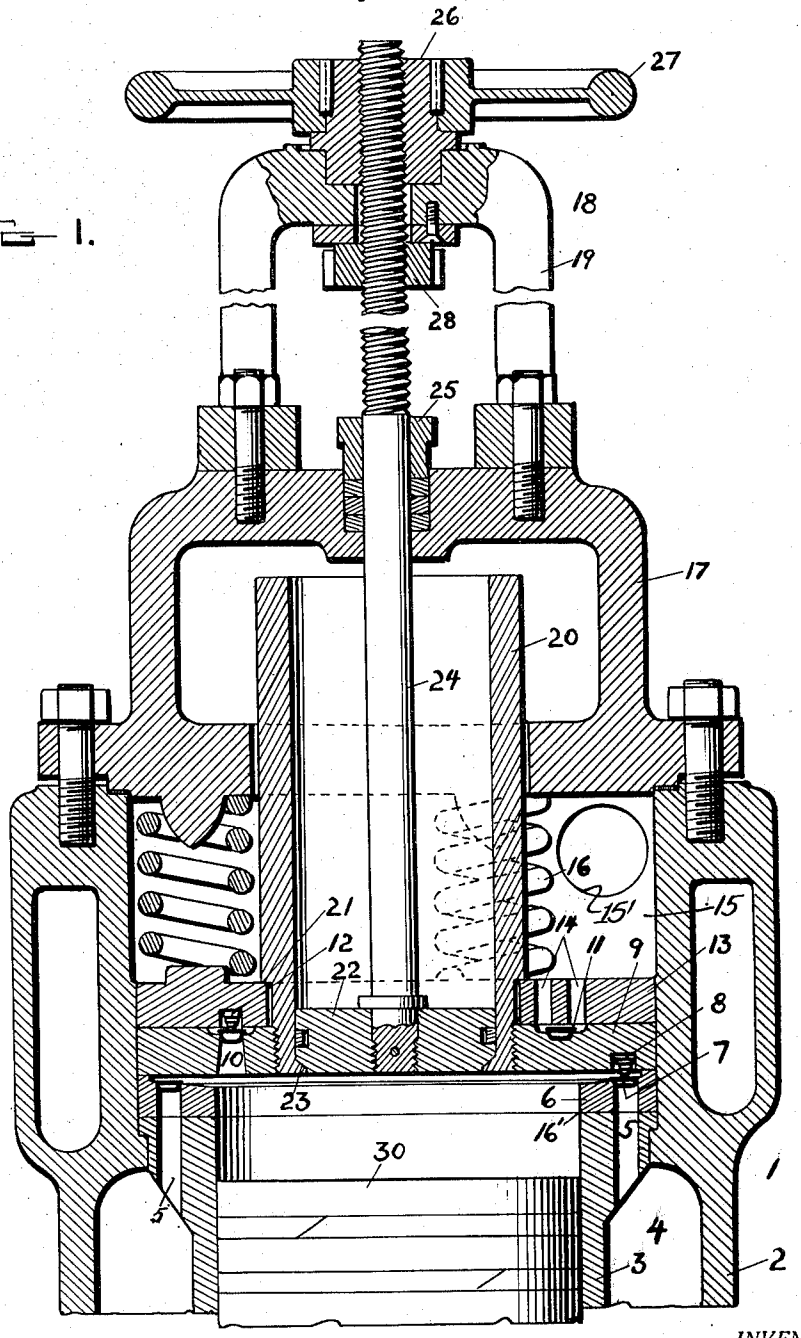
July 7, 1936. H. C. HELLER 2,047,167

ADJUSTABLE CLEARANCE MECHANISM

Filed April 13, 1932 3 Sheets-Sheet 1

FIG. 1.



