

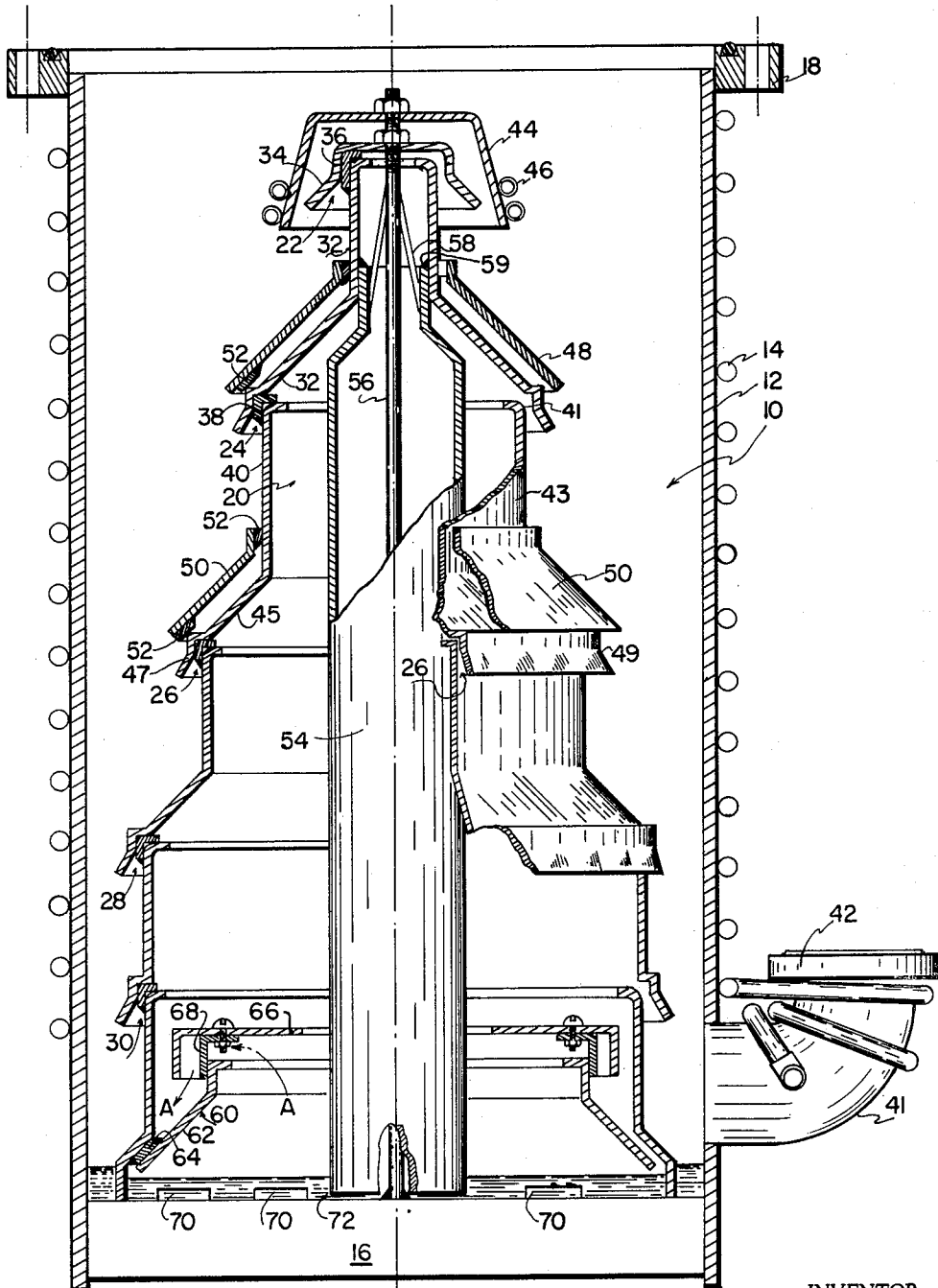
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HIGH VACUUM DEVICE

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HIGH VACUUM DEVICE

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This invention relates to high vacuum diffusion pumps and more particularly to fractionating, multi-stage diffusion pumps.

