May 14, 1935. W. LEHMANN 2,000,903

DIESEL ENGINE

Filed Feb. 20, 1934

FIG. 1

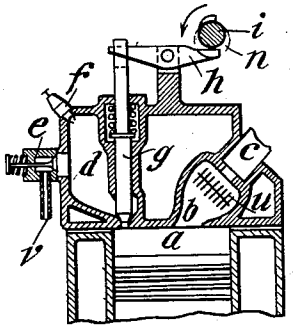


FIG. 2

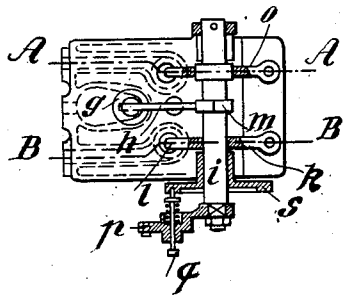


FIG. 3

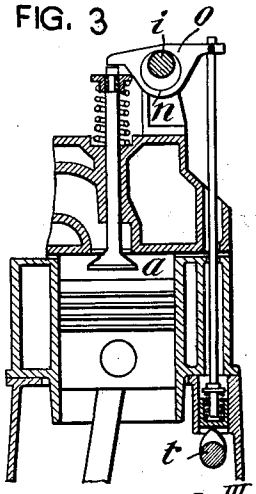


FIG. 4

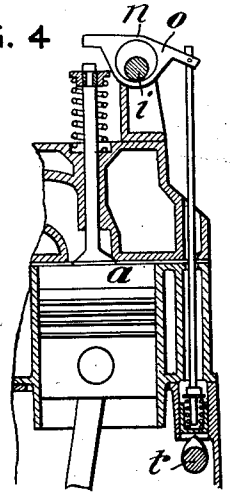
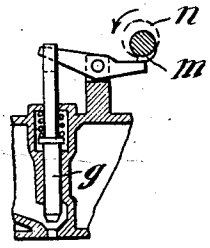


FIG. 5



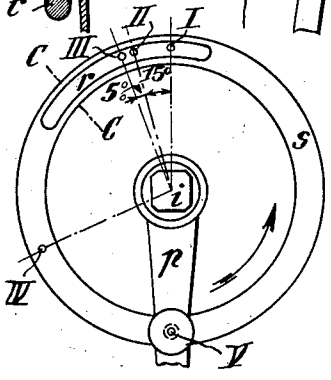


FIG. 7

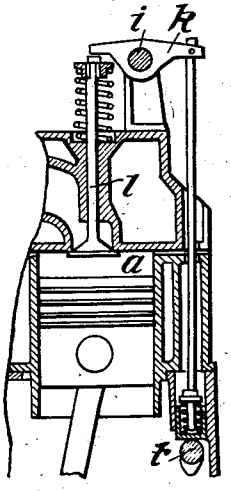


FIG. 6

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DIESEL ENGINE

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Application February 20, 1934, Serial No. 712,185
In Germany March 12, 1932

4 Claims. (Cl. 123—182)

The present invention relates to an arrangement and process for starting Diesel engines, more particularly Diesel engines used for working tugs, fishing boats or the like, that is to say engines in which strong construction and great simplicity are of importance.

The present arrangement and the present starting process make it possible to start the Diesel engines in an easy and convenient manner by hand from cold even in cold weather if desired, or by means of a small starting motor of any desired kind.

It has been found that it is impossible to change over directly the working process from the starting during which the engine works as an ordinary explosion engine, to the working as a Diesel engine.

With the hitherto known method of changing over it is impossible to avoid immediately after the changing over, the presence of petrol in the cylinder chamber, and this results in heavy petrol explosions in the cylinder, injurious to the working, as immediately after the changing over, a high compression is produced and the engine acts as a Diesel engine.

The object of the present invention is to eliminate these drawbacks.

The complete or nearly complete elimination of petrol from the cylinder at the moment of the first high compression is obtained by the following means:

The connection valve between the main compression chamber and the additional compression chamber, which is open during the first starting period, in which the engine works as an ordinary explosion engine, is closed, the admission valve proper of the engine is closed too and is not working.

The two valves mentioned remain thereupon closed for a certain period of time. The result of this is that during the suction period there is produced in the cylinder a more or less high vacuum whereupon a correspondingly smaller compression takes place during the compression period. At the third half revolution (in normal state this would be the combustion period), a certain vacuum is produced again at the end of the stroke whereupon, after the opening of the exhaust valve which always takes place in the normal manner, air flows back from the silencer and is immediately expelled again. In this way a washing or scavenging of the cylinder takes place in as far as the processes described extend over one or more revolutions. The petrol disappears therefore from the cylinder.

