No. 789,372. PATENTED MAY 9, 1905.

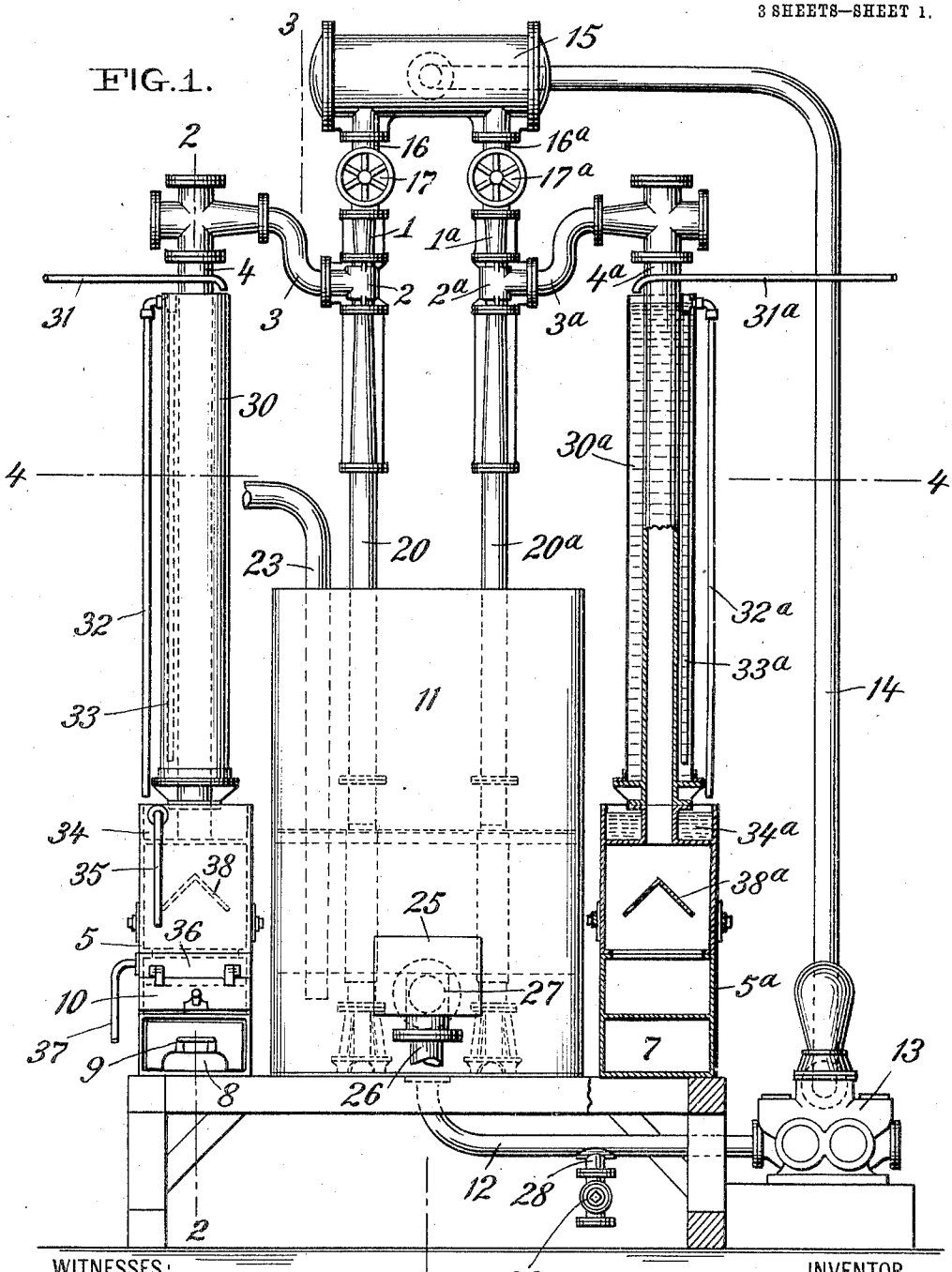
A. MAGUIN.

