Nov. 1, 1966 M. RADZIWILL ETAL 3,282,496

SEALING MEANS FOR A POWER DRIVEN MACHINE WITH A ROTARY PISTON

Filed Nov. 7, 1963

4 Sheets-Sheet 1

FIG. 1

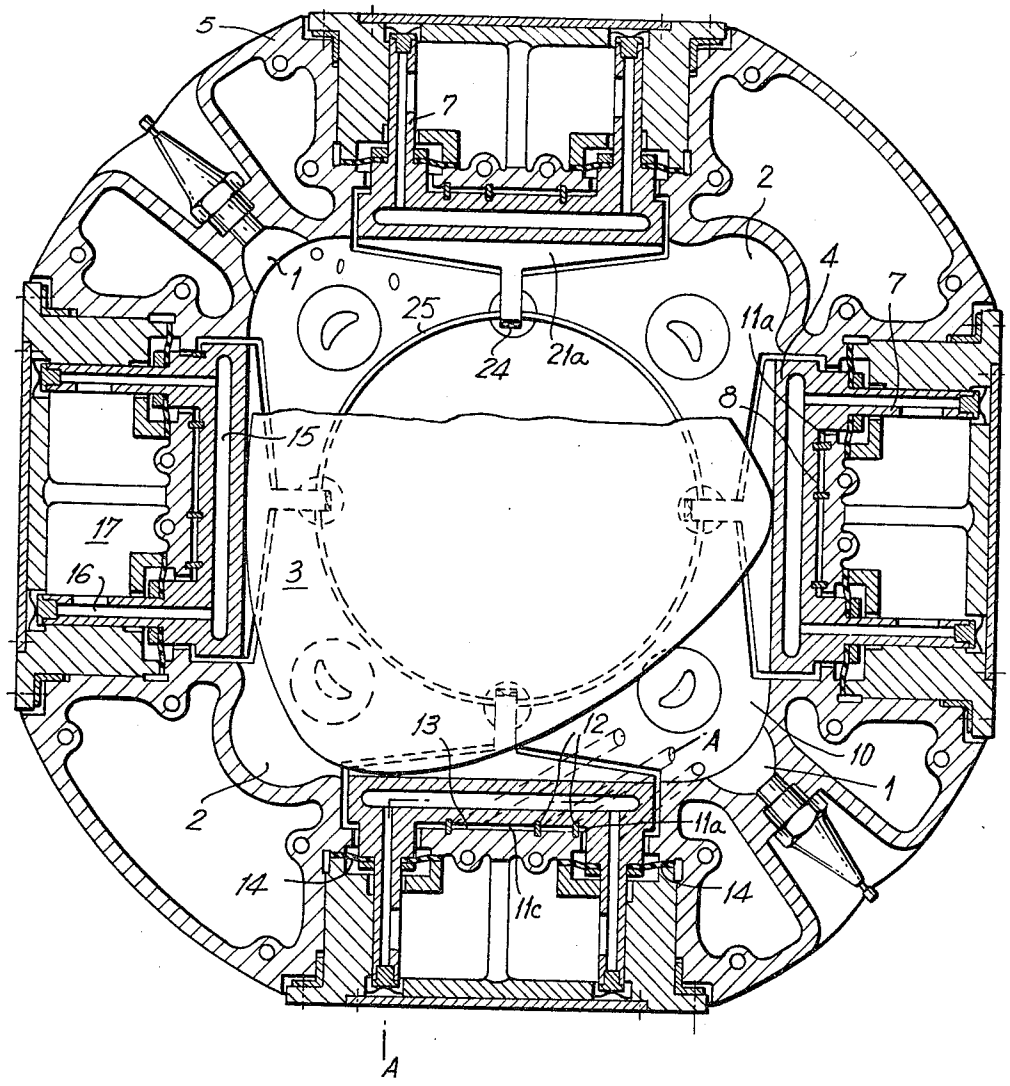

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FIG. 2

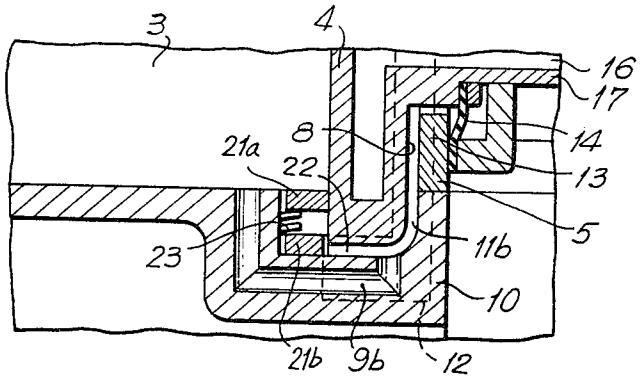

FIG. 5

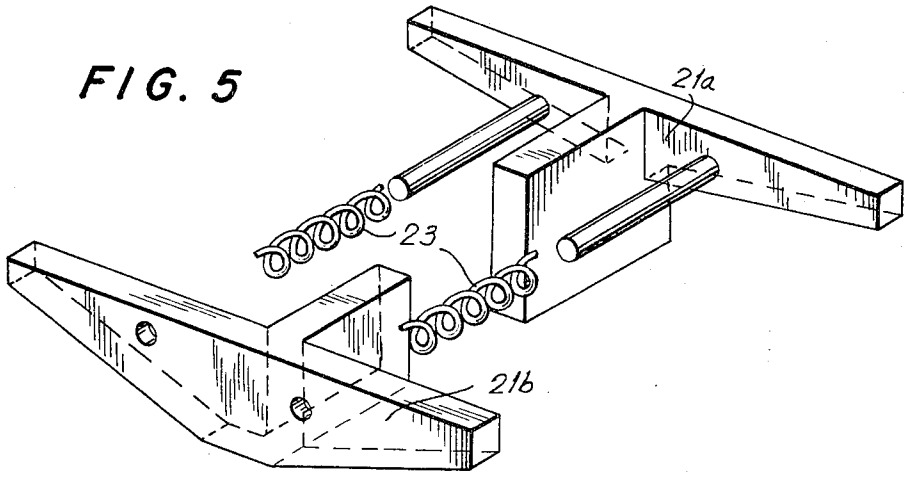

FIG. 6

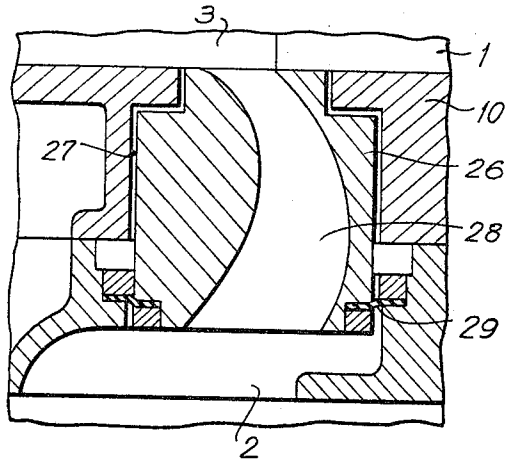

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FIG. 3

