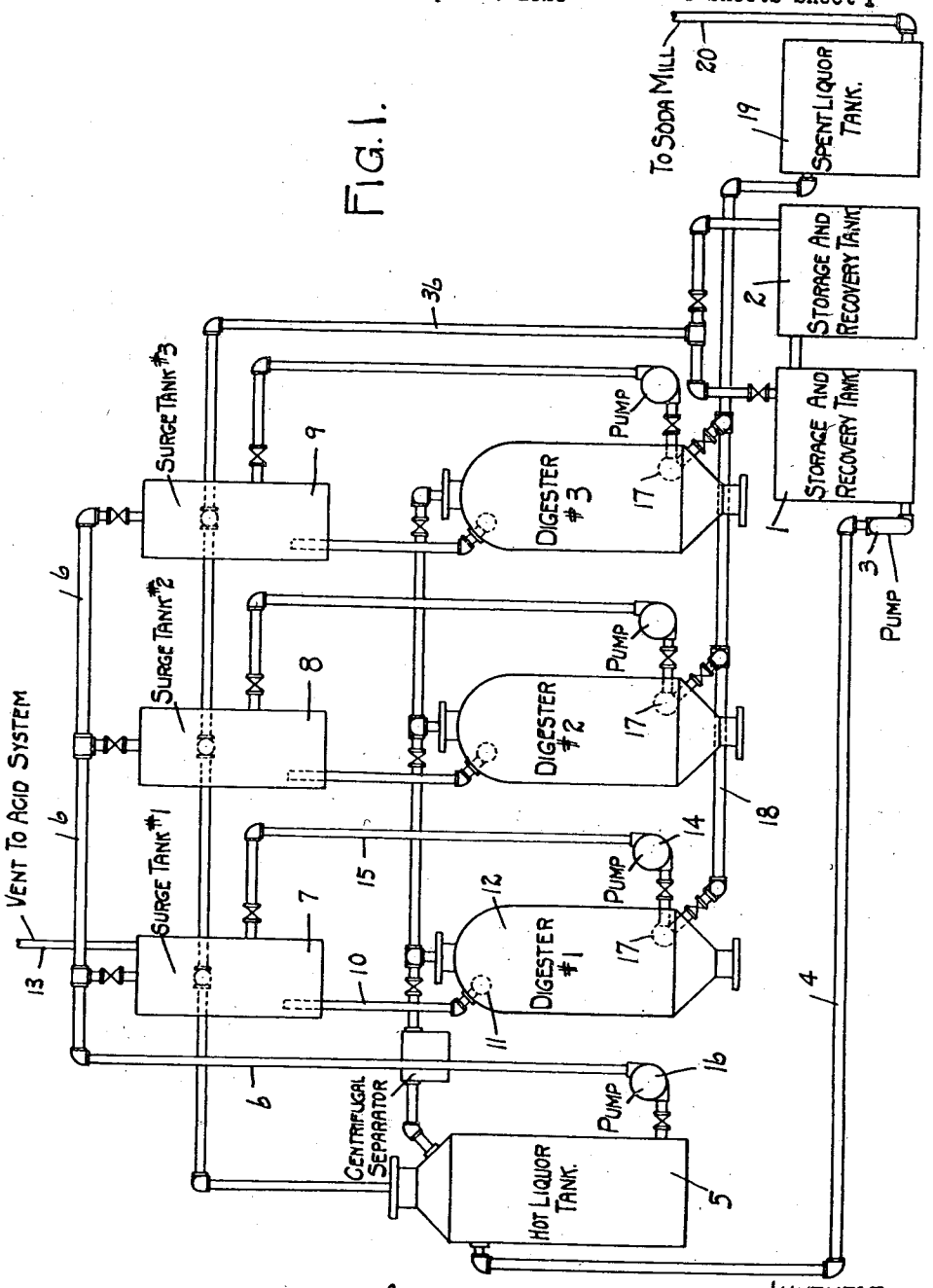
Oct. 18, 1927. 1,646,084

T. L. DUNBAR

METHOD AND APPARATUS FOR TREATING FIBROUS MATERIALS

Filed Sept. 3, 1926 3 Sheets-Sheet 1

FIG. 1.



