

L. WILLIAMS.
 FLUID COMPRESSOR.
 APPLICATION FILED APR. 23, 1920.

1,382,334.

Patented June 21, 1921.
 4 SHEETS—SHEET 1.

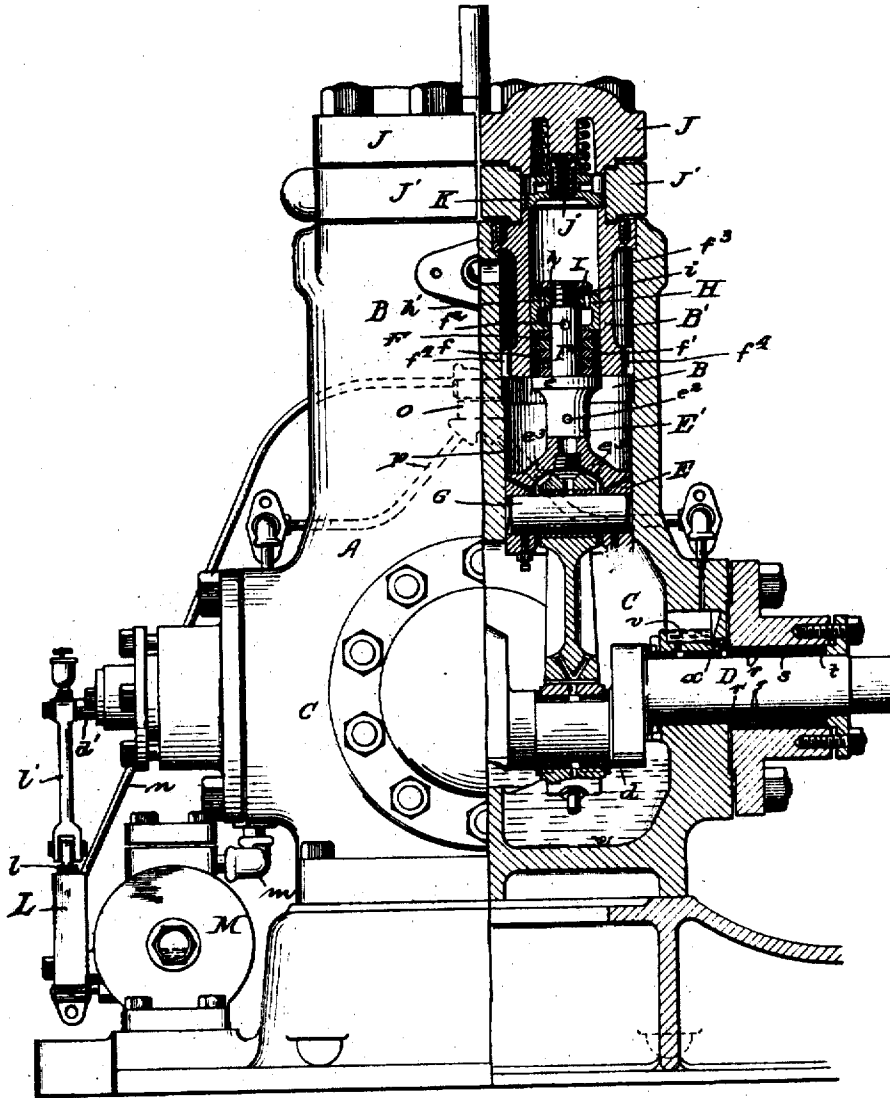


Fig. 1.