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ADJUSTABLE CLEARANCE MECHANISM

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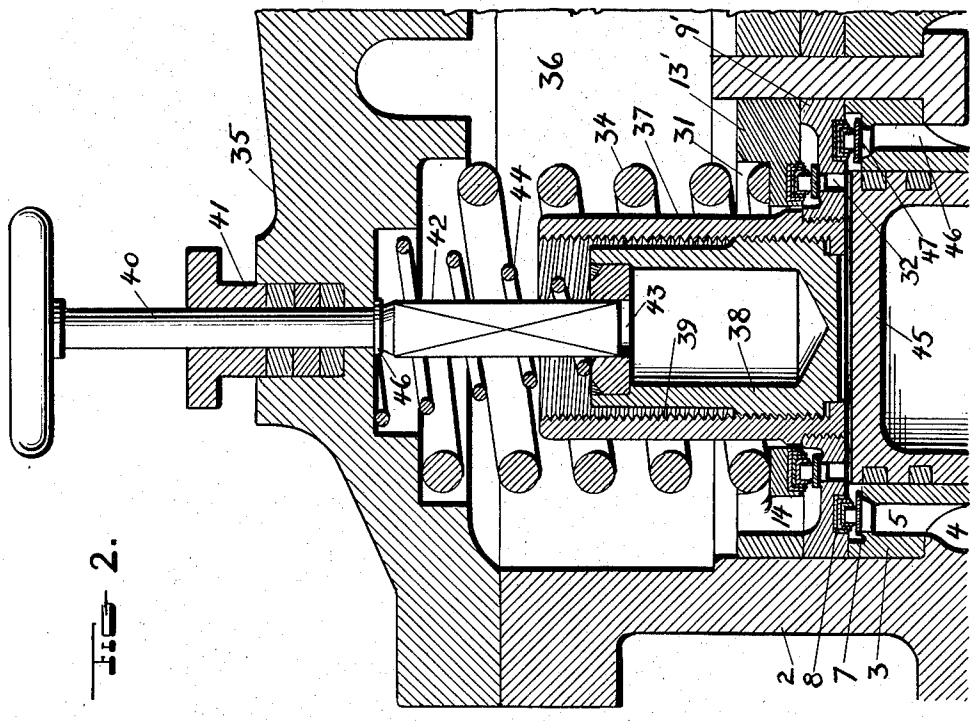

Fig. 2.

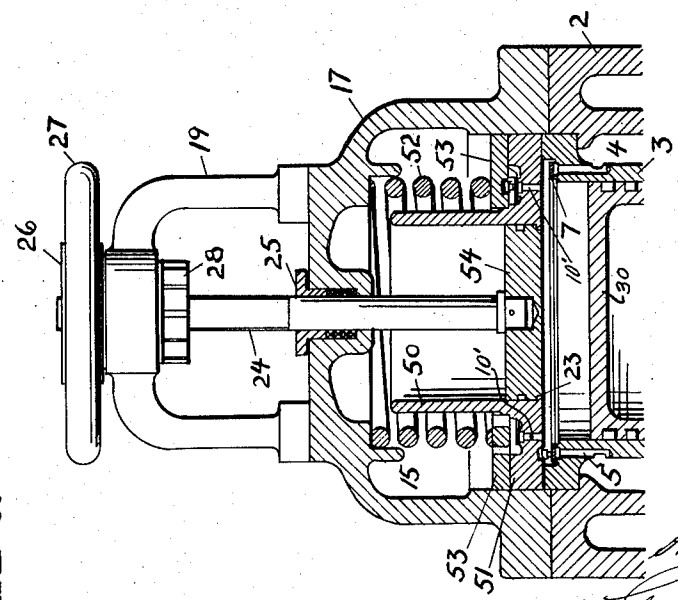

Fig. 3.