Inventor

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By John W. Strelli

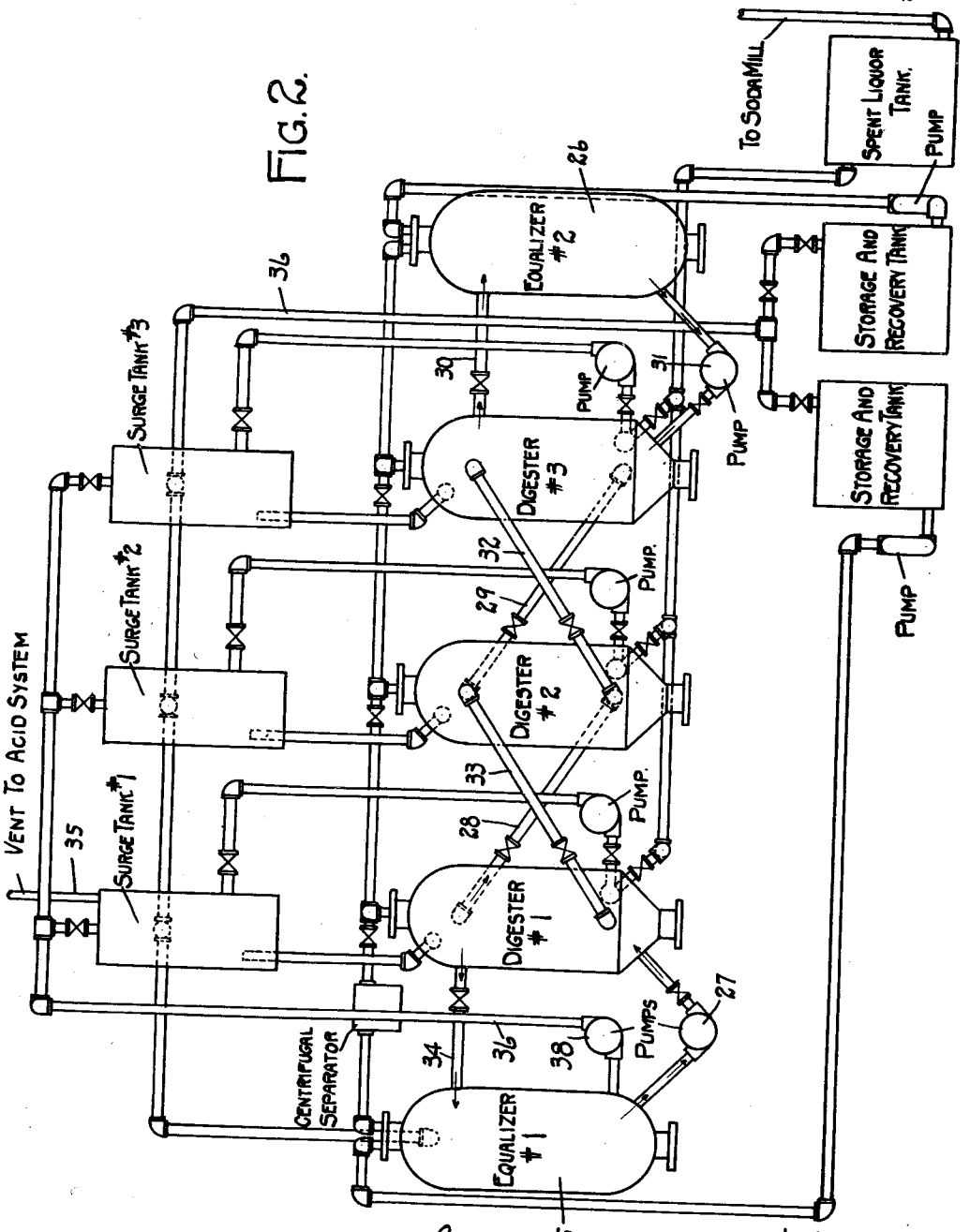
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Oct. 18, 1927. T. L. DUNBAR 1,646,084

METHOD AND APPARATUS FOR TREATING FIBROUS MATERIALS

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FIG. 2.



