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R. WIKANDER.

ELECTROPNEUMATIC BRAKING DEVICE FOR RAILWAY CARS.

APPLICATION FILED DEC. 26, 1906.

3 SHEETS—SHEET 1.

Fig. 1.

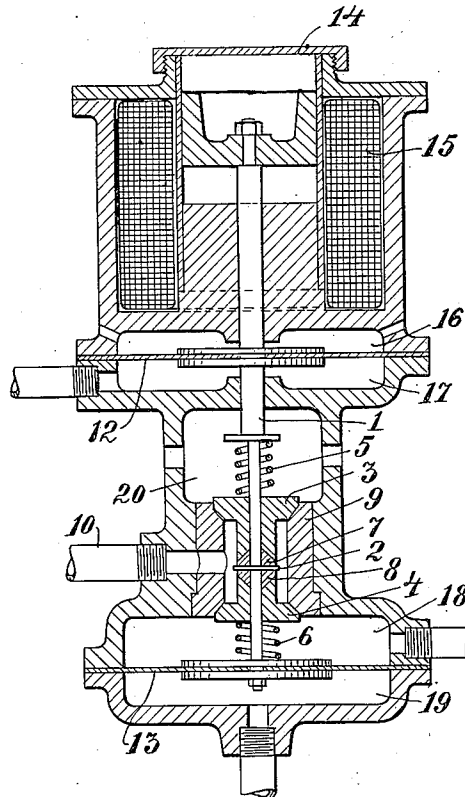
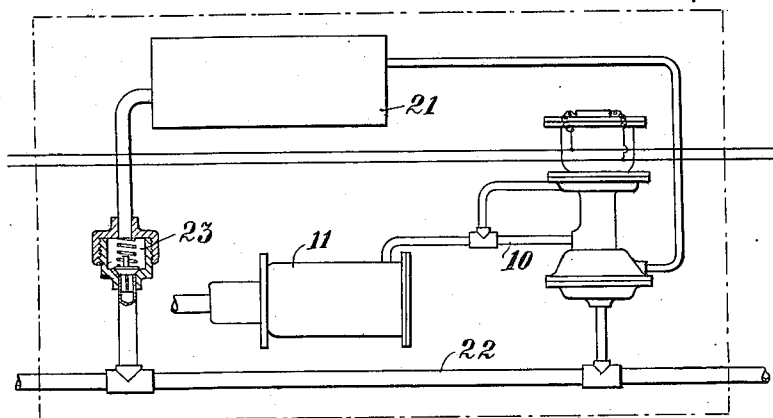


Fig. 2.



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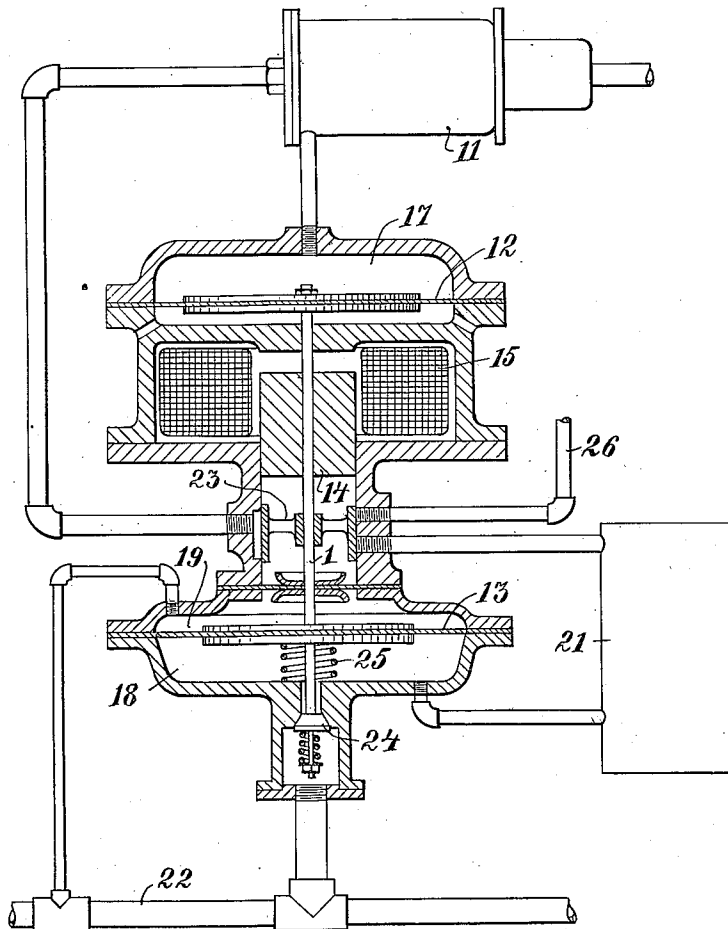
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3 SHEETS—SHEET 2.