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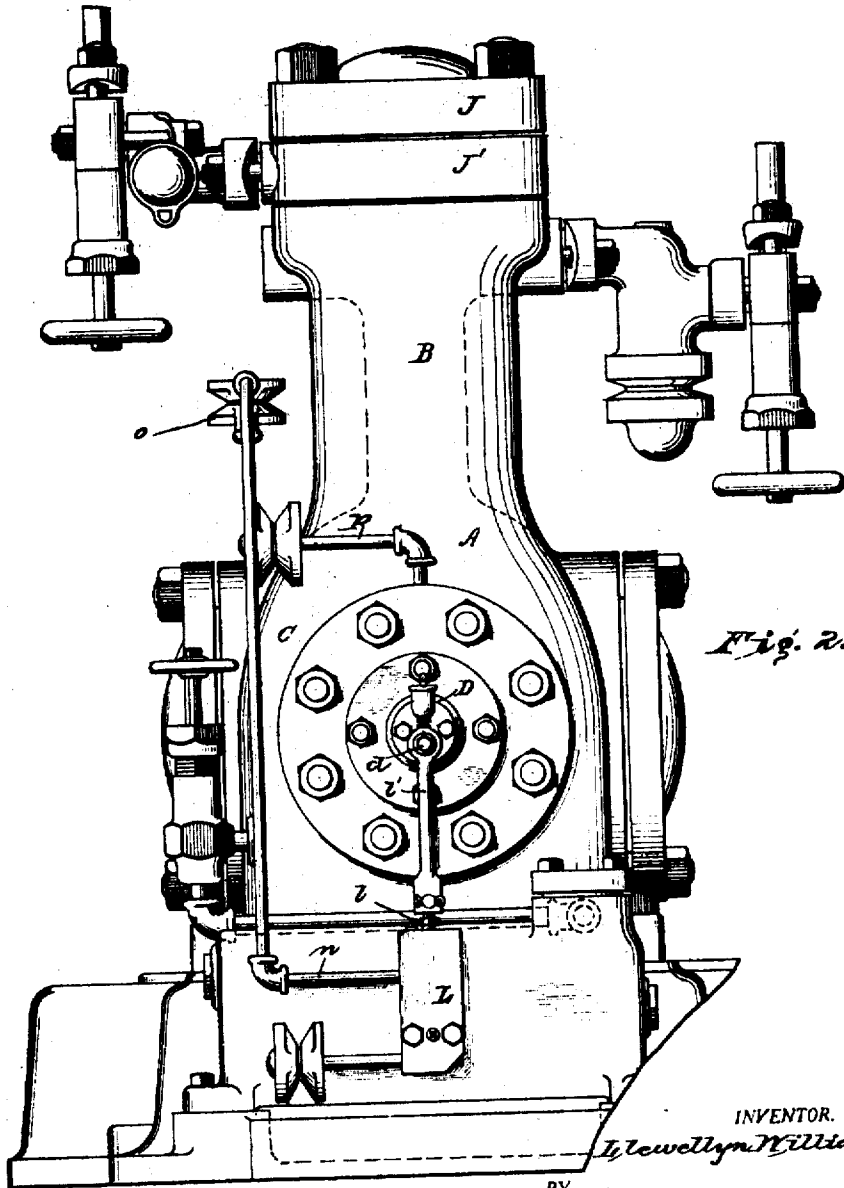


Fig. 2.

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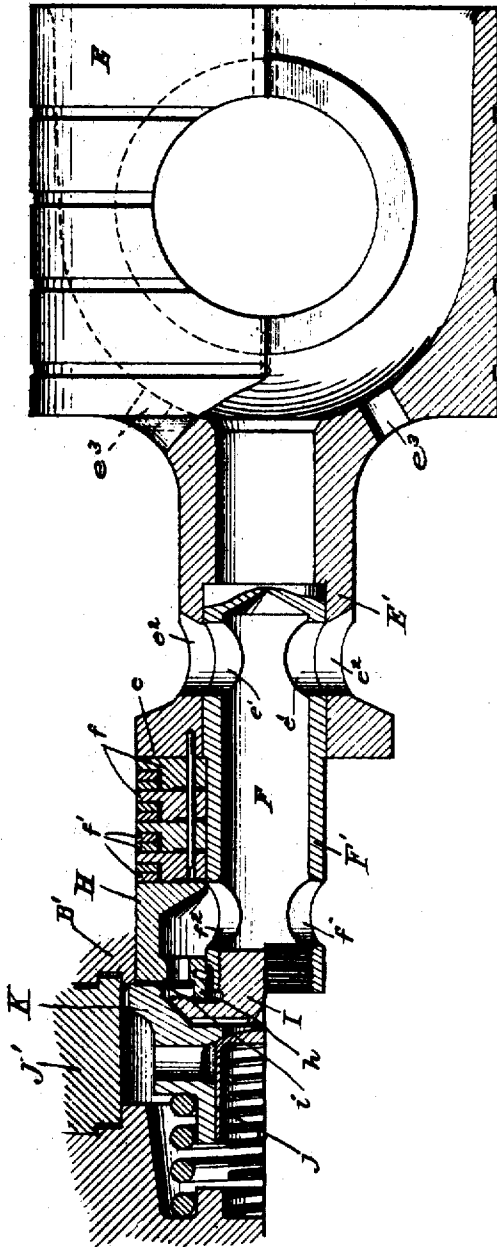


Fig. 3.

