Dec. 27, 1932. H. LEMP 1,891,936

CONTROLLING DEVICE FOR LOCOMOTIVES

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FIG.-1.

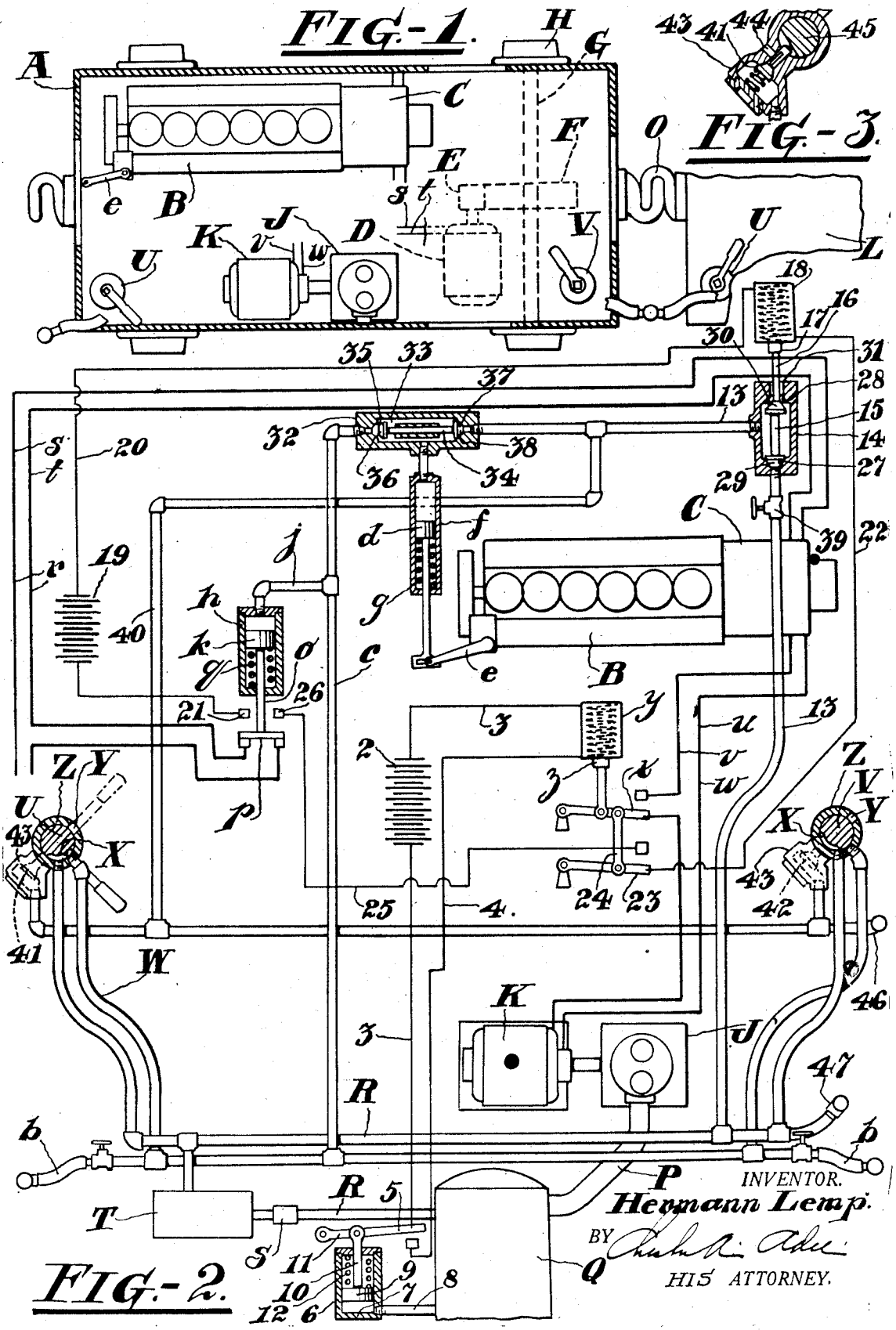


FIG.-2.

