United States Patent

[11] 3,601,109

[72] Inventors **James S. Barton Morton; Robert B. Bunting, Peoria Heights; Richard A. DeKeyser, Peoria; Marion R. Joy, Peoria; Dennis M. Ruttle, East Peoria, all of, Ill.**

[21] Appl. No. **836,413**
[22] Filed **June 25, 1969**
[45] Patented **Aug. 24, 1971**
[73] Assignee **Caterpillar Tractor Co. Peoria, Ill.**

[54] **ENGINE FUEL PUMP TIMING MECHANISM**
7 Claims, 2 Drawing Figs.

[52] **U.S. Cl.** ..... **123/139 AP, 64/25**
[51] **Int. Cl.** **F02m 59/20**
[50] **Field of Search** 123/139, 139.3, 139.13; 64/25

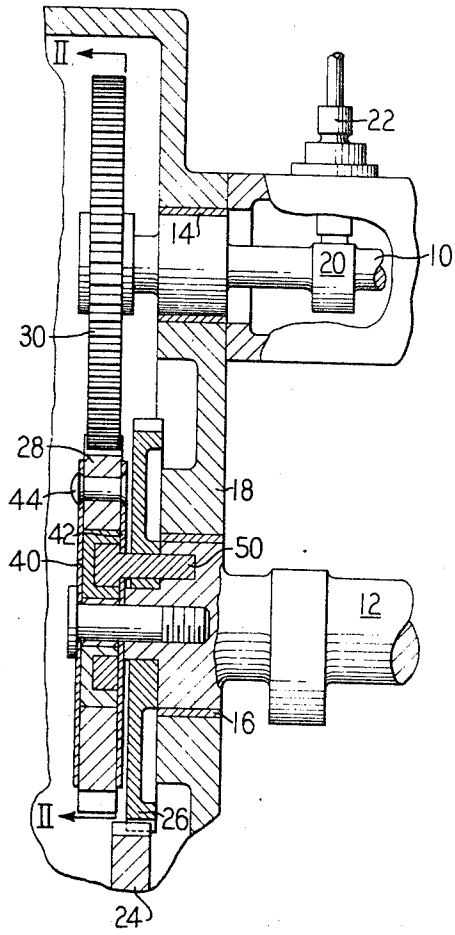
[56] **References Cited**

UNITED STATES PATENTS

2,488,361	11/1949	Witsky et al.	123/139.13
2,858,683	11/1958	Szlaga	64/25
2,977,778	4/1961	Backlund et al.	64/25
3,455,286	7/1969	Reisacher et al.	123/139.13

Primary Examiner—Laurence M. Goodridge
Attorney—Fryer, Tjensvold, Feix, Phillips & Lempio

ABSTRACT: Timing mechanism for adjusting the angular disposition of an engine fuel pump cam shaft in response to changes in engine speed which comprises flyweight means to adjust the angular relationship of two rotating elements. In the present case, these elements are not coaxial with the fuel pump cam shaft, but one is connected thereto by a gear train to isolate the flyweight means from shock or impulse forces which are transferred through the cam shaft and to increase inertia without undue increase in mass and complexity.