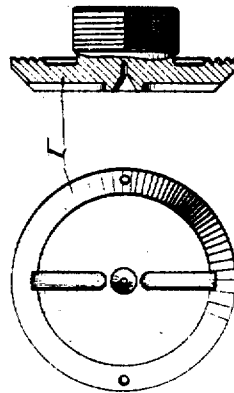


Fig. 5.

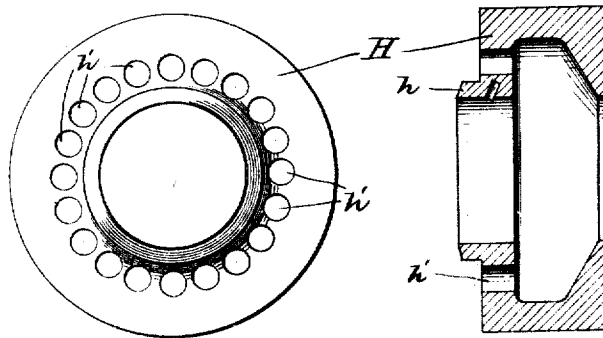
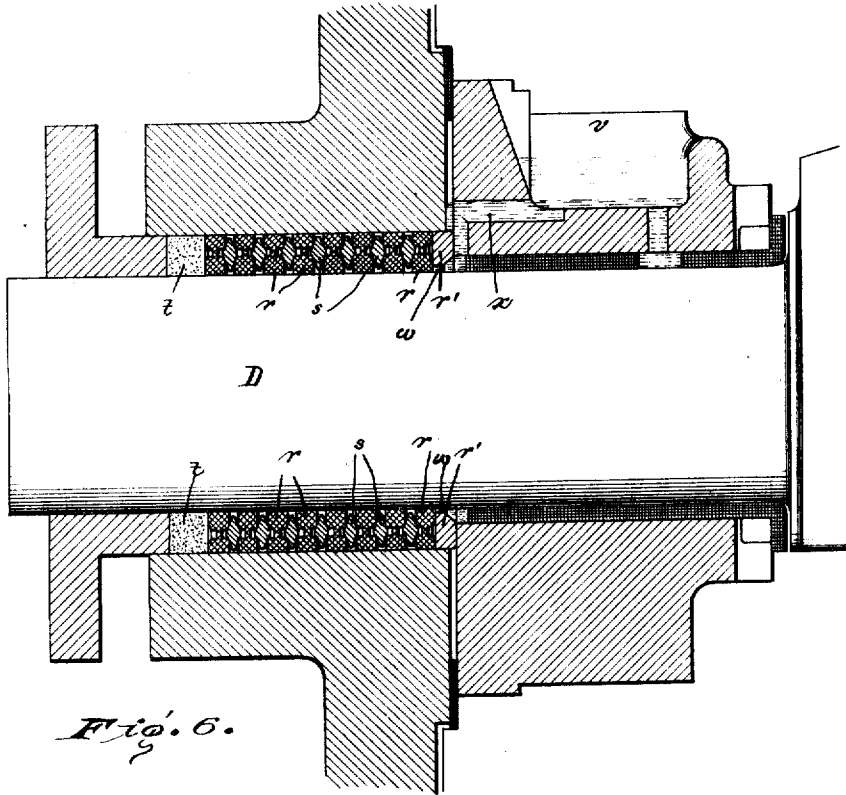
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4 SHEETS—SHEET 4.



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LLEWELLYN WILLIAMS, OF HOLLIS, LONG ISLAND, NEW YORK, ASSIGNOR TO YORK MANUFACTURING COMPANY, OF YORK, PENNSYLVANIA.

FLUID-COMPRESSOR.

1,382,334.

Specification of Letters Patent. Patented June 21, 1921.

Application filed April 23, 1920. Serial No. 376,039.

