

Nov. 28, 1961

J. ZUBATY

3,010,403

VARIABLE PRESSURE FLUID PUMP

Original Filed Jan. 10, 1957

2 Sheets-Sheet 1

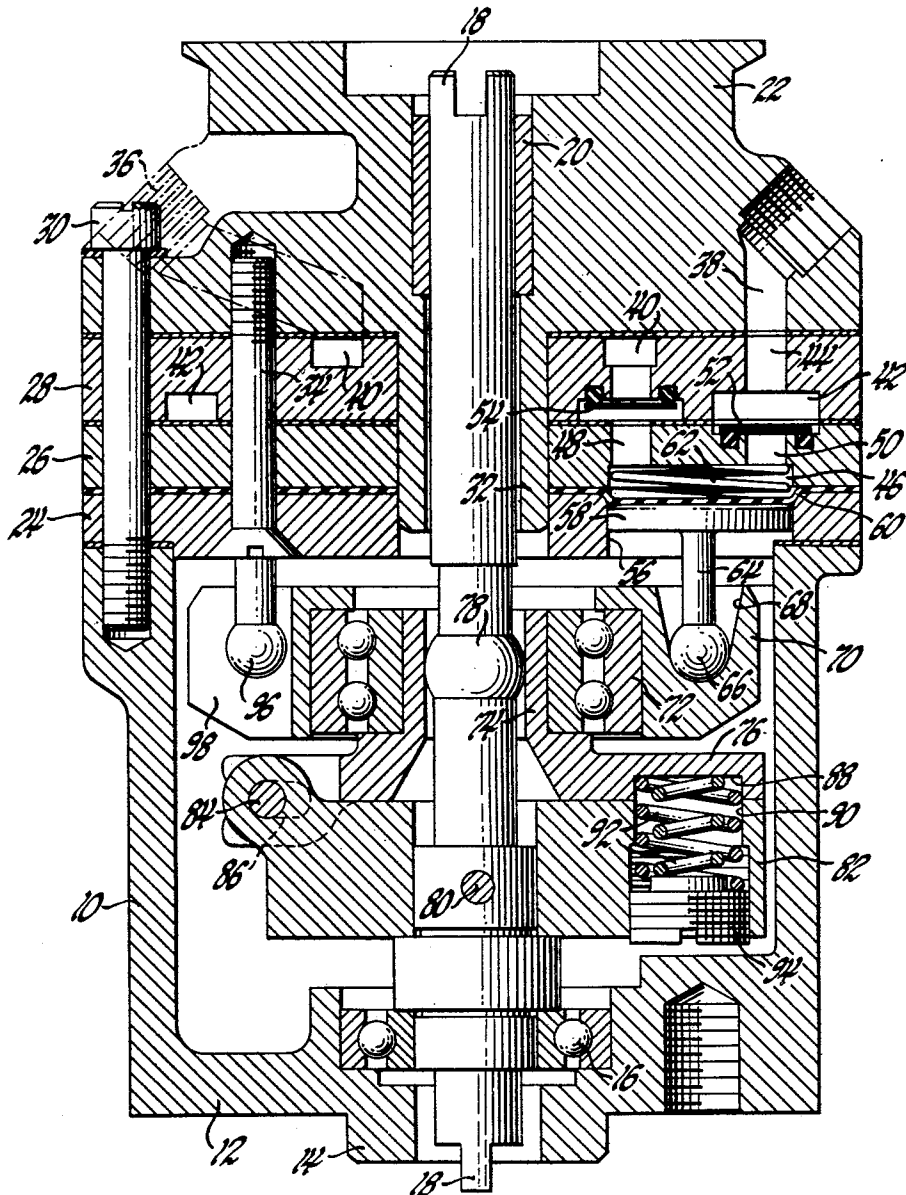


Fig. 1

INVENTOR.
Joseph Zubaty
BY
D. R. McGraw
ATTORNEY

Nov. 28, 1961

J. ZUBATY

3,010,403

VARIABLE PRESSURE FLUID PUMP

Original Filed Jan. 10, 1957

2 Sheets-Sheet 2

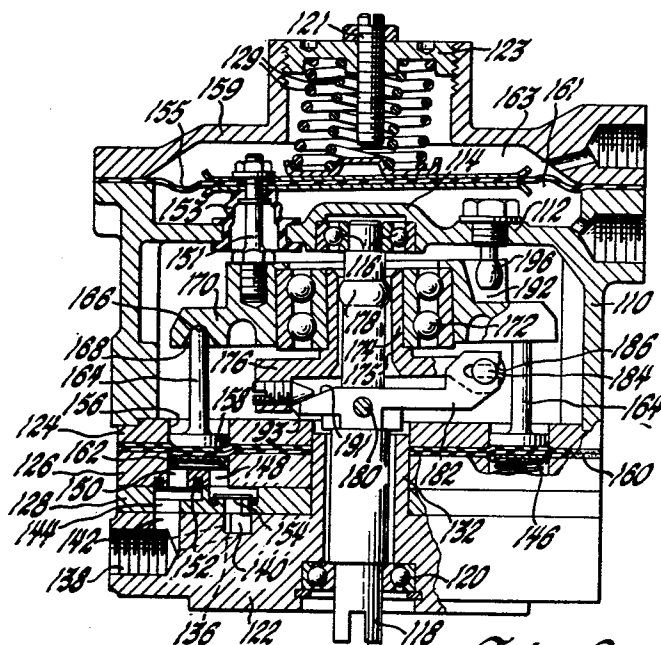


Fig. 2

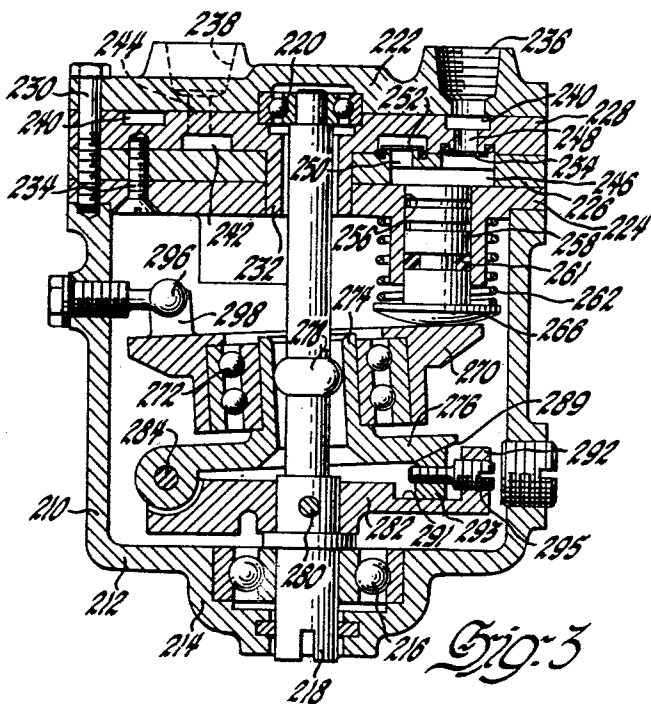


Fig. 3

INVENTOR.
Joseph Zubaty
BY
R. D. McGraw
ATTORNEY

1

3,010,403

VARIABLE PRESSURE FLUID PUMP

Joseph Zubaty, Flint, Mich., assignor to General Motors Corporation, Detroit, Mich., a corporation of Delaware
Original application Jan. 10, 1957, Ser. No. 633,456, now Patent No. 2,955,475, dated Oct. 11, 1960. Divided and this application June 8, 1959, Ser. No. 818,875
1 Claim. (Cl. 103—150)

The invention relates to a variable pressure fluid pump and more particularly to a pump of the wobble plate type. The pump disclosed is comprised of a plurality of plungers which are reciprocated by the action of a wobble plate and act upon either a common diaphragm or directly to produce a desired pressure in the fluid. Several arrangements for adjustment of the pump stroke are disclosed which provide minute adjustment. This is a division of my United States application Serial No. 633,456, entitled "Variable Pressure Fluid Pump," filed January 10, 1957; which issued as Patent No. 2,955,475 on October 11, 1960.

Pumps of the type with which the invention is concerned are adapted for use in systems requiring a relatively constant source of fluid under a predetermined pressure. They can be accurately adjusted by adjusting the tilt angle of the wobble plate. In order to be used in high pressure sensitive systems such as automotive fuel injection systems however, pumps previously known have not obtained the high degree of accuracy of pressure control necessary. Such pumps must have a long life and be relatively free from mechanical failures while providing the high degree of accuracy required. The pumps herein disclosed which embody the invention are adapted to a long troublefree life and may be very accurately controlled either by devices which are subject to the varying conditions in the associated equipment. The pumps may be used as fuel pumps for automotive engines and are also adapted to other uses requiring the features set out.

