Feb. 13, 1945. R. D. DELAMERE 2,369,539

DISPLACEMENT APPARATUS

Filed May 2, 1942

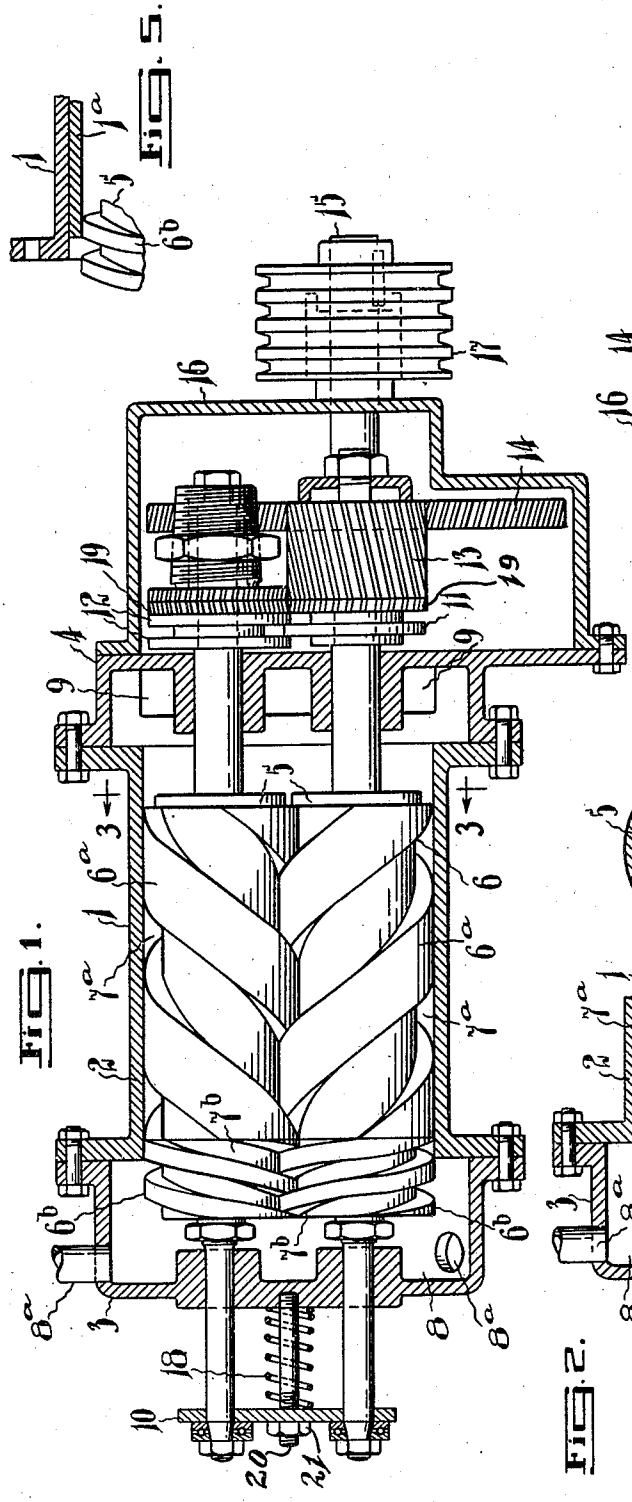


Fig. 1.

Fig. 5.

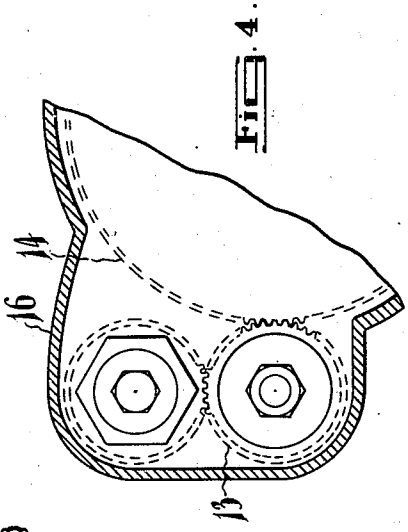


Fig. 4.

