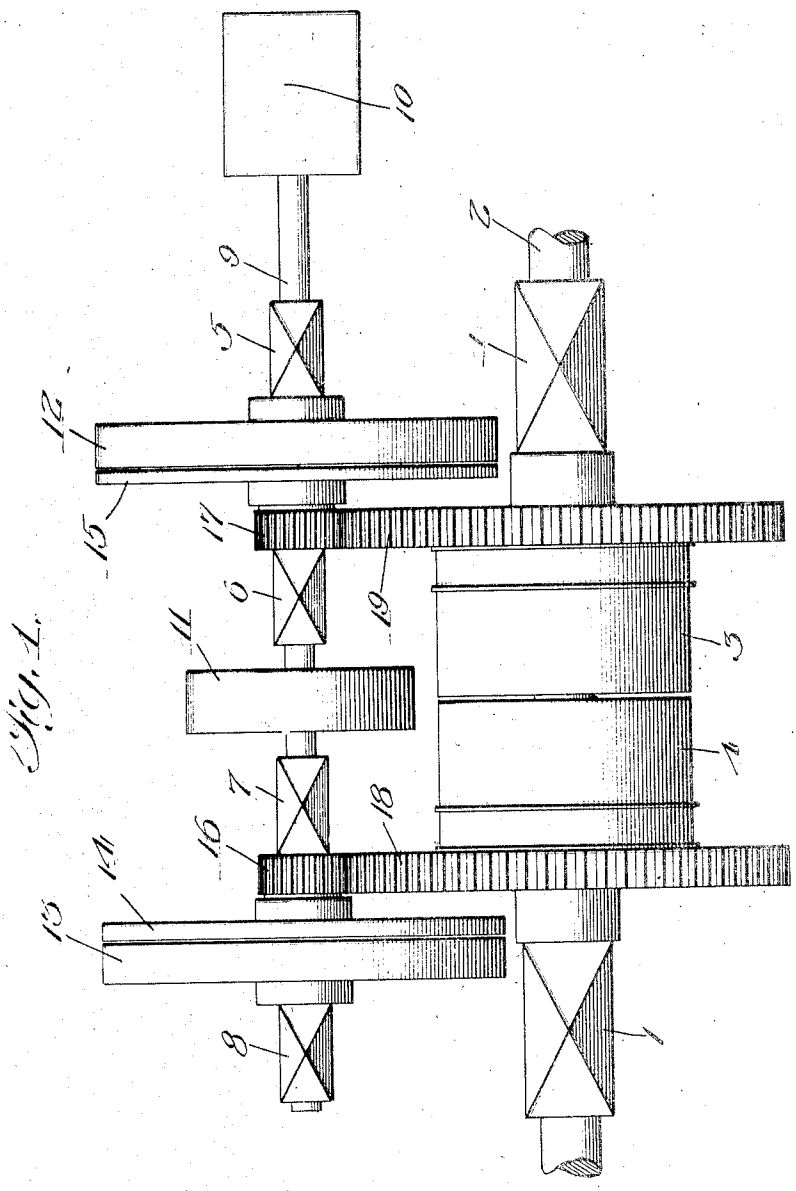
C. T. HENDERSON & N. C. BASSETT.

ELECTRICALLY OPERATED COAL HOIST.

APPLICATION FILED JAN. 15, 1906.

4 SHEETS—SHEET 1.

Fig. 1.



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4 SHEETS—SHEET 2.

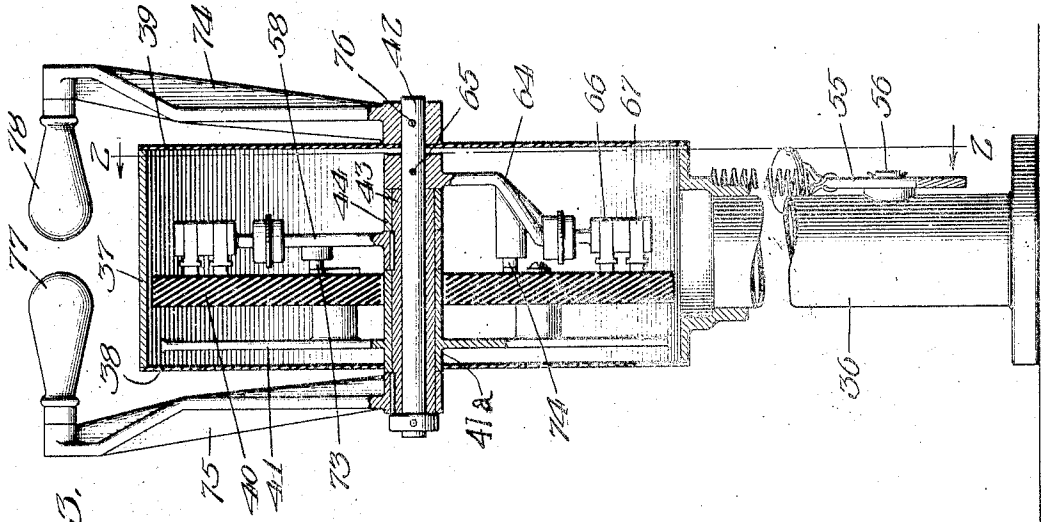


Fig. 5.

