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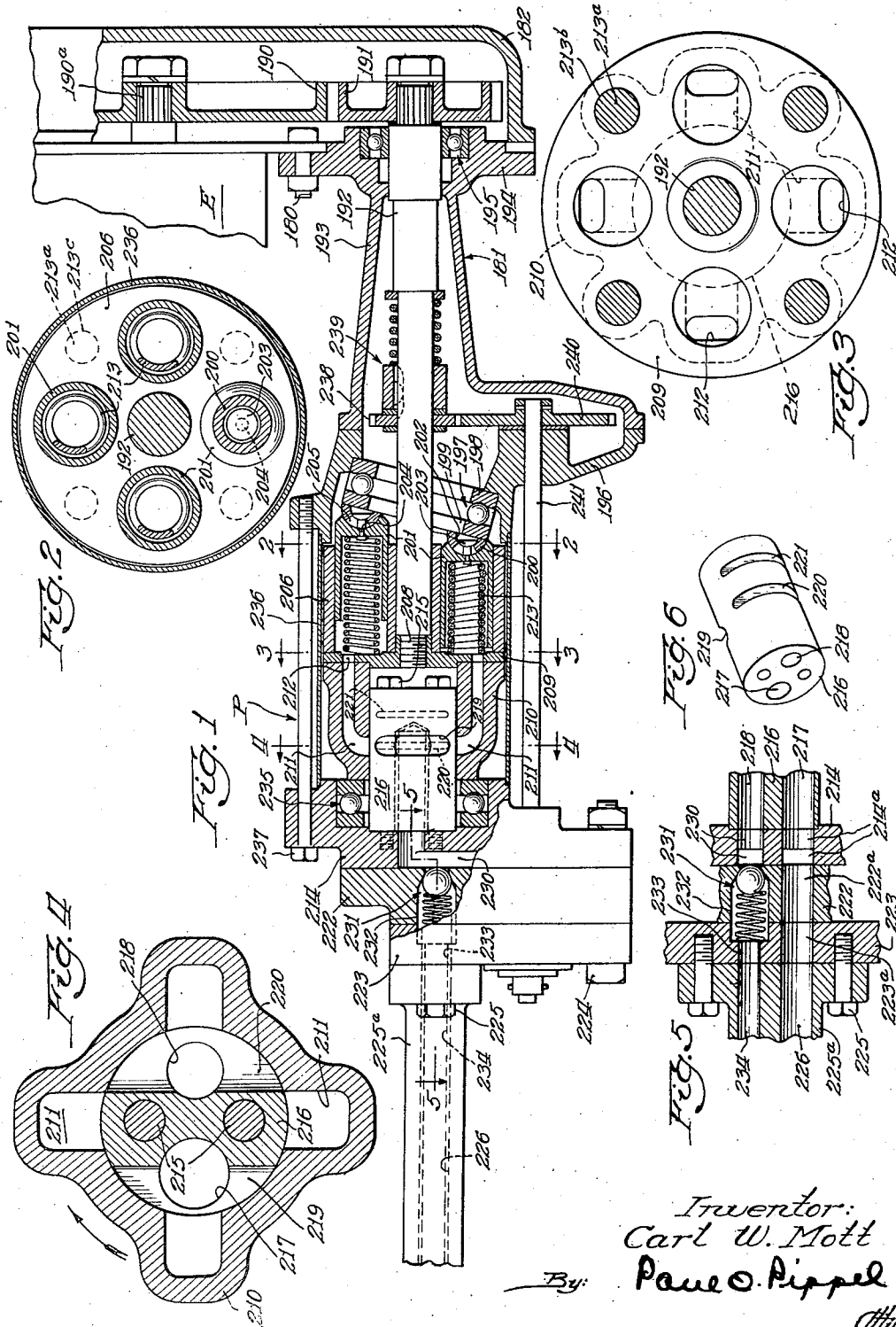
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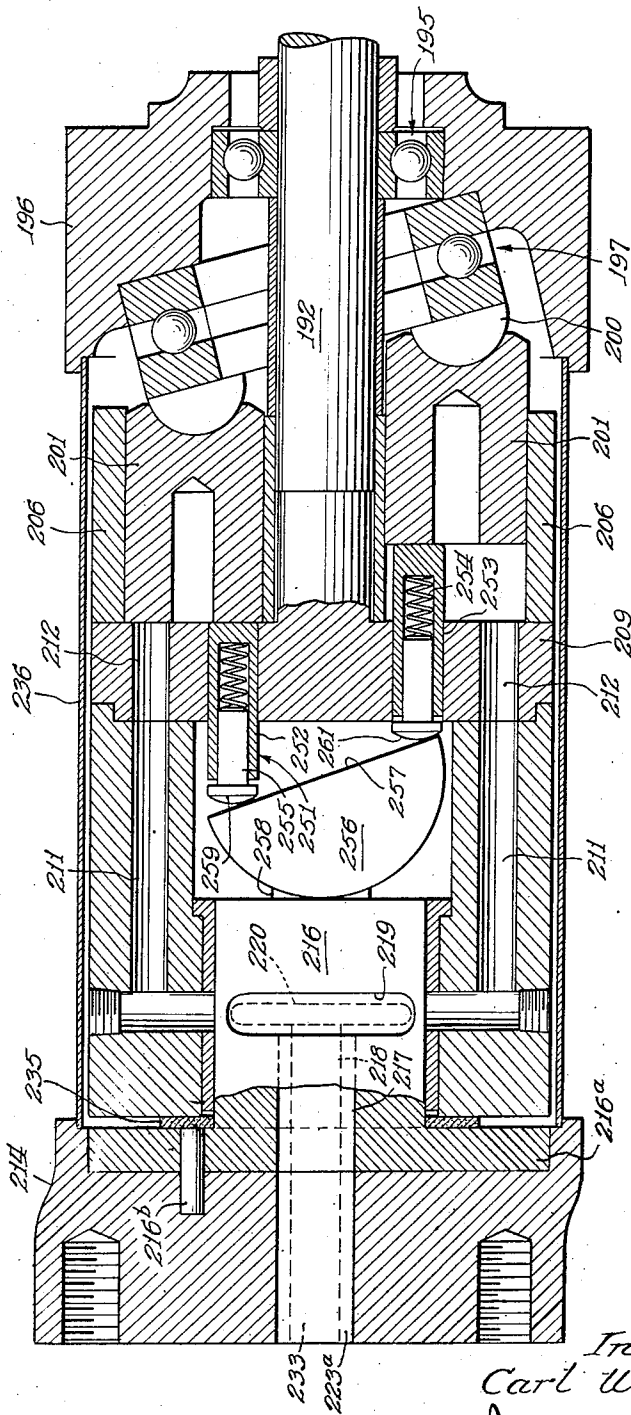
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Fig. 7