APPARATUS FOR THE CONTINUOUS SULFURATION OF SUGAR JUICES.

APPLICATION FILED MAR. 4, 1904.

3 SHEETS—SHEET 1.

FIG. 1.




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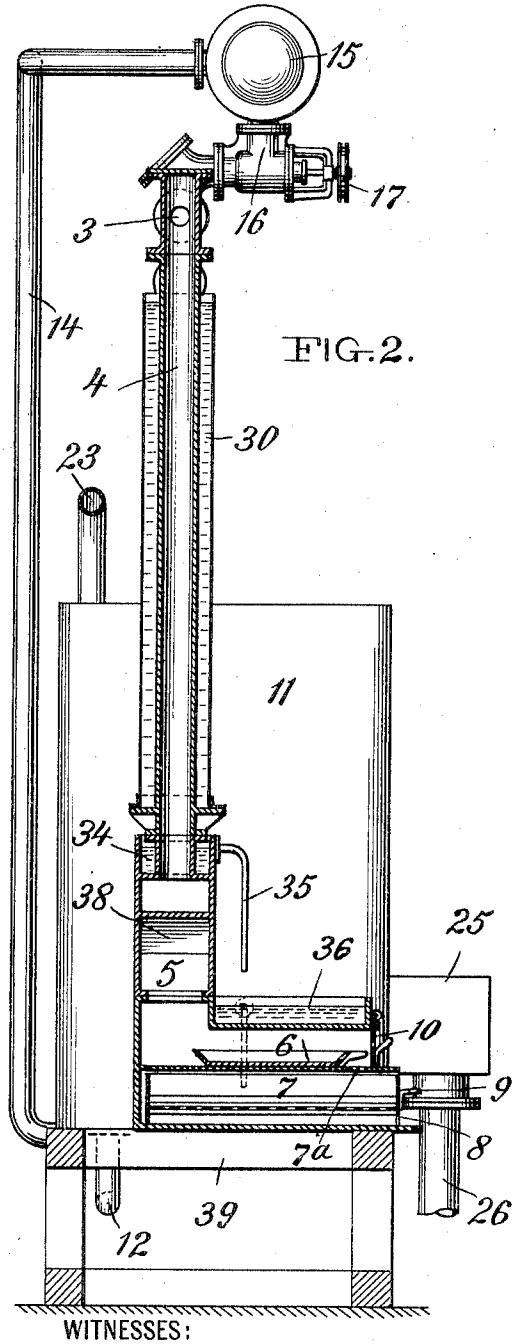



FIG. 2.