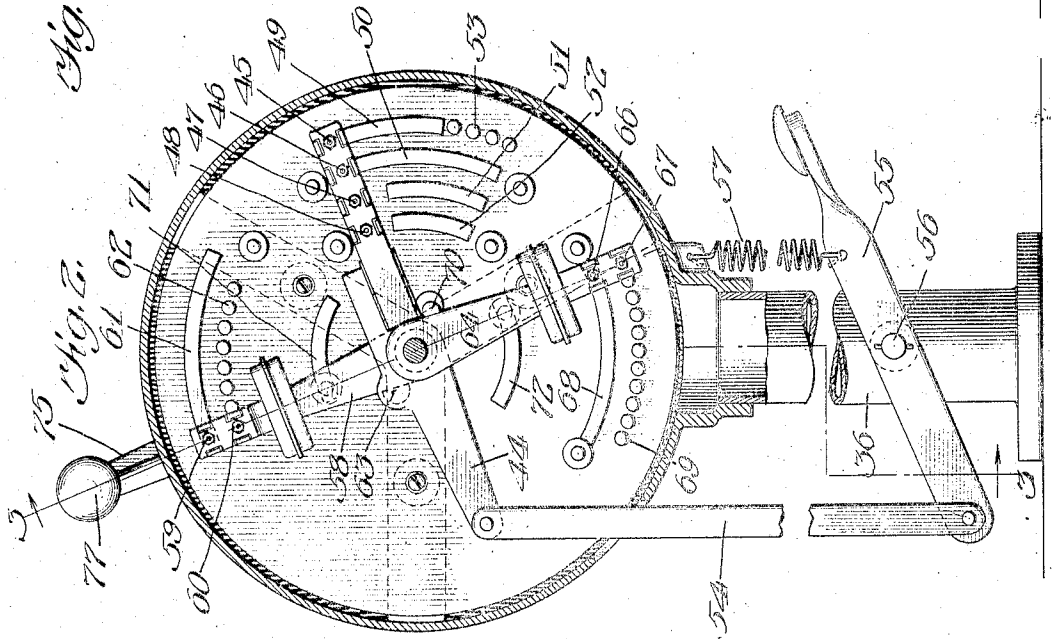


Fig. 6.

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4 SHEETS—SHEET 3.

Fig. 4.

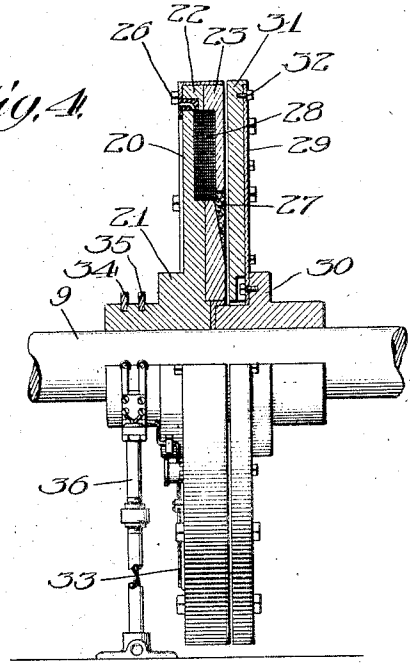
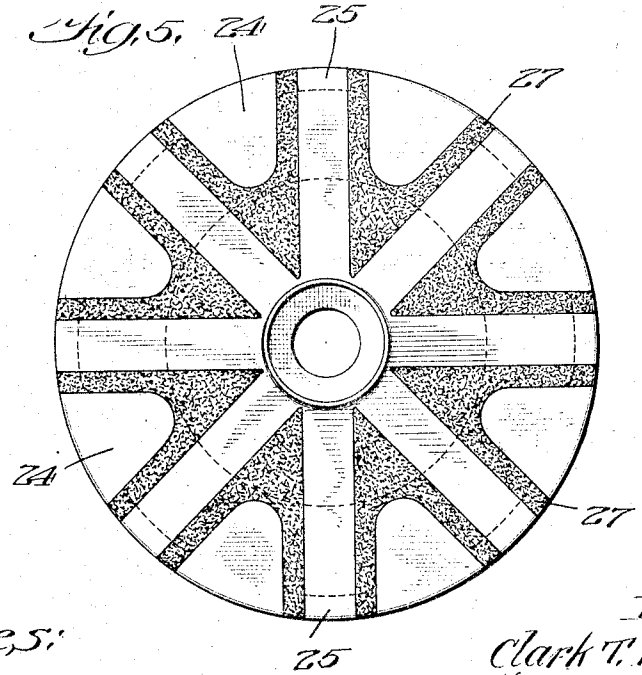


Fig. 5.



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ELECTRICALLY OPERATED COAL HOIST.

APPLICATION FILED JAN. 15, 1906.

