July 17, 1934. E. C. RASSBACH ET AL 1,967,101

FUEL FEED MECHANISM

Filed Aug. 29, 1929

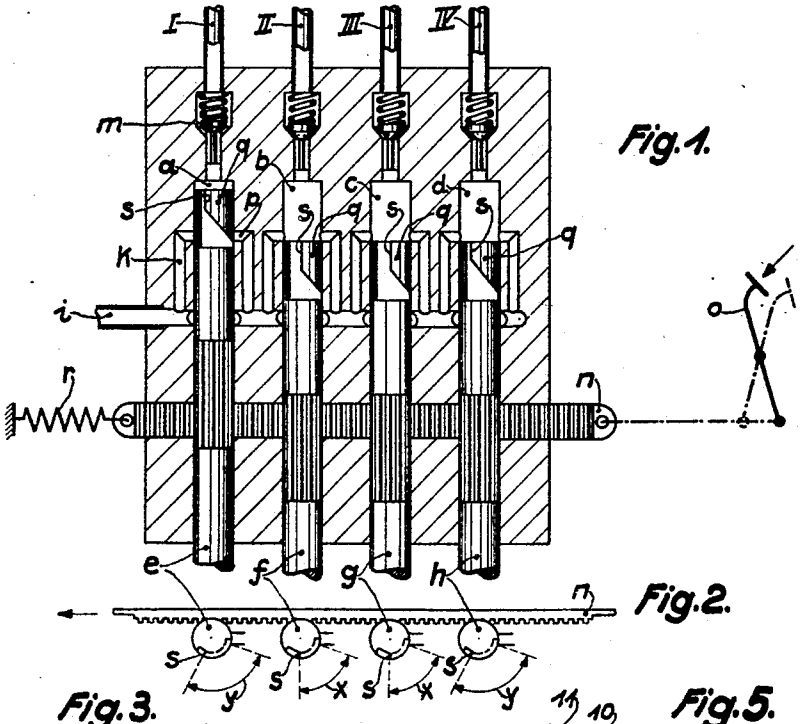


Fig. 1.

Fig. 2.

Fig. 3.

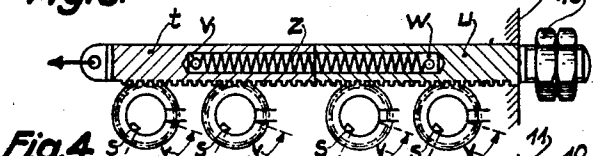


Fig. 4.

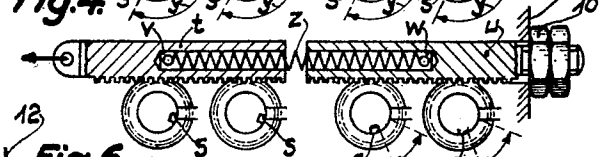


Fig. 5.



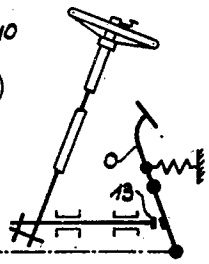
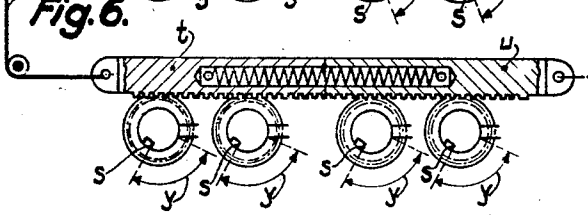


Fig. 6.



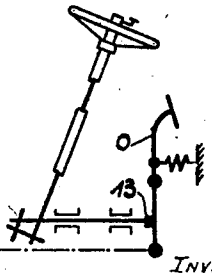
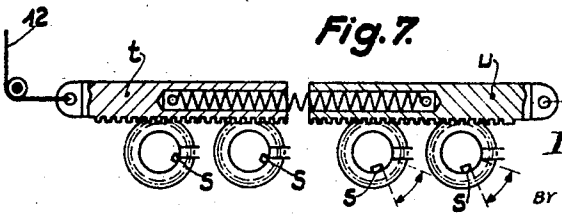


Fig. 7.



INVENTORS
Erich C. Rassbach
Ottmar Baur,
BY Stewart & McKay
ATTORNEYS.

