G. B. DUSINBERRE.

ELECTRIC CONTROLLER.

APPLICATION FILED JAN. 4, 1910.

1,038,320.

Patented Sept. 10, 1912.

2 SHEETS—SHEET 1.

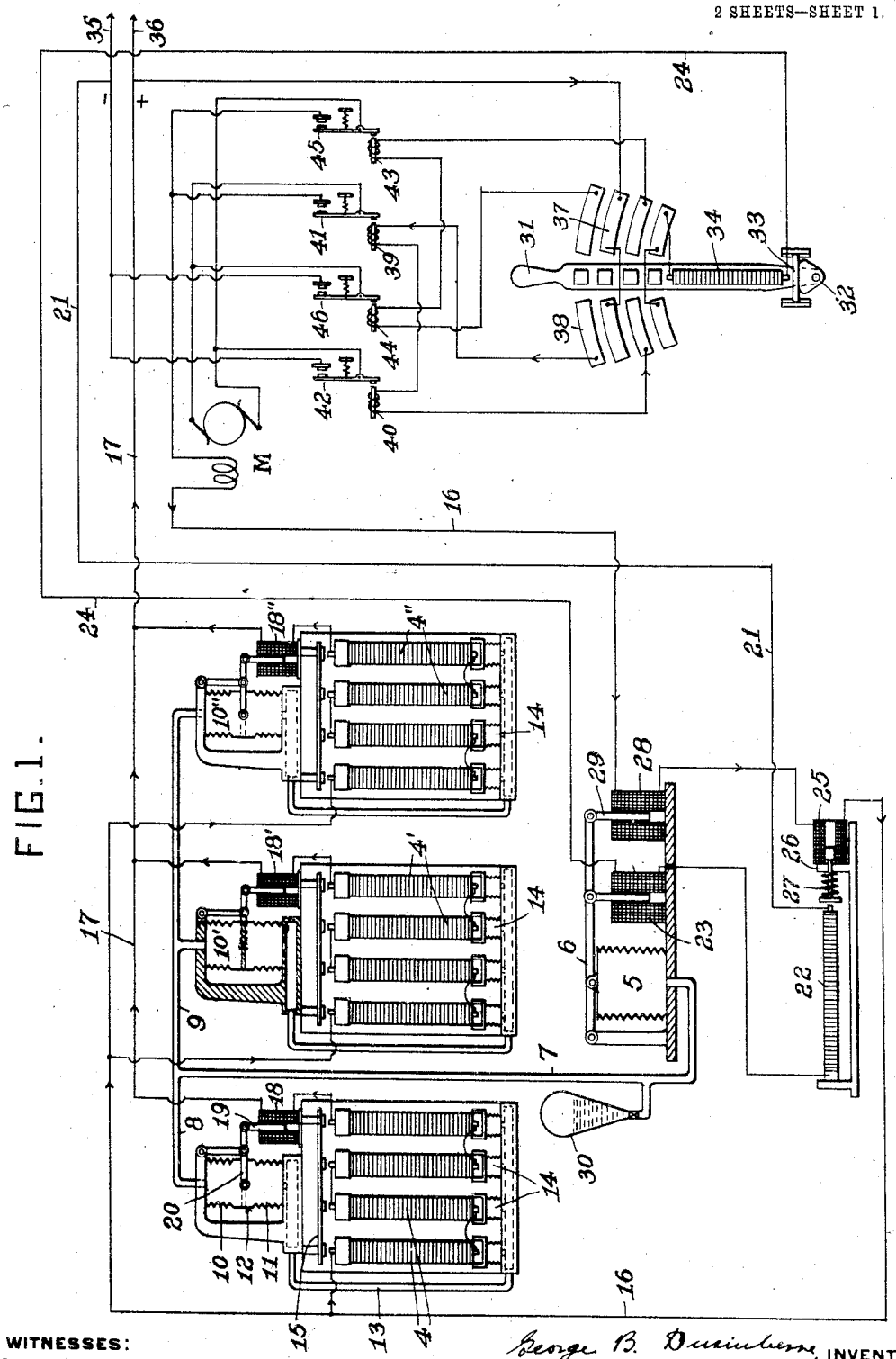

FIG. 1.

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2 SHEETS—SHEET 2.

FIG. 3.