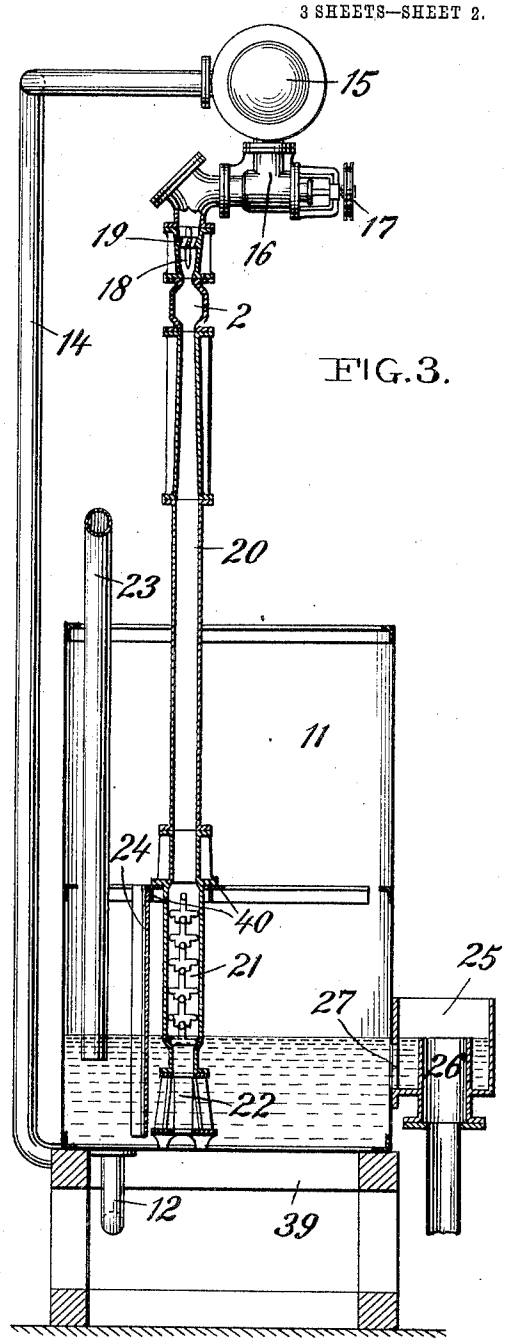



FIG. 3.

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3 SHEETS—SHEET 3.

FIG. 4.

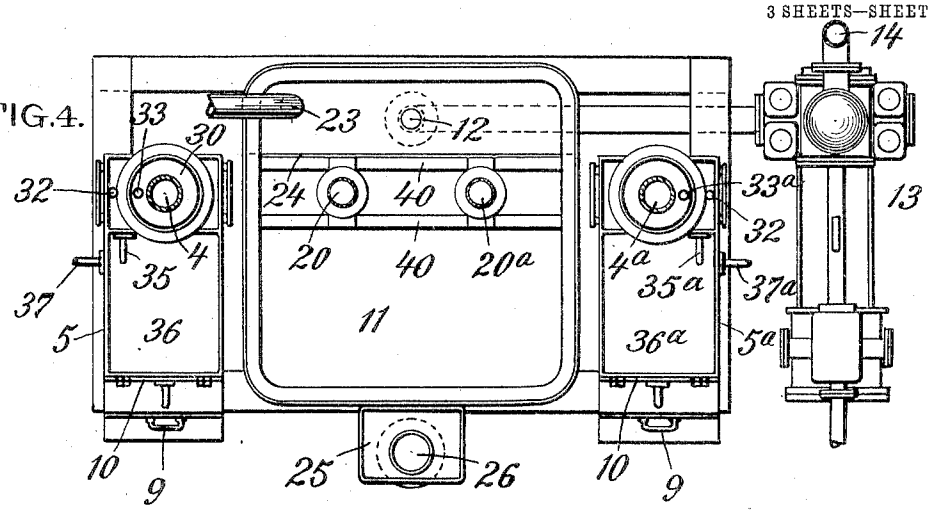
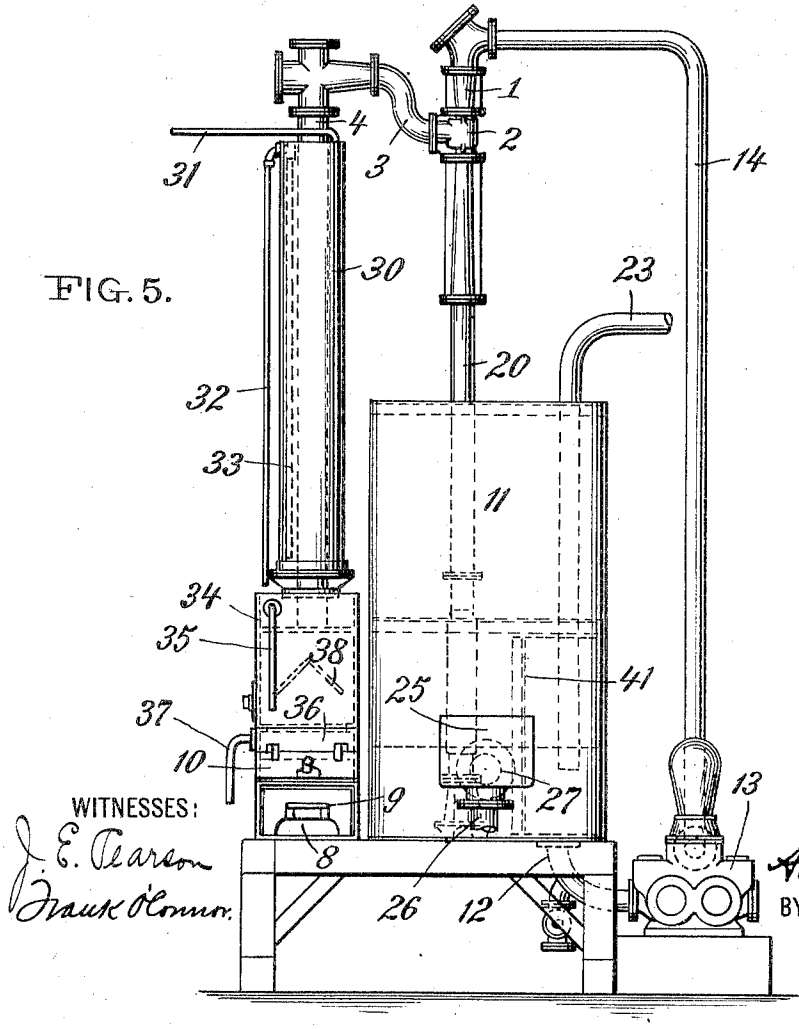