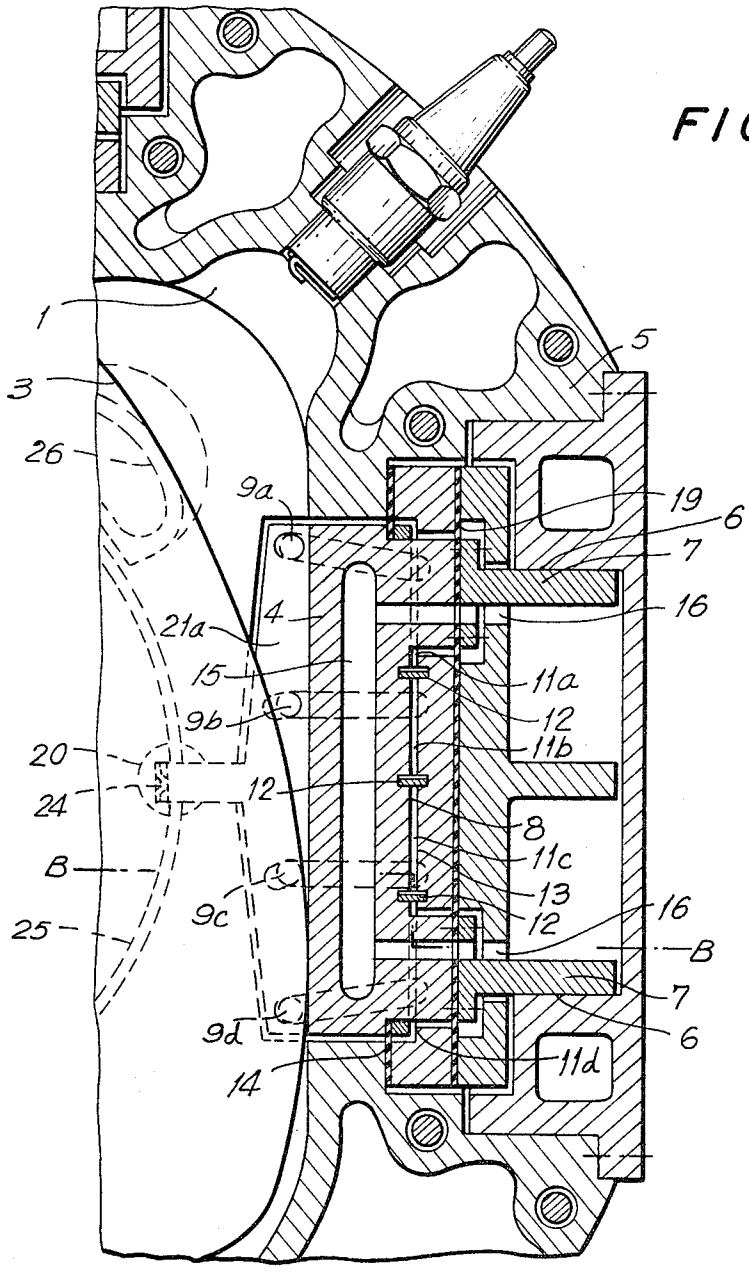

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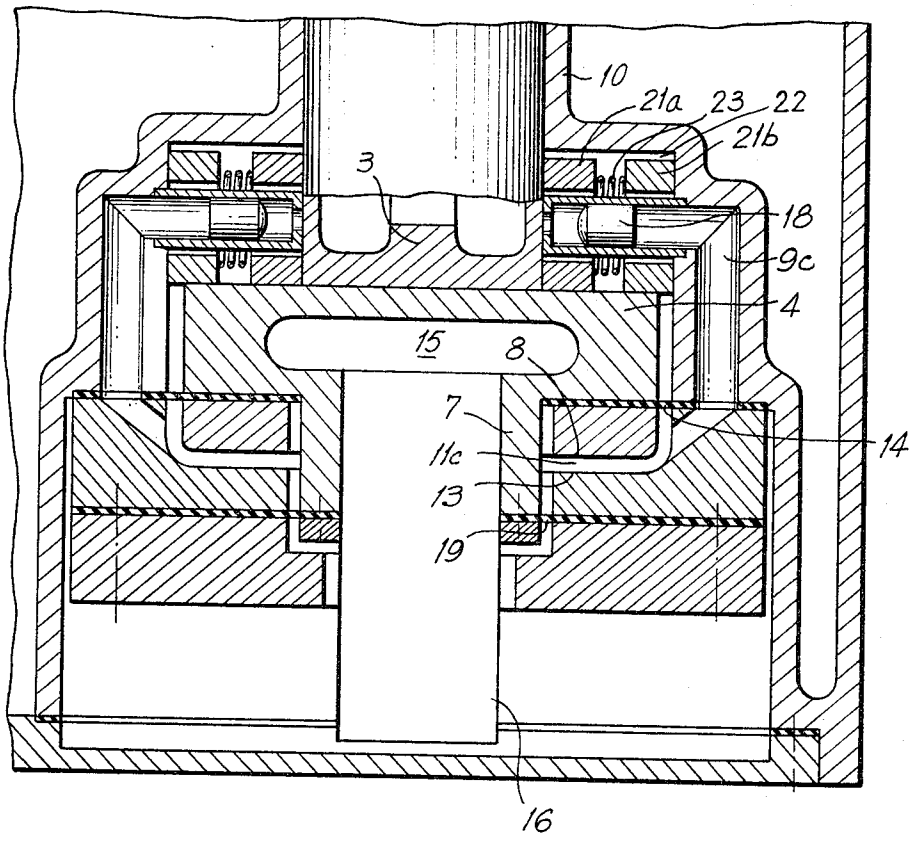
FIG. 4



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SEALING MEANS FOR A POWER DRIVEN MACHINE WITH A ROTARY PISTON

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8 Claims. (Cl. 230—145)

This invention relates to improvements in a machine which can alternatively serve as an internal combustion engine, or a compressor or a pump, said machine being of the type including a rotary piston moving with planetary motion within a piston chamber. The latter is of generally polygonal form, in cross section in a plane normal to the axis of rotation of the main shaft of the machine, and the main portions of the walls of the chamber are formed by slidable wall elements that are capable of movement in radial directions into and out of the piston chamber to maintain sealing contact with the piston.