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ADJUSTABLE CLEARANCE MECHANISM

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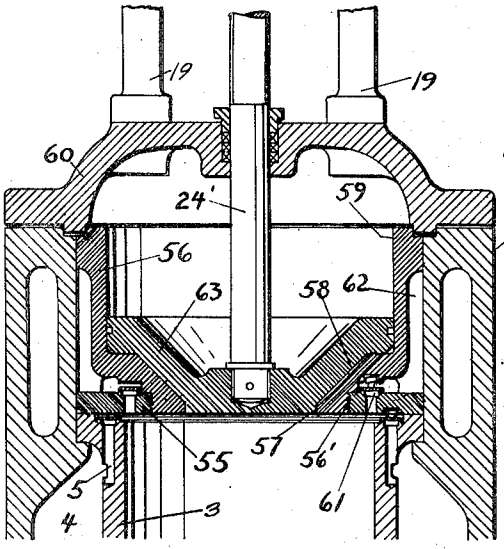

FIG 4.

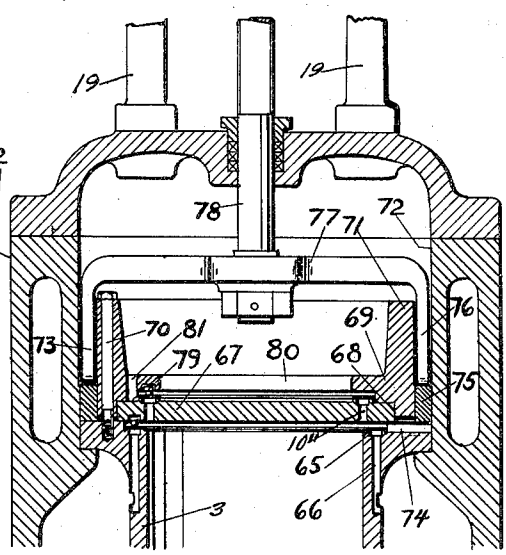

FIG 5.

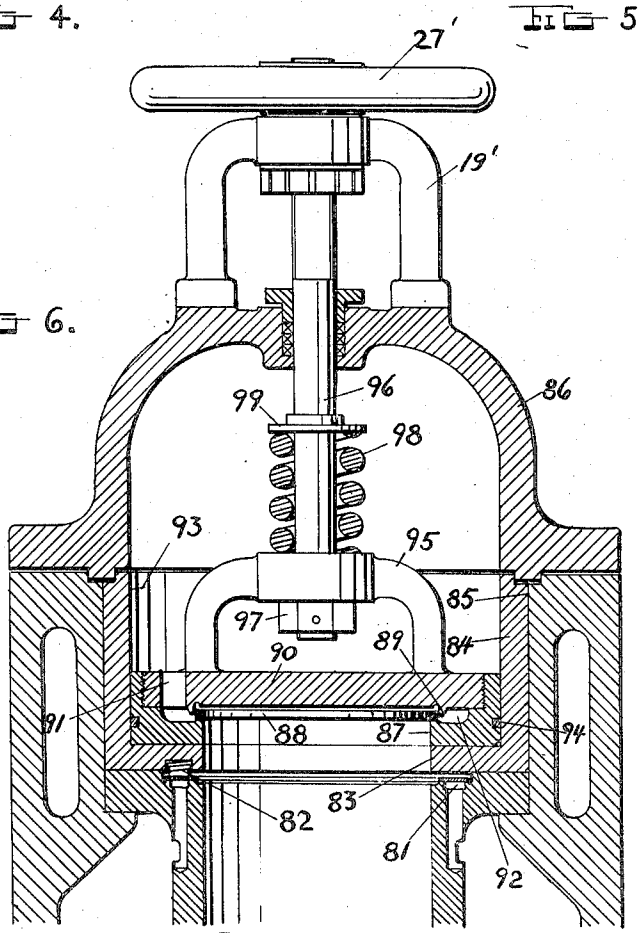

FIG 6.

