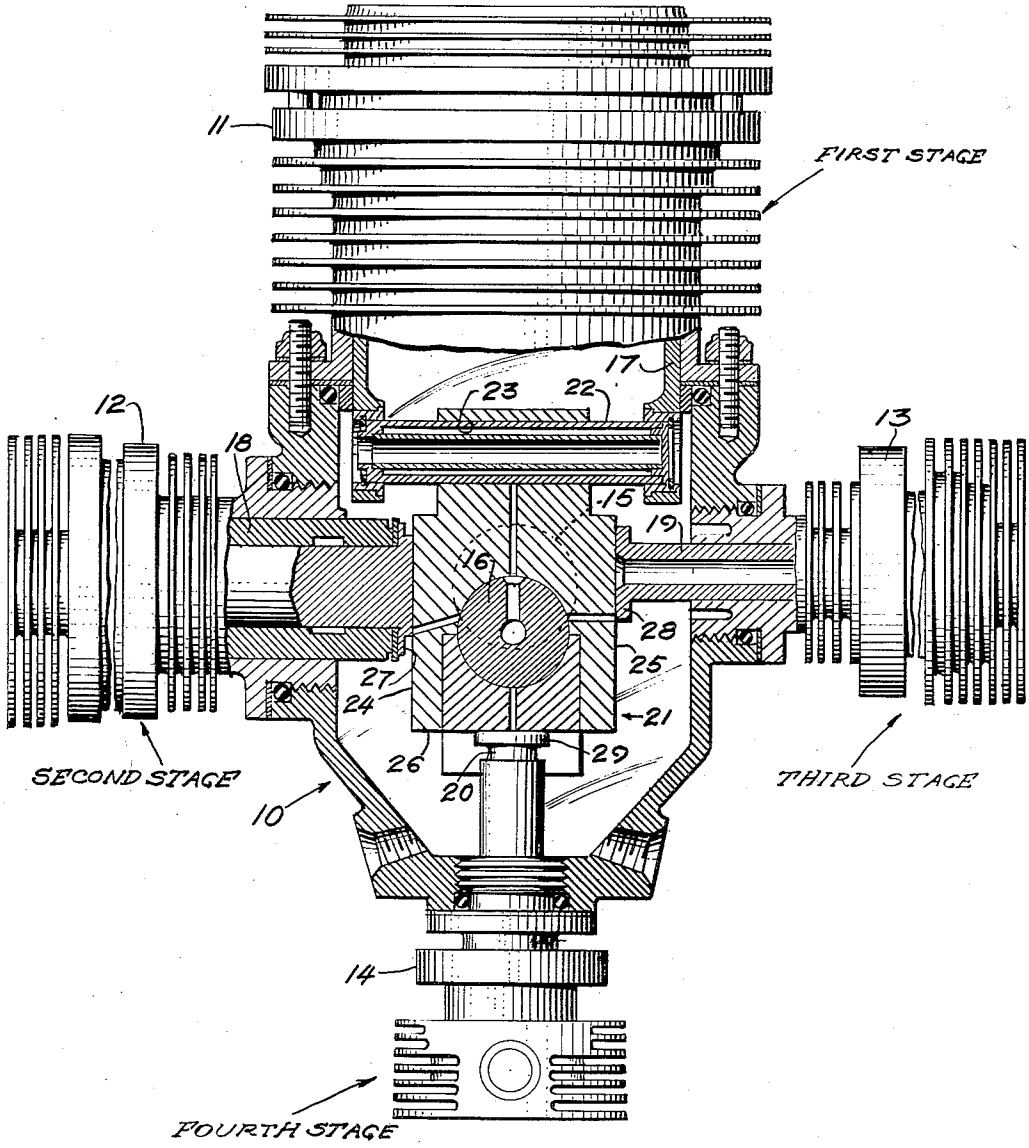
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COMPRESSOR

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COMPRESSOR

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The present invention relates to compressors, and, more particularly, to an air compressor of the multi-stage type which is an improvement over the four-stage radial compressor disclosed in United States Patent No. 2,562,954.