In the drawings:

FIGURE 1 shows a pump in cross-section and embodying the invention.

FIGURE 2 shows a modified pump with pressure adjusting controls sensitive to operating conditions of the engine and having parts broken away and in section.

FIGURE 3 shows another pump modification with a modified form of mechanism for adjusting the pump pressure.

The pump shown in FIGURE 1 includes a housing 10 having integrally formed therewith an end plate 12 in which a hub 14 is centrally located. Bearing 16 is mounted within hub 14 and receives drive shaft 18 therein. Drive shaft 18 extends through the housing and into a bearing 20 which is secured in pump end cover 22. Intermediate housing 10 and cover 22 are a plurality of plates extending transversely of the pump housing. These plates include plunger guide plate 24, outlet valve and pressure chamber plate 26 and inlet valve and manifold chamber plate 28. A plurality of bolts 30 may be used to secure cover 22 and plates 24, 26 and 28 to the housing 10. In order to properly assemble the plates in relation to the remainder of the pump, cover 22 may be provided with an inwardly extending hub 32 on which the plates 24, 26 and 28 are piloted. A key or other suitable means may be used to permit assembly of the plates only when they are in proper alignment relative to each other and to the cover 22. Bolts 34 may be provided to fasten the plates to the cover in order to permit removal and assembly of the plate and cover group as a unit. The housing, plates and cover are preferably separated and sealed by gaskets positioned between adjacent elements.

2

Cover 22 may be provided with an inlet passage 36 and an outlet passage 38. Plate 28 may be provided with an annular manifold type inlet chamber 40 which is preferably formed as a groove in the upper side of the plate. When the plate 28 is assembled on the cover 22, the lower surface of the cover closes the groove and forms the chamber. Inlet passage 36 is aligned with the chamber 40. Plate 28 is also provided with an annular manifold type outlet chamber 42 which may be formed as a groove on the lower side of the plate. Chamber 42 is concentric with and larger in diameter than chamber 40. An outlet passage 44 connects chamber 42 with outlet passage 38.

Plate 26 is provided with a plurality of pressure chambers 46 and an inlet passage 48 and an outlet passage 50 for each of the pressure chambers. Each of the outlet passages 50 is provided with an outlet valve 52 which is mounted in a recess formed in the upper side of plate 26. Each of the inlet passage 48 is provided with an inlet valve 54 which is mounted in recesses provided in the lower side of plate 28. The inlet and outlet valves may be of the check valve type.

The plunger guide plate 24 may be bored to form cylinders 56 which are adapted to receive pump plunger pistons 58. Each of the cylinders 56 are in alignment with an inlet passage 48 and an outlet passage 50 and a pressure chamber 46. The diaphragm 60 is preferably made of a material which operates satisfactorily as a gasket between plate 24 and plate 26. Each portion of the diaphragm 60 which extends between the pressure chamber 46 and the cylinders 56 is adapted to be engaged on its lower side by pistons 58 and on its upper side by a diaphragm return spring 62. Diaphragm 60 is therefore reciprocated with a pumping action when pistons 58 are reciprocated within cylinders 56.

Each of the pistons 58 has a plunger arm 64 extending down from its lower surface and terminating in a rounded end 66. Individual sockets 68 are formed within an actuating ring 70 and are adapted to receive plunger ends 66. Ring 70 is preferably mounted on the outer race of a bearing 72 with the inner race of the bearing secured to a hub 74 extending around drive shaft 18 and integrally formed with an oscillating member 76. Drive shaft 18 has an enlarged spherical gland 78 formed at a position within hub 74. The gland 78 has a diameter which is greater than the diameter of shaft 18 at this point and is substantially equal to the internal diameter of hub 74. This construction will permit actuating ring 70 to be tilted about the axis of drive shaft 18 when oscillating member 76 is tilted about that shaft. An enlarged section of the drive shaft 18 is formed intermediate the point at which drive shaft 18 passes through hub 14 and the gland 78. A drive pin 80 extends through this section in a transverse direction. A driving member 82 is mounted on pin 80 and is driven by shaft 18 through that pin. Oscillating member 76 is hinged at one side of driving member 82 with a hinge pin 84. The portion of oscillating member 76 extending around hinge pin 84 is preferably provided with an elongated hinge slot 86 to permit a slight radial movement of the oscillating member when it is tilted. A spring aperture 90 may be formed through driving member 82 and one or more plunger control springs 92 may be mounted within the depression 88 and the aperture 90. The lower end of aperture 90 may be threaded to receive a spring tension control plug 94. Plug 94 may be adjusted to impress the desired tension on plunger control springs 92. The tension so impressed tilts oscillating member 76 about hinge pin 84 to a desired angle. Actuating ring 70, being mounted on the outer race of bearing 72, also tilts at the same angle to regulate the stroke of pistons 58 within cylinders 56 as the drive shaft is rotated. Since