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CONTROLLING DEVICE FOR LOCOMOTIVES

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This invention relates to controlling devices, but more particularly to a controlling device for an electrically actuated locomotive in which the electric current for driving the locomotive and auxiliary apparatuses is generated by a generator carried by the locomotive and driven by a suitable prime mover, as for instance, an internal combustion engine.

One object of the invention is to enable the various controlling apparatuses of the locomotive, as well as the prime mover, to be conveniently controlled and in proper sequence from any one of a plurality of controlling stations which may be located either on a single locomotive or on a plurality of locomotives operatively connected to operate in tandem.

Another object is to assure an ample supply of pressure fluid to the various pressure actuated devices of the locomotive, as for instance, the locomotive brakes, during the time the locomotive or locomotives are idle.

Other objects will be in part obvious and in part pointed out hereinafter.

In the accompanying drawing in which similar reference characters refer to similar parts,

Figure 1 is a plan view partly in section of a locomotive,

Figure 2 is a diagrammatic view of the controlling system, and

Figure 3 is a sectional plan view of a detail.

Referring more particularly to the drawing, A designates generally a locomotive and B a prime mover, such as an internal combustion engine which may be connected to drive a generator C for generating current to supply the various electrically actuated devices mounted on the locomotive A.

One of these devices consists of a main motor D which is suitably connected, as by means of a pinion E and a gear F, to a driving axle G of the locomotive A and whereon are mounted the wheels H.

The locomotive A is further provided with a compressor J connected to an electric motor K whereby the compressor J is driven.

A portion of a second locomotive L is shown connected to the locomotive A by suitable coupling devices O.

The compressor J is connected, as by means of a conduit P, to a storage receiver Q, and from the storage receiver Q leads a supply line R for conveying pressure fluid to the various pneumatically actuated devices wherewith the locomotive A is equipped. Preferably a suitable reducing valve S is interposed in the supply line R to maintain a desired operating pressure within a service tank T also interposed in the supply line R.

The supply line R is provided with suitable control valves U and V to control communication between the supply line R and a control line W and also to effect communication between the control line W and the atmosphere. The valves U and V are provided with suitable recesses X to afford communication between the lines R and W and also to establish communication between the control line W and exhaust ports Y in casings Z which form housings for the valves U and V.

The control line W may be provided with suitable connections *b* for supplying pressure fluid to the service brakes (not shown) of the locomotive, and said control line W has a branch pipe *c* for conveying pressure fluid to a plunger *d* connected to an accelerator *e* of the engine B.

The accelerator *e* may be of a well known type which, in one limiting position, increases the fuel supply to the engine so that said engine may operate at full speed and in another limiting position supplies only sufficient fuel to the engine to operate said engine at an idling speed.

The plunger *d* is provided with a suitable casing *f* and a spring *g* is disposed beneath the plunger *d* to actuate the accelerator *e* into the position which it is intended to assume when the engine B is running at an idling speed.

To the end that the electrical current to the main motor D may be conveniently controlled by means of either of the valves U or V, a cylinder *h* is conected to the pipe *c* as by means of a pipe *j*, and, within said cylinder *h* is a plunger *k* having a rod *o* which car-

ries on its outer or free end a contactor *p*. Within the cylinder *h* is a spring *q* which, in the absence of pressure fluid within the cylinder *h*, holds the plunger *k* in retracted position. The contactor *p* is adatped to close a circuit designated by *r* and comprising a pair of wires *s* and *t* which lead from the generator to the main motor D.

The current for operating the compressor motor K is conveyed thereto by a circuit *u* comprising a pair of wires *v* and *w* having a switch *x* interposed therein for controlling the circuit *u*.

