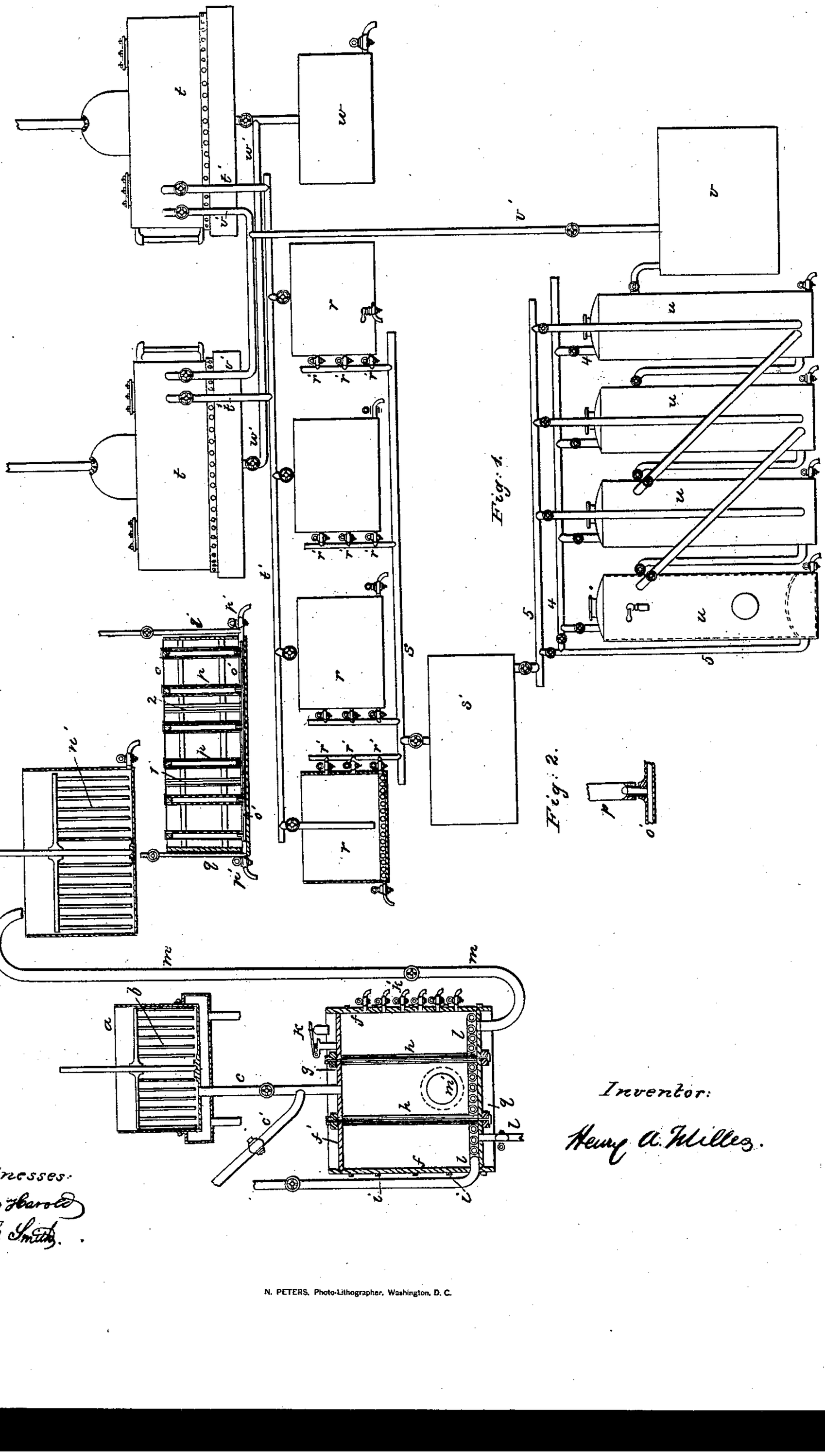
H. A. TILDEN.

Manufacture of Sugar from Corn.

No. 49,012. Patented July 25, 1865.



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UNITED STATES PATENT OFFICE.

HENRY A. TILDEN, OF NEW LEBANON, NEW YORK.

IMPROVEMENT IN THE MANUFACTURE OF SIRUP FROM CORN.

Specification forming part of Letters Patent No. **49,012,** dated July 25, 1865.

To all whom it may concern:

Be it known that I, HENRY A. TILDEN, of New Lebanon, in the county of Columbia and State of New York, have invented and made a certain new and useful Improvement in the Manufacture of Sirup from Corn and other Grains; and I do hereby declare the following to be a full, clear, and exact description of the said invention, reference being had to the annexed drawing, making part of this specification, wherein I have represented an apparatus in which to perform the consecutive operations of my process.

In the drawing I have shown an elevation of the apparatus generally, some of the parts being in section.

My invention relates to the consecutive operations performed for obtaining sugar from corn and other grains; and for the better understanding of my process I have represented an apparatus in which the various operations may be performed.

