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ENGINE CONTROL MEANS

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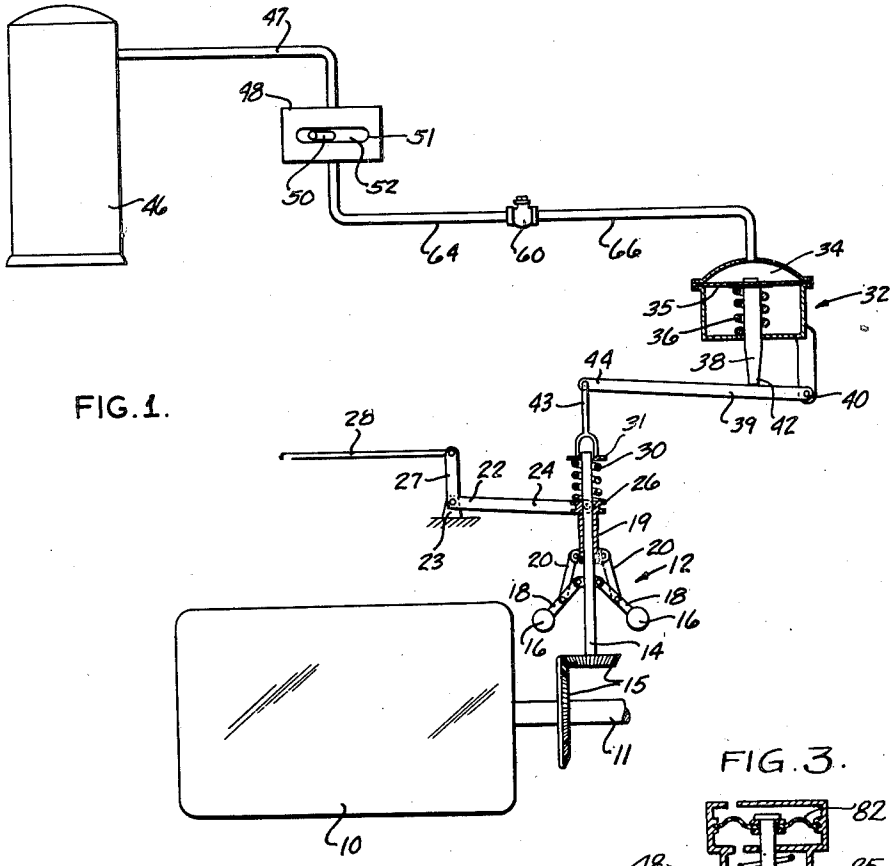

FIG. 1.

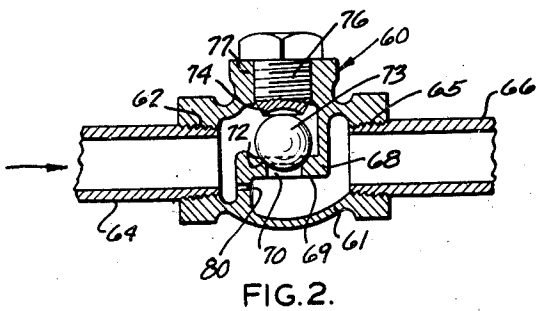

FIG. 2.

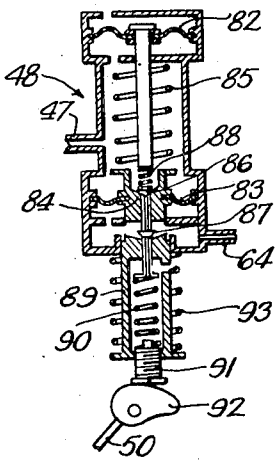

FIG. 3.

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ENGINE CONTROL MEANS

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This invention relates generally to control systems for internal combustion engines, and has particular reference to certain improvements in pneumatically operated control systems of a character suitable for effecting regulation of engine speed governor mechanism. The invention as will hereinafter appear, is applicable in particular to a pneumantically operated control system suitable for use with the governor mechanism of a Diesel engine serving as the power unit in a Diesel-electric locomotive or the like.

