Aug. 29, 1933. M. SKOLNIK 1,924,815

PROCESS OF MAKING FELT PAPER PULP

Filed Feb. 29, 1932 3 Sheets-Sheet 1

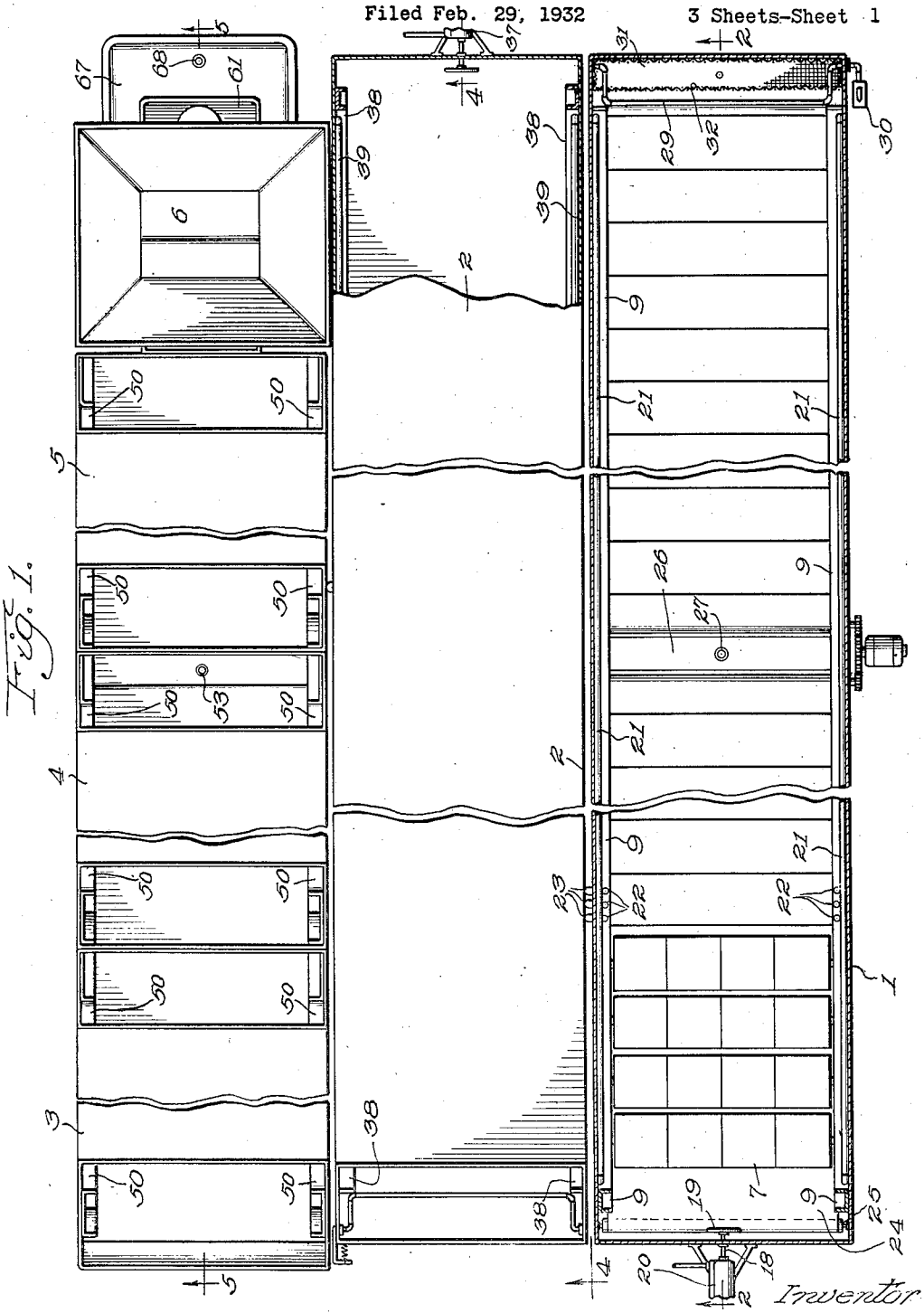


Fig. 1.