FIG. 3.



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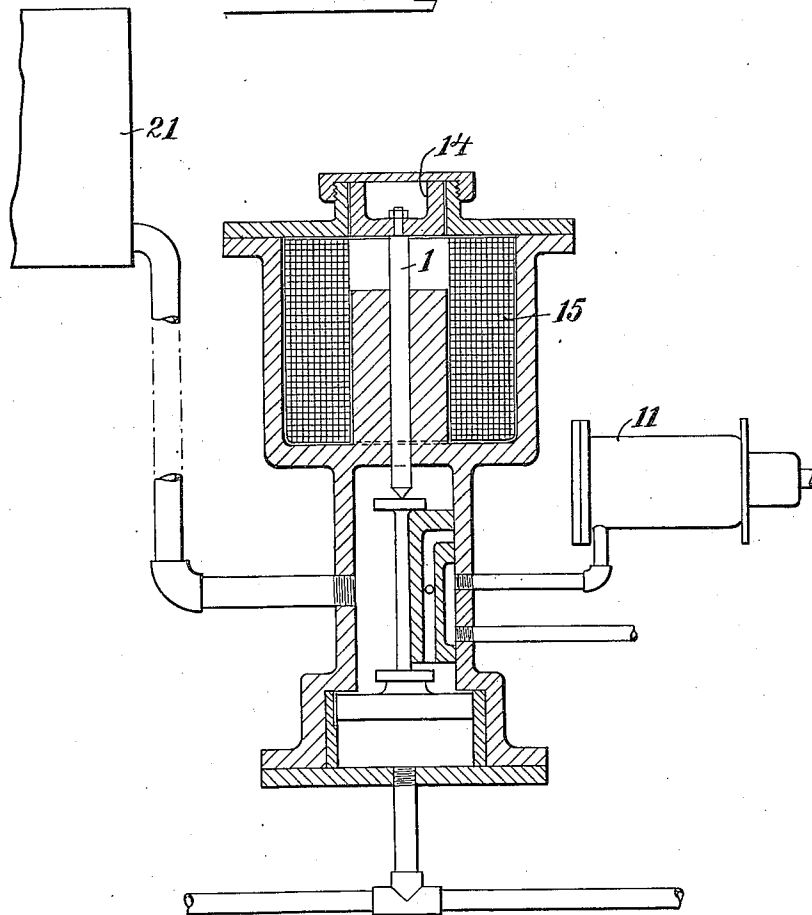
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3 SHEETS—SHEET 3.

Fig. 4.



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# UNITED STATES PATENT OFFICE.

RAGNAR WIKANDER, OF WESTERÅS, SWEDEN.

## ELECTROPNEUMATIC BRAKING DEVICE FOR RAILWAY-CARS.

No. 856,010.

Specification of Letters Patent.

Patented June 4, 1907.

Application filed December 26, 1906. Serial No. 349,409.

*To all whom it may concern:*

Be it known that I, RAGNAR WIKANDER, a citizen of the Kingdom of Sweden, residing at Westerås, Sweden, have invented new and useful Improvements in Electropneumatic Braking Devices for Railway-Cars or the Like, of which the following is a specification.

This invention relates to electro-pneumatic braking-devices for railway-cars, and the like.

In order to establish in the usual pneumatic brake-systems a simultaneous working of all the brakes of a railway-train a number of brake-systems have been proposed in which in addition to the pneumatic valves have been used electrically operated valves. In the most cases such brake-systems are more complicated than the pneumatic systems on account of the increased number of valves, and notwithstanding the said electro-pneumatic systems do not offer any increased safety as to their function.

The object of the present invention is to provide an electro-pneumatic braking-device in which only one valve-body will be required, and in which an automatic adjustment of the braking-pressure can be effected by means of each of the two controlling-systems.