4 SHEETS—SHEET 4.

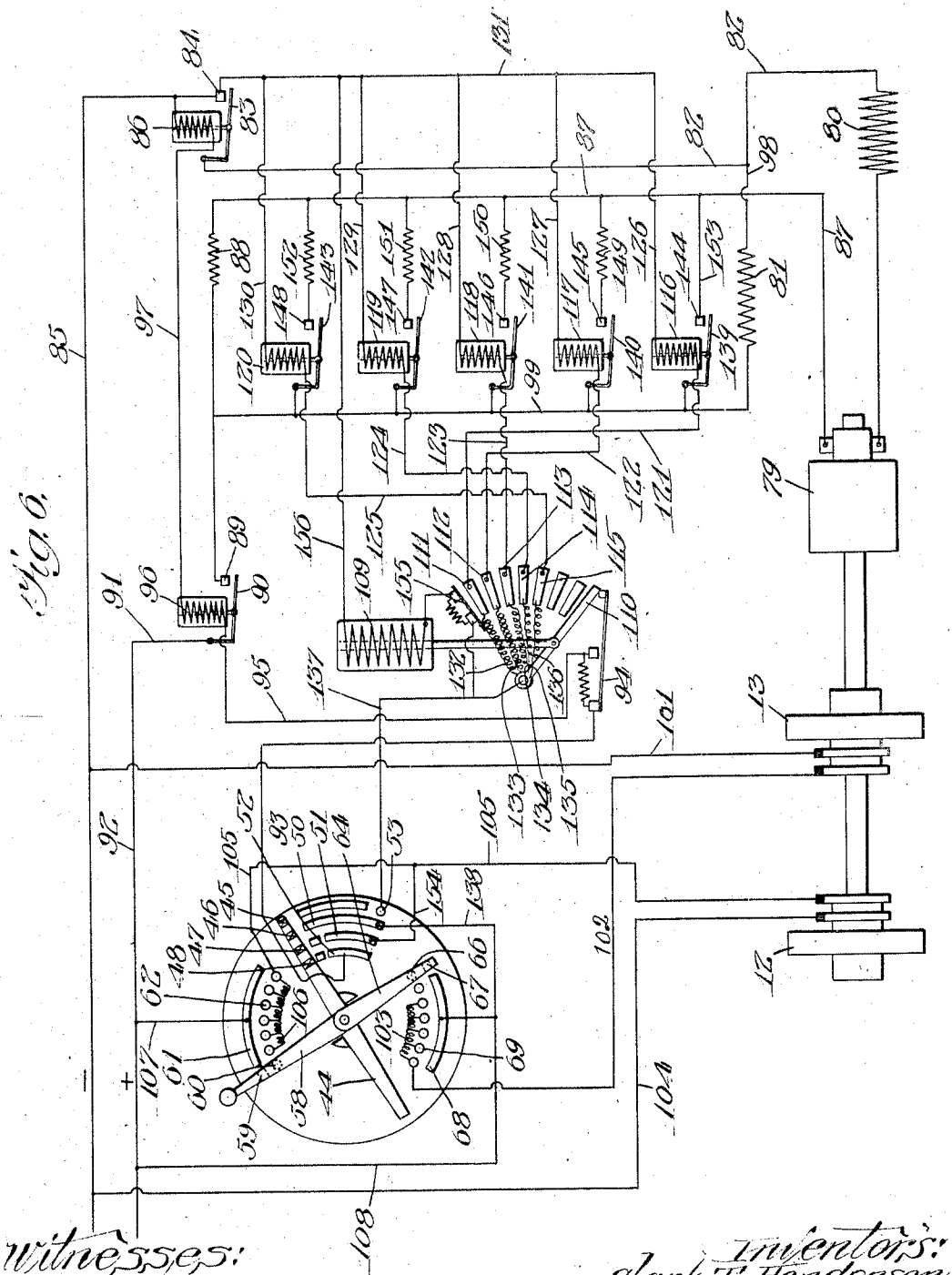


Fig. 6.

Witnesses:
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UNITED STATES PATENT OFFICE.

CLARK T. HENDERSON, OF PITTSBURG, PENNSYLVANIA, AND NORMAN C. BASSETT, OF MILWAUKEE, WISCONSIN, ASSIGNORS TO THE CUTLER-HAMMER MFG. CO., OF MILWAUKEE, WISCONSIN, A CORPORATION OF WISCONSIN.

ELECTRICALLY-OPERATED COAL-HOIST.

No. 873,312. Specification of Letters Patent. Patented Dec. 10, 1907.

Application filed January 15, 1906. Serial No. 296,172.

To all whom it may concern:

Be it known that we, CLARK T. HENDERSON, a citizen of the United States, residing at Pittsburg, in the county of Allegheny and State of Pennsylvania, and NORMAN C. BASSETT, a citizen of the United States, residing at Milwaukee, in the county of Milwaukee and State of Wisconsin, have invented new and useful Improvements in Electrically-Operated Coal-Hoists, of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawings, forming a part of this specification.

Our invention relates to magnetic clutch power transmitting apparatus, one of our objects being to provide an improved means whereby power may be transmitted from a suitable driving element to any desired driven mechanism in an efficient and economical manner.