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Filed Feb. 29, 1932 3 Sheets-Sheet 2

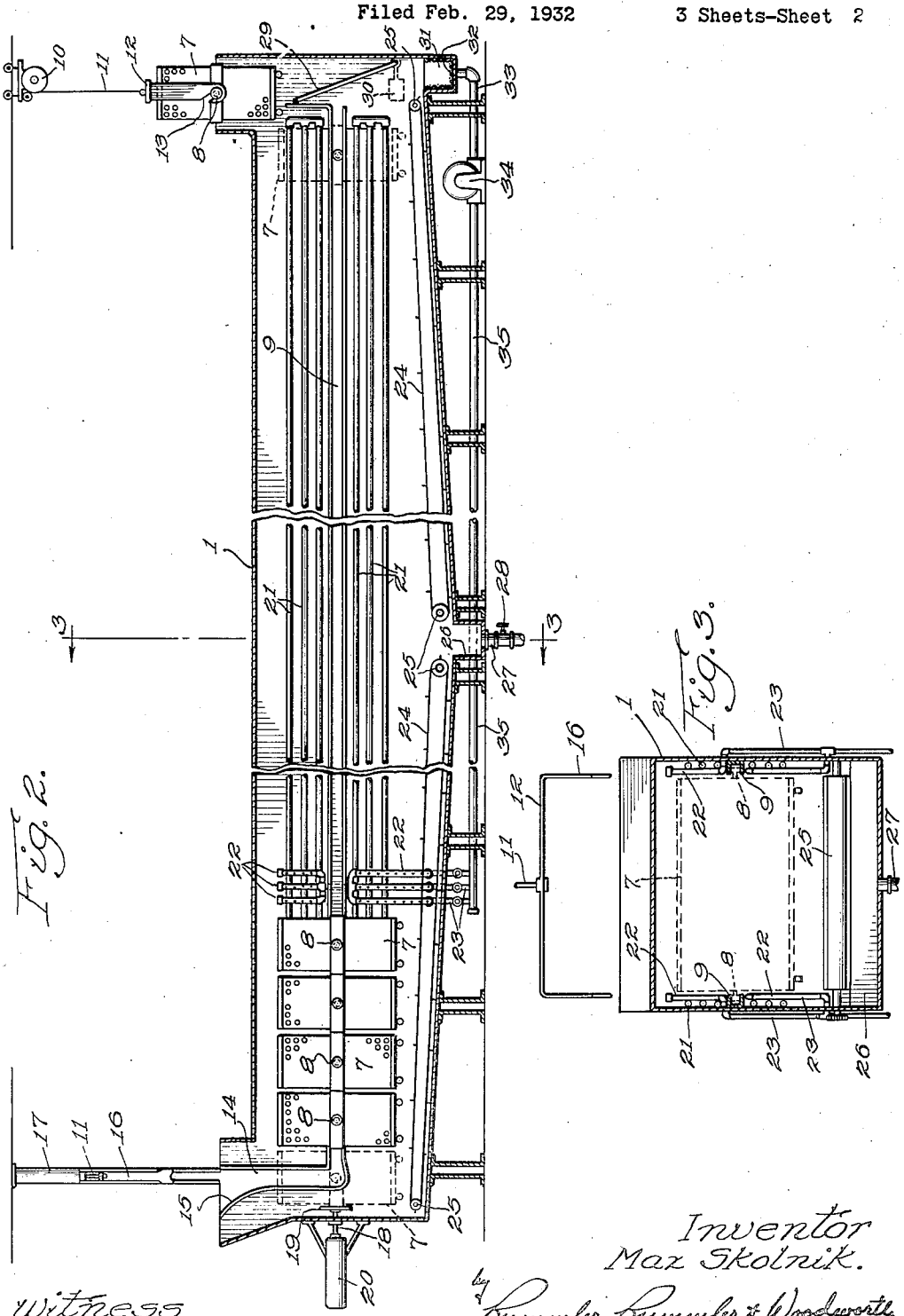


Fig. 2.

Fig. 3.