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UNITED STATES PATENT OFFICE

2,047,167

ADJUSTABLE CLEARANCE MECHANISM

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Application April 13, 1932, Serial No. 605,059

13 Claims. (Cl. 230—21)

This invention relates generally to an improved adjustable clearance mechanism for compressors and more particularly to an improved combination of an adjustable clearance mechanism with the compressor intake and discharge valves wherein at least one of the valves is relatively stationary.

In refrigeration compressors of the vertical type it is usual to have the intake valve carried by and movable with the compressor piston but in the type of valve arrangement herein shown the intake valve is preferably of the annular plate type supported in a relatively fixed position adjacent to the end of the cylinder sleeve and coaxial therewith. In such an arrangement the discharge valve is also coaxial with the cylinder and preferably forms what might be termed an inner cylinder head although in the broader aspect of the invention the inner cylinder head may or may not carry valves.

One object of my invention is to provide improved means for adjusting the compressor cylinder clearance, this being accomplished in combination with an inner cylinder head in such a manner that a relatively compact and simple construction is obtained. A still further object is to provide an adjustable clearance device associated in an improved manner with the cylinder head and valve mechanisms so that in one embodiment of the invention both valve mechanisms remain fixed during clearance adjustment or in another embodiment one valve may move with the adjusting mechanism while the other valve remains fixed.

Another specific object is to provide an improved clearance device so self-contained or arranged with valve mechanisms of the type herein disclosed as to provide a unitary structure which may yield in the event of a slug of liquid refrigerant being trapped between the compressor piston and valve mechanism on the compression stroke.

Further objects have to do with providing a relatively simple and inexpensive construction which will have the advantages above outlined and in addition will be compact, rigid, and easily adjustable without interfering with or causing material alteration of the compressor or its valve mechanisms thereby permitting my improved arrangement to be equally applicable to either existing or new compressor equipment.

Other objects and advantages will be more apparent to those skilled in the art from the following description of the accompanying drawings in which:

Fig. 1 is a vertical sectional view of the upper end of a compressor cylinder and valve mechanism with one form of my improved clearance adjusting mechanism associated therewith;

Fig. 2 is also a vertical section showing a modified form of clearance device applied to a multiple cylinder compressor only a portion of which is shown;

Fig. 3 is a further modification showing the clearance cylinder formed integrally with the seat member of the discharge valve;

Fig. 4 is a modification employing an enlarged clearance piston whereby a relatively short stroke is necessary for a given adjustment;

Fig. 5 is another modification showing an annular clearance piston and chamber; and

Fig. 6 is a modification employing improved means for holding the inlet valve mechanism in position while permitting bodily adjustment of the discharge valve for effecting clearance adjustment.

In one specific embodiment of the invention I have shown a compressor generally indicated at 1 having an outer wall 2 and a cylinder sleeve 3 insertable within the wall to provide a fluid inlet chamber 4 from which fluid is drawn into the cylinder through inlet ports 5 controlled by an inlet valve mechanism.

The inlet valve mechanism comprises a suction port ring in the form of lower annular member 6 provided with ports registering with ports 5 and controlled by a suitable annular plate valve 7 which in turn is pressed downwardly by usual springs such as are generally indicated at 8. These springs 8 are positioned in suitable recesses of an intermediate member or guard 9 in which are formed a series of discharge ports 10. The discharge ports are surrounded by a common annular valve seat controlled by a flat annular plate valve generally indicated at 11 yieldingly pressed to its seat by spiral springs 12 supported in suitable recesses of an upper plate or guard 13 in which a series of discharge ports 14 communicate with a pressure chamber 15. A suitable outlet passage 15' may be provided from chamber 15 for conducting the compressed fluid to any suitable point.

The various component parts of the valve mechanism such as 6, 9 and 13 are held, as by a series of coil springs 16, in a normally fixed down position against the top edge 16' of the cylinder liner 3. These holding springs are supported against what might be called an outer cylinder head 17, it being considered herein broadly that the valve mechanism 6, 9 and 13 constitutes a

combined valve mechanism and cylinder head which hereafter may be referred to as the inner cylinder head. The outer cylinder head 17 is suitably bolted to the cylinder casting 2 while suitable hand adjusting mechanism generally indicated at 18 is supported by a yoke 19 bolted to head 17.

