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CONTROLLING MECHANISM FOR INTERNAL COMBUSTION ENGINES.

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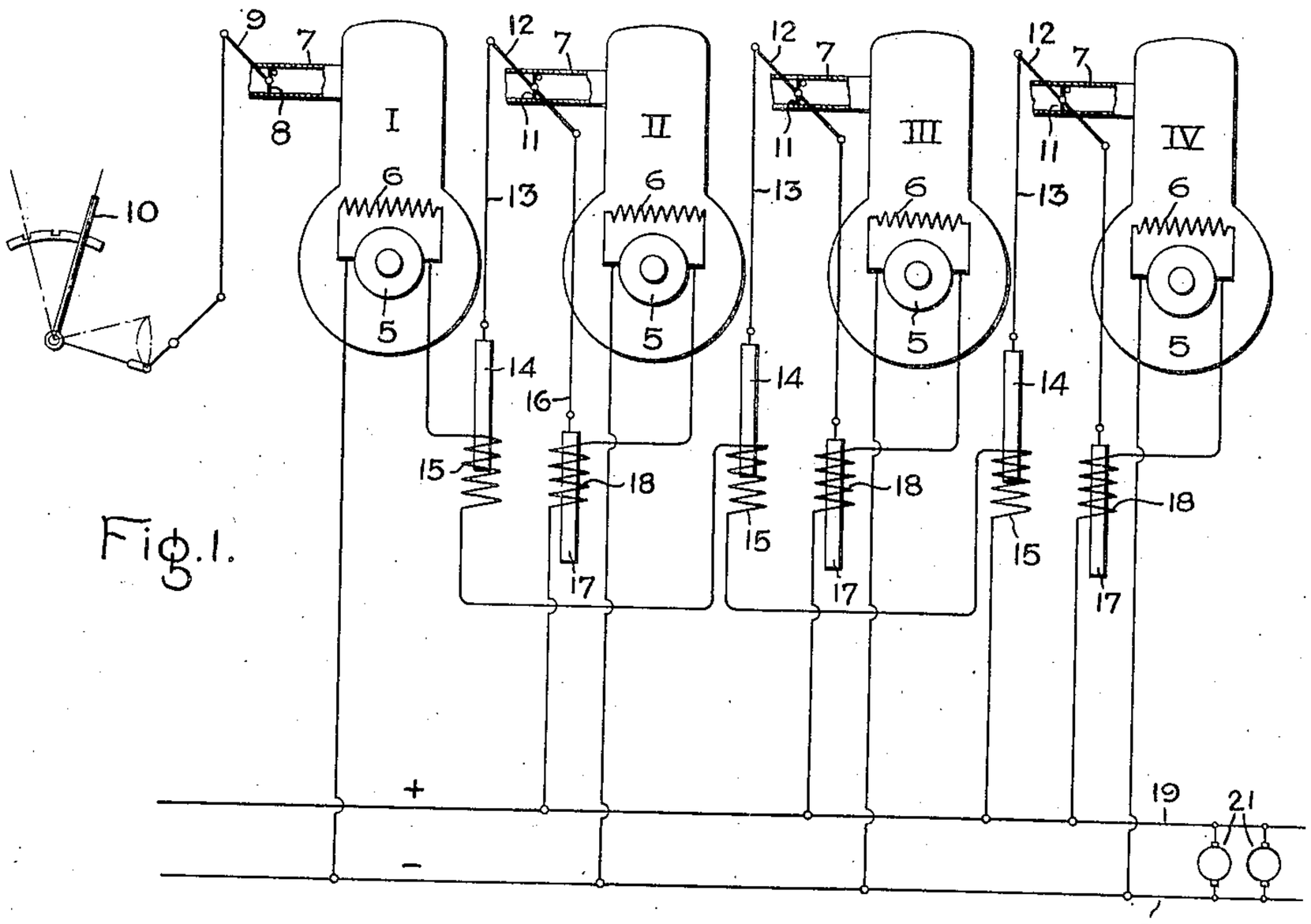

Fig. 1.

