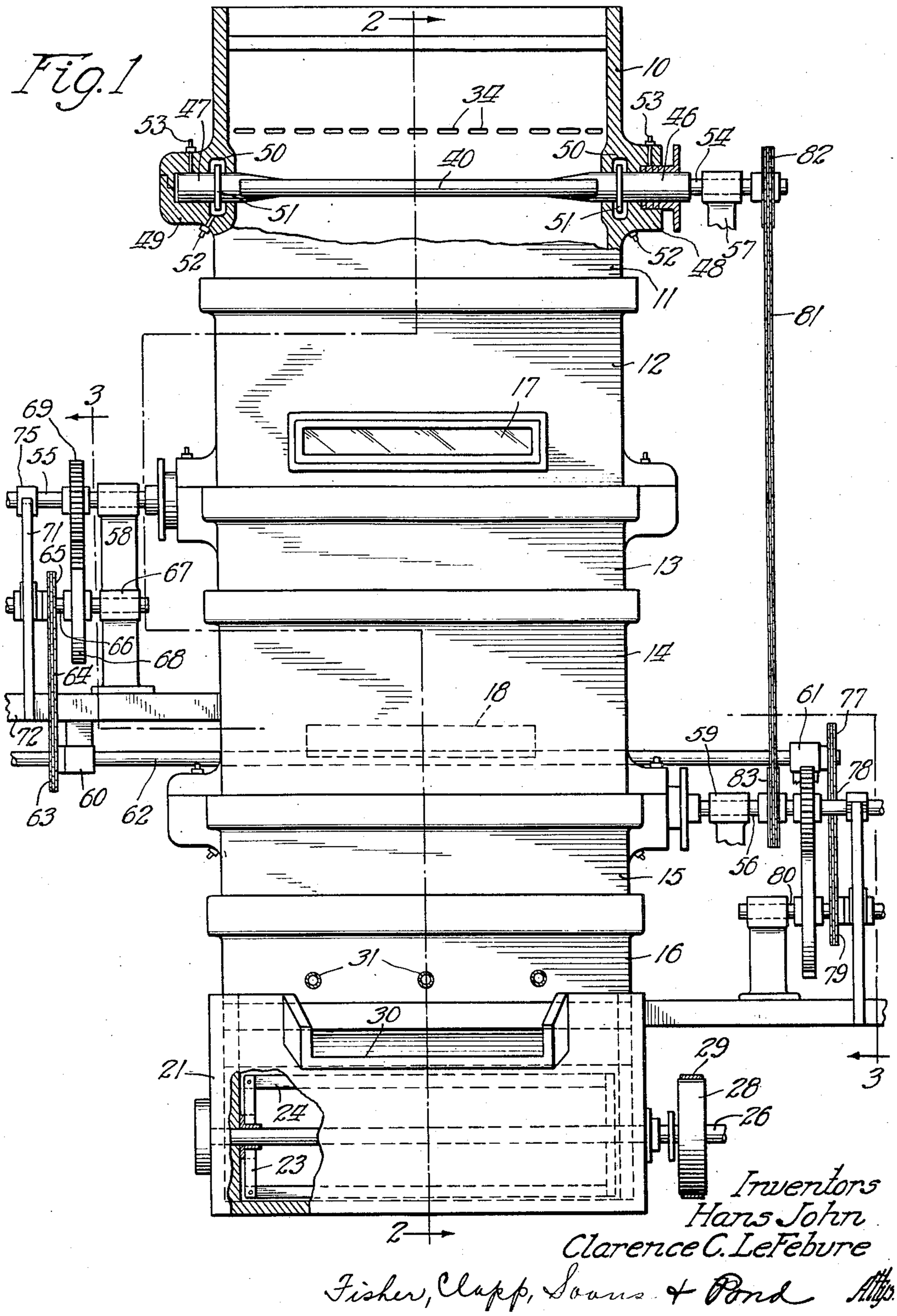
May 9, 1933. H. JOHN ET AL 1,907,548

PROCESS OF SUBJECTING FIBERS TO THE ACTION OF GASES

Filed Sept. 25, 1928 2 Sheets-Sheet 1

Fig. 1