In accordance with our invention, we employ a plurality of magnetic clutches or accelerators which are interposed between the driving element and the driven mechanism, these clutches being constructed and arranged for operation so that the load may be readily connected with the driving element and efficiently operated in connection therewith. Essentially the magnetic clutches or accelerators preferably used by us each comprise a primary or inducing member and a secondary or induced member, one of which is adapted to be connected with the driving element and the other with the driven mechanism. Through the energization of the clutch, the driven part thereof may be caused to rotate at any desired speed equal to or less than that of the driving part. In this clutch we utilize the effect of induction and also the effect of frictional contact between the driving and driven members to effect the acceleration of the driven member. Due to the peculiar and novel construction of this clutch, the energizing current when admitted to the winding thereof, does not, as in the case of ordinary magnetic clutches, cause the driving and driven parts to be forcibly gripped and clutched together, but on the contrary, the driven member is gradually accelerated in speed until eventually it is brought to the full speed of the driven part, if desired. This gradual acceleration is accomplished principally for two reasons: First: Because the clutch is so constructed that considerable inductance is developed therein, so that the energizing current does not bring the magnetic field to full strength immediately, as is the case with the ordinary ring type magnetic clutch, but causes the strength of the magnetic field to gradually increase until it reaches its maximum thereby exerting a gradually increasing torque upon the driven member. Second: Because the combined inductional and frictional effect upon the driven member caused the driving member to exert upon the driven member a torque which is so proportioned as to cause a gradual acceleration.

Another object of our present invention is to provide a device for controlling large clam-shell buckets for unloading and distributing coal, iron ore or other material. In the operation of a clam-shell bucket, it is customary to use two independent ropes, or cables, wound upon two independent drums, the cables being attached to the bucket in such a manner that if tension is put on one of the cables the hinged covers of the bucket will be caused to close about the body of coal or material and forcibly push the same inside the bucket and hold the covers tightly closed about the material to be lifted. A continued movement of the closing cable will lift the bucket and its contents. However, to lift and also to hold the bucket when the load is dropped, a second cable is connected to the bucket, which is fastened to the main frame of the bucket, and when the same is raised by the closing cable, it is customary to assist this cable by the main bucket cable. This is done by starting the second winding drum upon which the main bucket cable is wound, which takes up the slack of the main cable and assists the closing cable in raising the bucket. The mechanism, however, is so arranged that the bulk of the strain will be kept upon the closing cable, thereby making it impossible for the bucket to open and drop its load. When it is desired to dump the load, the closing cable is released so that the main cable takes the entire weight of the bucket and the clam-shell covers of the bucket are free to open by their own weight and allow the load to dump.

By our invention we are enabled to operate coal buckets in the above described manner automatically, and in such manner that

the load cannot be accidentally dumped through the failure of current, careless or ignorant handling or through other causes.

While we have described our invention as being applicable for operating clam-shell buckets it will be understood that this is only one of several uses to which the same may be put as there are various other places in which the invention may be used to advantage.

We have illustrated our preferred manner of constructing the device in the accompanying drawings, in which,

Figure 1 is a plan view of the hoisting drum and the clutches for connecting the same to the motor; Fig. 2 is a sectional view of our improved controller for controlling the operation of the device, taken on the lines 2—2 of Fig. 3; Fig. 3 is a sectional view of the controller taken on the line 3—3 of Fig. 2; Fig. 4 is an end elevation of the clutch used in connection with our invention, part of said clutch being shown in section; Fig. 5 is a face view of the field member of the clutch; and, Fig. 6 is a diagrammatic view of the circuit arrangement of our device.

In the preferred manner of constructing our invention in suitable bearings or supports 1, a shaft 2 is mounted having rotatably mounted thereon, winding drums 3 and 4 upon which are adapted to be wound the cables attached to the bucket. In suitable bearings 5, 6, 7 and 8 is mounted an extension 9 of the shaft of the motor 10, a brake-pulley 11 controlled by a solenoid, being fixed upon this shaft at an intermediate point. Also carried upon the shaft 9 are two clutches 12 and 13, the armature members 14 and 15 of which are rotatably mounted upon the shaft 9 and have secured thereto pinions 16 and 17, adapted to mesh with gears 18 and 19, secured to the winding drums 3 and 4, respectively.

The clutches 12 and 13 are constructed as more fully illustrated in Figs. 4 and 5 of the drawings and we have only illustrated in these figures the clutch 12, as both clutches are constructed alike, and a description of one is sufficient. In this clutch upon a back plate 20, formed integrally with the hub 21 keyed upon the shaft 9, are secured a pair of rings 22 and 23, the ring 22 carrying inwardly projecting polar projections 24 and the ring 23 carrying outwardly extending polar projections 25, the two sets of poles being arranged in overlapping positions and held against the back plate 20, by bolts or screws 26. The space between the pole pieces is filled with a non-magnetic material 27 which may be Babbitt metal or other equivalent material.

An annular channel is provided in the face of the back plate 20 and this channel with the rings 22 and 23 when placed together form an annular channel for the reception of the annular winding 28 of the clutch. By this arrangement, the exciting coil is entirely surrounded with iron, thus creating a large amount of inductance, established when the current through the coil is completed, and the current through the energizing coil and, consequently, the strength of the magnetic field, will increase slowly, preventing sudden acceleration of the driven member of the clutch. Furthermore, the arrangement of the outer and inner rings 22 and 23 provides a field magnet which is subdivided into a large number of smaller magnetic fields, which oppose each other, and cause the residual magnetism to disappear more rapidly than would be the case if a single magnetic circuit were employed. This causes the clutch to release rapidly when the current has been shut off from the energizing coils.

