W. D. LUTZ.

ELECTROMAGNETIC BRAKE.

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1,066,742. Patented July 8, 1913.

Fig. 1.

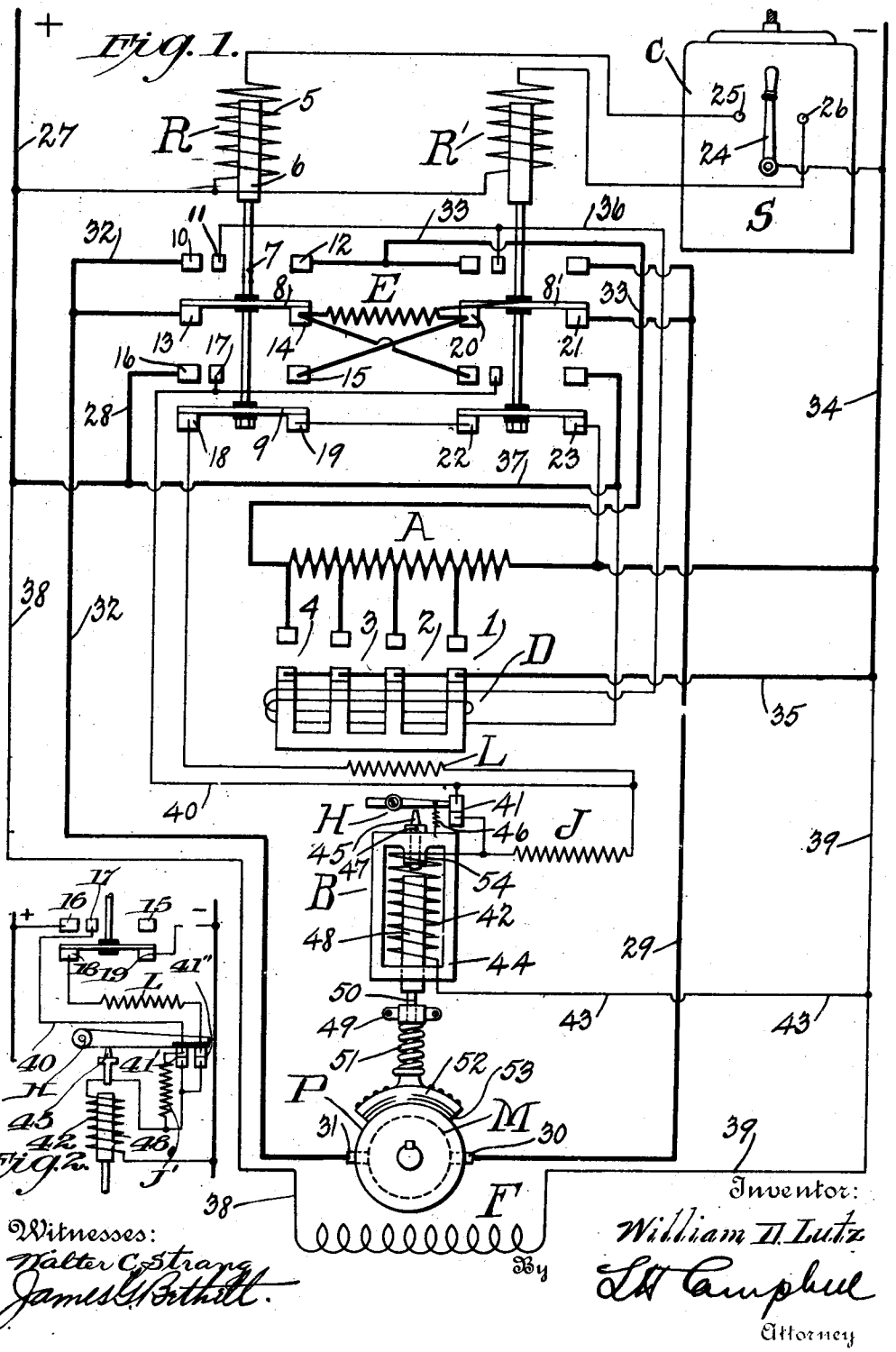


Fig. 2.

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ELECTROMAGNETIC BRAKE.

1,066,742. Specification of Letters Patent. Patented July 8, 1913.

Application filed February 23, 1910. Serial No. 545,311.

To all whom it may concern:

Be it known that I, WILLIAM D. LUTZ, a citizen of the United States, residing in Allendale, in the county of Bergen and State of New Jersey, have invented a new and useful Improvement in Electromagnetic Brakes, of which the following is a specification.