In machines of the above type it is necessary to provide sealing means to ensure that working medium cannot pass unintentionally from one working space within the piston chamber to another working space therein. Known sealing means for this purpose can be divided into two main categories.

In the first of these, sealing is effected by flaps, packing or the like moving in company with the rotary piston. In the second, reliance is placed on a fine degree of clearance between the cooperating surfaces of the piston and the chamber walls, and on the formation of slots formed at appropriate positions in the surface of the piston and/or chamber wall such as to produce turbulence in these slots sufficient to prevent passage of working medium from one working space to another.

This invention has for its principal object to provide sealing of the piston chamber and for supplying the required contact pressure between the peripheral surface of the piston and the portions of the piston chamber walls capable of radial movement.

The present invention contemplates sealing of the piston chamber of a machine of the type specified, by applying pressure from a working space in the piston chamber to the rear of the slidable wall elements to urge the slidable wall elements into engagement with the peripheral surface of the piston. Conveniently, admission of pressure from the working space to the rear of the slidable elements is controlled so as to increase in excess of the rise of pressure in the said working space.

In one embodiment of the invention, a plurality of passages connect the working space with the rear of the slidable elements, said passage being opened and closed by travel of the piston within the piston chamber.

The invention also contemplates the provision of sealing means in contact with the end walls of the rotary piston and situated between such walls and the slidable wall elements.

These and other objects and features of the invention will be more readily appreciated from the following description of a preferred form of the invention taken in conjunction with the accompanying drawing, in which:

FIGURE 1 is a cross section of the engine according to the present invention,

FIGURE 2 is a cross section taken along line A—A in FIG. 1,

FIGURE 3 is a sectional view on enlarged scale taken through the slidable element of the chamber wall, illustrating a modification of the construction,

FIGURE 4 is a cross section taken along line B—B of FIG. 3,

FIGURE 5 shows a set of T-shape seals used for sealing of the chamber end walls, and

FIGURE 6 is an axial cross section of the outlet passage of a channel of the engine timing system.

The engine shown in FIG. 1, comprises a body or casing 5 having an internal surface defining a piston chamber, the cross section of which is the basic shape of a square. At the corners of the square chamber are recesses 1 forming combustion chambers and recesses 2 forming initial compression chambers. The engine also comprises a piston 3 which moves with a planetary motion inside the piston chamber. The piston is connected with an output shaft (not shown) by means of an eccentric or crank on which the piston is rotatably mounted and the piston is also connected with the body by means of gears (not shown) comprising a stationary internal toothed ring gear and an intermeshing cylindrical toothed gear wheel moving therewithin.

The peripheral surface of the piston contacts the internal surface of the chamber along only the flat surfaces thereof. Such flat surfaces are formed by slidable elements 4 which are in constant contact with the peripheral surface of the piston 3 which rolls over the elements 4 in contact therewith with slippage, forming in this way the working chambers of the engine. The peripheral surface of the piston forms an envelope of the cooperating flat slidable elements 4 of the piston chamber.

Sealing of the working chambers according to the invention is based on employment of the slidable elements 4 forming the flat walls of the piston chamber. The elements 4 cooperate with the rotary piston and are mounted slidably in the body 5 in such a way as to enable the said slidable elements to be always urged radially against the peripheral surface of the piston.

In the embodiment illustrated in FIGS. 1 and 2, the body 5 is formed with annular guideways in which are slidably accommodated tubular carrier portions 7. The carrier portions 7 extend perpendicularly with respect to the flat faces of the elements 4. The pressure between the flat surfaces of elements 4 and the peripheral surface of the rotary piston 3 is established by making use of the working medium within the piston chamber.

Pressure is imparted to the elements 4, in dependence on the pressure within the piston chamber by applying the pressure existing in the piston chamber to a rear surface 8 of the elements 4, via a system of passages connecting different individual spaces in the piston chamber with different areas of the surface 8. The latter are separated from one another by partitions 12. The passages are opened successively by the travel of the piston so that the effective area of the surface 8 subjected to the pressure of the working medium will be gradually increased.