Patented July 17, 1934 1,967,101

UNITED STATES PATENT OFFICE

1,967,101

FUEL FEED MECHANISM

Erich Carl Rassbach and Ottmar Baur, Stuttgart, Germany, assignors to Robert Bosch Aktiengesellschaft, Stuttgart, Germany

Application August 29, 1929, Serial No. 389,247
In Germany August 31, 1928

12 Claims. (Cl. 103—41)

The present invention relates to fuel feed mechanism for multi-cylinder internal combustion engines, particularly for the engines of motor vehicles in which the delivery of individual fuel pumps to the respective cylinders of an engine can be cut off in succession or in groups when the load is light or when the engine is running free so that fuel is only injected into some of the engine cylinders. This cutting off of individual cylinders of an engine has the well known advantage that the cylinders still working must be correspondingly more heavily loaded, thereby allowing un-interrupted running of these cylinders under a light load or on running free.

In the known fuel feed mechanism of the type described, the individual pumps are cut off by control members actuated arbitrarily, for instance by cams which retain an overflow valve open for the duration of the compression stroke or by reversible cocks which in one position allow the fuel delivered to flow to the engine cylinders but in another position return it to the suction chamber.

Control members of this type for cutting off the supply of fuel to certain cylinders of an engine can be avoided according to the present invention by the provision of control means common to all the fuel pumps of an engine.

Three forms of construction of the invention are shown in the accompanying drawing in which:—

Figure 1 is a longitudinal section through one form of construction of a four-cylinder fuel pump. In the position shown the pump is supplying its maximum delivery.

Figure 2 is a plan view of the four pump pistons of the pump shown in Figure 1.

Figure 3 shows in plan view a second form of construction, again of a four-cylinder fuel pump, the elements being in their position of maximum delivery as in Figure 1.

Figure 4 shows the elements shown in Figure 3 in position when the engine is running free.

Figure 5 is an end view of the common regulating member.

Figure 6 is a similar view to Figure 3 of a third form of construction, also of a four-cylinder fuel pump, the elements being again shown in their position of full delivery.

Figure 7 shows the elements shown in Figure 6 in their position when the engine is running free.

Pump pistons *e*, *f*, *g*, *h*, reciprocate in four cylinders *a*, *b*, *c*, *d* of a pump shown in Figure 1 and thereby feed fuel sucked out of a common suction pipe *i* through a branch pipe *k*, and through pressure valves *m* into delivery pipes I, II, III, IV leading to the engine cylinders. The quantity of fuel supplied to the delivery pipes on each delivery stroke is regulated by a rack rod *n* mounted in the pump housing which meshes with teeth on each pump piston so that on moving the rack coupled through a connecting rod with a pedal *o* the pump pistons are rotated; thereby rotating the inclined undercut faces *q* provided thereon which control the opening of return ducts *p*. The height of a control face sliding over a return duct *p* varies on rotation of the piston and the quantity of fuel supplied to the corresponding delivery pipe varies in proportion.

A tension spring *r* anchored to the rod *n* tends to return the rod into the free running position against the action of pressure exerted on the pedal *o*.

The inclined undercut control faces are adjusted with regard to their respective return ducts so that the effective delivery of all the pump cylinders on returning the regulating rod from full delivery position at first decreases absolutely uniformly in all the pump cylinders. The control faces *q* on the pistons *f* and *g* associated with the compression pipes leading to the engine cylinders II and III, measured on the curve are shorter than the controlling faces of the pistons *e* and *h*. The angle *x* through which the pistons *f* and *g* have to be turned back from the full load position in order to position the vertical end faces *s* of the controlling faces *q* opposite the return ducts *p* is smaller than the angle *y* through which the two pistons *e* and *h* must be rotated in order to attain the same result. If therefore the pistons are turned back from the full load position through the angle *x* the two central pump cylinders *b* and *c* are cut off on further return movement and only the two outer cylinders *a* and *d* deliver fuel to their respective engine cylinders. The effective delivery of the cylinders *a* and *d* after cutting off the two cylinders *b* and *c* is such that it is sufficient to maintain reliable uninterrupted free running of the two corresponding engine cylinders.

