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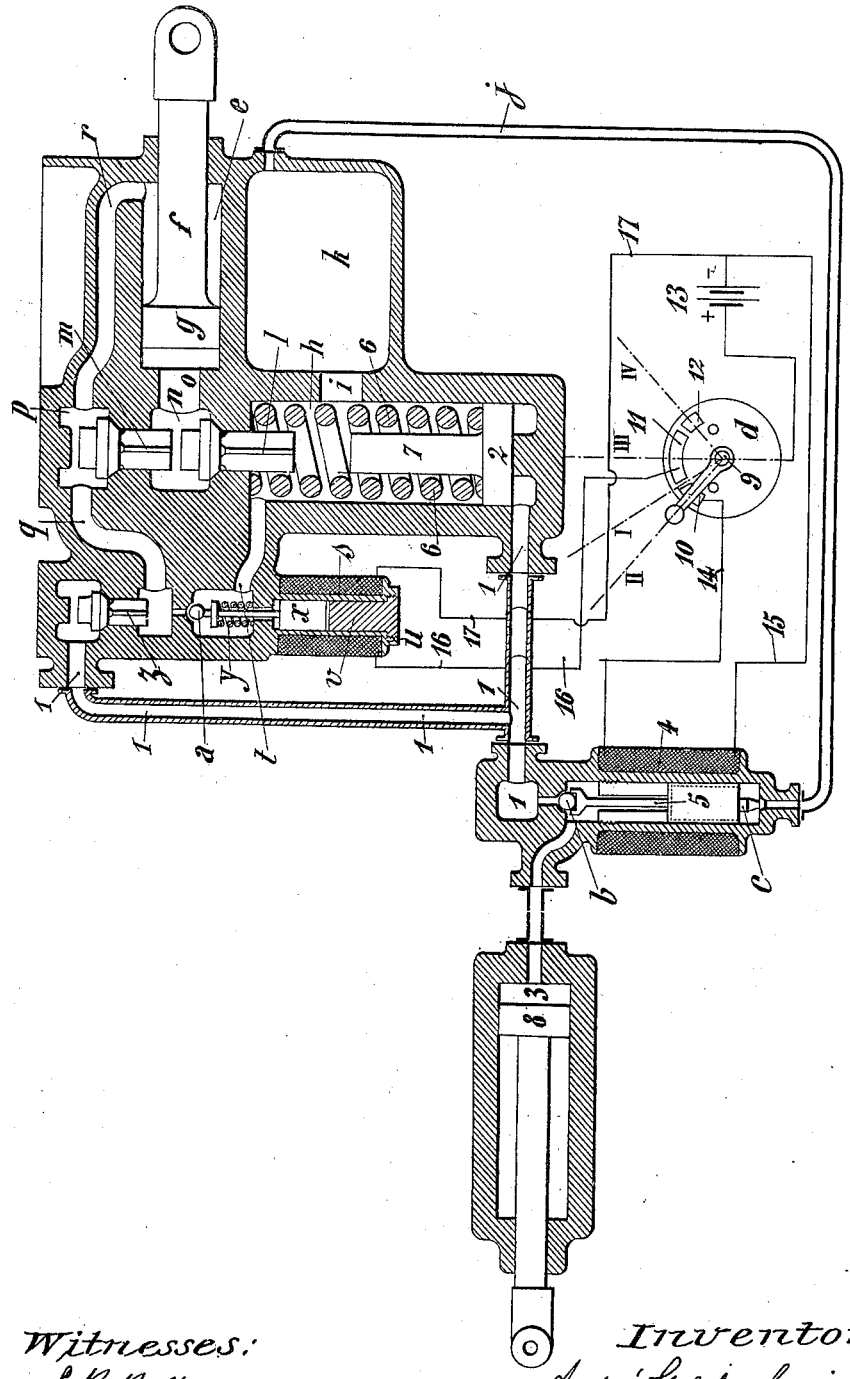
A. GOLDSCHMIDT.

ELECTROHYDRAULIC BRAKE FOR RAILWAY OR LIKE VEHICLES.

(Application filed Feb. 12, 1901.)

(No Model.)



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ELECTROHYDRAULIC BRAKE FOR RAILWAY OR LIKE VEHICLES.

SPECIFICATION forming part of Letters Patent No. 676,745, dated June 18, 1901.

Application filed February 12, 1901. Serial No. 47,071. (No model.)

To all whom it may concern:

Be it known that I, ANDRÉ GOLDSCHMIDT, a subject of the King of Belgium, residing at 73 Rue Caumartin, Paris, in the Republic of France, have invented certain new and useful Improvements in Electrohydraulic Brakes for Railway or Like Vehicles, of which the following is a full, clear, and exact specification.