The armature member comprises a flexible disk 29 secured at its inner end to the hub 30 formed integrally with the gear 16, and has mounted thereon a circular plate 31 forming the armature member of the clutch. This plate, it will be noted, is only secured to the flexible disk at its outer end by the bolts 32, whereby a sufficient play is permitted the armature plate, and due to the resiliency of the spring plate 29 when the armature plate is released by the deenergization of the coil 28, the armature plate will assume the position shown in Fig. 4. Suitable conductors, as 33, are connected with the winding 28 and with the contact rings 34 and 35, mounted upon the hub 21 and supply current to the energizing winding, brushes connected with the supply circuit, being provided upon a support 36.

Our device for controlling the motor for operating the winding drums and for controlling the clutches comprises a novel construction of controller and we have illustrated the same in our Figs. 2 and 3 of the drawings. In the preferred construction of our controller, upon a suitable base 36, is mounted a cylindrical casting 37 having secured thereto in any suitable manner heads 38 and 39 to form an inclosing casing for the respective parts of the controller. Secured within this casting is a plate 40 of soapstone or other insulating material mounted in position upon radial arms 41 secured at their outer ends to the casting 37. A shaft 42 passes through the casing being supported by the hub 41^a on the arms 41 cast with the casting 37 and has mounted thereon a loose collar 43. Loosely mounted upon the collar 43 is a master arm 44 upon one insulated end of which are carried brushes 45, 46, 47 and 48 adapted to sweep over contact segments 49, 50, 51 and 52 respectively mounted upon the plate 40. The brush 45 is also adapted to make contact with the contact buttons 53. The opposite end of the master arm 44 is connected by a link 54, with a foot-lever 55 piv-

oted to the base 36 at 56. The opposite end of the foot-lever 55 has connected thereto, one end of a coiled spring 57, the other end of the spring, being connected to the base 36 and serves to normally hold one end of the lever in a raised position. Also mounted upon the tubular shaft 43 is an arm 58 which is keyed thereto and adapted to rotate therewith. The arm 58 carries contact brushes 59 and 60, the brush 59 being adapted to sweep over the contact segment 61 and the brush 60 being adapted to contact with buttons 62. This arm is adapted to be moved in one direction by a projection 63 formed upon the arm 44. A second arm 64 is mounted upon the shaft 42 and is keyed thereto by a pin 65, which passes through the hub of said arm and the shaft. The arm 64 carries brushes 66 and 67 which are adapted to sweep over contact segment 68 and contact buttons 69, respectively. A lug 70 also formed upon the arm 44 is adapted to engage the arm 64 and move the same in one direction. In order that the arms 58 and 64 will remain in any position to which they are moved and not be jarred out of position, segments 71 and 72 are mounted upon the plate 40 which are engaged by projections 73 and 74, carried upon the arm, whereby, due to the friction between these parts the arms are held in any position to which they may be moved. Upon the ends of the shaft which project through the casing are suitably mounted hand levers 74 and 75, the lever 74 being keyed to the shaft 42 by the pin 76 passing through the hub of said lever and the shaft, and the lever 75 being keyed to the hollow shaft 43. Suitable handles 77 and 78 are mounted upon the levers 74 and 75 to enable the operator to readily move the levers to their respective positions. It will be noted that by the arrangement of the lugs 63 and 70 when the free end of the foot-lever 55 is depressed and the arm moved in a clock-wise direction, the arms 58 and 64 will also be moved in the same direction, but when the foot is removed from the free end of the lever 55, and the same permitted to return to its normal position, moving the arm 44 back to its normal position, the arms 58 and 64 will remain in the position to which they have been moved until their position is changed by operating the levers 74 and 75.

The motor 10 used in connection with our device is preferably of the compound type, having an armature 79, a series field 80, and a shunt field 81. One terminal of the armature of the motor is connected by a conductor 82, through the series field 80, with one side of the pivoted switch 83, a contact 84 of this switch being connected with one main 85 of the supply circuit. This switch is operated by a solenoid 86. The opposite terminal of the armature is connected by conductor 87, through the resistance 88 with the contact 89 of a pivoted switch 90, which is connected by the conductor 91 with the main 92 of the supply circuit. The contact 52 of the controller is connected by the conductor 93 through the safety switch 94 and by conductor 95, through the winding of the solenoid 96, which operates the switch 90, by conductor 97, through the winding of the solenoid 86, which operates the switch 83, with the supply main 85. A branch circuit is established for the shunt field from the conductor 82 by conductor 98 and conductor 99, across the switch 90 to the supply main 92.

