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H. J. ZIMMERMANN

1,825,843

APPARATUS FOR COMPRESSING AND EXPANDING FLUIDS

Filed June 23, 1928

2 Sheets-Sheet 1

Fig. 1

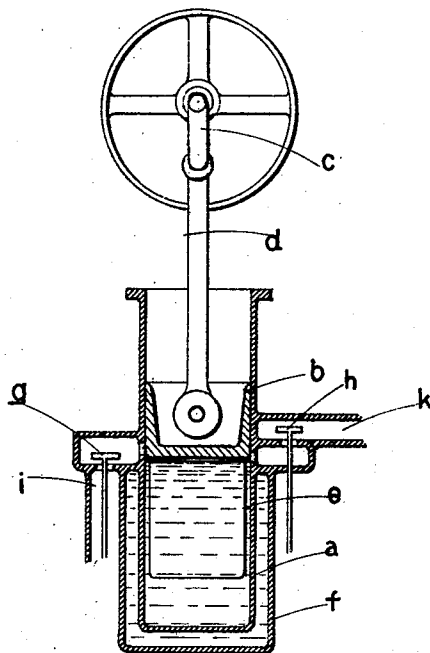
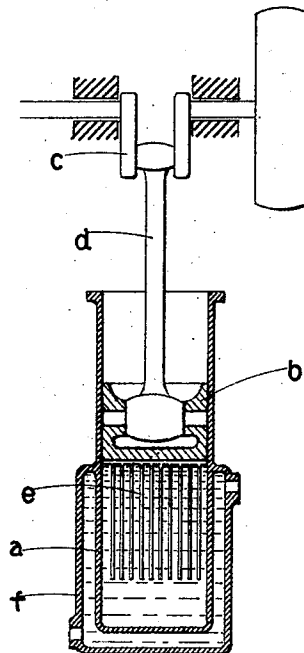


Fig. 2



Inventor:
Hans Joseph Zimmermann
by *K. H. H. H.*
Atty.

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Fig. 3

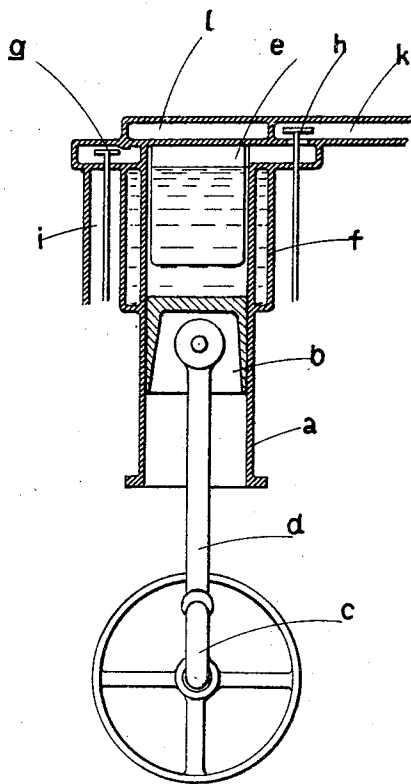
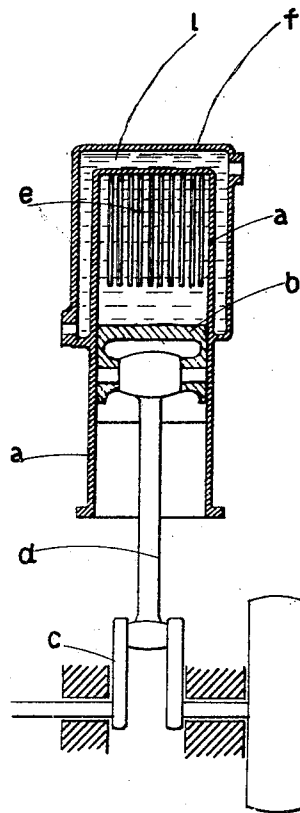


Fig. 4



Inventor:
Hans Joseph Zimmermann
by *Kunichstein*
att'y.

UNITED STATES PATENT OFFICE

HANS JOSEPH ZIMMERMANN, OF MANNHEIM, GERMANY

APPARATUS FOR COMPRESSING AND EXPANDING FLUIDS

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My invention relates to air refrigerating machines under isothermic, or substantially isothermic, conditions. To this end I subdivide the volume of fluid into a plurality of comparatively thin layers and connect each layer with a good heat conductor.

For instance, I may secure to the piston head, or to the cylinder head, a plurality of vanes or partitions of metal or other good heat conductor, and provide a volume of liquid in which the vanes are immersed to a greater or lesser extent during the complete stroke of the piston. Rapid heat exchange is effected by subdividing the volume of fluid and by connecting each unit of volume with a good heat conductor, as described.

