K. J. E. HESSELMAN.

MEANS FOR CONTROLLING REVERSIBLE INTERNAL COMBUSTION ENGINES.

APPLICATION FILED APR. 8, 1908.

997,253. **Patented July 4, 1911.**

2 SHEETS—SHEET 1.

Fig. 1.

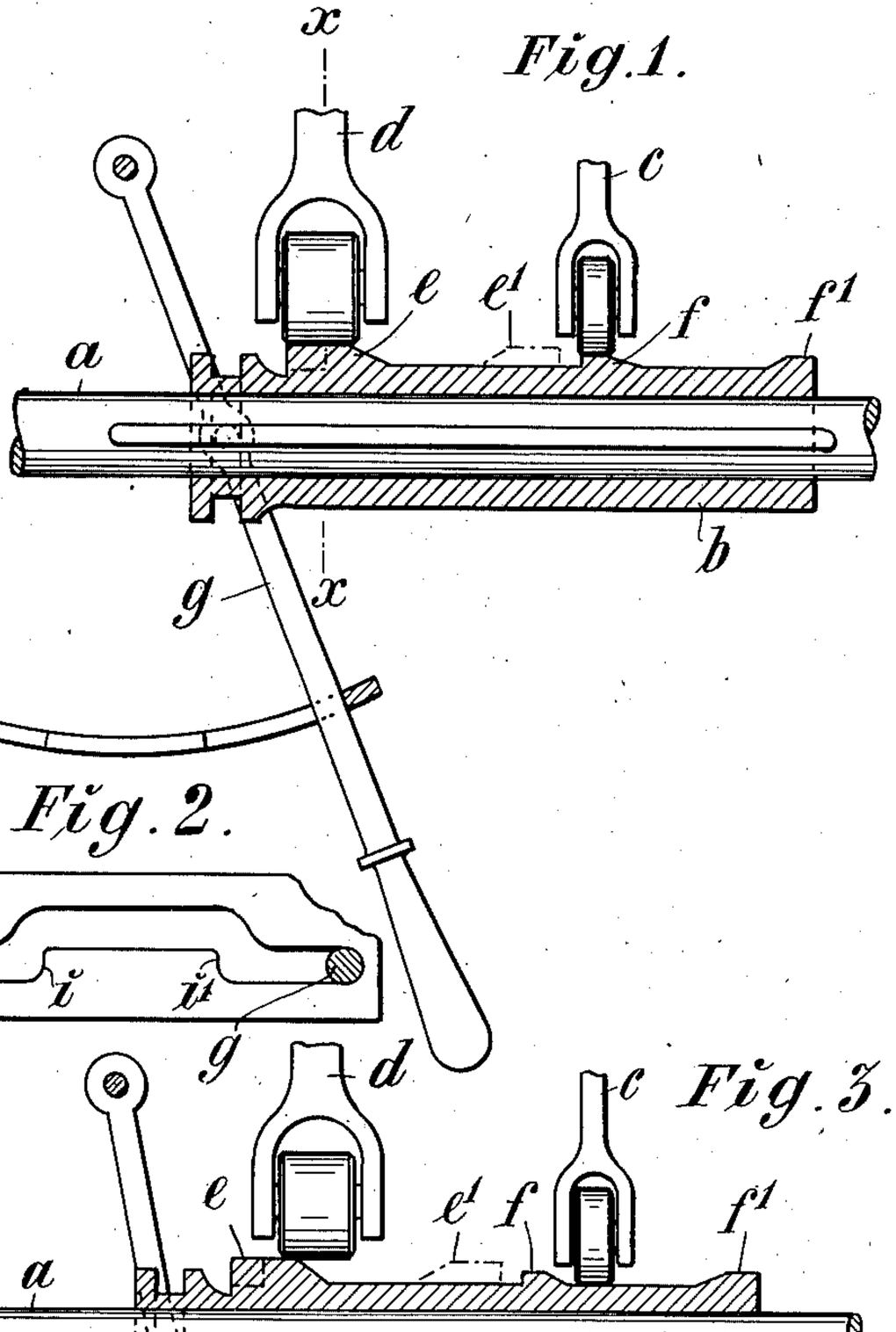


Fig. 1a

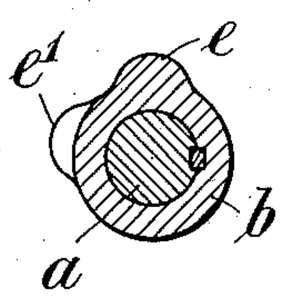