My invention relates to improvements in electromagnetic brakes, and has for its object the provision of means for automatically effecting a gradual application of an electric brake.

Other objects of my invention will appear hereinafter, the novel combinations of elements being pointed out in the appended claims.

In the accompanying drawing Figure 1 shows my invention as applied to an electric elevator system. Fig. 2 shows a modification. The heavy lines designate the main or motor circuits while the light lines show the brake, operating and field circuits.

Referring to the drawing, C designates an elevator car which is operatively connected to the armature M of an electric motor by means of cables, after the usual manner. A hand switch S is located in the car C by means of which the motor may be started, stopped and reversed.

R and R′ designate reversing switches. These switches are similar in construction and each comprises a solenoid core such as 6 which is adapted to be raised by the action of a solenoid 5 whenever the latter is energized. The core 6 is connected to a rod 7 which carries upon it a pair of insulated contact members or disks 8 and 9. Directly above the contact disk 8 are arranged stationary contacts 10, 11 and 12. Other contacts 13 and 14 are arranged below the disk 8 and are electrically connected or bridged by said disk when the magnet 5 is deënergized. In like manner, stationary contacts 16, 17 and 15 are arranged above the disk 9 while other contacts 18 and 19 are located below this disk and in normal electrical engagement therewith.

A designates the starting resistance which is automatically cut out of the armature circuit by the magnet D upon starting the motor.

M is the armature of an electric motor and F designates the motor field.

E is a resistance element which is used to absorb the energy of the rotating armature when it is desired to stop the motor.

B designates an electromagnetic brake comprising a frame 44 provided with a solenoid or magnet winding 42. A core 48 of iron or other magnetic material lies in the magnetic field of the solenoid 42 and is connected by a rod 50 to a brake member 52. The latter may be a shoe as illustrated or a flexible band and is preferably lined on its friction surface with leather or other suitable material designated by 53. The brake member is normally held in frictional engagement with the brake pulley P by means of a compression spring 51 which bears against the brake shoe 52 and a stationary bracket 49. The upper part of the magnet frame 44 is provided with a pole piece 54 through the center of which is located a movable pin 45 having a collar 47 thereon which limits its movement in a downward direction. Directly above the magnet frame 44, and in vertical alinement with the pin 45 is a normally closed switch H whose function is to control a resistance J connected across the contacts 41 of switch H and connected to the brake solenoid 42. The pin 45 is of such length and so positioned with respect to the switch H and the magnet core 48 that the switch H will be opened after the core has moved upwardly a short distance and before the latter has reached its upward limit of travel. A tension spring 46 may be connected to the contact arm of switch H for the purpose of maintaining the contacts 41 in closed relation except at such times as the latter are opened by the upward movement of the magnet core 48.

The operation of the system just described is as follows: The operator in the car moves the lever 24 of switch S to one side or the other until it engages one of the contacts 25, 26. I will assume that the contact 25 is thus engaged. This operation closes a circuit from the + main 27, to and through the solenoid 5 and by way of the switch contact 25 and switch lever 24 to the − main 34. The solenoid 5 is immediately energized to raise the core 6 and connected parts, causing the contact disk 8 to move out of engagement with the contacts 13, 14 and to bridge or electrically connect the contacts 10, 11 and 12. In like manner the disk 9 will move away from the contacts 18, 19 and