The switch *x* is magnetically actuated in this instance by a magnet *y* into which extends an armature *z* and connected at one end to the switch *x*. The electric current for energizing the magnet *y* may be supplied thereto by a battery 2 connected to the magnet *y* by a wire 3. A second wire 4 is connected to the magnet *y* and a suitable switch, designated by 5, is adapted to establish contact between the wires 3 and 4 for energizing the magnet *y*.

In apparatus of this type employing pressure fluid for actuating the various controlling devices associated with the locomtive it is desirable to normally maintain a predetermined maximum pressure within the storage receiver Q and, when the pressure in said receiver drops to a certain predetermined minimum, to automatically set the compressor motor in operation so that an ample supply of pressure fluid may at all times exist in the receiver Q. To this end the switch 5 is provided with a suitable actuating device designated generally by 6 and comprising a cylinder 7 which is connected to the receiver Q by means of a pipe 8.

The cylinder 6 contains a plunger 9 having a rod 10 which is pivotally connected to the lever 11 of the switch 5. The pipe 8 is connected to the cylinder 6 in such manner that pressure fluid will act against the plunger 9 to open the switch 5 and a spring 12 is interposed between the plunger 9 and that end of the casing adjacent the lever 11 to oppose the pressure acting against the plunger 9 tending to open the switch 5. The spring 12 may be calibrated to exert a pressure on the plunger 9 of a value substantially equal to that which it is intended to maintain in the receiver Q.

The operation of the device so far described is as follows: Let it be assumed that the engine B is being operated at the idling speed. During such time the plunger *k* is held in retracted position by its spring *q* and the contactor *p* will be removed from the wires *s* and *t* and the valves U and V are in the positions which they will occupy while the engine is operating at this idling speed. In such case, of course, there will be no pressure fluid in the control line leading from the valves U and V to the casing *f* and the cylinder *h*.

If then one of the control valves, as for instance the valve U, be rotated to a position in which communication is established between the supply lines R and W, pressure fluid will flow into the supply line W and through the pipe *c* into the cylinder *h* and into the casing *f*. The pressure fluid thus admitted into the cylinder *h* will actuate the plunger *k* so that the contactor *p* will be moved into position to establish contact between the wires *s* and *t* to supply current to the main motor D for starting the locomotive A.

In this connection it may be stated that the springs *q* and *g* in the cylinder *h* and the casing *f* respectively are calibrated to yield to pressures of different value. Preferably, the spring *q* is calibrated to yield to a lighter pressure than will the spring *g* so that the contactor *p* may first be actuated into contact with the wires *s* and *t* for setting the motor D in operation before sufficient pressure is admitted into the casing *f* to actuate the accelerator *e* from the idling position.

Upon further admission of pressure fluid into the control line the increased pressure within the casing *f* will act against the plunger *d* to actuate the accelerator *e* in the required direction to accelerate the speed of the engine B. In this way the possibility of closing the main motor circuit after the engine B commences to accelerate will be eliminated.

If during such operation of the engine and the generator, the pressure within the receiver Q drops to a value below that which it is desired to maintain or below that exerted by the spring 12, the said spring will actuate the plunger 9 and thus also the lever 11 to close the switch 5. By closing the switch 5 the magnet *y* will be energized so that the armature *z* will be retracted to close the switch *x*. Current will then be supplied to the motor K for driving the compressor J.

Whenever it is desired to decelerate the engine B the control valve may be rotated to a position in which the recess X will open communication between the control pipe W and the exhaust port Y. The pressure fluid acting against the plungers *k* and *d* will then be exhausted to the atmosphere whereupon the springs *q* and *g* will act to retract the plungers *k* and *d* respectively, thus removing the contactor *p* out of contact from the wires *s* and *t* and also moving the accelerator to the idling position.

