

Feb. 28, 1950

R. R. CANDOR
COUNTERBALANCING DEVICE

2,498,877

Filed Oct. 8, 1948

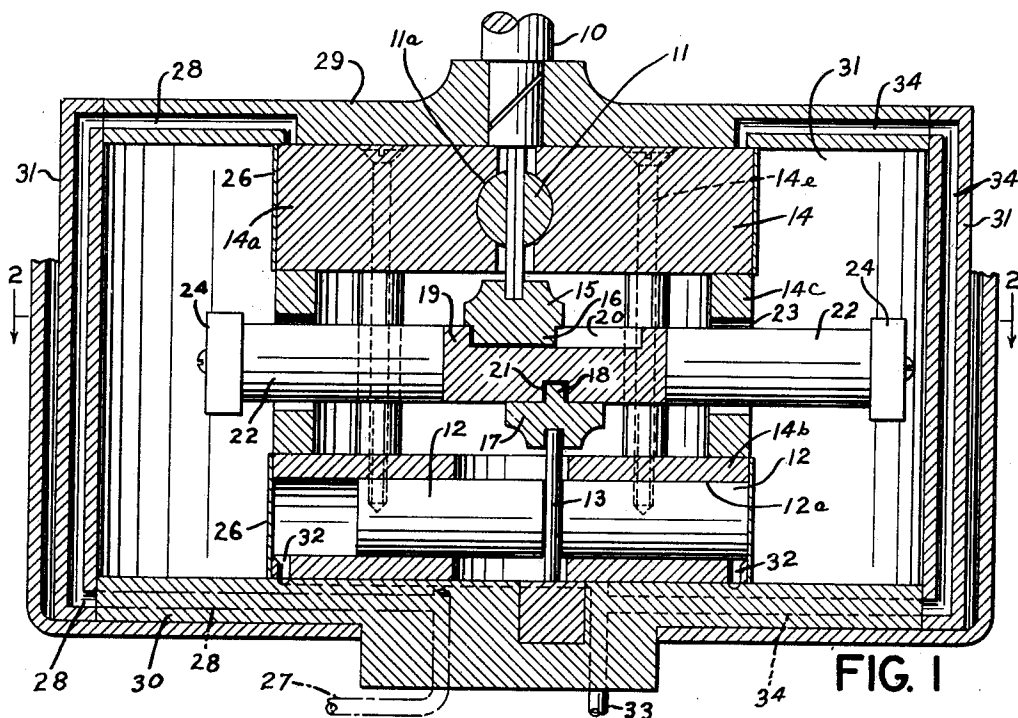


FIG. 1

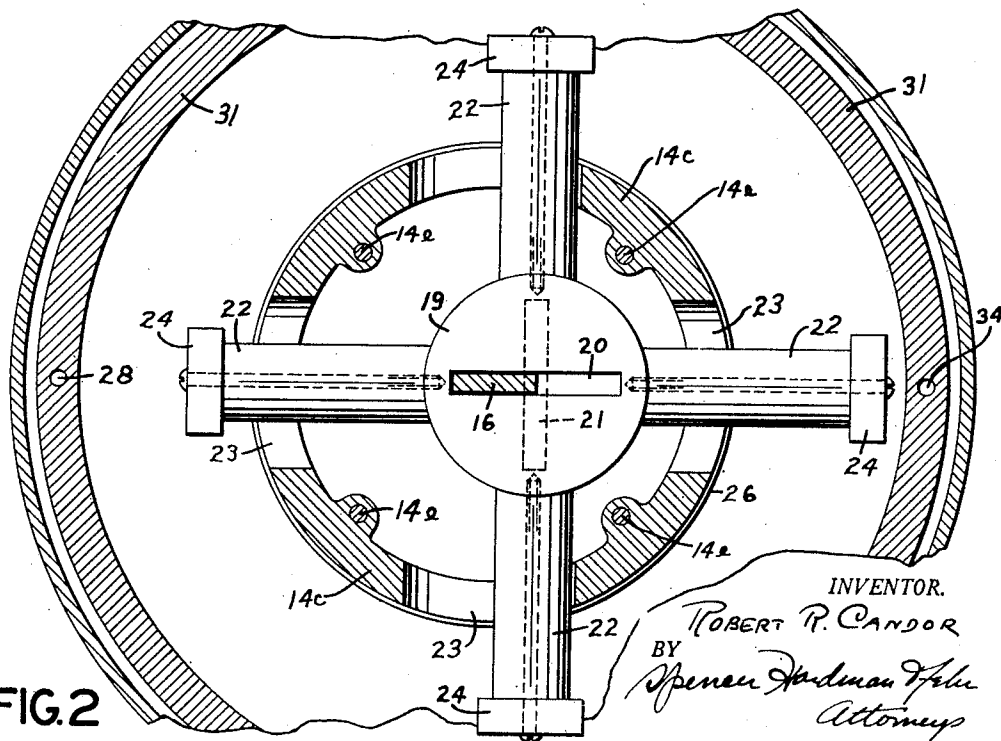


FIG. 2

INVENTOR.

ROBERT R. CANDOR

BY

Spencer Hardman Felt
Attorneys

UNITED STATES PATENT OFFICE

2,498,877

COUNTERBALANCING DEVICE

Robert R. Candor, Oakwood, Ohio, assignor to
General Motors Corporation, Dayton, Ohio, a
corporation of Delaware

Application October 8, 1948, Serial No. 53,584

6 Claims. (Cl. 74—603)

1

This invention relates to refrigerating apparatus; and more particularly to fluid translating devices for compressing gases or pumping liquids.

An object of this invention is to provide a fluid translating device, such as a gas compressor, or a liquid pump, in which pairs of aligned pistons rotate about offset axes, and cause a cylinder supporting structure to rotate about an orbital axis, and in which counterbalancing means is provided in counterbalancing relation to said cylinder supporting structure.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawing, wherein a preferred form of the present invention is clearly shown.

In the drawings:

Fig. 1 is a vertical cross-section of an apparatus embodying features of my invention; and

Fig. 2 is a horizontal cross-section taken more or less along the line 2—2 of Fig. 1.

The structure herein disclosed may compress a gas in a refrigerating system or in any other system, or may pump a liquid for any purpose.

The mechanism may include a rotary drive shaft 10, which is drivingly secured to a pair of aligned pistons 11, to rotate them about the axis of the shaft. A second pair of aligned pistons 12 are mounted to rotate about an axis offset from and parallel to the axis of the shaft 10. The pistons 11 may have a longitudinal construction substantially the same as that of pistons 12, but at right angles thereto. Conveniently the pistons 12 may be mounted to rotate about an axis established by the fixed pin 13. A cylinder supporting structure 14 is free to rotate about an orbitally moving axis, since it reciprocally receives the pistons 11 