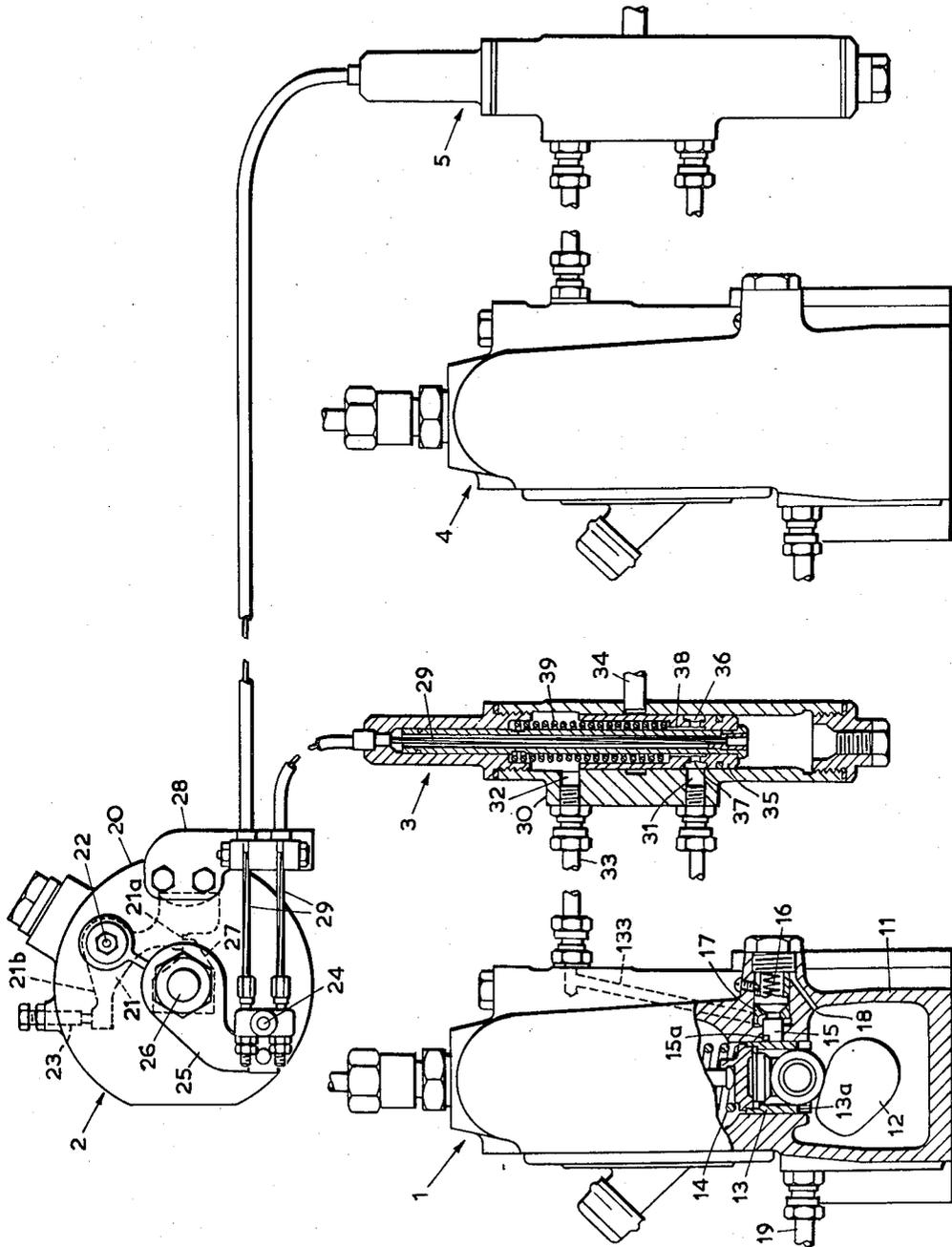


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C. A. CUSHING ET AL
EMERGENCY SHUT-DOWN GEAR FOR MULTI-CYLINDER
COMPRESSION IGNITION ENGINES
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Inventors:

Cyril Albert Cushing
John Henry William Speaight

By: Stevens, Davis, Miller & Mosher
Attorneys

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EMERGENCY SHUT-DOWN GEAR FOR MULTI-CYLINDER COMPRESSION IGNITION ENGINES
 Cyril Albert Cushing and John Henry William Speaight,
 Rugby, England, assignors to The English Electric
 Company Limited, London, England, a British company

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The present invention relates to an emergency shut-down gear for a multi-cylinder compression ignition engine.

