

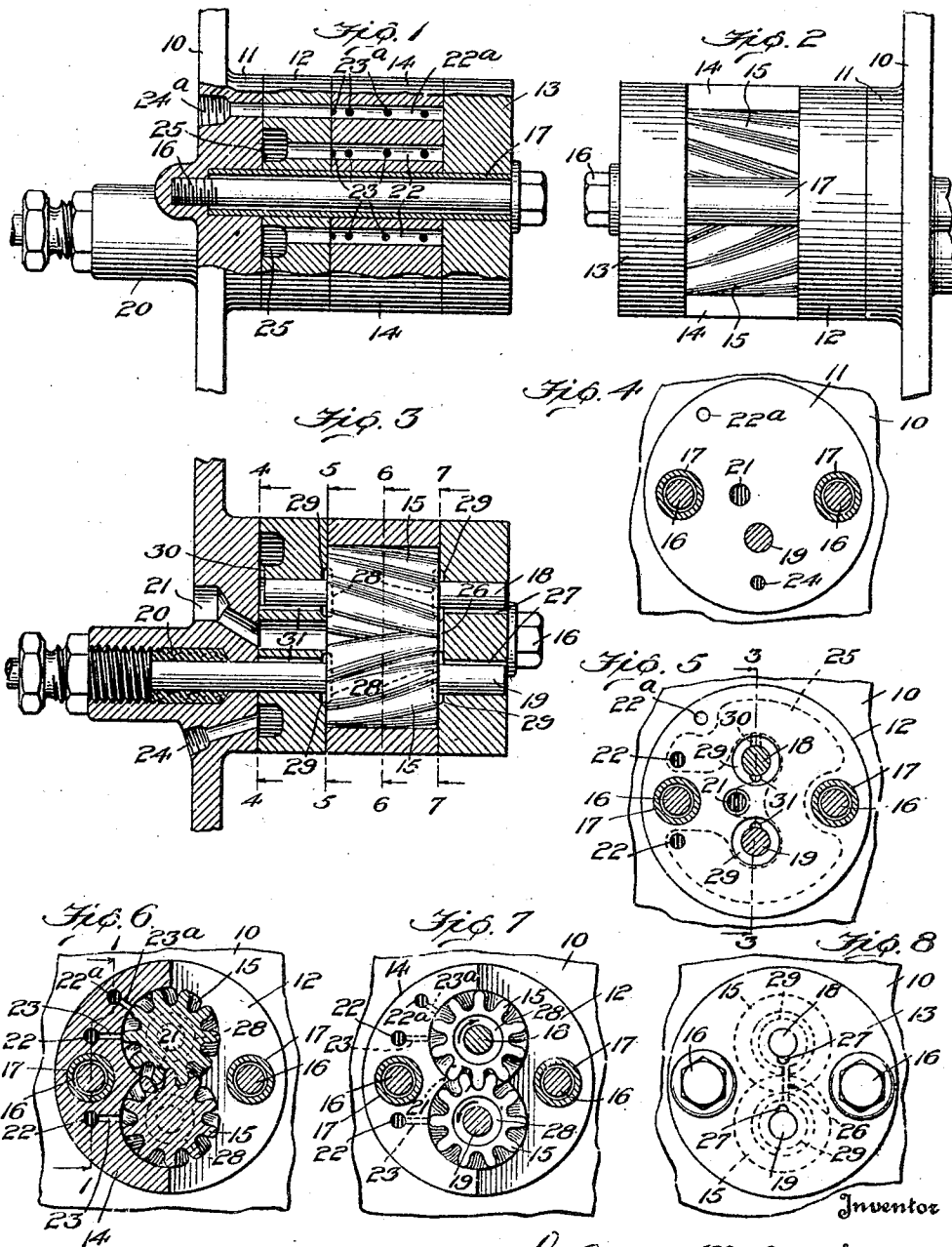
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C. M. DAVISON

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PUMP

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Clarence M. Davison
By *Charles H. H. H.*
Attorney

UNITED STATES PATENT OFFICE.

CLARENCE MARION DAVISON, OF BALTIMORE, MARYLAND, ASSIGNOR TO POOLE ENGINEERING & MACHINE COMPANY, OF BALTIMORE, MARYLAND, A CORPORATION OF MARYLAND.

PUMP.

