Aug. 5, 1952 J. W. HOUSTON 2,605,957

PUMPING APPARATUS

Filed June 20, 1945

Fig. 1.

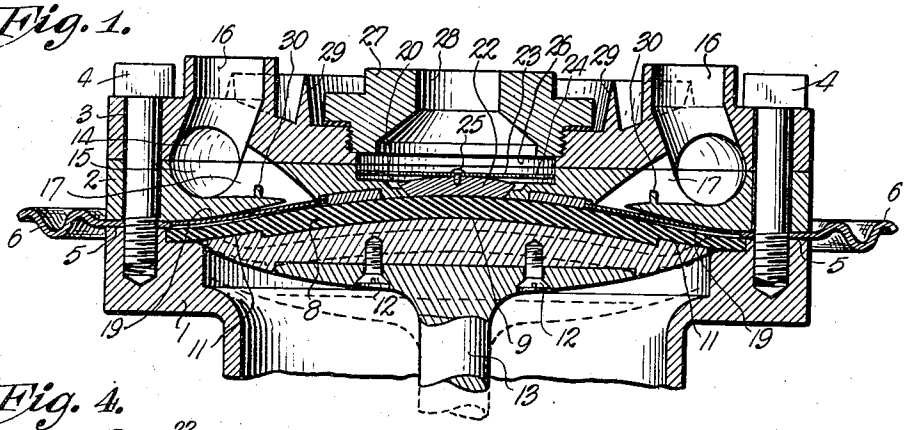
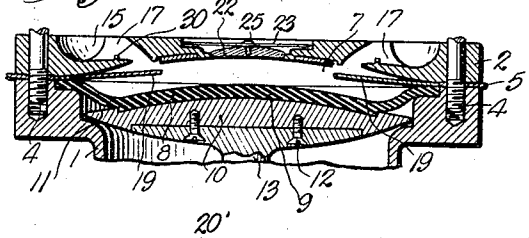


Fig. 4.



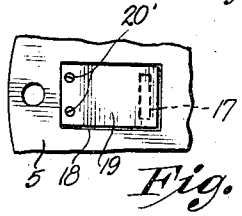


Fig. 6.

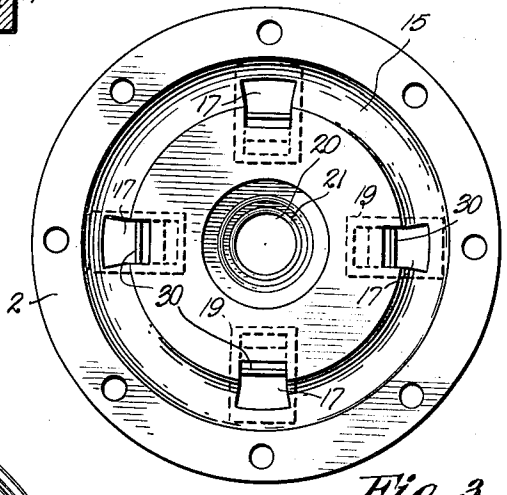
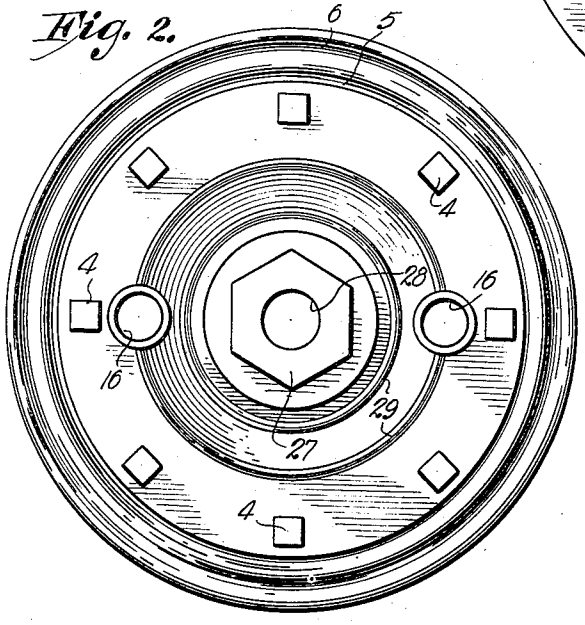


Fig. 3.

Fig. 2.