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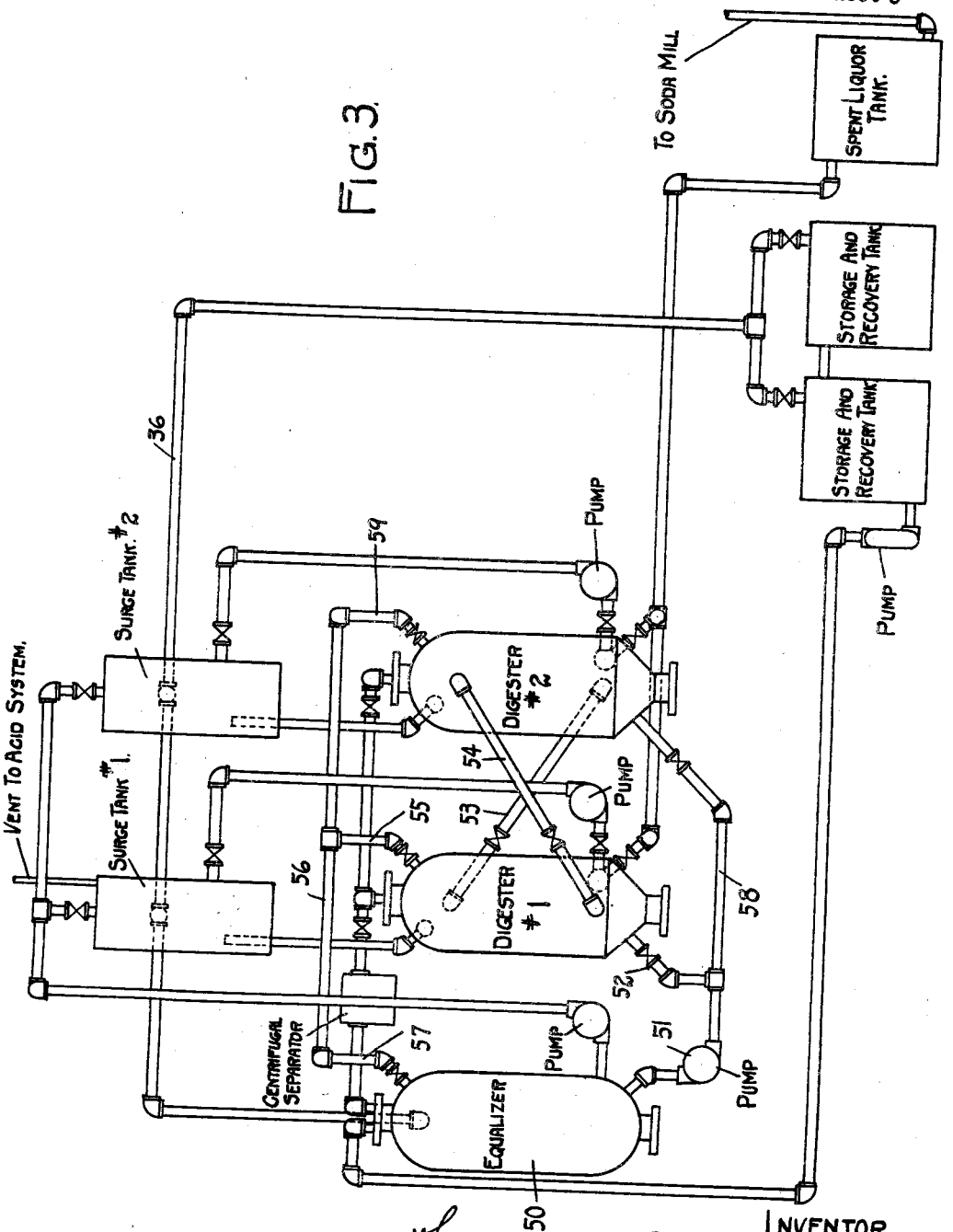
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METHOD AND APPARATUS FOR TREATING FIBROUS MATERIALS

Filed Sept. 3, 1926

3 Sheets-Sheet 3

FIG. 3.



