Aug. 13, 1935. A. G. KOBIOLKE ET AL 2,011,224

APPARATUS FOR PRODUCING VACUUM

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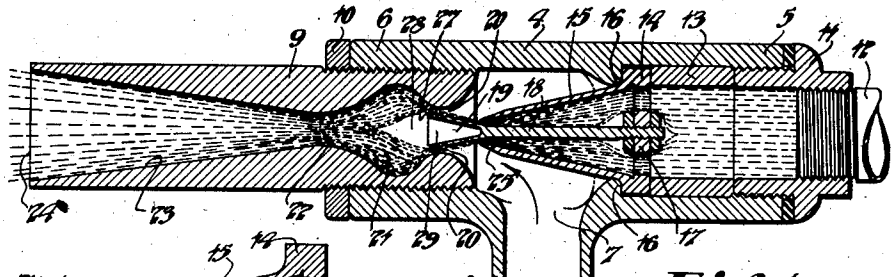


Fig. 1.

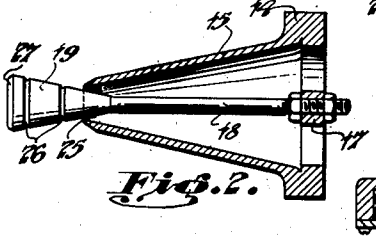


Fig. 2.

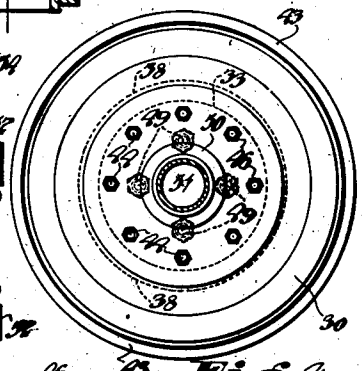


Fig. 4.

Fig. 3.

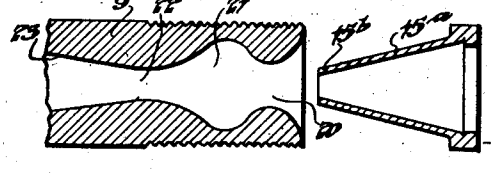


Fig. 5.

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APPARATUS FOR PRODUCING VACUUM

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10 Claims. (Cl. 230—92)

This invention has reference to an improved apparatus for producing vacuum and has been devised to provide such an apparatus that will be comparatively cheaper in manufacture, efficient in operation to effect the production of vacuum within the apparatus or device in which it is in circuit.

The object of the invention is to provide apparatus for producing vacuum that is entirely valveless and wherein fluid is directed under pressure through the internal co-relative elements to cause a constant suction to be exerted on the passage or pipe in communication with the article or apparatus from which air is to be evacuated.

In one embodiment of the present invention the apparatus may comprise a casing wherein an adjustable deflector cone is disposed in the restricted opening of an internal orifice leading into a diffusion chamber and arranged in the path of fluid pressure whereby on the said cone directing the fluid under pressure in a divided state into and through the internal orifice a constant suction is maintained on an adjacent passage leading to the article or apparatus to be evacuated.

The invention is characterized in that the deflector cone is hollow to communicate with a diffusion chamber formed in an exhaust member between the internal and external orifices thereof, whereby during the passage of a film of fluid on the cone into the diffusion chamber a constant vacuum is maintained at the centre of said chamber and the interior of the cone which creates a difference in air pressure on each side of the fluid film, thus causing a constant suction on the passage adjacent to said cone and communicating with the article or apparatus in which vacuum is to be produced.

A very important feature embodied in the invention consists in that the deflector cone receives the fluid or stream of water under pressure and divides the water up into a film thereon and the film of water is passed through an internal orifice having a restricted opening into a diffusion chamber, this passage of the water causing a constant suction on the article or apparatus from which the air is being exhausted, while the continuous operation effects the production of vacuum within the said article or apparatus.

A further essential feature comprises a novel exhaust member having internal and external orifices between which is formed a diffusion chamber adjacent to the cone deflector, the internal orifice being disposed in a restricted fashion around the base of the deflector cone whereby the constant suction is caused by the passage of the film of water over the cone to exhaust the air from the article in circuit with the pump, the film of water being atomized within the diffusion chamber prior to being consolidated in the external orifice during the exhaust of the used liquid through the external orifice.

A further important feature resides in the dual exhaust member which is constructed in the manner of a Venturi tube, the internal orifice being restricted and disposed around the base of the deflector cone while an enlarged diffusion chamber is formed adjacent to the internal orifice and having a reduced end in communication with the external orifice which is of a tapered or expanding nature to discharge the said liquid at a reduced pressure.