In the operation of Diesel-electric locomotives having a pneumatic control embodying a servomotor through which the engine governor is adjusted to determine engine speed and power output in accordance with engine loading, the operator frequently applies full or nearly full air pressure to the servo-motor quite suddenly, with the consequence as heretofore found in practice, that the servo-motor force-transmitting element in its resultant displacement, undergoes an appreciable vibratory or oscillatory movement in the initial period of its actuation. As a direct consequence thereof, the governor responds by assuming a so-called "hunting" action, with the result that the engine speed and power will vary correspondingly for an appreciable time, until the servo-motor becomes stabilized and the governor ceases "hunting." Such reaction of the control motor and governor at least in the initial period of adjustment, is a distinct disadvantage in locomotive operation, as it tends to result in an uneven movement of the locomotive. Consequently, the object of the present invention is to afford an improvement in the pneumatic control system provided for engine governor regulation, which will obviate the disadvantageous reaction as above discussed.

This and other objects of the invention will appear readily from the following description of a preferred embodiment thereof as illustrated by the accompanying drawing, wherein:

Fig. 1 shows diagrammatically, an internal combustion engine and engine speed governor, and a pneumatic control system in regulating association with the governor, wherein is embodied the present improvements,

Fig. 2 illustrates in enlarged section, a control device of a presently preferred form, as utilized in the pneumatic control system shown in Fig. 1, and

Fig. 3 is a diagrammatic view of a throttling mechanism suitable for incorporation in the showing of Fig. 1.

Referring to the drawing and first to Fig. 1,

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an internal combustion engine of a Diesel type, is indicated diagrammatically at 10, the engine in accordance with present example, serving as a power unit of a Diesel-electric locomotive (not shown), as to drive through the engine shaft 11, a suitable electric generator for supplying electric power to drive motors in operative association with the locomotive wheels, the several last named elements being deemed unnecessary of present disclosure.

An engine control governor indicated generally at 12, includes a shaft 14 in driven connection with the engine shaft 11 through gearing 15, governor weight 16 pivotally suspended from the shaft 14 through arms 18, and a tubular member 19 sleeved on shaft 14 and connected to the governor arms 18 by links 20, whereby to afford displacement of the member along shaft 14 in response to pivotal movements of the weighted arms 18, in the usual manner of centrifugal governor operation. A bell-crank lever 22 suitably pivotally supported as indicated at 23, has its long arm 24 extended to an operative connection 26 with the governor sleeve 19, and its short arm 27 connected to one end of a control rod 28. Rod 28 leads to the engine fuel pumps (not shown) for regulating the latter as to fuel delivery, in accordance with control positions of the governor-mechanism. Loading of the governor to condition it for maintaining engine speed and power output under load, is effected by a suitable capacity compression spring 30, here shown arranged between the sleeve 19 and a collar 31. According to the diagrammatic arrangement shown, altering the position of the collar 31, as to points nearer to or more removed from the sleeve 19, will produce correspondingly greater or lesser compression of the spring 30, whereby the governor may be thus set to maintain engine speed and power output predetermined according to the compression adjustment of the loading spring.

Positioning of the collar 31 to adjust the governor spring loading 30, is effected by a pneumatically operated control shown diagrammatically in Fig. 1, as comprising a servo-motor 32 providing an air chamber 34 closed on one side by a yieldable diaphragm 35 urged to an intial position by a spring 36, a plunger or actuator element 38 connected to the diaphragm, and an operating arm 39 pivotally supported at 40 and extending therefrom in a position for abutment by the free end 42 of the plunger 38. A link 43 connects the free end 44 of arm 39 with the collar 31 associated with the governor loading spring 30.

A suitable source of fluid pressure as the com-

pressed air tank 46, is connected with the servo-motor chamber 34 by a conduit 47, and located in the conduit line is an air throttle or valve device 48 having an operating lever or handle 50. Handle 50 is shown in a position which may be said to be the "off" position of the throttle, wherein compressed air is shut-off from delivery to the servo-motor, while any air under pressure above atmospheric in the motor chamber 34 and the piping to the throttle 48, may exhaust through the throttle valve to atmosphere. By moving the lever 50 to the right as viewed in Fig. 1, from the "off" position to the end 51 of the slot 52, air under the full source pressure, will be delivered to motor chamber 34, while disposing the lever in any position intermediate the above extremes, will condition the control 48 to throttle the air pressure to a degree corresponding to the lever position selected. The device 48 functioning as indicated, while well known in the art, is illustrated in Fig. 3 and described below in detail.

