Dec. 15, 1959 C. DI BENEDETTO ET AL 2,917,229

REFRIGERATED CENTRIFUGE

Filed April 17, 1958

FIG. 2.

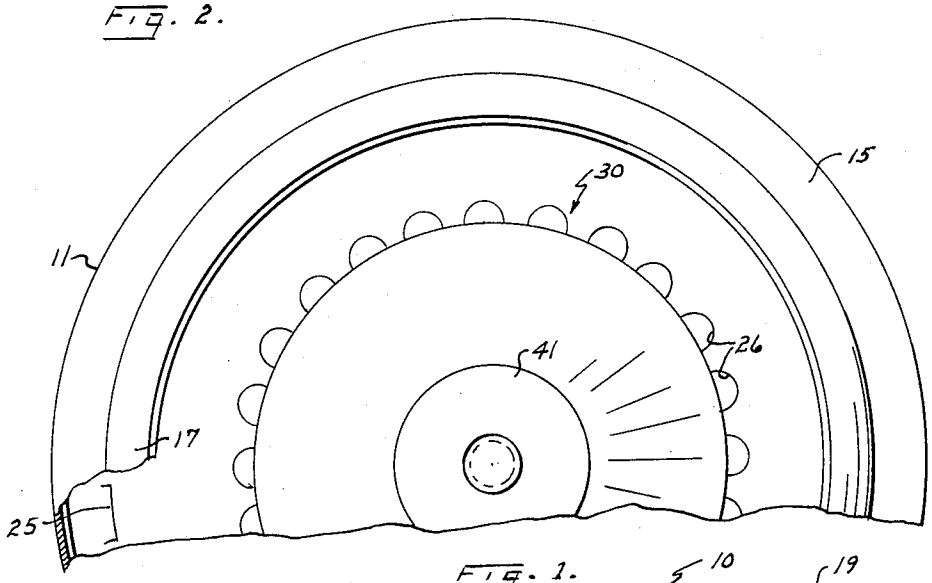
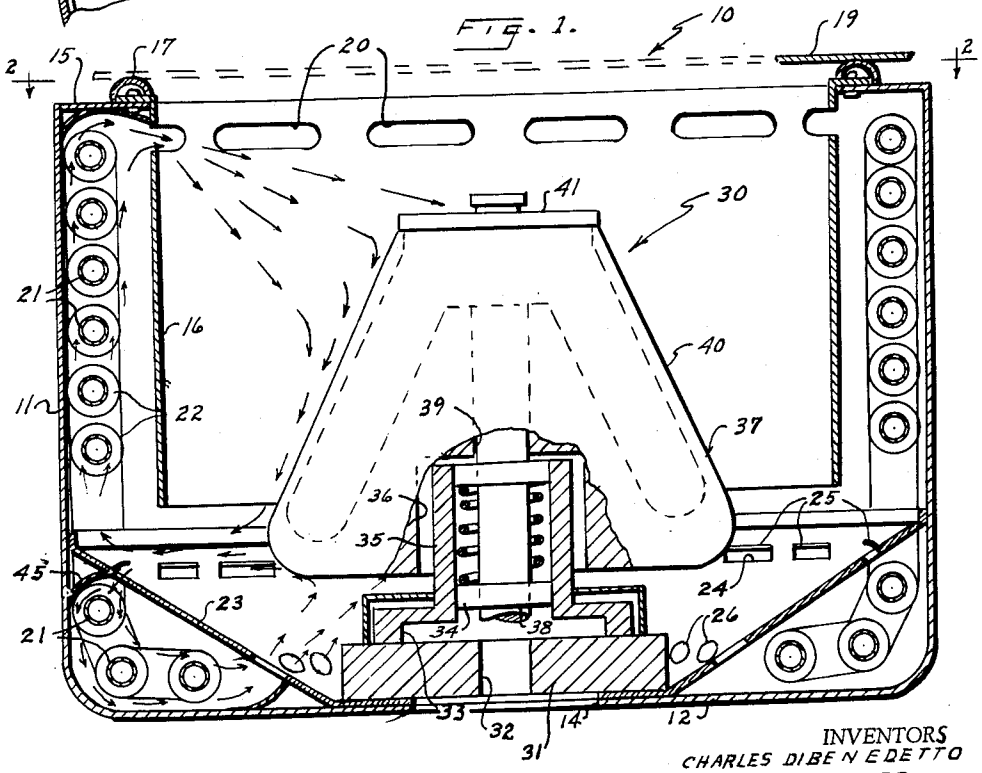


FIG. 1.