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UNITED STATES PATENT OFFICE.

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METHOD AND APPARATUS FOR TREATING FIBROUS MATERIALS.

Application filed September 3, 1926. Serial No. 133,502.

This invention relates to improvements in the methods and apparatus for treating fibrous material, such as wood pulp for the manufacture of paper, and one of the objects is to provide a novel process for manufacturing chemical pulp and for reclamation of waste liquors. The term "reclamation" applies to the spent liquors which are drained from the pulp after the same has been cooked, and which today are a source of pollution to the streams. These spent liquors contain a high percentage of chemicals which are useful if properly handled.

Another object of my invention is to digest the pulp fibers with an admixture of normal cooking liquor and spent liquor, or the spent liquor alone may be used as a precooking agent and as a solvent for breaking down the gummic substances in woods. This is accomplished both by a solvent and a catalytic action.

A further object of the invention is to provide a process in which the pressure in the digester can be raised as high as desired by pumping fresh additional acid into the digester and thereby permitting the reduction of steam, which is usually employed to obtain the high pressure necessary. The very high pressure obtained by my method is desirable in the cooking of pulp, as it permits the temperature on the digester to be maintained at a low point, that is, at a low temperature during the process of cooking. Heretofore, it has been thought impossible to synchronize a low temperature with a high pressure since it has been necessary to create pressure by means of saturated steam, which obviously increases the temperature. In my process, practically any pressure can be maintained, and the temperature can accordingly be controlled, thus very materially reducing the cost of steam consumption, and increasing the strength and improving the general qualities of the chemical pulp.

A further object of the invention is to provide an apparatus to permit a counter current liquor pumping effect in the cooking of digesters.

In order to eliminate all waste of the spent liquor drained from the pulp, I propose to utilize this spent liquor in combination with an alkaline solution, there being sufficient sulphur in the spent liquor to form sulphides in combination with the alkaline liquor, thus creating a liquor which will cook what is known to the trade as a modified sulphate pulp.

The following detail description taken in connection with the accompanying drawings, is for use in sulphite cooking, but the method and apparatus can be used in any pulp cooking process to which they are applicable.

Referring to the drawings:

Fig. 1, is a side view of one form of my improved apparatus.

Fig. 2, is a similar view of a modification employed for the counter-current circulation of the acid. This form of the apparatus including two equalizers.

Fig. 3, is a side view of a further modification employing the counter-current circulation principle with the use of a single equalizer.

In using the apparatus shown in Fig. 1 for my process, the storage and recovery tanks 1 and 2 may contain a mixture of normal cooking liquor and spent liquor in such proportions as are desirable for the particular operation at hand. This mixture is forced by pump 3 and pipe 4 to the hot liquor tank 5 where it is preheated before it is fed by way of pipe 6 into one or more of the surge tanks 7, 8 and 9. From either of the surge tanks, the liquor mixture flows by gravity through pipe 10 and strainer 11 into the digester 12. Assuming that the digester No. 1 is to be cooked, steam is turned into the same by the usual steam feeding pipe, (not shown) and this will tend to raise the pressure and heat up the pulp and liquor in the digester; any gas passing off by way of the pipe 10 and surge tank into the usual vent pipe 13 which conducts the same to the recovery system. After the digester has been brought to normal cooking pressure, the steam is practically cut off, and the pump 14 at the bottom of the digester is put in operation to force the liquor through the strainer 11 and pipe 10 into the surge tank, from which it may be passed by way of pipe 15 back to the inlet of the pump. In this way the liquor may be circulated in either direction through the pulp a number of times.