Only now the control of the admission valve proper is released, and the engine works as a Diesel engine.

In order to obtain the action described, it is therefore necessary to make an arrangement which would ensure that a certain time will pass after the closing of the valve between the compression chamber proper and the additional compression chamber, before it is possible to open the admission valve and to allow its control to become effective.

The whole process together with the corresponding arrangements is particularly suitable also for medium pressure engines (in combination with a heat accumulator near the fuel nozzle) as according to the present process the engine is pre-heated so that ignition of the Diesel driving medium is produced at relatively lower degrees of compression.

In the accompanying drawing:

Fig. 1 is a vertical section through the cylinder.

Fig. 2 a plan of Figure 1.

Fig. 3 a section on line A—A of Figure 2. Cylinder and admission valve during the Diesel working.

Fig. 4 the same as Figure 3, but in the starting position.

Fig. 5 is a part of Fig. 1. The change-over valve is in the starting position.

Fig. 6 is a section on line B—B of Fig. 2. Cylinder and exhaust valve.

Fig. 7 the change-over crank handle.

In the drawing, *a* is the chamber or space above the piston, *b* the compression chamber proper, *c* the fuel nozzle, *d* the additional compression chamber, *e* the valve drawing in the mixture, through which a mixture of petrol and air can get to *d*, *f* a sparking plug which is preferably actuated by a magneto apparatus, the armature of which is moved jerkily in a manner well known in itself when the number of revolutions is low, in order to provide sufficient ignition current.

g is the change-over valve which shuts off the compression chamber *a* and *b* from the auxiliary compression chamber *d*. The valve *g* is applied to its seat by a spring, *h* is a two-armed lever, *i* a shaft which is turned by hand only during the changing over from the starting to the Diesel period and is prevented from rotating both during the starting period and during the Diesel working period. In each position of this shaft it forms the axis of rotation for the lever of the exhaust valve. With the use of an eccentric

however it forms also the axis of rotation of the lever of the admission valve.

k is the lever of the exhaust valve and *l* the exhaust valve. The control of the exhaust valve is unmodified during the starting, during the Diesel working as well as during the time provided according to the invention between the two workings.

m is a cam on the shaft *i* which raises the valve *g* on a corresponding turning of *i*. *n* is an eccentric rigidly secured to the shaft *i*, which forms the pivot point of the admission lever. *o* is the admission valve lever. *p* a crank handle operated by hand which in the drawing is moved in the anti-clockwise direction (see also Figure 7). The crank handle *p* is rigidly secured to the shaft *i*.

q is (for instance) a handle with a corresponding pin which is pressed by a spring against a ring, *s* the said ring which is fixed relatively to the cylinder head, *r* a recess in the ring *s* which extends over a given angle, (see the following explanation), *t* the cam for the exhaust valve, *u* a heat accumulator in the chamber *b* which is required if the engine is run as a medium pressure engine.

The working of the arrangement is as follows:—

During the starting the crank *p* is in the position I. The cam *m* is then in the position indicated in Figure 5, it raises the valve *g* and releases the connection between *d*, *a* and *b*.

The engine works then as a four-stroke petrol engine, the admission valve proper (compare Figure 4) remaining closed.

When the crank *p* is in position I of Figure 7, the eccentric *n* is turned upwards, and even with the admission cam *t* in the highest position, the valve lever *o* cannot touch the admission valve so that the latter always remains closed under the action of the spring.

In this starting position, the pin of the button *q* engages with the groove *r*.

The change over to the Diesel process takes place as follows:

After the crank has reached the position II, the lever *h* (compare Figure 5) springs off from the cam *m*.

In the position III, the valve *g* is completely closed (Figure 1) but also the admission valve of the engine still remains completely closed (Figure 4) in view of a corresponding dimensioning of the eccentric *n*. Between the positions III and IV in Figure 7, the control of the admission valve gradually begins to become operative.

Without the provision of the recess *r* or of a corresponding other arrangement, the engine could be changed over almost instantaneously from the starting position to the working position. This would result in explosions of the petrol still contained in the cylinder chamber.