In the operation of the engine speed control arrangement as thus far described, assuming the engine 10 to be in operation without load and at normal idling speed, the operating parts of the governor 12 and servo-motor 32 will be positioned substantially as shown in Fig. 1, while the air throttle valve 48 will be in "off" position. Now, for example, when full load operation of the engine is desired, the lever or handle 50 of the air valve 48 is moved to full air pressure delivery position, as to the end 51 of the slot 52. In consequence thereof, full air pressure is applied to the diaphragm 35 in chamber 34 of the servo-motor 32, with the result that the diaphragm will be thereby displaced in opposition to the spring 36, to actuate the plunger 38 against the arm 39. Arm 39 thus displaced about its pivotal support 40, will effect through the link 43, positionment of the collar 31 to increase the effective compression of governor loading spring 30 such as will condition the governor mechanism for establishing full load running of the engine. Any intermediate positioning of the throttle lever 50 likewise will effect corresponding compression adjustments of the governor spring 30 to establish engine operation under intermediate loads.

The diagrammatic view of Fig. 3 shows a suitable form of pressure throttling member controlled by the throttle lever 50. This member is indicated at 48 in Fig. 1, and is connected between the supply conduit 47 and the delivery conduit 64. The conduit 47 is connected to open between opposed diaphragms 82 and 83 so that motion of the diaphragm 83, which carries a valve seat 84, is responsive to the force of the throttle spring 85 as opposed by fluid pressure on its opposite side. A supply valve 86 cooperates with the seat 84, and this valve 86 is held in mechanical connection with a release valve 87 by the light spring 88. The release valve 87 cooperates with a suitable seat at the inner end of the tubular operating member 89 which is slidably mounted in a housing sleeve guide. The valve 87 is urged to unseat by a light spring 90. The member 89 carries an adjustable tappet element 91 at its outer end for working engagement with the cam 92 on the throttle lever 50. The conduit 64 opens to a space between the small valves 86 and 87 so that fluid at the selected pressure flows therethrough toward the actuator 32. Upon lever 50 being moved to reduce speed the member 89 is backed off the valve 87 by action of spring 93 to open the release passage to atmosphere, and this condition maintains until the spring 85 can move the valve 87 to closed position at the desired reduced pressure.

As frequently happens in the operation of a Diesel engine powered locomotive embodying a control system as hereinabove described, the operator actuates the air throttle lever 50 from the "off" position to an intermediate or the full air delivery position thereof, by rapid displacement or quick shoving of the lever. Such results in sudden application of throttled or full air pressure in the servo-motor chamber 34 and against the diaphragm 35, and an equally sudden reaction of the diaphragm, as displacement thereof in opposition to the spring 36. As a consequence, a marked vibratory displacement is set up in both the diaphragm and the spring, which depending upon the period of oscillation characteristics of these parts, may last for an appreciable time. The resultant vibratory or oscillatory impulses are transmitted directly to the governor loading spring 30 through the servo-motor plunger 38, lever 39, link 43 and collar 31, so that until the pneumatic system and the adjusted compression of spring 30 become stabilized, the initial reaction of the governor 12 is one producing an alternating over and under speed regulation, or governor "hunting" as it is frequently called. The usual consequence of this reaction of the governor, is an uneven or jerky movement of the locomotive particularly when under load.