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This invention relates to improvements in pumps, the primary object of the invention being to devise a pump especially designed for use in circulating the refrigerating medium of a refrigerating system from the cooling unit of said system, at which time said medium is in a gaseous state to the condenser and back again in liquid form to the cooling element.

A further object is to provide a pump of this character in which there will be an effective oil seal for the gaseous refrigerating medium when the same is being pumped thereto.

A further object is to provide for the circulation of a sealing medium used in the pump in such fashion as to reduce the power required for operating the pump at a speed to obtain a given pressure. Expressed differently, the object is to permit the same pressure which has hereinbefore been obtained in prior devices to be obtained in the present instance with the use of approximately one third less power.

With these and other objects in view the present invention consists in certain novel details of construction and combinations and arrangements of parts, all as will be hereinafter more fully described and the novel features thereof particularly pointed out in the appended claims.

In the accompanying drawings,—

Figure 1 represents a side elevation, partly in elevation and partly in section of a pump embodying the present improvements, the section being taken on line 1—1 of Fig. 6.

Fig. 2 is a similar view of the side opposite to that shown in Fig. 1.

Fig. 3 is a sectional view on the line 3—3 of Fig. 5, the gears being shown in elevation.

Fig. 4 is a sectional view on the line 4—4 of Fig. 3.

Fig. 5 is a sectional view on the line 5—5 of Fig. 3.

Fig. 6 is a sectional view on the line 6—6 of Fig. 3.

Fig. 7 is a sectional view on the line 7—7 of Fig. 3.

Fig. 8 is an end view looking at the right hand end of Fig. 3.

The portion of the pump mechanism illustrated in the drawings is adapted to be enclosed in the pump chamber of a casing 10,

a portion only of said casing being shown in the present instance as it forms no part of the improvements claimed herein. Casing 10 is formed with an inwardly extending boss 11 against which abuts a bearing plate 12 and spaced from said bearing plate 12 is a second bearing plate 13, said bearing plates being held in their proper spaced relation by a segmental member 14 which partially houses the gears 15 that are located intermediate the two bearing plates. Both of said bearing plates and segmental housing 14 for the gears are supported from the boss by means of bolts 16 whose headed ends engage the exterior face of the bearing plates 13 and whose opposite threaded ends are received in threaded sockets in the pump casing 10. To facilitate alinement of the several members that are thus carried by the boss and bolts they are preferably supported by sleeves 17 through which the bolts 16 extend, said bolts primarily functioning as clamping means.

The shaft 18 of one gear 15 is journaled in bearings in the two end plates 12, 13 while the other gear has a shaft 19 elongated so as to extend through a packing gland 20 in the casing 10, its projecting end located exteriorly of the casing being connected to any suitable driving means for rotating the gears. With the construction outlined it will be seen that the gear teeth are housed by the end plates and the segmental housing 14 during a portion only of their rotation. Extending through the housing 10 and end plate 12 is a gas duct 21 through which gas may be introduced into the spaces between the adjacent gear teeth at a time just after the tooth of one gear begins to withdraw from the root of the cooperating pair of teeth on the other gear and also at the time the teeth between which the gas is thus introduced are passing into contact with the enclosing wall of the segmental housing member 14. The gas supplied to the duct 21 is at least under atmospheric pressure and as one tooth of one gear begins to withdraw from between the two teeth of the other gear it is apparent that there will be a tendency on the part of the gas to rush or be sucked into the evacuated space between said two teeth. The teeth of gears 15 are spirally cut and said gears are so mounted that the teeth thereof engage each other first at the intake end or the end abut-

ting against bearing plate 12 and, as they are rotated past the gas inlet port 21, and begin to disengage there will be a space between the root of the tooth of one gear and the corresponding crown of the other. Further, owing to the fact that the gears are spirally cut such space will gradually enlarge as the gears rotate into the segmental housing and consequently the gas from the intake port will completely fill this space. In this way the space between each pair of two adjacent teeth of each gear is substantially filled with the refrigerating gas or other medium.