INVENTORS
CHARLES DIBENEDETTO
WILLIAM PIEMONTE
BY SALVATORE DIBENEDETTO

Howard J. Jeandron
ATTORNEY

United States Patent Office 2,917,229 Patented Dec. 15, 1959

2,917,229

REFRIGERATED CENTRIFUGE

Charles Di Benedetto and William J. Piemonte, Brooklyn, and Salvatore Di Benedetto, Franklin Square, N.Y., assignors to Lourdes Instrument Company, Brooklyn, N.Y.

Application April 17, 1958, Serial No. 730,748

2 Claims. (Cl. 233—11)

This invention relates to a centrifuge and more particularly to cooling the centrifuge with refrigeration.

The word centrifuge as used throughout the specification is to be understood as primarily a laboratory instrument wherein a rotor or central bowl is rotated at extremely high r.p.m. (2,000–20,000). With this high r.p.m. there is an induced air flow developed. This air flow is directed through and around a plurality of refrigerated coils and in turn back to impinge upon the rotor.

A refrigerated centrifuge is not entirely new in the art; however, the prior attempts all provide cooling by means of a cylindrical sleeve type evaporator. With this type cooling there is considerable air turbulence and poor circulation, which may result in inefficient refrigeration. Also, the prior art shows that the surface cooling area is limited to the area of the cylindrical jacket.

It is an object of this invention to provide a centrifuge in which the high speed rotor is also the air impeller for the circulation of air through and around a plurality of refrigerated coils and back to the rotor to provide the desired cooling of the rotor.

It is a further object of this invention to provide a centrifuge in which the high speed rotor is also the air impeller for the circulation of air through and around a plurality of refrigerated coils and back to the rotor to provide the desired cooling of the rotor and in which the degree of air flow is in direct proportion to the r.p.m. of the rotor.

It is a further object of this invention to provide a centrifuge in which the high speed rotor is also the air impeller for the circulation of air through and around a plurality of refrigerated coils and back to the rotor to provide the desired cooling of the rotor and in which the degree of air flow is in direct proportion to the r.p.m. of the rotor and is directed in two paths, one stream of air passing through side refrigerated coils and being redirected back to the top and side of the rotor while the other stream of air is directed through bottom refrigerated coils and redirected to impinge on the bottom surface of the rotor to provide the desired cooling of the rotor.

It is a still further object of this invention to provide a centrifuge that is mounted within a refrigerated cabinet and in which the high speed rotor becomes the impeller for circulating air within the cabinet through a plurality of refrigerated coils and in which the air stream is controlled, that is, the air flow is predetermined by the shape of the rotor and the degree of air flow is controlled by the r.p.m. of the rotor.

It is a still further object of this invention to provide a centrifuge that is mounted within a refrigerated cabinet and in which the high speed rotor becomes the impeller for circulating air within the cabinet through a plurality of refrigerated coils and in which the air stream is controlled, that is, the air flow is predetermined by the shape of the rotor and the degree of air flow is controlled by the r.p.m. of the rotor and the air flow is divided into two air streams, one stream of air passing through the side refrigerated coils and being directed back to the top and side of the rotor while the other stream of air is directed through bottom refrigerated coils and redirected back to impinge on the bottom surface of the rotor to provide the desired cooling of the rotor.

It is a still further object of this invention to provide a centrifuge that is mounted within a refrigerated cabinet and in which the high speed rotor becomes the impeller for circulating air within the cabinet through a plurality of refrigerated coils and in which the air stream is properly deflected to provide laminar flow through a plurality of refrigerated coils.

It is a still further object of this invention to provide a centrifuge that is mounted within a refrigerated cabinet and in which the high speed rotor becomes the impeller for circulating air within the cabinet through a plurality of refrigerated coils and in which the air stream is properly deflected to provide laminar flow through a plurality of primary and secondary refrigerated surfaces.

It is a still further object of this invention to provide a centrifuge that is mounted within a refrigerated cabinet and in which the high speed rotor becomes the impeller for circulating air within the cabinet through a plurality of refrigerated coils and in which the air stream is properly deflected to provide laminar flow through a plurality of large area refrigerated coils with primary and secondary cooling surfaces.