I will proceed to describe my process in the order of the several operations, and also describe the apparatus I employ.

The grain or corn-meal is mixed with water and steeped in a tub having a proper agitating apparatus, after which the same is to be passed through a pipe into the boiler below.

a represents the mixing-tub; *b*, the agitator; *c*, the pipe to the boiler *d*. *e* is a steam-jacket to heat the tub *a*.

The corn is boiled in a wooden vessel or any other suitably-constructed boiler, either stationary or rotary and capable of resisting a high pressure of steam; or the boiling may be done in a similar boiler which is exhausted by an air-pump kept in constant operation, with the necessary condensing appurtenances to form a vacuum and produce the saccharification at a low temperature.

The boiler *f* is made in a cylindrical form, of staves of wood, with heads *f'*, made also of wood, the sides and heads being sufficiently thick to withstand the pressure to which they are subjected.

g g are cross-pieces to aid in sustaining the heads, and *h h* are tie-bolts passing through hollow wooden columns in the boiler.

i i are hoops surrounding the boiler. They should be formed of rods or bars with screw ends taking nuts or shackles, by which the hoops may be tightened up to compensate shrinkage in the wood. By this construction there will be no metal to come in contact with the contents of the boiler. Should there, however, be any bolt-heads, they are to be covered with sheet-lead. A safety-valve is provided at *k*, try-cocks at *k'*, a steam-heating coil at *l*, which should be made of lead pipe, and a pipe at *l'*, through which water used for washing the boiler may be discharged; and *m* is a pipe by which the contents of the boiler are conveyed to the next part of the apparatus.

If desired, two or more boilers may be used in place of one, as they can be made stronger if of smaller size, and a thermometer is attached to each boiler in any usual way, and a manhole is to be provided at *m'* for giving access in cleaning.

c is a pipe to supply water or other liquid to the boiler.

The steam-coil *l* may be perforated, so that the steam, in passing into the mass, shall agitate it.

Into the boiler I put usually about twenty gallons of water to each one hundred pounds of corn, to which is added three to five pounds of sulphuric acid to each one hundred pounds of grain or corn.

The temperature of the acidulated contents of the boiler is raised to 212° by steam admitted through the steam-coil. The mash from the tub is then admitted gradually through the feeding-pipe *c*. The temperature should be maintained at the boiling-point while the mash is being fed in. I then close the feeding-pipe by shutting the cock or valve in the same and raise the temperature to 220°, or higher, adjusting the safety-valve on top, so as to maintain a uniformity of pressure and temperature until the grain is completely saccharified. I ascertain when the saccharification is complete by drawing from the cock nearest the bottom of the tub a small quantity and diluting it with water. To this I add a few drops of iodine dissolved in alcohol, and if it shows no deeper color than when the same quantity is added to water I regard the operation complete. I then open the valve in the pipe *m*, and, if necessary, increase the pressure, so as to force the contens through the said pipe, *m*, into a tub, *n*, which is for neutralizing the mass.

The neutralizing-tub *n* is capable of holding twice the quantity treated in the boiler, and

is provided with a proper agitating apparatus, *n'*. As the contents of the boiler flow in I put in motion the agitating apparatus, and for the purpose of neutralizing the free acid I add gradually, in direct contact with the stream flowing in, carbonate of lime mixed with water, or carbonate of baryta, in sufficient quantity to nearly neutralize the free acid; or I sometimes add lime to complete the neutralization. I ascertain this point by the action of the liquid upon blue litmus-paper. When the neutralization is complete, or nearly so, I add hydrated alumina and thoroughly mix by keeping the agitating apparatus in motion for about an hour. I have ascertained that hydrated alumina at this stage of the process acts upon the pasty mass to precipitate the coloring and vegetable matter and render its filtration or drainage much easier and more perfect.

I then pass the contents of the tub *n* into a drainer, which is so constructed as to be converted at will into a vacuum or gravity drainer. I allow it to run in until the frames are coated, and as soon as it runs clear conduct the clear sirup into the clarifying-cisterns.

The drainer which I employ is made of wood in the form of a vat, *o*, perfectly tight. Through the ends and along the bottom is a pipe, *o'*, containing sockets to receive the thimbles at the bottom of the filter-frames *p*, (see detached Fig. 2,) which filter-frames are rectangular and of wood, fitted with slats of galvanized iron about two inches apart. In the lower part of the frames grooves are formed, to conduct the filtered sirup to the thimbles entering the socket in the pipe *o'*. The frames are covered with canvas, or woolen cloth, or any fitting substance.

Outside the box and at each end are two pipes, *q' q'*, connected with the pipe *o*, and leading to a receiver exhausted by an air-pump for the purpose of exhausting the air, and by the pressure of the atmosphere facilitate the drainage. The liquid drawn from the vat *o* is to be received into a suitable vessel that is exhausted by the air-pump, and thence allowed to run into the clarifying-vats *r r;* or, where the drainage is effected by gravity, the cocks *p'* may be opened to let the sirup run directly into these vats *r*.