FIG. 5.




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No. 789,372. Patented May 9, 1905.

# UNITED STATES PATENT OFFICE.

ALFRED MAGUIN, OF CHARMES, FRANCE.

## APPARATUS FOR THE CONTINUOUS SULFURATION OF SUGAR-JUICES.

SPECIFICATION forming part of Letters Patent No. 789,372, dated May 9, 1905.

Application filed March 4, 1904. Serial No. 196,709.

*To all whom it may concern.*

Be it known that I, ALFRED MAGUIN, a citizen of the Republic of France, residing at Charmes, France, have invented an Apparatus for the Continuous Sulfuration of Sugar-Juices, of which the following is a specification.

My invention relates generally to the intermingling of fluids and gases in an intimate mixture by a continuous process; and, more specifically, it consists of improved means for charging the sugar-juices employed in the manufacture of beet and other sugars with the necessary amount of sulfurous-acid gas. As is well known, it is customary in this industry to mix a certain proportion of this gas with the fluid juices for the purpose of rendering them less viscous and bleaching or cleansing them. It makes the crystallization of the mass easier and produces whiter and more brilliant crystals. Heretofore it has been customary to produce this treatment by driving compressed air through furnaces in which the sulfurous-acid gas is being produced and thence into the boilers where sugar-juices are being heated. This method of treatment has certain disadvantages comprising the production of a considerable quantity of sulfuric acid which is injurious to the apparatus, especially the valves, and some of which escapes into the open air and is injurious to the workmen, the possibility of ruining a charge of the sugar-juice by subjecting it to the action of an excess of sulfurous-acid gas, the same being generated in large quantities and in contact with a large body of the sugar-juice at all times, and also the large cost and the bulkiness of the apparatus required. I have invented an improved form of apparatus which avoids these difficulties and operates continuously without necessitating shutting down for discharging and recharging the sugar-juice.

The preferred form of apparatus embodying my invention is illustrated in the accompanying three sheets of drawings, in which—

Figure 1 is a side elevation of a duplex apparatus with some parts broken away in the right-hand portion. Fig. 2 is a section of the apparatus shown in Fig. 1 on line 2 2 thereof. Fig. 3 is a section of the same apparatus on line 3 3 of Fig. 1. Fig. 4 is a horizontal section on line 4 4 of Fig. 1. Fig. 5 is a side elevation of a machine having half the capacity of the one shown in the other figures of drawings.

Throughout the drawings like reference-figures indicate like parts.

1 $1^a$ indicate injectors whose suction-chambers 2 $2^a$ are connected by pipes 3 $3^a$ and standpipes 4 $4^a$ with sulfur-burning furnaces 5 $5^a$. Each sulfur-furnace, as clearly shown in Fig. 2, has a pan 6, in which the sulfur may be burned after ignition by opening the door 10, and the combustion-chamber in which the pan is placed is connected with the drying-chamber 7 through the opening $7^a$. This drying-chamber contains a quantity of lime or other similar material carried on a perforated tray 8, which may be withdrawn by handle 9 for recharging, &c.

