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WEAR-RESISTANT VANE FOR ROTARY COMPRESSOR

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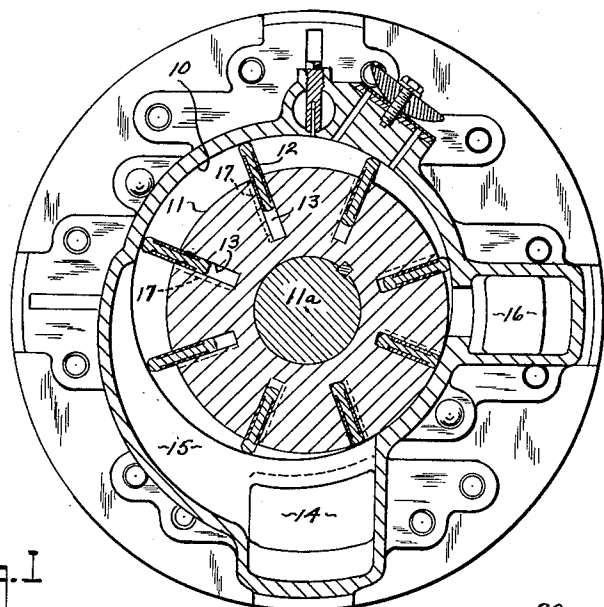


Fig. 1

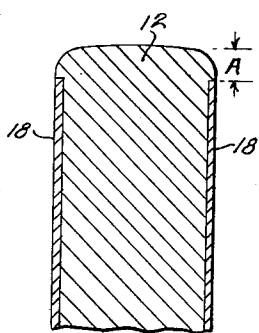


Fig. 2

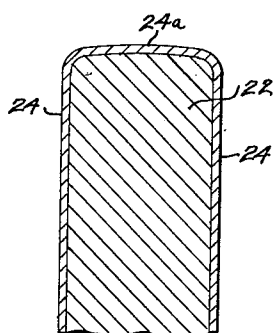


Fig. 3

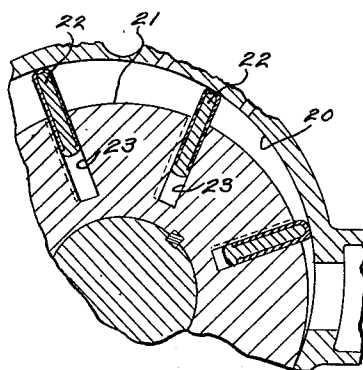


Fig. 4

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1 Claim. (Cl. 230-152)

This invention relates to improvements in a wear resistant vane for rotary compressors, and more particularly to such a vane composed chiefly of metal of high heat conducting capacity and light weight, but having a thin wear-resistant layer of harder metal on those surfaces of the vane subjected to wear, which harder metal is substantially bonded to the main body of the vane.

One of the objects of the present invention is to provide an improvement in the radially slidable vanes of a rotary compressor or pump of a known type wherein a cylindrical rotor is rotatably mounted within a cylindrical stator with the axes of the stator and rotor members eccentric, there being a plurality of radially extending slots in one of the members, usually the rotor, opening radially outwardly, and a plurality of vanes snugly received, usually one in each of the slots, and reciprocatable therein to maintain contact with the wall of the other of said members, usually the stator, so that air or other gas entering the stator at or near the point of greatest eccentricity is carried around the rotor by the vanes and exhausted from the stator at a point near the zone of least eccentricity.

Another object of the present invention is the provision of an improved vane for sealing between the rotor and stator of a rotary compressor or the like, wherein the vane is constructed chiefly from a solid body of metal of low density and high heat conducting capacity chosen from the group consisting of essentially magnesium and essentially aluminum, wherein the vanes are provided with a very thin layer of a harder metal substantially bonded to the main body of the vane.

Other objects and advantages of this invention will be apparent from the accompanying description and drawings and the essential features thereof will be set forth in the appended claim.

In the drawings—

FIG. 1 is a transverse sectional view through a rotary compressor embodying my invention;

FIG. 2 is a sectional view greatly enlarged taken through one of the vanes of FIG. 1;

FIG. 3 is a view similar to FIG. 2 being a cross section of a vane greatly enlarged and showing a modification of my invention; while

FIG. 4 is a fragmental sectional view through a rotary compressor utilizing the vanes of FIG. 3.

