

July 28, 1964

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3,142,261

FUEL INJECTION PUMP

Filed Oct. 3, 1961

Fig. 1

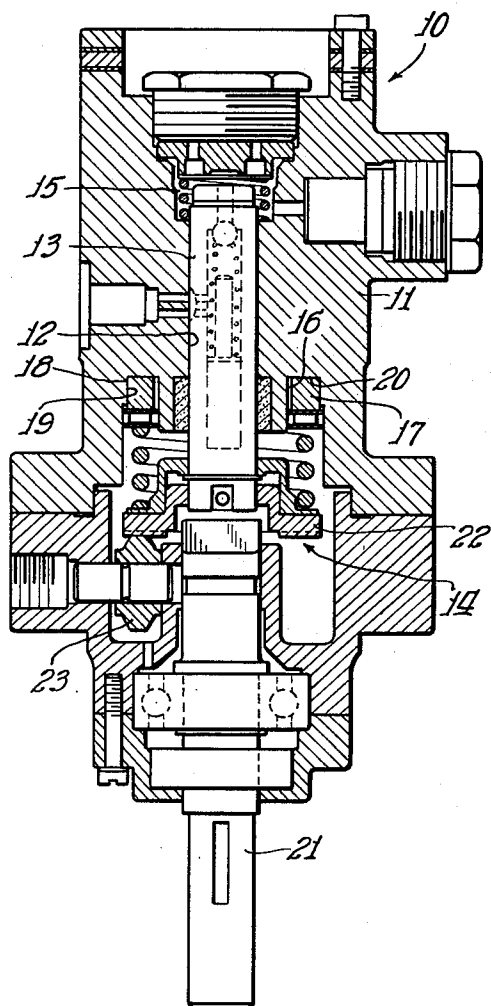


Fig. 2

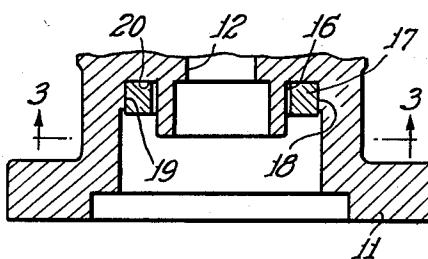
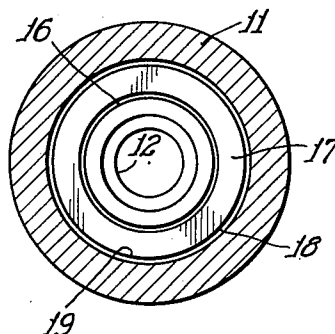


Fig. 3



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FUEL INJECTION PUMP

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Filed Oct. 3, 1961, Ser. No. 142,676

4 Claims. (Cl. 103-154)

This invention relates to a device for preventing seizure of the pumping plunger of a fuel injection pump.

More particularly, the present invention relates to means including an expansion ring of aluminum or other material having a relatively high co-efficient of expansion that is inserted into an annular groove formed in the fuel injection pump body surrounding the pumping plunger bore. The expansion ring either pre-stresses the bore or causes the bore to expand in a localized zone at a greater rate than the pumping plunger expands when the temperature of the plunger and pump body is increasing.

The pump in which the present invention is adapted to be utilized comprises a pump body having a longitudinal cylindrical bore formed therein and a pumping plunger that is closely fitted and adapted for reciprocation and rotation within the bore. The pumping plunger is reciprocated for pumping fuel and is rotated for distributing metered charges of fuel to a plurality of fuel injection nozzles. The plunger is connected to be rotated by a rotatable drive shaft, and is reciprocated by means of a face cam connected to one end of the plunger and riding in contact with a plurality of rollers. The rollers and face cam are lubricated by engine oil and are normally at crank case temperature. The pumping plunger is lubricated by a thin film of fuel present between the plunger and the bore.

The pump body customarily may be made of cast iron and the pumping plunger may be made of hardened steel. The hardened steel has a co-efficient of linear expansion that is greater than the co-efficient of linear expansion of cast iron. The Metals Handbook published by the American Society for Metals lists the co-efficient of expansion of iron as:

10.5 micro in./in./° C.

and for steel (.22% C) as:

11.7 micro in./in./° C.

It has been found that seizure of the pumping plunger within the bore may occur under certain operating conditions. An example of one such operating condition is under high speed-low fuel flow operation. The plunger expands more than the pump body when the temperature of both is increasing and the plunger ultimately sticks against the wall of the bore.

It is an object of the present invention to provide means for preventing seizure of a fuel injection plunger within the bore of a pump body, said means including an annular groove formed in the pump body surrounding the pumping bore, and an aluminum ring or ring of other material having a co-efficient of expansion greater than that of the pump body and which is closely fitted against the outer periphery of said groove.

It is to be understood that the invention is not to be limited to the specific construction and arrangement shown and described, except only insofar as the claims may be so limited, as it will be understood to those skilled in the art that changes may be made without departing from the principle of the invention.

FIG. 1 is a longitudinal sectional view of a portion of a fuel injection pump;

FIG. 2 is an enlarged sectional view of a portion of the pump body of FIG. 1; and

FIG. 3 is a view taken of line 3-3 of FIG. 2.