The adjustable clearance device includes in the Fig. 1 form a cylinder 20 screw threaded or otherwise suitably removably held in the valve mechanism, specifically the intermediate plate 9, while an annular shoulder 21 engages the upper plate 13, thus holding plates 9 and 13 together. When the type of valve mechanism described is used without clearance mechanism shown herein, plates 9 and 13 are entirely solid across their central portion but in applying my improved clearance device, axial openings are formed in plates 9 and 13 to receive the clearance cylinder 20 thus providing a self-contained unit which in addition to other advantages does away with extra supporting elements for the clearance cylinder.

An adjustable clearance piston 22 is axially movable in cylinder 20 which is provided with a suitable stop ledge or flange 23 for limiting inward movement of clearance piston 22. The piston if desired may be provided with piston rings or other suitable packing while an operating rod 24 is preferably rigidly secured to clearance piston 22. Rod 24 extends upwardly through a suitable packing gland 25 and is threaded at its upper end for cooperation with a nut 26 secured to and made a part of a hand wheel 27. Nut 26 is suitably supported in a recess of yoke 19 while a locking nut 28 is disposed on the inner side thereof whereby after adjustment the piston 22 may be securely held in position and any chattering avoided by tightening lock nut 28.

In operation, reciprocating piston 30 will upon its suction stroke draw fluid from inlet chamber 4, through port 5, past valve mechanism 7 and into cylinder 3 while during the compression stroke fluid is discharged through ports 10 and 14 into the chamber 15. If it is desired to adjust the clearance space in order to vary the capacity of the compressor while it is running say at constant speed, or for any other reason desired, clearance piston 22 is adjusted by rotation of hand wheel 27. If a slug of liquid refrigerant should become trapped between compressor piston 30 and the combined cylinder head and valve mechanism 9 and 13, then holding springs 16 will allow the same to yield to prevent damage. It will be noted that any movement of the inner cylinder head will cause similar movement of clearance cylinder 20, thus maintaining at all times the normal relation between the clearance device and valve mechanism. A further advantage of this self-contained valve and clearance construction is that the component parts may be properly assembled as a unit before being assembled with the machine, thus insuring that the parts when once properly adjusted will remain so.

The modification of Fig. 2 employs the same general type of valve mechanism shown in Fig. 1 and hence a detailed description thereof is not essential except to point out that the member 13' has an enlarged opening 31 into which fluid is discharged from the cylinder through discharge ports 32. A suitable annular plate valve, seating upon an annular seat, closes ports 32 and is yieldingly held by suitable springs contained in annular member 13' which normally rests upon a fixed abutment of a lower plate 9' corresponding to element 9 of Fig. 1. The discharge valve is adapted to yield under the action of excessive compression pressure or slugs of liquid by virtue of a single coil spring 34 interposed between member 13' and an outer cylinder head 35. The head 35 is common to a number of compressor cylinders, each of which discharges into a common discharge space or chamber 36 from which a suitable outlet may be provided.

The clearance device as shown includes an internally threaded cylinder 37 externally threadedly secured to plate 9'. An adjustable clearance piston 38 has threaded engagement with the internal threads 39 while hand wheel operating rod 40 extends through a suitable packing gland 41 and carries an enlarged shank 42 of preferably square cross section which slidably but non-rotatably engages the walls of a square opening 43. The opening 43 is formed in a suitable transverse disk secured to piston 38 to form an enlarged chamber therein permitting projection of shank 42 therein during axial adjustment of piston 38. A coil spring 44 is interposed between the top of piston 38 and head 35 to prevent unnecessary chattering of the piston.