According to the invention, emergency shut-down gear for a multi-cylinder compression-ignition engine comprises a source of hydraulic pressure; a single speed-responsive tripping device driven by the engine; at least two fuel-injection pumps driven by said engine and delivering fuel to the cylinders thereof; at least two hydraulic control valves each comprising a valve body having an inlet port, an outlet port, and a drain port, said inlet port being connected to said source of hydraulic pressure, a piston mounted to slide in said body between a first position, in which the inlet port is connected to the outlet port and the drain port is blocked, and a second position, in which the drain port is connected to the outlet port and the inlet port is blocked, and resilient means to bias said piston towards said second position; tension means connecting the piston of each said hydraulic control valve to said tripping device to oppose movement of said piston due to said resilient means; each said fuel-injection pump comprising a spragging pin housing having a bore, a spragging pin slidable in said bore, spring means to bias the spragging pin to lock the fuel pump, and the spragging pin having a surface acted on by the pressure in said bore in the sense to over-ride said spring means; and duct means connecting said bore to the outlet port of a hydraulic control valve, whereby on operation of said tripping device the pistons of said hydraulic control valves move substantially simultaneously under the influence of the resilient means to their second positions, so that said bore of each fuel-injection pump is connected through the outlet port of a hydraulic control valve to the drain port thereof and the spragging pins of said fuel-injection pumps move substantially simultaneously, under the influence of the corresponding spring means, to lock the corresponding fuel-injection pumps, and thus to cause the delivery of fuel to the cylinders of the engine to be terminated substantially simultaneously.

This arrangement is particularly suited to multi-cylinder engines where more than one multi-element fuel pump is fitted, and where these pumps are arranged remote from one another, for instance on a V-engine with the pumps outboard. The emergency gear according to the invention ensures complete synchronisation of operation in such an engine.

The source of hydraulic pressure controlling the spragging pin may be derived from the engine lubricating oil pressure system or from an independent closed hydraulic circuit.

The emergency shut-down gear according to the invention "fails safe" in the failure of hydraulic pressure caused by leakage or any other breakdown will lock the fuel pump, and accordingly bring the internal combustion engine to a standstill, the same way as the action of the overspeed tripping device upon overspeeding.

An embodiment of the invention will now be described with reference to the accompanying drawing, which shows a diagrammatic arrangement of emergency shut-down gear according to the invention.

In the drawing, the fuel pumps 1, 4, are controlled

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by an overspeed tripping device 2 by means of piston valves 3, 5. The piston valve 3 is connected to fuel pump 1 and piston valve 5 to pump 4.

Each fuel pump comprises a camshaft housing 11 wherein the engine-driven cam 12 is journaled, and the tappet assembly 13 of the pump plunger is mounted to slide perpendicularly to the axis of the camshaft, by which the plunger is reciprocated against the bias of a spring 14. A spragging pin 15 slidable in a bore in its housing 17 is biased by a spring 16 towards the tappet assembly 13 in a direction perpendicular to both the axis of said assembly and that of the cam shaft. This spragging pin has a shoulder 15a capable of engaging in a recess 13a of the tappet assembly 13 in the uppermost or near uppermost position of the latter, but is normally held back by hydraulic pressure applied to the surface on its left-hand side (as seen in the drawing) as will be explained hereinafter. The space behind the spragging pin 15 is connected to the camshaft housing 11 by a relief bore 18, and the camshaft housing is connected to drain by a pipe 19.

The overspeed tripping device 2 comprises a casing 20 wherein a trip latch 21 is pivotally mounted at 22. A lever 25 is mounted outside the casing 20 to rotate with a shaft 26, on which inside the casing a cam 27 is mounted which cooperates with a shoulder 21a of the trip latch 21. Normally the trip latch is biased clockwise and its arm 21b abuts a stop 23 adjustably fitted to the casing 20. In the event of overspeeding the trip latch 21 is swung anti-clockwise by conventional overspeed tripping means (not shown) and its shoulder 21a clears the cam 27. A bracket 28 attached outside the casing 20 holds the sheaths of tension cables 29 attached by a swivel joint 24 to the free end of the lever 25.

Each piston valve 3, 5 comprises a casing 30 having an inlet port 31 connected to a supply of hydraulic pressure, an outlet port 32 connected by a pipe 33 to the pump 1, and a drain port 34. A piston 35, having an annular groove 36 connected by radial ports 37 to an inner bore 38, is mounted to slide in the casing 30, and is biased downward (as shown in the drawing) by a powerful pre-loaded compression spring 39.