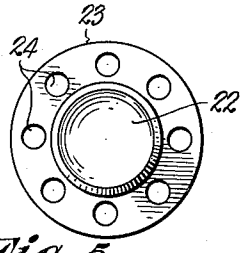


Fig. 5.

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Patented Aug. 5, 1952

2,605,957

UNITED STATES PATENT OFFICE

2,605,957

PUMPING APPARATUS

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Application June 20, 1945, Serial No. 600,489

3 Claims. (Cl. 230—170)

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My invention relates to improvements in pumping apparatus.

It relates particularly to a pumping apparatus intended to pump and compress, when desired, aeriform fluid, as air or gas, and is well adapted for compressing gaseous fluids for refrigerant purposes.

My improved pumping apparatus is of a type having a compression chamber and provided with valve controlled means for the ingress and egress of aeriform fluid to and from the compression chamber, said chamber having two opposite walls, one stationary and the other reciprocative toward and from the stationary wall, combined with means for effecting such reciprocation.

One of the objects of my invention is the provision of a novel construction of the kind described which will effect elimination of substantially all of the aeriform fluid from the compression chamber at the end of each compression stroke of the reciprocative wall.

Another object of my invention is the provision of novel means for dissipating to the atmosphere to a maximum extent heat developed in the apparatus during the compression of the aeriform fluid.

Another object of my invention is the provision of novel means for conduction of the aeriform fluid substantially equally to all parts of the compression chamber, and will eliminate dormant spaces that might fill with the fluid and reduce efficiency.

Another object of my invention is the provision of a novel reciprocating wall for the compression chamber, which wall will be flexible, resilient and compressible, and which at the end of its compression stroke will be compressed and will bear snugly and tightly against the stationary wall, to which it will conform in shape, so as to exclude from the chamber substantially all of the aeriform fluid.

Another object of my invention is the provision of novel means for trapping any introduced refrigerant fluid, which has become condensed into liquid, before such liquid reaches the compression chamber, in places where it will be subjected to the heat generated during compression, so that the liquid will be quickly evaporated and then taken into the compression chamber as useful aeriform fluid.

Still another object of my invention is the provision of a pumping apparatus of the kind described, which is comparatively simple, strong, durable, not likely to get out of order, which is easily operated and maintained in its operative

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condition by an unskilled person, and which is economical and efficient in its operation.

The novel features of my invention are hereinafter fully described and claimed.

In the accompanying drawings which illustrate my invention,

Fig. 1 is a central vertical sectional view of my improved apparatus, showing the reciprocative wall in solid lines at the end of its compression stroke, and in dotted lines at the end of its intake stroke, some parts being shown in side elevation.

Fig. 2 is a reduced top view of the apparatus.

Fig. 3 is a top plan view of the intermediate casing member which forms the stationary wall of the compression chamber, the casing clamping bolts and the egress valve and its guide being omitted, and the intake valves being shown in dotted lines.

Fig. 4 is a reduced vertical sectional view, of part of what is shown in Fig. 1, showing the reciprocative wall and its operating member at the lower end of the intake stroke, with the intake valves shown in the open positions, and the egress valve closed, the upper casing member being omitted and portions of the casing clamping bolts broken away.

Fig. 5 is an under plan view of the egress valve and its perforated guide plate.

Fig. 6 is an under plan view of one of the intake valves shown mounted in a portion of the heat dissipating lining at the under side of the stationary wall of the compression chamber.

Similar characters of reference designate similar parts in the different views.

My improved pumping apparatus is provided with what may be termed a casing comprising the following described parts.

1 designates the upper end portion of the body of a pump cylinder, which forms the lower member of the casing, and upon which is disposed the intermediate member 2 upon which is mounted the upper casing member 3. The members 1, 2 and 3 are circular in plan, and are held clamped together by vertical bolts 4, which extend through alined holes in the members 2 and 3, and have their lower threaded ends fitted in threaded holes in the upper side of the member 1.

The lower side of the member 2 is provided with a heat conductive lining, comprising, preferably, a metal plate of high heat conductivity, as copper, fastened in any suitable manner, as by fusion, to the under side of and mostly covering such under side of the member 2. The lining plate, which is designated by 5, is circular

and projects from the periphery of the member 2 a substantial distance, said projecting portion having circular corrugations 6, for radiating the heat to the atmosphere.