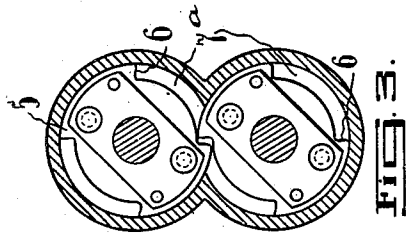


Fig. 3.

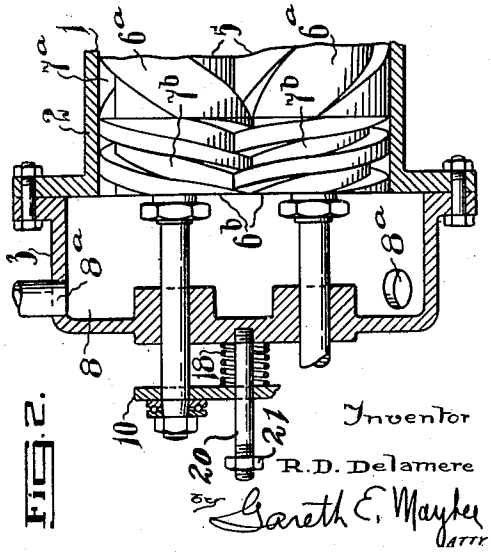


Fig. 2.

Inventor

R. D. Delamere

by Gareth E. Mayler

Attr

Patented Feb. 13, 1945 2,369,539

UNITED STATES PATENT OFFICE

2,369,539

DISPLACEMENT APPARATUS

Rudolf D. Delamere, Toronto, Ontario, Canada

Application May 2, 1942, Serial No. 441,517

4 Claims. (Cl. 230—143)

This invention relates to displacement apparatus and more particularly to apparatus which may be driven to serve as a pump or which may be operated to produce mechanical energy to serve as a turbine, motor or the like. The object of my present invention is to provide simple apparatus of this character in which the compression or expansion ratio may be varied. Other objects I have in mind will hereinafter appear.

The constructions are hereinafter fully described and are illustrated by way of example in the accompanying drawing, in which

Fig. 1 is a horizontal longitudinal section of the apparatus;

Fig. 2 a horizontal longitudinal sectional detail showing the ribbed elements positioned to obtain the maximum ratio of compression or expansion;

Fig. 3 a cross-section on the line 3—3 in Fig. 1;

Fig. 4 an end view of the apparatus showing the gearing; and

Fig. 5 a detail of a modified form of the apparatus.

In the drawing like numerals of reference indicate corresponding parts in the different figures.

1 is a casing which may include a central and two end sections 2, 3 and 4. The central section 2 has two substantially parallel, longitudinally intersecting bores in which are mounted two helically ribbed elements 5 so that their ribs 6 will mesh with one another when rotated in opposite directions. Each rib on each element comprises a comparatively long pitched portion 6^a and a short pitched portion 6^b. The outside diameter of the ribbed portions 6^a and 6^b on each element is constant throughout the length of the element. The said portions 6^a, 6^b may be made integral or on separate parts secured together so that the said portions on each element adjoin one another.

