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3,223,076

AUTOMATIC NONCOMPRESSION STARTING DEVICE

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Fig. 1

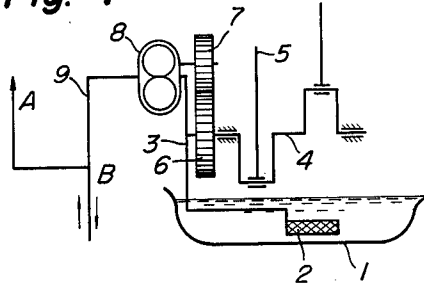


Fig. 2

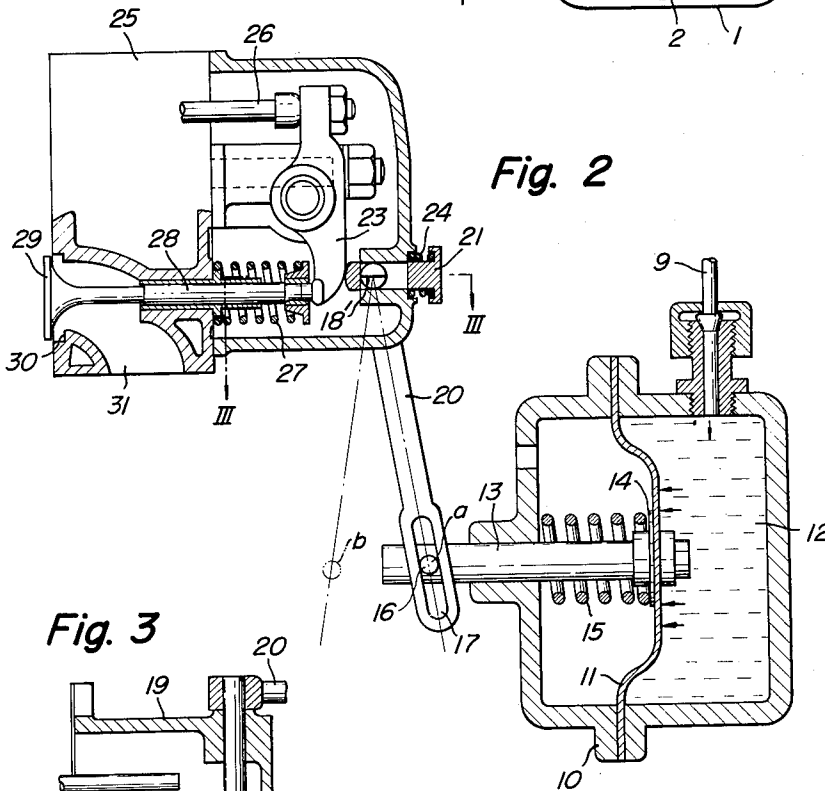
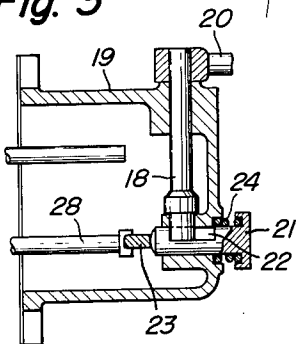


Fig. 3



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2 Claims. (Cl. 123—182)

This invention relates to starting devices for internal combustion engines.

In the past, internal combustion engines and particularly small diesel engines have been started by operating a noncompression lever by hand to place the engine in a state free from the loading due to compression, cranking the engine in this state manually or by an electric motor, and then turning the noncompression lever to its inoperative position as soon as the fly wheel obtains an appropriate momentum. Thus, the starting of an engine, has required a high level of skill to operate the noncompression lever accurately at proper instants.

The present invention has for its object to facilitate the starting of an engine and provides an automatic noncompression starting device for an internal combustion engine comprising means for normally maintaining the engine in a noncompressive state and means for automatically releasing the noncompressive state at the instant when the engine rotation has reached a predetermined level.

According to the present invention, a noncompression lever is normally biased to a noncompression position by spring means. In starting the engine, it is rotated manually or by an electric motor and when the engine rotation reaches a predetermined level the pressure of engine lubricating oil rising with the engine speed acts to displace a diaphragm, which is normally held under the oil pressure, against the bias of the said spring means thereby to move the noncompression lever to its compression position. It is apparent that it requires no effort to initiate the rotation of the engine by hand or by an electric motor (i.e. starter motor) since the noncompression lever is held in its noncompression position under the spring bias when the engine is at rest. When the engine rotation reaches the predetermined level, the oil pressure acting upon the diaphragm overcomes the spring bias to displace the diaphragm and hence the noncompression lever, which is connected with the diaphragm by way of a linkage, so that the engine starts to operate under compression.

The device of the invention will now be described in detail with reference to the accompanying drawing, which illustrates one embodiment of the invention.

FIG. 1 is an explanatory diagram illustrating the operation of a lubricating pump in an internal combustion engine; FIG. 2 is a cross-sectional view illustrating one embodiment of the invention as applied to a diesel engine in its noncompressive state; and FIG. 3 is a cross-sectional view taken along the line III—III in FIG. 2.