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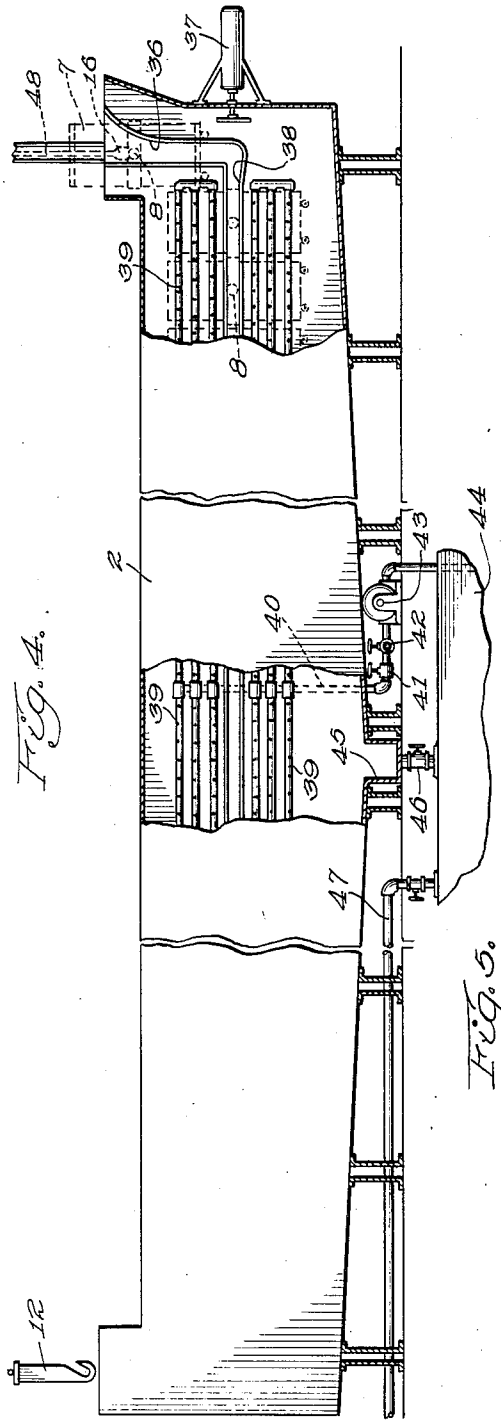


Fig. 4.

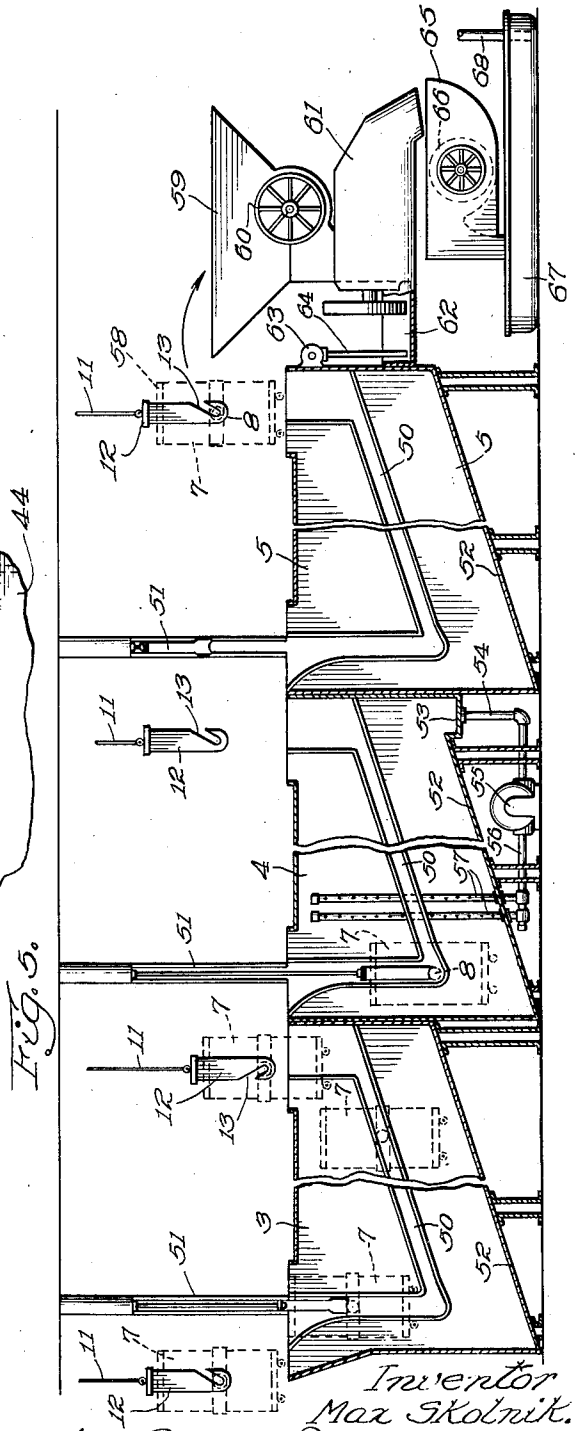


Fig. 5.