As seen from FIGS. 1 and 2, the passages 9*a*, 9*b*, 9*c*, each has one end opening in the inner face of an end wall of the piston chamber at positions that may be defined as the working spaces of the chamber, e.g. those spaces in which are effected suction, compression, firing and exhaust stages in the case of an internal combustion engine working on the principle of a four stroke cycle. The passage at their other ends communicate respectively with spaces 11*a*, 11*b*, 11*c*, located between the rear wall 8 of the slidable elements 4 and an inner fixed wall 13. The spaces 11*a*, 11*b*, 11*c*, are separated by partitions 12 and are sealed by means of flexible diaphragms or washers 14 covering the spaces between the head of the slidable elements 4 and adjacent surrounding portions of the casing 5.

The head of each element 4 is formed with a cavity 15 for the passage of a cooling medium, which cavity communicates through passages 16 with a space that is formed

within the body of the element and is supplied with a cooling medium in any suitable manner.

A system of passages 9*a*, 9*b*, 9*c*, is provided for each of the elements 4.

The operation by which the slidable elements 4 are urged against the peripheral surface of the piston 3 as a function of the pressure produced in the working chamber will next be described.

During its rotational motion, the piston 3 first uncovers the passage 9*a*. The working medium which is compressed in the working chamber flows through passage 9*a* to the space 11*a* producing a thrust on the corresponding portion of the rear surface 8 of the slidable element 4. The magnitude of this thrust is equal to the product of the pressure existing in the working chamber multiplied by the area of the portion of the surface 8 enclosed in the space 11*a*. The value of this thrust is suitably larger than the thrust of the working medium exerted on that area of the slidable element 4 which has been uncovered, in the working chamber, by the rotating piston.

The difference of the above two thrusts is equal to the required force for urging the flat surface of the slidable element 4 against the peripheral surface of the piston.

During its further motion, the piston 3 uncovers consecutively the channels 9*b* and 9*c* thereby permitting flow of the working medium into the separate spaces 11*b* and 11*c*, which results in increased thrust on the rear surface 8 of the slidable element 4. As a result, the respective increments of the thrust exerted on the surface 8 compensate the increased thrust of the working medium on the increasing exposed area of the slidable element 4 as it is uncovered by the moving piston. The difference of the two thrust forces always produces a resultant force, urging the slidable element 4 against the peripheral surface of the piston 3 to ensure fluid-tightness of the working chamber.

An alternative method of sealing according to the invention is illustrated in FIGS. 3 and 4. It differs from the above described embodiment in that in order to obtain the sealing pressure of the slidable element 4 against the peripheral surface of the piston 3, hydraulic fluid is utilized for transmitting the pressure from the working chamber to individual spaces. In the modification in FIGS. 3 and 4 there are utilized for each element 4, four spaces 11*a*, 11*b*, 11*c*, 11*d* separated as before by the partitions 12. Outlets of the channels 9*a*, 9*b*, 9*c*, 9*d* shown in FIGS. 3 and 4 are provided with devices 18 for transmitting the pressure of the working medium in the working chamber to the hydraulic medium in channels 9*a*, 9*b*, 9*c*, 9*d* and the individual spaces 11*a*, 11*b*, 11*c*, and 11*d*. The device 18 can be a plunger as shown, or a diaphragm or any other suitable element for transmitting pressure to the hydraulic medium. In order to separate the space in which the hydraulic medium is contained, the slidable element 4 of the piston chamber wall is connected with the casing 5 and with the casing wall 13 by means of at least two flexible diaphragms 14 and 19 which permit radial movements of the said slidable element 4.

The operation of the above described modification, for transmitting the pressure of the working medium from the working chamber to the rear surface 8 of the slidable element 4 is as follows:

The pressure of the working medium in the working chamber acts on the plunger 18 in the channel 9*a* when it is uncovered by the moving piston 3. This causes a corresponding increment of pressure on the hydraulic medium contained in said channel and in the separated space 11*a*. This results in an increment of the thrust exerted by the hydraulic medium on the corresponding portion of the rear surface 8 of the slidable element 4. As the moving piston 3 successively uncovers the next channels (9*b*, 9*c*, and 9*d*) the plungers in the outlets of said channels transmit the pressure of the working medium in the working chamber, to the hydraulic medium contained in the said channels and in the respective separate spaces 11*b*, 11*c* and 11*d*, this producing further increments of the total thrust acting on the rear surface 8 of the slidable element 4. The magnitude of this thrust is always established to ensure that it is always larger than the thrust caused by the pressure of the working medium exerted on the part of surface of the slidable element 4 uncovered in the piston chamber by the moving piston, and the difference of the two thrusts is equal to that required for urging the slidable element 4 against the peripheral surface of the piston 3, so as to ensure tight sealing between the working spaces in the piston chamber.