The second form of construction shown in Figures 3–5 differs from the first form chiefly in the control faces of the pump pistons not being different as in the first example but being absolutely similar to one another and in the regulating rod instead consisting of two co-axial portions *t* and *u* whilst in the former case the regu-

lating rod is made in one piece. A tension spring *z* is inserted in longitudinal borings *v* and *w* provided in the opposite ends of the portions of the rod. Each end of the spring is anchored to one of the portions *t* and *u*.

If the rod is displaced from the full delivery position shown in Figure 3, the delivery of all the four pump cylinders is uniformly decreased until further movement of the portion *u* of the rod is stopped, when the stop 10 mounted on its end bears against a stationary stop 11. The force acting on the control rod can now only displace the portion *t* of the rod whereupon the tension spring *z*, the tension of which is so adjusted that it does not yield until contact takes place between the stops 10 and 11, is extended (Fig. 4). Finally the pistons *e* and *f* controlled by the portion *t* of the control rod are rotated further than the pistons *g* and *h* by an amount such that the end faces *s* of their control faces uncover the return ducts. After this, the pump cylinders *a* and *b*, with which the pump pistons *e* and *f* are associated, supply no fuel to their compression pipes and the fuel supply to the corresponding engine cylinders is thus cut off.

In order to ensure un-interrupted free running of the two engine cylinders fed from the pump cylinders *c* and *d*, the stop 10 must bear against the stop 11 when the delivery of the two pump cylinders *c* and *d* controlled by the portion *u* of the rod, and which cannot be decreased any further, is still sufficient for free running of these engine cylinders. The stop 10 is adjustable in order to allow of regulation of this limit.

In the third form of construction shown in Figs. 6 and 7 the control rod is constructed exactly as in the second example but the stop 10 is omitted and the displacement force here acts on the portion *u* of the control rod. A cable 12 actuated at will from the driver's seat is secured to the free end of the portion *t* of the rod.

The control rod can be returned from the full delivery position shown in Figure 6 by releasing the pedal *o* until all the pump pistons are rotated so that they all cease delivering, the control rod being then in the stop position. The return movement of the control rod can however be limited by means of a stop 13, movable from the steering wheel so that it cannot return completely into the stop position.

If the engine is to run free or under a light load for a long period the portion *t* of the control rod can be drawn by means of the cable 12 into the position shown in Figure 7 in which the pump cylinders *a* and *b* deliver no fuel. The corresponding engine cylinders are then cut off and the engine continues to run, only being driven however by the other two cylinders corresponding to pump pistons *g* and *h*. In order to prevent the portion *u* of the control rod returning too far and the quantity of fuel being too small for the two engine cylinders still working alone the stop 13 actuated from the steering wheel must be suitably positioned.

The invention is applicable not only to pumps of the type described in which the pump pistons themselves regulate the return of the fuel but also to pumps with any other type of regulation of the delivery which can be used for fuel pumps.

What we claim is:

1. Fuel feeding mechanism for multi-cylinder internal combustion engines comprising a plurality of fuel pumps individually associated with the engine cylinders, means in each pump for regulating the amount of fuel delivery, and common operating means for said fuel regulating means, said regulating and operating means being arranged to provide substantially equal fuel delivery from each of the pumps at all loads between full load and light load and to cut off the fuel delivery of certain of said pumps in the light-load range of adjustment of said operating means.

2. Fuel feeding mechanism for multi-cylinder internal combustion engines comprising a plurality of fuel pumps individually associated with the engine cylinders, means in each pump for regulating the amount of fuel delivery, common means for operating said fuel regulating means, operating connections between said regulating means and said common operating means, said regulating and operating means being arranged to provide substantially equal fuel delivery from each of the pumps at all loads between full load and light load and certain of said fuel regulating means and their operating connections being arranged to cut off the fuel delivery of their respective pumps while the remaining pumps continue to deliver fuel for light loads.

3. Fuel feed mechanism for mutli-cylinder internal combustion engines comprising a plurality of fuel pumps, a control member formed of at least two resiliently connected portions each of which portions is operatively associated with certain of said pumps, actuating means for moving said control member to regulate the delivery of said pumps to the respective cylinders of an engine and stop means for limiting the movement of at least one of said portions in the cut off direction.