PATENTED AUG 24 1971

3,601,109

SHEET 1 OF 2

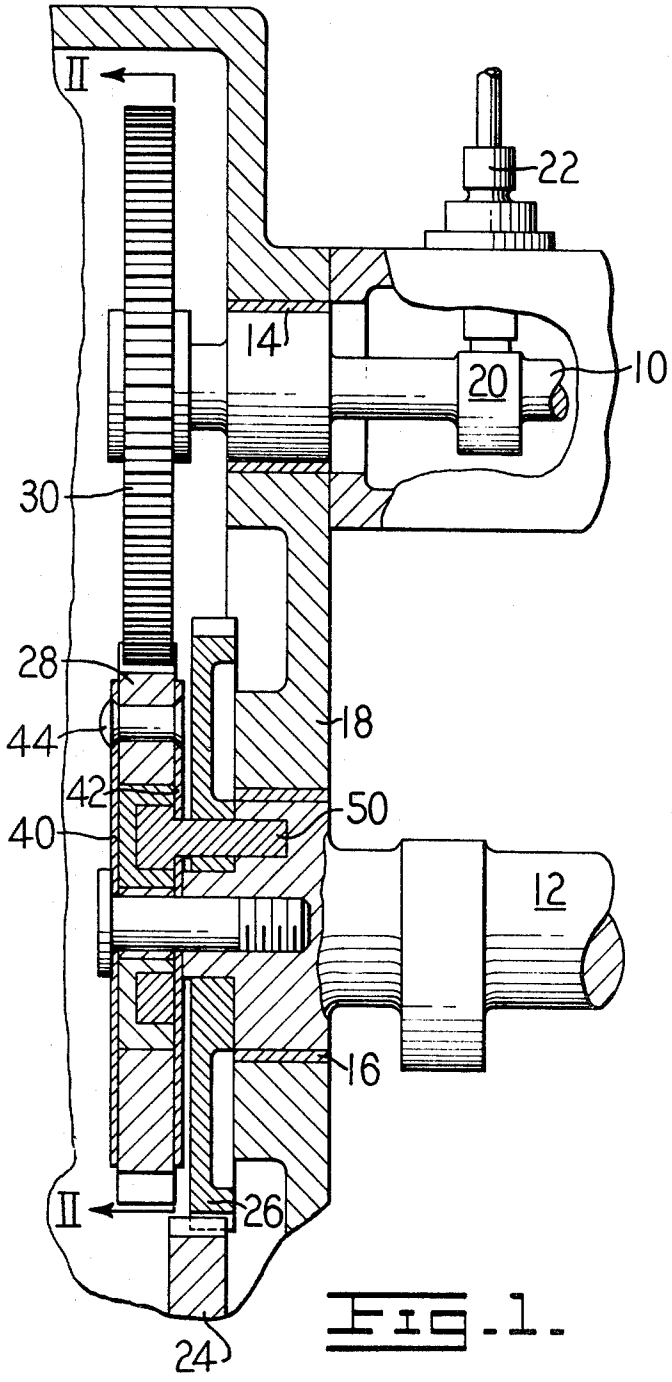


Fig. 1.