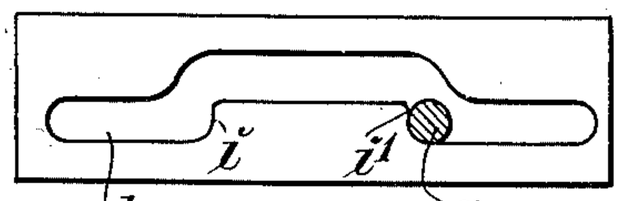


Fig. 2.

Fig. 3.

Fig. 4.



Witnesses

Aug. Lorentzen

Karl Lundkvist

Inventor

Knut J. E. Hesselman

by Munn & Co

Att'ys

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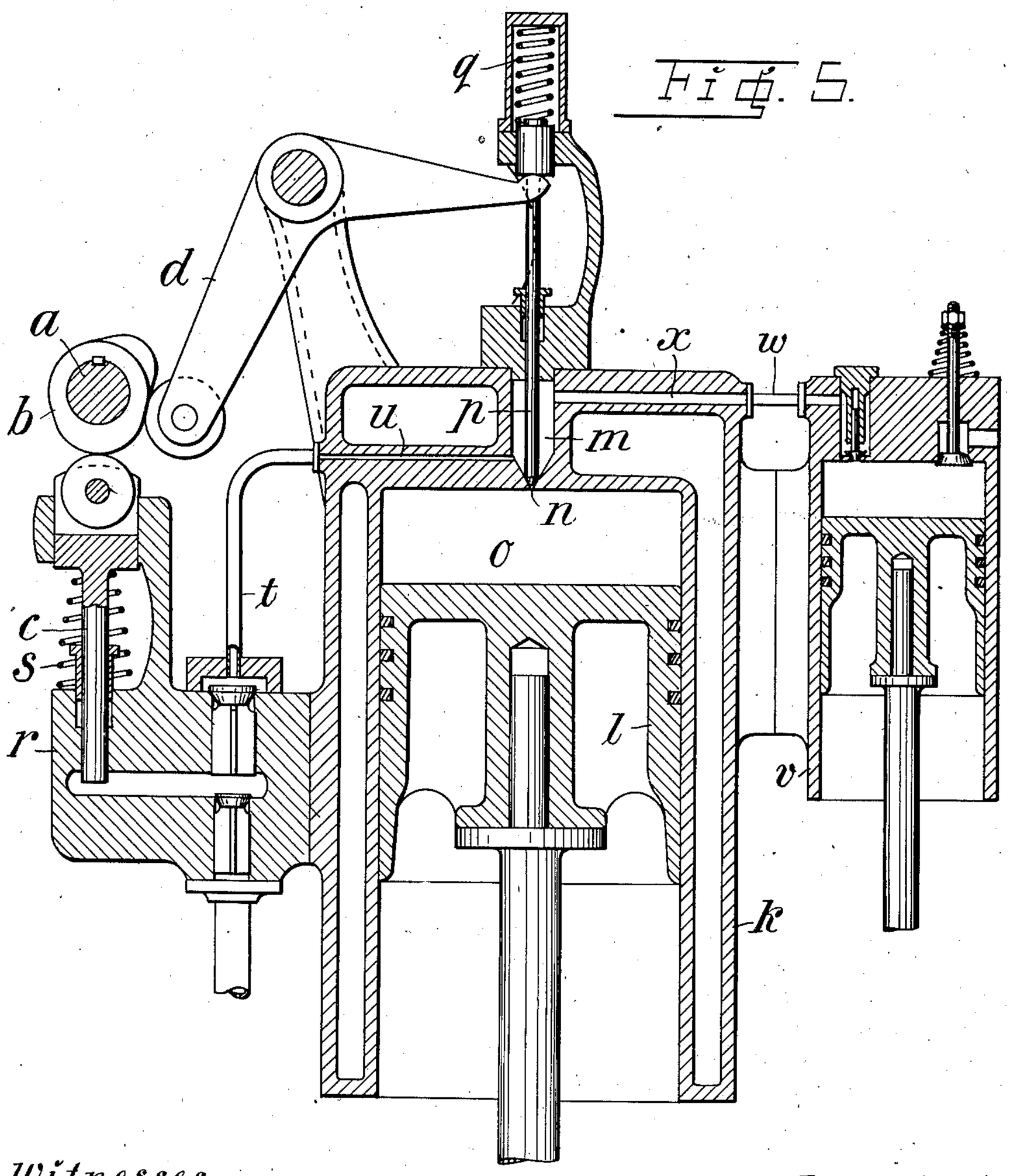
2 SHEETS—SHEET 2.