One terminal of the windings of the clutch 13 is connected by conductor 101 with the supply main 85, the other terminal thereof being connected by conductor 102, with the last button of the contact buttons 69, which are connected with sections of a resistance 103. One terminal of the winding of the clutch 12 is connected by conductor 104 with the supply main 85 and the other terminal thereof is connected by conductor 105 with the last button of the contact buttons 62, which are connected with sections of a resistance 106. The contact segment 61 is connected by conductor 107, with the supply main 92 and the contact segment 68 is connected by conductor 108, with the supply main 92. For starting the motor, a self-starting device is used, comprising a solenoid 109, which is mechanically connected with the movable arm 110, adapted to sweep over and make contact with the contact segments, 111, 112, 113, 114 and 115, which contacts are connected with the solenoids 116, 117, 118, 119 and 120, respectively, by conductors 121, 122, 123, 124, and 125 respectively. The opposite terminals of the solenoids 116 to 120 are connected by conductors 126 to 130 with the conductor 131, which in turn is connected with the supply main 85. The hub of the controller arm 110, has connected between the same and the contacts 111 to 115, a series of resistances 132 to 136 respectively. The movable element 110 is connected by conductor 137 with the contact button 53 on the controller, the contact 50 of said controller being connected by conductors 138 and 108 with the supply main 92. The solenoids 116 to 120 control a series of pivoted switch arms 139 to 143 respectively which are connected with the conductor 99 and make contact with the contacts 144 to 148 respectively. Between the contacts 145 to 148 and the conductor 87 are respectively connected a series of resistances 149 to 152 respectively, while the contact 144 is connected with the conductor 87 by conductor 153.

In operation, the first movement of the operator's foot-lever 55 moves the arm 44 in a clockwise direction and the brush 46 makes contact with the contact 50. A still further movement of the arm will cause the brush 47

to make contact with the contact 51. Circuit is then closed from the main 92 by conductors 108, and 138, to contact 50, across the arm 44 to contact 51, thence by conductors 154 and 105, through the windings of the clutch 12 and conductor 104, to the opposite supply main 85. Thus admitting full current to the winding of the clutch 12. A further movement of the lever causes the brush 48 to make contact with the contact 52 and a current is then admitted from the contact 50 across the arm 44 to contact 52, thence by conductor 93, across the switch 94, by conductor 95, through the solenoid winding 96, by conductor 97, through the solenoid winding 86 and thence to the opposite supply main 85. This current energizes solenoids 96 and 86 and the same operate to close the switches 90 and 83, closing the motor circuit. This circuit may be traced from main 92 by conductor 91, across the switch 90, contact 89, through resistance 88, conductor 87, through the armature 79, through the series field 80, by conductor 82, across the switch 83 to contact 84 and thence to the opposite supply main 85. The shunt field circuit may be also traced from supply main 92 across switch 90 by conductor 99 through shunt field winding 81 by conductors 98 and 82, across switch 83 to supply main 85. This causes the motor to start and operate slowly with the resistance 88 connected in circuit. A still further and final movement of the arm 44 will move the brush 45 into contact with the button 53, whereby full current will be admitted to the winding of the solenoid 109, this circuit being traced from the contact 50, across the arm 44 to contact button 53, thence by conductor 137 across the switch 155 through the winding of the solenoid, thence by conductors 156 and 131 to the opposite supply main 85. The winding of the solenoid 109 being energized, it attracts its core and moves the arm 110 slowly over the contacts 111 to 115, the arm first making contact with the contact 115, short circuiting the resistance 136. of the magnet 120 and permitting sufficient current to pass through the same to operate the switch 143. This closes an additional path through the resistance 152 for the current to flow to the armature 79 of the motor decreasing the ohmic resistance of the resistance 88 and the motor accordingly builds up speed. As the arm 110 continues to move over the remaining contacts, the resistance 135, 134 and 133 of the solenoids 119, 118 and 117 are short circuited and sufficient current is permitted to pass through the windings of the solenoids to operate the switches 142, 141 and 140 to close additional paths through the resistances 151, 150 and 149 for the current to flow to the armature 79 further decreasing the ohmic resistance of the resistance 88 causing the motor to further increase its speed. When the arm 110 finally rests on contact 111 the resistance 132 of the magnet 116 is short circuited and the magnet operates to close the switch 139 and no external resistance remains in the motor circuit, so that the motor attains full speed.

As the arm 44 is moved to start the motor as above described the arms 58 and 64 by the engagement of the lugs mounted upon the arm 44 are also moved and when the brushes 59 and 60 carried on the arm 58 make contact with the contact 61 and the first of the buttons 62, circuit will be closed from the supply main 92 through the conductor 107, contact 61, arm 58, resistance 106, conductor 105, through the windings of the clutch 12, and by conductor 104, back to the supply main 85. This circuit, however, will have no effect upon the windings of the clutch as it will be remembered that full potential has already been admitted to the coil. The other arm 64 will also be moved and when it reaches a position where the brushes 66 and 67 of said arm rest in contact with the contact 68, and the first of the contact buttons 69, circuit will be closed from the supply main 92, through conductor 108, to the contact 68, across the arm 64, to the first of the contact buttons, through the resistance 103 by conductor 102, through the windings of the clutch 13, and by conductor 101, back to the supply main 85. As the arm 64 sweeps over the contacts, it finally cuts out the resistance 103 in the circuit of the clutch 13, and this clutch is energized as fully as the clutch 12, whereby the hoisting drums will both be operating. The arms are moved by the movement of the foot-lever until the motor has attained its highest speed and they have been moved to their extreme positions. With the arms in this position the motor is operating at full speed and both clutches are energized to raise the bucket. In event it is desired to stop the bucket the operator removes his foot from the foot lever 55, which permits the arm 44 to move back to its normal position opening the motor circuit and stopping the same, and opening the circuit through the winding of the clutch 12 by conductors 154, 105 and 104. The arms 58 and 64, however, remain in the position to which they have been moved and though the circuit to the windings of clutch 12 is opened by way of contact 51, it remains closed by way of contact 61, so that the windings of both clutches are fully energized and the bucket is held in the position it has reached when the motor is stopped. To lower the bucket, the levers 74 and 75 are moved in a counter clockwise direction which moves the arms 58 and 64 and the resistances 103 106 are inserted in circuit with the windings of the clutches, whereby the weight of the bucket will overcome the strength of the clutches and the bucket will

