My invention relates to a centrifugal filtering device for separating liquids from solid matter.

Such devices have a variety of uses and are applied extensively in drying the residue of activated sludge, separating liquid treating solutions from solids in mineral mining processes, etc.

I will describe the device of my invention in connection with the separation of crystallized sugar from molasses in the sugar refining process. When the sap has been extracted from beets, sugar cane or other sugar bearing plants, it is first boiled until the sugar content is in the crystallized stage and the remainder of the sap is in the form of molasses. The sugar is then separated from the molasses by centrifugal means.

An object of my invention is to provide a new and improved centrifugal separator or filterer.

A further object is to provide a continuous centrifugal filterer.

A further object is to provide an efficient and effective centrifugal filterer which is simple in construction and economical in operation.

Other objects and advantages will appear as the description proceeds.

Referring to the drawings:

Fig. 1 is a side elevation partly in section of a device embodying my invention.

Fig. 2 is a fragmentary sectional view taken on line 2--2 of Fig. 3, and

Fig. 3 is a sectional plan view taken on line 3--3 of Fig. 2.

In general, my invention consists of the use of what I term an air scraper, with a centrifugal separator or dryer which may be of substantially standard type in other respects. The porous element carried by the rotatable head of most centrifugal dryers is a felt or similar material. When such a material is scraped for the purpose of removing the dried residue, there is considerable wear causing frequent renewals of the felt. Moreover, the manner in which centrifugal separators are now run requires periodical stopping to remove this material, thereby greatly increasing the length of time required to treat a given body of material. I have also found that some materials, such as sewage sludge for example, is not dried sufficiently on the ordinary type of centrifugal separator. Consequently, I not only employ an air scraper for removing solid material from the porous element, but I do this during the continuous operation of the device by progressively moving the residue from the top of the head downwardly until it is discharged off the bottom into a suitable receptacle. As the residue is moved downwardly it is turned over periodically, thus freeing particles of water which may be trapped in various parts of the solid matter and exposing fresh areas so that a drier final product is obtained. The air delivered under pressure also appears to aid in driving moisture through, which otherwise would not be moved by the centrifugal force alone. When the separator is used in the drying of sugar in refinement processes I also provide means for introducing water for washing the molasses from the sugar. This is also accomplished progressively so that the final solid product is freer from contaminating substances and drier than with any other type of separator or dryer with which I am familiar.

Now with reference to the drawings in which the construction of one embodiment of my invention is disclosed, the apparatus is mounted upon a base 11 having a pair of upwardly extending standards 12 connected by a cross piece 13. A second pair of standards 14 is mounted upon the cross piece 13 and are connected by a cross piece 15. Each of the cross pieces 13 and 15 supports a journal 16 and 17 respectively. Rotatably supported in journals 16 and 17 is a hollow shaft 18. Journal 16 carries a ball race 19 cooperating with a ball race 21 upon the hollow shaft to support roller bearings 22, forming a thrust bearing for supporting the shaft and its attachments against downward movement. The journal 16 is also provided with a dust cap 23 to prevent the ingress of dirt into the bearing. Journal 17 is provided with a pair of ball races 24 and a cooperating ball race 25...
25 is mounted upon the hollow shaft. These ball races support ball bearings 26, forming a combination radial and thrust bearing. This bearing is also preferably enclosed by being covered with a dust cap 27.

Hollow shaft 18 may be rotated by means of a pulley 20 secured thereon and supports a rotatable head 28 which comprises a top plate 29 which is curved downwardly at its outer periphery and has a plurality of radial vanes 31. These vanes extend longitudinally in an axial direction and carry a lower rim 32 which interconnects the lower ends of the vanes. The lower face of rim 32 is provided with a circular groove 33 and surrounding the rotatable head is a casing 34 having an annular trough 35, one side of which extends into groove 33. The top plate 29 has a boss 36 which is secured to shaft 18 so as to be rotatable therewith. Within the rotatable head, and spaced from top plate 29, is a disc 37 which is connected to the top plate by means of a plurality of arcuate vanes 38 which extend from a point near the center of the disc to a point close to the periphery of the disc.

The material to be dried is fed into the rotatable head through a stationary conduit 39 which extends through the hollow shaft and top plate 29. In order to prevent the lower end of conduit 39 from vibrating due to rotation of the head, the pipe may be provided with a ball race 41 which cooperates with a ball race 42 to retain ball rollers 43 therein and form a ball bearing support for the lower end of the conduit. Material fed into the conduit 39 is passed into the upper portion of the rotating head and deposited upon disc 37. The rotation of the head causes arcuate vanes 38 to draw the material through the conduit and move it outwardly on disc 37. The inner lateral wall of the rotating head has a shoulder 44 against which a coarse mesh screen 45 is adapted to rest. This screen extends substantially the entire length of the lateral wall of the rotating head and is supported by the inner side of vanes 31 and rim 32. Superposed upon screen 45 is a fine mesh screen 46, and over the fine mesh screen is a porous felt filter 47. The fine mesh screens 46 prevents the felt from being drawn into the meshes of the screen.