The invention consists, chiefly, in that the valve-body controlling the communication between an auxiliary reservoir and the braking-cylinder and between the latter and the atmosphere is controlled by a train-pipe as well as by an electric controlling circuit in such a manner that the operation of the said valve-body may be effected either by changing the pressure in the train-pipe or by changing the strength of current in the said circuit or both simultaneously. Hereby the constructional arrangement of the brake-valve will be simplified and further the function of the electric control will be substantially similar to that of the pneumatic device. By the possibility of using the two controlling-systems simultaneously the function will be more reliable than heretofore so that the brakes practically will never fail to work.

In the accompanying drawings I have illustrated substantially diagrammatically some embodiments of my invention.

Figure 1 shows a longitudinal section of an electro-pneumatically operated valve constructed in accordance with my present invention. Fig. 2 shows a diagram of the connection of the valve shown in Fig. 1 on a

railway-car provided with air-brakes. Fig. 3 shows a similar diagram with a modified form of the electro-pneumatically operated valve in longitudinal section. Fig. 4 shows a usual triple-valve provided with an electric controlling device.

The valve-device shown in Figs. 1 and 2 comprises a valve-stem 1 to which is secured a small metal-disk 2. Two valve-bodies 3 and 4 are by springs 5 and 6 pressed against the said disk 2 by means of elastic rings 7 and 8. Normally the said valve-bodies close both ends of the cylindrical valve-seat 9 in the center of which ends a pipe 10 connected to the braking-cylinder 11. To the stem 1 are secured two diaphragms 12 and 13 and an armature 14. As is shown in the drawing the stem 1 is operated both by the armature 14 which is magnetized by the current in the coil 15 and by the air-pressure in the chambers 16, 17, 18 and 19 on each side of the two diaphragms 12 and 13. If the powers actuating the stem 1 effect the raising of the latter, the braking-cylinder 11 will be put in communication with the atmosphere by means of the valve 3 and the chamber 20. If the said powers lower the stem 1 the valve 4 will be opened and the air contained in the auxiliary reservoir 21 of the car will be admitted to the braking-cylinder 11.

Referring to Fig. 2, 22 represents the air-pressure-pipe extending through the whole train and being supplied with air from the main-reservoirs connected to the air-pumps, as is usual.

Through the valve 23 compressed air flows into the auxiliary reservoir 21 of the car, until the pressure in the latter is the same as in the pipe 22. The braking-cylinder 11, the auxiliary reservoir 21 and the pipe 22 are connected with the electro-pneumatic brake-valve, as is shown in Fig. 2.

It will now be explained how the apparatus works when electric current is used for braking, it being supposed that the magnet coil 15 is first deenergized. In as much as the air-pressure in the auxiliary reservoir 21 is the same as that in the air-pipe 22, the pressure in the chamber 18 will be the same as in the chamber 19 and the diaphragm 13 thus will not actuate the stem 1. If the brake in such case is applied there is an overpressure in the braking-cylinder over the atmospheric pressure and the said overpressure then acts in the chamber 17 and raises the diaphragm 12 and thus also the stem 1 which is not ac-

tuated by any other power. The result will be that the valve 3 is raised and the braking-cylinder is put in communication with the atmosphere until the pressure in the braking-cylinder has been reduced and cannot keep the stem 1 raised, whereupon the latter by the spring 6 will be brought back into its normal position. The air-pressure at which this occurs is so chosen that the brake then is released by the spring in the braking cylinder. It will thus be understood that, if no current flows through the magnet, the brake will be released and remain released. It may now be supposed that an electric current of a certain strength be sent through the coil 15. The armature 14 now will be attracted, the stem 1 lowered, the auxiliary reservoir 21 put in communication with the braking-cylinder through the chamber 18 and the brake applied until the increasing pressure in the braking-cylinder through the chamber 17 has acted upon the diaphragm 12 and together with the pressure in the chamber 19 (which pressure now is greater than the pressure in the chamber 18) overcomes the action of the magnet and brings the stem back into normal position shown in Fig. 1. The brake will thereupon be kept in the said position as long as the strength of current in the magnet is unchanged. If the pressure in the braking-cylinder is diminished, for instance by leakage, the valve 4 will again be opened and fresh compressed air flows into the braking-cylinder, so that the determined pressure will be maintained. If the current in the magnet-coil 15 be increased, the stem will again be lowered and compressed air flows into the braking-cylinders until equilibrium has been reestablished, whereupon the stem 1 returns into its normal position. If the strength of current be diminished, the pressure in the chamber 17 will cause the valve 3 to open until the pressure in the braking-cylinder has been diminished so that the power of the magnet is sufficient to return the valve into normal position. It will thus be understood that to each strength of current corresponds approximately a certain pressure in the braking-cylinder and consequently also a certain braking-force.

