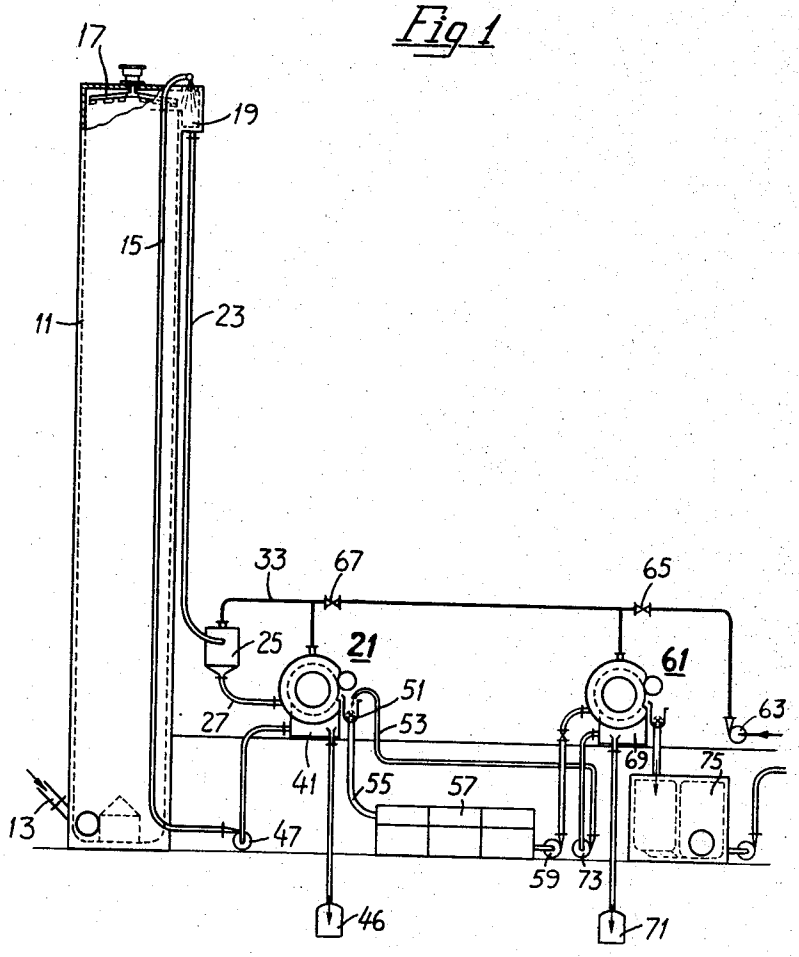
June 21, 1955 R. J. JOHANSEN 2,711,359

BLEACHING PLANT AND METHOD OF BLEACHING CELLULOSE PULP

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Fig 1



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Fig. 2

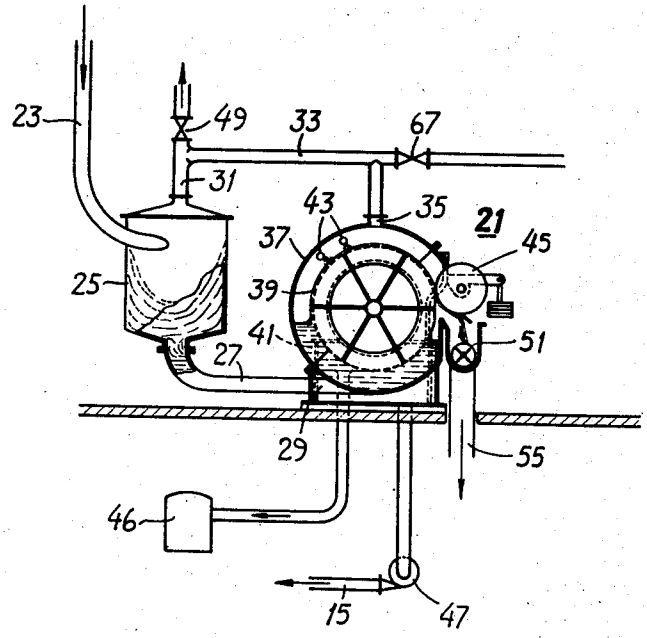
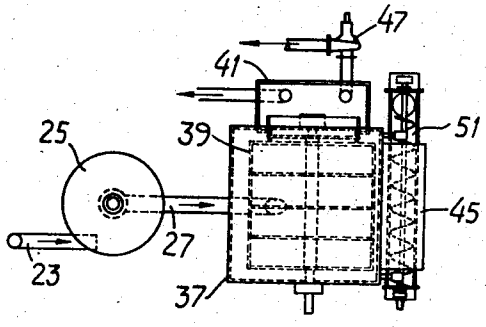