It is a still further object of this invention to provide a centrifuge that is mounted within a refrigerated cabinet and in which the high speed rotor becomes the impeller for circulating air within the cabinet through a plurality of refrigerated coils and in which the air stream is properly deflected to provide laminar flow through a plurality of bottom as well as side refrigerated coils.

Further objects of this invention shall be apparent by reference to the accompanying detailed description and the drawings in which:

Figure 1 is a cross sectional view of the centrifuge mounted in a refrigerated cabinet.

Figure 2 is a plan view taken on line 2—2 of Figure 1.

Referring to the drawing, there is illustrated a stationary circular supporting cabinet **10**. The cabinet **10** has a circular wall **11** and a bottom **12**. The bottom or base of the cabinet **12** is provided with a concentric aperture **14**. The top of the cabinet is provided with a flange **15** which is approximately 90° to the wall **11**. A cylindrical liner **16**, preferably of stainless steel, is provided to fit into the cabinet and abut with the edge of the circular flange **15**. The liner **16** may be turned over and bolted to flange **15**. This joint also provides the means of clamping a rubber gasket **17** as illustrated so that a cover **19** may be positioned over the cabinet in use. The liner **16** does not extend to the bottom of the cabinet. It is approximately ⅔ of the depth of the cabinet and the liner **16** is provided with a plurality of slots or apertures **20** adjacent the upper edge of liner **16**. Within the space formed by the circular wall **11** and the circular liner **16**, there are mounted a plurality of tubes **21**. Tubing **21** is preferably spiraled about the cabinet in the position illustrated and it is in turn connected to a refrigeration system so that the refrigerated gas, such as Freon 22, will be pumped through the tubing and the expansion of the Freon will take place within the tubing. The tubing **21** is also provided with a plurality of fins **22** in disk form or the fins may also be spiraled about the tubing **21**. In the base of cabinet **10**, there is also mounted a circular deflection plate **23**. The upper edge of the deflection plate **23** abuts with the wall **11** of the cabinet, while the lower edge of the deflection plate **23** abuts with and rests upon the bottom wall **12**. The deflection plate **23** is provided with a plurality of apertures **24**. It is to be noted that the apertures **24** are formed by cutting the plate **23** and forming or bending the metal inward, to form a curved baffle **25**. It is also to be noted that a plurality of apertures **26** are

punched in the deflection plate at a position in close proximity with the bottom edge of the plate as illustrated. Apertures 26 may be circular in form as shown or they may be enlarged in slot form to provide sufficient opening for the passage of the refrigerated or cooled air. It is to be noted that within the area formed by the wall 11 of the cabinet, the base or bottom 12 of the cabinet and the deflection plate 23, there are a plurality of refrigerated coils mounted. These coils are similar to those mounted in the upper portion of the cabinet. It is to be noted that the tubing 21 may be equally spaced along the wall 11 and the bottom 12.

With the cabinet as described, the centrifuge rotor and support assembly 30 may be centrally mounted within the cabinet. In this particular instance a base 31 is mounted in the cabinet to rest upon the bottom 12 and the flange or deflection plates 23. Base 31 is provided with a central aperture 32 to permit a drive shaft (not shown) to be passed therethrough for driving the centrifuge. A supporting structure 33 is mounted on base 31, structure 33 supporting thrust bearings 34. Structure 33 is formed with a smaller concentric portion 35 that fits within the lower bore 36 of a rotor 37. The thrust bearings 34 support a drive shaft 38, drive shaft 38 extending through the smaller bore 39 of the rotor 37. The rotor 37 is provided with angularly shaped walls 40 and a flat cover 41. It is to be noted that the rotor 37 in its mounted and supported position is retained with a spacing between the bottom of the rotor 37 and its supporting structure. This is to permit a free circulation of air around the bottom of the rotor.