This invention apprehends the application of the above principles and construction of co-related elements to a rotary type of apparatus as a modification of the invention and wherein the orifices, interposed diffusion chamber and deflector cone are arranged in the same relationship but are constructed in a continuous circular formation as the body of the pump or apparatus is shaped as a hollow disc with the spindle of said disc suitably driven while the lower portion of the disc is provided with a tube extending into a supply of water or connecting with pressure fluid whereby, during the rotation of said disc, water is drawn up into the interior of the disc and deflected outwardly by centrifugal force on to the inclined surface of the cone shaped rim, which is actually V shaped, and thence into the annular diffusion chamber to cause suction to be exerted on the passage communicating with the article to be evacuated.

A further important feature embodied in the invention consists in that in the modified form of apparatus the casing of same is constructed in the manner of a hollow disc carrying an inner disc shaped member formed with a peripheral V shaped rim, which is disposed in the restricted opening of an annular diffusion chamber formed in the outer disc that is constructed with a peripheral jet to deflect the used liquid by centrifugal force into a stationary catchment and means are included to direct the superfluous liquid back into the tank or catchment.

A further important feature embodied in the invention is that the driven spindle of the disc may be hollow in order to connect the article to be evacuated, any suitable flexible connection being disposed between said hollow spindle and the article, whereby as the water is drawn up into the inner disc and deflected by centrifugal force over the outer V shaped rim through the restricted opening of the diffusion chamber, a constant suction force is exerted on the hollow shaft to eventually produce a vacuum within the article or apparatus in circuit therewith.

Other features of the invention will be hereinafter described with reference to the accompanying drawing in which:—

Figure 1 is a view in section of the apparatus for producing vacuum constructed in accordance with this invention.

Figure 2 is a detail view of the deflector cone mounted within the tapered and flanged casting.

Figure 3 is a section of a modified form of apparatus.

Figure 4 is a plan view of the rotating element included in the apparatus illustrated in Figure 2.

Figure 5 is a fragmentary sectional view of a further modification of the apparatus wherein the deflector cone is dispensed with.

According to one form of carrying this invention into practical effect, the improved apparatus for effecting the production of vacuum comprises a casing 4 suitably bored out and threaded at each end 5 and 6 with the undersurface of the casing 4 having a passage 7 through a depending stem 8, the lower end of which is also threaded to suitably connect in any way the article or apparatus to be evacuated.

The casing 4 at one end 6 connects an orificed exhaust member 9 which is suitably threaded thereto and retained in any adjusted position by means of a lock nut 10.

The other end 5 of the casing 4 is threaded to receive a screw union 11 adapted to connect the pipe 14 or tubular connection from a supply of pressure fluid such as water which may be from a main. The union 11 is tightened against a packing ring 13 disposed within the casing 4 to impinge against the end 14 of a tapered and flanged casting 15 which acts as a nozzle as will be hereinafter described.

The flanged end 14 of this casting 15 seats against a shoulder 16 formed within the casing 4 whereby as the union 11 is tightened, the hollow casting 15 is firmly retained in position against the annular shoulder 16 of the casing 4 by means of the packing ring 13, the internal diameter of which coincides with the internal diameter of the union 11 to permit a ready flow of fluid therethrough.

The hollow tapered casting 15 at its flanged end 14 is provided with a central rib 17 centrally bored out and tapered to receive the threaded end of the stem 18 of a deflector cone 19, the stem 18 being attached to the apex of the deflector cone 19.

The base of the deflector cone 19 is disposed in spaced relationship and in close proximity to the internal restricted opening 20 of the orificed nozzle member 9 which, as illustrated in Figure 1, is constructed in the form of a Venturi tube.

The internal restricted opening 20 of the orificed nozzle member 9 is expanded into an enlarged and rounded diffusion chamber 21, the outer end of which is reduced to form the external orifice 22 of a tapered formation 23 towards the outer end or nozzle 24, whereby the used water is exhausted at reduced pressures.

If desired, one or more diffusion chambers may be employed in the nozzle provided that the pressure of the fluid is sufficient to overcome atmospheric pressure during the exhaust of the used fluid.

The hollow casting 15 which is also tapered in a conical formation to constitute a nozzle is positioned to terminate around the apex of the deflector cone 19 whereby the incoming fluid or liquid is issued or directed by said nozzle on to the cone through the narrow aperture 25 of the casting 15 whereby it is delivered in a finely divided state or film on to the deflector cone 19.