In FIG. 1, 1 is an oil pan, 2 an oil filter, 3 an oil suction pipe, 4 a crankshaft, 5 a connecting rod, 6 a crankshaft gear, 7 a gear pump driving gear, 8 a gear pump, and 9 an oil pipe. An arrow A indicates a passage of lubricating oil flowing to engine bearings and other points while another arrow B indicates a passage to a housing enclosing a diaphragm as will be described below.

In FIG. 2, 10 designates such housing of a hydraulic pressure device with the diaphragm 11 extending across the housing to divide it into two compartments. One of the compartments 12 is fed with oil pressure through said

oil pipe 9 connected therewith. 13 is a piston rod secured at one end to the central portion of the diaphragm and having the other end extended outwardly of the housing and slidably supported by its adjacent wall. A spring seat 14 is secured fast to the piston rod 13 adjacent that side of the diaphragm remote from the compartment 12. A spring 15 is arranged concentrically with the piston rod between the spring seat and the housing wall to bias the diaphragm to the right as viewed in the figure. The extended portion of the piston rod beyond the housing has a pin 16 secured to the rod portion normally thereto. A noncompression lever 20 has an elongated slot 17 formed in one end thereof to slidably receive said pin. As shown in FIG. 3, a noncompression shaft 18 extends at one end beyond a bonnet 19 and is connected with the noncompression lever 20. The other or inner end of the noncompression shaft 18 is slotted at the bottom over an appropriate axial length to form a semicircular end 18', which is fitted in an axial slot 22 formed in a rocker arm pusher rod 21. The pusher rod 21 is arranged for operation upon a rocker arm 23 and slidably supported in the adjacent wall of the bonnet 19. The upper end of the pusher rod 21 projects beyond the bonnet wall and is engaged by a spring 24, which biases the rod 21 outwardly so that when the noncompression lever is in its inoperative position the bottom end of the pusher and said arm 23 is spaced apart from each other by an appropriate distance. In the illustration, 25 designates a cylinder head, 26 a push rod, 27 a valve spring, 28 a valve stem, 29 an exhaust valve, 30 a valve seat, and 31 an exhaust port. The solid-line position *a* of pin 16 corresponds to the noncompressive state of the engine and the dotted-line position *b* corresponds to the inoperative position of the noncompression lever or the engine state in which compression is not hindered. In the noncompression position as illustrated, when the engine is rotated, the lubricant in the oil pan is drawn through oil filter 2 and suction pipe 3 and circulated by gear pump 8 through oil pipe 9 to the different sliding portions of the engine and into compartment 12. When the engine rotation is raised to a predetermined level, the increased oil pressure in the compartment 12 moves the diaphragm 11 to the left as viewed in the figure overcoming the bias of spring 15 to push the piston rod 13 to the left until pin 16 reaches point *b*. With this movement, the noncompression shaft 18 secured to the lever 20 is rotated with the semicircular end portion 18', which is integral with the shaft.

As described above, the semicircular end portion 18' is fitted in the slot 22 formed in the pusher 21, which is normally biased outwardly by spring 24. Therefore, the pusher is moved to the right as viewed in the figure into a position spaced from the rocker arm 23 by a predetermined distance. The exhaust valve 29 closes the exhaust port 31 acting under the bias of valve spring 27 through the intermediary of valve stem 28 so that the engine assumes a compressive state and regular explosions occur in the engine cylinder.

What is claimed is:

1. In an internal combustion engine, said engine including a cylinder, an exhaust port communicating with said cylinder, an exhaust valve adapted to open and close said port, a rocker arm adapted to actuate said valve, a push rod engaging said rocker arm, a bonnet surrounding said rocker arm, a slidable rocker arm pusher rod adjacent said rocker arm, bias means normally biasing said pusher rod out of engagement with said rocker arm, said rocker arm pusher rod being provided with a longitudinal slot having an abutment at one end thereof, a rotatable noncompression shaft having a half-round end positioned in said slot, said half-round end contacting said abutment, said rocker arm pusher rod causing said valve

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to open when in engagement with said rocker arm, a linkage coupled to said rocker arm pusher rod, said non-compression shaft coupled to said linkage, rotation of said noncompression shaft in one direction urging said rocker arm pusher rod against its said bias means and into engagement with said rocker arm, rotation of said shaft in the other direction allowing said bias means to act on said rocker arm pusher rod to move it out of engagement with said rocker arm, means coupled to said linkage for acting against the bias means thereby causing said valve to open before and during engine start-up, said means actuating the linkage after engine start-up to allow the bias means to move said pusher rod away from contact with the rocker arm thereby allowing said valve to close, said means acting as a function of engine speed.

2. The invention according to claim 1 wherein said means includes a pump whose output pressure varies di-

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rectly as the speed of the engine, the pump output acting directly on said linkage.

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