(No Model.) 3 Sheets—Sheet 1.

J. E. WEAVER.

PROCESS OF AND APPARATUS FOR MANUFACTURING SALT.

No. 303,348. Patented Aug. 12, 1884.

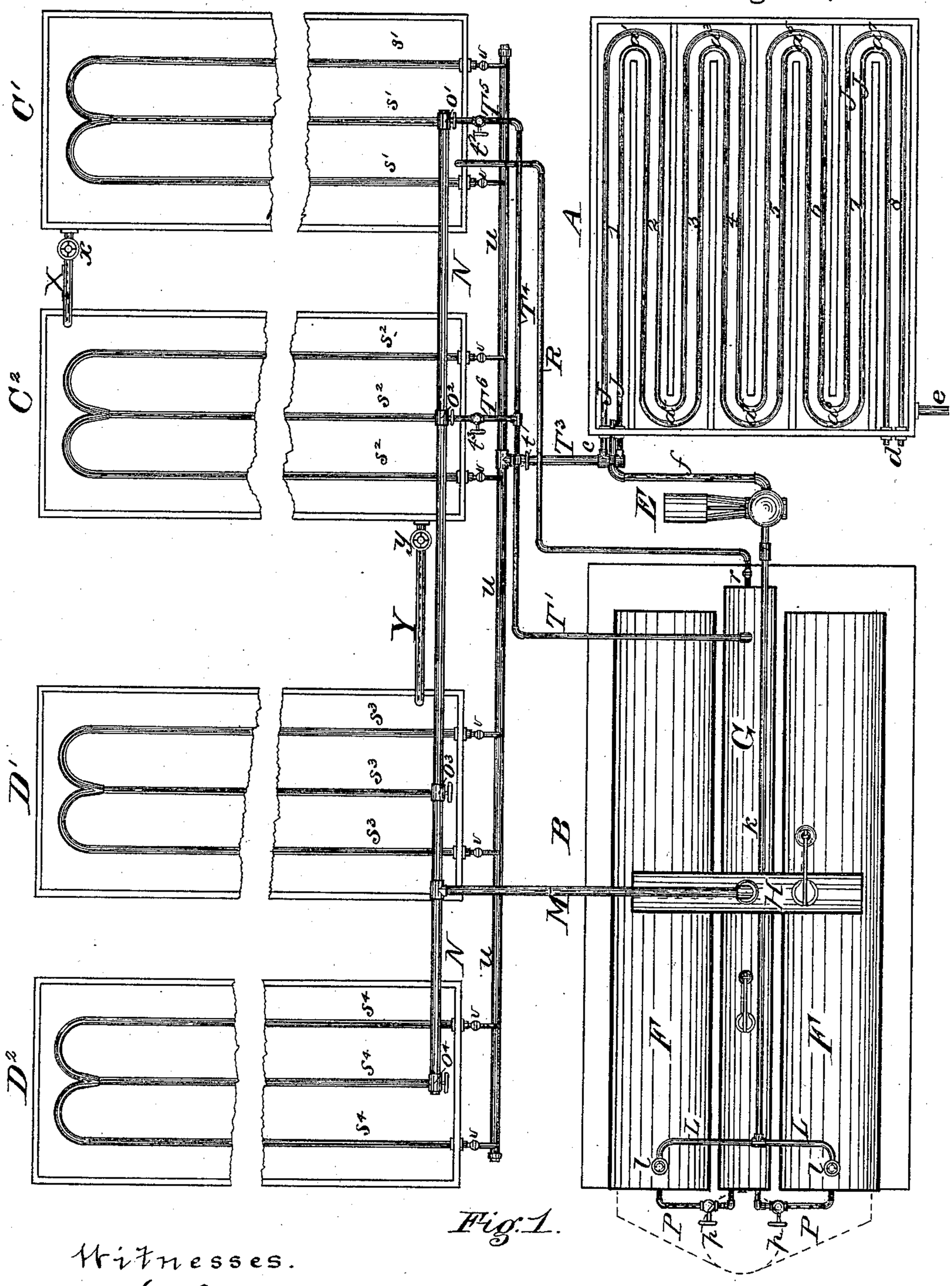

Fig. 1.

