March 2, 1943. J. A. LAUCK 2,312,655

PUMP

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Fig. 1

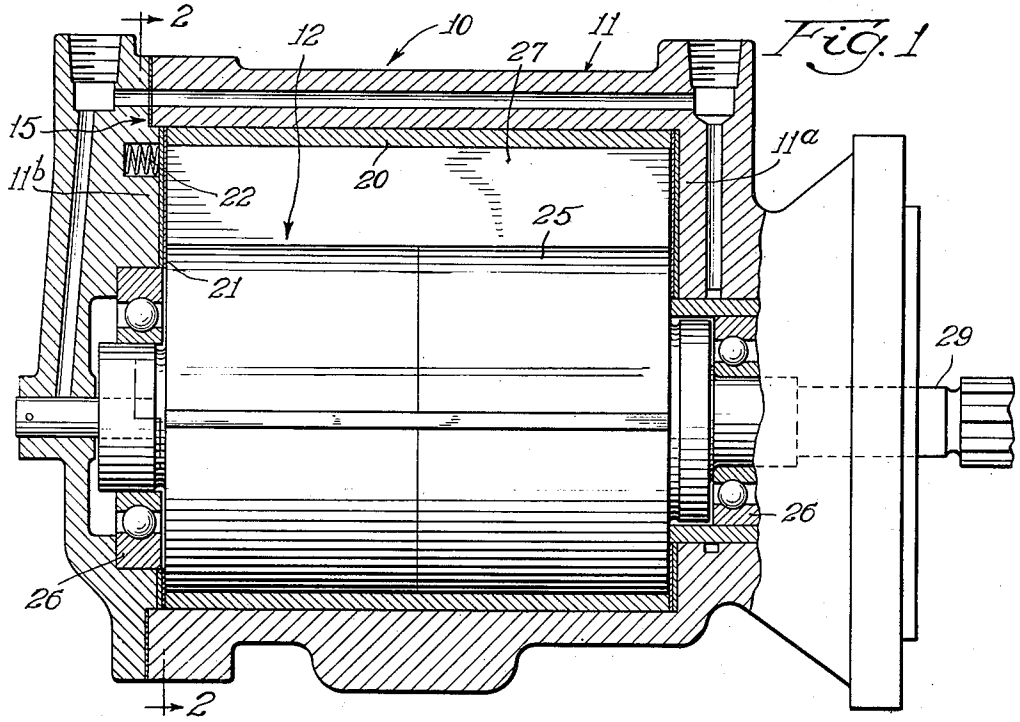


Fig. 2

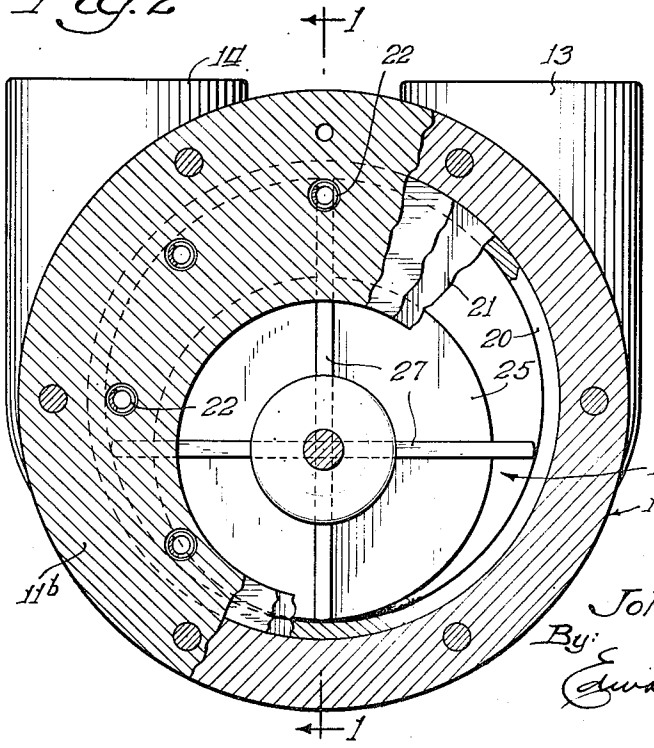
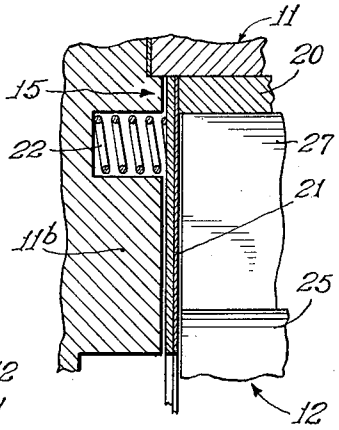