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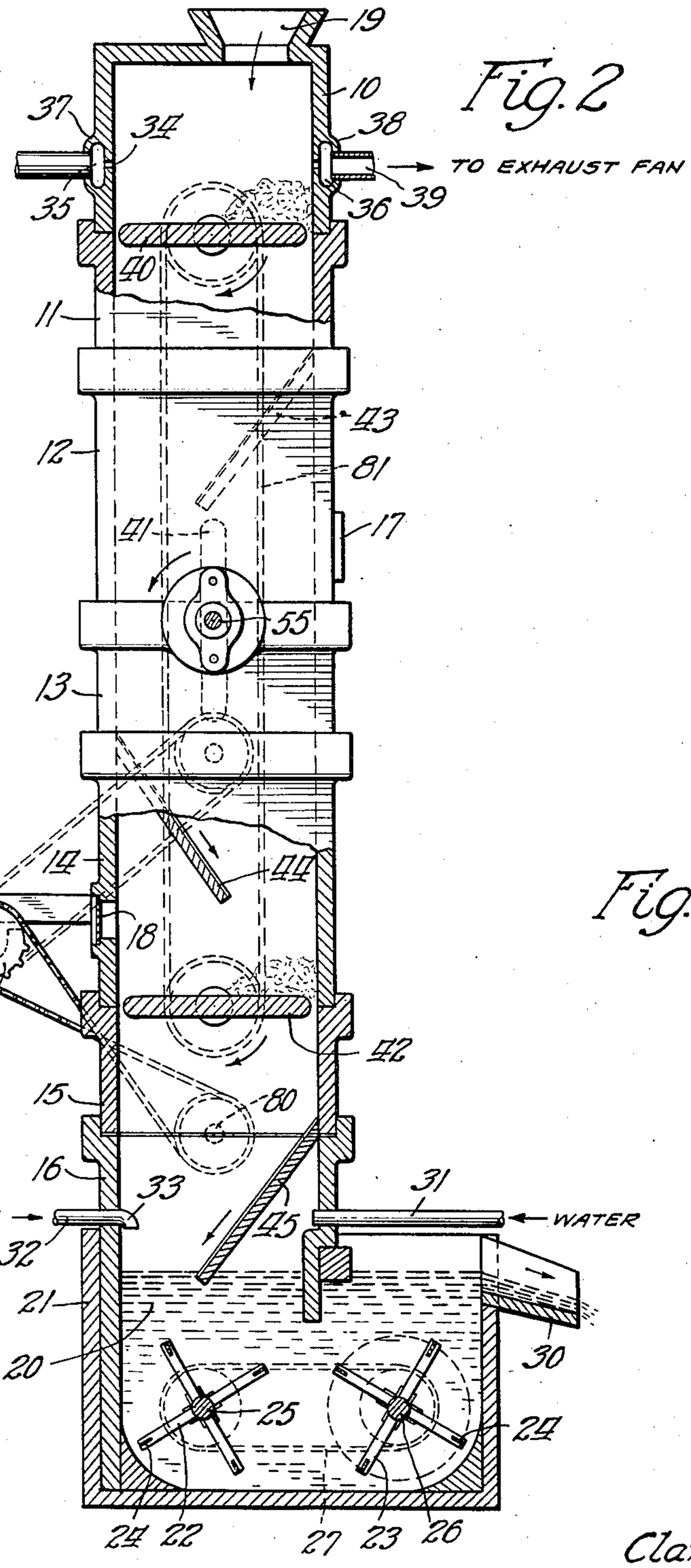


Fig. 2

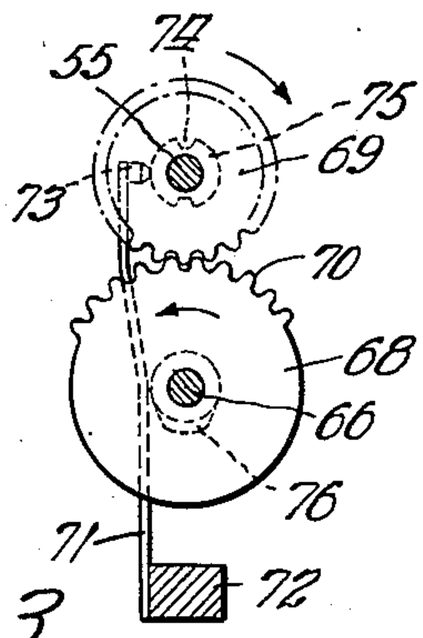
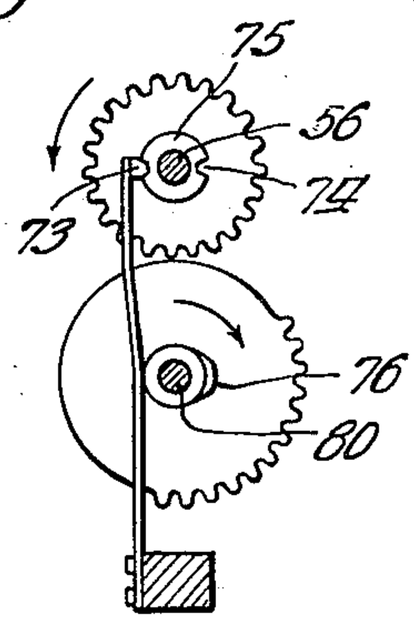