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UNITED STATES PATENT OFFICE

1,924,815

PROCESS OF MAKING FELT PAPER PULP

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Application February 29, 1932. Serial No. 595,813

21 Claims. (Cl. 92—13)

This invention relates to an improved process of making a felt paper pulp from straw or the like. By my invention I am able to produce a paper pulp from straw capable of making a felt paper having high absorptive power combined with increased tensile strength.

Heretofore in the manufacture of papers it has been believed that high absorptive power is obtained only by sacrifice of the tensile strength, due primarily to the weakening of the fibers during the harsh process thought necessary to remove the lignins and adhesives which retard the absorptive action of the fibers. By my improved process the time required for separation of the fibers is reduced and the raw material is uniformly chemically treated, such treatment being stopped at the critical stage where the fibers are washed loose and before softening or weakening of the fibers takes place. The washing is followed by neutralization of the residual chemicals in the pulp.

One of the main features of my process is that the fibers go through the entire process without being subjected to any mechanical force tending to break or injure them, resulting in a product containing natural length fibers which can be made into felt paper of unusual tensile strength.

The main objects of my invention are to provide an improved simple and inexpensive process for making pulp stock capable of being formed into felt paper combining strength and absorptive power; to provide a convenient handling apparatus in which the material to be processed is never subjected to any force tending to break the individual fibers; to provide a process in which the fibers are loosened just enough so that they can be washed free and subjected to a fluffing treatment; to provide a process in which the washed free fibers are treated to neutralize the residual fiber loosening chemicals; to provide efficient washing means and apparatus for removing excess water, at the same time recovering the waste chemicals; to provide a series of tanks through which the straw passes successively in closed containers; and to provide a straw pulping process comprising, in series, a first tank containing a hot solution of caustic soda or the like for removing the lignins, a second tank with a spray washing system, a third tank containing a solution of soda ash or the like, a fourth tank containing a spray washing system, and a fifth tank containing a solution of acetic acid or the like.

An illustrative embodiment of my invention is shown in the accompanying drawings, in which:

Figure 1 is a top plan view of the complete processing apparatus with parts broken away.

Fig. 2 is a cross section on the line 2—2 of Fig. 1, showing the caustic solution treatment tank.

Fig. 3 is a cross section on the line 3—3 of Fig. 2, showing the arrangement of the interior tank piping.

Fig. 4 is a vertical view on the line 4—4 of Fig. 1, showing the first washing tank with parts broken away to show its interior arrangement.

Fig. 5 is a vertical section taken on the line 5—5 of Fig. 1, showing the inclined bottom tanks for the last three processing steps.

In the form shown in the drawings the apparatus used in the preparation of pulp stock from straw or the like for the manufacture of strong, absorptive felt paper comprises a caustic tank 1, a washing tank 2, a soda ash tank 3, a second wash tank 4, an acid tank 5, and a moisture extractor 6.

The raw material being processed is carried in covered perforated baskets 7, each designed to carry four bales of straw. The baskets 7 are provided with roller bearing trunnions 8 designed to operate on a U-shaped track 9 which serves to guide the baskets 7 in their passage, through each of the five tanks, to the extractor 6. The transfer of the baskets 7 to and from the tanks is made by a hoist 10 which is connected by a link 11 to a double hook 12 which is formed to straddle the basket 7, each hook having bayonet slots 13 which coact with the basket trunnions 8.

A guide for the basket 7 in its passage into the cautic tank 1 is provided by a vertical section 14 of the U-track 9, which has a side flare 15 near the upper end of the vertical track section to facilitate entrance of the trunnions 8 into the track. The baskets 7 when filled with straw are forced into the tank by a piston 16, operated by a cylinder 17, which coacts with the horizontal trunnions 8.