To all whom it may concern:

Be it known that I, LLEWELLYN WILLIAMS, a citizen of the United States of America, and a resident of Hollis, Long Island, in the State of New York, have invented certain new and useful Improvements in Fluid-Compressors, of which the following is a specification.

My invention has reference to fluid compressors in which compression is carried to an exceedingly high degree, say from 800 to 1200 pounds per square inch, as in the compression of carbon dioxide (CO_2) and kindred gases to liquefy the same for refrigerating purposes.

Under my invention the CO_2 compressor is of "inclosed type" so-called, with the cross-head chamber—that is to say, the chamber in which the cross-head that connects the compressor piston with the connecting rod on its operating crank shaft is housed and moves—in free communication, on the one hand with the suction side of the compressor, and on the other hand with the interior of the air tight crank case in which the crank portion of the driving shaft is contained.

This and other features of my invention will first be described in connection with the accompanying drawings, forming part of the specification, and will then be more particularly pointed out in the claims.

In the drawings:—

Figure 1 is a front elevation of a double cylinder, inclosed-type CO_2 compressor embodying my improvement—the right hand one of the cylinders, its piston, piston operating means and portion of the crank case containing the same being shown in section in the plane of the axis of the cylinder.

Fig. 2 is an end elevation of the same.

Fig. 3 is a sectional working drawing on enlarged scale illustrative of the structural details of the piston, the piston packing rings, separating rings or filling pieces between which they are carried, and piston end cage which holds these parts in place being represented in fragmentary outline as also are the sectional top heads, and the conventional safety head of the compressor cylinder (not shown in this figure).

Fig. 4 is a detached view in plan and axial section of the piston end cage.

Fig. 5 is a similar view of the piston lock nut.

Fig. 6 is a section on enlarged scale of one of the crank case bearing heads and a portion of the crank shaft and the packing therefor.

A is a castmetal housing formed internally in this instance with two cylinder chambers B side by side, to receive each its own piston, and also formed below the cylinders B with a chamber C into which the cylinders open, said chamber C constituting a crank case for reception of the double crank piston of the shaft-D for operating the two compressor pistons. The crank case and compressor cylinder housing are in this instance formed by a single casting. They may, however, be formed separately and secured together by airtight joints, as in ammonia compressors of inclosed type—*e. g.*, Shipley's Patent No. 1,250,037 of December 11, 1917. The two compressor cylinder chambers B have a common suction inlet and a common discharge outlet, as shown more plainly in Fig. 2, and their internal structural details and fittings are identical, so that a description of one will answer for both.

The piston is of a double trunk type, made with two different diameters, and in that respect bears a certain superficial resemblance to the stepped piston used in multiple stage compressors. The lower and large cylindrical portion E of it, which is of considerable diameter to afford a large peripheral bearing surface, is designed, however, to form a crosshead of such mass and dimensions as to permit of receiving and holding a wrist pin G of the enlarged diameter and length required to withstand the severe piston thrust, and to afford sufficient open space within the body of the cross head to receive, and allow of the free action of the head of the connecting rod hung on the wrist pin and connecting the same with its appropriate crank *d* on the double crank shaft D, as indicated in Fig. 1. The upper portion F of much smaller diameter forms the piston proper. The double trunk piston thus formed is received in its appropriate cylinder chamber B in the housing A. The lower and large cylinder cross head portion E is received in the lower portion of the cylinder B which serves as a guide within which it fits and can move smoothly and easily. The upper portion F, constituting the piston proper, is contained

in the upper part of the cylinder chamber B, which is conveniently reduced to proper size to receive the piston by means of a cylindrical steel bushing, or lining B', of proper dimensions to fit closely within the upper portion of the cylinder chamber B, where it is held securely by suitable means as shown, and of an internal diameter and length to adapt it to serve as a working cylinder for the piston F.