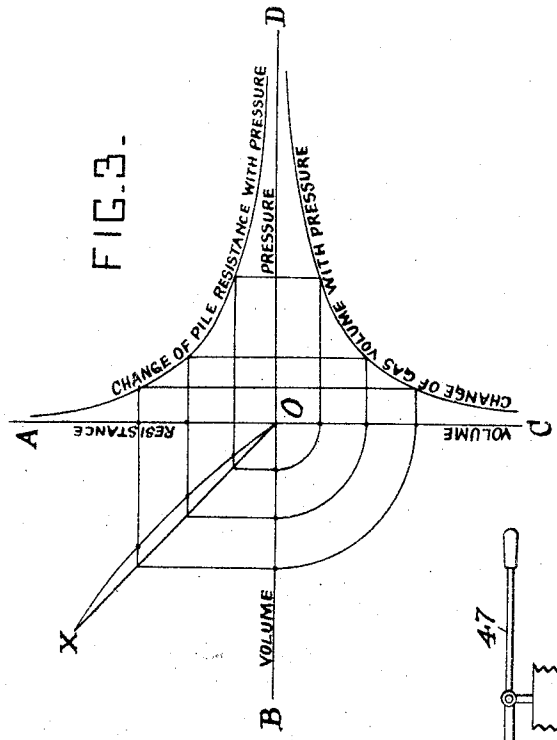
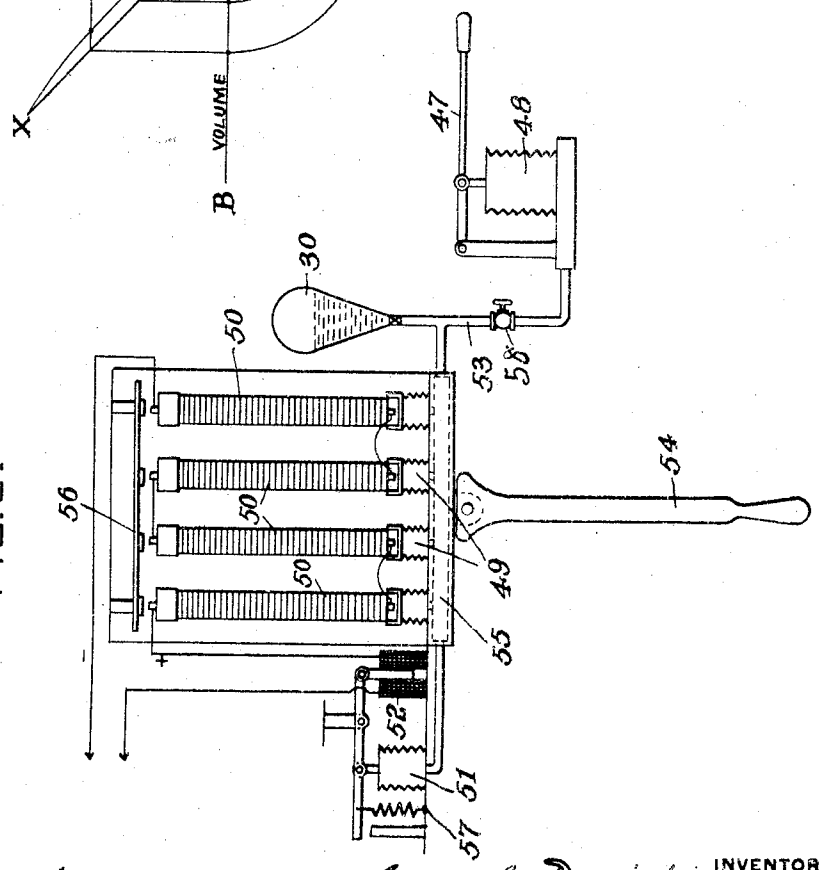


FIG. 2.



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UNITED STATES PATENT OFFICE.

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ELECTRIC CONTROLLER.

1,038,320. Specification of Letters Patent. Patented Sept. 10, 1912.

Application filed January 4, 1910. Serial No. 536,284.

To all whom it may concern:

Be it known that I, GEORGE B. DUSINBERRE, a citizen of the United States, residing at Cleveland, in the State of Ohio, have invented certain new and useful Improvements in Electric Controllers, of which the following is a specification.

My invention relates generally to the control of electrical currents, and especially to the type of controller employing piles of resistance elements with variable contacts, of which the total resistance is varied by changing the pressure thereon.

The primary objects of my invention are, to equalize the dissipation of energy by a number of such resistance piles; to make the variation of resistance correspond with variation in movement of the pressure device; to attain a stable balance between several resistance piles in parallel; to provide limiting devices to prevent excessive application of current to the controller; and to operate such resistance devices directly, by fluid pressure, without loss of motion and with great certainty.

I have illustrated the invention in one form in the accompanying drawing wherein—

Figure 1 is a diagram and partial section showing several sets of resistance piles in parallel and the individual elements of the sets in series, one form of a current limiting device, and a master controlling switch. Fig. 2 is a similar diagram representing a modification. Fig. 3 is a diagram illustrating resistance and pressure characteristic curves, to be hereinafter explained.