Fig. 3



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2,312,655

PUMP

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Application May 22, 1941, Serial No. 394,569

3 Claims. (Cl. 230—153)

This invention relates to rotary impeller type of vacuum pumps of light weight construction adapted for aircraft use and particularly to an arrangement for providing and maintaining a precise clearance between the walls and the adjacent impeller assembly irrespective of variations in the temperature of the pump.

In the manufacture of vacuum pumps for use on aircraft weight must be limited to a minimum without sacrificing efficiency. I have found that in vacuum pumps of the present type wherein the main housing is necessarily composed of a relatively light metal such, for example, as aluminum or magnesium or some alloy thereof, the resulting differential expansion between this main housing and the denser metal of the impeller assembly produces a varying clearance with changes in temperature. The efficiency of the pump varies of course with the change in clearance. As a specific example, I have noted in a production pump a variation in the total end clearance of as much as .007" where the housing was composed of aluminum and the impeller assembly of steel, and where the temperature variation was from 60° F. to 350° F.

I am of course aware that it has been proposed heretofore to provide spring urged end thrust plates for eliminating clearance completely. The resulting frictional contact caused by the pressure of the springs in such arrangements has been found to be completely unsatisfactory where the pump must be operated at the high speeds and high temperatures present in aircraft installations.

It is an object of this invention to provide in a vacuum pump of the above type a housing composed principally of a light-weight metal construction but having means providing for the differential expansion and contraction between said light-weight metal housing and the heavier metal of the impeller assembly.

A more specific object is the provision in a pump of the above type of a specially arranged auxiliary intermediate housing received between the impeller assembly and the main housing and effective to maintain a precise clearance irrespective of the differential expansion and contraction between said main housing and said impeller assembly.

The above and other objects, advantages and uses of my invention will become apparent from a reading of the following specification taken in connection with the accompanying drawing, which forms a part thereof, and wherein:

Fig. 1 is a broken-away axial cross-section;

Fig. 2 is a transverse broken-away cross-section taken substantially on the line 2—2 of Fig. 1; and

Fig. 3 is an enlarged broken-away axial cross-section showing to advantage the portion of my novel pump assembly shown in the upper left-hand corner of Fig. 1 and including particularly the axially adjustable end plate and one of the coil springs for biasing the same against the associated sleeve.

Referring in greater detail to the figures of the drawing, numeral 10 indicates a broken away axial cross section of a vacuum pump assembly corporating a preferred embodiment of my invention. This pump is composed essentially of a main housing 11 necessarily composed of a light weight metal such for example as aluminum, magnesium or some alloy thereof, this housing being formed with an impeller chamber receiving an impeller assembly indicated generally at 12 for producing a difference in pressure between ports 13 and 14, and finally my improved auxiliary intermediate housing assembly indicated generally at 15 for providing and maintaining a predetermined minute clearance with impeller assembly.

In view of the fact that the main housing 11 necessarily must be made of a relatively light metal in order to keep the weight within practical limits for aircraft use, and since at least portions of the propeller assembly 12 must be made of a heavier denser metal in order to withstand the wear and stress, it has been found that the differential expansion between the housing 11 and certain parts of the assembly 12 would normally result in a wide variation in the end clearance with changes in the temperature of the pump. In order to provide for a very definite and precise total clearance between the end walls 11*a*, 11*b* and assembly 12, as well as for maintaining this clearance within predetermined limits, I have provided the novel construction of intermediate housing indicated generally at 15.

This intermediate housing assembly 15 comprises, as shown to advantage in Fig. 3, a relatively thin metal sleeve number 20 composed of a metal or alloy having substantially the same characteristic of expansion and contraction under temperature changes as the metal of which the impeller assembly 12 is composed. This sleeve 20 has a length slightly greater than the overall coaxial dimension of impeller assembly 12 by an amount exactly equal to the desired total clearance to be provided. By arranging an axially adjustable end plate 21 to engage at

the periphery thereof with the end of sleeve 20 and urging the same into such engagement by means of a plurality of coil springs 22, the initially provided clearance is maintained regardless of the temperature changes in the pump assembly.