It is now possible by series—or parallel—connections or by any series—parallel—connection of all brake-valves of a train to effect the braking of all the cars simultaneously and at one and the same force, whereby an effective control of the train will be obtained and at the same time the rolling stock is spared and accidents are prevented. It will now be explained how the said valve can effect a reliable braking in the case that the electric current fails. In such case the braking is accomplished by opening any valve that allows the compressed air to flow out from the pipe 22. The decrease of pressure thus obtained has no influence on the auxiliary res-

ervoir, nor on the pressure in the chamber 18. However, the pressure in the chamber 19 is diminished and the stem 1 is lowered. From the auxiliary reservoir compressed air now will flow through the chamber 18 into the braking cylinder, and by keeping the said valve in the pipe 22 open a sufficient time the braking action will be stronger and stronger, until the pressure in the braking-cylinder acting in the chamber 17 has become the same as the pressure in the auxiliary reservoir. Then the valve returns into normal position and remain there, until the pressure in the pipe 22 is again increased, and the brakes will be released according as the said pressure increases.

The apparatus shown in Fig. 1 is provided with a continuous current magnet but may obviously be so modified that an alternating current magnet may be used. Further slides such as are used in the pneumatic brake-systems may be substituted for the valve-construction shown without departing from the principle of the invention. Obviously the present system may be modified so as to suit the vacuum-brakes.

In the device shown in Fig. 3 the valve-stem 1 is likewise combined with an armature 14, or the like, and with two diaphragms 12 and 13. The diaphragm 12 closes the chamber 17 which is in communication with the braking-cylinder, while the diaphragm 13 closes two chambers 18 and 19 of which the chamber 19 is in communication with the train-pipe 22 and the chamber 18 is connected to an auxiliary reservoir 21. The valve-stem 1 supports a slide-valve 23 controlling the supply of air to the braking cylinder and the exhaust from the latter. At the lower end the valve-stem is provided with a valve-body 24 adapted to establish communication between the train-pipe 22 and the auxiliary reservoir, when the valve-stem is moved downward, so as to fill the auxiliary reservoir from the train-pipe. The said device works as follows: When the braking-device is inactive, the pressure in the train-pipe and that in the auxiliary reservoir are substantially the same so that the diaphragm 13 is balanced. In the braking-cylinder 11 is no pressure, so that also the diaphragm 12 is balanced. No current flows through the magnet coil, and therefore the valve-stem 1 is kept in a middle position by a spring 25 in which position the air-supply from the auxiliary reservoir is cut off by the slide-valve 23. The brakes can be applied by supplying current to the magnet-coil 15, whereby the valve-stem 1 will be raised and compressed air will flow from the auxiliary reservoir 21 to the braking cylinder 11. From the latter compressed air now flows into the chamber 17, whereupon the diaphragm, when a certain braking-pressure has been reached, will be pressed down, so that the supply of air to

the braking-cylinder is cut off. If the strength of current in the magnet-coil be increased, the stem 1 will again be raised, so that a further quantity of compressed air can flow into the braking-cylinder, until equilibrium is reached. By increasing the strength of current to a maximum full braking-force will be obtained. For releasing the brakes it is only necessary to decrease the strength of the electric current, whereby the pressure in the chamber 17 on the diaphragm 12 will overcome the attraction of the magnet-coil on the core or armature 14, so that the valve-stem 1 will be lowered and communication between the braking-cylinder 11 and exhaust-pipe 26 will be established. Simultaneously the valve 24 is opened for admitting a fresh quantity of compressed air into the auxiliary reservoir 21. The exhaust continues until the braking-pressure has diminished so much that the powers acting on the valve-stem 1 again balance each other.

If braking is to be accomplished by diminishing the pressure in the train-pipe, it is only necessary in well known manner to exhaust a part of the air in the train-pipe, whereby the pressure in the chamber 19 is diminished and the valve-stem 1 will be raised and cause supply of air to the braking-cylinder, until the powers acting on the valve-stem again balance each other. In analogous manner the brakes may be released by increasing the pressure in the train-pipe.