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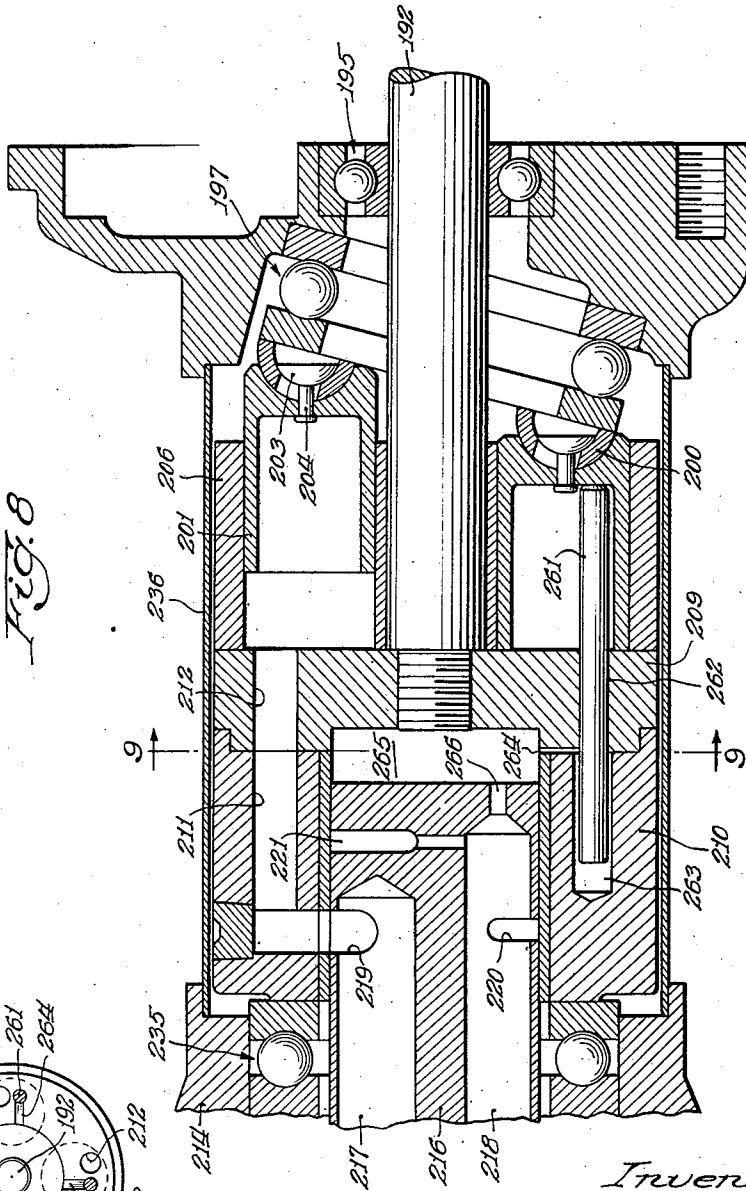
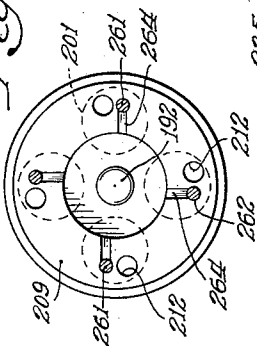