15 To build up a pressure on the gas thus introduced into the cavities between the teeth of the gears a compressing medium, usually in the form of oil is introduced under pressure into each of said cavities after the gas has been introduced into the same but before the teeth pass beyond the extremities of the segmental housing. In the construction illustrated this compressing medium is introduced at a plurality of points longitudinally of the gears, the construction preferred consisting in forming ducts 22 in the segmental housing 14 and end bearing plate 12, the compressing medium flowing from said ducts into the spaces between the teeth through passages 23 as illustrated in Figs. 1, 6 and 7. The compressing medium is supplied through a fitting 24 in the casing 10 to a groove 25 in the end bearing plate 12, and said groove communicates with both the longitudinally extending ducts 22 as shown in Figs. 1 and 5. The medium supplied to this groove 25 will be termed the primary supply because in some cases there is an auxiliary supply of medium to the gear teeth. Where such auxiliary supply is used it may take the form of a duct 22^a extending through the segmental housing 14 and end plate 12, the compressing medium being delivered to said duct through a fitting 24^a and flowing from said duct to the teeth through the passages 23^a.

As the gear teeth pass beyond the extremities of the segmental housing 14 the gas flows therefrom under pressure and accumulates, under such pressure, in the pump housing until there is built up sufficient pressure within said casing to force the gas to the condenser of the refrigerating system. The portion of the apparatus shown in the accompanying drawings being thus more or less surrounded by the refrigerating gas, under pressure, within the pump chamber, it is apparent that there is always a tendency of such surrounding gas to find its way back into the cavities between the teeth, and as the efficiency of the apparatus depends upon the quantity of gas that can be taken into said cavities through the normal gas supply duct 21, it is important that no gas from within the chamber should be ad-

mitted to said cavities to partially fill the latter and thereby reduce the volume of gas that can be taken through the normal supply duct 21. For this reason the compressing medium is usually in the form of oil in order that such oil may form a film on the gears and act as a sealing agent to prevent leakage of gas into and out of the pockets formed by the gear teeth.

The oil thus introduced between the teeth for purposes of compressing the gas therein and for forming a liquid seal as just described must, of necessity, be displaced from the teeth as said teeth come into complete engagement with each other at the end of the gears opposite the gas inlet duct 21. In some of the devices of the prior art this displacement of oil from between the teeth has been taken care of by having a comparatively loose fit between the ends of the gears and the bearing plate 13, but in such devices this looseness of fit between such parts has been found to lower the efficiency of the pump because the space between the ends of the gears and the bearing plate 13 permits gas within the chamber to enter and partially fill the pockets formed by those teeth whose crowns are in engagement with the segmental housing 14. In the structure contemplated by the present invention this difficulty of removing the oil from the teeth is not only eliminated but, in addition, the parts are so constructed as to have a close fit between the ends of the gears and bearing plate 13. For facilitating the escape of oil from between the teeth as they fully intermesh at their ends adjacent plate 13 said plate is formed with a relief groove 26 in registry with the point at which the said ends of the gear teeth fully intermesh. In the absence of such a relief groove 26 or of a loose fit between the parts it will be realized that the oil cannot escape and the gears would be locked against further rotation, or to such an extent as to require excessive power for driving them. In so far as escape of the oil between the teeth is concerned the relief groove 26 need only be in registry with the point at which the teeth fully intermesh, but for other reasons it is preferred that said groove be of such dimensions as to extend to a point where the teeth after having fully intermeshed have also begun to separate. With the relief groove of this character the initial opening of the teeth will permit a very small quantity of oil to reenter them so that they are provided with a film-like coating of oil for sealing purposes before their opposite ends come into registry with the gas inlet duct 21. In other words the end of each tooth adjacent plate 13 first comes into registry with the relief groove 26 for the purpose of having the oil removed from it into said groove; that end of the tooth then continues to traverse

the relief groove and receives a film of oil; and then the opposite end of that tooth passes the inlet duct 21 for the admission of gas between it and the next succeeding tooth.

This provision of the relief groove 26 reduces the power necessary to drive the pump and to further reduce the quantity of power necessary the relief groove is preferably extended so as to intersect the bearings of the shafts 18, 19 in the plate 13 and said bearings are formed with ducts 27 which permit the bearings to be thoroughly lubricated, it being understood that only a minor portion of the oil reenters the teeth from groove 26 while the greater portion thereof is caused to flow through the ducts 27 to the exterior of plate 13 whereupon it will drop and accumulate in the bottom of the pump casing chamber.

As has been stated it is desirable to have a neat fit between the ends of the gears and the adjacent bearing plates 12, 13. To secure this result the end faces of the gears are cut away around their shafts as at 28 leaving a comparatively narrow strip of metal between said cut away portions and the roots of the teeth and consequently reducing the wearing surface on the gears. Likewise, the end plates are cut away as at 29 immediately around the bearings for the gear shafts. The comparatively restricted wearing surface between the gears and bearing plates is advantageous, and as a further advantage the depressions formed by the cut away portions in the ends of the gears permit those narrow wearing surfaces to be dressed off very accurately, much more so than would be the case if those wearing surfaces extended radially inward to the shafts of the gears. This is true because if those surfaces extended entirely to the shafts it would be difficult to operate on the end face close to the shafts with the dressing tool.