In operation, it is seen that fluid will be drawn in by the compressor piston 45 through inlet ports 46 past the inlet valve mechanism generally indicated at 47 while upon the compression stroke fluid is discharged through ports 32 and into chamber 36. To adjust the compressor cylinder clearance a hand wheel rod 40 is rotated, thus causing rotation of piston 38 with consequent axial adjustment of the piston due to threads 39. Rod 40 is provided with a suitable collar 46 to prevent outward movement of rod 40 by fluid pressure acting on its inner end.

In the modification shown in Fig. 3 the clearance cylinder 50 is formed integrally with the discharge valve seat member 51. The remaining construction is generally similar to that shown in the other forms except that it will be noted a single coil spring 52 holds an annular valve guard plate 53 and valve seat member 51 in normally fixed position upon the upper end of the cylinder liner 3. An adjustable clearance piston 54 is actuated by the same type of mechanism shown in Fig. 1, and hence further description of this is not necessary nor is it necessary to further describe the compressor cylinder or valve construction as it also is identical to the Fig. 1 form except that the suction ports and valve seat therefor are formed in the cylinder liner rather than in a separate suction port ring 6, as in Fig. 1.

The Fig. 4 modification is particularly adapted for permitting a relatively short clearance mechanism and operating elements, it being noted that the discharge valve guard 55 has a clearance cylinder 56 removably secured thereto preferably by threads 56'. The clearance cylinder has a relatively small center opening 57 which rapidly flares outwardly as at 58 to terminate in an enlarged bore 59 formed in an annular sleeve portion which is engaged by the outer cylinder head 60 which upon being bolted to the cylinder casting 2 will hold the clearance cylinder and valve mechanism in rigid position. To permit discharge of fluid from the discharge valve mechanism, generally indicated at 61, a large annular recess 62 is provided in the outer surface of the clearance cylinder 56, this annular passage communicating with a usual conduit leading from the compressor. An adjustable clearance piston 63 has the same general shape as the interior of the clearance cyl-

inder so that clearance may be eliminated without difficulty although during adjustment it will be noted that a relatively small axial movement of the clearance piston will effect a relatively large amount of clearance due to the large piston area. The clearance piston may be adjusted in any suitable manner such for instance as by the mechanism shown in Fig. 1, and hence this has not been further shown or described except to show the operating stem 24'. The outer cylinder head 60 is also somewhat modified in order to make it conform to the relatively compact clearance device although its general structure remains substantially the same as in the Fig. 1 form.

In the Fig. 5 modification the intake valve mechanism generally indicated at 65 is of the same annular valve type as shown in Fig. 1 wherein the valve seats upon the upper end of the cylinder liner for controlling the intake ports 66. The suction valve springs are suitably supported in a cylindrical plate-like valve guard member 67 which is disposed within a recess 68 formed in a discharge valve guard 69. This guard 69 is secured to the cylinder liner by a series of bolts 70 extending through an annular wall 71 of the valve guard. It will be noted that this annular wall provides a clearance cylinder by being concentric to and spaced inwardly of the outer cylindrical wall 72 of the main compressor cylinder casting thereby providing an annular chamber 73 forming the adjustable clearance chamber in this particular modification. This chamber communicates with the compressor cylinder 6 by a series of radial ports 74. The clearance piston comprises an annular piston 75 connected through a series of axial fingers 76 to a suitable spider 77. This spider is provided with a hub to which is connected a rod 78 actuated by screw means such as shown in Fig. 1. The discharge valve mechanism is generally indicated at 79 and in order to provide ample passage area leading therefrom a center opening 80 and a series of axial ports 81 communicate with each side of the discharge valve mechanism.

