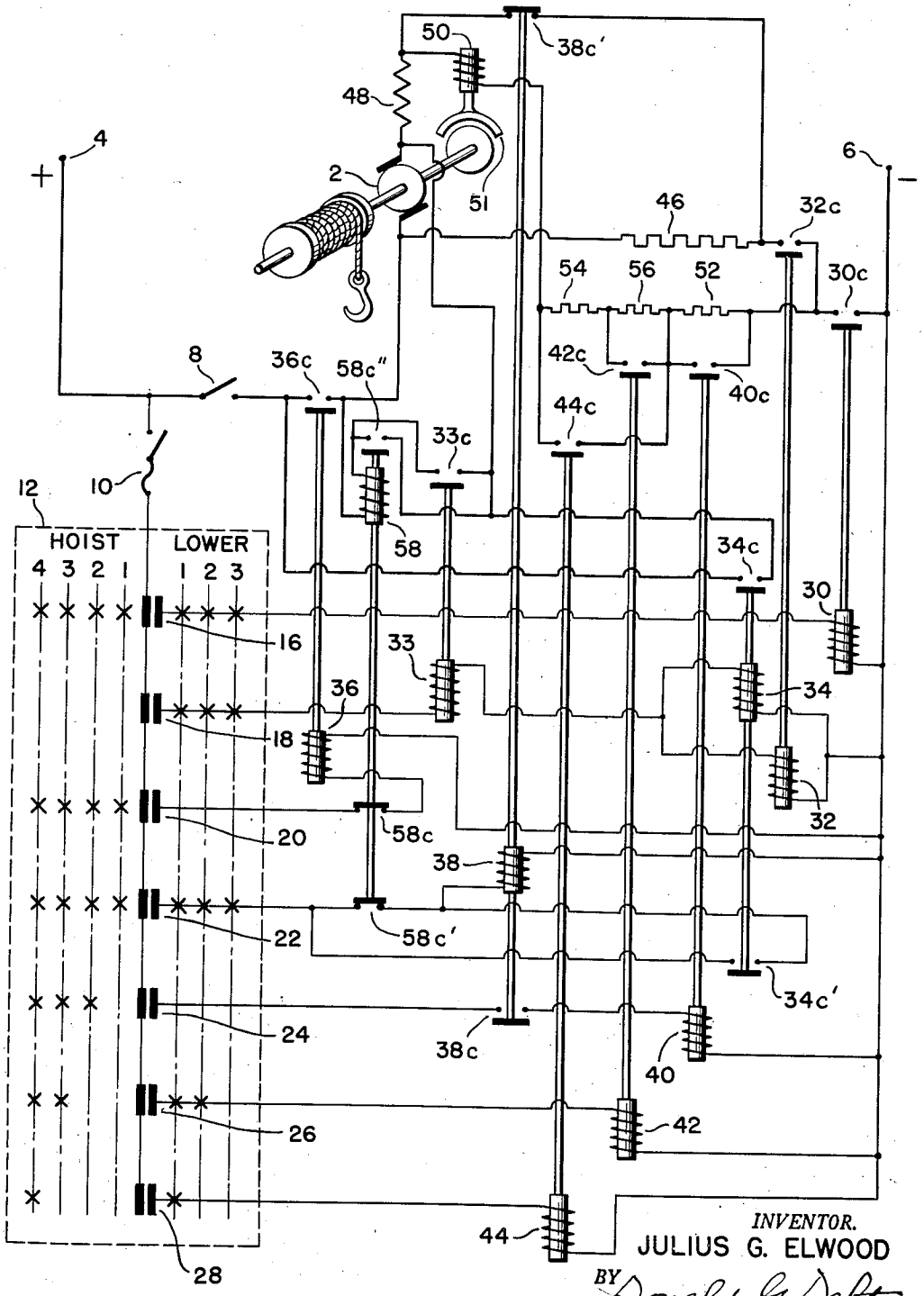
April 25, 1950 J. G. ELWOOD 2,505,281

ANTIPLUGGING CONTROL FOR MOTORS

Filed April 8, 1949



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Patented Apr. 25, 1950

2,505,281

UNITED STATES PATENT OFFICE

2,505,281

ANTIPLUGGING CONTROL FOR MOTORS

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Application April 8, 1949, Serial No. 86,352

2 Claims. (Cl. 318—383)

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This invention relates particularly to an antiplugging control for a hoisting motor and is a continuation-in-part of my copending application, Serial No. 658,054, filed March 29, 1946, now Patent 2,494,611, issued January 17, 1950.