bridge the contacts 16, 17 and 15. This operation closes a circuit to the motor armature and also releases the brake. The motor circuit may be traced as follows:—from the + main 27, wire 28, contact 16, contact disk 9, contacts 15 and 20, contact disk 8′, contact 21, wire 29 to the brush 30, through the motor armature M to brush 31, wire 32, contact 10, contact disk 8, contact 12, wire 33, to and through the starting resistance A, and to the — line 34. The circuit to the motor field F may be closed at all times as shown by having its terminals connected by the wires 38 and 39 to the + and — mains respectively. The brake circuit is closed from the + line 27 at the reversing switch contacts 16 and 17 and flows by way of the wire 40 to and through the contacts 41, which are at this time in closed relation, to and through the brake solenoid 42, and by wires 43 and 39 to the — main. The solenoid 42 is now energized to raise its core 48 and connected brake shoe 52 against the action of the compression spring 51. As soon as the core 48 has moved upwardly a short distance it engages the pin 45 which is thereby raised and effects the opening of the switch contacts 41 against the action of the spring 46. These contacts are connected across the resistance J, hence the latter is short-circuited whenever the contacts are closed. As soon, however, as the switch H is opened, the circuit to the brake solenoid 42 includes the resistance J, hence the current flow in the solenoid 42 is reduced, resulting in a substantial economy of power. The motor is now free to rotate and operate the elevator car C the starting current being limited by the resistance A. Upon tracing the circuit of the accelerating magnet D it will be seen that it is connected across the motor brushes, hence it will depend for its operation upon the counter-electro-motive-force of the armature. As the latter accelerates the magnet D will gather strength to effect the operation of the contacts 1, 2, 3 and 4 in successive order or sequence and in this manner short-circuit the resistance A step by step, thus bringing the motor gradually up to full speed. In order to stop the motor and thereby bring the elevator car to rest, the operator in the car moves the switch lever 24 out of engagement with the contact 25, thereby open-circuiting the solenoid 5 of the reversing switch R. The core 6 and connected parts will no longer remain in raised position but will drop, the contact disk 8 bridging the contacts 13 and 14, while the contact disk 9 will bridge the contacts 18 and 19. The current supply to the motor armature is now opened at the contacts 10, 12 and 16, 15 while the circuit from the main line to the brake solenoid 42 is simultaneously interrupted at the contacts 16 and 17. As soon as the disk 8 bridges the contacts 13 and 14 a dynamic brake circuit is closed around the motor armature including the resistance E. This circuit may be traced from the armature brush 30, wire 29, contacts 21 and 20 of reversing switch R′, resistance E, contacts 14 and 13, and by the wire 32 to the armature brush 31. The current generated by the motor acting as a dynamo with separately excited field, flows through this local circuit containing a resistance, resulting in a dynamic brake action tending to bring the motor to rest. If the lever 24 of the car switch is moved to the right until it engages the stationary contact 26, a circuit is closed to the winding of the reversing switch R′ which would operate to close a circuit to the motor and brake in the same manner as described in connection with the reversing switch R. In the present instance the current would flow through the motor armature in a reverse direction causing the motor to run in the opposite direction.

I will now describe the operation of the friction brake B.

As before pointed out, when the reversing switch magnet 5 is deënergized and the contact plate 9 moved out of engagement with the contact 17, the current supply from the main line to the brake magnet 42 is greatly reduced, the circuit only being temporarily maintained through the arc that is drawn at the contact 17; hence the core 48 starts to drop, being assisted by gravity and the action of the spring 51. In the meanwhile the disk 9 of the reversing switch R has dropped into electrical engagement with the contacts 18 and 19, thereby short-circuiting the brake solenoid 42 upon itself, this circuit including the resistances J and L. This short, or local circuit may be traced from the upper terminal of the brake solenoid through the resistances J and L in series, contacts 18, 19, 22 and 23, wires 34, 39 and 43 to the lower terminal of the brake solenoid. The resistance J is not short-circuited by the switch H at this time since the core 48 has not moved sufficiently to allow the pin 45 to permit the switch H to close. By closing the brake circuit upon itself through the resistances J and L in series, a path of comparatively high resistance is provided for the discharge of the brake solenoid. At the instant the reversing switch contacts 9 and 17 are separated, the magnetic flux in the brake magnet decreases. At about this time the contact plate 9 of the reversing switch short-circuits the contacts 18 and 19, thereby providing a path for the current induced in the brake solenoid, the flow of which tends to build up the decreasing magnetic flux and by so doing retard the action of the brake. Since this circuit contains a comparatively high resistance, the current flow is held in check, hence the

retardation of the brake is of comparatively small amount, allowing the spring 51 to bring the leather lined brake member 52 into frictional engagement with the periphery of the brake pulley P in a short space of time. The core 48 has by this time moved downwardly an amount sufficient to enable the spring 46 to close the switch H which heretofore was held in open position. The closing of the switch H places the contacts 41 into electrical engagement with each other, thereby short-circuiting the resistance J and thus reducing the ohmic resistance of the local or short circuit comprising the brake solenoid and the resistance L. As soon as the resistance J is removed from circuit, more current will flow, which, by retarding the decrease of the magnetic flux, tends to retard the further application of the brake. As the magnetic flux dies out the spring is enabled to exert its full strength and the brake is applied with maximum power to stop the rotation of the pulley P and connected parts.

From the foregoing it is seen that at the time of cutting off the current supply from the motor, the brake is quickly applied with a predetermined pressure, after which the brake pressure is automatically increased for a short space of time and finally applied with full strength. By properly proportioning the resistances J and L the action of the brake may be widely varied so as to suit different conditions met in practice.