The sealing between the end wall 10 of the body and the opposed surface of the piston 3 is obtained by means of a set of sealing elements, 21*a*, 21*b* carried on pins 20 slidably fitted in recesses in the end wall 10 and urged by means of springs 23 against the end surface of the piston 3. The sealing elements in a cross section transverse to the axis of rotation of the engine have the shape of a T with a long horizontal arm and are also used for sealing the surface of contact between the slidable element 4 with the end wall 10 of said chamber. Further sealing elements 25 are fitted in the face wall 10 of the cylinder and seal the recesses accommodating the pins 20.

The sealing elements 21*a*, 21*b* as seen in FIGS. 2 and 4 are urged by means of the springs 23 against the end surfaces of the piston 3 and engage also the working surfaces of the sliding elements 4. The sealing elements 21*a* and 21*b* are fitted in a recess 22 in the end wall 10 of the piston chamber and are forced apart by means of the springs 23 in order to produce a force urging them against the end face of the piston 3. The elements 21*a*, 21*b* are also urged by means of the elastic element 24, against the surface of the slidable element 4. The sealing elements 25 shown in FIG. 1 are in the form of rings yieldingly pressed by means (not shown) against the end surface of the piston 3.

In addition, the invention provides for a twin engine having two similar engine components side by side with sealing of outlet holes of certan passages in the engine timing system. In FIG. 6 there is shown an element 26 sealing the outlet passage between the initial compression recess 2 of one engine component and the combustion recess 1 of the other component. The sealing element 26 is in the form of a sleeve 26 slidably fitted in a recess 27 of an end wall 10 separating the two adjacent piston chambers of a twin engine. The sleeve 26 is provided with a channel 28 having a shape and cross sectional area which are suitable for the required flow of the working medium. The sleeve 26 is urged against the end face of the piston 3 by means of a spring ring 29 which also forms a diaphragm seal for preventing escape of fluid medium from the combustion chamber 1 of one of the twin engine components to the initial compression chamber 2 of the other engine component.

What is claimed is:

1. An engine comprising a body having an internal surface defining a chamber, a piston member in said chamber and having relative rotation therein, said piston member having a peripheral surface which contacts the internal surface of the chamber, said chamber being restricted to provide only flat surfaces where it is contacted by the peripheral surface of the piston, said flat surfaces being formed by slidable elements mounted in said body, said peripheral surface of the piston forming the envelope of the cooperating flat surfaces of the chamber to form combustion chambers therein for a working medium and means defining passage extending from the interior of the chamber to the rear of the slidable elements for the flow of working medium from within the chamber towards said slidable elements such that the resultant force of the working medium acting on the slidable elements urges the same against the peripheral surface of the piston member.

2. An engine as claimed in claim 1 comprising partitions in said slidable elements defining separated spaces

therein at the rear of the slidable elements, said passage means comprising separate channels connecting said spaces with the interior of the chamber, said body having end walls, said channels having outlets which open in said end walls of the body and are consecutively uncovered by the piston member.

3. An engine as claimed in claim 2 wherein said channels and spaces are adapted for being filled with a hydraulic medium which is adapted for transmitting pressure, and means in said channels for transmitting pressure from said working medium to said hydraulic medium.

4. An engine as claimed in claim 1 comprising diaphragms connecting the slidable elements with the body to seal the same while permitting relative sliding therebetween.

5. An engine as claimed in claim 1 wherein said body and piston member have associated end surfaces, and means accommodated in the end surface of the body for sealingly contacting the associated end surface of the piston member while also sealingly contacting the flat surface of an associated slidable element in a region immediately adjacent where it contacts the piston member.

6. An engine as claimed in claim 1 wherein said body and piston member have end surfaces, and means for sealing said end surfaces, comprising pins slidably fitted in the body at the end surface thereof, seals connecting said pins, and further seals having a T shape cross-section and including elastic means urging the latter

seals against the surface of the slidable element and the end surface of the piston member.

7. A engine as claimed in claim 6 wherein said T shape seals comprise two parts fitted in the body at said end surface thereof, said elastic means being between said parts to urge the same away from one another.

8. An engine as claimed in claim 1 wherein said engine has outlet channels for an engine timing system comprising a sleeve having a channel mounted slidably in the body in the end wall thereof to furnish said outlet channel, and ring type springs constituting sealing diaphragms acting on said sleeve to urge the same into contact with the piston member at the end surface thereof.

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