4. Fuel feed mechanism for multi-cylinder internal combustion engines comprising a plurality of fuel pumps, a control member formed of at least two portions each of which portions is operatively associated with certain of said pumps, resilient connecting means intermediate of said portions, actuating means for moving said control member to regulate the delivery of said pumps to the respective cylinders of an engine and separate actuating means for at least one of said portions.

5. Fuel feed mechanism for multi-cylinder internal combustion engines comprising a plurality of fuel pumps, a control member formed of at least two portions each of which portions is operatively associated with certain of said pumps, resilient connecting means intermediate of said portions, actuating means for moving said control member to regulate the delivery of said pumps to the respective cylinders of an engine, stop means for limiting the movement of at least one of said portions in the cut off direction and separate actuating means for at least one other of said portions.

6. Fuel feed mechanism for muti-cylinder internal combustion engines comprising a plurality of fuel pumps, a control member formed of at least two portions at least two of which have axial borings in the adjacent ends thereof, each of which portions is operatively associated with certain of said pumps, a connecting spring intermediate of said portions and housed in said borings, actuating means for moving the control member and stop means for limiting the movement of at least one of said portions in the cut off direction.

7. Fuel feeding mechanism for multi-cylinder internal combustion engines comprising a plurality of fuel pumps individually associated with the engine cylinders, fuel control means for each pump comprising a movable member having a

range of movement for uniformly controlling the amount of fuel delivery and a range of movement of no-fuel delivery, said control means having the same total range of movement, but certain of said means having a wider control range than other of said means, and common means for operating said fuel control means together and in the same direction, whereby the fuel delivery of certain pumps are cut off at a point in the movement of said common operating means still within the control range of movement of the remaining pumps.

8. Fuel feeding mechanism for multi-cylinder internal combustion engines comprising a plurality of fuel pumps individually associated with the engine cylinders, fuel control means for each pump comprising a duct formed in the surface of the pump piston having an inclined wall face cooperating with a return duct formed in the pump cylinder around said piston, said pump pistons being rotatable to vary the point at which said return duct becomes effective, the effective control inclined faces of certain of said pump pistons being shorter than the inclined faces of the remaining pump pistons, and a common means for rotating said pistons simultaneously and in the same direction, whereby the fuel delivery of the pumps having the shorter control faces are cut-off at a point in the movement of said common operating means still within the control range of movement of the remaining pumps.

9. Fuel feeding mechanism for multi-cylinder internal combustion engines comprising a plurality of fuel pumps individually associated with the engine cylinders, means in each pump for controlling the amount of fuel delivery, and common means for operating said control means operable from full-load to no-load position, said common operating means comprising two parts each controlling the fuel control means of certain pumps, and means for moving both parts from full-load position towards no-load position for uniformly reducing the fuel supply of all pumps, and means for arresting the movement of one of said parts at a point intermediate full-load and no-load to prevent the further reduction in fuel delivery of the pumps controlled thereby while permitting the other part to be further shifted towards no-load position to reduce and finally cut-off fuel delivery of the pumps controlled by said second part.

10. A fuel feeding mechanism as claimed in claim 9 wherein the two parts of the common operating means are connected by a spring which tends to force said parts together, and in which one of said parts elements is drawn by the other through said spring, said spring being adjusted to have a tension greater than the force required for regulating the fuel control means operated by the part which is drawn by said spring.

11. A fuel feeding mechanism according to claim 9, wherein the common operating means is enclosed within the pump housing, and the two parts of said common operating means are joined together by a spring arranged in aligned holes formed in the abutting ends of said parts, said spring tending to force said parts together and having a tension greater than the force required for regulating the fuel control means associated with either of said parts.

12. In a vehicle, the combination of a crude oil engine of the multi-cylinder type, a fuel pump for supplying fuel to the cylinders, and a regulating mechanism for said fuel pump comprising two spring-connected movable elements, operative at times to regulate a section of said pump, and means for limiting the stroke of one of said elements in a position in which the associated part of the pump supplies the corresponding cylinders with sufficient fuel to keep the engine idling, and means for shifting the other of said elements to a position in which the supply of fuel from the other pump section associated therewith, to the corresponding other cylinders, is interrupted.

ERICH CARL RASSBACH.
OTTMAR BAUR.