and 12 in cylinders 11a and 12a respectively. The structure 14 is a rigid structure which may be constructed by providing an upper disc 14a containing cylinders 11a and a lower disc 14b containing cylinders 12a, which discs are joined together by vertical walls 14c. The entire structure 14 is clamped rigidly together by the bolts or screws 14e.

A counterbalancing structure is provided, together with means to drive the counterbalancing structure in counterbalancing relationship to the cylinder supporting structure 14. This conveniently may take the form of a first counterbalance guider 15 which is keyed to the shaft 10, and is rotatable coaxially with the shaft 10. The guider 15 is provided with a first linear sliding surface, formed by the key 16. The key 16 is at right angles to the first pair of pistons 11. A second

2

counterbalancing guider 17 is mounted to rotate coaxially with the second pair of pistons 12, and conveniently may have a bearing surface on the pin 13 to cause such rotation. The guider 17, has a second linear sliding surface, which is formed by the longitudinal key 18. This sliding surface 18 is at right angles to the second pair of pistons 12. A counterbalancing structure 19 is free to rotate about an orbitally moving axis, and is guided in its rotation by the third and fourth linear sliding surfaces 20 and 21 respectively in sliding relationship to the surfaces 16 and 18. The sliding surfaces 20 and 21 preferably are longitudinal grooves formed in the structure 19, at right angles to the pairs of pistons 11 and 12 respectively, as shown in the drawings. The counterbalancing structure 19 may be a heavy weight formed wholly within the cylinder supporting structure 14, or it may be provided with radial arms 22 extending through openings 23 in the structure 14. The arms 22 may be provided with weights 24. The openings 23 are sufficiently large to permit the necessary relative movement of the arms 22. The mass of the counterbalancing structure is so chosen that it exerts a substantially equal and opposite centrifugal force to the cylinder supporting structure 14.