Fig. 3



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Fig. 4

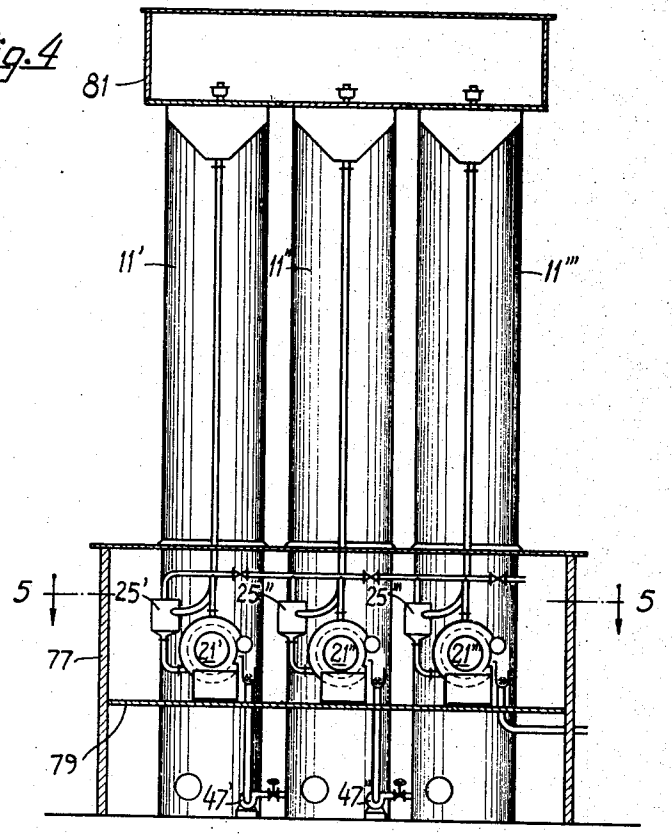
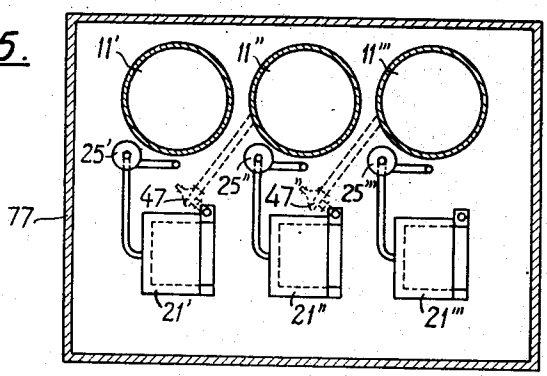


Fig. 5.



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BLEACHING PLANT AND METHOD OF BLEACHING CELLULOSE PULP

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5 Claims. (Cl. 8—156)

Modern bleaching plants for cellulose or paper pulp usually consist of a number of bleaching operations conducted in a high reaction tower, each such operation being followed by a filtration operation in which the retained pulp is washed. The height of the reaction tower is usually of the order of 15 to 25 meters, but in exceptional cases the tower may be as short as 10 meters or as long as 30 meters. The great differences in height between the upper and lower ends of the tower present the possibility of producing the pressure difference between the inlet and the outlet side of the filter necessary for the operation of the same, without the use of pumps. Previously, suction or vacuum filters have been used, in which the necessary vacuum has been derived from a suction or drop tube in which filtrate water is allowed to drop 8 to 10 meters carrying air with it. In this way a vacuum corresponding to a water column of 1 to 3 meters is produced in the filter. In view of the presence of said drop tube the filters and the attendance floor are usually placed at a level of about 15 to 25 meters above the ground, the roof height of the enclosing building being 20 to 30 meters.

An object of the present invention is to achieve an improvement and a simplification of bleaching plants, especially aimed at reducing the volume of the building, decreasing the building costs and effecting a better localization of the filter attendance floor in relation to neighboring departments, such as screening and beating departments, drying machines etc.

Other and further objects will be apparent from the description of the invention which follows.