In a similar manner the baskets 7 are caused to travel horizontally on the U-track 9 by a piston 18, having a pusher head 19, which is actuated by a cylinder 20. Fastened to the inside walls of the tank 1 are horizontal steam pipes 21 which serve to heat the tank contents and maintain a uniform temperature and chemical spray pipes 22 are positioned between the steam pipes 21 and the plane of the inside edge of the tracks 9 to force the chemical into the baskets and to thoroughly impregnate the straw material, the chemical spray pipes 22 being fed through pipes 23. Also, sediment conveyor belts 24, mounted on rollers 25, are positioned just above the in-

clined tank bottom and arranged to gather and deliver any sediment that may form to a sump 26 located near the center of the bottom of the tank 1. Leading from the sump 26 is an outlet pipe 27 having a control valve 28 through which the collected sediment is discharged.

At the exit end of the tank 1 the basket 7 is shown positioned free from the track 9, but the basket 7, before it leaves the track, contacts with a lever 29 which is normally held in an inclined position by a weight 30. When the basket 7 reaches the end of the track 9, the lever 29 is forced into the vertical position, which closes the main valve on the pipe (not shown) controlling the pusher cylinder 20, thus preventing further operation of the piston 18 and jamming of the baskets. When the basket 7 is lifted by the hoist 10 and is free of the lever 29, the weight 30 will drop and open the supply line to the cylinder 20, thereby causing another basket to be advanced to the removing position.

At the bottom of the tank 1 near its exit end is a sump 31, provided with a filter 32, through which concentrated chemical solution is removed from the tank for recirculation. A pipe 33 connects the sump with a circulating pump 34, thence through a pipe 35 and to pipes 23 supplying the vertical spray pipes 22.

The baskets move through the caustic tank from left to right, and are then transferred to the right end of the washing tank 2, shown in section in Fig. 4, where the baskets 7 are received in guides 36 formed by the flared track which is similar to the U-track in the caustic tank 1. A pushing cylinder 37 then forces the trunnions 8 to engage the horizontal U-track 38.

On the side walls of the washing tank 2 are fastened a plurality of horizontal washing spray pipes 39, which serve to force the washing water into and through the baskets to thoroughly rinse the straw held therein. These spray pipes are fed by the pipe 40, having control valves 41 and 42, which lead from a circulating pump 43 having connection to a supply tank 44. The bottom of the wash tank 2 is inclined to a center sump 45, which is directly connected through a valve 46 with the supply tank 44, to provide a means whereby the washing water can be removed for recirculation and the recovery of the chemical rinsed off the material being processed. A main feed pipe 47 is also connected to the supply tank 44 to provide a fresh water supply.

The baskets 7, on entering the wash tank 2, are pushed down into the tank by a piston 48 controlled from a pressure cylinder, not shown. After traveling to the leaving end the baskets are removed from the tank by a hoist hook 12, and transferred to the soda ash tank 3. In a similar manner the baskets are passed through the tanks 3, 4 and 5, each of which is provided with a flared trunnion receiving U-track 50 which is inclined upward in the direction of travel, and each of which is provided with pushers 51 and transfer hoists. Also, the bottom 52 of each tank is arranged to slope upward in the direction of travel to minimize the volume of the liquid contents.

The second wash tank 4 is also provided with a sump 53, at the upper end of its sloping bottom, which is connected by pipe 54 to a circulating pump 55 and thence through pipe 56 to vertical spray pipes 57.

When the baskets 7 are lifted out of the acid tank 5, the cover 58 is opened and the pulp is emptied into a hopper 59, from which it is delivered by a feed roll 60, to a compressor 61, containing a screw adapted to extract the acid solution which flows into a sump 62. A small circulating pump 63 returns the acid solution, by way of a pipe 64, directly into the acid tank 5. From the compressor 61 the pulp is delivered to a tempering trough 65, where it is gently agitated by the rotor 66, mixed with fresh water and passed to a pulp tank 67 from which it is pumped to a pulp storage tank or a felt making machine through pipe 68.

In operation baled straw is placed in a perforated basket, the tie wires are removed and the cover fastened in place where it remains until the finished paper pulp is delivered from the same basket to the hopper at the finishing end. Because of the buoyancy of the straw, which displaces less than its volume in water, even when placed in an iron basket, force must be used to submerge the filled basket, and the roller bearings on the trunnions of the baskets are caused to engage the U-shaped horizontal tracks in the treating tank by pushing the baskets down between the vertical track guides. The baskets are then forced through the tank by a pressure device acting on the last basket placed in the tank.