11 is a tank of considerable height and capacity mounted on the base 39 or other suitable support and having the outlet-pipe 12, which leads to the intake of the pump 13. The discharge end of said pump is connected by the pipe 14 to the drum 15, from which the two injectors are fed by means of the connections 16 $16^a$, controlled by the valves 17 $17^a$. The injector-nozzle is controlled by the needle 18 in the usual manner, and in order to produce a whirling action of the fluid discharged from the injector-nozzle I provide a series of helical passage-ways 19, through which said material is forced in passing through said nozzle. (See Fig. 3.) The fluid discharged through the injector-nozzle and the gas drawn into the suction-chamber 2 by the action of said jet are of course intermingled and passed down through the discharge-pipes 20 $20^a$. In order to insure a more complete mixture, I employ the mixing-chamber 21, which comprises a series of deflecting passage-ways formed by the series of baffle-plates therein shown or by other well-known means. The mixture after leaving the mixing-chamber is discharged, through the cages 22 $22^a$, into the lower portion of the tank 11.

23 is a pipe leading from that portion of the plant where the sugar-juices are pro-

duced and discharging the same into the bottom of the tank 11 in the small chamber formed to the left of the partition 24, (looking at Fig. 3.) This partition reaches nearly to the bottom of the tank, but leaves a narrow space through which communication may be had between the two chambers or sections of the tank thus formed. It will be noticed that the suction connection to the pump also leads out of the first-mentioned chamber. An overflow-receptacle 25 is attached to the tank at a point remote from the inlet and other connections to said tank and is provided with a discharge-pipe 26. This receptacle 25 is left open to enable the operator to see and test the contents and is connected with the second of the before-mentioned chambers of the tank 11 by a passage-way 27, located below the fluid-line.

28 is a discharge connection from pipe 12, controlled by the valve 29.

30 30ª are jackets respectively surrounding the stand-pipes 4 4ª and filled with a constantly-moving body of cold water supplied through the inlet-pipes 31 31ª and removed through the outlet-pipes 32 32ª, the portion 33 of which inside of the jacket extends nearly to the bottom thereof, so as to insure the complete circulation of the water through said jacket. The outlet-pipes 32 32ª discharge into the water-pans 34 34ª, located on top of the higher portion of the sulfur-furnaces, and from thence the water is discharged by the pipes 35 35ª to the water-pans 36 36ª, one of which is on the lower part of each sulfur-furnace directly over the combustion-chamber. From these pans it is discharged by the pipes 37 37ª.

38 38ª are deflecting-plates located in the upper portion of the sulfur-furnaces.

The discharge-pipes 20 20ª and the mixing-chambers at the lower ends thereof are supported in any convenient way, as by means of the angle-irons 40 40, extending across the interior of the tank. (See Fig. 4.)

The apparatus shown in Fig. 5 is in all respects similar to that shown in the first four figures of the drawings except that it has only half the capacity thereof, having a single circulating system, while the other apparatus is duplex, having two complete circulating systems. The inlet-pipe 23 and the outlet-pipe 12 connect with a chamber or section of the tank 11, formed by the partition 41, shown in dotted lines, which fences off a small portion of the tank interior for this purpose in the same manner as does the partition 24. (Shown in Fig. 3.)