While compressors of the type described in the aforementioned patent can be operated at high speeds to supply compressed air or other gases at pressures of 3000 pounds per square inch and a satisfactory rate of flow, it has been found that the compressors vibrate considerably and that the keystone member and follower means are subjected to excessive wear.

Accordingly, an object of the present invention is to provide a radial multi-stage compressor wherein vibrations are reduced to a minimum.

Another object is to provide such a compressor wherein the wear life of the cam and follower means is prolonged.

Another object is to reduce the size and mass of such a compressor without sacrifice of flow rate or output pressure.

A further object is to simplify the design of such compressors to thereby reduce the cost thereof and facilitate manufacture and assembly.

Other and further objects of the invention will be obvious upon an understanding of the illustrative embodiment about to be described, or will be indicated in the appended claims, and various advantages not referred to herein will occur to one skilled in the art upon employment of the invention in practice.

In accordance with the invention, the foregoing objects are accomplished by embodying improvements in such compressors which comprise arranging the cylinders so that two are in vertical alignment and two are in horizontal alignment, preferably with the longitudinal axes of the vertical cylinders and one of the horizontal cylinders intersecting at the axis about which the shaft rotates (the other horizontal cylinder being offset with respect to the shaft axis) and with the first stage cylinder opposite the fourth stage cylinder and the second stage cylinder opposite the third stage cylinder; providing a cam having two cam surfaces at the sides which are parallel to each other and a third surface at the bottom which is perpendicular to the parallel surfaces with the fourth stage piston cam follower means engaging the bottom surface and the second and third stage piston cam follower means engaging the side surfaces; and providing cam follower means which are rigid with respect to the pistons carrying the same, and which preferably are integrally formed or secured therewith.

A preferred embodiment of the invention has been chosen for purposes of illustration and description, and is shown in the accompanying drawing, forming a part of the specification, wherein the single figure is a front elevational view, partly in longitudinal section, of a radial multi-stage compressor illustrating the essential elements of the present invention and their arrangement.

Referring to the drawing, there is shown a radial

multi-stage compressor generally comprising a casing or housing **10** having a first stage cylinder **11** at the top, second and third stage cylinders **12** and **13** at the sides and a fourth stage cylinder **14** at the bottom; a drive shaft **15** (shown in broken lines) journalled for rotation and supported by the casing, for example, as shown in the aforementioned patent, including an eccentric, such as a crank **16** within the casing; pistons **17**, **18**, **19** and **20** for the first, second, third and fourth stage cylinders, respectively; and a cam **21** carried by the crank which is operatively associated with the pistons for effecting reciprocation thereof.

As shown herein the first and fourth stage cylinders are in vertical alignment and the second and third stage cylinders are substantially in horizontal alignment but with axis of the third stage cylinder slightly above the axis of the second stage cylinder. In this manner, torque forces acting on the cam about the axis of the shaft are minimized, and the sum of the components of the vertical forces is substantially equal to that of the horizontal forces.

The details of the inlets and outlets of the cylinders and the valving associated therewith, and the outer ends of the pistons are not shown because the present invention is not concerned therewith. A suitable arrangement of such elements is illustrated in the aforementioned patent. The outlets of the first, second and third stage cylinders are respectively connected to the inlets of the second, third and fourth stage cylinders. The bore of the cylinders decreases in the order in which the cylinders are named numerically.

The first stage piston **17** carries a horizontal pin or rod **22** at the lower end thereof which extends through a horizontal bearing aperture **23** at the upper end of the cam **21** to slidably connect the cam and piston, whereby circular movement of the cam under the influence of the crank imparts reciprocating movement to the piston **17**.