In the forms heretofore shown, both the intake and discharge valve mechanisms are normally held in a fixed position even during adjustment of the clearance device whereas in the modification of Fig. 6 the intake valve mechanism is normally maintained in a fixed position and so related to the discharge valve mechanism that the latter is movable for adjusting clearance. In order to accomplish this relation of functions, the intake valve mechanism generally indicated at 81 is yieldingly held to its compressor cylinder seat by a series of spiral springs 82 disposed in recesses formed in a guard 83 carrying an annular sleeve 84 which is slidably received within an enlarged cylinder casting bore 85. Sleeve 84 and valve guard 83 are held in fixed axial position by the outer cylinder head 86 secured to the main cylinder casting by usual bolts. The discharge valve mechanism comprises a valve seat member 87 having an annular seat with which a solid cylindrical plate valve 88 cooperates and is guided by a suitable annular wall 89 projecting inwardly from a valve guard 90 which has threaded engagement with the valve seat member 87. Ports 91 in valve guard 90 communicate with an annular recess 92 into which fluid is directly discharged from the compressor cylinder past annular valve plate 88. The discharge valve mechanism including elements 87 and 90 is movable as a unit and in the nature of a piston in a bore 93 formed in annular sleeve 84, a suitable piston ring 94 being provided in valve seat member 87 if desired.

To move this discharge valve unit of Fig. 6 a yoke 95 is supported on an axially movable but non-rotatable operating rod 96. This rod may be actuated by a screw and hand wheel arrangement such as generally shown in Fig. 1 and here indicated at 27' but will have in addition a keyway formed in rod 96 in which is disposed a key supported by the yoke 19'. To permit yielding of a discharge valve unit in the event of a slug of liquid refrigerant being trapped at the end of the cylinder upon the compression stroke, yoke 95 is slidably supported upon the lower end of rod 96 and normally held against a nut 97 secured to the lower end of rod 96 as by a coil spring 98 interposed between yoke 95 and a collar 99 formed on rod 96. It is thus seen that the discharge valve unit may yield when unnecessary pressure is applied thereto while rotation of hand wheel 27' will cause axial movement of rod 96 and corresponding adjustment of the discharge valve unit to vary the compressor cylinder clearance. The construction and mode of operation of the cylindrical plate valve 88 per se does not constitute a part of my invention and is shown here merely as one form of valve which might be employed in connection with this improved form of adjustable clearance device.

In any of the forms shown it is seen that the clearance cylinder projects rearwardly (outwardly) from the inner cylinder head which in certain specific embodiments constitutes part of the suction or intake valve mechanism while in other embodiments the discharge valve is also part of the unitary valve and cylinder head. In any of the various forms, the clearance mechanism may be adjusted to insure the same absolute minimum amount of compressor cylinder clearance the same as though the clearance device was not used. This is obtained in part because of the compact arrangement of parts permitting direct communication between the compressor and clearance cylinders, the clearance piston being adjustable to close completely the communicating passage. Also by having the clearance cylinder communicate with the end of the compressor cylinder where it is flat, the clearance piston with its flat end can be adjusted to make these surfaces flush with each other and thus totally eliminate any undesired clearance, if such should be necessary. It is understood that in the Fig. 6 form the compressor piston extends upwardly into the bore of valve seat member 87 adjacent valve plate 88 so that the advantages just mentioned are applicable here also. The same is substantially true of the Fig. 5 form as lateral or radial passages 74 add very little adidtional permanent clearance.

While several forms of my invention have been disclosed, it will of course be understood that other modifications and arrangement of parts could be made by those skilled in the art from the principles outlined herein and without departing from the spirit of the invention as set forth in the appended claims.

I claim:

1. In combination, a compressor cylinder having a combined cylinder head and annular plate valve mechanism, a clearance cylinder secured to said head coaxially of said annular valve, said head having an opening coxial with said annular valve thereby utilizing for clearance purposes the inner space surrounded by said annular valve,

and an adjustable clearance piston in said clearance cylinder.

2. In combination, a compressor cylinder, a combined cylinder head and valve mechanism, said valve mechanism having concentric annular plates, and adjustable clearance mechanism associated with said combined valve and head at a point disposed centrally of the innermost annular plate valve, said head having an opening coaxial with said annular valve for allowing communication between the compressor cylinder and clearance mechanism, thereby utilizing the inner space surrounded by said annular valve for clearance purposes.