Any suitable valving or porting may be provided for the compressing or pumping spaces. For example, the cylinders 11a and 12a may be sealed at the ends by means of bands 26, which may be welded or bolted to the discs 14a and 14b. An inlet pipe 27 is connected to a passageway 28 leading to suitable grooves in the plates 29 and 30, which form the outer casing of the compressor, together with the cylindrical wall 31. The inlet grooves are formed in the plates 29 and 30 in arc-like forms at those places in the orbits of the ends of the cylinders where the pistons are moving relatively inward to perform a suction stroke. The grooves in the plates 29 and 30 are joined to the cylinders by passageways 32 which cooperate with the inlet grooves to connect the cylinders with the intake pipe 27. Likewise a discharge pipe 33 is connected by passageways 34 with other arc-like discharge grooves in the plates 29 and 30, so positioned as to connect with the cylinders at those places in their orbits where the pistons are performing a compressing stroke. The location of the grooves may be correctly determined by assembling the machine and providing markers in the passageways 32, which will make arc-like marks on the plates 29 and 30, and these may be used to guide in the forming of the grooves. The arcs forming the intake and com-

pression strokes may be ascertained by observing the relative movement of the pistons and the cylinders, and thus correct grooves may be formed in the plates 29 and 30 to provide inlet and discharge grooves for the cylinders.

While the porting of the cylinders has been indicated to be formed by grooves, it is to be understood that other valving means may be provided, such as check valves at the ends of the cylinders and pistons, together with the passageways leading into the center of the pistons which may be hollowed out with each passageway leading to the check valves at ends of the pistons, as is well known in the compressor and pumping art.

Proper lubrication may be provided by placing lubricant in the casing formed by the plates 29 and 30 and the cylindrical wall 31. Lubrication may be accomplished by splash action, or by the usual oil grooves formed in relatively moving surfaces, as is well known in the lubrication art.

In the operation machine, the shaft 10 is rotatably driven by any suitable power means. This causes the pistons 11 to rotate about the axis of shaft 10 and also causes similar rotation of the guider 15. Rotation of the pistons 11 cause rotation of the cylinder supporting structure 14, which cylinder supporting structure 14, however, is also free to reciprocate relatively to the pistons 11, since the cylinders 11a which receive pistons 11 are longer than the pistons 11 and extend throughout the diameter of the plate 14a. Rotation of the structure 14, including the plate 14b, in turn causes rotation of the pistons 12 about the offset axis formed by the pin 13. The structure 14 is also free to reciprocate relatively to the pistons 12 by reason of the longitudinal extent of the cylinders 12a which are longer than the pistons 12. The axis of rotation of the cylinder supporting structure 14 moves about a circular orbit the diameter of which is established by the axes of the shaft 10 and pin 13, and this orbit is completed twice during each revolution of the shaft 10. The cylinder supporting structure 14 therefore has a planetary rotating movement about a center midway between the axes of the shaft 10 and pin 13.

In the meantime, the counterbalancing structure 19 also has a planetary rotating movement, with its axis of rotation moving in a circular orbit the center of which is midway between the axes of the shaft 10 and pin 13. The axis of rotation of the counterbalance structure 19 is at 180 degrees from the axis of rotation of the cylinder supporting structure 14, by reason of the 90 degree offset between grooves 20 and 21 and the respective pistons 11 and 12. Therefore the counterbalancing structure 19 completely counterbalances the otherwise unbalanced centrifugal force of the structure 14, and provides a dynamically and statically counterbalance mechanism.

While the form of embodiment of the invention as herein disclosed, constitutes a preferred form, it is to be understood that other forms might be adopted, as may come within the scope of the claims which follow.