The deflector cone 19 is of hollow construction as illustrated and tapers outwardly from the end of the stem 18, said deflector cone 19 may have formed thereon grooves 26 of desired shape and depth arranged in parallel or spiral form to assist in creating the production of vacuum within the article in circuit with the apparatus. If desired the deflector cone may be solid in lieu of being hollow and the bevelled or rounded base may be extended to form a double cone effect.

The deflector cone 19 is adjustable in relation to the tapered liquid delivery nozzle 15 whereby the liquid may be within limits directed under greater or lesser pressure over the surface of the deflector cone 19, this adjustment being achieved by means of the threaded engagement of the stem 18 with the rib 17 in the end of the casting 15 and the adjusting nut on said stem as illustrated.

In operation, the union 11 at one end of the casing 4 is connected with a supply of fluid under pressure or liquid under pressure such as from a main, while the lower tubular extension 8 of the casing 4 is connected with the article to be evacuated.

As the water or fluid under pressure is passed into the casing 4, its pressure is increased by being passed into the delivery nozzle 15 so that it issues on to the surface of the deflector cone 19 in a finely divided state in the manner of a film from which it is forced through the restricted opening 20 of the internal orifice 9 into the diffusion chamber 21, impetus being given the liquid under pressure by means of the inturned curved or bevelled end 27 of the deflector cone 19. The forcing of the water through this restricted passage 20 around the base of the deflector cone 19 in the diffusion chamber 21 sets up or causes a constant suction to be maintained in the adjacent passage 7 of the tubular extension 8 connecting the article or apparatus from which air is to be withdrawn.

The film of water is passed under pressure into the diffusion chamber 21 to follow the contour thereof, its natural tendency, after passing into the diffusion chamber 21 in a finely divided state is to expand to the shape of said chamber and atomize with the air withdrawn by suction from the passage 7, and as illustrated by the path of fluid in Figure 1, vacuum is formed at the centre 28 of the diffusion chamber and the interior 29 of the deflector cone 19, thus creating relative differences in air pressure between the centre 28 of the diffusion chamber 21 and the passage 7 connecting the article to be evacuated, whereby the air in the article or apparatus has a natural tendency to break through the film of water on the deflector cone 19 and enter the diffusion chamber 21 which, in conjunction with the natural suction effect obtained by the forcing of the film of water through the restricted opening into the diffusion chamber, maintains a constant suction on the passage way 7 which eventually produces a high vacuum within the article or apparatus in circuit therewith.

The atomized liquid in the diffusion chamber 21 on following the contour of the walls thereof, is forced through the reduced end of the external orifice 22 and discharged or exhausted to atmosphere at a lesser pressure owing to the expanding nature of the latter orifice 22.

The orificed exhaust member described is of particular utility in the apparatus described as it is preferably cast in one piece with the external and internal orifices 22 and 20 tapering towards the enlarged diffusion chamber 21, one side of which is disposed adjacent to the deflector cone 19 which is mounted in the internal orifice 20 as previously described and by the construction of

this latter orifice 20 the film of water is atomized within the diffusion chamber 21 by causing a suction on the passage 7 and is then consolidated in the external orifice 22 during the exhaust of the used liquid.

When operating under a low pressure fluid supply the external orifice 22 of the nozzle member may be provided with a fluid seal to prevent the ingress of air from the atmosphere.

As illustrated in Figure 5, a modification of the apparatus is shown in which the orificed exhaust member 9 described with reference to Figures 1 and 2 operates in conjunction with a modified form of tapered and flanged nozzle 15a whereby the deflector cone is dispensed with, the effective end 15b of said tapered and flanged nozzle 15a being positioned in relation to the orificed member 9 in such a manner that as the water or fluid is passed under pressure through the nozzle end 15b and thence through the restricted opening 20 of the internal orifice of the exhaust member into the diffusion chamber 21 a constant suction is maintained in the adjacent passage 7 of the tubular extension 8 connecting the article or apparatus from which air is to be withdrawn.

The operation of this modified form of the invention is similar to that previously described in relation to Figure 1.

Figures 3 and 4 illustrate a modification of the construction illustrated in Figures 1 and 2 and in the particular adaptation of the invention, the orifices, diffusion chamber and deflector cone operate in substantially the same manner as has been previously described, but are constructed in circular formation.

To achieve this construction, the casing 30 of the pump or apparatus is constructed in the manner of a hollow disc, the upper and lower surfaces 31 and 32 being curved towards the periphery.