3. In combination, a compressor cylinder having inner and outer cylinder heads, a clearance cylinder supported by said inner head, an adjustable clearance piston in said clearance cylinder, an adjusting rod projecting through said outer head and provided with screw threads, and an adjustable nut supported by said outer head for engagement with said threads to effect axial adjustment of said clearance piston.

4. In combination, a compressor cylinder having an inner head, means for yieldingly supporting said head whereby upon occurrence of excessive compressor pressures said head may yield, and adjustable clearance mechanism carried by said head and adapted to yield therewith.

5. In combination, a compressor cylinder having a yieldable head composed of a plurality of parts, and adjustable clearance mechanism rigidly associated with said head and adapted to hold certain of said parts in assembled relation, whereby said clearance mechanism yields with said head and positively holds the parts of said head in their normal relation.

6. In combination, a compressor cylinder, a combined cylinder head and valve mechanism having an annular discharge valve seat member and an annular discharge valve guard, a clearance cylinder secured to said valve seat member and extending rearwardly through said valve guard and having direct communication with the compressor cylinder, and an adjustable piston in said clearance cylinder.

7. In combination, a compressor cylinder, a combined cylinder head and valve mechanism having an annular discharge valve seat member and an annular discharge valve guard, a clearance cylinder secured to said valve seat member and extending rearwardly through said valve guard and having direct communication with the compressor cylinder, an adjustable piston in said clearance cylinder, and means for limiting inward movement of said clearance piston.

8. In combination, a compressor cylinder, a combined cylinder head and valve mechanism having a discharge valve seat member and a guard member therefor, each of said members having coaxial openings one of which is provided with screw threads, a clearance cylinder having threaded engagement with said threaded opening and projecting rearwardly through the coaxial opening of the guard, said clearance cylinder having a shoulder for engaging and holding the guard in fixed position to the valve seat member, and an adjustable piston in said clearance cylinder.

9. In combination, a compressor cylinder, a combined cylinder head and annular valve mechanism having a valve seat member and a separate valve guard member, a clearance cylinder formed integrally with one of said members and projecting axially therefrom from the central portion thereof surrounded by said annular valve, said clearance and compressor cylinders having communication with each other through said central portion, and an adjustable piston in said clearance cylinder.

10. In combination, a compressor cylinder, a combined cylinder head and valve mechanism having a valve seat member and a separate valve guard member, a clearance cylinder formed integrally with one of said members and projecting rearwardly therefrom, an adjustable piston in said clearance cylinder, and a coil spring encircling said clearance cylinder for yieldingly holding said guard and valve seat members in a normally fixed position.

11. In combination, a compressor cylinder having in its wall axially extending inlet ports terminating adjacent an annular valve seat coaxial to the compressor cylinder, an annular plate valve engageable with said seat, a guard member for said valve, a clearance cylinder projecting rearwardly thereof and coaxial therewith, and an adjustable piston in said clearance cylinder.

12. In combination, a compressor cylinder having in its wall axially extending ports terminating adjacent an annular valve seat coaxial to the compressor cylinder, an annular plate valve engageable with said seat, a guard member for said valve having a substantially central opening therethrough, a clearance cylinder secured to said guard and projecting rearwardly thereof and having communication with the compressor cylinder through said central opening, and an adjustable piston in said clearance cylinder.

13. In combination, a compressor cylinder, a combined cylinder head and annular valve mechanism provided with a substantially central opening coaxial of said annular valve, a clearance cylinder communicating with said central opening and the inner edge of said opening lying in a plane, and an adjustable piston in said clearance cylinder, said piston having a flat end surface adapted for adjustment so as to be contained within said plane whereby excessive clearance in the compressor cylinder is eliminated.

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