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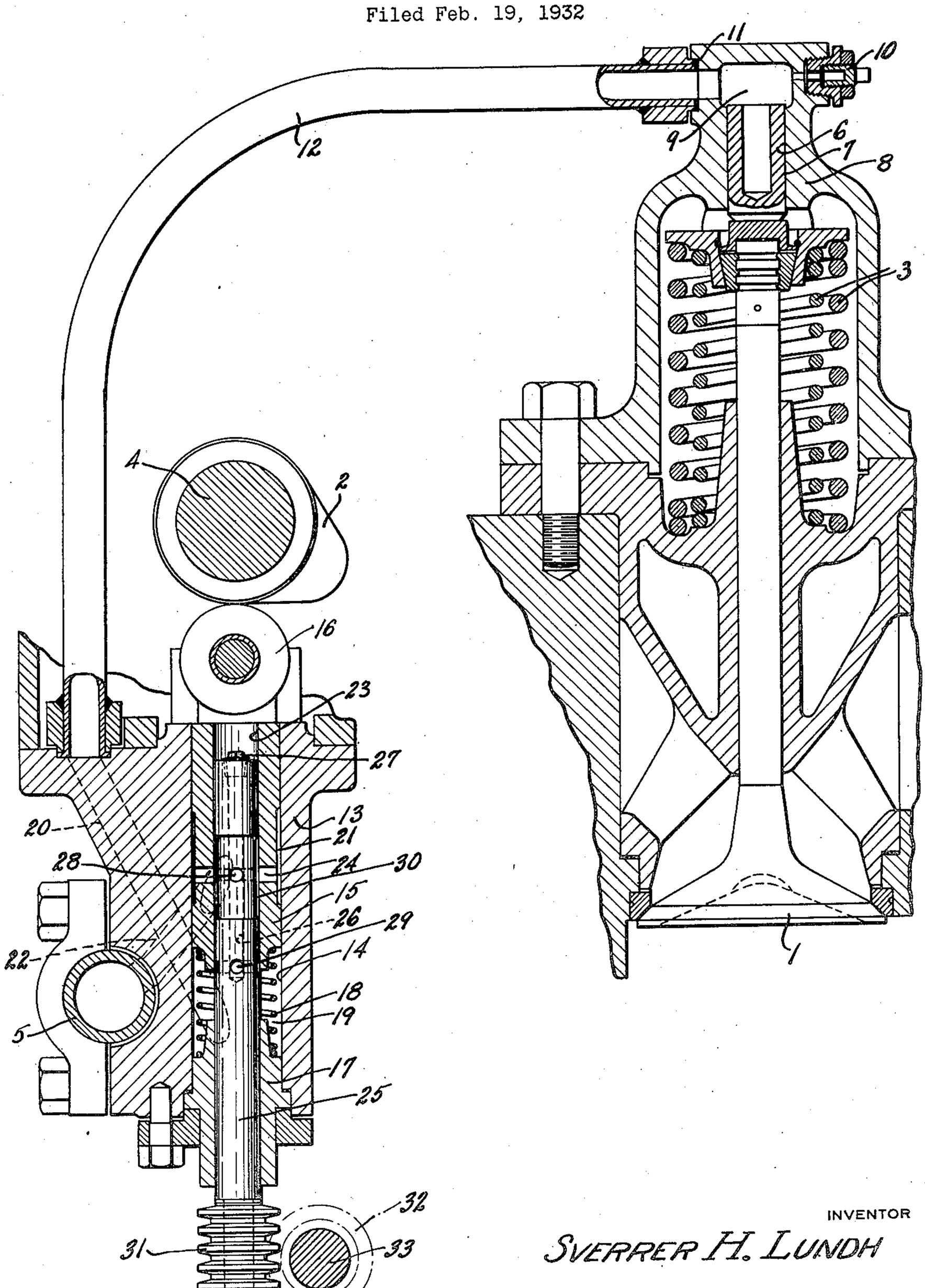

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This invention relates to valve-actuating gear for an internal combustion engine having a cam and an inlet valve to have actuation therefrom, and more particularly the gear of this invention is of hydraulic type.