By thus having narrow accurately finished end faces on the gears an exceedingly fine fit can be had between such gears and the end plates, but this closeness of fit is not, however, relied upon entirely for preventing gas within the pump chamber gaining access to the points formed by the gear teeth. In addition the joints at these points are adapted to be provided with a liquid seal. It will be apparent that oil from relief groove 26 will find its way into depressions in end plate 13 and the adjacent ends of the gears thus sealing the joint between these ends of the gears and said end plate. For supplying oil to the cavities in the opposite ends of the gears and in the bearing plate 12 passages 30 are formed in said bearing plate 12 between the oil supply duct 24 and the bearings for the gear shafts and said bearings have a small duct 31 extending longitudinally thereof to permit the oil to flow

into the cavities and the joint between bearing plate 12 and the adjacent ends of the gears.

As a summary, it might be stated that the introduction of oil into the spaces between the gear teeth by means of the elongated oil ducts 22; the provision of the relief groove 26 for facilitating the discharge of the oil from between the teeth as they intermesh at their ends adjacent bearing plate 13 and the provision of the oil ducts 27 in the shaft bearings for lubricating those bearings; the location of relief groove 26 so as to introduce a small quantity of oil into the gear teeth as their ends adjacent bearing plate 13 begin to separate and before their opposite ends come into registry with gas inlet duct 21; and the provision of the comparatively narrow wearing surfaces at the ends of the gears combined with the oil receiving depressions in said ends and the adjacent faces of the bearing plates; all tend to produce a pump which is not only very efficient in operation but which may be operated at a much lower cost. In actual tests compressors equipped with these new features have been capable of obtaining pressures at least 50% in excess of those obtainable with other types of machines, this difference in pressure indicating not only an increase in efficiency but at least 33 1/3% reduction of the power required to drive the pump. That is believed to be due primarily to the provision of the relief groove in the bearing plate 13 and the thorough liquid seal which is obtained in the present pump and, also, the thorough lubrication of the rotating parts. Another advantage is the particular way in which the oil is introduced between the gear teeth. That is, the use of the oil supply passages 22, 22^a, insures the oil being equally distributed along the entire length of the teeth regardless of that length. Not only is a minimum amount of oil required with this arrangement but there is a resultant reduction in the power required to drive the pump. If the oil should be introduced through a port at the ends of the teeth, the same as the gas, it remains in globular form and produces water hammer effect when impacting against the bearing plate at opposite end. This has been found to be true in actual practice and in an effort to secure a more thorough distribution of the oil and thereby eliminate the noise made by the water hammer effect, a comparatively large quantity of oil has been introduced at the ends of the spaces in the comparatively short period of time such spaces are in registry with the oil opening but, such efforts have only resulted in an increase in the power required to drive the pump without securing the desired results which, it seems, can be secured only by introducing the oil at points along the teeth.

I claim:

1. In a pump, the combination with the pump chamber casing, of intermeshing spirally cut gears, means for introducing the pumped fluid into spaces between intermeshing teeth at one end of the gears, means for introducing a sealing liquid into said spaces, and end plates enclosing the ends of the gears, the plate at the end opposite the point of admission of pumped fluid having a relief recess therein located at the point at which the adjacent ends of the teeth are fully intermeshed.

2. In a pump, the combination with the pump chamber casing, of intermeshing spirally cut gears, means for introducing the pumped fluid into spaces between intermeshing teeth at one end of the gears, means for introducing a sealing liquid into said spaces, and end plates enclosing the ends of the gears and provided with bearings for said gears, the plate at the end of the gears remote from the point of admission of pumped fluid having a recess therein located at a point where the adjacent ends of the teeth fully intermesh, said recess being in communication with the bearings in said end plate.

3. In a pump, the combination with the pump chamber casing, of intermeshing spirally cut gears, means for introducing the pumped fluid into spaces between intermeshing teeth at one end of the gears, means for introducing a sealing liquid into said spaces, and end plates enclosing the ends of the gears and provided with bearings in which said gears are journaled, and means on the inner face of the plate at the end of the gears remote from the point of admission of pumped fluid for delivering sealing fluid forced from between intermeshed teeth to the bearings in said end plate.