It is the aim of the present invention to improve on the vanes commonly encountered in rotary compressors today. A usual form of such vanes is to make them of laminated plastic material in an attempt to get sufficient strength, resistance to heat and wear, and still obtain suitable sealing between the rotor and stator. Such laminated vanes have given great operating difficulties resulting largely from the progressive delamination of the vanes which operate at a relatively high temperature in a heavy mist of oil fog, together with a high degree of friction between the vanes and the slots in which they move radially during the operation of the compressor.

Another difficulty in the use of the laminated plastic vanes mentioned in the preceding paragraph has been the deterioration of the oil used in the lubricating oil system of the compressor. It is a known fact that the heat of compression in a rotary compressor of this type is largely accumulated at the leading edge of each vane, which is the last portion in contact with the air as it reaches

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its point of greatest compression, and therefore the zone of greatest temperature. This, together with the friction of the radially outermost edge of the vane against the stator causes the radially outermost edge of each vane to become very hot. Since the transfer of heat through a laminated plastic vane is poor, the leading edges of these vanes are unable to dissipate the high temperatures and, therefore, they cause a progressive delamination of the blades and a destructive action of the heat on the lubricating oil which is in contact with the heated vanes sufficiently to raise the oil above its polymerization point which often breaks down the oil into gummy masses. It is therefore desirable that the heat thus naturally concentrated at the leading edges of the vanes or blades should be conducted away in a material of high heat conducting quality, such as aluminum and magnesium, and spread quickly over the entire surface of the blades, from which it can be quickly and effectively removed by the mist of lubricating oil provided inside the compressor.

In the following description of my invention, I shall describe first a preferred form of my invention wherein thin layers of steel are clad upon a main body of aluminum to provide the vane for the compressor, and this will be followed by a modification in which steel is clad upon magnesium, and then I shall describe another modification where an aluminum alloy adapted to resist wear and abrasion, is clad or otherwise deposited upon a main body of tougher aluminum.

In FIG. 1, I have shown a cross section through a rotary compressor adapted to utilize my invention. In a cylindrical stator 10, is eccentrically mounted a cylindrical rotor 11 on a shaft 11a by means of which the rotor is turned by any desired motive power. A plurality of vanes 12 reciprocate in radial slots 13 of the rotor so as to close the gap between the rotor and stator during a pumping action. Inlet to the compressor is through the opening 14 and the inlet passage 15 extending part way around the stator. This is at the point of greatest eccentricity. The compressed gases are discharged through the outlet 16 which is near the point of minimum eccentricity. In the usual manner, one or more small passageways 17 are provided to vent the bottom of each slot 13 so that the vanes may reciprocate freely in their receiving slots.

A preferred form of my invention is illustrated in FIGS. 1 and 2 wherein the main body of the vane 12 may be of any commonly used alloy chiefly aluminum, having the necessary strength to function as a vane in the rotary compressor. For instance, I have used No. 2014 aluminum which has approximately the following analysis: 4.4% copper, 0.8% silicon, 0.8% manganese, 0.4% magnesium and the balance aluminum. To each of the side wearing surfaces of the vane I secure, substantially by a molecular bond, a thin layer 13 of steel. A preferred form uses SAE 1040 steel although I may also use steel having quite a wide range of analysis and have used SAE 1020 and also stainless steel for this purpose. The drawing of FIG. 2 is greatly exaggerated. In an actual embodiment where the vane was seven inches long, about  $1\frac{3}{4}$  inches wide and  $\frac{3}{32}$  inch thick, the layer 13 was approximately .019 inch thick on each side. For the purposes of my invention, it is not imperative that the steel layer extend clear to the edge of the vane and in an actual embodiment the distance A from the end of the steel layer to the end of the vane is approximately  $\frac{1}{16}$  inch.

In one manner of forming the vane of FIG. 2, the heated aluminum body 12 between the thin sheets of steel 13 are submitted to a terrific pressure in a 20,000 ton press, the purpose being to create practically a molecular bond between the steel 13 and the aluminum 12. Any oxide surface which may be on the aluminum

at this time is displaced by the flow of the heated aluminum under the heavy pressure.