Fig. 5.



Witnesses

August Löfman

Karl Runeskog

Inventor

Ernst J. E. Hesselman

by Reynolds

his Att'y

UNITED STATES PATENT OFFICE.

KNUT JONAS ELIAS HESSELMAN, OF SICKLA, SWEDEN.

MEANS FOR CONTROLLING REVERSIBLE INTERNAL-COMBUSTION ENGINES.

997,253. Specification of Letters Patent. Patented July 4, 1911.

Application filed April 8, 1908. Serial No. 425,857.

To all whom it may concern:

Be it known that I, KNUT JONAS ELIAS HESSELMAN, a subject of the King of Sweden, and resident of Sickla, in the Kingdom of Sweden, have invented new and useful Improvements in Means for Controlling Reversible Internal-Combustion Engines, of which the following is a specification, reference being had to the drawings accompanying and forming a part hereof.

My invention relates to improvements in means for controlling reversible internal combustion engines.

In internal combustion engines adapted to work in either direction it is of importance that the engine can be reversed without any backward explosions taking place, which, especially if the engine is designed for developing greater power, may have a highly detrimental effect upon the durability of the engine. Attempts have been made to avoid such backward explosions by throwing the fuel pump, or the means supplying fuel, out of action during the time the reversal takes place, so that, even if the engine continues, after the reversing operation has been performed, to make one or more revolutions in the same direction as before, no fuel is, during this time, supplied by the fuel pump. It appears, however, that merely cutting off the supply of fuel, during reversal, is not sufficient, due to the fact that, during the last stroke of the fuel pump, before reversal, a quantity of fuel enters the valve chamber, or the chamber to which the fuel is supplied by the pump, in order to be thereupon introduced, by special means, into the combustion chamber of the engine. When reversal takes place and the fuel supplying means are thrown out of operation in the manner hereinbefore stated, the quantity of fuel thus supplied immediately before reversal remains within the valve chamber, or the corresponding chamber. Thus, if the engine continues, after the reversing operation has been finished, to make one or more revolutions, due to inertia, as is usually the case, the drawback will arise that, when the fuel introducing means continues operating, the quantity of fuel thus remaining in the valve chamber is forced into the combustion chamber at such a time that a counter explosion may take place.

The object of the invention is to remove the said drawback by exhausting the fuel contained within the valve chamber, or the corresponding chamber, during the time the reversing operation is performed, that is before the said operation is completed, so that the said valve chamber, or the corresponding chamber, shall not contain any fuel, when the reversing operation is completed.

The invention consists, chiefly, in such an arrangement of the mechanism controlling the direction of movement of the engine that, when the engine is reversed, the mechanism introducing the fuel contained within the valve chamber, or the corresponding chamber, into the combustion chamber of the engine remains active a sufficiently long time after the mechanism supplying fuel to the valve chamber, or the corresponding chamber, has been thrown out of action, to be able to remove the fuel within the said chamber before the controlling mechanism is again thrown into action. Preferably, the fuel within the valve chamber, or the corresponding chamber, is admitted into the combustion chamber, or the working cylinder of the engine, to be burned, or exhausted through the exhaust valve without being burned, but the removal may be performed otherwise.

In the drawings, Figure 1 is diagrammatical sectional view of a controlling device embodying the invention. Fig. 1ª is a cross-section on line *x*—*x* of Fig. 1, viewed from the left hand side thereof. Fig. 2 is a view of part of the same device in a position at right angles to that of Fig. 1. Figs. 3 and 4 are similar views of the same device with the parts in other positions. Fig. 5 is a sectional view of part of an internal combustion engine controlled by devices according to this invention.

Like reference letters are used to denote similar parts throughout the specification.

