Feb. 7, 1967 E. L. GORDON 3,302,758

VEHICLE BRAKE

Filed Nov. 23, 1964

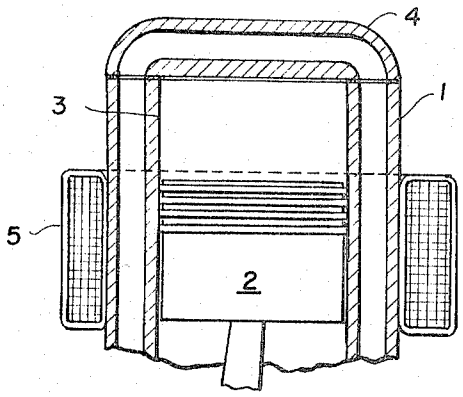


Fig. 1.

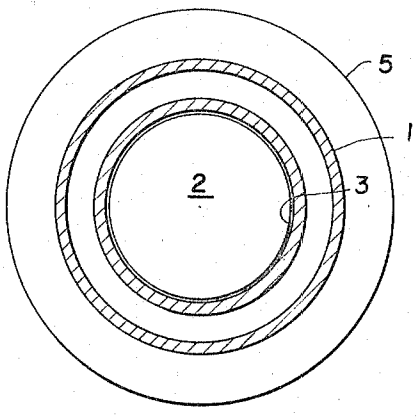


Fig. 2.

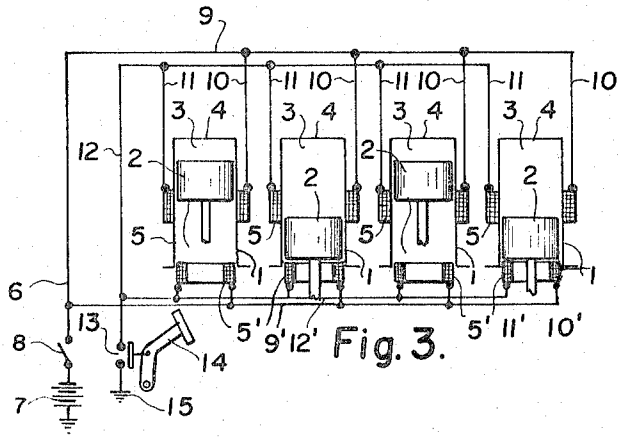


Fig. 3.

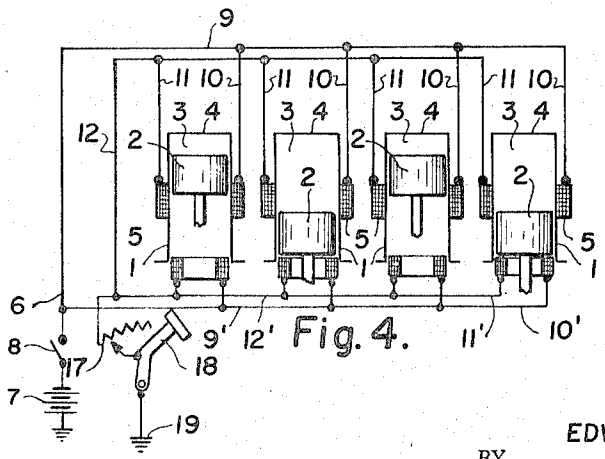


Fig. 4.

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VEHICLE BRAKE

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This invention relates to improvements in internal combustion engines of the piston reciprocating type and, more particularly, relates to a novel electromagnetic braking means for such engines.

Conventional braking means for vehicles usually employ friction discs and the like which are hydraulically or electromagnetically operated. When the brake lining is worn, or if the hydraulic fluid should leak, the brake is ineffective and a great danger of accident arises.

An object of my invention is to provide novel braking means which will overcome the abovementioned difficulties of conventional brakes and which will normally serve as an auxiliary braking means to assure at all times very effective braking of the vehicle by electromagnetic drag or braking of the pistons of the internal combustion engine.

A more specific object of my invention is to provide an auxiliary electromagnetic brake for retarding the movements of the pistons of an internal combustion engine, which brake is energized as the result of application of the braking pedal, and is deenergized by release of such pedal.

Other objects and advantages of the invention will become more apparent from the following description taken with the accompanying drawing wherein:

FIG. 1 is a fragmentary, vertical, cross-sectional view of one of the cylinders of an internal combustion engine provided with electromagnetic braking means embodying the present invention;

FIG. 2 is a transverse, sectional view of the structure shown in FIG. 1;

FIG. 3 is an electrical, schematic diagram of the electromagnetic braking circuit for retarding movements of the pistons of the engine; and

FIG. 4 is a modification of the circuit shown in FIG. 3.