The continuous and automatic electrohydraulic brake which forms the subject of the present invention is an improvement on the ordinary type of hydraulic brake controlled by electricity, in which the lever connections which operate the brake-shoes are actuated by the active force of the vehicle in movement.

In American Patent No. 585,089, issued June 22, 1897, an electrohydraulic brake was described working on the following principle: The active force of the vehicle in movement serves to automatically maintain a hydraulic accumulator arranged under each vehicle under a high and constant pressure, said accumulator being capable of being brought into communication with a brake-cylinder. In this system each time that it is desired to apply the brake communication is established by means of the electric operating mechanism between the accumulator and the brake-cylinder by opening a valve placed on the pipe connecting these two parts. When it is required to maintain the brake in a certain braking position, this communication is closed again after having been established, and the pressure created is preserved by means of a spring arranged between the two piston-heads of the brake-cylinder. In order to take off the brake, this spring must be completely relaxed and all the liquid which had served to produce its compression forced into the reservoir. This system presents the two following drawbacks: First, a somewhat slow removal of the braking, seeing that it is connected with a greater or lesser rapidity of the expansion of the spring of the brake-cylinder, which is itself dependent upon the rapidity with which the liquid flows away behind the head of the internal piston of this cylinder, and, second, considerable consumption of liquid under pressure, seeing that all the liquid which had served to produce a braking is returned without pressure into the reservoir which communicates with the atmosphere. The result of this is the necessity of employing a powerful pump for equalizing the supply of liquid and rapidly reëstablishing in the accumulator the pressure necessary for a subquent application of the brake. This drawback—viz., the use of a powerful pump necessitating a great expenditure of motive power—is particularly felt in the starting of a train after a more or less prolonged stoppage. In fact, the pump for charging the accumulator does not unprime itself automatically except at the moment when that high pressure is reached which it is desired to maintain in the accumulator, and as at the start it frequently happens that the pressure is low the necessary power for establishing this pressure is borrowed from the axle of the vehicle, thus rendering more difficult the starting of the train.

My improved electrohydraulic brake entirely avoids the drawbacks which I have just pointed out.

For the sake of clearness I will now first describe the apparatus and its mode of working, and I will then show how the construction and peculiar arrangement of its parts enable the drawbacks hereinbefore indicated to be avoided.

The accompanying drawing shows a sectional plan view of the apparatus.

Each of the vehicles of the train is provided with a similar apparatus, and the apparatuses are connected electrically by suitable couplings. The whole is operated by a single switch *d*, placed within reach of the hand of the operator on the motor-car or engine. When running normally the electric current circulates in all the distribution, actuating an electromagnet governing the valves in such a way as to maintain the brakes held off. The stoppage of the current, on the contrary, whether produced voluntarily by the action of the operator or whether it be caused by an accident—such, for instance, as the breakage of a coupling—gives rise to a movement of

the said valves resulting in an application of the brakes.

The apparatus comprises a pump *e*, the piston *g* of which is connected by its rod *f* with an eccentric or any other suitable means of transmission mounted on the axle of the vehicle and constantly set in motion by this latter. The body of the pump communicates by a chamber *h* and a pipe *i* with a liquid-reservoir *k*, open to the air, which may form part of the apparatus, as shown, or be mounted at any suitable point on the vehicle.

n is the valve-chamber, which communicates with the rear face of the piston *g* by a passage *o* and in which are arranged on the same vertical axis a suction-valve *l* and a returning or compression valve *m*. A chamber *p* above the compression-valve communicates with the compression-pipe proper, *q*, and also with a pipe *r*, which communicates with the end of the pump-body behind the piston *g*, so that the valve is single-acting in suction and double-acting in compression. A valve *a*, arranged on the pipe from the pump *g*, establishes or interrupts communication of this latter with the reservoir *k*, according as said valve is opened or closed, such opening or closing being obtained by means of the manipulating-switch *d*, causing the passage or the suppression of the current in an electromagnet *u*. This electromagnet consists of a coil *s*, the internal armature of which comprises a fixed part *v* and a movable part *x*. This latter is subjected to the action of a spring *y*, which tends to force it out of the coil and to cause it to bear on the valve *a*, in the form of a ball or any other suitable arrangement. When the current passes into the electromagnet, the movable core of *x* is drawn toward the fixed part *v*, the valve *a* is freed, and the liquid which the pump forces back may return to the reservoir by the passage *t*, the chamber *h*, and the passage *i*. When, on the contrary, the current is suppressed in the electromagnet *s*, the valve *a* rests on its seat, and so long as the valves *l* and *m* work freely the liquid forced by the piston *g* of the pump will lift a retaining-valve *z* and pass into the passage. This latter passage is terminated, on the one hand, by the front face of a piston 2 and, on the other hand, by a double valve *b c*. The valve *b*, according as it is opened or closed, establishes or interrupts communication between the pipe 1 and the brake-cylinder 3, the piston 8 of which actuates the brake-levers, and the valve *c* similarly, through a pipe *j*, establishes or interrupts the communication between the cylinder and the reservoir *k*. The valve *c* may consist of a prolongation of a core 5 or movable part of the armature of the electromagnet 4, such core being drawn down by its own weight alone, its opposite extremity acting on the valves *b*. When the armature 5 is drawn up in consequence of the passage of the current into the coil 4, the valve *b* is closed and the valve *c* opened, and vice versa. The result is that the passage of the current into the coil 4 causes the brake-cylinder to communicate with the reservoir *k* by the body of the electromagnet and the passage *j*, while the suppression of the current closes this communication and causes the said cylinder to communicate with the passage.