The term, molecular bonding, as used herein, refers to the bond obtained by pressing together in a high capacity press two dissimilar metals such as layer 18 of stainless steel and body 12 of aluminum (as seen in FIGS. 1 and 2) to obtain a strong and tenacious bond. This molecular bond is obtained by the very high pressures employed, under which, as previously indicated, the heated aluminum flows between the stainless steel and aluminum surfaces to form the strong pressure bond.

A compressor constructed as disclosed hereinabove in FIGS. 1 and 2 is very efficient. The parallel side faces of the vane where they rub the embracing slot 13 are protected against wear by the steel coating 18. This action is lubricated by the usual oil mist which is utilized in the rotary compressor. At the same time, the heat which tends to collect at the radially outermost edge of each vane is readily carried away through the aluminum where the heat transfer coefficient is very high. In any case, the amount of steel present is very small. Above all, the vane is of light weight which is of great advantage in a rotary compressor.

In the modification of FIGS. 3 and 4, the cylindrical stator is shown at 20 and the cylindrical rotor at 21. A plurality of vanes 22 reciprocate in radially extending slots 23. One such vane is shown in greatly enlarged cross section in FIG. 3. Here the main body 22 of the vane is comprised as before of aluminum and the protective layer of steel 24 extends not only along the two parallel side surfaces of the vane but also continuously around the leading edge thereof as indicated at 24a. This construction would only be resorted to if one desired to reduce the amount of wear at the radially outermost edge of the vane. The vane of FIG. 3 is made in a similar manner to that described in connection with FIG. 2. The thin sheet 24 of steel, say, approximately 0.019 inch thick, is folded around an aluminum slug in U-form and then the heated aluminum is subjected to a very high pressure as previously described so as to create substantially a molecular bond between the steel and aluminum.

The structure of FIGS. 3 and 4 operates in exactly the same way as that described in connection with FIGS. 1 and 2.

As a further modification, either the structure of FIGS. 2 or 3 may be made utilizing a block or main body 12 or 22 of magnesium in place of the aluminum previously described. A high strength magnesium alloy, as commonly used today, is suitable for this purpose and the steel layers 18 or 24 may be bonded to the magnesium body of the vane by the use of heat and extremely high pressure as previously described.

The magnesium of the last described form of my invention would serve to dissipate the heat through the vane from the leading edge thereof in the same manner as occurred in connection with aluminum, and at the same time the magnesium vane would be even lighter than the one made of aluminum.

A further modification of my invention comprises the pressure bonding of a relatively low strength aluminum

bearing alloy to a high strength aluminum vane body so that the combination provides high strength as well as a surface with excellent bearing characteristics against the sides of the slots 13 or 23. To this end, the main body of the vane either 12 or 22 is made of the No. 2014 aluminum previously described. To the side of such a vane I pressure bond two thin sheets as indicated at 18 in FIG. 2 or a single thin sheet in U-shape form as shown at 24 in FIG. 3, such thin aluminum sheets being made of a bearing aluminum commonly used for connecting rods and known as aluminum alloy No. 195. Such an alloy has 4 to 5 percent copper, 1 percent iron, 1.2 percent silicon, 0.3 percent manganese, 0.03 magnesium, 0.3 zinc, 0.2 titanium and the balance approximately 92 percent of aluminum. In this alloy there is approximately 0.15 percent limit to the total impurities. To pressure bond the aluminum alloy No. 195 to the No. 2014 aluminum base does not require quite such high pressure as the bonding of steel to aluminum or magnesium previously described. The desired condition is to have substantially a molecular bond between the high strength main body of the vane and the relatively low strength but friction resisting bearing alloy which provides the outer surface at 18 or 24.

Other modifications of my invention will appear to those skilled in the art but I believe that I have given enough illustrations of my invention to illustrate the same as defined in the following claim.

What is claimed is:

30 A vane for a rotary compressor and the like, having a stator and an eccentric rotor mounted therewithin, in which the vane is adapted to reciprocate in a slot of the rotor, while maintaining contact with the stator wall, the vane having flat parallel sides and comprising a main body portion of a light weight metal of the group consisting of magnesium, aluminum, an alloy consisting chiefly of magnesium, and an alloy consisting chiefly of aluminum, and a thin surface layer portion covering at least the major portion of the parallel sides and consisting of a metal more abrasion resistant than said main body portion, said layer portion molecularly bonded to said body portion by the action of heat and high pressure in a high capacity metal press in which a strong bond is obtained by flow under the high pressure of the light metal between said layer and body portions.

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