Fig. 8

Fig. 9



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3 Claims. (Cl. 103—162)

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This invention has to do with a hydraulic pump having a plurality of cylinders and relates particularly to an arrangement in which the cylinders are revolved to cause the reciprocation of cylinders or the equivalent therein. The present application is a continuation-in-part of my co-pending application, Serial No. 466,463, filed November 21, 1942, Patent No. 2,427,871, September 23, 1947.

A general object of the invention is the provision of a slender compact multicylinder or chamber pump operable at high speed to deliver liquid at a relatively high pressure.

A further general object is the provision of a pump in which there is a carrier rotatable to revolve pumping chambers thereon having parts reciprocable axially of the carrier to cause expansion and contraction of such chambers, together with novel means for imparting reciprocable movement to said parts while the chambers are revolved.

A still further general object is the provision of a new commutating means containing inlet and outlet channels having ports within an annular sealing surface swept over by ports respectively communicating with the revolving chambers, all coordinately arranged so the chamber ports successively register communicatively with the channel inlet port during chamber expansion and with the channel outlet port during chamber contraction.

These and more specific objects inherent in and encompassed by the invention will be better understood upon reading the ensuing portion of this specification with reference to the annexed drawings, wherein:

Fig. 1 is a sectional view taken axially and substantially centrally through a pump embodying a preferred form of the invention;

Figs. 2, 3, and 4 are transverse sectional views taken on the lines 2—2, 3—3, and 4—4 of Fig. 1;

Fig. 5 is a fragmentary sectional view taken on the line 5—5 of Fig. 1;

Fig. 6 is a perspective view of a commutating member employed in the Fig. 1 embodiment;

Fig. 7 is a view taken similarly to Fig. 1 through a second preferred form;

Fig. 8 is a view taken similarly to Fig. 1 through a third preferred form; and

Fig. 9 is a sectional view taken on the line 9—9 in Fig. 8.

That form of the invention shown in Figs. 1 to 6, which has been carved out of the aforesaid co-pending application, will now be described. In Fig. 1, the pump, indicated in its entirety by the reference character P, is shown mounted upon a front side portion of an internal combustion engine E from which it is adapted to receive driving force. Bolts 100 connect the pump casing 101

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to a gear casing 102, which is suitably attached to the engine.