Fig. 3



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UNITED STATES PATENT OFFICE

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PROCESS OF SUBJECTING FIBERS TO THE ACTION OF GASES

Application filed September 25, 1928. Serial No. 308,266.

The invention relates to treatment of fibres by gases and is of particular value in paper manufacture where certain undesirable encrusting materials are to be eliminated or removed from the fibres of the pulp before the latter is used in making up the furnish or batch used in the actual production of the sheet.

Usually, the removal of the encrusting materials from the fibres in the later stages of the preparation of the pulp is effected as an incident to the bleaching process, and the invention is therefore of obvious value in the so-called bleaching operation. However, it may be also employed in connection with a prior step or stage of fibre treatment which ordinarily precedes the actual bleaching of the pulp and is not considered properly included in the actual bleaching operation.

The invention is, in certain of its aspects, a modification or improvement upon the invention described in the co-pending application of Hans John, Serial No. 273,474, filed in the United States Patent Office under date of April 28, 1928 now abandoned.

The principal objects of the present invention are: to provide an improved process and apparatus by means of which fibres may be treated by a gaseous medium efficiently and economically to effect removal of encrusting or other undesirable materials capable of being acted upon by said gas; to provide an apparatus of relatively large capacity compared with floor space occupied by said apparatus; to provide process and apparatus capable of ready adjustment or control so to suit various conditions encountered in operation and various kinds or conditions of the fibres which are to be treated, and, in general, to provide an improved, efficient and economical process and apparatus of the character described.

In the drawings, we have illustrated one form of apparatus by means of which the improved process may be efficiently practiced.

In said drawings:

Figure 1 is a vertical elevation of the main parts of the apparatus, certain parts being broken away or shown in section to illustrate the interior construction;

Figure 2 is a section taken on the line 2—2 of Figure 1, and

Figure 3 is a section taken on the line 3—3 of Figure 1.

The apparatus and process will be described as used in the preparation of pulp from wood fibres, for example, hemlock stock. In the preparation of such pulp, the wood sticks are de-barked, cut up into chips and subjected to any usual digesting process, after which the digested and washed product is conducted to a de-watering or thickening apparatus, which preferably may comprise what in the paper trade is designated as an Oliver filter. Such filter is adjusted to turn out a rather heavy sheet of about 25% consistency; i. e., one pound of sheet contains one-fourth of a pound of bone dry fibres.

After the sheet or web leaves the Oliver filter, it is comminuted or shredded by any suitable form or type of macerating device, thereby converting the same into shreds or pieces of relatively small size; say, not to exceed an inch or two in the greatest length or width. No difficulty is encountered in effecting cutting or shredding of the web, as the same, when it leaves the filter, is quite limp and fragile. In fact, a web of 25% consistency will not ordinarily support its own weight if more than ten feet or so in length. In this condition the crumbs or shreds are characterized by a high porosity, in which the individual fibers are separated from each other and the spaces between the fibers are unoccupied by liquid. In this condition the material is ideally adapted for gaseous bleaching, inasmuch as the gas may readily act upon each individual fiber, as the moist fibers are separated and are not surrounded by liquid.

The shredded pulp or web is conducted progressively, and preferably continuously to the top or inlet of the apparatus disclosed in the drawings. Said apparatus, as to its principal elements, comprises a vertical tower or chamber having its interior constructed of a material which will not be injuriously affected or acted upon by the gas, preferably chlorine, which is used for the treatment. Said chamber, in this instance,

is made of superposed sections of chemical stoneware, the various sections 10, 11, 12, 13, 14, 15 and 16 having suitable spigot and socket joints sealed with some plastic material which will also resist the action of the treating gas and will at the same time provide a gas-tight joint between the various sections of the gas chamber or tower.