As the elements are rotated, a succession of pockets 7^a, 7^b are formed which vary in size in accordance with the variation in the pitch of the ribs 6. The large sized pockets 7^a are formed by the peripheral spaces between adjacent ribs on the long pitched portion 6^a and the wall of the bore in which the element is rotated, and the small sized pockets 7^b are similarly formed by the short pitched portions 6^b. The small pockets communicate with a chamber 8 in the end section 3 of the casing. Said chamber has an outlet 8^a. The large pockets communicate with openings 9 in the end section 4. Thus gas trapped in a large pocket 7^a is moved longitudinally by the long pitched portion 6^a into contact with the short pitched portion 6^b whereby the pocket is reduced to the small pocket 7^b and the gas is compressed therein. The compression ratio of the gas entering and leaving the pockets may be such that the pressure of the gas in the small pocket 7^b equals the pressure of the gas in the chamber 8. There will thus be no flow of gas from the chamber into the small pocket when it is opened whereby only the supply of gas in the small pocket is ejected by the short pitched portions 6^b when said pocket is opened into the chamber. By preventing the backflow of gas under pressure from the chamber into the pockets not only is less power required to drive the elements when the apparatus is being used as a pump but it eliminates flutter or pulsation from the outflowing gas. Heretofore, in pumps having elements driven in opposite directions of rotation it has been found necessary to employ three ribs, formed like a triple thread, on each element to reduce the noise created by the pulsations. In pumps of the above mentioned type, what I term, the total geometrical leakage area increases directly as the number of ribs employed. The said leakage area may be defined as the area of the material removed from a rib to permit the rib of an oppositely rotating element to mesh therewith in spite of the difference in helical angle of the top and bottom of a rib. Thus the more ribs used, the greater the leakage. Moreover, other things being equal this leakage area increases rapidly with an increase in lead. By preventing backflow, as hereinbefore described, my pump operates quietly and efficiently with only one or two ribs on each element. If the pump is to be operated at high speed which necessitates inherent dynamic balance two ribs are necessary.

The short and long pitched rib portions also have another purpose in that steam or other gas under pressure may be directed through the pipe 8^a and chamber 8 into the small pockets to drive the elements 5. The steam or other compressed gas trapped in the small pockets will travel longitudinally as the short pitched portions of the ribs 6 are rotated until it is brought into contact with the long pitched portions of the ribs when it will expand into the succeeding large pockets thus providing additional energy without additional steam. The expanded gas then escapes through the openings 9.

The opposite ends of the elements are provided with spindles which are journalled in the end sections 3 and 4. These spindles are of sufficient length to permit relative axial movement of the elements 5 and the casing 1 whereby the compression or expansion ratio between the pockets 7^a and 7^b may be varied. The spindles may be

connected, at one end of the casing, by a bar 10 and, at the other end of the casing, by a disk 11 and flanged wheel 12 to receive the disk. Pinions 19 suitably carried by the spindles are meshed with one another to rotate the elements in opposite directions of rotation. One of the spindles carries a long pinion 13 which meshes with a gear 14 on a shaft 15 which is suitably journalled in a housing 16 carried by the end section 4. The shaft 15 carries one or more pulleys 17 whereby the shaft may be driven to drive the elements or the latter may be driven to drive the pulleys.

One or more springs 18, disposed on studs 20 or the like threaded into the end section 3, may be employed to urge the elements 5 to the position shown in Fig. 1 in which only about 25% of the small pockets is effective and thus the compression ratio is about 1.25 to 1, i. e., about 80% cut-off. The spring 18 bears against the bar 10 to urge it against the nut 21 threaded on the stud 20. The nut thus forms a stop to limit the axial movement of the elements 5 and initially control the point of communication between the pockets 7^b and the bores in the casing as shown in Fig. 1. It is obvious that the point of communication may be varied to vary the compression ratio of the gas by adjusting the nut 21 on its stud 20. If the apparatus is being used as a pump, the pressure in the chamber 8 gradually increases to correspondingly shift the elements relative to their bores against the compression of the spring 18 whereby the small pockets 7^b are correspondingly closed to increase the compression ratio until it reaches its maximum as shown in Fig. 2. In the drawing the maximum ratio is 4 to 1, i. e., 25% cut-off since the long pitch 6^a of the ribs 6 is four times the length of the short pitch 6^b. If the short pitched portions of the elements are entirely withdrawn from the bores in the casing only the large pockets are closed and a one to one compression ratio would be obtained, i. e., 100% cut-off. If the apparatus is being used as a turbine in which steam or other gas under pressure is admitted through the pipe 8^a into the chamber 8, the elements would be shifted to obtain the maximum expansion ratio between the small and large pockets immediately sufficient pressure is built up in the chamber to overcome the pressure of the spring or springs 18. As the elements are axially moved to cover or to uncover the small pockets 7^b, the teeth of the long pinion 13 slide across the intermeshing teeth of the gear 14.