The method of operation of my invention is as follows: The necessary quantity of sugar-juice being discharged into the tank 11 to seal the inlet and outlet connections thereof, a quantity of sulfur placed in the pans 6 is ignited, the door 10 closed, and the pump 13 started up. The pump forces the sugar-juice up into the drum 15, from which it passes in regulated quantities, determined by the valves 17 17ª, to the injectors 1 1ª. Issuing from the nozzles of said injectors in the form of a whirling spray into the suction-chambers 2 2ª, it draws in the sulfurous-acid gases generated in the sulfur-furnaces and becomes intimately mixed therewith. The air drawn into the sulfur-furnace having passed over the lime in the drying-chamber 7 is devoid of moisture, and consequently in a condition to most readily combine with the sugar-juice. The mixture thus formed from the sugar-juice and the gases evolved from the burning sulfur is mechanically broken up and its uniformity still further increased by passing through the mixing-chambers 21 21ª and is then discharged into the larger chamber of the tank 11. Juice is continuously flowing through the pipe 23 into the smaller chamber of the tank and being continuously drawn therefrom through the pipe 12 and is continuously returned to the larger chamber through the cages 22 22ª. If the pump is run at a speed to draw out the juices faster than it is fed in through the pipe 23, it is evident that a portion of the supply for the pump must also come from the larger chamber, where the treated juice has been returned. Consequently said juice will be subjected two or more times to the mixing action of the injectors, according to the speed at which the pump is run. As all juice drawn from the tank is returned to it and an additional supply is continuously entering through pipe 23, it is evident that a body of treated juice will collect in the larger chamber of the tank and the level thereof will rise until the level of the same in the overflow-receptacle 25 reaches the opening in the draw-off pipe 26, when it will begin to flow through said pipe into any receptacle connected therewith. The operator can therefore by occasionally testing the liquid in the receptacle 25 by means of litmus-paper determine whether it has been properly acidulated, and by varying the speed of the pump and manipulating the valves 17 17ª he can rectify any tendency of the apparatus to mix too much or too little of the sulfurous-acid gas with the juice.

The gases generated in the sulfur-furnace are drawn upward by suction through the stand-pipes 4 4ª, and any dust particles drawn with them will settle back in the combustion-chamber by reason of the action of the baffle-plates 38 38ª. The constant current of cold water through the cooling-jacket and water-pans will cool down the gases of combustion to the proper temperature before they reach the injector. It will be observed that the water-jacket system is highly efficient, inasmuch as the coolest water comes in contact with the coolest gas and the warmer water in

the jacket touches the most heated portion of the gas chambers and conduits, thereby preserving the greatest difference of temperature between the gases and the adjacent water and producing the most efficient cooling action. The tank 11 may be emptied at any time by opening the valve 29.

The advantages of my invention are numerous. As before stated, the process is easily regulated by the simple method of varying the speed of the pump. Only a small portion of gas comes in contact with a small quantity of the sugar-juice at any one time, and consequently the excessive saturation of a large quantity of juice with the gas is impossible. If an excess of gas is being absorbed, it will be a gradual process and the tendency will be promptly discovered by occasional tests of the liquid in the overflow-receptacle and can be promptly checked before it has gone too far. This tendency is further reduced by the fact that the generation and supply of sulfurous-acid gas is automatically controlled by the amount of juice which is forced through the injector, and consequently when the injectors are once properly designed the apparatus is almost self-regulating. The gas being handled entirely through suction, there is no possibility of any of it escaping to the injury of the workmen and apparatus and loss of economy. The gas does not come in contact with any valves or other destructible apparatus. The most thorough intermingling of the juice and the gas is secured without consumption of power in mechanical agitation. The plant occupies but small space compared with the old system, and there is no loss of time through shutting down for discharging and recharging, the operation being continuous after once started.

It is evident of course that various changes could be made in the details of construction illustrated without departing from the spirit and scope of my invention. Other forms of sulfur-furnace might be substituted, and different arrangements of the injectors, the chambers in the tank, and various connections might be made. Other forms of mixing-chamber could be substituted for that shown, and the proportions of the various parts could be modified to suit varying conditions of different plants. All these modifications I should, however, still consider within the boundaries of my invention so long as the principles of operation herein disclosed were retained.

Having therefore described my invention, what I claim as new, and desire to protect by Letters Patent, is—

1. The combination of an injector, a source of sulfurous-acid gas connected to the suction-inlet of said injector, a reservoir of sugar-juice, a pump having its inlet connected to said reservoir and its discharge-outlet connected to the injector-nozzle, and connections from the discharge end of said injector back to the reservoir of sugar-juices.