Previous to my invention, constant trouble was experienced with crane hoist motors because the existing means of protection against plugging are ineffective under certain conditions. The term "plugging of a motor" means reversing the direction of rotation of the motor before the motor has come to a complete stop from its original direction of rotation. This causes a greatly intensified current to flow through the armature coils of the motor which, if not controlled, may damage the motor. The high currents are due to the fact that the C. E. M. F. (counter electromotive force), which is the stabilizing element of the motor speed, is in the same direction as the applied E. M. F. at the instant of plugging and therefor there is no electrical restraining force. The C. E. M. F. can be of large proportions when there is a large overhauling load on the motor. This C. E. M. F. plus the unrestrained line voltage sets up high stresses within the coils of the motor armature which often wreck the armature and also the field windings.

In case the motor speed becomes excessive while lowering a heavy load, the operator usually becomes excited and his first thought is to throw the motor into the reverse direction in order to stop the load. Most cranes are built without any protection against plugging the hoist motor although in some instances partial protection under certain conditions is provided for.

It is therefore an object of my invention to provide a control for preventing the harmful effects of plugging hoist motors.

Another object is to provide protection of hoist motor armatures against overloading stresses due to acceleration of the load being lowered.

These and other objects will be more apparent after referring to the following specification and attached drawings, in which the single figure is a schematic wiring diagram of my invention.

Referring more particularly to the drawing, the power circuit is shown in heavy lines and the control circuit is shown in light lines. Power is supplied to the motor armature 2 from the power source 4, 6 through the knife switch 8. Power is supplied to the control circuit through combined knife switch and fuse 10. The control circuit is provided with a master switch 12 having a number of contacts operated by cams whose positions are controlled by the master switch

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handle. As shown, the master switch is provided with three lowering positions and four hoisting positions. The switch is provided with contacts 16, 18, 20, 22, 24, 26 and 28. When the operator places the master switch handle in the first position on the lowering side, the contacts 16, 18, 22, 26 and 28 close, this being indicated by the X adjacent the contacts under position 1. This energizes the contactor coils 30, 32, 33, 34, 38, 42 and 44 to close contacts 30c, 32c, 33c, 34c, 34c', 38c, 42c and 44c and to open contact 38c'. In this position the motor armature 2 is connected to the power source 4, 6 in series with the dynamic braking resistance 46 which limits the armature current. The motor series field 48 is connected to the power line in series with the magnet coil 50 of the motor brake 51 and resistor 52. Thus the motor is connected and operated as a shunt motor which gives the series motor the ability to hold back the load in lowering by becoming a generator. The series brake releases when current flows through its coil 50.

In the second lowering position the contacts closed in the first lowering position remain closed with the exception of contact 28 which opens, thus deenergizing coil 44 to open contact 44c. This inserts the resistance 54 in series with the series field to reduce the field current, thus increasing the lowering speed of the motor.

In the third position, contact 26 is open which deenergizes coil 42 to open contact 42c. This inserts resistor 56 in series with the series field to reduce the field current still further, thus increasing the lowering speed of the motor.

For the first position of the master switch on the hoist side, the switch contacts 16, 20 and 22 close, thus energizing coils 30, 36 and 38 to close contacts 30c, 36c and 38c and open contact 38c'. This places the motor armature 2, series field 48, magnet coil 50 and resistances 52, 54 and 56 in series. The hoisting torque of the motor is limited by the resistances 52, 54 and 56.

When the master switch is placed in the second hoisting position, contact 24 is closed in addition to the contacts previously closed. This energizes coil 40 which in turn closes contact 40c to short out resistance 52 to increase the hoisting torque of the motor and accelerate it to a higher speed.

In the third position, the additional contact 26 is closed, thus energizing coil 42 which closes contact 42c to short out the resistance 56. This further increases the hoisting speed.