In devices for governing the current used for operating a motor for example, it has been proposed to use, instead of a number of fixed resistances which are cut in and out, step by step, a variable resistance device composed of a pile of carbon disks in which the resistance is gradually changed by varying the pressure upon the pile, thereby varying the contact between separate disks of the pile. It will be understood that such resistance elements have a limited capacity and it is sometimes necessary to subdivide the elements and to multiply the number of piles in order to put them in commercially applicable form and space. In such case, in order that each of the subdivisions may dissipate approximately the same amount of energy with equal current, the pressure upon various similar piles must be at all times equal. I provide means for directly and exactly equalizing pressures by use of fluid pressure; in connection with which I employ a gas or air chamber which I have found to vary in volume with variation of pressure, at approximately the same ratio that the carbon piles vary in resistance with variation of pressure thereon.

Referring first to Fig. 3, it will be observed that if the line O A be taken to represent resistance changes, and the line O B volume changes, then the curve O X will represent the resistance variation due to change of volume in a gas, approximately a straight line. Also if the line O C represents volume changes and the line O D represents the pressure changes corresponding, the curve C D will represent actual variation in volume resulting from variation in pressure. Again, on coördinates O A and A D I have found by experiment that curve A D represents change of resistance with pressure, in a column of carbon disks. That is to say, the curve of variation of resistance in the carbon pile corresponds approximately to the curve of variation of volume of air with change of pressure; from which it will appear that by using a gaseous medium to apply pressure to the carbon pile, or using other fluid pressure connected with a gas chamber, it will be possible by equal displacements of a pressure controlling diaphragm on the fluid to produce approximately equal changes of resistance in the carbon pile.

Considering the left half of Fig. 1, it will be noted that I have shown a controller comprising three parallel sets of variable resistance piles or columns 4, the individual piles being connected in series in each set. Considering first the matter of varying resistances of these in such a way as to dissipate the same amount of energy by each one of several sets of piles 4, it will be observed that I employ a pressure chamber 5 comprising an expansible bellows, supporting a pressure bar 6 and its interior space being connected by a pipe 7 and branches 8 and 9 leading to compensating devices and conducting fluid pressure to the columns 4. Thus, the pipe 8 is connected to a double bellows, 10, 11, having two expansible chambers separated by a diaphragm 12 and the lower chamber 11 communicates through pipe 13 with all the expansion chambers 14,

in the corresponding set of piles and governing the pressure on the piles 4, which it will be understood are pressed upward against a fixed abutment 15. The piles 4 are connected in series as shown, and on one side lead to the main line 16 going to the motor M, and on the other side lead to the motor by line 17. This lead, however, passes through a solenoid 18, so that by reason of the movable core 19 thereof, and the arm 20 connected to diaphragm 12 of the compensating chamber, the pressure on the bellows 14 is directly effected by the current passing through the piles. This is for the purpose of balancing the resistance among the several sets of resistance piles, as follows: That is, I show two other sets of resistance piles 4′ and 4″, which are exact duplicates of the set 4 just described, and it will be observed that the wiring for these connects them in parallel in the motor circuit 16, 17. The pressure on all the compensating chambers 10, 10′, 10″, is the same and therefore ordinarily the pressure on all twelve of the columns 4 would be the same. If however, for any reason, the resistance of the four columns 4 to the left of Fig. 1, should be less than normal under given pressure, the current through the coil 18 will increase, whereupon the upward lift of the lever 20 on the diaphragm 12 of the compensating chamber 10, 11, will reduce the pressure on the piles 4 of this group and therefore raise the resistance to its proper value. This also increases the pressure on the system 10, 10′, 10″, and so on the piles of the other sets, thus tending to maintain an electrical balance between the sets. So with each of the groups; and it will thus be seen that the device automatically causes the several groups of resistance piles to dissipate the same amount of energy. In some cases I may employ a compensator for each individual pile in a group, constructed in practically the same way as described.

In order that excessive current may not be thrown upon the motor, I use a current limiting device shown in one form at the left bottom of Fig. 1. The current from a master controller or switch passes directly by wire 21 through a pile of carbon blocks 22 and through a solenoid coil 23, and by lead 24, direct to the master switch 31 hereafter to be described. By this means the master controller electrically operates the pressure arm 6 to govern the fluid pressure in the chamber 5. The main current from the resistance piles however, passes through a solenoid 25 whose core 26 operates to release pressure on a spring 27 normally exerting pressure on the pile 22 and thus reducing its resistance. From this it will appear that if an excessive current be thrown on, it will have the immediate effect of introducing a resistance at 22, cutting down the current that passes through solenoid 23 operating the pressure resistance piles, and this reducing pressure on the piles 4, preventing excessive flow of the main current. This main current also passes through solenoid 28 whose movable core 29 is connected to the pressure arm 6, and in order to counterbalance the pressure on the several compensator chambers 10 introduced by the operation of solenoids 18, 18′, 18″, this solenoid 28 carrying the total current thus renders controlling solenoid 23 independent of the current in the main motor circuit.