4. In a pump, the combination with the pump chamber casing, of intermeshing spirally cut gears, means for introducing the pumped fluid into spaces between intermeshing teeth at one end of the gears, means for introducing a sealing liquid into said spaces, and end plates enclosing the ends of the gears, the plate at the end of the gears remote from the point of admission of the pumped fluid having a duct therein extending from its exterior face to a point on its interior face in registry with the point at which the teeth fully intermesh at that end of the gears.

5. In a pump, the combination with the pump chamber casing, of intermeshing spirally cut gears, means for introducing the pumped fluid into spaces between intermeshing teeth at one end of the gears, means for introducing a sealing liquid into said spaces, and means permitting escape of said liquid from between the teeth at a point where the opposite ends of the teeth are

completely or fully intermeshed, said last mentioned means being also located to reintroduce a small quantity of sealing liquid into each pair of co-operating teeth as said opposite ends begin to separate and before their other ends come into registry with the point at which the pumped liquid is introduced.

6. In a pump, the combination with the pump chamber casing, of intermeshing spirally cut gears, means for introducing the pumped fluid into spaces between intermeshing teeth at one end of the gears, means for introducing a sealing liquid into said spaces, and end plates enclosing the ends of the gears, the plate at the end opposite the point of admission of pumped fluid having a relief recess therein located at the point at which the adjacent ends of the teeth are fully intermeshed, said relief recess being of sufficient breadth to permit a small quantity of sealing liquid to be reintroduced between co-operating teeth as they begin to separate and before said teeth come into registry with the point at which the pumped liquid is introduced into them.

7. In a pump, the combination with the pump chamber casing, of inner and outer spaced bearing plates, intermeshing spirally cut gears journaled between the spaced plates, means for introducing pumped fluid into spaces between intermeshing teeth at one end thereof, and means for compressing and sealing said fluid therein during a portion of the rotation of each pair of intermeshing teeth, the end faces of the said gears engaging the bearing plates being cut away at their centers to provide a comparatively narrow wearing surface on said gear ends and to facilitate sealing the pumped fluid in the spaces between the intermeshing teeth.

8. In a pump, the combination with the pump chamber casing, of inner and outer spaced bearing plates, intermeshing spirally cut gears journaled between the spaced plates, means for introducing pumped fluid into spaces between intermeshing teeth at one end thereof, and means for compressing and sealing said fluid therein during a portion of the rotation of each pair of intermeshing teeth, the end faces of the said gears engaging the bearing plates being cut away at their centers to provide a comparatively narrow wearing surface on said gear ends and to facilitate sealing the pumped fluid in the spaces between the intermeshing teeth, and means for supplying a sealing liquid to said cut away portions.

9. In a pump, the combination with the pump chamber casing, of inner and outer spaced bearing plates, intermeshing spirally cut gears journaled between the spaced plates, means for introducing pumped fluid into spaces between intermeshing teeth at one end thereof, and means for compressing

and sealing said fluid therein during a portion of the rotation of each pair of intermeshing teeth, one face of each pair of abutting faces of the gears and plates having its central portion cut away to reduce the wearing surface between the gears and plates and provide a cavity for the reception of a sealing and lubricating medium.

10. In a pump, the combination with the pump chamber casing, of intermeshing spirally cut gears, means for introducing the pumped fluid into spaces between intermeshing teeth at one end of the gears, and means for introducing a sealing medium into the space between adjacent teeth of the gears at a plurality of points longitudinally of the gears.

11. In a pump, the combination with the pump chamber casing, of intermeshing spirally cut gears, means for introducing the pumped fluid into spaces between inter-

meshing teeth at one end of the gears, and means for introducing a sealing medium into the space between adjacent teeth of the gears at points located adjacent both ends of the gears.

12. In a pump, the combination with the pump chamber casing, of intermeshing spirally cut gears, a bearing plate at each end of the gears, a segmental housing intermediate said plates partially enclosing the gears, means for introducing the pumped fluid into the spaces between intermeshing teeth at one end of the gears, and means for introducing a sealing liquid into the spaces between said teeth, said last mentioned means comprising a duct in said segmental housing extending longitudinally of the gears and communicating with the spaces between the gear teeth at a plurality of points longitudinally of said gears.

CLARENCE MARION DAVISON.