According to the invention, these objects are attained by supplying the pulp containing liquid, together with air to the filter under super-atmospheric pressure and employing the height difference between the top of the reaction tower and the ground to create the aforesaid pressure instead of creating a vacuum as has heretofore been common in bleaching plants. The filter may consequently be placed at a low level, i. e., ground level or only slightly thereover to thereby achieve a simplification of the structure necessary to house the equipment and a considerable reduction in building costs.

In accordance with the invention, a drop tube, preferably directly connected to the top of the reaction tower, is interposed between the bleaching operation and the filtration operation. The upper end of the drop tube is permitted to have free access to air, so that the pulp containing liquor dropping down therein carries air with it to create the pressure differential necessary for the operation of the filter in a simple and effective manner. The lower end of the drop tube is connected to an air separating device, preferably of cyclone type. The air outlet of the separating device is connected to the air inlet of the pressure filter, and the pulp outlet of the separating device is connected to the pulp inlet of the filter.

When the plant comprises a plurality of bleaching operations constructed according to the invention, the

air outlets of the several separating devices may be connected together. The pressure air conduit connected to one or more air separating devices may be branched off to the pressure air inlet of a pressure filter not equipped with a separate drop tube for the supply of pulp containing liquor and air under pressure to thereby avoid the use of a compressor. Said conduit may also be connected to a compressor serving as a reserve source of air under pressure which can be used when starting up the filters or when disturbances occur in the plant.

By placing the filters at a comparatively low level in accordance with the invention it is possible to radically change the shape of the building in which the bleaching plant is housed. Thus, the filters may be placed in a low building and put either approximately on the ground level or preferably on an attendance floor arranged a few meters above said level, whereas the reaction towers which usually are made of concrete, are completely or partly placed in open air. The towers may either project up through the roof of the building which houses the filters and auxiliary apparatus, or be placed at the side of said building. In order to protect the discharging devices located at the top of the reaction towers, these towers may be provided with protection in the form of a hood or similar covering structure. If a plurality of towers are placed close to each other, the hoods may be built together to form a unitary superstructure.

The invention is illustrated by the following description in which reference is made to the accompanying drawings wherein:

Figure 1 shows diagrammatically and partly in section an elevational view of a bleaching plant constructed in accordance with the invention,

Figure 2 is an elevation on an enlarged scale and partly in section showing the details of the air-pulp containing liquor separating device, the pressure filter and associated parts,

Figure 3 is a plan view of Figure 2,

Figure 4 is an elevation partly in section of a bleaching plant constructed according to the invention showing the building therefor, and

Figure 5 is a cross-sectional view taken substantially on the lines 5—5 of Figure 4.

Referring to Figure 1, **11** designates a high cylindrical concrete tower in which cellulose pulp is treated with a bleaching agent, such as chlorine, hypochlorite or sulphur-dioxide. The pulp is supplied through a conduit **13** at the bottom of the tower and moves, mixed with the bleaching agent, slowly upwards in the same, so that the desired bleaching reaction is completed when the pulp reaches the top of the tower. There the pulp is diluted with diluting water taken from the conduit **15**, preferably to a dry content of 1 to 3 per cent. By means of a rotary scraping device **17** (which may be omitted or replaced by a feeding screw or similar equipment) the pulp containing liquor is then brought down into an outlet **19** from where the pulp, in order to have the used chemicals washed off, is fed to a pressure filter **21** placed at a low level, usually at a height of a few meters above the bottom level of the tower. Arranged between the outlet **19** and the filter **21** is an essentially vertical drop tube **23** having a length of 6 to 15 meters or more and a cross section dimensioned with regard to the pulp quantity according to similar known principals which apply to drop tubes in suction filters.

Outlet **19** has access to the atmosphere, and therefore, the pulp falling through the drop tube **23** will carry with it air which, due to the high drop velocity, cannot pass back past the pulp containing liquor in a direction counter-current thereto but is compressed and carried along with the pulp to a separating device **25** connected to the lower end of the drop tube.

Preferably, the separating device 25 consists of a cylindrical vessel into which the tube 23 enters tangentially, whereby pulp and air are separated by cyclonic action. Connected to the bottom of said vessel is a conduit 27 leading to the pulp inlet 29 of the filter 21. Provided on the cap of the vessel 25 is an air outlet 31 which is connected by a conduit 33 to the air inlet 35 of the filter.

