Nov. 5, 1929. H. H. CANNON 1,734,325

TUBULAR FILTER PRESS

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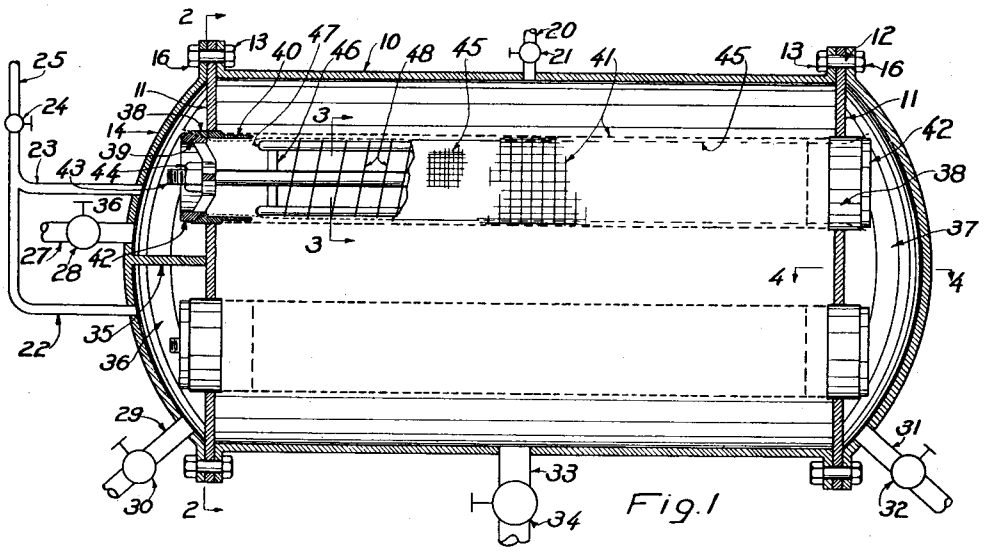


Fig. 1

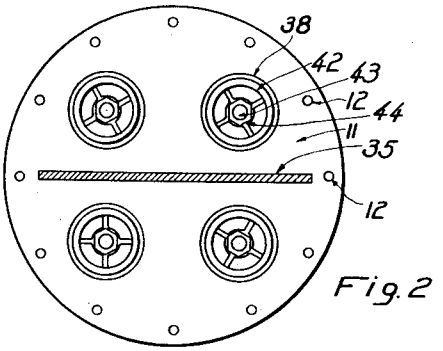


Fig. 2

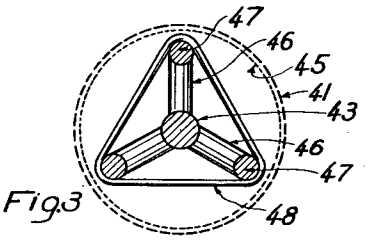


Fig. 3

Fig. 4

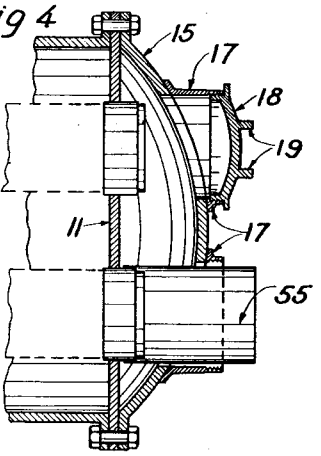
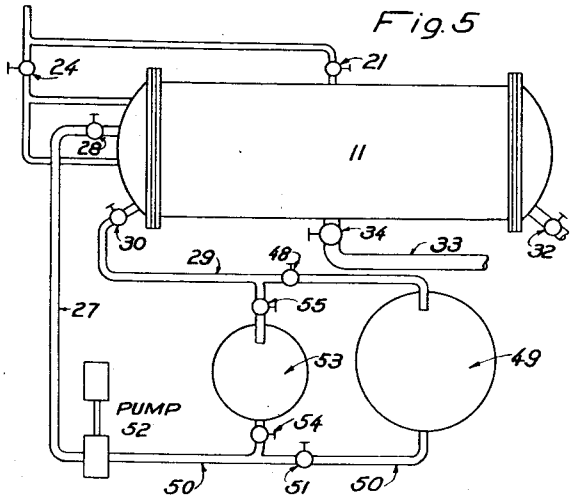


Fig. 5



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UNITED STATES PATENT OFFICE

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TUBULAR FILTER PRESS

Application filed May 28, 1928. Serial No. 281,300.

The object of my invention is to provide a press of exceptional simplicity and cheapness, which can be operating at high pressures without leakage, which may be adapted to use with any kind of foraminous medium and to all the usual materials of construction, which will distribute the solid matter uniformly over the entire area of cloth, which will not cut nor damage the filter cloth, and which may readily be emptied and cleaned without hand labor.