While the impeller assembly 12 may take any of the well known forms, I have illustrated the same as being made up of an axially fixed rotor 25 provided with bearing assemblies 26 at the opposite ends thereof and formed with radially directed slots therein receiving impeller blades 27, rotor 25 being eccentrically disposed with reference to the impeller chamber resulting in the reciprocation of impeller blades 27 upon the rotation of rotor 25 and the consequent development of a pressure differential between the ports 13 and 14.

As a specific example, I have found that very satisfactory results are obtained where rotor 25 is made of steel, blade 27 of steel, sleeve 20 of cast iron, axially adjustable end plate 21 of bronze, and housing 11 including closure member 11b composed of aluminum.

End plate 11b may be held in attached relation to housing 11 by the usual arrangement of cap screws (not shown) and a conventional driving connection indicated generally at 29 is provided as well as the usual other accessories not forming a part of the present invention, and hence not shown.

It will be understood that while I have disclosed my invention in connection with a specific embodiment thereof and mentioned certain preferred arrangements and compositions of metal, I nevertheless consider these in their more specific aspects by way of example rather than by way of limitation, and it is intended that my invention be defined by the appended claims, which should be given a scope as broad as consistent with the prior art.

I claim:

1. In a light weight vacuum pump adapted for aircraft use, including a light weight metal main housing having an impeller chamber therein, a rotary impeller assembly received within said chamber, said impeller assembly being composed at least in part of a relatively heavier metal than the metal of said main housing in order to withstand the stress and wear, said lighter weight metal housing having a greater coefficient of expansion than the metal of said impeller assembly, means providing a predetermined total clearance between said impeller assembly and the walls embracing the same irrespective of temperature changes in said pump, including an auxiliary housing composed of a metal having substantially the same coefficient of expansion and contraction as the metal of said impeller assembly located between said main housing and said impeller assembly, said auxiliary housing comprising an axially adjustable end wall, a metal sleeve embracing said rotary impeller assembly for contact with the inner periphery thereof and means for maintaining said end wall in engagement with said sleeve adjacent the periphery thereof while allowing for the relative expansion and contraction of said lightweight surrounding housing without affecting said engagement.

2. In a light weight vacuum pump adapted for aircraft use, including a main housing composed of a relatively light weight metal and having an impeller chamber therein, a rotary impeller assembly composed at least in part of a relatively heavier metal received within said chamber, said differences in the weight of said metals resulting in a differential expansion therebetween when subjected to varying temperatures, the combination therewith of means for eliminating variations in clearance, said means comprising a relatively thin sleeve composed of a metal having substantially the same characteristics of expansion and contraction as the metal of said impeller assembly and interposed between said main housing and said assembly, said sleeve being of a length greater than the overall length of said impeller assembly by an amount equal to the desired predetermined end clearance, an axially adjustable end plate interposed between one end wall of said light weight housing and the end of said impeller assembly and compression spring means disposed between said auxiliary end plate and said housing for urging said auxiliary end plate into axial engagement at the periphery thereof with said sleeve only, whereby differential expansion may take place between said main housing and said impeller assembly without changing the end clearance.

3. In a vacuum pump assembly adapted for aircraft use, including a main housing composed of a relatively light weight metal and having an impeller chamber therein, a rotary impeller assembly composed at least in part of a relatively heavier metal received within said impeller chamber, the combination therewith of means providing and maintaining a definite predetermined end clearance between said impeller assembly and the adjacent end walls, said means comprising a relatively thin sleeve composed of a metal having substantially the same characteristics of expansion and contraction as said impeller assembly interposed between said main housing and said impeller assembly, said sleeve having a length greater than the length of said impeller assembly by the amount of end clearance desired, at least one axially adjustable end wall defining auxiliary plate received between the end wall portion of said main housing and said impeller assembly, a plurality of radially disposed compression coil springs positioned between said plate and said housing for urging the periphery of said plate axially against the adjacent end only of said sleeve whereby differential expansion may take place between said main housing and said impeller assembly without affecting said end clearance.

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