INVENTORS
JAMES S. BARTON
ROBERT B. BUNTING
RICHARD A. DeKEYSER
MARION R. JOY
DENNIS M. RUTTLE

BY

Fryer, Tjensvold, Feix, Phillips & Lempio
ATTORNEYS

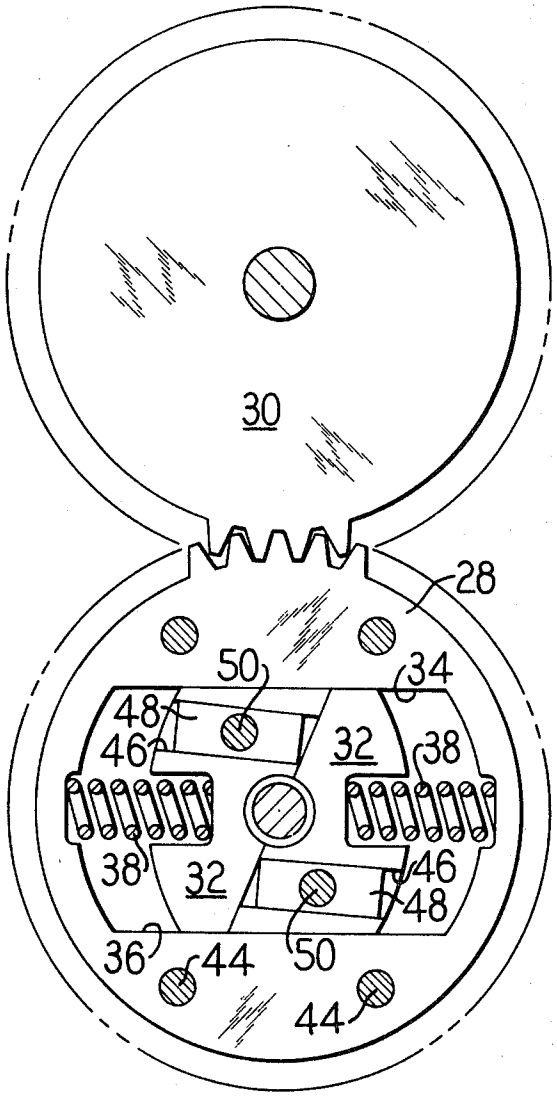


Fig-2.

INVENTORS
JAMES S. BARTON
ROBERT B. BUNTING
RICHARD A. DeKEYSER
MARION R. JOY
DENNIS M. RUTTLE

BY
Fryer, Tjensvold, Feit, Phillips & Lempio
ATTORNEYS

ENGINE FUEL PUMP TIMING MECHANISM

It is known that the efficiency and economy of an internal combustion engine depends upon the time of firing with relation to crankshaft position and that it is desirable to vary this time as the speed of operation of the engine varies. Devices for automatically varying the time of firing, or the time of injection in a compression ignition-type engine, are known and usually comprise a system for connecting two shafts including weights adapted to move away from each other under the influence of centrifugal force and against an opposing resilient action. The angular relationship between the two shafts phase position is modified in response to movement of the weights. Such a timing device is disclosed in our Assignee's U.S. Pat. to Backlund, et al. for Automatic Timing Device for Engines, No. 2,977,778. The timing device disclosed in said patent, like most such devices, is disposed coaxially with the fuel pump camshaft and, while this design is generally used, it presents some disadvantages.

The camshaft which actuates fuel pumps is subjected to impulse forces to which it is exposed during the pumping stroke and these forces are transmitted to the timing device as shock loads. The sudden loading of the timing mechanism causes a decelerating effect for each pumping stroke. At the termination of the impulse force, the fuel pump cam and timing mechanism accelerate, creating a rapid oscillating motion in the timing mechanism. This motion causes erratic injection of fuel resulting in high levels of smoke in the engine exhaust. Some timing mechanisms are designed to avoid this problem by utilizing fluid damping. This has been successful but adds to the complexity of the timing mechanism because of the requirement for fluid passages and sealing means. The effect of impulses may be overcome by the addition of weight to increase inertia but this adds mass in areas where it is undesirable and costly.

The present invention overcomes the undesirable effect of the impulse forces transferred through the pump camshaft to the timing mechanism by disassociating the timing mechanism from the pump camshaft and providing a gear train between the timing mechanism and the fuel pump cam shaft. In the present instance, the timing mechanism is arranged coaxially with the main engine camshaft. It is disposed centrally of a gear which it adjusts and which meshes with a gear on the fuel pump camshaft. The invention will be best understood by reading the following specification wherein it is described in greater detail by reference to the accompanying drawings.

In the drawings:

FIG. 1 is a vertical sectional fragmentary view taken through the pump camshaft and the main camshaft by an engine and showing part of the timing gear train including the timing device of the present invention; and

FIG. 2 is a sectional view taken on the line II—II of FIG. 1.

Referring first to FIG. 1 of the drawing, an engine fuel pump camshaft is shown at **10** and the main engine camshaft is shown at **12**. Both camshafts are shown as having one end journaled in bearings **14** and **16** respectively disposed in a wall **18** of the engine block. The fuel camshaft **10** is provided with cams, one of which is shown at **20** which upon rotation actuate fuel pumps, as at **22**, of which there is one for each of the engine cylinders. Both shafts are driven by the timing gear train of the engine a portion of one timing gear being illustrated at **24** as meshing with and driving a gear **26** which is fixed against rotation to the end of the main camshaft **12**.

