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DEVICE FOR INJECTING FUEL INTO INTERNAL COMBUSTION ENGINES

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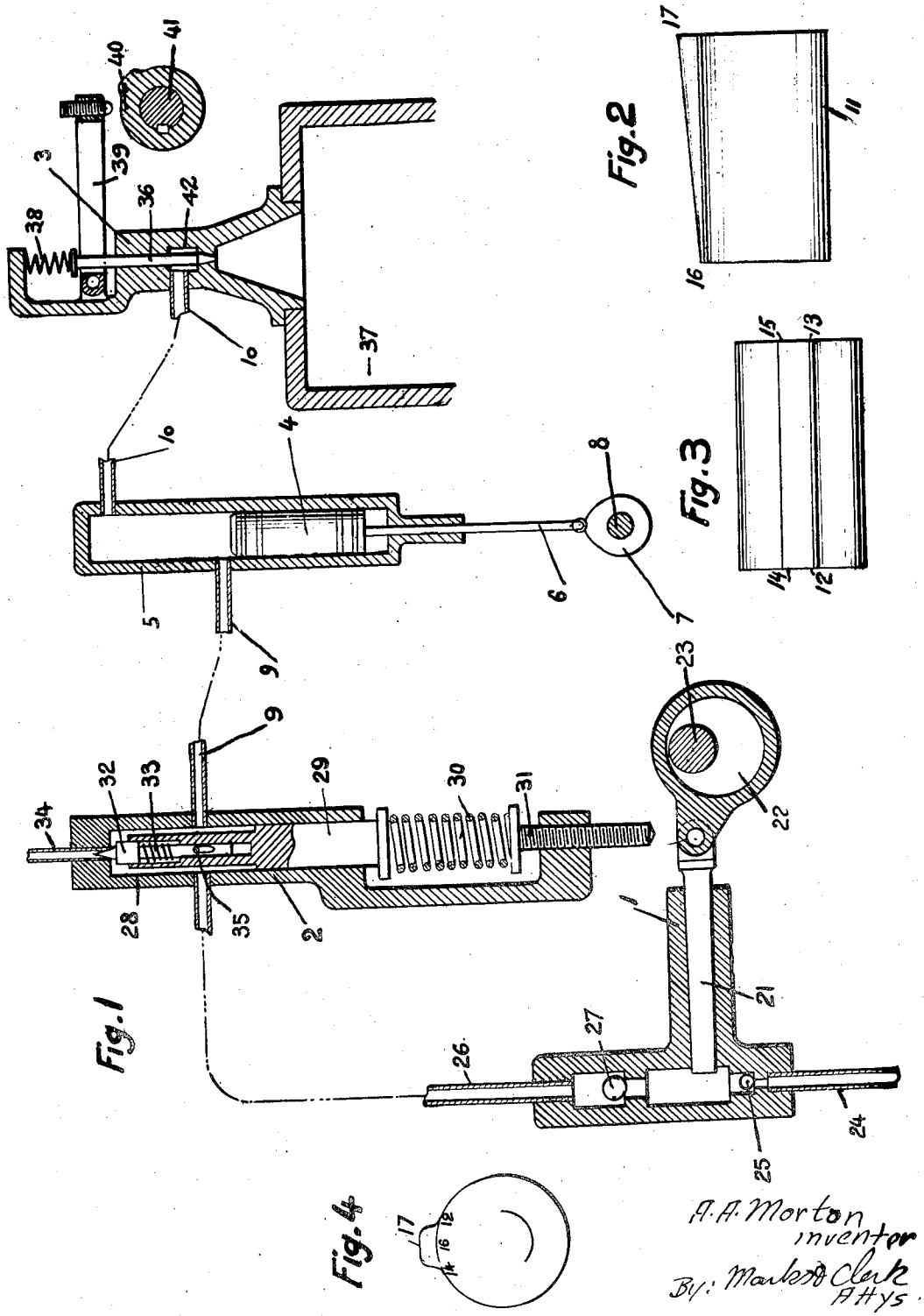


Fig. 1

Fig. 2

Fig. 3

Fig. 4

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DEVICE FOR INJECTING FUEL INTO INTERNAL COMBUSTION ENGINES

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My invention has for its object a device for injecting liquid fuel into an internal combustion engine, which device, is particularly applicable to engines having a high speed of rotation.

It is commonly known that the fuel must be injected through a very small aperture under a pressure of several hundred kilograms per square centimeter. In the pumping devices proposed up till now, the pump rotates at the same speed as the engine and as the amount of fuel to be injected at each stroke of the piston is very small, the capacity of the pump body must necessarily be very small too. This capacity must also be adjustable so as to meet the power requirement of the engine at every moment.