As will be readily understood, when the engine B is operating at only idling speed the speed of the generator C will of course also be such that only an insufficient amount of electrical energy will be generated by the generator C to supply the motor K for operating the compressor J. It is, however, essential that during the time the locomotive is at a stand-still sufficient current be sup-

plied to the compressor motor K to assure an ample supply of pressure fluid within the receiver Q. In furtherance of this end, the supply line R is provided with a branch pipe 13 which is adapted to supply pressure fluid to the casing *f* for actuating the accelerator *e* to the maximum speed position without requiring the manipulation of the manually operable control devices, such as the valves U or V.

The pipe 13 has interposed therein a casing 14 containing a valve 15 and said valve has a stem 16 to which is connected an armature 17 adapted to be actuated by a magnet 18. The electrical energy for energizing the magnet 18 may be supplied thereto by a battery 19 interposed in a wire 20 leading to the magnet 18 and having at its other end a contact 21 which is arranged in the path of the contactor *p*.

A second wire 22 leads from the magnet 18 to a switch 23 which is interlocked with the switch *x* by means of a lever 24 so that, upon actuation of the switch *x*, the switch 23 will also be actuated to closed position to establish communication between the wire 22 and a wire 25 which also has a terminal contact 26 arranged to lie in the path of the contactor *p*. The contacts 21 and 26 are so arranged that when the spring *q* within the cylinder *h* acts to retract the plunger *k* and thus the contactor *p* said contactor *p* will bear against the contacts 21 and 26 to establish communication between the wires 20 and 25.

Within the casing 14, and at the opposite ends thereof, are seating surfaces 27 and 28 to accommodate heads 29 and 30 respectively of the valve 15. The heads 29 and 30 are so spaced that only one head may bear against its seat at one time. Adjacent the seating surface 28 is an exhaust port 31 through which the rod 16 may extend and said exhaust port affords communication between the interior of the casing 14 and the atmosphere.

Interposed between the pipes *c* and 13 is a valve casing 32 having a valve chamber 33 therein to accommodate a shuttle valve 34 whereby the admission of pressure fluid from either the pipe 13 or the pipe *c* into the casing *f* may be controlled. At the end of the chamber 33 adjacent the pipe *c* is a seating surface 35 to accommodate a head 36 of the shuttle valve 34, and a similar seating surface 37 is provided at the opposite end of the chamber 33 to accommodate a head 38 of the valve 34. The valve 34, like the valve 15, is also of less length than its chamber so that only one head may bear against its seat at one time.

Preferably a suitable valve 39 is disposed in the pipe 13 between the receiver Q and the valve casing 14 to restrict the amount of pressure fluid flowing into the casing 14 from the pipe 13.

In order to evacuate that section of the pipe 13 which is located between the casings 32 and 14 so that the shuttle valve 34 may be actuated into a position for cutting off communication between the pipe 13 and the casing *f* prior to the admission of pressure fluid to the control line W, the pipe 13 is provided with a branch pipe 40 which is connected to suitable exhaust valves, such as those designated by 41 and 42, and one of which may be associated with each control valve U and V.

The exhaust valves 41 may be spring pressed and are disposed in casings 43 which may be formed integrally with the casings Z. The casings 43 are provided with exhaust ports 44 so that upon unseating of one or the other of the valves 41 or 42 communication will be established between the pipe 13 and the atmosphere.

To effect the exhaust of pressure fluid from the pipe 13 and the casing 32 the control valves U and V may be provided with cams 45 connected fixedly to the control valves and being adapted to unseat the exhaust valves 41 and 42 as the control valves are being moved from the idling position to the position which they will occupy for admitting pressure fluid from the supply line to the control line. In this way the pressure fluid will be exhausted from the valve casing 32 prior to the establishing of communication between the supply and control lines.

The cams 45 are preferably so located with respect to the recesses X in the control valves U and V that upon operation of one of the control valves its cam will open its respective exhaust valve before the recess X establishes communication between the pipes R and W.