The apparatus is so constructed that the liquor thus pumped, may, if desired, be forced through the pipe 6 from one surge

tank to the next, or back into the hot liquor tank 5. As each digester has its own pump 14, a similar operation may take place with any digester, and the operation may be intermittent or continuous from one digester to another, until the chips or other fibrous material undergoing treatment, have practically exhausted the strength of the liquor. At this time, or at any other desired time, fresh strong liquor can be forced by pump 16 into either surge tank and circulated through one digester as a unit, or continuously through any number of digesters until the strength of the liquor in the digester or digesters has been built up to any desired point. By pumping fresh additional liquor into the digester by way of pump 16, pipe 6 and the surge tank, the pressure in the digester may be raised. The high pressure thus obtained is highly desirable in the digestion of pulp, since it permits the temperature on the digester to be maintained at a low point, which has been one desideratum in the industry for many years. With my method and apparatus, practically any pressure can be maintained in the digester or digesters, and the temperature can accordingly be controlled, thus very materially reducing the cost of steam consumption, and increasing the strength and improving the general qualities of the chemical pulp.

This method may be pursued until the chips have been thoroughly pulped, leaving a strong liquor in solution with the pulp at the termination of the end point of digestion. At this time the liquor may be drained off from the pulp through strainers 17 and the pipe 18 to the spent liquor tank 19, where it is ready for a re-use.

Only about 50% of the amount of spent liquor drained from the pulp can be used again through this cooking process, consequently, there is about 50% ordinarily following such procedure, that would be wasted. In order to eliminate all waste, I propose to utilize this spent liquor in combination with caustic soda, there being enough sulphur in the spent liquor to form sulphide of sodium in combination with an alkaline liquor, creating a liquor which will cook a modified sulphate pulp.

In order to reclaim this spent liquor, I pass the same by way of pipe 20 to a soda mill where it is combined with caustic soda.

It may be said that an admixture of normal cooking liquor and spent liquor alone can be used as a pre-cooking agent, and as a solvent for the breaking down of the gummic substances in woods. Consequently, by my process, I not only eliminate the pollution of streams, but I utilize the waste liquor, and thus reduce the cost of operating this system.

In the apparatus shown in Fig. 2, I have a system to permit counter-current circulation of the liquor through the digesters, and for this purpose, I combine with the digesters, two equalizer tanks 25 and 26. After the pressure has been raised in the digesters to a proper degree, the pump 27 may be started, and this will force liquor from the equalizer 25 upwardly through the digester No. 1, from which it may be discharged by way of pipe 28 into the lower end of digester No. 2. It leaves the upper end of this digester by pipe 29, which conveys it to the lower portion of digester No. 3. It flows from digester No. 3 by way of pipe 30 into the equalizer tank 26. In this way, liquor from equalizer No. 1 may be transferred by an upward flow through each one of the digesters. Then it may be returned from equalizer No. 2 by way of pump 31. This pump forces it upwardly through digester No. 3, from which it is discharged by pipe 32, which leads the liquor into the lower end of digester No. 2. The liquor flows upwardly in digester No. 2 and may be discharged from the top of the same through pipe 33 which leads it back to the lower end of digester No. 1. It flows by pipe 34, from the upper end of digester No. 1 to the equalizer 25.

By properly controlling the valves in the lines connecting the digesters and equalizers, the direction of flow may be varied as desired.

In using this form of the apparatus, the digesters are started cooking with equalizer No. 1 partly filled with liquor, while equalizer No. 2 is empty. The pressure in the digesters is brought up to the proper point, and the pump 27 is then employed to introduce strong liquor into digester No. 1. If equalizer No. 1 is filled up to the pipe 34, then it is obvious that the circulation in equalizer No. 1 may be in either direction, and by properly controlling the valves in the pipe lines, the liquor may be moved either upwardly or downwardly, through each digester. A continuation of this operation can be maintained until digestion has been completed, and the digesters are ready to blow off gas, at which time fresh liquor is pumped from the storage tank into a mixing tank, (not shown) and this fresh liquor is intermingled with hot gas vented off through pipe 35. In the mixing tank, the hot gas may be absorbed by fresh liquor, and will thereby heat this liquor up for succeeding cooks.

Uniform recovery pressure is maintained during the cooking operation by bleeding back to the storage tank from the equalizers through pipe 36.