3

hinge pin 84 may move radially within slot 86, the pivot point for oscillating member 76 and actuating ring 70 is at the center of spherical gland 78.

The position of the tension control plug 94 is pre-set prior to assembly of the plate and cover group to the pump cover and the pump will have a stroke of the desired length. An access may be provided in end plate 12 to permit further adjustments without disassembling the pump if desired. As the pistons 58 reciprocate within cylinders 56, diaphragm 60 is reciprocated within the pressure chamber 46. On the down stroke, fluid is drawn through inlet passage 36 and annular manifold chamber 40. The inlet check valve 54 is opened and fluid flows through inlet passage 48 to the pressure chamber. On the up stroke of the piston and diaphragm, inlet valve 54 is closed and outlet valve 52 is opened, permitting the pressurized fluid to flow through outlet passage 50 to annular manifold chamber 42 and to be delivered to a desired point from outlet passage 38.

A pin 96 may be secured to the lower side of plate 24 in order to prevent the rotation of actuating ring 70. This pin may mesh with a pair of lugs 98 which are formed on actuating ring 70. Pin 96 will then prevent any rotary motion of actuating ring 70 in either direction.

A modified pump and adjusting mechanism is shown in FIGURE 2. The pump has the actuating pistons concentrically disposed in relation to the manual tilt adjusting mechanism. The actuating ring is rigidly attached to a vacuum sensitive diaphragm which provides the vacuum sensitive adjustment of the stroke of the pump pistons.

The pump of FIGURE 2 includes a housing 110 with which a web 112 is integrally formed. A bearing hub 114 is located centrally within web 112. A bearing 116 is received within hub 114 and provides a rotatable mount and end locating point for the end of drive shaft 118. A pump cover 122 is provided through which drive shaft 118 extends and bearing 120 is located in the pump cover 122 to provide a rotatable mount for the drive shaft. Intermediate the housing 110 and the pump cover 122 are several stacked plates which may be separated by gaskets. These plates include the plunger guide plate 124, the pressure chamber plate 126 and the valve plate 128. Pump cover 122 may have an inwardly extending hub 132 on which plates 124, 126, and 128 are piloted. An inlet passage 136 may be provided in pump cover 122 to enable the fluid being pumped to enter. An outlet access passage 138 may also be provided in pump cover 122 for delivery of the fluid from the pump. Pump cover 122 has formed within its upper surface an annular inlet manifold chamber 140. Individual outlet manifold chambers 142 may be provided concentrically outward from inlet manifold chamber 140. Outlet passages 144 connect each of the pressure chambers 146 with an outlet manifold chamber 142. Inlet passages 148 connect each of the pressure chambers 146 with inlet manifold chamber 140. Inlet valve 154, which may be of the check valve type, is mounted in between inlet passage 148 and manifold chamber 140 and may be located within plate 128. Outlet valve 152, which may also be of the check valve type, is located between outlet passage 150 and outlet passage 144 and occupies a recess provided in plate 128. Plate 124 has a plurality of cylinders 156 formed therein which are complementary to pressure chambers 146 in plates 126. Cylinders 156 and chambers 146 are separated by a pump diaphragm 160 which is mounted between plates 124 and 126. The diaphragm acts as a gasket between these plates and the portions of the diaphragm which are exposed to the pressure chambers 146 act as pump diaphragms. Pump plunger pistons 158 are reciprocally received within cylinders 156 and engage diaphragm 160 at their outer ends. A diaphragm return spring 162 may be provided in each of the pressure chambers 146. Pistons 158 may be integrally formed with plunger arms 164 which terminate at their ends opposite the pistons in rounded ends 166.