As is illustrated in Figure 2, the line 40 which connects the valve casings 43 may be provided with a suitable extension 46 for connection to the control valves on an adjacent locomotive such as that designated by L and the supply pipe R may be likewise provided with an extension 47 to connect with the control valves on the adjacent locomotive L.

The manner in which the various devices, either electrically or pneumatically actuated, may operate to assure a supply of sufficient current to the compressor motor K for operating the compressor J while the locomotive A is inoperative, is as follows: If, while the accelerator *e* is in the idling position and the control line is evacuated, the pressure within the receiver Q reaches a value below that which it is desired to maintain therein the spring 12 will actuate the plunger 9 to close the switch 5. As has been previously explained, this will energize the magnet *y* to retract the armature *z* and the switch *x* will then be closed. Inasmuch as the switch 23 is connected to be simultaneously actuated said switch 23 will also be closed. With the control line evacuated the spring *q* will of course retract the contactor *p* so that the said

contactor will connect the wires 25 and 20. The magnet 18 will then be energized to retract the armature 17 together with the valve 15 to a position in which the head 30 of the valve will bear against the seating surface 28, thus cutting off communication between the interior of the casing 14 and the atmosphere.

By actuating the valve 15 to the position described, pressure fluid will flow from the supply line R through the pipe 13 and the casing 15 and will shift the shuttle valve 34 into a position in which the head 36 of said shuttle valve will bear against the seating surface 35 to prevent the admission of pressure fluid into the control line.

Pressure fluid will then flow into the casing *f* and will act against the plunger *d* to actuate the accelerator *e* into a position for accelerating the speed of the engine B. The generator C will then be operated at its rated speed so that the required current will be generated for operating the compressor motor K.

As is of course well known there are instances where an immediate start of the locomotive is required and also where it is essential that the operation of the compressor J be not then interfered with. Obviously, while the engine B is operating at a high rate of speed it would be inadvisable to supply current to the main motor D since, in such case, the main motor D and the associated elements would be subjected to tremendous strains. In order to avoid the necessity of starting the locomotive under such unfavorable conditions one of the control valves U or V may be rotated to supply pressure fluid to the control pipe for manually controlling the speed of the engine B. As the control valve is being rotated in the direction necessary for supplying pressure fluid to the control line the cam 45 will immediately unseat the exhaust valve 41 associated therewith so that the pressure fluid admitted into the casing *f* by the pipe 13 will be exhausted to the atmosphere. The spring *g* will then retract the accelerator *e* and the speed of the engine will thus be reduced to the idling speed.

Upon continued rotation of the control valve communication will be established between the supply and control lines and pressure fluid will then again flow into the cylinder *h* and into the casing *f*. During its course through the casing 32 the pressure fluid will actuate the shuttle valve 34 into a position where the head 37 will bear against the seating surface 38 to prevent the flow of pressure fluid from the pipe *c* into the pipe 13.

Upon admission of pressure fluid into the cylinder *h* the plunger *k* will be depressed to move the contactor *p* into contact with the wires *s* and *t*. The circuit leading to the magnet 18 will then be broken and the valve 15 will be actuated in a well known manner into a position in which the head 29 of the valve will prevent the flow of pressure fluid from the pipe 13 into the casing 14.

This movement of the valve 15 will of course not take place until after the shuttle valve 34 has been shifted into a position to admit pressure fluid from the control line to the casing *f*. Inasmuch however, as the exhaust port 31 is of sufficiently large area to prevent the accumulation of pressure within the casing 14, and therefore in the section of the pipe 13 between the casing 14 and the casing 32, the pressure fluid flowing into the casing 14 will be ineffective to interfere with the movement of the valve 34 or with its position.

Upon the admission of pressure fluid into the casing *f* and the cylinder *h* the motor circuit *r* will be closed prior to the acceleration of the engine B, and the generator C may then supply current to both the main motor D and to the compressor motor K.