The piston 2, which is arranged in the cylindrical chamber *h* so that the axis of its rod 7 is in the prolongation of the axis of the valves *l* and *m*, is subjected on its rear face to the action of a powerful spring 6, which tends to move it away from the valves. It will thus be seen that when the valve *a* is closed the liquid forced back by the piston *g* of the pump arriving in the passage will act on the front face of the piston 2 and compress the spring 6. This spring is so regulated as to attain a given tension at the moment when the rod 7 in rising encounters the suction-valve *l* of the pump. At this moment the valves *l* and *m* remain raised, and the retaining-valve continuing to be pressed on its seat the liquid drawn from the reservoir by the piston *g* will return to said reservoir, and the pump will work without resistance so long as the spring 6 preserves its tension. As the valve *b* is closed, (the valve *c* consequently being open,) all the liquid which comes into the pipe 1 will remain confined in this pipe and serve solely for compressing the spring 6 through the piston 2. If the valve *b* be opened, the liquid under pressure contained in the pipe 1 will partly flow to the brake-cylinder, forced by the piston 2 and the spring 6, which serves as an elastic and storing means for transmitting energy to the piston 8 for operating the series of brake-levers. The brake-cylinder proper has no springs. While the valve *b* is open the liquid reaches the brake directly from the back of the forcing-pump by the pipe 1, which forms a continuous chamber between the piston 8 of the brake-cylinder and the piston 2.

The switch-handle *d* has four contacts—a central one 9, connected with the positive pole, for instance, of a source of electricity 13, and three contacts in the form of an arc of a circle 10, 11, and 12. The contact 10 is connected by a conductor 14 with one of the terminals of the coil 4, while the other terminal is connected by a wire 15 with the negative pole of the source of current 13. The contact 11 is connected by a conductor 16 with one of the terminals of the coil *s*, while the other terminal is connected by a conductor 17 with the negative pole of the source of current 13. The contact 12 is a dead contact. The handle of the switch may assume the positions I, in which it is astride of two contacts 10 and 11, II on the contact 10, III on the contact 11, and IV on the contact 12. Under normal working the handle must be placed on the contact 10 in the position II. In this position, which corresponds with the taking off of the brake, the current is suppressed in the electromagnet *s*, but passes into the coil 4, whereby the valve *a* is closed, the valve *b*

is closed, and the valve *c* opened. The valve *c* being opened and valve *b* closed, the brake-cylinder communicates with the reservoir, and its communication with the pipe 1 is closed. The valves *b* and *a* being closed, the piston *g* of the pump forces into the pipe 1 all the liquid drawn up by the passage *i* until on the rise of the piston 2 the rod 7 lifts the valves *l* and *m*. At this moment the piston ceases to force liquid into the pipe 1, but returns into the reservoir *k* all the liquid which it draws therefrom, and consequently the pump no longer absorbs energy. In the pipe 1, which is only separated from the brake-piston 8 by the valve *b*, there is thus in reserve a quantity of liquid at a pressure which corresponds to the tension of the spring 6. Now if it be desired to apply the brake, the handle of the switch is brought into position IV on the dead contact 12. The current then passes into none of the coils and the valve *a* is closed, the valve *b* opened, and the valve *c* is closed, which means that communication between the brake-cylinder 3 and the reservoir *k* is closed, while, the valve *b* being open the piston 8 is in communication with the pipe 1—that is to say, communication is established between this piston and the pressure of the pump on the one hand and the piston 2 on the other hand. Before the pump has need to come into play the liquid under pressure available in the pipe 1 suffices for displacing the piston 8 in such a way as to bring the brake-shoes in contact with the tires of the wheels. If the valve *b* is left open, the pump continuing to force liquid into the pipe 1 will increase the application of the brakes until the driver reëstablishes the current in the coil 4; but the limit of the braking will be always attained when the spring 6, which forms, with the piston 2, an elastic storing device for transmitting energy to the brake-engine, is sufficiently compressed to allow the rod 7 to lift the valve *l*; but at any suitable moment, according to requirements, the driver can stop the application of the brake or maintain it at the pressure which it has reached by bringing the handle into the position III, which is a position of *statu quo* on the contact 11. In this position the circuit is closed on the coil *s*, the valve *a* being open, the valve *b* open, and the valve *c* closed.