An object of the invention is to provide, in such a gear, means for varying at the will of the operator, the operation of the valve relative to that of the cam, which latter is as usual in fixed relation with the other working parts of the engine.

A further object of the invention is to accomplish this purpose by a hydraulic system associated with the engine lubricating system, whereby the engine will automatically stop immediately upon failure of lubrication.

The exact nature of this invention together with further objects and advantages thereof will be apparent from the following description taken in connection with the accompanying drawing which shows a valve together with its operating gear, parts appearing in section to show details of construction.

With reference now to the drawing, 1 is an inlet valve and 2 is the cam from which the valve is to have actuation.

The valve is of poppet type seating in the head of one of the engine cylinders as will be understood. Spring means such as indicated at 3, are arranged to yieldably maintain the valve seated.

The cam 2 is one of a plurality, one for each valve 1 of the engine, upon the shaft 4, this shaft being driven in timed relation with the engine crankshaft as is usual in the art.

The engine is also provided with a header 5 arranged in the pressure lubricating system to be maintained full of oil under pressure, by the usual pump whereby lubricant is supplied under pressure to the principal engine bearings such as the crankshaft bearings.

The parts thus far described will be recognized as generally typical of internal combustion engine practice.

According to my invention a ram is provided, for immediate opening actuation of the valve 1 against the springs 3. This ram comprises a plunger 6 movable in a bore 7 in a casting 8 which may be a part of the valve cage as indicated. The cylinder 7 opens into a cavity 9 which may have an air relief 10 and connection at 11 with the pipe 12. It will be apparent that by fluid pressure transmitted through the pipe 12, the plunger 6 will be moved to open the valve 1 against the springs 3, by which the valve will be caused to reseat when the fluid pressure is relieved.

I arrange to provide such fluid pressure in impulses periodic with the motion of the cam 2, emplcying lubricating oil supplied from the header 5. More specifically, I provide pump means for actuation by the cam, the principal parts of such means comprising a body casting 13 having a bore 14 to receive the pump plunger 15. The bore 14 is in line with the cam, and the plunger 15 is provided with a roller 16 adjacent the cam. The opposite end of the bore is closed by head means such as a plug 17, and a compression spring 18 is arranged between the plug 17 and the pump plunger to yieldably urge the roller 16 against the cam 2. The pump plunger thus follows the cam.

The cavity 19 within which the spring 18 is positioned, has communication with the pipe 12 by way of a lead 20, indicated by broken lines, in the casting 13. The pump plunger 15 is provided intermediate its ends with an annular groove which forms an annular chamber 21, this chamber having communication with the header 5 by a lead 22 indicated in broken lines. The plunger has a central bore 23 and transverse leads 24 providing communication between this bore and the chamber 21 described.

A generally cylindrical valve 25 is fitted in the bore 23 and extends through an aligned bore in the plug 17. This valve has a central lead 26 indicated in broken lines, closed at its end by the plug 27. The valve is provided with transverse through openings connecting with the lead 26 generally in the zone of the annular chamber 21, as indicated at 28, and in the zone of the chamber 19 as indicated at 29. The valve is provided with an annular groove 30, generally in the zone of the annular chamber 21. At its outer end the valve is provided with a rack 31 meshing with a gear 32 carried upon a shaft 33 which shaft is arranged for operator control and extends with the cam shaft 4 so that all of the valves 1 of the engine may be coincidentally controlled as will be seen.

When the engine is in operation, the cam 2 moving in timed relation with the other engine parts, the pump plunger 15 will follow the cam and have periodic reciprocating motion. The valve 25, however, will remain stationary in the position to which it has been adjusted by the operator. Generally, communication is had between the header 5 and the pipe 12 by way of the pump, and more specifically by way of the pump housing lead 22, annular pump chamber 21, pump

plunger leads 24, annular valve chamber 30, transverse valve leads 28, longitudinal valve lead 26, transverse valve leads 29, chamber 19 and pump housing lead 20.