From the foregoing description it will be readily apparent to those skilled in the art that sufficient current will at all times be available to assure the efficient operation of the compressor J and therefore to maintain the required pressure within the receiver Q. Moreover, owing to the manner in which the pressure fluid from the various conduits is supplied to the plunger *d* for actuating the accelerator *e* it will be impossible to simultaneously subject the shuttle valve 34 to opposing pressures. Only a single manually operable device is required to be manipulated for controlling the system and all of the various devices operate in proper sequence to avoid undue strains to the main motor and at the same time to assure an abundant supply of pressure fluid necessary for controlling these devices.

I claim:

1. In a control system for locomotives, the combination of an engine and a generator driven thereby, a main electric motor for driving the locomotive, a compressor, a receiver for the compressor, an electric motor for driving the compressor, pressure actuated means for controlling the speed of the engine, manually controlled means for normally controlling the supply of pressure fluid to the said pressure actuated means, and means including a plurality of electrically and pneumatically operated apparatuses for automatically supplying pressure to the pressure actuated means to accelerate the speed of the engine and thus assure an ample current supply to the compressor motor when the supply of pressure fluid to the pressure actuated means is cut-off by the manually controlled means.

2. In a control system for locomotives, the combination of an engine and a compressor, an electric motor for driving the compressor, an electric main motor for driving the locomotive, there being periods of time during

which the main motor is idle, a generator to supply current to the motors and being driven by the engine, pressure actuated means for controlling the speed of the engine, manually controlled means for normally supplying pressure fluid to the pressure actuated means, means including a plurality of pneumatically and electrically operated apparatuses for automatically supplying pressure fluid to the pressure actuated means to accelerate the speed of the engine and thus assure an ample supply of current to the compressor motor during the idle period of the main motor, and means for rendering the said apparatuses ineffective before pressure fluid is admitted to the pressure actuated means by the manually controlled means, thus allowing the engine to decelerate to an idling speed before the main motor is set in operation.

3. In a control system for locomotives, the combination of an engine and a compressor, an electric motor for driving the compressor, a receiver for the compressor, an electric main motor for driving the locomotive, there being periods of time during which the main motor is idle, a generator driven by the engine to supply current to the motors, pressure actuated means for controlling the speed of the engine, manually controlled means for supplying pressure fluid to the pressure actuated means to normally control the engine, means including pneumatically and electrically operated apparatuses supplying pressure fluid to the pressure actuated means to accelerate the speed of the engine during the idle period of the main motor and to simultaneously connect the compressor motor to the generator, one of said apparatuses being automatically operated by the receiver pressure to actuate the other apparatuses whenever the receiver pressure reaches a certain predetermined minimum value, and means for rendering the said apparatuses ineffective to control the engine speed immediately before pressure fluid is admitted to the pressure actuated means by the manually controlled means, thus allowing the engine to decelerate to an idling speed prior to the starting of the main motor.

4. In a control system for locomotives, the combination of an engine and a compressor, an electric motor for driving the compressor, a receiver for the compressor, an electric main motor for driving the locomotive, there being periods of time during which the main motor is idle, a generator driven by the engine to supply current to the motors, pressure actuated means for controlling the speed of the engine, manually controlled means for supplying pressure fluid to the pressure actuated means to normally control the engine, means including pneumatically and electrically operated apparatuses supplying pressure fluid to the pressure actuated means to accelerate the speed of the engine during the idle period of the main motor and to simultaneously connect the compressor motor to the generator, one of said apparatuses being automatically operated by the receiver pressure to actuate the other apparatuses whenever the receiver pressure reaches a certain predetermined minimum value, and means associated with the manually controlled means and operated thereby for rendering the apparatuses ineffective to control the engine speed immediately before pressure fluid is admitted to the pressure actuated means by the said manually controlled means, thus allowing the engine to decelerate to an idling speed prior to the starting of the main motor.