The tension cables 29 are attached to the pistons 35, and while the trip latch 21 keeps the lever 25 locked, these cables 29 hold the pistons 35 in a first position as shown, in which the inlet port 31 is connected to the outlet port 32, and the drain port 34 is blocked. Hence hydraulic pressure is transmitted through the pipe 33 and the duct 133 is the casing of each fuel pump 1, 4 and acts on the surface of the spragging pin 15 to hold it back against the bias of spring 16.

However, when the trip latch 21 releases the cam 27, the spring 39 of each piston valve pushes the piston 35 downward to a second position, in which it blocks the inlet port 31, and connects the outlet port 32 to the drain port 34.

Following the closing of the inlet port 31 and before the opening of the drain port 34, the piston 35, which has the form of a hollow plunger, displaces a fixed volume of liquid which is equivalent to the volume of liquid in the bore of the spragging pin housing 17 of the corresponding fuel pump. Accordingly the hydraulic pressure inside the bore of the housing 17 of the fuel pump drops at once, and the spragging pin 15 is pushed to the left by spring 16 and engages with its shoulder 15a in a recess 13a of the respective tappet assembly 13 when the latter is in its maximum or near maximum lift position, and prevents it from following the cam 12 downward under the bias of spring 14.

The fuel pumps 1, 4 are thus put out of action immediately and substantially simultaneously and the in-

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ternal combustion engine supplied by them is brought to a standstill at once.

When the overspeed trip device 2 is reset—by hand or otherwise—the piston 35 is returned to its first position (as illustrated), hydraulic pressure is re-established in the bore of the housing 17 of the pumps 1, 4, the spragging pin 15 is thereby withdrawn from the tappet assembly 13 against the bias of spring 16, and the fuel pumps 1, 4 are ready to resume operation.

The "fail-safe" effect of the arrangement will be noted: failure of hydraulic pressure for any reason will stop the fuel pumps 1, 4 in the manner described, and they cannot then be restarted before the hydraulic pressure is restored.

Owing to the fact that the tappet assembly 13 is locked by the spragging pin 15 at or near the maximum lift position, the cam 12 of each fuel pump 1, 4 is free to rotate clear of the tappet assembly until the associated spragging pin 15 is retracted under re-established hydraulic pressure, this action being independent for each fuel pump.

What we claim as our invention and desire to secure by Letters Patent is:

1. Emergency shut-down gear for a multi-cylinder compression-ignition engine, comprising a source of hydraulic pressure; a single speed-responsive tripping device driven by the engine; at least two fuel-injection pumps driven by said engine and delivering fuel to the cylinders thereof; at least two hydraulic control valves each comprising a valve body having an inlet port, an outlet port, and a drain port, said inlet port being connected to said source of hydraulic pressure, a piston mounted to slide in said body between a first position, in which the inlet port is connected to the outlet port and the drain port is blocked, and a second position, in which the drain port is connected to the outlet port and the inlet port is blocked, and resilient means to bias said piston towards said second position; tension means connecting the piston of each said hydraulic control valve to said tripping device to oppose movement of said piston due to said re-

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silient means; each said fuel-injection pump comprising a spragging pin housing having a bore, a spragging pin slidable in said bore, spring means to bias the spragging pin to lock the fuel pump, and the spragging pin having a surface acted on by the pressure in said bore in the sense to over-ride said spring means; and duct means connecting said bore to the outlet port of a hydraulic control valve, whereby on operation of said tripping device the pistons of said hydraulic control valves move substantially simultaneously under the influence of the resilient means to their second positions, so that said bore of each fuel-injection pump is connected through the outlet port of a hydraulic control valve to the drain port thereof and the spragging pins of said fuel-injection pumps move substantially simultaneously, under the influence of the corresponding spring means, to lock the corresponding fuel-injection pumps, and thus to cause the delivery of fuel to the cylinders of the engine to be terminated substantially simultaneously.

2. Emergency shut-down gear as claimed in claim 1 wherein each said piston has the form of a hollow plunger, the interior of which is in constant communication through said outlet port and said duct means with said bore wherein the pressure acts on the surface of the spragging pin in the sense to over-ride the spring means, whereby on movement of said piston from said first piston to said second position, resulting from operation of said overspeed trip device, a substantial volume of liquid is displaced from said bore along said duct means towards said hollow plunger, thereby facilitating movement of said spragging pin under the influence of its spring.

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