For instance with an eninge having a cylinder the inner diameter of which is 100 mm. the piston being allowed a stroke of 160 mm. and the speed of rotation varying between 600 and 1800 revolutions, the pump must rotate at the same speed and its capacity should be only about 72 cubic millimeters; when the power required is smaller, this capacity should be still smaller. A pump of such small capacity and rotating at so high a speed works under very bad conditions because the inlet and outlet valves show an inertia which is also shown by the column of liquid fuel to be moved and this inertia prevents the movement of the valves as well as of the liquid fuel to respond immediately to the movement of the pump piston.

My invention provides means for overcoming this drawback. It consists in a device for injecting liquid fuel into an internal combustion engine by means of a pump, this device being characterized by the fact that the pump rotates at a speed which is small in comparison with that of the engine and that its capacity which is constant is slightly above that necessary for feeding the engine during the time corresponding to each stroke of the pump piston, that is to say the capacity is slightly above the capacity of the normal pump which would be used with the engine considered multiplied by the ratio of the speeds of rotation of the engine and of the pump.

Moreover my invention provides for the arrangement of an accumulator for liquid fuel under pressure between the pump and the atomizer and for means for varying the power given out by the engine at every moment by varying the amount of fuel injected through bringing a change in the time during which or the height by which the needle valve for injection is raised or else in the value of the fuel pressure in the accumulator.

For instance the pump can be controled by the engine with a speed-reducing ratio equal to 20 which would in the case considered give the pump a speed of 30 to 90 revolutions per minute and a capacity substantially 20 times greater than that of the usual pump that is about 1440 cubic millimeters. Such a pump will provide evidently a much more regular feed of liquid fuel. As each pump piston stroke corresponds to several engine piston strokes (20 in the case considered) it is necessary to arrange an accumulator for the fuel under pressure between the pump and the atomizer. This accumulator is preferably constituted by a cylinder wherein a piston urged by an adjustable spring is adapted to move. This cylinder is provided with a discharge tube closed by a spring-urged valve sliding inside the said piston between two stops. When the amount of liquid fuel in the accumulator has reached the adjustable value required for a proper feed of the engine, the piston moves sufficiently downwards to open the sliding valve controlling the discharge tube.

Besides I have noticed that in certain cases the efficiency of this device can be improved by inserting between the fuel accumulator and the atomizer a device which I will hereinafter term "pulsator" and which comprises a cylinder without any valve and the piston of which is actuated at the speed of the engine. This pulsator is adapted to give the fuel entering the engine through the atomizer an extra dynamic pressure over the static pressure provided by the accumulator. Generally the period during which the pulsator provides this extra pressure is slightly longer than the time during which the atomizer injects fuel into the engine, the said period

beginning before and ending after the time during which this injection takes place.

The arrangement used for adjusting the power of the engine provided with the injecting means disclosed hereinabove comprises for instance a longitudinally movable cam controlling the needle valve for injection. This cam is substantially cylindrical and shows a longitudinal projection the width of the basis of which is constant throughout the length of the cam, the height of the projection varying however along this length.

I have shown by way of example on appended drawings and described hereinbelow a form of execution of my invention.

Fig. 1 gives diagrammatically a view of the whole device.

Figs. 2, 3, 4 are respectively a side view, a plan view and an end view of a cam controlling the height by which the needle valve for injection is raised, the duration of injection not being varied thereby.

The device illustrated comprises essentially the pump 1, the accumulator 2 and the atomizer 3. The pump is constituted by a cylinder wherein the piston 21 can move under the action of the eccentric ring 22 controlled by the eccentric shaft 23. The liquid fuel is sucked in through the pipe 24 provided with a ball valve 25 and is discharged through the pipe 26 also provided with a ball valve 27.

The fuel accumulator is constituted by a chamber 28 inside which a piston 29 can move. This piston is urged upwards by the spring 30 which can be adjusted through the screw 31. At the top of the piston 29 is provided a central channel through which can pass a projection secured to the lower end of the valve 32 which is urged upwards by the spring 33 so as to close the discharge tube 34. A pin 35 engages a slot provided in the above mentioned projection of the valve 32.

The pump 1 is of comparatively large size and its speed is comparatively small. It sends the fuel into the chamber 28 of the accumulator whereby the piston 29 is forced downwards until the accumulator contains the required amount of fuel. The pressure is adjusted by the adjustable spring 30.

The atomizer 3 is constituted as usual by a needle valve 36 controlling the entrance of the fuel into the engine cylinder 37. The needle valve is held down by the spring 38 and can be raised by the pivoting lever 39 controlled by a cam 40 keyed to the shaft 41 rotating at the same speed as the engine if latter is a two stroke cycle engine and at half its speed in the case of a four stroke cycle engine. Above the seat of the needle 36 is a small chamber 42 communicating through the pipe 9—10 with the fuel accumulator 2.

The chamber is thus fed continuously with liquid fuel at the proper pressure. The fuel is sprayed into the engine cylinder when the needle valve 36 is raised.

The adjustment of the power and of the speed of the engine can be provided in a number of manners through the adjustment of the amount of fuel injected and of the moment and duration thereof. For instance one of the following methods can be used.