Removable divisions are provided at 1 and 2 across the draining-vat *o*, so that part of the apparatus may be used for draining while the other part is being cleaned out.

A metallic case is provided for each filter-frame. It is closed at top and open at bottom, as seen in the drawing, and sets over said filter-frame; hence when the apparatus is exhausted of air the pressure causes the sirup to rise within these cases and filter through the whole surface until the contents of the vessel *o* are exhausted, or nearly so. When the mass in the vat *o* has drained nearly dry I close the cocks *p'* in the pipe *o* and fill the drainer-box with warm water, and again draw off the clear sirup, and repeat the washings until the sirup is entirely removed, keeping the weak sirup for washing the next drainer. The pulpy mass is then let out by plugs in the bottom of the filter and the filter washed out.

The clarifying-vats *r r* may be constructed of wood or boiler or galvanized iron, having a steam-coil or steam-jacket to heat them, and cocks *r'* and pipes connect with the main pipe *s* to the receiving-cistern *s'*. The cocks *r'* are about eight inches apart vertically. I clarify the sirup as it comes from the drainer, or else concentrate it to about 20° Baumé, depending upon circumstances and strength of the sirup as it leaves the drainer. If I concentrate before clarifying, I draw the sirup into the vacuum pan or pans *t* by pipes *t'*, provided with cocks, as shown, and concentrate to the desired specified gravity, and then let it into the clarifying-vats *r*. In either case the process of clarifying is substantially the same.

I increase the temperature of the sirup in the clarifiers *r* to about 140°. I then add powdered animal-black in the proportion of about ten to twenty pounds to each one hundred gallons, of 10° Baumé. Skimmed or sweet milk or bullock-blood and milk of lime are to be added, the latter gradually, until a slight ammoniacal odor is evolved, and indicating by blue bitmus-paper a slight acid reaction, care being taken against any excess of alkali. I then immediately raise the temperature to the boiling-point and boil slowly, and skim until the impurities appear to cease to rise. I then shut off the steam and let cold water into the steam pipe or jacket to lower the temperature to 140° or 150° Fahrenheit. I then allow it to settle, and as soon as impurities have settled below any one of the cocks *r* that cock is opened and the clear sirup runs into the receiving-cistern *s'*. The sediment should be washed and the clean sirup, if weak, should be used instead of water in the drainer *o*.

When I desire to completely remove the sulphate of lime in solution, I treat the sirup in the cistern *s'* or other vessel, first, with hydrate of baryta in sufficient quantity to precipitate the sulphuric acid of the sulphate of lime, and, second, the lime and excess of baryta and precipitate in the same by carbonic-acid gas obtained from the saturation of the primitive liquor with carbonate of lime, or by carbonic-acid gas introduced by an apparatus specially provided for that purpose. It is then passed through the animal-black filters.

For decolorizing the sirup I boil it with hydrated alumina in the cistern *s'* or other vessel, and then pass it through animal-black in the filters *u u*, or pass it directly from the cistern *s'* through the filters, depending upon the object to be attained. The sirup is admitted from the cistern *s* through the pipe 3, and by the pressure is forced upward through the animal-black in the first filter *u*. Thence it passes to the second filter, then upward through the animal-black in the second, and so on through such number of the series as may be necessary

to produce a colorless sirup; or it can be stopped at any one of the filters, depending upon the quality of the sirup desired; and it is thence conducted to a cistern, *v*, from which it is drawn by the pipe *v'* into the vacuum pan or pans *t* and concentrated to any desired density, usually 36° to 40° Baumé. The sirup should be kept at a temperature of 140° to 160° by a steam-coil in the bottom of the filter, as sulphate of lime is less soluble in hot than cold water.

The decolorization can be effected by any of the ordinary filters; but the advantages of the filters here described are that the precipitated sulphate of lime in suspension, together with the impurities, deposit in the lower part of the filter in a chamber left beneath a perforated diaphragm that supports the animal-charcoal, (see dotted lines,) and, instead of coating the upper surface and filling up the black, they settle from the diaphragm by their gravity and fall to the bottom and are readily drawn off.

The concentrated sirup from the vacuum-pans *t* is received into a vessel, *w*, through the pipes *w'*. By connecting the pipe *v'* to the filters they can be sucked nearly dry; or they may be washed out by hot water introduced through the pipe 4.

By the foregoing process sirup is produced directly from corn without it being necessary, as heretofore usual, to first remove the starch from the gum, albumen, gluten, and ligneous matter; hence the yield of sirup is much greater than heretofore, in consequence of forming glucose from these materials, instead of either removing or destroying them, as in the processes heretofore adopted.

What I claim, and desire to secure by Letters Patent, is—

Treating the entire grain of maize and other cereals so as to produce sirup, substantially as herein described.

In witness whereof I have hereunto set my signature this 28th day of March, A. D. 1865.

HENRY A. TILDEN.

Witnesses:

LEMUEL W. SERRELL,

CHAS. H. SMITH.