As heretofore objectively stated, the principal purpose of the present invention, is to afford such improvements in a pneumatic regulator system for an engine governor, as will avoid governor "hunting" reaction to regulator actuation. As shown by Fig. 1, the pneumatic regulator system includes an air flow control device 60 positioned at a suitable point in the portion of the air conduit 47 extending between the servo-motor chamber 34 and the air throttle valve 48. The device 60 appears in section in Fig. 2, and comprises a casing 61 having a connection 62 to the section 64 of conduit 47 leading from the throttle 48, and an opposite connection 65 to the conduit section 66 leading to the servo-motor chamber 34. Within the casing 61 is a step-like partition or wall 68 provided in the portion 69 thereof, with a port 70 of a predetermined relatively large area, the port at its upper side presenting a valve seat 72 for a ball check valve element 73. Port-opening displacement of the ball valve is adjustably limited by an abutment 74 constituted by the lower end of a bolt-like member 76 threaded through the upper wall 77 of casing 61. In the partition wall portion 68 adjacent the casing-conduit connection 62, is a port 80 of predetermined small area, for a purpose now to appear.

With the control device 60 in the pneumatic regulator system, the operator may now move the throttle valve lever 50 from its "off" position to the end 51 of slot 52 for full air pressure delivery, or to any intermediate throttled air pressure delivery position, by a quick actuation or "throw" thereof without fear of producing governor "hunting", since the device 60 prevents immediate application of air under full or throttled pressure, to the servo-motor chamber 32 and against the diaphragm 35. The action of the device 60 in this instance, is to retard or effect a time-delay in air pressure delivery to the servo-motor such as to permit only a relatively gradual application of air pressure on the diaphragm 35. Since the air pressure admitted to the conduit section 64 through the throttle valve 48, is effective on the ball check 73 to hold it seated in closing relation

to the large port 70, the air is thereby constrained to passage through the small port 80, the latter being calibrated as to area, so as to afford the desired gradual build-up of air pressure in the servo-motor chamber 34. In consequence of this, the response of the servo-motor is correspondingly gradual, and produces an equally gradual adjustment of the governor-loading spring 30. Therefore, there is avoided in this manner, any appreciable vibratory impulsing reaction of the servo-motor, so that governor "hunting" will not occur.

When the throttle valve is returned toward "off" position, the air pressure acting on the servo-motor will decrease correspondingly under the control effect of the throttle valve 48 to reduce the air pressure in the line to the servo-motor. Accordingly, the spring 36 may then act to return the diaphragm toward its normal inactive position, which thus effects through the plunger 38, a release of arm 39 for upward movement in response to expansion of the governor spring 30. The latter in expanding, readjusts the governor mechanism for operation to determine engine speed and power output in accordance with the extent to which the throttle arm 50 is moved toward "off" position. When the foregoing takes place, the return movement of the diaphragm assists air pressure relief in the conduit portions 66 and 64, the ball valve 73 in this instance, lifting to permit a more rapid air pressure release through the port 70 than would obtain otherwise, through the small port 80.

Having now described one preferred embodiment of my invention, what I desire to claim and secure by Letters Patent is:

1. The combination with an internal combustion engine speed governor having governor loading spring means adjustable for regulating the speed control action of the governor, of a fluid-pressure actuated mechanism operatively connected with the governor spring loading means, a source of fluid under pressure having a conduit connected with said pressure actuated mechanism, a manual control valve inserted in said conduit to permit flow of pressure fluid toward said mechanism and to release such pressure fluid for purposes of adjusting the governor spring loading means, and a flow control device inserted in said conduit between said manual control and said mechanism, said control device being constructed and adapted to retard the flow of pressure fluid toward said mechanism to prevent vibratory impulsing reaction of said mechanism, and to permit rapid reverse flow of pressure fluid away from said mechanism.

2. Engine control means comprising the combination with an engine governor of the type permitting variations of engine speed and power output in accordance with engine loading and having a governor loading spring adjustably coacting with the governor to determine the engine speed and power output by increasing and decreasing the load on the governor; of a fluid-pressure actuated means operatively connected to the loading spring to adjust its load on the governor, a source of fluid under pressure connected to said pressure actuated means, and control means inserted in the connection between said fluid pressure source and said pressure actuated means, said control means including a manually adjustable valve for throttling the flow of pressure fluid to said pressure actuated means between off and full on positions and for releasing the pressure fluid upon adjustments out of its full on position, and a flow control device adapted to provide a time-delay in the application of fluid pressure at said pressure actuated means whereby to effect a gradual adjustment of the loading spring to increase the load on the governor, and to effect a rapid release of the fluid pressure on said pressure actuated means to decrease the spring loading on the governor.

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