5. In a control system for locomotives, the combination of an engine and a generator driven thereby, a fuel control means for the engine, a plunger connected to actuate the control means for increasing the fuel supply to the engine, a spring to oppose the plunger, a traction motor for the locomotive having a circuit leading to the generator, a switch controlling the circuit, a plunger to close the switch, means for supplying pressure fluid simultaneously to the plungers, and a spring opposing the last-mentioned plunger and adapted to yield to a lower pressure than the first said spring to assure closing of the switch prior to the acceleration of the engine.

6. In a control system for locomotives, the combination of an engine and a generator driven thereby, a traction motor for the locomotive having a circuit leading to the generator, pressure-responsive accelerating means for the engine, pressure-responsive switch means for controlling the circuit and being adapted to yield to a lower pressure than the first said means, and means for simultaneously admitting pressure fluid to both means.

7. In a control system for locomotives, the combination of an engine and a generator driven thereby, a traction motor for the locomotive having a circuit leading to the generator, pressure-responsive accelerating means for the engine, pressure-responsive switch means for controlling the circuit and being adapted to yield to a lower pressure than the first said means, and manually-operable control means for simultaneously admitting pressure fluid of the same value to the pressure-responsive accelerating means and the pressure-responsive switch means.

8. In a control system, the combination of an engine and a generator driven thereby, pressure responsive speed control means for the engine, a compressor, a receiver connected to receive the discharge from the compressor, an electric motor for driving the compressor and having a circuit leading to the generator, a switch to control the circuit, a magnet connected to actuate the switch, a source of electrical energy, a switch to control the flow of electrical energy to the magnet, pressure-

responsive means exposed to receiver pressure and connected to normally hold the last-mentioned switch open, and a spring acting against the pressure-responsive means for closing the last said switch whenever the pressure within the receiver reaches a certain predetermined minimum value, thereby energizing the magnet for closing the motor circuit.

9. In a control system, the combination of an engine and a generator driven thereby, pressure-responsive accelerating means for the engine, a compressor, a motor to drive the compressor and having a circuit leading to the generator, a receiver for the compressor, a conduit for conveying pressure fluid from the receiver to the pressure-responsive accelerating means, a magnetically actuated switch to control the circuit, pressure-responsive means for initiating closing movement of the magnetically actuated switch whenever the pressure in the receiver reaches a certain predetermined minimum value, and a magnetically actuated valve in the conduit for admitting pressure fluid to the pressure-responsive means for accelerating the speed of the engine.

10. In a control system, the combination of an engine and a generator driven thereby, a plurality of motors supplied by current from the generator, means for automatically connecting one motor to the generator during only idling speeds of the engine, and means for automatically connecting the other motor to the generator during all speeds of the engine.

11. In a control system, the combination of an engine and a generator driven thereby, a plurality of motors supplied by current from the generator, means for automatically connecting one motor to the generator during only idling speeds of the engine, and means for automatically connecting and disconnecting the other motor to and from the generator during all speeds of the engine.

12. On a vehicle, the combination of an engine, a pressure actuated speed control therefor, a generator driven by the engine, an electric motor supplied with current from the generator, a compressor driven by the motor, and means for automatically connecting and disconnecting the motor to and from the generator during operation of the vehicle.

13. On a vehicle, the combination of an engine, a pressure actuated speed control therefor, a generator driven by the engine, an electric motor supplied with current from the generator, a fluid compressor driven by the motor, and means subject to the pressure of fluid compressed by the compressor for automatically connecting and disconnecting the motor to and from the generator during operation of the vehicle.

14. On a vehicle, the combination with an engine driven generator and an electric motor supplied with current from the generator, of a fluid compressor driven by the motor, control means automatically operable when the engine is idling for accelerating the engine to increase the output of fluid compressed by the compressor, and manually operable means for rendering said controlling means inoperable when movement of the vehicle is desired.

In testimony whereof I have signed this specification.

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