4

Sockets 168 are formed within actuating ring 170 and receive the ends 166 of the plunger arms. Actuating ring 170 is preferably mounted on the outer race of the bearing 172. The inner race of bearing 172 is secured to hub 174 which extends around and is radially spaced from drive shaft 118. Hub 174 is integrally formed with an oscillating member 176. At a point within hub 174 drive shaft 118 is provided with an enlarged spherical gland 178 which has a diameter substantially equal with the diameter of oversized hub passage 175. Actuating ring 170 may be tilted about the axis of drive shaft 118 by arcuate movement of hub 174 about gland 178.

An enlarged section of the drive shaft has a drive pin 180 extending transversely therethrough at a point intermediate the place where drive shaft 118 passes through hub 132 and the position of gland 178. Driving member 182 may be press fitted on drive shaft 118 and secured thereto by drive pin 180. Oscillating member 176 is hinged at one side of driving member 182 by means of a slidable hinge 184. Driving member 182 is provided with a hinge slot 186 which permits hinge 184 to slide radially when the oscillating member is tilted. Actuating ring 170 may be prevented from rotational movement with respect to housing 110 by pin 196 which extends downwardly from web 112 and engages ring 170 in recess 192.

An initial manual adjustment of the oscillating member 176 may be made by screwing tapered adjusting screw 193 inwardly or outwardly in the threaded depending lug attached to the lower side of member 176. The tapered end of screw 193 may contact bevel surface 191 which is formed on the side of driving member 182 adjacent screw 193. When screw 193 is moved inwardly, the angle between oscillating member 176 and drive member 182 is increased.

The pump of FIGURE 2 may be controlled during engine operation by intake manifold vacuum. A vacuum sensitive diaphragm 155 is provided for this purpose. Cover plate 159 may be suitably secured to pump housing 110 so that web 112 and the cover plate form a space divided by diaphragm 155 to define atmospheric chamber 161 and vacuum chamber 163. One or more springs 129 may be mounted between cover 159 and diaphragm 155 to resist movement of the diaphragm when vacuum is increased therein and to return the diaphragm to its neutral position when the vacuum approaches atmospheric pressure. The springs 129 may be adjusted by an adjustable spring retainer 123 which may be threaded into the cover plate 159. A stroke limiting screw 121 may be threaded through retainer 123 to provide a maximum stroke limiting position for diaphragm 155. Control arm 151 may be rigidly attached to diaphragm 155 and extend in a generally perpendicular direction from the diaphragm. The opposite end of arm 151 may be threaded into or otherwise attached to actuating ring 170. A bellows seal 153 may be secured in the aperture in web 112 through which arm 151 extends. Seal 153 allows longitudinal movement of arm 151 while effectively sealing atmospheric chamber 161 from the interior of the pump. When diaphragm 155 is moved under the influence of increased vacuum in chamber 163, arm 151 is moved in a direction generally parallel to drive shaft 118 and actuating ring 170 is pivoted about spherical gland 178. The tilt of ring 170 therefore depends upon the speed and torque requirements of the engine which are sensed by engine intake manifold vacuum.

The modified pump and adjusting mechanism shown in FIGURE 3 does not require the use of a pump diaphragm nor a vacuum control system. The pump housing 210 includes an end plate 212 in which an outwardly extending hub 214 is formed to receive bearing 216. Drive shaft 218 extends through hub 214 and is rotatably supported by bearing 216. The other end of drive shaft 218 is supported in bearing 220 which is secured in a

5

depression formed in pump cover 222. Cover 222 may be secured to pump housing 210 by any suitable means such as bolts 230. A plunger guide plate 224, an inlet valve and pressure chamber plate 226 and an outlet valve and manifold chamber plate 228 are positioned between cover 222 and housing 210. Bolts 234 may be provided to secure plates 224 and 226 to plate 228. Plate 228 is provided with an inwardly extending hub 232 on which plates 224 and 226 are piloted.