Referring more particularly to FIGS. 1 and 2 of the drawing, numeral 1 denotes the outer wall, numeral 3, the inner wall, and numeral 4, the top wall of an aluminum cylinder head of an internal combustion engine, between which walls cooling liquid is circulated. Slidably mounted in the inner wall is a piston 2 of magnetic material, such as steel. Surrounding the outer wall 1 is an electromagnet 5 in the form of a coil which completely surrounds the piston and surrounding walls and which when energized, will tend to pull the piston 2 into the position shown in FIG. 1 so as to provide minimum reluctance to the magnetic path or flux lines.

A plurality of electromagnetic coils may be used for each piston, as shown in FIG. 3, that is, an upper coil 5 and a lower coil 5', which lower coil is disposed immediately beneath the bottom surface of piston 2 at the extremity of the downward movement of the piston. One of the terminals of the storage battery 7 of the vehicle is connected to ground and the other, through a switch 8, is connected to conductors 6, 9 and 10 for passing current through the coils 5, thence through return conductors 11 and 12 to a switch 13 which is closed as the result of braking movements of the brake pedal 14 so as to complete the circuit to ground 15. A parallel circuit may be provided which extends from conductor 6 through conductor 9' auxiliary coils 5' thence through conductor 12' to conductor 12 for energizing the coils 5', which exert magnetic attraction to the bottom surfaces of pistons 2. Instead of electromagnetic coils

5', permanent magnets (not shown) may be used, such as "Alnico" magnets manufactured by the General Electric Company of Schenectady, New York of like or unlike polarity with the piston bottom to repel or attract it, when moved into position by mechanical linkage connected to the brake pedal.

In operation, therefore, when switch 8 is closed, and when switch 13 is also closed by depressing braking pedal 14, the circuit is completed so as to energize both coils 5 and 5'. Thus, as the pistons move away from horizontal alignment with coils 5, the magnetic lines of force tend to pull them back into alignment with the coils and in so doing will exert a braking effort so as to retard movements of the pistons 2. As the pistons reach the lowermost positions, as indicated by the second and fourth pistons, the lower surface of the pistons will be attracted by the magnetic lines of force of electromagnetic coils 5' so as to tend to hold the pistons in their lowermost position and thus exert a further braking effort. If desired, coils 5 or 5' may directly surround the stems of pistons 2 instead of the pistons themselves.

FIG. 4 is a modification, very similar to FIG. 3, with the addition of a variable resistor 17 which is varied by depressing the foot pedal 18 and which completes a circuit through ground 19 at all times. As the pedal is gradually depressed, more resistance is cut out, therefore, greater current flow through coils 5 and 5' will result and in this way, maximum electromagnetic braking action is obtained when the foot pedal is depressed to a maximum extent.

It should be understood that the above described electromagnetic braking means is not depended upon as the sole braking means for the vehicle, but is merely an auxiliary brake to be used in addition to the conventional brake to aid in slowing down movements of the vehicle by effecting magnetic attraction between the pistons and surrounding magnetic means. Therefore, if for some reason, there is mechanical or hydraulic failure in the conventional brakes, limited braking effort will be exerted by the present invention so as to considerably increase the safety of the vehicle. However, it should be understood that the present system is not solely for emergency, that is a substitute for brakes that fail, but is particularly useful as an additional or auxiliary braking means to be used to supplement the braking effort of such means and thus add to the total braking effort on the vehicle and thereby enhance safety and full control of the vehicle. In short, the present auxiliary braking system provides a vast increase in braking effort or efficiency when used in addition to conventional braking means.

Thus it will be seen that I have provided an efficient auxiliary electromagnetic braking system for retarding movements of the pistons of an internal combustion engine in response to movements of the brake pedal so as to provide increased braking effort of the vehicle over and above that provided by conventional braking means, such as friction discs operated by hydraulic means; furthermore, I have provided electromagnetic braking means which will retard the vehicle when going down hill even in high gear without unduly wearing out brake linings, also I have provided an emergency system, which, upon failure of conventional brakes, will assure some braking effort on the vehicle and thereby considerably increase safety.

While I have illustrated and described several embodiments of my invention, it will be understood that these are by way of illustration only, and that various changes and modifications may be made within the contemplation

of my invention and within the scope of the following claims.

I claim:

1. In combination with a vehicle having an internal combustion engine including a plurality of non-magnetic cylinders containing reciprocable, magnetic pistons therein, auxiliary braking magnetic means surrounding each of said cylinders for retarding reciprocation thereof when the pistons are immediately adjacent said magnetic means, a brake pedal operating conventional vehicle brakes, and means operated by said pedal for controlling said auxiliary braking magnetic means.

2. The combination recited in claim 1 wherein the auxiliary braking magnetic means includes an electromagnet surrounding the bottom portion of each cylinder for retarding the piston as it recedes from the bottom of its stroke.

3. The combination as recited in claim 1 wherein the auxiliary braking magnetic means comprises a magnetic coil surrounding each cylinder, and an energizing circuit controlled by said brake pedal of said vehicle.

4. The combination recited in claim 3 together with

resistance means in said circuit which is progressively reduced by depression of said pedal for increasing the current through said coils.

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