The pressure filter 21 consists of a closed cover 37 and a sieve drum 39 mounted for rotation therein. The cover is sealed to the ends of the sieve drum so that superatmospheric pressure can be maintained in the space between the cover and the sieve drum. In operation of the filter, the space between the cover and the sieve drum is partly filled with pulp containing liquor introduced into the lower portion of the cover through the inlet 27 and partly filled with air under pressure introduced near the top through the air inlet 35. The interior of the sieve drum is maintained under atmospheric pressure. Adjoining one end of the sieve drum is a stationary box 41 in which the filtrate passing through the sieve drum is collected. 43 designates sprinkle tubes by which the pulp layer formed on the screen surface of the drum is sprinkled with washing liquid. The pulp layer is removed from the drum and taken out of the filter by means of a discharge roll 45. The air pressure within the space between the cover and the sieve drum is maintained by the presence of the pulp containing liquor at the lower portion thereof which acts as a seal, the close fit between the discharge roll 45 and the sieve drum 39 and the layer of pulp on the surface of the sieve drum. The pulp containing liquor is prevented from escaping through the opening in the cover located below the discharge roll 45 by a sealing strip which bears against the surface of the sieve drum. The filtrate collected in the box 41 runs in part into the sewer 46, and another part thereof is by means of the pump 47 returned through the conduit 15 to the top of the bleaching tower where it is used for dilution of the pulp leaving the tower.

Pulp and air are fed from the cyclone 25 to the filter 21 under a pressure which is dependent upon the length and cross-sectional area of the drop tube 23, upon the thickness and character of the pulp layer formed on the filter surface, and upon the wash water quantity etc. The actual operating pressure may vary between values corresponding to water heads of about 1 to 5 meters. The filter is self-controlling in the respect that when starting the same and when the pulp layer on the surface of the sieve drum is thin and highly pervious to air, the pressure of the pulp as well as of the air will be comparatively low, and the pulp dropping down in the drop tube will, on account of the reduced counter-pressure in the lower end of said tube, carry with it a comparatively large volume of air, which is exactly what is required in this case. When the pulp layer on the sieve drum becomes thicker and tighter, less air is required and the pressure in the filter rises. Because of the high back pressure so developed, the pulp in the drop tube 23 can not carry with it as much air as previously, but instead the air that is entrained is compressed to a higher pressure. In order to be able to control the air quantity in relation to the pulp quantity a valve 49 is provided by means of which pressure air may be let off. Said valve may be controlled automatically, e. g., by the pressure of the filter, the pulp level therein or by other conditions of operation.

The pulp layer discharged from the filter 21 drops into a mixer 51 where the pulp is diluted with white water supplied through a conduit 53 (shown in Figure 1) and from where it is fed through a conduit 55 to a screening device 57 (indicated generally in Figure 1). With reference to Figure 1, the pulp is pumped from the screening device by means of the pump 59 to another pressure filter 61. The air under pressure necessary for the operation of this filter is taken from the conduit 33 connected to the cyclone 25. Consequently no compressor is needed for supplying air to this filter, although the same is not equipped with a separate drop tube. However, for reserve purposes, it is preferable to have a compressor 63 which, when no longer needed, may be shut off by the valve 65. If desired, the pressure air conduit connecting the two filters may be closed by a valve 67, so that the filters will have separate air supply sources.

The filtrate obtained in the filter 61 is collected in the box 69. Part of the filtrate goes into the sewer 71 and another part is pumped back by means of the pump 73 to the mixer 51 and is there used as diluting water. The dewatered pulp layer goes into a pulp bin 75 from where the pulp is pumped on to a drying machine or otherwise further handled in conventional manner.

The above described bleaching step consisting of the reaction tower 11 and the pressure filter 21 may be the last step of a bleaching plant in which the pulp is treated in a number of steps by different bleaching agents. In that case, the preceeding steps are constructed similarly.