1. The time during which and the height to which the needle valve is raised being constant, the pressure of the fuel in the accumulator is varied for instance by acting on the spring 30.

2. The pressure in the accumulator and the amount which the needle valve is raised remaining constant, the time during which the latter is raised is adjusted for instance by providing a longitudinally movable cam 40 the shape of which varies according to the part of it which controls the lever 39; this cam is in this case a cylinder provided with a longitudinal projection the height of which is constant, but the width of the basis of which varies from one end to the other of the cam cylinder.

3. The pressure of the fuel and the duration of the raising of the needle valve remaining constant, the height to which the latter is raised is varied. A cam allowing this variation is shown on Figs. 2, 3 and 4; it comprises an elongated substantially cylindrical body 11 provided between two generatrices 12—13 and 14—15 with a longitudinal projection the height of which increases between zero at one end 16 to a maximum at the opposite end 17. By moving this cam transversely under the lever 39 controlling the needle valve, the said needle will always be raised during the same time but the height to which it is raised will be varied.

The arrangement disclosed hereinabove can be improved by inserting between the accumulator 2 and the atomizer 3 a pulsator 4 constituted by a cylinder 5 wherein a plunger piston 6 can move under the action of a cam 7 keyed to the shaft 8 driven by the engine at its own or at half its own speed according as the case may be. The pipes 9 and 10 connect the pulsator respectively with the accumulator 2 and the atomizer 3.

The device works in the following manner:

The atomizer chamber is always full of liquid fuel received from the fuel accumulator 2 at a static pressure of several hundrel kilograms per square centimeter. When the needle valve of the atomizer is raised and the fuel advances towards it, this static pressure may not be sufficient to insure a speedy and proper injection. The pulsator 4, the piston 6 of which is moved upwards slightly before and after and whilst the needle valve is raised, provides a high dynamic pressure in the feed pipe and in the atomizer

whereby the flow of fuel towards the engine is substantially increased and made more regular. This allows the engine to work more regularly and provides a greater and readily adjustable power.

What I claim is:

1. Device for injecting fuel in Diesel engines, including a fuel pump with relatively high capacity and operating at a relatively slow speed, a mechanically controlled injection valve, a fuel accumulator between the pump and the valve, a pulsating member, inserted in the fuel pipe under pressure between the accumulator and the valve, moved periodically by the engine, so that during each injection, the advancing stroke of the said member diminishes the capacity of the fuel pipe under pressure, the phase of compression of the pulsator being greater than the phase of injection in the cylinder of the engine and commencing before and terminating after the phase of injection.

2. Device for injecting fuel in Diesel engines, including a fuel pump with relatively high capacity and operating at a relatively slow speed, an injection valve controlled mechanically, a fuel accumulator between the pump and the valve, a pulsating member, inserted in the fuel pipe under pressure between the accumulator and the valve, moved periodically by the engine, so that during each injection, the advancing stroke of the said member diminishes the capacity of the fuel pipe under pressure, the phase of compression of the pulsator being greater than the phase of injection in the cylinder of the engine and commencing before and terminating after the phase of injection, the pulsating member comprising a piston moving in a cylinder and inserted in the pipe so that the openings for communication between the pipe and the cylinder remain open in each position of the piston, the movement of this piston being controlled by a cam.

3. Device for injecting fuel in Diesel engines, including a fuel pump with relatively high capacity and operating at a relatively slow speed, an injection valve controlled mechanically, a fuel accumulator between the pump and the valve, wherein the quantity of liquid may vary without an appreciable modification of the pressure within the limits resulting from the operation of the pump and from the operation of the injecting device, a pulsating member inserted in the fuel pipe under pressure between the accumulator and the valve and moved periodically by the engine so that during each injection, the advancing stroke of the said member diminishes the capacity of the fuel pipe under pressure, the phase of compression of the pulsator being greater than the phase of injection in the cylinder of the engine and commencing before and terminating after the phase of injection.

4. Device for injecting fuel in Diesel engines, including a fuel pump with relatively high capacity and a number of relatively short piston strokes, an injection valve controlled mechanically, a fuel accumulator between the pump and the valve formed by a cylinder closed by a piston subjected to the action of a spring for receiving substantial deformations without an appreciable variation of the action which it exerts on the piston so that the quantity of fuel which the accumulator contains may vary without any appreciable variation of the pressure within limits resulting from the operation of the pump and from the operation of the injecting device, a safety valve mounted on the cylinder of the accumulator, a pulsating member inserted in the fuel pipe under pressure between the accumulator and the valve and moved periodically by the engine so that during each injection the advancing stroke of the said member diminishes the capacity of the fuel pipe under pressure, the phase of compression of the pulsator being greater than the phase of injection in the cylinder of the engine and commencing before and terminating after the phase of injection.

In testimony whereof I have affixed my signature.

ANDRÉ ADOLPHE MORTON.