be lowered. By controlling the amount of resistance in circuit with the winding of the clutch the bucket may be lowered and stopped at the position desired. To dump the coal, the operator moves the handle 75 in a counter clockwise position which moves the arm 58 to the full "off" position, de-energizing the clutch and permitting the bucket to open.

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

1. The combination with a motor, of a plurality of resistances arranged in parallel in the circuit thereof, a plurality of switches controlling said resistances, a plurality of solenoids for operating said switches, and means for automatically and successively admitting operating current to said solenoids.

2. The combination with a motor, of a plurality of resistances arranged in parallel in the circuit thereof, a plurality of switches for controlling said resistances, a plurality of solenoids for operating said switches, a plurality of resistances in the circuits of said solenoids, and means for automatically and successively cutting out said solenoid resistances.

3. The combination with a motor, of a plurality of resistances arranged in parallel in the circuit thereof, a plurality of solenoids for controlling said switches, a plurality of resistances in said solenoid circuits, a movable element, and means for automatically operating said movable element to cut out said solenoid resistances successively.

4. The combination with a motor, of a plurality of resistances arranged in parallel in circuit thereof, a plurality of switches for controlling said resistances, a plurality of solenoids for controlling said switches, a plurality of resistances in circuit with said solenoids, a movable element, and a solenoid for operating said movable element to successively cut out said solenoid resistances.

5. The combination with a motor, of a plurality of resistances arranged in parallel in the motor circuit, a plurality of switches for controlling said resistances, an electro-responsive device for operating each of said switches, means for automatically and successively admitting operating current to said device, and an automatically operated switch for controlling the motor circuit.

6. The combination with a motor, of a plurality of resistances therefor, a plurality of switches for controlling said resistances, a plurality of solenoids for operating said switches, a plurality of resistances in circuit with said solenoids, a movable element, a solenoid for operating said element to cut out said solenoid resistances successively, and a plurality of electrically operated switches for controlling the circuit through said motor.

7. The combination with a motor, of a plurality of resistances arranged in parallel in circuit thereof, a plurality of switches for controlling said resistances, a plurality of solenoids for controlling said switches, a plurality of resistances in circuit with said solenoids, a movable element, a solenoid for operating said element to successively cut out said solenoid resistances, a plurality of switches for controlling the circuit through said motor, a plurality of solenoids for operating said switches, and means for closing the circuit through the solenoids controlling the motor circuit switches and through the solenoid for operating said movable element.

8. The combination with a motor, of a starting device therefor, comprising a movable element, and a solenoid for operating said movable element, a plurality of clutches adapted to be operated by the current in the motor supply circuit for connecting said motor with the mechanism to be driven, and a device for controlling the circuit through said solenoid and through said clutches, said device including means for regulating the strength of the current through the clutch-windings.

9. The combination with a motor, of a starting device therefor, comprising a movable element and a solenoid for operating the same, a plurality of switches for controlling the circuit through the motor, a plurality of solenoids for controlling said switches, a plurality of clutches adapted to be operated by the current in the motor supply circuit for connecting said motor with the mechanism to be driven, and a device for controlling the circuit through said solenoids and said clutches, said device including means for regulating the strength of the current through the clutch-windings.

10. The combination with a motor, of a plurality of clutches for connecting the same with the mechanism to be operated, a controlling device having means for starting and stopping said motor, and means for controlling the circuit through said clutches, means whereby said clutch controlling means and motor controlling means will be simultaneously operated to start the motor and close the circuit through said clutches and said clutch controlling means may be operated to control the circuit through the clutches after the motor has been stopped.

11. The combination with a motor, of a plurality of clutches for connecting the same with the mechanism to be operated, resistances in circuit with said clutches, a controlling device having means for starting said motor, and means for controlling the circuit through said clutches, means for simultaneously operating said motor starting means and said clutch controlling means to start the motor and close a circuit through one of

said clutches with no resistance therein, and a circuit through the other of said clutches with all the resistance therein.

12. The combination with a motor, of a plurality of clutches for connecting the same with the mechanism to be operated, a controlling device having means for starting the motor, and means for controlling the circuit through said clutches, means whereby said clutch controlling means will be operated with said means for starting the motor when the motor has started, but will be unaffected by said motor starting device, when the same is operated to stop the motor.

13. The combination with a motor, of a plurality of clutches for connecting the same with the mechanism to be operated, of a controlling device having means for starting the motor, and means for controlling the circuit through said clutches, means whereby said clutch controlling means will be operated conjointly with said motor starting means when the motor is started but may be operated independently when said motor starting means is in a position to stop the motor.