A principal object of this invention is to provide an improved construction of a diffusion pump which is easily assembled and provides reliable location of parts, particularly where the critical jet nozzle dimensions are formed between spaced parts.

It is a further object of this invention to provide an improved construction of a diffusion pump wherein splashing of pump oil within the vapor jet assembly is inhibited.

It is another object of this invention to provide, in a diffusion pump equipped with a cold cap, an improved pump construction enhancing the cooperation between the pump and cold cap.

Other objects of this invention will in part be obvious and will in part appear hereinafter.

The invention accordingly comprises the apparatus possessing the construction, combination of elements and arrangement of parts which are exemplified in the following detailed disclosure, and the scope of the application of which will be indicated in the claims.

For a fuller understanding of the nature and objects of this invention, reference should be had to the following detailed description taken in connection with the accompanying drawing which shows a sectional view of a preferred embodiment of the present invention.

The diffusion pump 10 comprises a tubular body cooled by coils 14, a boiler 16, an inlet flange 18 and vapor jet assembly 20. The vapor jet assembly includes first, second, third, fourth and fifth annular nozzles indicated at 22, 24, 26, 28 and 30, respectively.

The first annular nozzle 22 is formed by a tube 32 subtending approximately one-fourth the cross-sectional diameter of the tubular body 12 and a hot jet cap 34. Three uniformly spaced angles 36 are welded to the top of the tube. These angles afford reliable location of the jet cap and ease of assembly. Similar expedients are used in fabricating the subsequent annular nozzles, e.g. the tube 32 rests on angles 38 welded to tube 40. The elbow 41 terminating at flange 42 provides a foreline at the high pressure side of the pump. All the tubes and caps are preferably nickel plated, mild steel spinings.

Each of the top three tubes has a similar form. Referring to tube 40, for example, the tube starts with a first right angle bend 41 leading down to a cylindrical portion 43, leading down to a first conical portion 45, leading down to a second right angle bend 47 and terminating in a second conical portion 49.

The diameter of each annular nozzle is larger than that of the preceding annular nozzle 22, as indicated in the drawing. The diameters of the respective annular nozzles preferably increase in the following proportion:

$$8.5:20.5:25.25:29:30$$

The jet cap 34 and each of the tubes terminate in a flared skirt spreading out from a right angle bend which rests on angles welded to the tube below. The inner diameter of the tubular body is 32 inches and the height of the tubular body is approximately 5 feet. The pump is adapted to pump at a speed of approximately 30,000 liters

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per second, in the micron range in cooperation with the heater and cold cap, described below.

Cold Cap

The top annular nozzle of the pump is provided with a cold cap 44 cooled by circulating coolant fluid in coil 46. The cold cap substantially reduces backstreaming—the tendency of a portion of the organic vapor exhausted from first annular nozzle to migrate towards the inlet end of the pump. The cold cap, per se, does not comprise the instant invention. Rather, the invention comprises the pump structure described below which enhances the cooperation between the pump and cold cap.

A significant mechanism of the operation of the cold cap is the condensation of molecules of organic vapor which would otherwise migrate back to the system being pumped. As noted above, the second and succeeding annular nozzles of the diffusion pump are of large diameter compared to the first annular nozzle. The instant invention is based on the realization that the top structure of these lower annular nozzles presents targets to condensate dripping from the cold cap. This top structure, heated by the organic vapor passing below it, tends to reboil the dripping condensate.

The problem is overcome by the provision of conical shields 48 and 50 protecting the top structure of the second and third annular nozzles. As noted above, these annular nozzles subtend a diameter three times that of the first annular nozzle. It is known that a cold cap must closely surround its associated nozzle for efficient operation. It will be apparent from the above and from inspection of the drawing that the shields guard substantially all optical targets that the hot vapor jet assembly 20 would otherwise present to condensate dripping from the cold cap 44 and shield 48.

The lowest stages, viz.—fourth and fifth annular nozzles 28 and 30, need not be shielded since the preceding jets from the upper nozzles effectively pump any vapors migrating back from the lowest annular nozzles.

Each of the shields is spaced from the vapor jet assembly by bars 52 welded to the shields. The shields are polished so that they reflect heat back to the tubes 32 and 40. This radiation, together with the spacing of the shields from the vapor jet assembly, maintains their temperatures lower than that of the assembly 20. The spaced bars, like the angles 36, afford reliable location and ease of assembly.