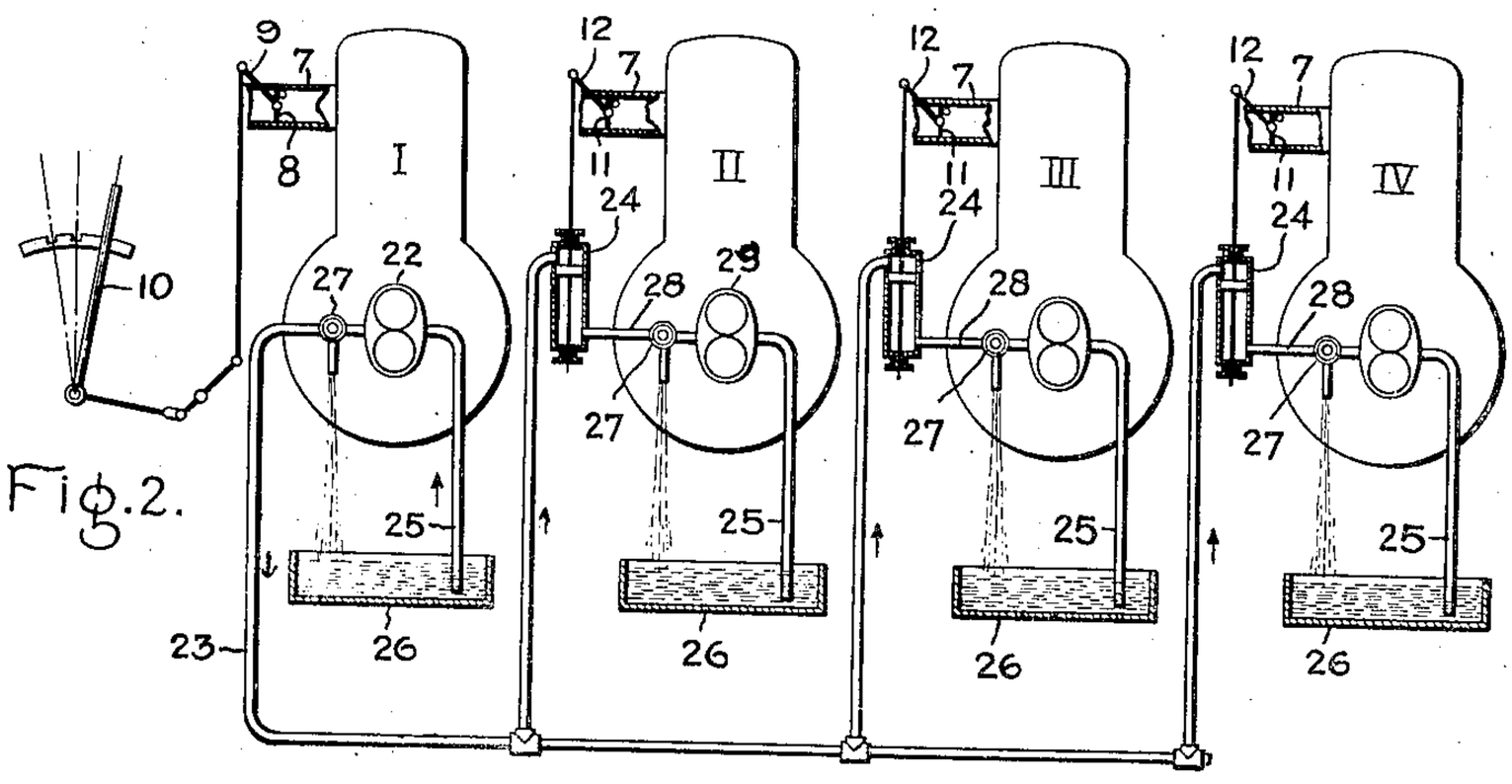

Fig. 2.

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UNITED STATES PATENT OFFICE.

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CONTROLLING MECHANISM FOR INTERNAL-COMBUSTION ENGINES.

1,154,785. Specification of Letters Patent. Patented Sept. 28, 1915.

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To all whom it may concern:

Be it known that I, HERMANN LEMP, a citizen of the United States, residing at Erie, county of Erie, State of Pennsylvania, have invented certain new and useful Improvements in Controlling Mechanism for Internal-Combustion Engines, of which the following is a specification.