After the material is fed into the rotating head at its upper end it is fed over the filter by gravity and restrained from too rapid movement by centrifugal force. The centrifugal force is great enough to restrain the downward movement of the material too much, and therefore, it is advisable when filtering certain materials to taper the walls of the head outwardly from the top to bottom, thereby causing the centrifugal force to aid in the downward movement of the material. The moisture which is to be separated from the solid material fed into the rotating head is moved outwardly and tends to pass through the screen by centrifugal force. This movement of the moisture is aided by vanes 31 which on account of the rapid rotation of the head create a suction on the exterior wall of the screen to draw the moisture therethrough. Any moisture extracted from the material is thrown against casing 34 and accumulates in trough 35, from which it may be drained through a drain spout 48.

One of the difficulties encountered in the operation of a machine of this type is the necessity of stopping the machine periodically for the purpose of removing the solid residue. As far as the actual drying operation is concerned, prior machines have failed to perform with full satisfaction due to the accumulation of the material to be filtered upon a lateral wall of the cylinder, which may become packed in layers so as to prevent the moisture in the upper layers from penetrating the lower layers and passing through the screens. I overcome all of these difficulties by removing the residue continuously with air as the machine is in operation, as previously mentioned. For this purpose I provide a stationary hollow central shaft 51 having a plurality of tubular arms 52 extending into close proximity to the felt filter. These arms are provided with heads 33 having flat ends 55 capable of discharging a blast or wedge of compressed air against the solid residue on the felt to remove the same. The removed portion has a tendency to drop by gravity, but it is still under the influence of centrifugal force, which causes it to turn over and again be deposited against the felt, where it can be acted upon by another head or air brush, as will appear clear.

The arms 52 are disposed circumferentially on shaft 51 and are staggered at the same time so that upon rotation of the head the entire interior surface of the felt will be exposed to the arms. The ends of the arms are flat as shown at 53', and are inclined diagonally to have an action very similar to that of a plow share and aid the turning movement of the solid residue as it is acted upon by the air. The material striking the face of a flat end 53 moves radially inward thereon and is turned over, thus bringing the layer which was underneath prior to striking the end of the arm, on top. The hollow shaft 51 may be connected through a pipe 59 to any suitable source of air pressure to create a driving blast from the ends of arms 53. This blast, in addition to its use for removing the solid residue from the felt, also tends to propel the liquid through the screen.

When the apparatus is used for separating crystallized sugar particles from molasses, I preferably also provide a plurality of radially extending pipes 55 through which water may be sprayed upon the screen to assist
in washing the molasses from the crystalline sugar particles. Pipes 55 extend radially inward toward shaft 51 and downwardly along shaft 51 to a distributor 56. The distributor is supplied with liquid through a common pipe 57 leading to any suitable source of liquid pressure.

The sugar or other filtered material passes progressively downwardly on the felt, and from the open lower end of the rotating head into a stationary cylinder 58, thence through a second cylinder 59 and funnel 61, into any suitable container. Cylinder 58 is of slightly smaller diameter than cylinder 59 for the purpose of inspecting and repairing the apparatus. To this end cylinder 58 is provided with a pair of laterally projecting arms 62, to which a rope 63 is secured passing over a pulley 64 and downwardly through an aperture in base 11. The ends of rope 63 are provided with counter weights 65 which normally hold cylinder 58 in its uppermost position. In order to limit the upward movement of cylinder 58 and preventing it from frictionally engaging the rotating head, a plurality of stops 66 may be provided thereon which engage against the bottom trough 35 and thus limit the movement of the cylinder.

The apparatus has been found to be highly satisfactory for separating various kinds of liquid from the solids with which they are combined. The vanes 31 mounted on the exterior wall of the filtering screens to create a suction on the exterior wall of the screens adds greatly in drawing the liquid particles through the screen. This action, in connection with the turning of the material by an air blast assisted by the plow share arms insures a thorough drying or separation of the liquids from the material to be filtered.

What I claim is new and desire to protect by Letters Patent of the United States is:

1. In a centrifugal filtering device, a rotatable head having a perforated side wall, a top plate having means for admitting material to the wall, the lower end of the wall being open, a plurality of arms extending into close proximity to said perforated wall, means for supplying a blast of air through said arms, and shares carried by the arms and through which the air blast is delivered for aiding in turning over the material collected on said wall, and removed therefrom by said air blasts.

2. In a centrifugal filtering device, a rotatable head having a perforated side wall, a top plate having means for admitting material to the wall, the lower end of the wall being open, a plurality of hollow arms extending into close proximity to said perforated wall and having flat outlet orifices extending diagonally and means for discharging air through said arms for turning over the material collected on the wall and directing it downwardly.

3. In a centrifugal dryer, a rotatable head carrying a circular porous element, means for introducing material to be dried at the top of said porous element, a plurality of means for delivering air under pressure against the porous element to progressively move the material downwardly as the head is rotated, and means in advance of each air directing means for spraying the material with water for the purpose described.

4. In a centrifugal drier, a rotatable head, a cylindrical porous element carried by the head for passing liquids but retaining solids, means for introducing material to be dried onto said porous element near the top thereof, a material engaging member having the general shape of a plow share and having a relatively flat and wide opening at the end thereof close to the porous element, and means for delivering air through said opening, the air serving to remove the solid material from the porous element and bring the same into contact with the share, and the share turning the material over as such material is fed thereto.

5. A combination as described in claim 4, including a plurality of said share members substantially overlapping each other, whereby the material is progressively moved downwardly until it is removed at the bottom of the porous element.

In witness whereof, I hereunto subscribe my name this 18th day of July, 1930.

HARRY W. ABBOTT.