The underside of the member 2, with its lining plate 5, comprises the stationary wall of a compression chamber, and is concavely arcuate, said chamber being designated in Fig. 4 by 7.

Directly below the lining plate 5 is the vertically reciprocative wall of the compression chamber 7 which comprises a circular flexible resilient and compressible disc member 8, a peripheral portion of which is held tightly clamped between the member 1 and the lining plate 5. The disc member 8 is composed of a suitable material having flexibility, resilience, and compressibility, and which is resistant to cold and heat to a large degree, such as synthetic rubber.

For operatively reciprocating upwardly and downwardly the disc member 8, its larger central circular portion is thicker than its outer circular peripheral portion, which central portion is fitted in and secured to the upper side of a circular central recessed convexly arcuate portion 9 of a circular piston head 10 vertically reciprocative in the upper enlarged portion of the cylinder member 1. The peripheral portion of the piston head, outside the portion 9 has its upper side curved to conform to the underside of the lining plate 5 immediately above. Such peripheral portion of the piston head 10 is designated by 11. Fastened by screws 12 to the under side of the piston head 10 is the piston rod 13.

Any suitable means, not shown, may be employed for imparting vertical reciprocation to the piston rod 13 and the piston head 10, the length of stroke required, which is relatively short.

That portion of the disc member 8 which is between the portion secured tightly to the central portion of the piston head designated by 9, and the peripheral portion held clamped between the member 1 and the lining plate 5, is free to swing when the piston head reciprocates. When the piston head moves upwardly on its compression stroke, its peripheral portion 11 engages the under side of the free swinging portion of the disc member 8, and at the upper end of its stroke presses the free swinging portion tightly against and conforming to the lining plate 5, while the central portion is tightly compressed against the lining plate 5.

The following described means are employed for introducing the aeriform fluid that is to be pumped into the compression chamber 7, and for equally distributing it therein.

The under side of the member 3 is provided with a horizontal circular channel 14, semi-circular in cross section, which registers with a corresponding circular channel 15 in the top of the member 2 and forms therewith a circular channel, circular in cross section.

In the member 3 are provided two intake passages 16 having their lower ends communicating with the channel 14 at diametrically opposite points, and having their upper ends adapted to be connected with the aeriform fluid which is to be compressed. The circular channel 14—15 forms a manifold having four equally spaced apart ducts 17 extending from its inner side through the members 3 and 2 and the lining plate 5, thus forming four intake ducts leading to the compression chamber 7.

Normally respectively closing the lower ends of the ducts 17 are four flat plates forming intake valves respectively located in four rectangular openings 18 through the lining plate 5. Each intake valve is designated by 19, and is fastened by two screws 20', adjacent to its outer end, as shown in Fig. 6, to the under side of the member 2. The tension of the valve plates 19 normally holds them against the member 2 respectively closing the lower ends of the intake ducts 17, as shown in solid lines in Fig. 1.

The casing member 2 has through it a circular outlet opening 20, the lower end of which is of reduced diameter and is formed into a downwardly converging egress valve seat 21, Figs. 1, 3 and 4, which communicates with the compression chamber 7.

An egress valve 22 is fitted in the seat 21, and has secured to its upper side a circular guide plate 23, having through it vertical holes 24, and a fastening screw 25, Figs. 1 and 5.

In the casing member 3 is a circular opening 26, which registers with the opening 20, its upper end being threaded and having fitted in it a fluid discharge member 27 having through it a vertical opening 28, registering with the opening 26, and adapted to be connected with conveying means, not shown, for conducting the compressed aeriform fluid to where it is to be stored. The member 27 is so disposed as to limit the upward movement of the perforated guide plate 23, and the opening movement of the egress valve 22, the latter automatically closing by gravity, when the disc member 8 lowers from the upper end of its compression stroke, shown in Fig. 1.

For aiding in cooling the heated parts, the upper side of the casing member 3 is provided with two concentric upwardly extending integral fins 29, Figs. 1 and 2.

In operation, when the piston head 10 and its piston rod 13 move downwardly, with the central portion of the disc member 8, from the uppermost position, shown in Fig. 1, the aeriform fluid to be compressed or pumped is forced downwardly through the intake passages 16 into the circular channel 14—15, from which it divides equally and passes through the ducts 17, forcing the intake valves 19 downwardly to the open positions, as shown in Fig. 4.