The retaining-valve *z* closes the communication between the pipe 1 and the pump. The liquid drawn up by the piston of the latter returns to the reservoir, and the brakes remain applied with an energy which varies according to the degree of pressure of the liquid contained between the piston 8, valve *z*, and piston 2. If it be desired to increase the brake-pressure, it suffices to increase the degree of pressure in this liquid mass contained between the elastic part 2 and the brake-piston. For this object the handle is returned into the position IV, and the valve *a* again closing a fresh quantity of liquid is admitted to the pipe 1 and the pressure exerted on the piston 2 as a point of support is shown by an increase of reaction on the piston 8.

In order to remove the brake after it has been applied, the handle is returned to the contact 10 into the position (II) of normal working. As the starting of a train may be somewhat difficult, especially on leaving a terminal station or after a prolonged stoppage, and, on the other hand, the energy available for an application of the brake does not exist at this moment, seeing that it is attained from the momentum of the vehicle, it is advisable to prevent the pump from using up the energy of the vehicle during the first revolutions of the wheels of the train.

The arrangement which has just been described of the two valves *a* and *b*, the latter situated on the pipe 1 and the former on the communication between the pump and the reservoir, enables the pump to be thrown out of action at any suitable moment, whatever may be the pressure of the liquid in the pipe 1 at this moment and the corresponding position of the piston 2. It suffices, in fact, to return the handle into the position I (starting position) astride of—that is to say, in contact with—the two contacts 10 and 11. The two coils *s* and 4 are then placed in circuit. The result is that valve *a* is opened, valve *b* closed, and valve *c* opened. The pump then does not force liquid either into the pipe 1 or cylinder 3. It returns to the reservoir all the liquid which it draws therefrom, and its piston then works in consequence without absorbing other energy than what is due to friction.

It will be noted that to operate a removal of the brake the valve *b* is closed, opening by the same action the valve *c*. On the other hand all the liquid under pressure contained in the pipe 1 and which serves for maintaining the brakes applied remains in this pipe with its original pressure. There is only discharged into the reservoir the quantity of liquid under pressure which has penetrated into the cylinder 3 in front of the valve *b*. On the other hand this valve now separates the brake-cylinder from any elastic organ, and in order that the removal of the brakes may be operated and that the fall of pressure may be brought about it suffices to allow a single drop of liquid to escape into the reservoir. There is therefore an increase in the rapidity of the removal of the brakes and a considerable economy of liquid under pressure obtained at each revolution of the brake, allowing of the use of a compression-pump of smaller dimensions, and finally the starting of the trains is facilitated by rendering it possible to throw out of action the pump by a simple movement of the handle of the switch.

I claim as my invention—

1. A continuous hydraulic electrically-operated brake in which the energy necessary for applying the brake is obtained from a compression-pump actuated by the momen-

tum of the vehicle, consisting of: a brake-cylinder 3 communicating, by means of an electrically-operated valve with the pressure-pipe q of the compression-pump through a pipe 1 on which is placed a retaining-valve z at the side of the pipe q and in a branch of which a piston 2 works under the pressure of a spring h, said piston and spring serving, during the application of the brake, as elastic organs for transmitting to the brake-piston 8 the pressure of the liquid contained in the communicating pipe 1, the greater part of this liquid under pressure remaining available in said chamber when the valve b is closed for taking off the brake, substantially as hereinbefore described and shown.

2. In an electrohydraulic brake such as described, the combination with the communicating pipe 1 of an elastic mechanism for transmitting energy, consisting of a piston 2, and a spring h, so arranged that the rod 7 of said piston 2 is situated in the prolongation of the axis of the valves l and m of the compression-pump, and adapted to automatically lift said valves to arrest the action of the pump when the liquid in the communicating pipe 1 has attained a given pressure, substantially as hereinbefore described and shown.

3. In an electrohydraulic brake such as described the combination with the pressure-pipe q, of the compression-pump, and at the rear of the retaining-valve z, of an electrically-operated discharge-valve a communicating with the liquid-reservoir, and enabling the operator to effect a stoppage of the pump, that is to say to cause it to work without absorbing energy, whatever may be the pressure of the liquid contained in the communicating pipe 1 between the pump and the brake-cylinder, substantially as hereinbefore described and shown.

In witness whereof I have hereunto set my hand in presence of two witnesses.

ANDRÉ GOLDSCHMIDT.

Witnesses:
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