When the tank is full of baskets the pressure device is automatically shut off or made inoperative until the first or end basket has been removed from the exit end. However, it will be readily understood by those skilled in the art that this safety interlock can also be supplemented by visible or audible signal means to safeguard against crushing the baskets.

The caustic tank is supplied with a water solution of caustic soda or the like, which is maintained at or near the boiling temperature of the water. The strength of the caustic solution is a function of the time of treatment which is controlled by the rate at which the baskets are fed into the tank; and circulation of the caustic solution is maintained by circulating pumps connected with an end sump. When the straw is treated in the caustic tank, there is removed from the straw a large portion of the encrusting elements or lignins, a part of which go into solution, and a part of which drop to the bottom of the tank, where they are automatically carried along the inclined bottom to a center sump, from which they can be removed. The contents of the sump are saved and treated to form a lignin by-product.

Substantially the same kind of equipment is used to transfer and propel the baskets through the caustic tank 1 and the washing tank 2. However, the washing tank contains a closed spray water circulating and spraying system in which the baskets are subjected to the force of many jets of water during the entire washing period.

After washing the baskets are transferred to a dip in a tank containing a two per cent solution of soda ash, thence to a second washing tank having a self-contained spray washing system, followed by treatment in a tank containing a two per cent solution of acetic acid. On removal from the acid bath the baskets are opened and the contents placed in the hopper of an extractor, from which a part of the acid solution is recovered and returned to the acid tank. In the last three tanks the baskets are forced down into the tanks through guides to engage the inclined U-track, and pass upwardly through the tanks as rapidly as baskets are removed from each tank, the baskets being lifted upwardly through the tanks by the natural

buoyancy of the straw material which is maintained throughout the entire process.

The pulp is fed to the squeezer from the hopper of the extractor by a power driven feed roll. From the extractor the pulp drops into the tempering trough having a driven paddle mixer, and thence into the storage tank in condition so that it can be pumped to a paper making machine.

The final product or paper is principally made from the fiber or cellulose which forms the walls of the cells commonly known as the woody portion, which comprises about sixty-five per cent, by weight, of the raw material. In nature the fibers are bound together by an encrusting material forming a more or less rigid structure, the encrusting material comprising resinous, glutinous and siliceous constituents, which are more or less soluble in the caustic soda solution.

The fibers are not injured by the caustic solution unless the treatment is too prolonged. Strong paper depends upon the strength and elasticity of the fibers together with certain adhering glutinous material which assists in the felting process. Therefore, it is very important to remove all traces of the caustic solution which would otherwise deteriorate the fibers, and I have found that by placing the washed pulp in a soda ash bath, which gently washes away most of the remaining gummy adhesives, and then in a neutralizing acid bath, the felting action of the pulp is changed so that it forms a strong, highly absorbent paper.

The natural fibers are easily damaged when going through any process of separation wherein mechanical force is applied to the material. For that reason, in my process, the raw material is placed in a container where it remains undisturbed by forces tending to disrupt the fibers. In the caustic tank the action of the hot solution very rapidly loosens the encrusting material or lignins, at which stage a large portion of such fiber binding material can be removed by causing a spray of the solution to contact with the straw. However, if the straw at this stage is roughly handled, the fibers are broken into short lengths, and if the fibers are allowed to stay too long in the solution, they become softened, thereby reducing the strength of the finished product.

In the first washing tank substantially all of the caustic soda which has soaked into the fiber is removed. The pulp at this stage still retains a considerable amount of glutinous material and is in condition to be converted into hard paper pulp, as described in my copending patent application, Serial No. 577,968, filed November 30, 1931.

In the present disclosure the pulp is subjected to further treatment for the purpose of making felt paper. This is accomplished by taking the water washed pulp still in the original basket and dipping it in soda ash or soapy solution, which not only washes away most of the remaining adhesive materials which cling to the fibers after washing but apparently forces the fibers to retain permanently substantially the somewhat expanded condition that they acquire when going through the washing tank. The soapy solution is then rapidly removed by placing the pulp in another water spray tank from which the material is then transferred to the final treatment in a tank where the solution is maintained in a slightly acid condition. The acid solution serves to neutralize the fibers and make them suitably pliable for felt paper. The pulp is then pressed to remove the entrained acid solution, which is returned to the last tank, and is tempered or put in condition so that it will flow and can be pumped to a paper making machine.