These and many other advantages inherent in my novel type of construction will be evident from the following description of a preferred embodiment of my invention, this description referring to the attached drawings, in which:

Figure 1 is a vertical, longitudinal section through my improved filter.

Figure 2 is a cross section on the line 2—2 of Fig. 1.

Figure 3 is a cross section through one of the filtering tubes, on the line 3—3 of Fig. 1.

Figure 4 is an alternative detail of the right hand end of the assembly shown in Fig. 1, cross-sectioned in the same plane as that figure.

Figure 5 is an elevation of the filter shell shown in Fig. 1 and further illustrates certain tanks, pump and piping which may advantageously be used in the installation and operation of my improved filter.

Referring to Fig. 1, 10 is a metallic shell, here illustrated as being of cylindrical cross section. 11—11 are inner heads or tube sheets, these sheets being made fast to the shell 10 either permanently, as by welding or riveting, or detachably as by the bolts and nuts 12 and 13. If these latter are used the body of each bolt should be welded into the tube sheet so that each end of the bolt may be tightened independently of the other.

14 and 15 are outer heads, dished to withstand the pressure required in the filtering operation, and hinged or otherwise movably supported (in a manner not shown) against the tube sheet 11. In this position they may be firmly retained by the bolts 12 and nuts 13 or in other convenient manner.

The left hand head 14 need be removed only for the purpose of repairs or to replace the cloths, and may desirably be semipermanently attached as shown. The right hand head 15 must be opened every time the press is discharged, if a dry cake discharge is required, and should either be readily detachable or should be constructed with small closures opposite the tube ends as indicated in Fig. 5.

Figure 4 illustrates an alternative and preferred construction for the right hand head 15, in which a nozzle 17 is placed in the head opposite each filter tube end, this nozzle having a readily detachable closure. Such closure may be the screwed plate 18 having the lugs or bosses 19 for turning it into place by means of a bar, or it may be the ordinary plate and temper bar with screw or cam, or other of the well known quick closures.

Referring again to Fig. 1, 20 is an inlet pipe controlled by valve 21, for air under pressure; 22 and 23 are also air inlet pipes controlled by valve 24 in the pipe 25 which communicates with a source of air supply. 27 is an inlet pipe for the liquid to be filtered, controlled by valve 28. Pipes 29 and 31, controlled by valves 30 and 32, drain the chambers 36 and 37 formed between the heads and tube sheets, and pipe 33 controlled by valve 34 drains filtrate from the interior of shell 10.

A plate 35 affixed to head 14 and bearing against tube sheet 11 divides the chamber 36—36 into two compartments, one of which may act as an inlet chamber for unfiltered liquid, the other as an outlet chamber for excess feed, thus diverting the flow in one direction through one set of tubes and back through the other. The object of this diversion is to produce a flow of unfiltered liquid over the filtering surfaces and a better distribution of the solid matter contained therein, easier precoating, and more complete washing due to higher velocity of the wash water. The use of this plate or its equivalent is highly desirable, but is not essential to the functioning of my press, which may have but a single tube.

The filtering tubes referred to consist of two elements—the outer or supporting tube, which is substantially fixed in position in the

shell, and the inner or foraminous tube, which is readily replacable. These I construct and position in the shell in the following manner.

Through each of the tube sheets I insert any desired number of thimbles 38, placing them in opposed pairs in the two sheets, and weld them firmly into place. The inside of the outer or head end of these thimbles is bevelled as at 39, to form a seat the use of which will appear, and the inner end, i. e., the end looking toward the body of the shell, is allowed to project inside the tube sheet for a substantial distance, say from an inch to three inches. It is desirable to reduce the thickness of this projecting portion by removing material circumferentially from the outside, as at 40.

The outer tube 41 should be of such internal diameter as to slip freely over the internally projecting end of the thimbles, and of such length as to substantially equal the distance between the two tube sheets when assembled. The tube sheets being put into place with the thimbles inserted into opposite ends of the tubes, the latter are thus supported at each end and also fixed against any material end movement such as might damage the foraminous tube which is to be placed within them.

The outer tube may be of any material which will withstand the stresses placed upon it; weight of tube and unfiltered liquid contained therein, and bursting strain due to internal pressure; and which will not seriously impede the flow of filtered liquid through its walls. Thus I may use perforated or slotted pipe or casing, or battery screen rolled into tubes and welded along the seam. I prefer, however, to make these tubes out of strong wire mesh, say 12 mesh 18 gauge crimped steel screen, as indicated at 41. A very satisfactory way to make these tubes is to cut the screen into strips from two to three inches wider than the circumference desired and the full length of the tube, turn up each edge at right angles to form a shallow channel, roll up the tube with the turned edge outward, thus bring these edges face to face and forming a lateral standing seam, and finally bolting the faces together with a light angle iron on each side of the seam. This makes a light and rigid tube having a high bursting strength and offering a minimum of resistance to the permeation of the liquid.