Referring to FIG. 1, the fuel injection pump shown

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may be designated generally by the numeral 10 and comprises a body 11 formed with a longitudinal cylindrical bore 12, a pumping plunger 13 disposed within the bore, and drive means 14 for rotating and reciprocating the pumping plunger 13 within the bore 12. A fuel pumping chamber 15 is also formed within the body 11 adjacent the free end of the plunger 13. The pump body 11 is also formed with an annular groove 16 surrounding the bore 12 and an expansion ring 17 is press-fitted within the groove 16. The annular groove 16 surrounds the bore 12 at the end of the bore adjacent to the drive means 14 or at the opposite end from the pumping chamber 15.

The ring 17 may be made of aluminum and its outer periphery 18 is in the form of a right cylindrical surface which maintains tight contact with the outer periphery 19 of the groove 16. It is also preferable that the ring 17 maintain close contact with the upper surface 20 of the groove 16 to facilitate rapid heat transfer from the body 11 to the ring 17. To establish close contact with the outer periphery 19, the ring 17 may be chilled prior to insertion into the groove 16 and allowed to warm to the temperature of the body 11.

The drive means 14 includes a rotatable drive shaft 21 for rotating the plunger 13 and a face cam 22 in contact with a plurality of rollers 23 for reciprocating the plunger 13 as it rotates.

The aluminum expansion ring 17 is operable to prevent seizure of the pumping plunger 13 primarily during transient conditions when the temperature of the pumping plunger is increasing rapidly. In normal operation, the drive section 14 of the pump 10 is lubricated by engine oil which is substantially at engine crank case temperature. This temperature may be approximately 180° F. The upper end of the pumping plunger 13 adjacent the pumping chamber 15 is cooled by the gasoline or fuel being pumped through the pumping plunger 13 and may be at a temperature of approximately 60 to 70° or at least substantially less than engine oil temperature. The lower end of the pumping plunger 13 adjacent the drive section 14 is in contact with the lubricating oil and a temperature gradient is thus established from the lower to the upper end of the pumping plunger 13.

For a condition of high speed-low flow, which would occur for example on descending a hill with closed throttle, the flow of gasoline through the pumping plunger 13 ceases and the cooling effect of the gasoline is substantially removed. Under this condition, the overall temperature of the plunger 13 tends to increase and it expands correspondingly. The pump body 11, being of a greater mass, does not tend to expand as rapidly as the plunger 13. Also, because of its greater mass, the pump body 11 tends to dissipate the heat generated or developed due to friction at the boundary between the pumping plunger and the pump body 11. The plunger 13 being contained within the bore 12 cannot dissipate heat as rapidly and consequently as its temperature increases it tends to expand until seizure may occur.

The aluminum ring 17 is in close proximity with the end of the bore 12 and as the temperature of the pump body 11 increases, the temperature of the ring 17 also increases and it tends to expand correspondingly. Since the co-efficient of expansion of the aluminum 17 is substantially greater than that of the pump body 11 or of the pumping plunger 13, the net or effective co-efficient of the expansion of the body 11 is greater than that of the plunger 13. This means that under such a condition of localized heating, the lower end of the bore 12 will tend to expand more than the plunger 13 expands for a given temperature change and therefore renders seizure improbable.

There has been provided by this invention a device effective to prevent seizure of a pumping plunger within

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the bore of the pump body by causing a localized expansion of the pumping bore at a point where seizure might normally occur. The expansion ring introduces an effective co-efficient of expansion for the pump body within the localized zone that is greater than the co-efficient of expansion of the pumping plunger.

It is to be understood that the invention is not to be limited to the specific constructions and arrangements shown and described, except only insofar as the claims may be so limited, as it will be understood to those skilled in the art that changes may be made without departing from the principles of the invention.

I claim:

1. In a fuel injection pump having a pump body formed with a longitudinal cylindrical bore therein and a pumping plunger closely disposed within the bore, the combination of means defining an annular groove formed in said body surrounding said bore, and an annular ring in close axial contact with said body and tightly fitted against the outer periphery of said groove and spaced from the pumping plunger, said ring having a co-efficient of thermal expansion greater than that of the pumping plunger.

2. In a fuel injection pump, the combination of a pump body formed with a longitudinal cylindrical bore therein, a pumping plunger disposed within said bore, means including a rotatable drive shaft connected to rotate said plunger, drive means including a plurality of rollers mounted within said body and a face cam attached to one

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end of said plunger and riding in contact with said rollers for reciprocating said plunger as it rotates, and thermal responsive means mounted in said pump body surrounding said bore at the end thereof adjacent said face cam and operable to provide an effective co-efficient of thermal expansion for the pump body at least as great as the co-efficient of thermal expansion of said plunger for thereby preventing seizure of the pumping plunger within said bore due to an increase in temperature.

3. In a fuel injection pump having a pump body formed with a longitudinal cylindrical bore and a pumping plunger disposed within the bore, the combination of: an annular ring having a coefficient of thermal expansion greater than that of the pumping plunger surrounding and spaced from the pumping plunger and in contact with the pump body, said annular ring being operable to provide an effective coefficient of thermal expansion for the pump body at least as great as the coefficient of thermal expansion of the plunger to prevent seizure of the pumping plunger within said bore due to an increase in temperature.

4. The device of claim 3 wherein the annular ring is operatively positioned at one end of the bore.

References Cited in the file of this patent

UNITED STATES PATENTS

702,501	Stansbury	June 17, 1902
2,930,320	Dahl et al.	Mar. 29, 1960