14. The combination with a motor, of a plurality of clutches for connecting the same with the mechanism to be operated, a controlling device having a movable element for starting and stopping the motor, a movable element for controlling the circuit through one of said clutches and a second movable element for controlling the circuit through the other of said clutches, means whereby all three of these movable elements will be moved in unison when the motor controlling element is operated to start the motor, and means whereby the clutch controlling movable elements may be operated independently of the motor controlling movable element and of each other when the controlling movable element is in a position to stop the motor.

15. In a controlling device, the combination with a plurality of movable elements, of means whereby when one of said elements is moved in one direction, the remaining movable elements will be moved therewith, means whereby when said first mentioned movable element is moved in an opposite direction, the remaining movable elements will stay in the position to which they have been moved and may be moved to a new position independently of said first mentioned movable element and of each other.

16. The combination with a motor, of a plurality of magnetic clutches for connecting the motor with the mechanism to be operated and means for controlling the circuit of each clutch operative independently of each other, and regulating the strength of the current through the clutch-windings.

17. The combination with a plurality of magnetic clutches, of means for controlling the circuit of each clutch, operative independently of each other, and means for operating said controlling means for closing the circuit to the clutches at substantially the same time.

18. The combination with a motor, of a plurality of magnetic clutches for connecting the motor with the mechanism to be operated, of a movable element for controlling the circuit through each clutch, operative independently of each other, and regulating the strength of the current through the clutch-windings.

19. The combination with a plurality of clutches, of a movable element for controlling the circuit through each clutch operative independently of each other, and means for operating said movable elements in one direction in unison.

20. The combination with a motor, of a plurality of magnetic clutches for connecting the same with the mechanism to be driven, means for controlling the circuit of each clutch operative independently of each other, and an arm or lever for operating said controlling means in unison.

21. The combination with a motor, of a plurality of magnetic clutches for connecting the same with the mechanism to be driven, a plurality of means for controlling the circuits of said clutches operative independently of each other, and means for operating said controlling means in unison.

22. The combination with a motor, of a plurality of magnetic clutches for connecting the same with the mechanism to be driven, of a movable element for controlling the circuit of each of said clutches and movable independently of each other, and means for moving said movable elements in one direction in unison.

23. The combination with a motor, of a plurality of magnetic clutches for connecting the same with the mechanism to be driven, a plurality of controlling means for controlling the circuit of said clutches operative independently of each other, means for operating said controlling means in unison, and a controlling means for said motor.

24. The combination with a motor, of a plurality of magnetic clutches for connecting the same with the mechanism to be driven, a plurality of controlling means for controlling the circuits of said clutches operative independently of each other, a controlling means for said motor, and means whereby when said motor controlling means is operated to start the motor, the clutch controlling means will be operated to close the circuits of said clutches.

25. The combination with a motor, of a plurality of magnetic clutches for connecting the same with the mechanism to be driven, a plurality of movable elements for controlling the circuits of said clutches operative independently of each other, a movable element

for controlling said motor, and means whereby all of said movable elements will be moved in one direction in unison.

26. The combination with a motor, of a plurality of magnetic clutches for connecting the same with the mechanism to be driven, a plurality of movable elements for controlling the circuits of said clutches, a movable element for controlling said motor, means whereby said movable elements will be moved in one direction in unison, and said movable element for controlling the motor may be operated in a reverse direction independently of said clutch controlling movable elements.

27. The combination with a motor, of a starting device therefor, comprising a movable element and a solenoid for operating the same, a plurality of magnetic clutches for connecting said motor with the mechanism to be driven, a movable element for controlling the circuit through said solenoid, and a plurality of independently operative movable elements for regulating the strength of the current through the windings of said clutches.

28. The combination with a motor, of a starting device therefor, comprising a movable element of a solenoid for operating the same, a plurality of magnetic clutches for connecting said motor with the mechanism to be driven, a plurality of independently operative movable elements for controlling the circuit through said clutches, a movable element for controlling the circuit through said solenoid, and means whereby when said solenoid controlling element is moved in one direction the clutch controlling elements will be moved therewith.

29. The combination with a motor, of a plurality of parallel paths arranged in the circuit thereof of comparatively high resistance and a single path of comparatively low resistance, a plurality of switches controlling said paths, a plurality of solenoids for operating said switches and means for automatically and successively admitting operating current to said solenoids.

30. The combination with a motor, of a plurality of parallel paths in the circuit thereof of comparatively high resistance, and a single parallel path of comparatively low resistance, a plurality of switches for controlling said paths, a plurality of solenoids for operating said switches, a plurality of resistances in circuit of said solenoids, and means for automatically and successively cutting out said solenoid resistances.

In witness whereof, we have hereunto subscribed our names in the presence of two witnesses.

CLARK T. HENDERSON.
NORMAN C. BASSETT.

Witnesses to the signature of Clark T. Henderson:

CHARLES BARNETT,
NORMAN C. BASSETT.

Witnesses to the signature of Norman C. Bassett:

JOHN DAY, Jr.,
G. F. DE WEIN.