The outer disc 30 has disposed therein and suitably spaced, a similarly shaped hollow disc 33, the centre of which has attached thereto a depending tube 34, the lower portion of which is flared to receive an integral screw 35 for the purpose of providing a lift for the water contained in a tank 36 or the like within which the discs 30 and 33 are rotated above the water level as illustrated in Figure 3.

The periphery 37 of the inner disc 33 is constructed with deflecting surfaces 38 which in section are V-shaped to correspond in outline with the deflector cone illustrated and described with reference to Figures 1 and 2, while this modified construction provides a V shaped deflecting rim.

The base 39 of the V-shaped rim 37 is positioned in the annular restricted opening 40 of an annular diffusion chamber 41 formed concentrically in the outer disc 30, the said chamber 41 being reduced to unite with a tapered peripheral jet 42 comprising the periphery of the outer disc shaped member 30, the lower surface 32 of which is curved upwardly to form a lip 43, the edge of which is superimposed above the opening of the jet, this space between the jet and the lip forms a seal for the liquid during rotation of the apparatus to obviate the influence of atmospheric pressure on the apparatus.

The inner disc member 33 is attached to the outer disc 30 by means of vertical bolts 44 extending through spaced sleeves 45 and are secured by nuts 46.

The V rim 37 of the inner disc 33 is supported on a central rib 47 mounted between spaced sleeves 45 retained in position within the inner disc 33 by means of hollow bolts 49 concentrically arranged, the bolts being hollow for the purpose of allowing for the free passage of air therethrough for the purpose hereinafter described.

Attached to the upper surface 31 of the outer disc 30 is a central flange 50 in which is socketed the lower end of a hollow spindle or shaft 51 substantially vertical and supported on anti-friction races 52 between which a pulley 53 is mounted for the purpose of driving the hollow spindle or shaft 51.

Figure 3 illustrates one means of supporting and driving the hollow shaft 51 but it will be obvious that any mechanical means may be employed for effecting this operation.

The upper end of the hollow shaft 51 has fitted thereto a coupling 54 for the purpose of connecting the rotating shaft 51 with a tubular connection or pipe 55 leading to the article from which air is to be withdrawn.

In operation, the shaft 51 is driven at a suitable speed which causes the disc 30 and shaft members to rotate in a unitary manner and the pipe extension 34 from the inner disc 33 rotates within the water in the tank whereby water is elevated by means of the action of the screw 35 therein into the inner hollow disc.

The rotation of the disc shaped members 30 and 33 causes the water to be deflected outwardly by centrifugal force and the curved tapering nature of the inner disc 33 towards its periphery causes the water to be increased in pressure to issue on to the deflecting surfaces 38 of the V shaped rim 37 in a finely divided state as a film in which condition it is forced through the annular restricted opening 40 into the diffusion chamber 41.

As its is forced through the restricted opening 40, the film of water causes suction to be exerted on the interior of the outer disc member 30 and consequently through the medium of the hollow shaft 51 upon the article to be evacuated and air is drawn downwardly into the disc shaped members 30 and 33 to each side of the inner disc 33, air being drawn through the hollow bolts 49, the lower side 30a of the outer disc to be drawn through the annular restricted opening 40 adjacent the V shaped rim 37 to effect the atomization thereof with the finely divided liquid in the diffusion chamber 41.

The deflected liquid conforms to the contour of the annular diffusion chamber 41 whereby a vacuum is formed at the centre of this chamber and the inside of the V shaped rim 37 so that there is at all times a tendency for the air within the outer disc 30 to force its way into the diffusion chamber 41 through the film of deflected water.

The used water is forced outwardly through the tapered peripheral jet 42 and deflected upwardly to the lip 33 of the outer disc 30 where a seal is formed for the purpose described.

During continuous operation, the used water is caught by a stationary catchment 59 formed at the top of the tank 36 to be discharged for re-use.

In lieu of the screw member 35 in the hollow extension 34 from the inner disc 33, propeller blades or the like may be utilized to elevate the liquid from the tank 36 into the inner disc 33.

In lieu of forming the shaft 51 in its combined sense of a vacuum pipe and driving medium, the pipe for connecting the article to be

evacuated may be passed into the outer disc in any suitable manner.

The operation of the modification of the invention described with reference to Figure 3 is similar to the stationary apparatus illustrated in Figure 1 with the difference that the disc shaped members are rotated and the orifice and cone shapes are formed circumferentially or annularly to cooperate as herein described.

We desire it to be understood that various improvements and modifications may be embodied in the invention without departing from its spirit and scope.