When the piston head 10, and the central portion of the disc member 8 fastened thereto, have reached the lower end of the intake stroke, the peripheral portion of the disc member 8 will have cleared the peripheral portions 11 of the piston head, the egress valve 22 in the meantime remaining closed.

When the piston head starts on its upward compression stroke, the intake valves 19 will close and compression of the aeriform fluid will begin in the compression chamber 7, and the egress valve 22 will open and rise from its seat 21, and the fluid will pass through the outlet opening 20, holes 24 in the guide plate 23, and openings 26 and 28.

As the piston head 10 moves upwardly, the free to swing peripheral portion of the disc member 8 will gradually seat upon the peripheral portion 11 of the piston head, so that by the end of the up stroke, it will be fully supported by the portion 11 and with the central portion of the disc member 8 will be held tightly compressed against the upper stationary wall of the compression chamber 7 and the intake valves 19, whereby a substantially complete elimination of the aeriform fluid will have been effected, thus affording a maximum of efficiency.

During the compressing operation heat will be produced a large amount of which will be ab-

sorbed by the lining plate 5 and conducted to the outer peripheral portion 6, where it will be disseminated to the atmosphere, a certain amount of the heat also being disseminated to the atmosphere by the fins 29 and the casing members 1, 2 and 3.

In the compressing of certain aeriform fluids, as for refrigerant purposes, some of the fluid may be condensed on reaching the manifold channels 14—15, and to prevent such liquid reaching the compression chamber 7, there are respectively provided in the ducts 17 transverse fins 30, one on the bottom of each duct 17, Figs. 1, 3 and 4. These fins 30 will prevent the liquid entering the compression chamber 7, and, due to the nearness of the fins 30 to the compression chamber, the heat generated in compressing the gaseous fluid will be evaporated and will enter the chamber in gaseous form, with the other incoming gas.

Many modifications of my invention, within the scope of the appended claims, may be made without departing from the spirit of my invention.

What I claim is:

1. In a pump, a hollow casing having a concave wall surface; a reciprocable piston having a head in the casing and provided with a convex end movable toward and away from said wall surface as the piston reciprocates; a recess formed in said end of the piston head and presenting a band-like, marginal face portion on said end of the piston head surrounding the recess, said marginal face being appreciably narrower than the diameter of said recess; an imperforate, flexible diaphragm between said wall surface and said end and secured at its marginal edge to the casing, a portion of the diaphragm filling said recess and being secured to the piston head throughout said recess, that part of the diaphragm between said marginal edge and said recess-filling portion thereof and circumscribing the latter being in overlying relationship to said marginal face portion of the piston head and movable toward and away from said marginal face portion as the piston reciprocates.

2. In a pump, a hollow casing having a concave wall surface; a reciprocable piston having a head in the casing and provided with a convex end movable toward and away from said wall surface as the piston reciprocates; a recess formed in said end of the piston head and presenting a band-like, marginal face portion on said end of the piston head surrounding the recess; a flexible diaphragm between said wall surface and said end and secured at its marginal edge to the casing, a portion of the diaphragm filling said recess and being secured to the piston head throughout said recess, that part of the diaphragm between said marginal edge and said recess-filling portion thereof and circumscribing the latter being in overlying relationship to said marginal face portion of the piston head and movable toward and away from said marginal face portion as the piston reciprocates, that face of the diaphragm remote from the piston head being smooth and conforming complementally with the contour of said wall surface when the piston moves the diaphragm flatly against the wall surface.

3. In a pump, a hollow casing having a concave wall surface; a reciprocable piston having a head in the casing and provided with a convex end movable toward and away from said wall surface as the piston reciprocates; a recess formed in said end of the piston head and presenting a band-like, marginal face portion on said end of the piston head surrounding the recess; a flexible diaphragm between said wall surface and said end and secured at its marginal edge to the casing, a portion of the diaphragm filling said recess and being secured to the piston head throughout said recess, that part of the diaphragm between said marginal edge and said recess-filling portion thereof and circumscribing the latter being in overlying relationship to said marginal face portion of the piston head and movable toward and away from said marginal face portion as the piston reciprocates, said diaphragm having an increased thickness at said recess-receiving portion thereof sufficient to present a face conforming complementally with the contour of said wall surface when the piston moves the diaphragm flatly against the wall surface.

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