Fig. 2 shows a modification in which the resistance J is omitted from the brake discharge circuit. The wire 40 in this arrangement leads from the contact 17 to the switch contacts 41′ between which is connected a resistance J′. This resistance serves to reduce the current consumption while the brake is lifted. The brake discharge circuit includes only the resistance L, and this local circuit is established by means of an extra set of contacts 41″, also operated by the switch H, the local circuit being established only when the switch contacts 41″ have been brought together.

This automatic operation of the brake has proven of great practical value in elevator work. In all hoisting machinery where a spring applied brake is used, it is necessary to employ a spring which will have sufficient power to hold the hoisting apparatus at rest regardless of the load. If such a spring is used it is found that the retarding or brake action when stopping, is too severe. Particularly is this the case when the retarding action of the friction brake is augmented by the dynamic brake action of the motor itself acting as a dynamo. By means of my invention the dynamic brake is assisted by the partial action of the friction brake and as the motor slows down and the dynamic brake action becomes less and less, the friction brake becomes proportionally more powerful and in this manner the hoisting machinery and connected parts are quickly and smoothly brought to rest without shock or jar and without setting up unsafe stresses or strains in the various parts of the apparatus.

Instead of controlling the resistance in the brake magnet circuit by a single set of contacts such as shown at 41, I contemplate using additional contacts so as to control this resistance in several steps, thereby effecting a more refined action of the brake, the principal of operation remaining unchanged.

It is obvious that those skilled in the art could readily make changes in the details of construction herein set forth without departing from the spirit and scope of my invention, and I do not desire to be limited to the precise arrangement of parts herein disclosed.

What I claim as new and desire to secure by Letters Patent of the United States, is:—

1. The combination of an electromagnetic brake, and means controlled thereby for modifying a local current induced in the brake winding and thereby automatically effecting a slow application of the brake.

2. The combination of an electromagnetic brake, a local circuit therefor, and means operated by the brake for modifying said circuit to control the magnetic flux and thereby effect a slow application of the brake.

3. The combination of an electromagnetic brake, a supply circuit therefor, and means for opening the supply circuit and during the application of the brake automatically establishing a local circuit through the magnet and varying the resistance of said circuit.

4. In an electromagnetic brake, the combination of a coil for operating the brake, a supply circuit for said coil, and means for controlling the current induced in said coil by the decreasing magnetic flux after the supply circuit is interrupted.

5. In an electromagnetic brake, an exciting coil for releasing the brake, a supply circuit for said coil and means controlled by the brake for modifying a local current generated in the brake coil and thereby permitting a gradual application of the brake upon the interruption of said supply circuit.

6. The combination with the operating coil of an electromagnetic brake, of a resistance arranged to be connected in parallel with said coil, and means operated by the brake for varying said resistance, substantially as described.

7. In an electromagnetic brake, the combination of a supply circuit therefor, an elec-

tro-responsive device adapted to open and close said circuit, means operated by said device when in open-circuited position for short-circuiting the coil of said brake through a resistance, and means for varying the resistance, substantially as described.

8. In an electromagnetic brake, the combination of a supply circuit therefor, an electro-responsive device arranged to connect the brake coil to said supply circuit when in one position and to connect the brake coil is a closed circuit containing resistance when in another position, and means operated by the brake for controlling said resistance, substantially as described.

9. In a system of motor control, the combination with a motor, of an electromagnetic brake therefor, a dynamic brake for said motor, an electro-responsive device arranged simultaneously to effect the operation of said brakes, and means controlled by said electromagnetic brake for retarding its application, substantially as described.

10. In an electromagnetic brake, the combination with a supply circuit, of a brake coil, means for connecting said supply circuit to said coil when in one position and for short-circuiting said coil through a resistance when in another position, and a switch operated by the brake for controlling said resistance, substantially as described.

11. In an electromagnetic brake, the combination with a brake coil, circuit closing means for effecting the energization and de-energization of said coil, a resistance arranged to be inserted in series with said coil after the latter is energized to release the brake, means for connecting said brake coil in a local short-circuit including said resistance and an additional resistance in series therewith, and a switch operated by said brake for controlling the resistance in said local circuit, substantially as described.

12. In an electromagnetic brake, the combination with a brake coil, of a source of current supply therefor, and a switch operated by the brake for controlling the current in said coil both when the latter is connected to and disconnected from the source of current supply, for the purpose set forth.

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

WILLIAM D. LUTZ.

Witnesses:
JOHN F. RULE,
WALTER C. STRONG.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."