It will be understood that I may have in the fluid pressure system at any convenient place a quantity of air for the purposes first above described; I have here shown it in the form of an ordinary pump bell 30 to the left of Fig. 1.

On the right of Fig. 1, I show the master controller and switch, which I ordinarily use for convenience in operating the motor controller at a distance. The handle 31 is pivoted at 32 and by means of a cam and movable platform 33 it introduces pressure on a column of carbon blocks 34 when thrown to either side, for reversing. From the mains 35 and 36, the current may pass to contact 37, through the handle to contact 38, to solenoids 39 and 40, through the resistance pile 34 and thence to the main resistance controller by lead 24. Solenoids 39 and 40 close the switches 41 and 42 respectively direct to the motor M. Similarly when the handle is thrown to the right, the motor is reversed by similar action of solenoids 43, and 44, and switches 45 and 46. It will be clear that the distance the handle 31 is thrown over will, by varying pressure on column 34, change the current in leads 21, 23, thus varying the pressure in chamber 5 and the compensating chambers 10 of the principal resistance piles. It is obvious that other means may be employed for controlling this auxiliary current passing through the limiting resistance 22 and operating solenoid 23, such as a resistance of the usual wire construction. And of course the main switches may be manually operated.

In Fig. 2, I have shown a modification for operating directly, by the handle 47, the fluid pressure in bellows 48, and pipes 53 altering the resistance in chambers 49 of the resistance piles 50, which are connected in circuit as desired and have a compensating device in the bellows 51 and a solenoid 52 carrying the total current for the purposes heretofore described. I also show a lever 54 with two cams which may alternately be used in place of lever 47 and diaphragm 48. This operates to induce pressure on the chamber 55 inducing pressure in the chambers 49 and thence on the piles 50; the valve 58 being closed in such operation. In this

form, it will be understood that the spring 57 corresponds in function to spring 27 in Fig. 1 and the solenoid 52 to solenoid 25 therein.

Having thus described my invention and illustrated its use, I claim the following:

1. An electric controller comprising sets of resistance elements whose resistances are variable by pressure, and a fluid equalizer to impress pressure thereon, including a compensating device to cause the several columns to dissipate the same amount of energy.

2. An electric controller comprising several resistance elements in which the resistance is variable by pressure, means for inducing fluid pressure on all said devices, and compensators operated by the current to maintain the resistances equal, substantially as described.

3. An electric controller comprising several resistance elements in which the resistance is variable by pressure, means for inducing fluid pressure on all said devices, and compensators operated by the current to maintain the resistances equal, and means to equalize changes of fluid pressure due to operation of the compensators.

4. The combination with a variable pressure resistance device, of means for inducing fluid pressure thereon including a volume of gas, acting as part of the operating fluid body.

5. The combination with a resistance controller, of a current limiting device comprising a resistance variable by pressure and compensating means for varying the pressure thereon, operated by the total current.

6. The combination of a master controller, a resistance variable by pressure and means operated by the master controller to vary pressure on said resistance, and an auxiliary circuit containing a current limiting device operated by the main current.

7. The combination with several resistance piles whose resistances are varied by pressure, of a master diaphragm and a fluid chamber and connections adapted to impress equal pressures on all of said resistance piles.

8. The combination with a circuit including a resistance variable by pressure, of a current limiting device comprising a solenoid adapted to change the pressure on said resistance, inversely with changes of current strength.

9. The combination of a current controller consisting of a series of resistance elements variable by pressure thereon, electric means to control such pressures, a compensating device to balance the pressures on the several resistance elements inversely as the current therethrough, a master switch and a current limiting device acting automatically to prevent throwing excessive current on the said resistances.

10. In a current controller comprising a series of sets of resistance elements variable by pressure thereon, the combination of fluid means electrically operated to induce pressure on said resistance elements and an automatic compensator to cause equal amounts of energy to be absorbed by each of said sets of resistance elements.

In testimony whereof I have hereunto signed my name in the presence of the two subscribed witnesses.

GEORGE B. DUSINBERRE.

Witnesses:
JAS. W. BREMER,
C. J. QUEEN.