A gear **28** concentric to the gear **26** is driven thereby through the timing mechanism presently to be described and drives a gear **30** which is fixed to the pump camshaft **10** in driving relationship thereto. Consequently, when the gear **28** is advanced or retarded with respect to the shaft **12**, the angular position of the pump cam shaft **10** is advanced or retarded with respect to rotation of the engine crankshaft. This affects timing of fuel injection which is varied with respect to top dead center position of the engine pistons as a result of adjustment of the angular position of the fuel pump camshaft.

The mechanism which automatically adjusts the position of the gear **28** is best illustrated in FIG. **2** wherein the gear is illustrated as having a central opening housing two flyweights **32**. These flyweights are confined, by parallel walls **34** and **36** of the opening, to radial outward movement in opposite direction and are urged inwardly as by springs **38**. Cover plates best shown at **40** and **42** in FIG. **1** are secured to opposite sides of the gear as by rivets **44**. Each of the flyweights **32** has a slot **46** disposed at an angle to the walls **34** and **36** which slots guide the flyweights as they move outwardly as engine speed increases. Slot **46** contains a sliding shoe **48** with a shank **50** which, as shown in FIG. **1**, extends through the gear **26** and into the end of the shaft **12**. Consequently, as the flyweights move outwardly and away from each other, the shoes **48** have a camming action transmitted through the flyweights to the walls **34** and **36** which guide them and slight rotary movement is imparted to the gear **28** with respect to the gear **26**.

While the construction and function of the timing mechanism is very much like that disclosed in U.S. Pat. No. 2,977,778, referred to above, the rather costly arrangement for damping shocks transmitted through the fuel pump camshaft has been eliminated in the present construction. The inertia afforded by the weight of the gear **30** which is fixed to the fuel pump camshaft and by the weight of the gear **28** and timing mechanism contained serve effectively to damp the objectionable shocks which interfere with effective operation of such timing mechanisms.

What is claimed is:

1. In an engine having a fuel pump camshaft and a main engine camshaft in generally parallel relation, one to the other, a mechanism for automatically adjusting the angular disposition of an engine fuel pump camshaft with respect to the main engine camshaft comprising a first gear concentrically fixed to said fuel pump camshaft, a second gear in mesh with said first gear, means for rotatably mounting said second gear in concentric relation to said main engine camshaft, a third gear fixed to and in concentric relation with said main engine camshaft, and flyweight means responsive to engine speed located intermediate said second and third gears and mechanically linked therebetween for changing the angular disposition of said second gear with respect to said third gear and thereby the angular disposition of said main engine camshaft with respect to said engine fuel pump camshaft, said flyweight means comprising an opening extending entirely through said second gear with a plurality of flyweights therein, said opening in said second gear defining a pair of parallel walls, said second gear defining a central axis, said plurality of flyweights comprising first and second flyweights disposed on either side of said central axis, said flyweights each having a slot therein disposed at an angle with respect to said pair of parallel walls, a sliding shoe disposed in each slot, and means extending through said third gear and directly connecting each of said sliding shoes to said main engine camshaft.

2. The mechanism of claim **1** wherein said means connecting each of said sliding shoes to said main engine camshaft comprise a shank having one end fixed to a respective shoe and the other end fixed to said main engine camshaft.

3. The mechanism of claim **1** further including biasing means operably connected to said flyweights for normally holding said flyweights in abutting relationship when the main engine camshaft is not rotating.

4. The mechanism of claim **3** wherein the biasing means comprise a spring associated with each flyweight contained within said opening in said second gear.

5. The mechanism of claim **4** wherein said springs are disposed parallel to said parallel walls.

6. The mechanism of claim **1** wherein cover plates are fixed to the second gear so as to cover said flyweights.

7. The mechanism of claim **1** wherein said main engine camshaft and said fuel pump camshaft comprise generally elongated members disposed in parallel relation with each other, said first gear being fixed to an end of said fuel pump camshaft, said second gear being rotatably mounted on an end of said main engine camshaft, and said third gear being fixed to the same end of said main engine camshaft as said second gear.