By this improved process felt paper is produced from straw or the like having a tensile strength equal to and even exceeding paper made from regular rag stock. Further, my felt paper has an absorptive power considerably in excess of that obtainable with the best grades of porous rag felt paper. The apparatus required to rapidly handle large quantities of pulp is comparatively inexpensive, and, assuming that the straw has been placed in the baskets and the ties are removed, all that is required by way of handling is the transfer of the baskets to and from the tanks containing the proper solutions.

Although but one specific embodiment of this invention has been herein shown and described, it will be understood that numerous details of the construction shown may be altered or omitted without departing from the spirit of this invention as defined by the following claims.

I claim:

1. The method of producing felt fibers from straw which consists in treating the straw with a caustic chemical to remove the lignins, washing the straw in a soapy solution, and neutralizing the resultant fibers with an acid.

2. The method of producing felt fibers from straw which consists in treating the straw with a caustic chemical to loosen the lignins, washing the straw to substantially remove the entrained caustic chemical, washing the straw in a soapy solution to remove the lignins, and neutralizing the resultant fibers with an acid.

3. The method of producing felt fibers from straw which consists in treating the straw with a caustic chemical to loosen the lignins, washing the straw to reduce the entrained caustic chemical, washing the straw in a soapy solution to remove the remaining lignins, washing the straw in water to remove the entrained soapy solution, and neutralizing the resultant fibers with an acid.

4. The method of producing felt fibers from straw which consists in treating the straw with a caustic chemical to loosen the lignins and partially remove the same, washing the straw to reduce the entrained caustic chemical, washing the straw in a soapy solution to remove the remaining lignins, and neutralizing the resultant fibers with an acid.

5. The method of producing paper pulp from fibrous organic material which consists in treating the material with a caustic chemical to loosen the fibers, washing the material to reduce the entrained caustic chemical, and treating the material with a soapy solution to reduce remaining adhesive elements.

6. The method of producing paper pulp which consists in treating fibrous organic material with a caustic chemical for a predetermined time to loosen the lignins, washing the material in water, washing the material in a soapy solution to remove the lignins, and neutralizing the resultant fibers with an acid.

7. The method of producing paper pulp from fibrous organic material which consists in treating the material with a caustic chemical to loosen the fibers, washing the material to reduce the entrained caustic chemical, treating the material with a soapy solution to reduce remaining adhesive elements, and washing the material to remove the entrained soapy solution.

8. The method of producing paper pulp from fibrous organic materials, which consists in treating the material with a caustic chemical to loosen the fibers, washing the material to reduce the

entrained caustic chemical, treating the material with a soapy solution to remove glutinous elements, washing the material to remove the soapy solution, and neutralizing the fibers with an acid.

9. The method of producing paper pulp from straw which consists in passing straw through a caustic bath, removing the straw from said bath after a predetermined time in which the straw fibers have been loosened, passing the straw through a washer and chemical remover, passing the straw through an alkali solution to remove the lignins, neutralizing the straw fibers with an acid, and removing the excess free moisture from the straw.

10. The method of producing paper pulp from straw which consists in treating the straw in a caustic bath to loosen the straw fibers, removing the straw from said bath after a predetermined time, washing the straw to remove the entrained caustic chemical, treating the straw with a sal soda solution, neutralizing the resultant fibers with an acid, and removing the entrained moisture.

11. The method of producing paper pulp from straw which consists in continuously passing straw through a caustic bath, removing the straw from said bath after a definite time when the straw fibers have been loosened, continuously washing the straw to remove the entrained chemical, continuously passing the straw through an alkali bath, removing the straw from said alkali bath, washing a second time to remove the entrained alkali solution, and continuously passing the straw through an acid solution to neutralize the resultant fibers.

12. The method of producing paper pulp from straw which consists in passing the straw through a strong caustic bath at a predetermined rate, removing the straw from said bath at the time when the straw fibers are loosened, washing the straw to remove the entrained caustic chemical, washing the straw in an alkali bath to remove the lignins, washing the straw to remove the entrained alkali solution, and neutralizing the resultant fibers in an acid bath.