Cover 222 may have an inlet access passage 236 and an outlet access passage 238 formed therein. Plate 228 may have an annular inlet manifold chamber 240 formed in its upper side and an annular outlet manifold chamber formed in its lower side. These chambers are preferably concentric with the axis of plate 228 and of different diameters. An outlet passage 244 may connect passage 238 with chamber 242. Inlet passage 248 may be formed in plate 228 and connect chamber 240 with the pump pressure chambers 246. An inlet valve 254 may be located within the pressure chamber 246 adjacent passage 248. An outlet passage 250 may be provided in plate 226 to connect chamber 242 with pressure chamber 246 and may be controlled by an outlet valve 252. Plate 224 may have a plurality of bosses extending downwardly therefrom in which pump cylinders 256 are formed. A pump plunger piston 258 may be mounted for reciprocal movement within each of the chambers 256. A piston ring 261 may be provided to seal the pressure chambers from the interior of the pump housing. A piston return spring 262 may abut plate 224 and surround the bosses through which cylinders 256 are formed. The other end of springs 262 may abut the upper side of enlarged arcuate contacting ends 266 of the pump plunger 258. The arcuate surface of ends 266 are in engagement with actuating ring 270 and are reciprocated by the wobble plate movement of that ring. Ring 270 is secured to the outer race of bearing 272. The inner race of that bearing is secured to hub 274 which is formed on oscillating member 276. A spherical gland 278 is formed on shaft 218 and is of sufficient diameter to engage the internal surface of hub 274. The enlarged diameter of this gland permits oscillating movement of member 276. Drive shaft 218 is provided with a transversely extending drive pin 280 at a point intermediate gland 278 and bearing 216. A drive member 282 is mounted for pivotal movement on this pin and is driven rotatably by the pin when drive shaft 218 is rotated. Oscillating member 276 is pivoted to one side of drive member 282 by slidable hinge 284. The upper surface of drive member 282 which is opposite hinge 284 may be provided with a flat surface 291 and a threaded lug 292 adjacent the flat surface and generally perpendicular thereto. A differential thread adjusting screw 295 may be threaded in the lug 292 and terminate in an adjusting wedge 293. The upper surface of wedge 293 may be beveled and be complementary to the bevel surface 289 formed on oscillating member 276. When adjusting screw 295 is turned, web 293 moves radially inward or

6

outward to increase or decrease the angle formed between drive member 282 and oscillating member 276. The change in this angle causes a commensurate change in the tilt angle of actuating ring 270. The stroke of the pistons 258 are adjusted by changing the tilt angle of ring 270 to adjust the output pressure of the pump. Actuating ring 270 is prevented from rotation relative to housing 210 by a pin 296 which is attached to the housing. Pin 296 extends inwardly to engage a pair of lugs 298 which are formed on the upper side of ring 270.

The pumps which are the subject of the invention provide for a constant delivery of a fluid under a predetermined pressure which may be preset or controlled by operating conditions of associated mechanisms such as an internal combustion engine.

What is claimed is:

In a pump housing and fluid control section of a fluid pump, a housing having an open end, a first plate secured to said housing and closing said open end and having a plurality of cylinders formed therein, a second plate adjacent to said first plate in covering relation thereto and having a plurality of pressure chambers formed therein, a third plate adjacent to said second plate in covering relation thereto and having an annular inlet manifold chamber and an annular outlet manifold chamber formed therein, a cover for said housing in covering relation to said third plate, said cover having an inwardly extending hub, said plates being piloted on said hub, said first and second plates being separated by a pump diaphragm, and inlet and outlet valves respectively connected to said inlet and outlet manifold chambers for controlling the flow of fluid from said inlet manifold chamber through said pressure chamber to said outlet manifold chamber.

References Cited in the file of this patent

UNITED STATES PATENTS

1,052,569	Cherry	Feb. 11, 1913
2,016,802	Fick	Oct. 8, 1935
2,324,524	Mercier	July 20, 1943
2,386,675	Ford	Oct. 9, 1945
2,400,119	Joy	May 14, 1946
2,570,698	Manseau	Oct. 9, 1951
2,650,545	Cornelius	Sept. 1, 1953
2,765,751	Osius	Oct. 9, 1956
2,809,868	Thompson	Oct. 15, 1957
2,840,002	Elder et al.	June 24, 1958
2,889,781	Thompson	June 9, 1959
2,895,424	Tramontini et al.	July 21, 1959
2,935,063	Zubaty	May 3, 1960

FOREIGN PATENTS

929,832	Germany	July 4, 1955
---------	---------	--------------

OTHER REFERENCES

Ser. No. 335,386, Mercier (A.P.C.), published June 1, 1943.