Instead of having the magnetic attraction power counteracted by the pressure in the braking-cylinder for balancing the powers acting on the valve-stem, one may let the said powers coöperate and be compensated by a third constant or variable power, whereby a decrease of the electric attraction power will cause a corresponding increase or decrease, respectively, of the braking-pressure, until equilibrium is reached. Further the usual air-brake-valves may be arranged for being operated both electrically and pneumatically. For this purpose one may, as is shown in Fig. 4, provide an electromagnet the armature 14 of which by means of the stem 1 operates the triple-valve of the air-brake-system when electric current is supplied to the coil 15. A stronger or weaker current through the coil 15 has the same effect as a greater or smaller decrease of the air-pressure in the train-pipe. The said device may be so modified that the operation of the triple-valve by the electric current is accomplished indirectly by combining the triple-valve with a piston, diaphragm, or other movable closing-device which normally has no influence on the usual working of the said valve, but is put in operation for displacing the same into a position for braking by air under pressure, or vacuum, the strength of which depends on the strength of current in an electric circuit.

Having now described my invention what I claim is:

1. An air-brake-apparatus for electric railway-cars, and the like, in which the brakes are applied or released by means of the variable air-pressure in a train-pipe or by means of an electric controlling-circuit, characterized by the fact that the valve-body, which controls the communication between an auxiliary reservoir and the braking-cylinder and between the latter and the atmosphere, is controlled both by the train-pipe and by the said electric circuit in such a manner that the displacing of the said valve-body into desired positions may be accomplished by changing either the pressure in the train-pipe or the strength of current in the said controlling circuit or both simultaneously.

2. An air brake apparatus for electric cars, and the like, in which the brakes are applied or released by means of the variable air pressure in a train pipe or by means of an electric controlling circuit, characterized by the fact that the valve body, which controls the communication between an auxiliary reservoir and the braking cylinder and between the latter and the atmosphere, is controlled both by the train pipe and by the said electric circuit in such a manner that the displacing of the said valve body into desired positions may be accomplished by changing either the pressure in the train pipe or the strength of current in the said controlling circuit or both simultaneously, and in which the valve body is operated on the one side by the electric controlling circuit against the action of the pressure in the braking cylinder, and on the other side by the pressure in the train pipe against the action of the pressure in the auxiliary reservoir by means of diaphragms, pistons, or the like, connected to the said valve body.

3. An air brake apparatus for electric railway cars, and the like, in which the brakes are applied or released by means of the variable air pressure in a train pipe or by means of an electric controlling circuit, characterized by the fact that the valve body, which controls the communication between an auxiliary reservoir and the braking cylinder and between the latter and the atmosphere, is controlled both by the train pipe and by the said electric circuit in such a manner that the displacing of the said valve body into desired positions may be accomplished by changing either the pressure in the train pipe or the strength of current in the said controlling circuit or both simultaneously, and in which the valve body is operated on the one side by the electric controlling circuit against the action of the pressure in the braking cylinder, and on the other side by the pressure in the train pipe against the action of the pressure in the auxiliary reservoir by means of diaphragms, pistons, or the like, connect-

ed to the said valve body, and further characterized by the fact that for operating the valve body the electric controlling circuit and the pressure in the braking cylinder work in one and the same direction and are compensated by a constant or yielding resistance which in equilibrium keeps the valve body in a middle position in which the braking cylinder is cut off both from the auxiliary reservoir and from the atmosphere, while destruction of the equilibrium in the one direction or the other will cause a displacing of the valve body so as to put the braking cylinder in communication with the auxiliary reservoir or with the atmosphere.

4. An air brake apparatus for electric railway cars, and the like, in which the brakes are applied or released by means of the variable air pressure in a train pipe or by means of an electric controlling circuit, characterized by the fact that the valve body, which controls the communication between an auxiliary reservoir and the braking cylinder and between the latter and the atmosphere, is controlled both by the train pipe and by the

said electric circuit in such a manner that the displacing of the said valve body into desired positions may be accomplished by changing either the pressure in the train pipe or the strength of current in the said controlling circuit or both simultaneously, and further characterized by the fact that the triple valve body in a pneumatic brake apparatus is placed under the influence of an electromagnet inserted in an electric controlling circuit in such a manner that the said valve body by changing the strength of current in the said electric controlling circuit will be caused to make the same movement as are caused by changing the pressure in the train pipe, while the electric operation device when in zero position has no influence on the pneumatic device.

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

RAGNAR WIKANDER.

Witnesses:

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JOHN DELMAR.