At the present time there is a type of locomotive in service which is driven by an internal combustion engine through the intermediary of an electric generator and motors, the engine and generator being located in the cab and the motors on the trucks. The engine and generator are flexibly supported so as to prevent vibrations thereof from being transmitted directly to the frame sills of the locomotive. As a result of this, the engine has a limited amount of movement independent of the said sills. For certain reasons that need not be discussed herein, it is sometimes desirable to employ two or more engine driven generators on the same locomotive for furnishing current to the motors instead of one large engine and generator. In such an arrangement in order to obtain the best results, the load should be divided equally between the engines. Where ordinary regulators, such as throttle valves for example, are provided for controlling the admission of fuel to the engines which regulators are positively moved by the same handle or lever, it is difficult to cause the proper division of load for all conditions of service. This is largely due to the fact that the movements of the engines on their flexible supports are or may be dissimilar at any given instant, thus disturbing the relation between the actuating lever and the regulators and causing different settings of the latter. It is also due in part to the individual peculiarities or characteristics of the engines. The load under certain circumstances may be divided equally, but not under others, a condition of affairs that is obviously unsatisfactory.

The object of my invention is to provide an improved governing mechanism for a locomotive of the general character referred to, by means of which the load will be automatically and substantially equally divided under all conditions between the two or more independently supported engines and generators, supplying power to the driving motors. To accomplish this each engine is provided with a regulator adapted to its requirements. This regulator may for example, control the engine by throttling the fuel mixture admitted to the cylinders or by varying the effective discharge of one or more fuel pumps to the injectors, in the case of heavy oil engines. The regulator of one engine, which for the purpose of distinction may be termed the "pilot" engine, is controlled by hand, by a speed governor or other means. Each of the remaining regulators is controlled by the joint action of its engine and the pilot engine. As a specific illustration, all of the regulators except the first are controlled by two differentially acting forces, one of which responds to an operating condition of its engine and the other to an operating condition of the pilot engine. The particular setting of the regulator at any given instant will therefore be brought about when said forces are balanced.

In the accompanying drawing which is illustrative of my invention, Figure 1 is a diagrammatic view showing four engine driven generators driving a common load with electrical means controlled by a pilot engine for regulating the remaining engines, and in Fig. 2 is shown a modification in which fluid pressure means are employed to actuate the regulators of the engines subject to control of the pilot engine.

In Fig. 1 I have shown engines marked I, II, III, IV. These engines may be of any suitable construction and have one or more cylinders. Ordinarily each engine will have a plurality of cylinders and is independently supported. Each engine drives an electric generator 5 which is provided with a suitable field magnet winding 6. The generator is indicated diagrammatically to simplify the illustration. Each engine is provided with an inlet 7 through which the fuel is admitted from some suitable source of supply. When the engines are operated on gasolene the inlets will be connected to carbureters of any suitable construction. In each inlet is a regulator which, in the present illustration, takes the form of a butterfly valve. The butterfly valve 8 of the first engine, which for convenience, may be termed the "pilot" engine, is provided with an arm 9, that is actuated through a system of links and levers by a hand lever 10. The regulators 11 on the other engines are also made in the form of butterfly valves, and on the

spindle of each valve is a lever 12. To one arm of each of these levers is attached a rod 13 and core 14 of a solenoid 15. The other arm of each lever is connected by a rod 16 to the core 17 of a solenoid 18. The solenoids 15 are supplied with current from the generator 5 of the pilot engine, all of said solenoids being connected in series. These solenoids and cores should be so arranged that the pull on the core in all positions is substantially constant. The effective action of each core depends upon the number of ampere turns in the coil. Each solenoid coil 18 is connected to the generator driven by the engine to be controlled. The coils 15 and 18 act differentially on the valve 11. Assuming that engine I is running, the current flowing through coil 15 will open the valve 11. This action is opposed by the current delivered at the generator of engine II. A balance will be effected between the two forces when the speed of engine II equals that of engine I. To state the matter in another way, the operator moves the lever 10 to the desired position to adjust the regulator for the pilot engine. This causes the other engines to increase their speeds because the current through coils 15 opens all of the regulators. As soon as the remaining engines increase their speeds, the current from the other generators, acting in opposition to the current of the pilot engine, adjusts the valves to a position closely corresponding to the position of valve 8, and the load will, therefore, be divided equally, or substantially so, between all of the engines. As the throttle valve 8 is opened or closed, the throttle valves 11 will be moved in the same sense or direction and by substantially the same amount. The exact opening is, however, determined by the effective action of the coils 15 and 18. It is this independence of action of regulators 8 and 11 that enables the engines to divide the load equally between them.