A driving gear 190, driven from an engine part as a valve operating cam shaft 190^a, drives a pinion gear 191 wedged on a pump shaft 192. This pump shaft is enclosed for a portion of its length by a hollow casting 193 forming part of the pump casing 101 and on the outer end of which there is a bearing support 194 for a ball bearing unit 195 for the shaft 192. A second casing casting 196, suitably connected to the casting 193, supports a ball bearing unit 197 having a race 198 fitted in the casting and encircling the pump shaft within a plane oblique thereto. The second race 199 of the bearing unit 197 has hemispherical bearing members 200 fixed thereto for establishing journaled driving connections with hollow cylindrical pump pistons 201. These bearing members 200 also have respective interior hemispherical bearing surfaces 202 within and against which head portions 203 of connecting pins 204 are slidably seated for universal movement. There are crown openings 205 in the hemispherical bearing members through which the pins 204 extend for connection with the plungers 201.

The plungers 201, of which there are four distributed equidistantly circumferentially about the drive shaft 192, are seated within the bores of cast cylinders or chambers 206 of which the pistons constitute parts axially reciprocable to expand and contract the same. On the back end of the shaft 192 (the end disposed to the left as viewed in Figure 14) there is a threaded portion 208 to which a disk-shaped cylinder or chamber carrier 209 is rotatably fixed. A ported member 210, having four axial channels or ports 211 respectively for the cylinders 206 and communicating therewith through openings 212 in the carrier, is fixed to and for rotation with said carrier. As the parts connected to the shaft 192 are rotated, the pistons 201 will be complementally actuated by axially compressible springs 213 within the pistons and diametrically opposite portions of the ball bearing unit that are inclined axially of the carrier to reciprocate in their cylinders for alternately sucking oil in through the ports 211 and forcing it out through said ports.

Cap bolts 213^a, Figs. 2 and 3, hold the cylinders 206 and the ported block 210 on the carrier. These bolts extend through holes (not shown) in the block 210 and thence through holes 213^b in the carrier into threaded recesses 213^c in the block in which the cylinders 206 are formed.

At the back end of the pump, there is another casing casting 214 to which is bolted, by means of bolts 215, a stationary cylindrical valve or commutating member 216. This commutating member 216 has axial intake and discharge ducts 217 and 218, Figs. 4 and 5, and the cylindrical

exterior of said member forms a sealing surface having a sliding fit with the cylindrical center bore through the ported casting 210, facilitating rotation of the latter thereabout while maintaining a fluid seal contact therewith. While the back ends of the ports 211 are in registry with a transverse port 219 which communicates with the axial intake duct 217 (see Fig. 4), their respectively associated pistons 201 will be receding axially forwardly under the force of their springs 213, as permitted by an inclined portion of the force reaction unit 197 then being traversed, to suck oil inwardly through the ports 211, and subsequently as the back ends of the ports 211 associated with the filled cylinders reach registry with a transverse port 220, which communicates with the discharge duct 218, their associated pistons will be moving rearwardly under force exerted by the opposite inclined portion of the force reaction unit to expel the oil from said ports 211 into the discharge duct 218. Since the intake slot 219 is broader than the diametrically opposite discharge slot 220, an additional slot 221 is provided on the side of the member 216 with the narrower slot 220 so the frictional drag of the rotating casting 210 thereon is properly balanced.

To the casting 214, there is connected another casting 222 and a plate 223 by bolts 224. Cap bolts 225 connect a multiduct communicating conduit 225^a to the plate 223. Fluid as from a reservoir (not shown) is delivered to the pump through an intake passage 226 in the conduit and thence flows through a hole 223^a in the plate 223, a hole 222^a in plate 222, and an L-shaped passage 214^a in the casting 214 into the above described axial intake duct 217 of the fixed cylindrical valve member 216. During the suction strokes of the pistons 201, fluid will be taken into the cylinders 206. After each piston completes its forward suction stroke under the force of its spring 213, it is immediately moved rearwardly while recompressing its spring 213 and forcing oil from its cylinder under pressure through the slot 220 and the passage 218 in the cylindrical commutating member 216, an L-shaped channel 230 in the casting 214 past a check valve 231 in a hole 232 in the plate 222, and through a hole 233 in the plate 223 into a high pressure discharge channel 234 in the multichannel conduit 225^a.