2. The combination of an injector, a source of sulfurous-acid gas connected to the suction-inlet of said injector, a reservoir of sugar-juice, and a pump having its inlet connected to said reservoir and its discharge-outlet connected to the injector-nozzle, said injector-nozzle being provided with helically-arranged passages.

3. The combination of an injector, a source of sulfurous-acid gas connected to the suction-inlet of said injector, a reservoir of sugar-juice, and a pump having its inlet connected to said reservoir and its discharge-outlet connected to the injector-nozzle, a discharge-pipe for said injector, and a mixing-chamber connected thereto.

4. The combination of an injector, a source of sulfurous-acid gas connected to the suction-inlet of said injector, a reservoir of sugar-juice, and a pump having its inlet connected to said reservoir and its discharge-outlet connected to the injector-nozzle, a discharge-pipe for said injector, and a mixing-chamber connected thereto, said mixing-chamber discharging into the before-mentioned reservoir.

5. The combination of an injector, a source of sulfurous-acid gas connected to the suction-chamber of said injector, a reservoir of sugar-juice consisting of two chambers connected by a restricted passage-way, an inlet-pipe discharging into one chamber, an outlet-pipe for the same chamber, a pump to which the outlet-pipe leads, a connection from the discharge end of the pump to the injector-nozzle, and a discharge connection from the injector leading to the other chamber of the reservoir of sugar-juice.

6. The combination of an injector, a source of sulfurous-acid gas connected to the suction-chamber of said injector, a reservoir of sugar-juice consisting of two chambers connected by a restricted passage-way, an inlet-pipe discharging into one chamber, an outlet-pipe for the same chamber, a pump to which the outlet-pipe leads, a connection from the discharge end of the pump to the injector-nozzle, and a discharge connection from the injector leading to the other chamber of the reservoir of sugar-juice, said reservoir-chambers being closed to the atmosphere and all inlet and outlet connections being below the level of the fluid therein.

7. The combination of an injector, a source of sulfurous-acid gas connected to the suction-chamber of said injector, a reservoir of sugar-juice consisting of two chambers connected by a restricted passage-way, an inlet-pipe discharging into one chamber, an outlet-pipe for the same chamber, a pump to which the outlet-pipe leads, a connection from the discharge end of the pump to the injector-nozzle, and a

discharge connection from the injector leading to the other chamber of the reservoir of sugar-juice, together with an overflow-outlet for said second reservoir-chamber situated at a point remote from the injector discharge.

8. The combination with a source of sugar-juice and a source of sulfurous-acid gas, of means whereby said sugar-juice is caused to flow as a stream, and means for injecting sulfurous-acid gas into said stream while moving.

9. The combination with a source of sugar-juice and a source of sulfurous-acid gas, means for moving said sugar-juice as a stream and imparting a rotary motion to it, and means for injecting into said stream while moving a body of sulfurous-acid gas.

10. The combination of a sulfur-furnace, an injector, connections from said furnace to the suction-chamber of the injector, and means for forcing sugar-juices through the nozzle of the injector.

11. The combination of a sulfur-furnace, an injector, connections from said furnace to the suction-chamber of the injector, and means for forcing sugar-juices through the nozzle of the injector, together with means for cooling the sulfur-gases located between the furnace and the injector.

12. The combination with a source of sugar-juice and a source of sulfurous-acid gas, of means whereby said sugar-juice will be caused to move as a rotating stream, means for introducing into said stream while moving a body of sulfurous-acid gas, and means for agitating said mixed stream of sugar-juice and sulfurous-acid gas.

13. The combination of a sulfur-furnace, an injector, connections from said furnace to the suction-chamber of the injector, and means for forcing sugar-juices through the nozzle of the injector, together with air-drying means connected to the air-inlet of the furnace.

In testimony whereof I affix my signature in the presence of two witnesses.

ALFRED MAGUIN.

Witnesses:

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M. MEMENEL.