Referring to the drawings, *a* is a revoluble shaft having a cam roller *b* slidably mounted thereon, said cam roller being connected to the said shaft in such a manner as to revolve therewith. The shaft *a* may be the shaft of the engine or a separate cam shaft. In Fig. 5 the shaft *a* is supposed to be driven from the shaft of the engine (not shown). The cam roller *b* operates two members *c* and *d* forming part of the controlling mechanism. The member *c* controls the supply of fuel to the valve chamber, or the corresponding chamber of the engine,

and the member *d* attends to the introducing of the fuel supplied to the said chamber into the combustion chamber of the engine. The member *d* is actuated by one or the other of two cams *e*, *e'*, and the member *c* is actuated by one or the other of two cams *f*, *f'*. The cams *e* and *f* are operative during the movement of the engine in one direction (for instance forward) and the cams *e'* and *f'* are operative during the movement of the engine in the opposite direction (backward). As shown in Figs. 1 and 3, the cams *e* and *e'* actuating the member *d* may be broader in the longitudinal direction of the shaft than the cams *f* and *f'* actuating the member *c*, or the cams *e* and *e'* may be so placed relatively to the cams *f* and *f'* that the member *c* is thrown out of action before the member *d* leaves the cam *e* or *e'* respectively. Obviously, the same result will be obtained by making the roller appertaining to the member *d* sufficiently broader than the roller of the member *c*.

Supposing the engine to move in the forward direction, when the cam roller takes up the position shown in Fig. 1, the engine is reversed for backward movement by moving the cam roller *b* toward the left. In the embodiment illustrated this is performed by a lever *g* connected to the said cam roller. During the movement of the said cam roller toward the left the member *c* leaves the cam *f* so that the fuel-supplying pump ceases to work. The member *d*, however, which is actuated by the broader cam *e*, remains upon the said cam and continues to work a short time after the reversing operation has commenced. By this continued working of the member *d* the purpose is gained, *i. e.* the quantity of fuel supplied to the valve chamber, or the corresponding chamber, before the reversing operation commences, is exhausted. When, during the continued movement of the cam roller toward the left, the member *d* leaves the cam *e*, there is no fuel in the valve chamber, or the corresponding chamber, and when the member *d* is, finally, engaged by the cam *e'*, there is no danger of fuel entering the combustion chamber and causing a backward explosion, even if the engine has not ceased to run in the forward direction. When the reversing operation is finished, the members *d* and *c* are on the respective cams *e'* and *f'* in position to work in the normal way, as soon as the engine commences to move in the opposite direction. If the engine is reversed again by the cam roller *b* being moved toward the right, the same course is repeated.

Though the time necessary for the member *d* to continue its operation does not exceed a fraction of a second it is, however, of importance that the said moment is of a sufficient length to cause the remaining quantity of fuel to be completely removed. It is, therefore, suitable to cause the cam roller to stop for a short moment during its longitudinal movement necessary for reversal so that the cam *e* or *e'*, respectively, will continue to act upon the member *d* for a sufficiently long time. In the embodiment illustrated this arresting of the cam-roller is effected by means of a plate, or the like, having a guiding slot *h* for the lever *g*, said guiding slot having, preferably, the form shown in Figs. 2 and 4 of the drawings, in which there are two abutments *i*, *i'*, for the lever *g* each adapted to arrest the lever *g* during its movement in one direction. Thus, when the lever *g* is moved toward the left, from the position indicated in Fig. 2, it strikes the abutment *i'*, which occurs when the cam roller takes up the position shown in Fig. 3 in which the member *c* has left the cam *f* while the member *d* is still actuated by the cam *e*. By the arresting of the lever *g* thus caused by the abutment *i'* the member *d* is actuated by the cam *e* for a sufficiently long time to secure the removal of the quantity of fuel supplied during the last action of the member *c* to the valve chamber, or the corresponding chamber. The arresting of the lever *g* does not constitute any real interruption of the movement of the lever, for by pressing the lever, simultaneously with the turning movement, in a direction at right angles to the slot *h*, it glides over the abutment so that the lever is not stopped for any longer time than that required for the lever to glide along the abutment. In order to allow such a movement of the lever *g*, it may be connected to a spring, or it may be springy itself, or provided with a pivot-joint. By giving the abutment *i* or *i'* a suitable height the arresting of the cam roller can be extended for any desired length of time.