In order to furnish large capacity, the treatment tower may be made of considerable length in its horizontal cross-section as compared with its width, and to facilitate examination and to observe the action of the gas upon the material, windows, as at 17 and 18, may be provided in the walls of some of the stoneware sections. The top section 10 is closed at its top except for an inlet slot or trough-shaped opening 19 extending all the way across the major dimension of its horizontal cross section and into which trough the shredded pulp is fed by a belt or other suitable feeding equipment.

The lower end of the bottom section 16 of the tower extends into and some distance below the surface of a bath 20 contained in a tank or vat 21 which need not be of stoneware, but may be made of wood or other relatively cheap material. The said tank 21 is made of considerable size so as to provide room for a pair of paddle wheels 22 and 23 having beater blades as at 24 which serve to break up the treated pulp which is discharged from the lower end of the tower. Said beater wheels 22 and 23 are mounted upon parallel horizontal shafts 25 and 26 rotating in suitable journals in the sides of the vat 21 and extending outwardly thereof. Said shafts 25 and 26 are geared together by a belt or chain 27 and are actuated by a pulley 28 and belt 29 operated by any suitable source of power.

The dilution tank 21 which, except for the portion occupied by the lower section 16 of the tower, is open to the atmosphere, is equipped with a discharge spout 30 by which the treated and diluted pulp is delivered from the apparatus ready for further treatment or finishing.

Clear water is fed into the tank or vat 21 by means of a pipe 31 extending through the side wall of the bottom section 16 of the tower, preferably above the level of the bath of liquid in the vat, and is admitted in such quantities as to dilute the pulp to the desired consistency, preferably about 2%. The treating gas, preferably heavier than air, in this instance, chlorine, is admitted into the bottom of the tower by means of a series of pipes 32 also extending through the wall of the lower section 16 of the tower above the level of the liquid of the bath 20. Preferably, the inner ends of said pipes are directed downwardly, as shown at 33, so that the discharge openings in the ends of said pipes will not be blocked by the descending pulp.

In order to effect prompt removal from the upper end of the tower of any chlorine or other gas which may by any chance ascend through the top of the tower, and to prevent such gas from entering the room or building in which the apparatus is located, there is provided in the side walls of said section 10 of the tower a series of small slots or openings 34 furnishing communication between the inside of the section 10 and a pair of side conduits 35 and 36 formed in integral enlargements 37 and 38 of said side walls. Each of said conduits 36 communicates with one or more exhaust pipes, as at 39, which lead to a fan or other suitable exhausting apparatus, preferably discharging into the atmosphere outside of the building. Said exhaust arrangement serves only to prevent rising gases from escaping through the inlet opening 19 and does not produce any perceptible upward draft effect in the tower, since the opening 19 is relatively large compared with the area of the slots 34 and pipes 39.

Special means are provided to conduct the fibres downwardly through the tower at a prescribed rate of travel so that the gas will have the proper opportunity to exert the required chemical action; and to this end, the tower is equipped with a plurality—in this instance, three—of dampers, 40, 41 and 42, and cooperating inclined baffle plates, 43, 44 and 45. The baffle plates 43, 44 and 45 are stationary and serve merely to direct the downward movement of the pulp when such movement is allowed to occur as an incident to the actuation of the dampers 40, 41 and 42 which are arranged to rotate on horizontal axes, preferably intermittently and alternately.

The dampers 40, 41 and 42, and the baffles 43, 44 and 45, are preferably manufactured of the same material as the tower sections or units so as to resist the chemical action of the gas, and the shafts which support the rotary dampers may be formed as integral parts of the dampers and of the same material. As shown best in Figure 1, the shafts take the form of short studs or trunnions 46 and 47 which are journaled in bearing boxes 48 and 49 formed by enlarging the abutting portions of adjacent superposed tower unit sections so that the shafts and dampers may be inserted, removed or replaced by merely separating the tower sections. It will be found advantageous to form the bearings with annular enlargements, as shown at 50, to accommodate flanges or rings 51 fixed on the shaft ends. The purpose of said flanges or rings 51 is to prevent the seepage of bearing oil into the tower. Any oil which obtains access to the ring 51 or enters the enlargement 50 may be withdrawn through a drain conduit 52 at the bottom of said chamber 50. The bearings themselves

are oiled through oil pipes 53. However, in most cases, very little oil will be required, or water may be used as a lubricant since the rotation of the damper shafts is relatively slow. As shown in Figure 1, the dampers are driven from one side only, the other end of the shaft being completely enclosed, as shown. Rotation is imparted to the dampers and their driving ends through shafts 54, 55 and 56, each of said shafts being preferably of metal and united to the trunnion ends 46 in any suitable manner. Said shafts 54, 55 and 56 may be supported by pedestal bearings 57, 58 and 59.