With the device as described it is apparent that the rotor 37 is concentrically balanced within the cabinet and driven by means of a drive shaft 38 that is supported in a thrust bearing 34 and with the cover 19 closed down upon the gasket 17, the cabinet will be sealed with the refrigeration system (not shown) connected to the tubing 21 and operating to provide the required degree of refrigeration for the system. When the rotor 37 is driven at its minimum or maximum r.p.m. the rotation of rotor 37 has the effect of impelling or moving the air surrounding said rotor. The high r.p.m. produces a throwing off of the air at the greatest diameter of the rotor. As indicated by arrows, the air will be cast off by centrifugal force and will impinge against the deflection plate 23. The air would normally be directed upward according to the arrows passing around the refrigerated coils 21 and upward through the area bounded by wall 11 of the cabinet and the liner 16. As the flow of air builds up within this area it will be redirected through the apertures 20 at the top of liner 16 and since the high r.p.m. of the rotor induces considerable velocity to the air, the air will flow at a rapid rate and will be thrown out of the apertures 20 to impinge upon the cover 41 and the angular walls 40 of the rotor. The air will absorb the heat from the rotor and will be circulated to be again coiled as it passes around refrigerated coils.

Referring to the deflection plate 23 and particularly the apertures 24 and the deflecting baffles 25, it is apparent that a certain portion of the air stream will be directed through these apertures to circulate within the area below the deflection plate passing around the refrigerated coils and being redirected through the apertures 26 and due to the velocity flow of the air will pass from apertures 26 upward and impinge upon the lower surface of rotor 37. The cabinet 10 at the area where the wall 11 and base 12 join, may be curved to assist the natural air flow and prevent turbulence. Likewise where the air passes through apertures 24, a further curved deflection guard 45 may be added to also assist in controlling the air flow and prevent turbulence. It is apparent that as the rotor 37 is operated, the minimum r.p.m. operation is sufficient to provide the desired air circulating for cooling the rotor. However, as the rotor 37 is increased in its r.p.m., it also tends to heat to a greater degree and the increased r.p.m. also creates a greater velocity flow of air and thus produces a greater degree of cooling so that the increase in degree of heat created is easily and properly taken care of by the increased cooling effect produced by the increased air flow. As long as the refrigerated coils are adequately cooled, there will be a very effective cooling of the rotor 37, regardless of the r.p.m. at which it is driven (from minimum to maximum as designed).

Although the refrigerated cabinet described is provided with refrigerated coils of tubing, the cabinet may be similarly provided with other types of radiating elements as long as the radiating elements are positioned within the area of the air stream without departing from the spirit of this invention and although the rotor is designed primarily for centrifuge operation, the rotor may be utilized to provide the dual function of impelling a circulation of air and the shape of the rotor may be altered to a greater or lesser angular degree to assist or change the degree of circulation without departing from the spirit of this invention, and although the cabinet has been designed to provide a division of the air being circulated to provide two paths of circulation, the air may be divided into a plurality of other paths of circulation if it is to the advantage of the rotor to be cooled without departing from the spirit of this invention and this invention shall be limited only by the appended claims.

What we claim is:

1. A refrigerated centrifuge which includes an enclosing walled cabinet, having a base and a top cover, a plurality of refrigerated coils positioned adjacent to the walls of said cabinet, a vertically positioned rotor and supporting assembly for said rotor mounted in the center of said cabinet, a liner positioned to enclose said rotor and separate said rotor from said refrigerating coils, said base of said cabinet retaining a deflection plate positioned at an angle to the rotor axis to direct the air stream from said rotor upward through the refrigerated coils, said deflection plate provided with a plurality of inlet ports and baffles positioned on a horizontal plane adjacent the area at which the air stream normally leaves said rotor, said baffles being positioned above said inlet ports, to direct a portion of the air flow through said inlet ports, said deflection plate provided with a plurality of outlet ports adjacent the base of said rotor, said deflection plate dividing the air stream from said rotor into two laminar flows, one of said air streams directed toward the bottom of said rotor and the other directed upward and redirected to the top and sides of said rotor.

2. A refrigerated centrifuge which includes an enclosing walled cabinet having a base and a top cover, a single vertically positioned centrifuge rotor which is also the container for the medium to be separated mounted in the center of said cabinet, said rotor having angular outer walls and in which the base of said rotor has the greater dimension, a plurality of refrigerated coils positioned adjacent the walls of said enclosing cabinet, an inner vertically positioned dividing wall to separate said refrigerated coils from said rotor, said rotor supported by a central supporting assembly, said dividing wall extending from a point slightly above the bottom of said rotor to the top of said cabinet which forms a vertical air passage and provides an inlet at the bottom of said dividing wall for the flow of air into said passage, a plurality of outlets positioned at the top of said dividing wall to direct the flow of air out of said passage toward said rotor.

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