Referring to Fig. 5, *k* is the cylinder of the engine having a piston *l* movable therein. *m* is a valve chamber communicating, through an opening *n*, with the combustion chamber *o*, or the space between the piston and the top of the cylinder. *p* is a valve which is pressed, by a spring *q* or otherwise, against its seat so as to close the connection between the valve chamber and the combustion chamber unless the valve *p* is lifted by the member *d* against the action of the spring *q*. Fuel is supplied to the valve chamber *m* by a fuel pump *r* operated by the member *c* which is pressed, by a spring *s* or otherwise, against the cam roller *b* on the rotating cam shaft *a*. The pump communicates with the valve chamber through a pipe *t* and a passage *u*. When the valve *p* is opened, the fuel enters the combustion chamber, for instance by its own pressure, if a gaseous fuel is used. If a liquid fuel is

used, as is usually the case, the fuel may be forced into the combustion chamber by an air compressor *v* communicating with and furnishing air to the valve chamber through a pipe *w* and a passage *x*.

Having now described my invention, what I claim as new and desire to secure by Letters Patent is:—

1. In an internal combustion engine, the combination with a cylinder, of fuel supplying means therefor, fuel introducing means, and operating means adapted to operate said supplying and introducing means for forward and rearward running and to throw said fuel supplying means out of action previous to said fuel introducing means in changing the operation of said operating means for reverse running.

2. In an internal combustion engine, the combination with a cylinder, of fuel supplying means therefor, fuel introducing means, and operating means for said supplying and introducing means adapted to throw said fuel supplying means out of action previous to said fuel introducing means in reversing the engine.

3. In an internal combustion engine, the combination with a cylinder, of a fuel supply pump, an inlet valve introducing fuel to said cylinder, and operating means adapted to operate said supply pump and inlet valve for forward and rearward running, and to throw said fuel supplying means out of action previous to said fuel introducing means in changing for reverse running.

4. In an internal combustion engine, the combination with a cylinder, of a fuel supply pump, an inlet valve introducing fuel to said cylinder, and operating means comprising cams adapted to operate said supply pump and inlet valve for forward and rearward running, and disposed relatively to successively throw said supply pump and inlet valve out of action and to throw said supply pump out of action previous to said inlet valve in changing for reverse running.

5. In an internal combustion engine, the combination with a cylinder, of a fuel cylinder, and operating means comprising a shaft having cams thereon adapted to operate said supply pump and inlet valve for forward and rearward running, and disposed relatively to successively throw said supply pump and inlet valve out of action, and to throw said supply pump out of action previous to said inlet valve in changing for reverse running.

6. In an internal combustion engine, the combination with a cylinder, of a fuel supply pump, an inlet valve introducing fuel to said cylinder, operating means comprising cams adapted to operate said supply pump and inlet valve for forward and rearward running and disposed relatively to successively throw said supply pump and inlet valve out of action, and to throw said supply pump out of action previous to said inlet valve in changing for reverse running, and means for retarding the change of said operating means.

7. In an internal combustion engine, the combination with a cylinder of a supply pump, an inlet valve introducing fuel to said cylinder, a cam-actuated member connected to said supply pump and inlet valve, operating means comprising cams adapted to operate said cam-actuated members for forward and rearward running, said sets of cams being located a less distance apart than the distance between said cam-actuated members, whereby said supply pump will be thrown out of action before said valve in changing for reverse running.

8. In an internal combustion engine the combination with the engine cylinder, of a valve chamber adapted to be supplied with fuel, a pump for supplying fuel to the said chamber, means for controlling the connection between the said chamber and the combustion chamber of the engine, a longitudinally shiftable cam roller having operating cams for the said fuel supplying pump and connection controlling means arranged relatively to the same in such a manner that, when the said cam roller is shifted for reversing the engine, the fuel supplying pump will be thrown out of action before the connection controlling means is thrown out of action, a lever for shifting the said cam roller, and abutments for the said shifting lever placed in such positions that the said lever will be arrested, during movement in either direction, in a position in which the fuel supplying pump is out of action, while the connection controlling means are still in action.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

KNUT JONAS ELIAS HESSELMAN.

Witnesses:
KARL RUNESKOG.
AUGUST SÖRENSEN.