The shafts 54, 55 and 56 are actuated by the following mechanism: On a suitable support, there are mounted at the respective sides or ends of the apparatus journal boxes 60 and 61 for rotatably supporting a horizontal shaft 62, which shaft is continuously driven by any suitable source of power not shown herein. On the left-hand end of said shaft 62 (see Figure 1), there is fixed a sprocket 63, which through a chain 64 drives a sprocket 65 keyed to a jack shaft 66 mounted to rotate on a horizontal axis in an intermediate bearing 67 of the pedestal 58. The other end of said shaft 66 is rotatably supported in any suitable manner.

The shafts 66 and 55 are connected by means of an intermittent drive gear train, which in the present instance comprises a mutilated spur gear 68 keyed to the shaft 66 and a driven pinion 69 meshing with the teeth 70 of gear 68 and keyed to the shaft 55 on the end of the damper trunnion. The number of teeth 70 of the mutilated gear 68 and the number of teeth in the driven pinion or gear 69 is such that the shaft 55 will make one-half of a complete revolution for a complete revolution of the constantly running jack shaft 66. Also, the diameter of the spur gear 68 is such that the rotation of the shaft 55 occurs during approximately one half or less of the cycle represented by a complete revolution of the shaft 66, so that the damper shaft 55 will be idle approximately one half of the time or more.

In order to prevent improper rotation of the damper shaft 55, an automatically actuated locking device is employed. This comprises a plate spring 71 having its lower end secured to a fixed support 72, while its upper end is actuated with a wedge-shaped dog 73, which, by reason of the resiliency of the spring 71, is pressed strongly towards the center of the shaft 55. Said dog 73 is of proper shape to enter diametrically opposed and correspondingly shaped notches 74 in a collar or disk 75 keyed to the damper shaft extension 55. With this arrangement, it will be manifest that when the teeth of the spur pinion 69 are no longer engaged by the teeth 70 of the driving gear 68, the shaft 55 will remain quiescent by reason of the engagement of the dog 73 in one of said notches 74.

In order to insure that the dog 73 will not interfere unduly with the rotation of the gear 69 when it is engaged by the teeth 70, there may be employed a small radial cam 76 keyed to the shaft 66 and so positioned that it will push back the spring 71 and release the dog 73 at about the time when the teeth 70 mesh with the teeth of the gear 69 and commence to rotate the shaft 55.

The lowermost damper 42 is driven in the same manner as the intermediate damper 41, the shaft 62 having at its right-hand end a sprocket 77 which, through a chain 78, drives a sprocket 79 keyed to the jack shaft 80. Said jack shaft 80 is keyed to the shaft 56 by the same kind of mechanism as in the case of the connection between the jack shaft 66 and the damper shaft 55 as has just been described.

For a purpose which will appear later, the dampers 42 and 40 are driven in a direction opposite to the direction of rotation of the damper 41, and therefore it is necessary to drive the shaft 80 in a direction opposite to the direction of rotation of shafts 66 and 62. To accomplish this purpose, the chain 78 is shown crossed, but in practice, if the shafts 62 and 80 are located close together, it will be found advisable to use some other suitable form of reversing means, for example, an intermediate spur gear.

As the dampers 40 and 42 should have the same direction of movement and are to rotate simultaneously and to remain quiescent during the same portion of the cycle of operations, it is unnecessary to provide intermittent mechanism for the damper 40. Rotation of such damper 40 is effected by means of a vertically extending chain 81 connecting sprockets 82 and 83 keyed respectively to the shafts 54 and 56.

In operation, the column of heavier-than-air gas is maintained at or slightly above the level of the baffle 43 and below the damper 40, so that when the supply of shredded pulp is accumulating upon the damper 40 while the same is in horizontal position, it is not being acted upon by the gas. The height of such column is controlled by effecting proper control of the supply of gas through the injection pipes 32.

The dampers in each case are arranged to receive the pile or heap of pulp upon that side of the baffle which descends when rotation occurs. This is to prevent packing of the pulp which might interfere with its free downward movement. The baffles 43 and 44 are so located as to direct the downward movement of the pulp upon the upper side of the damper, while the baffle 45 is for the purpose of controlling the descent of pulp into the bath 20.