13. The method of producing paper pulp from straw which consists in passing straw through a continuous caustic bath at a predetermined rate and dissolving resinous material from the straw, removing the straw from said bath at the time the straw fibers are loosened, passing the straw through a washer and removing the entrained caustic chemical, passing the straw through a continuous alkali bath to remove glutinous materials, passing the straw through a washer to remove the entrained alkali chemical, and passing the straw through a continuous acid bath to neutralize the resultant fibers.

14. The method of producing felt paper pulp from straw which consists in subjecting straw to a strong caustic treatment for a definite predetermined period, removing the straw from such treatment at the time the resinous materials in the straw have been softened sufficiently to be washed away and the straw fibers loosened, washing the treated straw to remove the entrained caustic chemical and the softened resinous material, washing the straw in a soapy solution to remove glutinous materials, washing the straw to remove the entrained soapy solution and subjecting the straw to an acid treatment to neutralize the resultant fibers.

15. The method of producing felt paper pulp from straw which consists in subjecting the straw to a strong caustic treatment to soften the resinous materials in the straw and loosen the straw fibers, limiting the period of such treatment so that only the lignins in the straw are attacked, washing the treated straw to remove the entrained caustic chemical, washing the straw in a soapy solution to remove the lignins, washing the straw with water to remove the soapy solution and subjecting the straw to an acid treatment to neutralize the resulting fibers.

16. The method of producing felt paper pulp from straw which consists in subjecting the straw to a strong caustic treatment to soften the resinous materials in the straw and loosen the straw fibers, limiting the period of such treatment so that only the lignins in the straw are attacked, washing the treated straw to remove the entrained caustic chemical, washing the straw in a sal soda solution to remove the lignins, washing the straw with water to remove the sal soda solution and subjecting the straw to an acid treatment to neutralize the resulting fibers.

17. The method of producing paper pulp from straw which consists in loading straw in its baled form into a closed mesh container, passing said container through a caustic treatment tank and forcing caustic chemical through said container and the straw therein to loosen the straw fibers, passing said container through a washing tank to remove entrained caustic chemical from said container and straw, passing said container through a sal soda solution tank and forcing such solution through the container and straw to reduce remaining adhesive elements, and removing the straw from said container to separate the resultant fibers.

18. The method of producing felt paper pulp from straw which consists in loading straw into a carrier, passing said carrier and straw through a caustic treatment tank at a definite rate predetermined to loosen the straw fibers and affect only the lignins in the straw, passing said carrier and straw through a washing tank to wash the entrained caustic chemical from the straw, passing said carrier and straw through an alkali tank to wash away the lignins, passing the carrier and straw through a washing tank to remove the entrained alkali solution, passing said carrier and straw through an acid solution tank to neutralize the straw fibers, and removing the resultant straw fibers from said carrier.

19. In the manufacture of felt paper pulp from straw the method of treating the straw in its baled form to remove the lignins therefrom while keeping the straw fibers intact, which consists in subjecting untied bales of straw to a predetermined period of caustic treatment while being carried in closed mesh containers, passing the containers and straw through a continuous washing water tank, passing the containers and straw through a washing tank containing a soapy solution, washing the containers and straw to remove the entrained soapy solution, passing the containers and straw through an acid treatment to neutralize the resulting fibers, and removing the straw from said containers after such treatment to separate the fibers.

20. In the manufacture of paper pulp from straw, an apparatus comprising a mesh container adapted to hold straw in its baled form, a series of covered treatment tanks, each having a top entrance and exit at respective ends adapted to receive and discharge said container, a roller trunnion on opposite sides of said container, a track positioned adjacent the inner sides of each of said tanks adapted to receive said trunnions

and guide said carriers in a predetermined path through said tanks, and means to cause said carriers to travel through said tanks successively.

21. In the manufacture of paper pulp from straw, a treatment tank having top openings at opposite ends, a mesh container having roller trunnions on opposite sides and being adapted to pass through said tank openings, a track positioned adjacent the inner sides of said treatment tank adapted to receive said trunnions and to guide said container along a predetermined path through said treatment tank, said track extending to the entrance opening of said treatment tank and being flared at said opening, and means to introduce said containers into said treatment tanks and cause said trunnions to engage said track.

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