It will be distinctly understood that various modifications may be made without departing from the spirit of the invention. For instance, the intermeshing elements 5 may be mounted in longitudinally intersecting bores formed in non-rotary sleeves 1^a which are suitably guided for axial movement relative to the casing 1 and to the elements 5. Thus by manually or automatically moving the sleeves axially relative to the elements, the compression or expansion ratio between the large and small pockets will be varied.

What I claim as my invention is:

1. A gas pump or motor comprising a casing having a central and two end sections, the central section having two bores intersecting one another; two axially movable helically ribbed elements meshed with one another and rotatable in opposite directions in said bores to form gas trapping pockets between the ribs and the walls of the bores, the ribs on the elements having comparatively long and short pitched portions to form large and small pockets, the end section of the casing adjacent the short pitched portions of the elements being of greater cross sectional area than that of the bores; means for admitting or exhausting gas into or from the last mentioned end section; means for exhausting or admitting gas from or into the other end section, the gas being thus brought directly into communication with the small or large pockets and with the ends of the ribbed elements, the elements being axially movable in the bores in a direction to correspond to a difference in pressure between the end sections, the extent of movement of the short pitched portions into the bores varying the length of the small pockets to correspondingly vary the compression or expansion ratio of said small and large pockets; and spring means opposing the axial movement of the elements by pressure against the ends of the elements adjacent the short pitched portions thereof to proportion the extent of movement of said short pitched portions into the bores in accordance with the pressure against the said ends.

2. A gas pump or motor constructed in accordance with claim 1 in which a stop is provided to limit the axial movement of the elements imparted thereto by the spring means so that a predetermined length of the short pitched portions of the elements may be initially positioned in the bores to obtain an initial compression or expansion ratio.

3. A gas pump or motor comprising a casing having a central and two end sections, the central section having two bores intersecting one another; two axially movable helically ribbed elements meshed with one another and rotatable in opposite directions in said bores to form gas trapping pockets between the ribs and the walls of the bores, the ribs on the elements having comparatively long and short pitched portions to form large and small pockets, the end section of the casing adjacent the short pitched portions of the elements being of greater cross sectional area than that of the bores; means for admitting or exhausting gas into or from the last mentioned end section; means for exhausting or admitting gas from or into the other end section, the gas being thus brought directly into communication with the small or large pockets and with the ends of the ribbed elements, the elements being axially movable in the bores in a direction to correspond to a difference in pressure between the end sections, the extent of movement of the short pitched portions into the bores varying the length of the small pockets to correspondingly vary the compression or expansion ratio of said small and large pockets; spring means opposing the axial movement of the elements by pressure against the ends of the elements adjacent the short pitched portions thereof to proportion the extent of movement of said short pitched portions into the bores in accordance with the pressure against the said ends; and an adjustable stop for limiting the axial movement of the elements imparted thereto by the spring means so that a variable predetermined length of the short pitched portions of the elements may be initially positioned in the bores to obtain a variable initial compression or expansion ratio.

4. A gas pump or motor comprising a casing having a central and two end sections, the central section having two bores intersecting one another; two helically ribbed elements meshed with one another and rotatable in opposite directions in said bores to form gas trapping pockets between the ribs and the walls of the bores, the ribs on the elements having comparatively

long and short pitched portions to form large and small pockets, the end section of the casing adjacent the short pitched portions of the elements being of greater cross sectional area than that of the bores, the elements and bores being axially movable relative to one another; means for admitting or exhausting gas into or from the last mentioned end section; means for exhausting or admitting gas from or into the other end section, the gas being thus brought directly into communication with the small or large pockets and with the ends of the ribbed elements, the elements and bores being axially movable relative to one another in a direction to correspond to a difference in pressure between the end sections, the extent of relative movement of the elements and bores varying the length of the small pockets in the bores to correspondingly vary the compression or expansion ratio of said small and large pockets; and spring means opposing the relative movement of said elements and bores by pressure against the movable part of said elements and bores to resist an increase in the length of the small pockets to proportion the length of said small pockets in accordance with the aforesaid pressure against the movable part of said elements and bores.

RUDOLF D. DELAMERE.