The piston as shown in structural detail in Fig. 3, is preferably composed of a central tubular stem F' closed at its lower end, which is inserted and held fast in the tubular neck E' of the crosshead E. To the stem are fitted annular separating rings or fill pieces *f*, and metallic packing rings *f'*. The packing rings are arranged in pairs, carried between the separating rings or fill pieces, having suitable peripheral recesses in their upper faces to receive said packing rings as shown. The lowermost fill piece *f* is seated upon an annular flange *e* surrounding the upper open end of the neck E', and upon the uppermost fill piece *f* is placed the annular end cage H which fits around and is secured to the upper end of the stem F' and holds the fill pieces and packing rings in place. The packing rings are preferably made narrow and of heavy cross section and are machined to the exact bore of the working cylinder, thus assisting by their added stiffness in supporting the high internal gas pressures. The annular end cage H in this instance is held in place by the piston lock nut I, the screw-threaded shank of which passes down through the annular cage and screw into and closes the internally screw-threaded upper end of the tubular stem F'. Drawing down the head of the nut to rest tightly upon a raised annular rim *h* surrounding the central opening in the top of the piston end cage H. In that portion of the upper face of the cage surrounding the rim *h*, and overhung by the head of lock nut I, is formed an annular series of holes *h'* communicating with the interior of the cage, which in turn communicates through lateral holes *f''* in the stem F' with the interior of said stem. The suction gas which enters the lower portion of the tubular valve stem through registering lateral openings *e'*, *e''* in said stem and the neck of the cross head portion in which said stem is held, passes thence upward through the stem out through the lateral openings *f''* therein into the interior of the piston end cage H, and thence up through the annular series of outlet holes *h'* in the upper face of the cage to the discharge side of the piston. The suction gas is led from the suction inlet through suitable passages into that portion of the cylinder chamber B below the bushing or working cylinder proper B', and thence passes through the registering holes in the

valve stem F' and neck of the cross head into the interior of the stems where it passes up and out through the head of the piston as just explained. Full communication between said portion of the cylinder chamber B and the interior of the crank case is provided by passages *e'''* (Fig. 3) in the top of the cross head, thus maintaining the interior of the crank case at suction pressure whenever the suction inlet is open.

On the exterior of the working cylinder are annular laterally projecting end flanges which serve to support the same in the portion of the cylinder chamber which it occupies, leaving between these two flanges an annular space *f'''* around the working cylinder which communicates with the suction inlet, so that the cold suction gas entering the compressor, on its way to the discharge side thereof, is caused to pass around and in contact with the barrel of the compressor cylinder proper, and thus to absorb the excess heat of compression. Openings or passages *f'* are formed in the lower flange of the working cylinder, for the passage of the suction gas therethrough to the portion of the cylinder chamber B below. The suction valve *i* mounted on and carried by the piston, is a simple, plain steel plate annulus having a slightly concave under face, which rests upon and covers that portion of the top of the piston end cage in which the annular series of outlet passages *h'* is found, and is capable of up and down play between the top of the piston end cage below and the overhang of the head of the piston lock nut above, it being guided in this movement by the annular rim *h* of the cage H which it encircles.

Each cylinder has a top head consisting of two suitably secured and separately removable sections J, J' placed one over the other as indicated in Figs. 1 and 2, thus making it possible to remove the top section for removal and inspection of the safety head, discharge valve, suction valve and piston packing rings without disturbing the pipe connections, none of which is attached to the upper top head section J. In the top head, and principally in the lower section J' are located the discharge valve *j* and its seat, the conventional steel safety head K, and their closing springs as shown.

The interior of the crank case C being in full communication through the passages *e'''* in the top of the crosshead with the cylinder chamber B above the cross head, is maintained at suction gas pressure while the machine is running. In compressors of the inclosed type, the far end of the crank shaft—that is to say, that end of it which is farthest from the crank shaft actuating motor—has hitherto, so far as I am informed, stopped short of the end of the crank case, and has been inclosed within the same. In

these circumstances, that end of the crank shaft outside of the crank case is exposed to atmospheric pressure only, while the end that is inclosed in the crank case is exposed to the pressure that prevails therein, resulting in unequal end thrusts upon the crank shaft, which increase in violence with the increase in difference between the two pressures and measurably impair the efficient action of the machine. To remove this trouble, I extend each end of the crank shaft beyond the crank case, so that both ends shall be subject to atmospheric pressure, for which purpose, as represented in Fig. 1, the far end of the crank shaft D is supported in and protrudes through and beyond a bearing head, shown in elevation, closing the left-hand end of the crank case, similar to that shown in section at the opposite end of the crank case, for the proper support of the crank shaft at that point. Inequalities in pressure on the opposite ends of the crank shaft being thus removed, objectionable end thrust on the crank shaft consequent upon such inequalities necessarily ceases.