In the fourth position, contact 28 is closed in addition to the contacts previously closed. This energizes coil 44 which closes contact 44c to short

out resistance 54 and still further increase the hoisting speed.

The operation so far described is mostly standard, it being understood that overload relays and limit switches may be applied to the power circuit, while under-voltage relays may be applied in the control circuit.

My invention includes a coil 58 of an anti-plugging relay which is connected across the motor armature 2 in series with normally open contacts 33^c and $58^{c''}$ arranged in parallel. The relay 58 is provided with two normally closed contacts 58^c and $58^{c'}$ in addition to normally open contact $58^{c''}$. Contact 58^c is in the line energized by the closing of contact 20 and contact $58^{c'}$ in the line energized by the closing of contact 22. As pointed out above, the motor is connected as a shunt motor during lowering of the load and the potential energy of the load is converted into electrical energy which is dissipated in the resistances in the armature and field circuits. When the switch is thrown to the lowering side the coil 34 will close contact 34^c and the coil 33 will close contact 33^c. This causes current to flow in the anti-plugging circuit so that the coil 58 will be energized, thus closing contact $58^{c''}$ and opening contacts 58^c and $58^{c'}$. If the motor is suddenly plugged, that is, placed in the hoisting position, the relay 33 is deenergized, thus opening contact 33^c. However, relay 58 continues to be energized through closed contact $58^{c''}$ and holds the contacts 58^c and $58^{c'}$ open, thus preventing the coils 36 and 38 from being energized and attempting to make the motor raise the load while it is still lowering. Since coil 33 is deenergized, normally closed contact $38^{c'}$ will be closed. Thus, the kinetic energy of the load is absorbed in the dynamic braking resistance 46 as heat energy, and also in the brake lining and brake wheel as heat energy. Stopping the load in this fashion imposes the minimum strain on the motor. The relay 58 is pre-set at a predetermined potential which will occur at or just before the dynamic and mechanical braking brings the load and motor to a stop. When the motor comes to a complete stop the coil 58 deenergizes closing the contacts 58^c and $58^{c'}$ and permitting the motor to hoist the load in accordance with the position of the master switch. In the hoisting position relays 33 and 34 will always be deenergized so that the contacts 33^c and 34^c will be open. If desired the relays 32, 33, and 34 may be combined, it only being necessary that they be in a circuit which is energized only during lowering.

While one embodiment of my invention has been shown and described it will be apparent

that other adaptations and modifications may be made without departing from the scope of the following claims.

I claim:

1. An anti-plugging control for a hoisting motor or the like having a power circuit for supplying power to the motor and a control circuit for controlling the direction of rotation of the motor which control comprises a dynamic braking resistance in the power circuit, an anti-plugging relay coil connected across the motor armature, two pairs of normally open contacts in series with said relay coil and in parallel with each other, a relay in said control circuit energized during lowering only, one of said pair of contacts being operable by the anti-plugging relay and the other being operable by the second named relay, contacts in the control circuit operable by said anti-plugging relay, said last named contacts being closed during rotation of the motor in a hoisting direction, said anti-plugging relay coil being energized when lowering and remaining energized when the lowering circuit is interrupted to thereby hold said contacts open and prevent rotation of said motor in a hoisting direction until the kinetic energy of the load is absorbed.

2. An anti-plugging control for a hoisting motor or the like having a power circuit for supplying power to the motor and a control circuit for controlling the direction of rotation of the motor which control comprises a dynamic braking resistance in the power circuit, a magnet coil for a brake in series with said motor, an anti-plugging relay coil connected across the motor armature, two pairs of normally open contacts in series with said relay coil and in parallel with each other, a relay in said control circuit energized during lowering only, one of said pair of contacts being operable by the anti-plugging relay and the other being operable by the second named relay, contacts in the control circuit operable by said anti-plugging relay, said last named contacts being closed during rotation of the motor in a hoisting direction, said anti-plugging relay coil being energized when lowering and remaining energized when the lowering circuit is interrupted to thereby hold said contacts open and prevent rotation of said motor in a hoisting direction until the kinetic energy of the load is absorbed in the dynamic braking resistance and by the brake.

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No references cited.