It has already been suggested in isothermal air compressors to provide heat-exchanging means on the piston and on the cylinder head, and a liquid in the cylinder, for the purpose specified, but in this compressor separate means are provided for cooling the liquid while in my invention the liquid itself is relied on for absorbing the heat and for transferring it to the cylinder walls, or any other part which is in contact with a cooling medium. Obviously, my machine is much simplified as compared with the compressor aforesaid by the elimination of separate cooling means for the liquid and by providing a normal cooling jacket or the like on the cylinder. Besides, my invention relates to air refrigerating machines, and not to compressors.

Air refrigerating machines heretofore have not been adopted on account of their poor efficiency. Practically all modern refrigerating machines are operated on the vapor-compression system in which the poor efficiency of the compression is not as important as in air refrigerating machines. On the other hand, air refrigerating machines have the good feature that they do not require any chemicals for their operation. By operating such machines in accordance with my method, the drawback of poor efficiency is eliminated and the air refrigerating machine is enabled to compete successfully with the vapor-compression machine.

In the drawings affixed to this specification and forming part thereof, two types in which my method may be performed, are illustrated diagrammatically by way of example.

In the drawings, Figs. 1 and 2 are axial sections taken at right angles to each other through the cylinder having vanes secured to its piston,

Figs. 3 and 4 are corresponding sections in which the vanes are secured to the cylinder head.

Referring first to Figs. 1 and 2, *a* is the cylinder, *b* is its piston, *c* is its crank, *d* is its connecting rod, *f* is a cooling-water jacket surrounding the cylinder, *g* is the suction valve and *h* is the delivery valve, *i* and *k* are the suction and delivery passages, respectively, and *e* are blades or vanes of good heat-conducting material secured to the piston head. The cylinder *a* is filled with liquid to such a level that in the lower dead centre position of the piston *b* some clearance is left between the piston head and the liquid, as required. The length of the vanes *e* is such that they are permanently immersed in the liquid during the complete stroke of the piston, that is, their lower ends must still be immersed in the liquid when the piston is in its upper dead centre position.

Referring now to Figs. 3 and 4, identical parts have been marked with the same reference numerals as in Figs. 1 and 2. In this case the cylinder *a* is arranged above the crank shaft and the vanes *e* are not secured to the piston head but to the cylinder head, projecting downwardly toward the piston. In this instance the liquid is moving with the piston and its volume is such that the vanes *e* remain immersed in the liquid in any position. The liquid acts as an extension of the piston and care should be taken that clearance be provided between the level of the liquid and the cylinder head when the piston *b* is in the upper dead centre position.

In operation the fluid which the piston compresses, is broken up into a plurality of comparatively thin layers which rapidly give up their heat to the vanes and to the liquid in which the vanes are permanently immersed.

I wish it to be understood that various changes may be made in the details disclosed in the foregoing specification without departing from the invention or sacrificing the advantages thereof.

I claim:

1. In an air compressing machine, the combination of a cylinder, a piston adapted to reciprocate in said cylinder, partitions of heat-conducting material subdividing the space of said cylinder into a plurality of chambers, and means for cooling said cylinder on the outside.

2. In an air compressing machine, the combination of a cylinder, a piston adapted to reciprocate in said cylinder, partitions of heat-conducting material on said piston for subdividing the space of said cylinder into a plurality of chambers, and means for cooling said cylinder on the outside.

3. In an air compressing machine, the combination of a cylinder, a piston adapted to reciprocate in said cylinder, partitions of heat-conducting material in said cylinder for subdividing the space of said cylinder into a plurality of chambers, and means for cooling said cylinder on the outside.

4. In an air compressing machine, the combination of a vertical cylinder, a piston adapted to reciprocate in said cylinder, a body of liquid at the bottom of said cylinder, heat-conducting means on the bottom of said piston adapted to move within said body of liquid while said piston reciprocates, and means for cooling said cylinder on the outside.

5. In an air compressing machine, the combination of a vertical inverted cylinder, a piston adapted to reciprocate in said cylinder, a body of liquid supported by, and reciprocating with said piston, the volume of said body being so determined as to compress air between the liquid and the bottom of said cylinder, and means for cooling said cylinder on the outside.

6. In an air compressing machine, the combination of a vertical inverted cylinder, a piston adapted to reciprocate in said cylinder, heat-conducting means on the bottom of said cylinder, a body of liquid supported by and reciprocating with said piston while in contact with said heat-conducting means, the volume of said body being so determined as to compress air between the liquid and the bottom of said cylinder, and means for cooling said cylinder on the outside.

In testimony whereof I affix my signature.
HANS JOSEPH ZIMMERMANN.