As to lubrication—the crank pins and piston wrist pins receive their lubrication from the splash produced by the connecting rods striking the oil carried in the lower section of the crank case as usual in machines of this general type. For the main crank shaft bearings a force feed system is preferably employed, more especially in the larger sized compressors. Such an arrangement is here shown, the oil being circulated by means of a small plunger pump L driven direct from the lefthand end of the crank shaft D in Fig. 1, which is provided with a wrist pin d' connected by a connecting rod l' to the pump plunger l as shown. The oil flows from the lower section of the crank case through the connection m to the oil reservoir M from which it is drawn by the pump and forced into the two main crank shaft bearing heads, passing from the pump through pipe n to the oil header T shown in dotted lines in Fig. 1, whence it is conducted through the branch pipes p , p to the crank shaft bearing heads at opposite ends of the crank case as indicated in Figs. 1 and 2. The construction of the bearing heads, crank shaft packing, lubricating means, etc., is the same at both ends of the crank case, so that a description of one will serve for both. Fig. 6 shows the preferred construction on enlarged scale. The crank shaft packing is made up of a succession of rings of steel and soft metal arranged alternately. The first or innermost ring r' , termed a neck ring, forms a base for the first soft metal ring r and also provides an annular space w around the shaft into which oil fed to the bearing head, through the pipe p into the oil basin r formed for its reception in the bearing head,

is constantly supplied through a suitable duct x leading from the basin, thus keeping the space w constantly filled with oil, forming an oil seal under crank case pressure—or, in other words, suction pressure—which effectively prevents the leakage and escape of the CO_2 gas at that point. The soft metal rings r and of H section and fit the shaft and stuffing box neatly. The interposed steel rings s have a double wedge shaped cross section. The last or outermost ring t is a fibrous composition ring of standard make used as a final sealing ring and serving also to render the system of packing rings more or less elastic. When the packing gland is drawn up, the pressure on the series of steel rings tends to spread the soft metal of the soft metal rings—the packing rings proper—and to form tight joints between the crank shaft, soft metal, and walls of the stuffing box.

Manifestly, the working cylinder can be reduced in size as compared with the cross head chamber, by means other than the introduction of a steel bushing into the cylinder chamber of the surrounding housing. It is also obvious that my improvements are applicable to compressors of the inclosed type heretofore indicated whether the suction valve is carried by the piston, as in the present instance, or is mounted on the head of the cylinder surrounding the piston. Either of these well-known arrangements of the suction valve may be used as preferred.

Having described my improvements and the best way now known to me of carrying the same into practical effect, I state in conclusion that I do not restrict myself narrowly to the structural details hereinbefore described in connection with the accompanying drawings in illustration of my invention, since manifestly the same can be varied considerably without departure from the spirit of the invention; but what I claim herein as new and of my own invention and desire to secure by Letters Patent is as follows:—

1. In a high pressure fluid compressor of inclosed type, the combination with the compressor cylinder, piston, suction and discharge valves, and gas tight crank case and crank shaft mounted therein, of a crosshead chamber of greater diameter than the compressor cylinder interposed between, and having a gas-tight connection with, said cylinder and crank case, and in free communication at all times on the one hand with the suction side of the compressor cylinder, and on the other hand with the interior of the crank case, a crosshead fitting and reciprocable in the crosshead chamber, and directly connected to the compressor piston, and driving connections between the crank shaft and the crosshead, substantially as and for the purposes hereinbefore set forth.

2. The combination with the elements

specified in claim 1 of an annular chamber
surrounding the compressor cylinder and
communicating with the suction inlet; com-
municating openings between said annular
5 chamber and the crosshead chamber through
which the suction gas after passing around
the compressor cylinder is led into that por-
tion of the crosshead chamber above the re-
ciprocable crosshead therein; and a tubu-
10 lar axial stem for the compressor piston
provided at or near its lower end with pas-
sages through which the suction gas in the

crosshead chamber is led into the interior
of the stem, and at its upper end with suc-
tion-valve controlled passages through which 15
the thus-admitted suction gas passes to the
discharge side of the compressor piston.

In testimony whereof I affix my signature
in presence of two witnesses.

LLEWELLYN WILLIAMS.

Witnesses:

WILLIAM H. ORR,
RALPH R. WARDELL.