The generators are arranged to deliver current to the bus bars 19 and 20, said bus bars supplying current to the motors 21 for driving the locomotive. In addition to supplying current to the motors, the bus bar may supply current for other purposes. The motors may be connected in series or parallel with the usual controller used on street cars.

Referring to Fig. 2, I have shown a slight modification of the invention. In this case each engine drives a generator as before and in addition is provided with a gear pump which delivers fluid under pressure, which pressure varies with changes in speed of the engine. The pump 22 of engine I delivers to the pipe 23 from which fluid flows to the control cylinders 24 associated with the other engines. The pump of the pilot engine I receives fluid by the pipe 25 from the tank 26. In the discharge pipe of the pump is a by-pass relief valve 27 by means of which the action of the pump can be adjusted. By opening the valve the pressure in the pipe 23 and in the cylinders 24 will be less; closing the valve will have the effect of increasing the pressure. Each cylinder 24 is also connected to the discharge pipe 28 of the pump 29. Inside of the cylinder is a piston, the under side of which is subject to pressure of the fluid of pump 29 and the upper side to the pressure of the fluid delivered by pump 22. These two pumps act differentially on the regulator 11 and determine its position. The action of the apparatus in this figure is similar to that described above, except that the former depends upon the number of ampere turns in the solenoid coils, and the latter depends upon the pressure on opposite sides of the piston on the cylinder 24. The engines may be started from a position of rest by any suitable means, such as compressed air or electric current. The throttle valves will ordinarily be so set as to keep the engines running after once started.

The pilot engine is controlled by the regulator 8 which is moved positively and independently of the regulators of the other engines. For illustration, I have shown a hand lever for the purpose, although the invention is not limited thereto.

My improvement governing the mechanism has the advantage that the operator only has to control the speed of the pilot engine, the control of the remaining engines being entirelv automatic.

In accordance with the provisions of the patent statutes, I have described the principle of operation of my invention, together with the apparatus which I now consider to represent the best embodiment thereof; but I desire to have it understood that the apparatus shown is only illustrative and that the invention can be carried out by other means.

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

1. In combination, a pilot engine and one or more additional engines, said engines being independently supported and arranged to drive a common load, regulators for said engines, a means for directly moving the regulator of the pilot engine, and fluid pressure means driven by the pilot engine and by said additional engines and responsive to the speed thereof for actuating the remaining regulators, said means being responsive to the action of the pilot engine and to the modifying action of the said additional engines.

2. In combination, a pilot engine and one or more additional engines, said engines being arranged to drive a common load, regulators for said engines, a device for moving the regulator of the pilot engine, fluid ac-

tuated means for moving each of the remaining regulators, and means driven by the pilot engine and also by the said additional engines for creating fluid pressures that act differentially on said fluid actuated means.

3. In combination, a pilot engine and one or more additional engines, said engines being arranged to drive a common load, regulators for all of the engines, a device for moving the regulator of the pilot valve independently of the other regulators, a means driven by and responsive to the speed of the pilot engine which creates a force tending to move all of the remaining regulators in the same sense and to the same degree, and an individual means for each of said additional engines which is driven by and responds to the speed thereof to create a force which coöperates with the force created by said pilot engine means to determine the final setting of its regulator.

4. In combination, a pilot engine and one or more additional engines, said engines driving a common load, regulators for all of the engines, a device for moving the regulator of the pilot valve independently of the other regulators, a pump driven by the pilot engine whose pressure varies with changes of speed thereof, a pump driven by each of said additional engines whose pressure varies with changes of speed thereof, and a means for moving the regulator of each of said additional engines which is responsive to the pressure developed by its pump and that of the pilot engine.

In witness whereof, I have hereunto set my hand this sixth day of April, 1914.

HERMANN LEMP.

Witnesses:
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O. T. FOUCHE.