A thrust bearing unit 235 nested in the left end casting 214 is pressed against by the ported casting 210 to prevent axial displacement of the carrier 209 and the cylinders 206 when the pistons 201 are pressed forwardly incident to traversing the one inclined portion of the oblique reaction bearing unit 197. The end castings 196 and 214 are predeterminedly spaced by a cylindrical casing member 236 and are held firmly against the ends of such casing member by long bolts 237 of which one is shown in Fig. 1.

Attention is directed to a by-pass control drive consisting of a gear 238 connected for impositive drive with the shaft 192 by means of a slip-clutch device 239, a gear 240 drivable by gear 238, and a counter-shaft 241 drivable by the gear 240 for operating a by-pass valve mechanism encased within lower portions of the plates 222 and 223 but not shown since it is not hereinafter claimed.

The modification shown in Fig. 7 has for the most part elements identical with or corresponding to respective elements of the embodiment shown in Figs. 1 to 6. To expedite this descrip-

tion, those identical or corresponding parts are designated by the same respective reference characters.

One difference that the embodiment in Fig. 7 has with respect to that in Figs. 1 to 6 is the omission of the counter-shaft 241, the gearing driving this counter-shaft from the pump shaft 192, the by-pass valve mechanism driven by the counter-shaft, and consequently the plates 222 and 223 in which the by-pass device was encased. Therefore, the plate 214 is provided with the inlet passage 223^a and the outlet passage 233. The check valve 231 is omitted from the passage 232. The further detailed difference is the provision of a flange 216^a upon the left end of the commutating block 216 for attachment to the casting 214, and the proper orientation of the block 216 with respect to the pump is maintained by a pin 216^b inserted through the flange 216^a into a recess therefor in the casting 214. A flat annular bearing member 235 is substituted for the ball bearing unit 235 in the first embodiment.

The primary difference between this second embodiment and the first embodiment is in the means employed for maintaining the pistons 201 seated upon the hemispherical bearing studs 200 on the inclined bearing unit 197. This second embodiment dispenses with the springs 213, which were used for piston translation in the first embodiment, and employs instead a plurality of thrust units 251 comprising hollow members 252 slidable axially within holes 253 in the carrier 209. The right ends of the members 252 bear constantly against left-end portions of the pistons 201, against which they are urged by springs 254 which are held under compression by headed members 255 slidable within the members 252 by bearing reactively against a member 256 having a flat inclined face 257 generally parallel with the inclined plane occupied by the bearing unit 197 but being slightly more inclined with respect to the pump axis. The member 256 is fixed at 258 to the commutating member 216 so as to remain fixed and thereby held against rotation. During rotation of the carrier 209 with the pump shaft 192, the heads 259 of the members 255 slide about a peripheral edge portion of the inclined face 257 while rocking radially with respect to said face as facilitated by curved surface portions 261 of these heads 259. As mentioned hereinabove, the plane of the face 257 on the fixed member 256 is slightly more inclined with respect to the pump axis than the plane occupied by the inclined bearing unit 197. The reason for this is that the centers of the pistons 201 are farther from the pump axis than the centers of the reciprocal units 251, but since it is essential for these units 251 to have the same length of reciprocal stroke as the pistons, the axial displacement of the annular path about the edge of the surface 257 must be the same as that of the pistons 201 though a shorter radial distance from the pump axis. The operation of the pump shown in Fig. 7 is the same as that described above with respect to the pump shown in Figs. 1 to 6.

A third embodiment of the invention shown in Figs. 8 and 9 is also generally like the embodiment shown in Figs. 1 to 6, wherefore the same expedient is followed of designating the same or corresponding parts by the same respective reference characters.