But the pin connected to the handle *q* (Figure 2) is in the groove *r* (Figure 7) already before the position I is reached and if desired even earlier. The groove ends at an angle at which the eccentric *n* is still in such a position that the lever *o* does not yet open the admission valve at any point. The crank *p* cannot be at first turned beyond this angle.

In order to make possible a further turning of the crank *p*, the operator who wants to start the engine working, must for instance release *p*, then pull out the button *q* so that it shall no longer engage with the groove *r*, and only then will he be able to bring the crank *p* quickly to the position V.

This results in an intended loss of time.

In as far as the above mentioned time-wasting manipulations last for instance only one second, and in as far as the engine makes in starting at the moment of changing over say 420 revolutions per minute, all the petrol traces will be washed out of the cylinder during the time lost by seven revolutions of the engine.

If this loss of time is considered too large, the handle of the crank *p* and the button *q* could be made to coincide.

The whole starting arrangement offers particular advantages in combination with medium pressure engine. As is well known, the latter are characterized in that their compression is always sufficiently strong to enable them to work in warm state (preferably in combination with the heat accumulator *u*) (Figure 1) on the Diesel principle, whilst the compression is not so great as to enable the engine to start in a reliable manner from cold with cold atmospheric air.

The starting device such as it is here described pre-heats the engine in a manner well known in itself, and enables it to work on the Diesel principle with a weaker compression:

At the same time however the general arrangement hereinbefore described which eliminates the petrol from the cylinder, becomes of particular importance, for the advantage of being able to build the engine lighter since it has to withstand only medium pressures would disappear if it had to be built strong enough to be able to withstand the heavy initial petrol explosions.

I claim:

1. In a Diesel engine, the combination of a main compression chamber, an admission valve, an exhaust valve and actuating mechanism for said exhaust valve with an additional compression chamber in communication with the main compression chamber and having a supply inlet for admitting a starting fuel, a change-over valve for closing the communication between the main and additional compression chambers, operating means for moving the change-over valve into and out of the closing position and actuating mechanism for the admission valve including an actuating member adjustable from an operative position to an inoperative position and adjusting means for said actuating member operatively connected to the operating means for the change-over valve for moving the said actuating member into the inoperative position on the change-over valve being moved into the open position and into the operative position after the change-over valve has been moved into the closing position, so as to prevent the admission valve opening while the main and additional compression chambers are in communication with one another.

2. In a Diesel engine, the combination of a main compression chamber, an admission valve, an exhaust valve and actuating mechanism for said exhaust valve with an additional compression chamber in communication with the main compression chamber and having a supply inlet for admitting a starting fuel, a change-over valve for closing the communication between the main and additional compression chambers, operating means for moving the change-over valve into and out of the closing position and actuating mechanism for the admission valve, including an actuating member adjustable from an operative

position to an inoperative position and adjusting means for said actuating member operatively connected to the operating means for the change-over valve for moving the said actuating member into the inoperative position on the change-over valve being moved into the open position, said adjusting means being arranged to move the actuating member into the operative position after the change-over valve has been moved into the closing position, and checking means for retarding the movement of the adjusting means beyond the closing position of the change-over valve so as to enable the engine to perform a number of idle strokes with the admission valve closed.

3. In a Diesel engine, the combination of a main compression chamber, an admission valve, an exhaust valve and actuating mechanism for said exhaust valve with an additional compression chamber in communication with the main compression chamber and having a supply inlet for admitting a starting fuel, a change-over valve for closing the communication between the main and additional compression chambers, operating means for moving the change-over valve into and out of the closing position and actuating mechanism for the admission valve, including a valve lever, an eccentric pivot for said valve lever turnable from an angular position in which the valve lever is in operative relationship with the valve to an angular position in which the valve lever is out of operative relationship with the valve, a control shaft fixed to said eccentric pivot and operatively connected to the operating means for the change-over valve so as to bring the valve lever out of operative relationship with the valve on the change-over valve being moved into the open position and into operative relationship with the valve after the change-over valve has been moved into the closing position.

4. In a Diesel engine, the combination as set forth in claim 2, in which the operating means for the change-over valve comprises an operating handle and the checking means comprise a positive stop member associated with said operating handle and a fixed stop arranged for cooperation with the movable stop member to arrest the movement of the operating handle when the change-over valve is in the closing position, said movable stop member being movable from a position in which it can engage the fixed stop into a position in which it is incapable of such engagement, whereby the further movement of the operating handle beyond that corresponding to the closing position of the change-over valve is delayed until the movable stop member is moved into the second-mentioned position.

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