Figures 4 and 5 show a bleaching plant consisting of three bleaching operations each comprising a reaction tower 11′, 11″ or 11‴ and a pressure filter 21′, 21″ or 21‴ cooperating in the above described manner, the building arrangements and the mutual location of the various devices being clearly shown therein. The three reaction towers are placed in a row close to each other, and their lower parts are enclosed in a building 77 which is of considerably lower height than the towers, and through the roof of which the towers extend upwardly. Arranged in said building at a height of a few meters above the ground level is a floor 79 on which the three pressure filters are placed, each opposite the tower with which it cooperated. The upper floor of the building also houses the air separating devices 25′, 25″, and 25‴. Placed on the lower level are the pumps 47′, 47″ by means of which the pulp coming from the filter of a preceding bleaching step is pumped into the bottom of the following bleaching tower. Arranged around the tower tops is a common superstructure 81 which covers and protects the upper ends of the towers and makes possible a comfortable supervision and attendance to the discharge scrapers there. Between the superstructure 81 and the roof of the building 77 the bleach towers are not surrounded by a building of any kind, which considerably reduced the volume and the cost of the building.

It is not essential to the invention that the pulp supplied to the filter through a drop tube is directly connected to the top of a high bleach tower. For example, the plant shown in Figure 1 may be modified by providing a vertical drop tube before the filter 61, the upper end of which is connected to a box located at a sufficiently high level. The pulp can then be pumped up into said box by the pump 59, and when the pulp drops through the drop tube air is carried along and is compressed. This method of getting pulp as well as air under pressure by means of a single pump may also be used for other purposes than for washing after a bleaching operation, viz. for instance for washing off black liquor after a digesting alkaline cook.

The present invention is illustrated by the following specific example;

In a bleach plant dimensioned for a capacity of 300 tons of pulp a day, digested ligno-cellulosic pulp having a consistency of 10% is bleached in a bleach tower 11 having a height of 70 feet and a diameter of 16 feet. The pulp suspension discharged at the top of the tower is diluted with 4000 gallons water per minute supplied through the tube 15, whereby the consistency of the pulp suspension is decreased to a dry content of 1.5%. The drop tube 23 has a length of 40 feet and a diameter of 14 inches. The separating device 25 has a diameter of 8 feet and a height of 8 feet. The filter drum 39 has a diameter of 10 feet and a length of 14 feet. The filter cover 37 has a diameter of 12 feet and a length of 14 feet. The air pressure generated in the device 25 is about 12 inches Hg.

I claim:

1. In a process for bleaching cellulosic pulp containing at least one bleaching operation conducted in a reaction tower wherein the bleached pulp is discharged at the top of the tower and thereafter washed in a filter, the improvement which comprises diluting the bleached pulp at the top of the tower with a wash liquor, dropping the diluted bleached pulp into a substantially vertical drop tube the top of which has access to the atmosphere, discharging said diluted bleached pulp together with the air under pressure entrained therein from the lower end of said drop tube into a device for separating liquid and air, feeding said diluted bleached pulp and said air under pressure into a pressure filter and removing said pulp from the air and liquid present in said filter.

2. A process as recited in claim 1 in which the vertical distance between the top of said tower and said separating device is at least approximately 6 meters.

3. An apparatus for filtering pulp containing liquors comprising a rotary drum filter having inlets for pulp containing liquor and air respectively and capable of filtering said pulp from a liquor containing the same supplied under pressure in the presence of air under pressure, a substantially vertical drop tube having its upper end open to the atmosphere, means communicating with said upper end for introducing pulp into said drop tube whereby falling pulp containing liquor will entrain and compress air, the lower end of said drop tube communicating with a device for separating liquid and air, said separating device having conduits for leading the separated liquor and gas to the said inlets for liquor and gas respectively in said filter.

4. An apparatus as recited in claim 3 in which said liquid-air separating device is a cyclone separator, the discharge of said pulp containing liquor together with air under pressure entrained therein from said drop tube being discharged tangentially into said cyclone separator, said cyclone separator having a liquid outlet at the bottom thereof connected to an inlet for pulp containing liquor positioned at a lower portion of said filter and having an air outlet at the top of the separating device connected to an inlet for air positioned at an upper portion of said filter.

5. In combination, a reaction tower for treating pulp having discharge means for liquid positioned at the upper end thereof, a device for separating liquid and air, a substantially vertical drop tube having its upper end open to the atmosphere, said upper end of said drop tube being positioned to receive the liquid discharged from the upper end of said tower, said drop tube having a lower end communicating with said device for separating liquid and air, the latter said separating device having a liquid outlet communicating with a lower portion of a rotary drum pressure filter and an outlet for air communicating with an upper portion of said filter.

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