In this embodiment a third means is employed for urging the pistons 201 toward and maintaining them in seated relation with the hemispher-

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ical bearings 200 upon the inclined bearing unit 197. This means includes cylindrical plunger members 261 which are slidably disposed within holes 262 in the cylinder carrier 209, respectively beside the port holes 212 in the carrier as is illustrated in Fig. 9. The ported member 210 is provided with oversized recesses 263 for receiving the left-end portions of the plungers 261. Radial channels 264 in the left end face of the carrier 209 communicate respectively between the recesses 263 and a chamber 265 formed between the right end of the commutating block 216 and a central left-end portion of the carrier. Fluid under pressure from the high pressure outlet channel 218 is introduced into the chamber 265 through a channel 266 in the member 216, and this high pressure fluid is forced radially outwardly through the channels 264 into the recesses 263 to apply a force upon the left ends of the plungers 261 for urging them and the cylinders 201 with which they abut to the right for maintaining the cylinders seated upon the hemispherical bearings 200.

While I have herein shown and described a limited number of embodiments with the view of illustrating the invention, it should be understood that the invention extends to other forms, arrangements, structures and details falling within the scope and spirit thereof and not sacrificing all of its material advantages.

What is claimed is:

1. In a pump, a rotatable carrier having a radially extending web-like body, cylinders on one end of the carrier body with their axes generally parallel with the rotational axis of the carrier and revolvable about said axis pursuant to carrier rotation, pistons reciprocable in said cylinders to cause expansion and contraction of the space therein, cylinder ports leading through the carrier to the opposite end of the carrier body, commutating means having inlet and outlet ports successively communicatively traversed by the cylinder ports respectively during expansion and contraction of the space in their associated cylinders, an annular force-reaction member encircling the carrier axis at the one end of the carrier within a plane oblique thereto to incline diametrically opposite edge portions of said member axially of the carrier, and means for pressing said pistons axially toward said reaction member to cause the pistons to alternately traverse said inclined edge portions and thereby incur the reciprocation of the pistons, the last-named means including a member having an annular force-reaction portion encircling the carrier axis at the other end of the carrier within a plane generally parallel with the first-named plane, and axially reciprocable thrust members extending axially through the carrier body between the pistons and said annular force-reaction portion.

2. In a pump, a rotatable carrier having a radially extending web-like body, cylinders on one end of the carrier body with their axes generally parallel with the rotational axis of the carrier and revolvable about said axis pursuant to carrier rotation, pistons reciprocable in said cylinders to cause expansion and contraction of the space therein, cylinder ports leading through the carrier to the opposite end of the carrier body, commutating means having inlet and outlet ports successively communicatively traversed by the cylinder ports respectively during cylinder expansion and contraction of the space in their associated cylinders, an annular force-reaction member encircling the carrier axis at the one end of the

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carrier within a plane oblique thereto to incline diametrically opposite edge portions axially of the carrier, and means for pressing said pistons axially toward said reaction member to cause the pistons to alternately traverse said inclined edge portions and thereby incur the reciprocation of the pistons, the last-named means including axially reciprocable thrust members extending axially through the carrier body into respective thrust-applying relation with the pistons, and chamber means at said other end of the carrier into which ends of said thrust members project, and said chamber means being communicative with the commutating means outlet port to receive fluid therefrom under pressure for forcing the thrust members into said thrust-applying relation with the pistons.

3. In a pump, a rotatable carrier having a radially extending body, pump chambers carried on said body in radially spaced relation from the carrier rotational axis, the principal axes of said chambers being substantially in parallelism with the carrier axis, wall portions of said chambers disposed toward one end of said body being displaceable axially of the respective chambers for expanding and contracting the same pursuant to such movement, each of the said chambers having a port-like channel leading through the carrier body to the opposite end thereof, commutating means having inlet and outlet ports successively commutatively traversed by said channels respectively during chamber expansion and contraction, an annular force-reaction member encircling the carrier axis at said one end of the carrier within a plane oblique thereto to incline diametrically opposite edge portions of said member axially of the carrier, and means for urging said chamber wall portions axially toward said reaction member to cause said wall portions to alternatively traverse and react upon said inclined edge portions and thereby incur axial reciprocation of such wall portions in predetermined phase relation with the traversal of said commutating means by said channels, and said pressing means including axially reciprocable thrust members extending axially through the carrier body in sealing relation therewith and into said chambers into respective thrust-applying relation with said wall portions, and means at the other end of said carrier body for applying pressure against said thrust members for urging them and their associated chamber wall portions toward said reaction member.

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