The inner or foraminous tube 45 may be formed of any preferred cloth or other fibrous material, or for high temperatures or corrosive liquids it may be of monel or other metal. This tube is of such diameter as to fit snugly and smoothly inside the outer tube, and if sewed should have the seam turned inside. The length of the inner tube should be the tube sheet distance plus sufficient length to pass through the thimble and form the end joint.

When metal gauze is used for the inside tube it may be drawn through the outer tube and thimbles and soldered thereto at each end. These cloths are little subject to wear and seldom need replacement, but are likely to cut if the joint is made in the manner most suitable for softer material. If filter cloth is to be used for the inner tubes I prefer to draw the tube a short distance beyond the end of the thimble and to bring it to non-leaking engagement with the bevelled seat 39 by first inserting into its end the spider 42, which has its periphery bevelled to correspond with bevel 39, and then drawing this spider into place by means of the tension rod 43 and nut 44. A nut and spider are provided for each end of this rod, which extends the full length of the tube and thimbles. By this means a tight joint between cloth and thimble may be made and leakage around the end of the inner tube prevented. To remove the cloth in case of wear or damage the spiders are removed and the tube drawn out from either end.

A valuable feature of my invention is the spreading and supporting device illustrated in Figs. 1 and 3. This consists of the tension rod 43 and three or more parallel rods 47, attached to and spaced from the tension rod by the struts 46, placed along the length of the rod at short intervals. These rods should be of such length as to extend at least up to and preferably a short distance into the inner ends of the thimbles.

This continuous spider may be made up of welded rods, or the struts and parallel members may be assembled from small screwed fittings and pipe. It is also highly desirable to wrap the entire length of the spider with turns of stout wire spaced say one inch apart, these wires being useful in cutting up the cake as will hereafter appear. This winding may be dispensed with if the cake is extremely dry and friable, but without it a cake having any degree of toughness is liable to plug the tube.

This device forms a novel means for cleaning cake from filter cloth, and is also useful in placing the cloth tubes within the outer tubes, the cloth being drawn smoothly over the spider before inserting.

The operation of the above described apparatus is as follows, oil carrying earth in suspension being used as a specific example, though the apparatus is equally adapted to the filtration of other mixtures.

Valve 34 is opened for drainage of filtered oil and valve 28 is opened to admit oil under pressure, all other valves being closed. Oil enters the upper half of chamber 36, passes through spider 42 into and through the upper tube into chamber 37, and flows through the lower tube into the lower half of chamber 36. Being here stopped by closed valve 30 the oil fills the tubes and chambers, dis-

placing air from the apparatus through the filter cloths and finally following it through the cloth tubes and into the shell. The earth remains in the form of a tubular cake lining the interior of the cloth tube 45, which is pressed outward against and supported by the screen tube 41.

Feed of oil under pressure is continued until the desired thickness of cake is obtained or until the pressure capacity of the press is reached. Oil flows continuously through cake, cloth and screen and drips from the outside of the tubes into the shell, from which it escapes through drain pipe 33.

At this point the oil feed is stopped by closing valve 28, and air (or steam, fixed gas or other gaseous fluid) may be admitted to the chambers and tubes by opening valve 24, the air following the remains of oil through the cakes and drying them out in the usual manner. The air and the oil removed from the cakes pass from the shell through drain pipe 33 to a filtered oil tank, not shown.

During the course of the filtration, particularly during the earlier stages when the coating of earth on the cloths is thin and cloudy oil is liable to come through, it is desirable to pump an excess quantity of oil into the tubes and to allow a considerable portion of it to flow back to an unfiltered oil tank from which the feed is drawn. Thus in Fig. 5 the pump 52 draws unfiltered oil from a storage tank 49 through pipe 50 and valve 51 and discharges it into the press through pipe 27 and valve 28, the desired pressure on the press being maintained by regulating valve 30 through which the excess feed flows through pipe 29 and valve 48 to storage tank 49. By thus maintaining a low initial pressure and a high velocity through the tubes the cloths may be smoothly precoated and cloudy filtrate entirely avoided.

Following such blowing with air (or other gas or steam) the cake may be washed in place, in the usual manner, by pumping into the press a suitable wash oil or naphtha. This may be contained in a tank 53 (Fig. 5) and withdrawn through branch pipe and valve 54, the naphtha passing through the cake into the shell, from which it is drained to a solution tank not shown through a suitable branch pipe communicating with drain pipe 33. The washing just described is an optional step and is not essential to the operation of my filtering apparatus, but is useful where the oil is valuable or is of such character as to render the earth cake slimy or sticky. It is customary to follow a washing step with a repetition of the blowing with air, to dry the cake and to bring it to the most friable condition possible.