What we claim as our invention and desire to secure by Letters Patent is:—

1. Apparatus for producing vacuum comprising a casing adapted to connect to a supply of fluid under pressure, said casing having two ends, a hollow deflector cone disposed within said casing, a nozzle mounted in alignment with said cone to direct the fluid under pressure over said cone in a film, means to adjust said cone in relation to said nozzle, a passage in said casing adjacent to said cone and nozzle to communicate with the article from which air is to be withdrawn, an exhaust member fitted into one end of said casing, a diffusion chamber in said exhaust member formed between the internal and external orifices of the latter with the internal orifice being disposed around the base of the deflector cone, and an expanding discharge opening extending outwardly from the external orifice to discharge the atomized fluid.

2. Apparatus for producing vacuum according to claim 1 and wherein the deflector cone is positioned in axial alignment with the diffusion chamber to direct the pressure fluid in a film through the internal orifice into the diffusion chamber to cause suction on the passage leading to the article to be evacuated.

3. Apparatus for producing vacuum comprising an outer rotary casing to be connected with an article from which air is to be withdrawn, a spaced rotary casing disposed within the outer casing to receive pressure fluid, a peripheral rim formed on the inner casing, an annular diffusion chamber in the outer casing disposed adjacent to the peripheral rim, the pressure fluid being deflected by centrifugal force in a film over the said rim into the diffusion chamber to cause suction in the outer casing.

4. Apparatus for producing vacuum comprising an outer rotary casing to be connected with an article from which air is to be withdrawn, a spaced rotary casing disposed within said outer casing to receive pressure fluid, a peripheral rim formed on the inner casing having diverging surfaces, an annular diffusion chamber in the outer casing adjacent to said rim and having a circumferential restricted opening positioned around the periphery of the diverging surfaces, the pressure fluid being deflected by centrifugal force over the diverging surfaces of said rim in a film to pass through the restricted opening into said diffusion chamber for the purpose herein specified.

5. Apparatus for producing vacuum comprising an outer rotary casing to be connected with an article from which air is to be withdrawn, a spaced rotary casing disposed within the outer casing, a pipe connected with said inner casing to draw pressure fluid thereinto during the rotation of the casings, a V-shaped peripheral rim formed on the inner casing, an annular diffusion chamber in the outer casing adjacently disposed to said rim and having a restricted circumferential opening positioned around the periphery of said rim and a jet constructed on the outer casing to discharge the used and atomized fluid.

6. Apparatus for producing vacuum comprising an outer rotary casing to be connected with an article from which air is to be withdrawn, a spaced rotary casing disposed within the outer casing, means to draw fluid into the latter casing during the rotation of said casings, a V-shaped peripheral rim formed on the inner casing to reduce the fluid to a film, an annular diffusion chamber in the outer casing disposed adjacently to said rim and having a restricted circumferential opening positioned around the periphery of the rim and converging walls in the inner casing to deflect the fluid under pressure by centrifugal force over the peripheral rim, through the restricted opening into the diffusion chamber for the purpose herein specified.

7. Apparatus for producing vacuum according to claim 6 and wherein means are included to effect an initial lift to the fluid to draw same into the inner rotary casing.

8. Apparatus for producing vacuum, an outer rotary casing, a hollow shaft fitted to said casing to be connected with an article from which air is to be withdrawn, a spaced rotary casing disposed within the outer casing, means to draw fluid into the inner casing during the rotation of said casing, a V-shaped peripheral rim formed on the inner casing to reduce the fluid to a film, an annular diffusion chamber in the outer casing with a circumferential opening positioned around the periphery of said rim and a circumferential jet constructed on the outer casing in communication with the annular diffusion chamber to discharge the used and atomized fluid.

9. Apparatus for producing vacuum, an outer rotary casing, a hollow shaft fitted to said casing for the purpose of rotating said casing and connecting an article from which air is to be withdrawn, a spaced rotary casing disposed in the outer casing, a pipe to draw pressure fluid into the inner casing during the rotation of the casing, the inner casing having converging walls towards the periphery thereof to increase the pressure of the fluid, means within said pipe to provide an initial lift to the pressure fluid, a V-shaped rim formed on said inner casing to reduce the pressure fluid to a film, an annular diffusion chamber disposed in the outer casing adjacent to said rim and having a restricted opening around the periphery of the rim and a circumferential jet formed in the outer casing in communication with the diffusion chamber to discharge the used and atomized fluid.

10. Apparatus for producing vacuum according to claim 9 and wherein the inner casing is formed with a central rib, spaced bolts to attach said rib to the curved walls of said casing, said bolts being hollow to permit the passage of air therethrough for the purposes specified.

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