The cam **21**, as shown, has a pair of vertical, parallel side surfaces **24** and **25**, and a horizontal bottom surface **26** perpendicular to the side surfaces. The second, third and fourth stage pistons have cam follower means **27**, **28** and **29**, respectively, for engaging the cam surfaces in the order named. As shown herein, the cam follower means are in the form of rigid heads integrally formed or secured at the inner ends of their respective pistons and having flat faces parallel to the cam surface they engage. Also, as illustrated in the aforementioned patent, the pistons **18**, **19** and **20** are so arranged that they do not displace all the air compressed in their cylinders, whereby the compressed air remaining therein is effective to cause the pistons to be urged towards the cam block **21** after their compression stroke to maintain their followers in engagement with the cam surfaces.

With this arrangement, the cam followers of the horizontal second and third stage pistons serve as a slide or guide to maintain the cam in vertical alignment and all the forces applied between the cam and these followers are parallel to the pin **22**, whereby no wedging forces are applied between the pin and the cam so that the wear life of the pin and the bearing is greatly prolonged. The only forces applied between these elements are sliding friction between the pin and the bearing, and the vertical thrust of the cam bearing on the pin in moving the first stage piston up and down. Also, since tilting movement of the cam is prevented and the cam followers are rigid, the followers are constantly in sliding engagement with the cam surfaces without freedom of movement other than such sliding movement, whereby noise and vibration are practically eliminated within the compressor casing.

By arranging the stages as indicated herein, the forces acting on the cam and the forces transmitted by the cam are almost in perfect dynamic balance. This also is in-

strumental in reducing vibration and wear of contacting parts. In view of such vibration and wear reduction, the compressor may be smaller in mass and size than prior compressors of this general type having the same output flow and pressure rating.

From the foregoing description, it will be seen that the present invention provides a highly improved radial multi-stage compressor which has a high output weight rating, at a given pressure, and which is economical to manufacture and durable in construction.

As various changes may be made in the form, construction and arrangement of the parts herein, without departing from the spirit and scope of the invention and without sacrificing any of its advantages, it is to be understood that all matter herein is to be interpreted as illustrative and not in any limiting sense.

We claim:

1. In a radial multi-stage compressor, the combination of a drive shaft including an eccentric, first, second, third and fourth stage cylinders, said cylinders being radially disposed with respect to said shaft and spaced circumferentially with respect to each other with two of said cylinders in vertical alignment and two of said cylinders substantially in horizontal alignment, a cam member carried by said eccentric for movement in a circular path, said cam member having three linear surfaces, a piston for said first stage cylinder, means for slidably connecting said cam member to said piston whereby said cam member imparts reciprocating motion thereto, and pistons for said second, third and fourth stage cylinders having follower means each adapted to be slidably engaged by a surface of said cam member to effect reciprocation of the last mentioned pistons, the longitudinal axes of said vertical cylinders and one of said horizontal cylinders intersecting at the axis about which said shaft rotates, and the axis of the other of said horizontal cylinders extending slightly above the shaft axis.

2. A compressor according to claim 1, wherein two of said cam surfaces are parallel to each other and the other of said cam surfaces is perpendicular to said two parallel surfaces.

3. A compressor according to claim 2, wherein said second and third stage piston cam follower means each engage one of said parallel cam surfaces, and said fourth stage piston cam follower means engages said other cam surface.

4. A compressor according to claim 1, wherein said cam follower means are rigid with respect to said second, third and fourth stage pistons respectively.

5. A compressor according to claim 4, wherein said cam follower means are integral with said second, third and fourth stage pistons respectively and have faces parallel to the cam surfaces they engage.

References Cited in the file of this patent

UNITED STATES PATENTS

2,427,253	Browne	Sept. 9, 1947
2,450,468	Cornelius	Oct. 5, 1948
2,562,954	Schmidlin	Aug. 7, 1951

FOREIGN PATENTS

902,097	France	Nov. 27, 1944
1,018,559	France	Oct. 15, 1952