In the drawing details of mounting the central chimney splash baffle and cold cap are omitted for clarity. However, it should be noted that the chimney 54 is arranged to clutch the topmost tube 32. Leakage pads are provided, as indicated at 70 and 72, to permit condensed oil at the bottom of the pumps to enter the vapor jet assembly and the chimney. The jet cap and cold cap are secured to the boiler by the rod 56, which is welded to the boiler, so that the entire vapor jet assembly is held down in case of accidental venting of the foreline. The chimney is suspended from rod 56 by ribs 58.

Splash Baffle

Referring to the lower portion of the drawing, there is shown a splash baffle assembly 60. The assembly is spaced from the lower vapor jet assembly structure by spaced bars 64. The bars are welded to the lower vapor jet assembly structure and to the splash baffle plate 62 for mounting the latter. The baffle plate 62 is spaced from baffle plate 66 by angle irons 68, thus directing the splashed oil as indicated by arrows A. Location of the assembly outlet below lowest of the jet nozzles permits them to run dry.

Since certain changes may be made in the above apparatus without departing from the scope of the invention herein involved, it is intended that all matter contained in the above description, or shown in the accompanying drawing shall be interpreted as illustrative and not in a limiting sense.

What is claimed is:

1. An improved construction of a fractionating, high vacuum oil diffusion pump, equipped with a cold cap comprising in combination:

- (a) a vertically arranged, tubular pump body and means for cooling the pump body, the pump body being open at its upper end to provide a large inlet and closed at its lower end and having an exit opening in its tubular wall near the lower end thereof;
- (b) a fractionating, vapor jet assembly mounted in the pump body and having a vertical series of outwardly and downwardly facing jet nozzles, including a jet nozzle near the top of the assembly, the assembly having a generally stepped form so that lower portions of the assembly present optical targets to the said top jet nozzle;
- (c) heater means located at the bottom of said pump body for producing oil vapors within the vapor jet assembly;
- (d) a cold cap mounted over the said top jet nozzle in closely surrounding, yet thermally isolated, relation therewith and arranged to intercept a portion of the vapor jet emerging from said nozzle and means for cooling said cold cap so that it condenses the intercepted vapor; and
- (e) means for shielding the said lower portions of the assembly presenting optical targets to the top jet nozzle from condensation dripping downwardly from said cap, said shielding means being arranged so that it maintains the condensate at a temperature below its boiling point.

2. The pump of claim 1 wherein the shielding means (e) comprises at least one shield and small spacers, said shield being mounted on the vapor jet assembly by said small spacers so that the shield is in close proximity to the protected portion of the vapor jet assembly, but spaced therefrom to limit conductive heat transfer.

3. A fractionating, vapor jet assembly for a high vacuum, oil diffusion pump comprising, in combination, a vertical array of stacked tubes and a tubular hot cap stacked on the topmost tube, right angle bar spacers separating adjacent tubes from each other and separating the cap from the topmost tube to define annular nozzles therebetween, said tubes having first annular right angle bends, opening inwardly, at the tops thereof with said spacers permanently attached to and fitting over the right angle bends, each of said tubes having second annular right angle bends therein, opening inwardly, for seating on the said spacers of the next adjacent lower tube, each tube having its form defined by the first right angle bend leading down into a cylindrical portion which leads down into a first downwardly opening conical portion which leads down into said second right angle bend which leads down into a second downwardly opening conical portion; and a central chimney centered by the topmost tube to provide a vapor path from the bottom of the vapor jet assembly to the annular nozzle formed between the hot cap and topmost tube bypassing the lower nozzles.

4. The vapor jet assembly of claim 3 with a tubular cold cap mounted over the said hot cap in closed spaced relation thereto and extending into the exit path of the jet nozzle, defined between the hot cap and topmost tube, means for cooling the cold cap to condense oil vapors intercepted thereby; at least one conical shield and spacer bars therefor and the conical portions and second right angle portion of at least the topmost tube being surrounded by said conical shield which is spaced from the topmost tube by said spacer bars which are attached to the inner surface of the shield.

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