What is claimed is as follows:

1. In a device of the character described in combination: a rotary drive shaft; a first pair of aligned pistons drivingly secured to said shaft to rotate about the axis of said shaft; a first counterbalance guider rotatable coaxially with said shaft and having a first linear sliding surface at right angles to said first pair of pistons; a second pair of aligned pistons mounted to rotate

about an axis offset from the axis of said shaft; a second counterbalance guider mounted to rotate coaxially with said second pair of pistons and having a second linear sliding surface at right angles to said second pair of pistons; a cylinder supporting structure free to rotate about an orbitally moving axis and including cylinders reciprocally receiving said first and second pairs of pistons; and a counterbalancing structure free to rotate about an orbitally moving axis and having third and fourth linear sliding surfaces at right angles to each other and reciprocally receiving said first and second linear sliding surfaces respectively.

2. In a device of the character described, in combination: a rotary drive shaft; a first pair of aligned pistons drivingly secured to said shaft to rotate about the axis of said shaft; a first counterbalance guider rotatable coaxially with said shaft and having a first linear sliding surface at right angles to said first pair of pistons; a second pair of aligned pistons mounted to rotate about an axis offset from the axis of said shaft; a second counterbalance guider mounted to rotate coaxially with said second pair of pistons and having a second linear sliding surface at right angles to said second pair of pistons; a cylinder supporting structure free to rotate about an orbitally moving axis and including cylinders reciprocally receiving said first and second pairs of pistons; and a counterbalancing structure free to rotate about an orbitally moving axis and having third and fourth linear sliding surfaces at right angles to each other and reciprocally receiving said first and second linear sliding surfaces respectively, said counterbalancing structure being located between said pairs of pistons.

3. In a device of the character described in combination: a rotary drive shaft; a first pair of aligned pistons drivingly secured to said shaft to rotate about the axis of said shaft; a first counterbalance guider rotatable coaxially with said shaft and having a first linear sliding surface at right angles to said first pair of pistons; a second pair of aligned pistons mounted to rotate about an axis offset from the axis of said shaft; a second counterbalance guider mounted to rotate coaxially with said second pair of pistons and having a second linear sliding surface at right angles to said second pair of pistons; a cylinder supporting structure free to rotate about an orbitally moving axis and including cylinders reciprocally receiving said first and second pairs of pistons; and a counterbalancing structure free to rotate about an orbitally moving axis and having third and fourth linear sliding surfaces at right angles to each other and reciprocally receiving said first and second linear sliding surfaces respectively, said counterbalance guiders being located between said pairs of pistons.

4. In a device of the character described, in combination: a rotary drive shaft; a first pair of aligned pistons drivingly secured to said shaft to rotate about the axis of said shaft; a first counterbalance guider rotatable coaxially with said shaft and having a first linear sliding surface at right angles to said first pair of pistons; a second pair of aligned pistons mounted to rotate about an axis offset from the axis of said shaft; a second counterbalance guider mounted to rotate coaxially with said second pair of pistons and having a second linear sliding surface at right angles to said second pair of pistons; a cylinder supporting structure free to rotate about an orbitally moving axis and including cylinders reciprocally receiving said first and

5

second pairs of pistons; and a counterbalancing structure free to rotate about an orbitally moving axis and having third and fourth linear sliding surfaces at right angles to each other and reciprocably receiving said first and second linear sliding surfaces respectively, said counterbalancing structure and counterbalance guiders being located between said pairs of pistons.

5. In a device of the character described, in combination: a rotary drive shaft; a pair of aligned pistons drivingly secured to said shaft to rotate about the axis of said shaft; a second pair of aligned pistons mounted to rotate about an axis offset from the axis of said shaft; a cylinder supporting structure free to rotate about an orbitally moving axis and including cylinders reciprocably receiving said pairs of pistons; a counterbalancing structure; and means to drive said counterbalancing structure in counter-

6

balancing relationship to said cylinders and cylinder supporting structure.

6. In a device of the character described, in combination: a rotary drive shaft; a pair of aligned pistons drivingly secured to said shaft to rotate about the axis of said shaft; a second pair of aligned pistons mounted to rotate about an axis offset from the axis of said shaft; a cylinder supporting structure free to rotate about an orbitally moving axis and including cylinders reciprocably receiving said pairs of pistons; a counterbalancing structure; and means to drive said counterbalancing structure rotatably about an orbitally moving axis in counterbalancing relationship to said cylinders and cylinder supporting structure.

ROBERT R. CANDOR.

No references cited.