In practice, it is found that it is not necessary to subject the pulp to the action of

chlorine for longer than a few minutes, which period suffices in the case of most wood fibres to accomplish about 75% or more of the desired bleaching effect. It is not advisable to attempt to complete the bleaching operation in a single stage for the reason that as bleaching progresses, the action slows up and it would not be economical to subject the fibres to the action of the gas for a length of time sufficient to complete the bleaching in this stage. Furthermore, as is well known, when pulp is left in contact with strong chlorine gas for any considerable time, the gas attacks the fibres themselves and a serious loss of pulp results, as well as damage to the fibres.

The plup, when it is delivered into the treatment bath 20, contains some chlorine gas which is dissolved in the bath and is used up in partially completing the bleaching of the pulp after the latter has been diluted in the vat. If a white pulp is desired, the pulp which has been subjected to the action of gas in this apparatus should receive a further bleaching treatment for the purpose of bleaching out the balance of the impurities or encrusting materials.

Since the action of the gas upon the fibres results in a change of color, such change of color may be utilized for the purpose of observing the action of the gas upon the pulp, so that the supply of chlorine or rate of pulp feed may be properly regulated so that the column of chlorine is maintained at the proper height in the apparatus. It will be understood that there is no object in feeding an excessive amount of chlorine gas into the tower. If this is done, because of the rapid retardation of the chemical action after a short time, the chlorine will not be used up and will rise to the top of the tower where it ill be sucked out by the fan and wasted.

In practice, the color of the pulp in the diluting bath, usually a bright orange, will indicate that the supply of chlorine is properly co-ordinated with the speed at which the pulp is traveling through the tower. Obviously, this may be further verified by chemical test of the diluted pulp.

We claim as our invention:

1. The improved process of treating paper pulp which includes substantially thickening said pulp to form a relatively solid mass, comminuting said mass, feeding the comminuted mass downwardly into a column of gaseous chlorine, mechanically maintaining the material in contact with chlorine to accomplish a substantial bleaching in a relatively brief time, repeatedly dividing said pulp so as to present new surfaces thereof for the contact of chlorine therewith, and then plunging the material into a diluting bath before said material has been deleteriously affected by the chlorine.

2. The improved process of treating pulp which comprises feeding the same in solid comminuted form through a column of gaseous bleaching agent while agitating the same, the time during which said pulp is allowed to remain in contact with the bleaching agent being so regulated as to accomplish a substantial bleaching before the bleaching agent can deleteriously affect the pulp and thence substantially diluting said pulp with water so as to render the same fluid and halt deleterious reactions.

3. The improved process of treating pulp which comprises feeding the same in substantially thickened solid comminuted form downwardly through a chamber containing a gaseous treating medium and repeatedly dividing said pulp in the course of its downward movement, whereby to provide a large area of contact for said gas.

4. The improved process of treating pulp which comprises feeding the same in solid comminuted form downwardly through a chamber containing a gaseous treating medium and repeatedly tumbling said pulp in the course of its downward movement, so as to divide the mass of pulp and thus provide a large area of contact for said gas.

5. The improved process of bleaching pulp which comprises feeding the same in substantially thickened solid comminuted form downwardly through a chamber containing a gaseous bleaching medium and repeatedly dividing said pulp in the course of its downward movement, whereby to provide a large area of contact for said gas, and promptly plunging said pulp into a diluting bath after substantial bleaching has been accomplished, in order to avoid deleterious reactions.

6. The improved process of bleaching pulp which comprises feeding the same in substantially thickened solid comminuted form downwardly through a chamber containing a gaseous bleaching medium and repeatedly tumbling said pulp in the course of its downward movement, so as to divide the mass of pulp and thus provide a large area of contact for said gas, and promptly plunging said pulp into a diluting bath after substantial bleaching has been accomplished, in order to avoid deleterious reactions.

7. A process as defined in claim 3, wherein the pulp which is fed through the bleaching chamber is in a porous condition.

8. A process as defined in claim 6, wherein the pulp which is fed through the bleaching chamber is in a porous condition.

HANS JOHN.
CLARENCE C. LEFEBVRE.

CERTIFICATE OF CORRECTION.

Patent No. 1,907,548. **May 9, 1933.**

HANS JOHN, ET AL.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 4, line 86, claim 4, after "in" insert the words "substantially thickened"; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 11th day of July, A. D. 1933.

M. J. Moore.

(Seal) Acting Commissioner of Patents.