It will be observed that the chamber 19 is the expansible pump chamber whose volume is varied by motion of the pump plunger. So long as this chamber 19 has the communication described, with both the header 5 and the pipe 12, motion of the pump plunger will not cause flow in the pipe 12 because of the strength of the springs 3, and will therefore merely produce alternating flow in the valve housing lead 22. This will be true whenever the valve openings 29 have communication with the expansible chamber 19. When, however, these openings 29 are closed by the piston 15, any further piston motion under the action of the cam 2 will force liquid into the pipe 12 and against the ram plunger 6 to open the valve. Thus with the pump plunger 15 having the invariable motion imparted by the cam 2, the engine valve 1 may have variable motion dependent upon the setting of the pump valve 25, the lower the position of the pump valve 25 (in the drawing) the shorter will be the lift of the engine valve 1, the later will it open, and the earlier will it close.

The structure described will be recognized as essentially hydraulic coupling means between the plungers of the pump and ram and thus effectively between the engine valve 1 and its cam 2. Also the structure includes means for varying the stroke of the ram plunger and consequently the lift of the valve, the stroke of the pump plunger being invariable. It will also be apparent that the arrangement constitutes a safety device in that upon failure of the lubricating system of the engine, producing failure of oil supply to the valve-actuating pump by way of the header 5, actuation of the engine valve 1 will cease, and this being an inlet valve, operation of the engine will also cease.

What I claim is:

1. Pump means for the purpose described and comprising a pump body having a bore, with head means at one end of said bore, a control valve mounted for longitudinal adjustment in said head and extending into said bore, a pump plunger reciprocable in said bore upon a fixed stroke and having a cavity to receive said valve, whereby an expansible pump chamber is formed within said bore between said head and said plunger and about said valve, a liquid supply line connected to said pump body, and a discharge line leading from said expansible chamber, said plunger and valve having passages cooperative in series relation to provide communication between said supply line and said expansible chamber, said parts being so proportioned and arranged that said communication may be only by way of said plunger and valve in succession, and also that said communication will be cut off during the discharge stroke of said plunger, by relative motion between plunger and valve, to effect delivery of liquid to said discharge line.

2. Pump means for the purpose described and comprising a pump body having a bore, with head means at one end of said bore, a control valve mounted for longitudinal adjustment in said head and extending into said bore, a pump plunger in said bore and having a cavity to receive said control valve, whereby an expansible pump chamber is formed within said bore between said head and said plunger and about said control valve, means providing inward actuation of said plunger, a liquid supply line connected to said pump body, and a discharge line leading from said expansible chamber, said plunger and valve having passages cooperative in series relation to provide communication between said supply line and said expansible chamber, said parts being so proportioned and arranged that said communication may be only by way of said plunger and valve in succession, and also that said communication will be cut off during said inward stroke of said plunger, by relative movement between plunger and valve, to effect delivery of liquid to said discharge line, and spring means arranged in said expansible chamber and about said control valve to be effective between said head and said plunger to cause outward actuation of the latter.

3. Pump means for the purpose described and comprising a pump body having a bore, with head means at one end of said bore, a control valve mounted for longitudinal adjustment in said head and extending into said bore, a pump plunger reciprocable in said bore with a fixed stroke and having a cavity to receive said control valve, whereby an expansible pump chamber is formed within said bore between said head and said plunger and about said control valve, a liquid supply line connected to said pump body, and a discharge line leading from said expansible chamber, said plunger and valve having passages cooperative in series relation to provide communication between said supply line and said expansible chamber, said passages including in said body a passage communicating with said bore in the zone of said plunger, a passage in said plunger leading from the zone of said body passage to said valve, and a passage in said valve leading from the zone of said body plunger passage to the zone of said expansible chamber, said parts being so proportioned and arranged that said communication may be only by way of said plunger and valve in succession, and also that said communication will be cut off during the discharge stroke of said plunger, by relative movement between plunger and valve, to effect delivery of liquid to said discharge line.

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