In the embodiment illustrated in Fig. 3, a single equalizer 50 is employed. This equalizer will be partially filled with fresh liquor, and whenever desired, this liquor is forced from the lower end of the equalizer by pump

51, through a pipe 52 into the lower end of digester No. 1. It passes up through the pulp in this digester, and is then discharged from the upper end of the digester by way of pipe 53 which leads it to the lower end of the digester No. 2. The liquor will pass up through this digester and be discharged by way of pipe 54 which will lead it to the lower end of digester No. 1. The liquid may then, if desired, be discharged from this digester by way of pipes 55, 56 and 57, back into the equalizer tank. Instead of operating the apparatus in this manner, the pump 51 may force the liquor through pipe 58 into the lower end of the digester No. 2, and the liquor may be discharged from the upper end of this tank, either by way of pipe 59 or pipe 54. With either method, the liquor will be fed from the equalizer back into the equalizer.

From the foregoing, it is believed that the essentials of the present invention may be readily understood, and it may be obvious to those skilled in the art, that changes may be made in the details disclosed, without departing from the spirit of the invention as expressed in the claims.

What I claim and desire to secure by Letters Patent is:

1. In a chemical pulping process, heating fresh liquor to a predetermined temperature, then pumping the same into a digester during the cooking process, to build up a relatively high pressure in the digester, and maintaining a relatively low temperature in the digester while creating said pressure.

2. In a chemical pulping process, bringing the contents of a digester to a predetermined temperature while pumping fresh additional liquor into contact with the pulp to create a high pressure.

3. In a chemical pulping process, digesting the pulp with liquor in a closed chamber at a predetermined temperature, and increasing the pressure in said chamber during the digestion by forcing fresh liquor heated to a predetermined point into said chamber.

4. In a chemical pulping process, digesting the pulp with liquor until a predetermined pressure is reached, and then circulating hot fresh liquor through the pulp.

5. In a chemical pulping process, digesting the pulp with liquor at a relatively low temperature, and under high pressure, and circulating fresh liquor in heated condition through the pulp after a predetermined pressure has been reached.

6. In a chemical pulping process, heating fresh liquor to a predetermined temperature, and circulating said heated liquor in countercurrent directions through the pulp, while the latter is undergoing cooking.

7. In an apparatus of the class described, a digester, a surge tank, a pipe connecting the digester to the surge tank, and adapted to feed liquor by gravity from the tank to the digester, a hot liquor tank, and means for forcing hot liquor from the last mentioned tank to the surge tank.

8. An apparatus of the class described, including a digester, a surge tank, pipes connecting the upper and lower ends of the digester to said surge tank, a pump interposed in one of said pipes for circulating liquor through the surge tank and digester, a hot liquor tank, and means for feeding liquor from the last mentioned tank to the surge tank.

9. In an apparatus of the class described, a storage tank, a hot liquor tank, means for forcibly feeding from the storage tank to the hot liquor tank, a surge tank, means for feeding liquor from the hot liquor tank to the surge tank, a digester, a pipe connecting one end of the digester to the surge tank, another pipe connecting the other end of the digester to said surge tank, and a pump interposed in one of the last mentioned pipes for circulating liquor through the digester and surge tank.

10. An apparatus as claimed in claim 9, including a bleed pipe connecting the surge tank to the storage tank.

11. An apparatus of the class described, including a plurality of digesters, a plurality of surge tanks, a pair of pipes connecting each digester to its associated surge tank, pumps in certain of said pipes for circulating liquor through the surge tanks and digesters, a hot liquor tank, a pipe connecting the hot liquor tank to the surge tanks, and means for forcing liquor from the hot liquor tank through the last mentioned pipe.

12. An apparatus as claimed in claim 11, in which liquor may be forced by one of said pumps from a surge tank to a digester, another one of the surge tanks, or to the hot liquor tank.

13. An apparatus of the class described, including a storage tank, a hot liquor tank, means for forcibly feeding liquor from the storage tank to the hot liquor tank, a surge tank, means for feeding liquor from the hot liquor tank to the surge tank, a digester, a pipe connecting one end of the digester to the surge tank, another pipe connecting the other end of the digester to the surge tank, and a pump interposed in one of the last mentioned pipes for circulating liquor through the digester and surge tank.

In testimony whereof, I affix my signature at Watertown, New York, this 30th day of August, 1926.

THOMAS L. DUNBAR.