The treatment of the cake in the press, if any, being completed, two steps are required to clean the press and put it into condition for renewed use; the first, to detach the tubular cake from the cloth and break it into fragments; the second, to remove this fragmental material from the tubes. In taking the first step I close valve 34, leaving valve 30 open to provide an air vent, and fill the shell with air under pressure by opening valve 21. This pressure coming on the outside of the tubes is transmitted freely through the outer screen tubes, but being obstructed by the cloth tubes causes them to collapse against the longitudinal bars 47 and the wire winding 48.

Even in the absence of wire winding the cake will be thoroughly crushed and broken throughout its length and thus freed from the cloth. If the winding be present the long fragments of cake will also be forced through the wires and thus cut into small pieces which may readily be blown out in the next step. Thus the wire winding is to be recommended unless it is known that the cakes formed will be very light and friable.

The cakes being now thoroughly comminuted and freed from the cloth, the material of which they were composed is blown from the tubes by opening valve 24 and admitting a strong current of air to both sides of chamber 36. If the material is light and does not pack it may be carried through and out of chamber 37 if a large diameter pipe 31 and valve 32 are provided near the bottom of this chamber, the force of the air blast being sufficient to carry the spent earth out of the chamber and into a bin. If the cake is heavier or of tougher consistency, as for instance an unwashed lubricating oil cake, it may be necessary to provide a more direct vent. In such case the entire head over chamber 37 may be swung back, leaving the ends of all tubes exposed, or if this head be built as shown in Fig. 4 the individual closures may be opened and the cake blown out through them. In such cases it is desirable to slip a light metal conductor 55 into the nozzle 17 and over the end of thimble 38 to prevent solid material from dropping into the bottom of chamber 37.

It should be noted that a forcible flow of air is required to remove the cake fragments if the cake is at all tough or if it is of heavy earth. Thus, and particularly if the tubes are large or numerous, it is desirable to provide an accumulator in which a small quantity of air may be stored under relatively high pressure. A heavy shot of air applied suddenly is far more effective for this purpose than a much larger total quantity admitted at low velocity.

Cleaning of the press in this manner may be effected very rapidly and with little labor. The cloth travels only a short distance toward the tube center in collapsing and comes back always to the same place without wrinkling or cutting, expanding into place in the supporting screen tube as soon as the air pressure is applied to force out the broken

cake material. As there are no metal joints to be made up over the cloths each time they are cleaned, nor any abrasion of the cloths by metal cleaning tools or scrapers, the inner tubes are exceptionally long lived and seldom have to be replaced.

It is important in the management of my press to avoid building up a cake so thick that it will close up the tube, or will form an arch too stiff to crush by air pressure applied outside as described. Unless the cake material is exceptionally loose the thickness of the cake should not exceed one-third to one-fourth the radius of the tube.

In the drawings the tubes in my improved press are shown as being relatively short and of large diameter. While this is entirely permissible I prefer to use narrower and longer tubes, a desirable relation being an internal diameter of say four inches to a length of twelve to twenty feet. This, however, is mainly a matter of convenience in construction and operation, and I do not limit my invention to this or any other definite relation of diameter to length.

While I have shown my improved press in a horizontal position and as having a double tube pass and two tubes in each pass, it will be obvious that it might also be set in a vertical position, and might have any desired number and arrangement of tubes. By increasing or diminishing the number of partition walls in the end chambers any desired number of counterpasses through the shell may be produced, and my preference is to use not less than the two passes shown, as too low a velocity through the tubes is liable to lead to uneven distribution of solids over the filtering surface.

I claim as my invention:

1. In a filter press: a hollow body for receiving filtrate: a plurality of tubes of foraminous material disposed in parallel relation within said body and nonleakably secured into opposed walls thereof, the latter dividing said body into three chambers; a partition within one of said chambers separating it into sections each communicating with one or more of said tubes; means for introducing a liquid under pressure into one of said sections; means for withdrawing a portion of said liquid from the other of said sections, and means for withdrawing filtrate from said body.

2. In a filter press substantially as set forth in claim 1: means for introducing a fluid under pressure into said body to cause the partial collapse of said tubes.

3. In a filter press substantially as set forth in claim 1: means for introducing a fluid under pressure into said body to cause the partial collapse of said tubes; means for exposing an end of each said tube, and means for introducing a gas under pressure into the opposite end of each said tube to eject solid matter therefrom.

4. In a filter press substantially as set forth in claim 1: means for exposing an end of each said tube for the withdrawal of solid matter therefrom.

5. In a filter press substantially as set forth in claim 1: means for exposing an end of each said tube and means for introducing a gas under pressure into the opposite end of each said tube to eject solid matter therefrom.

In witness that I claim the foregoing I have hereunto subscribed my name this 21st day of May, 1928.

HUGH HARLEY CANNON.