Witnesses.
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(No Model.) 3 Sheets—Sheet 2.

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Fig. 4.

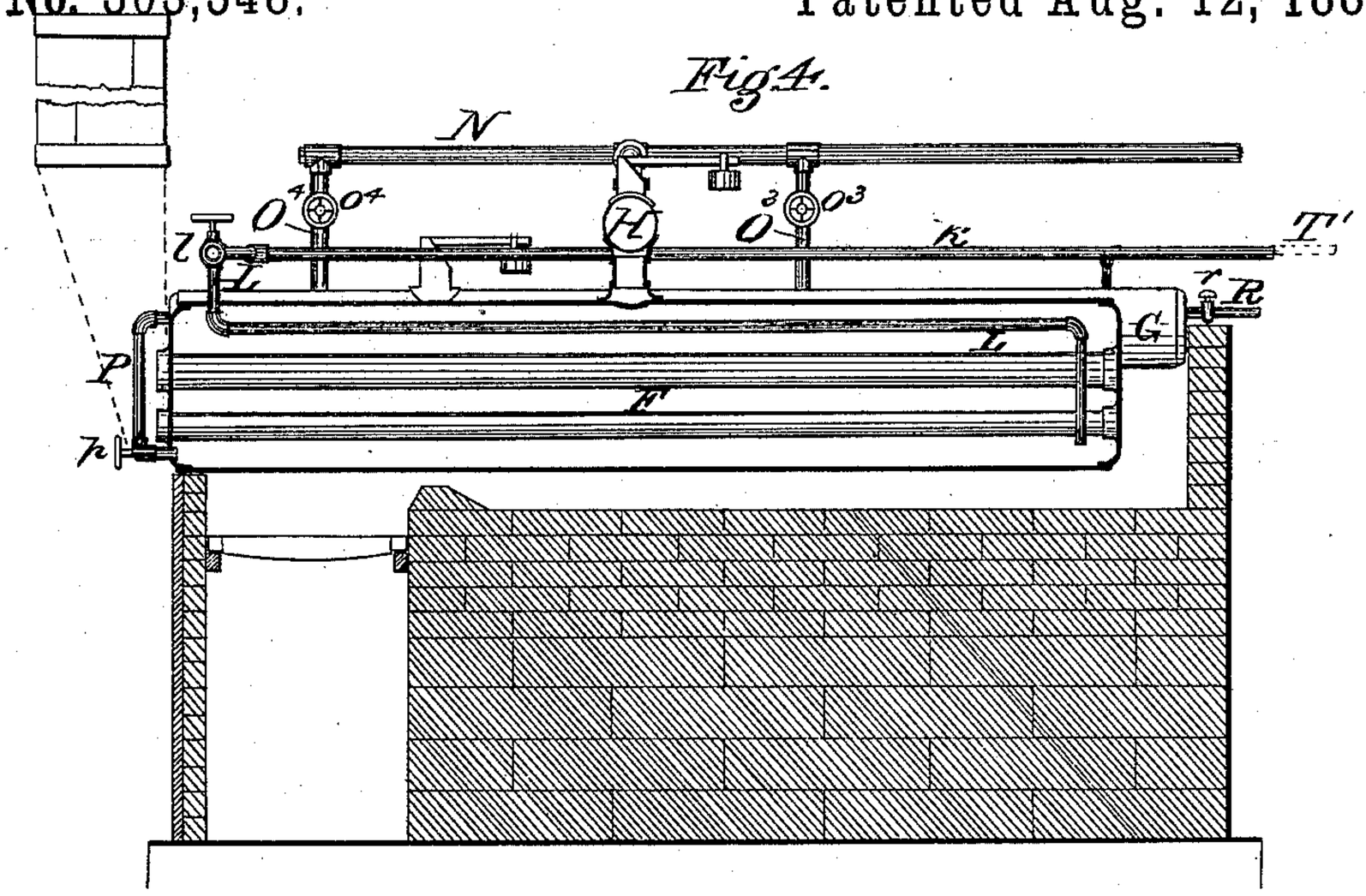
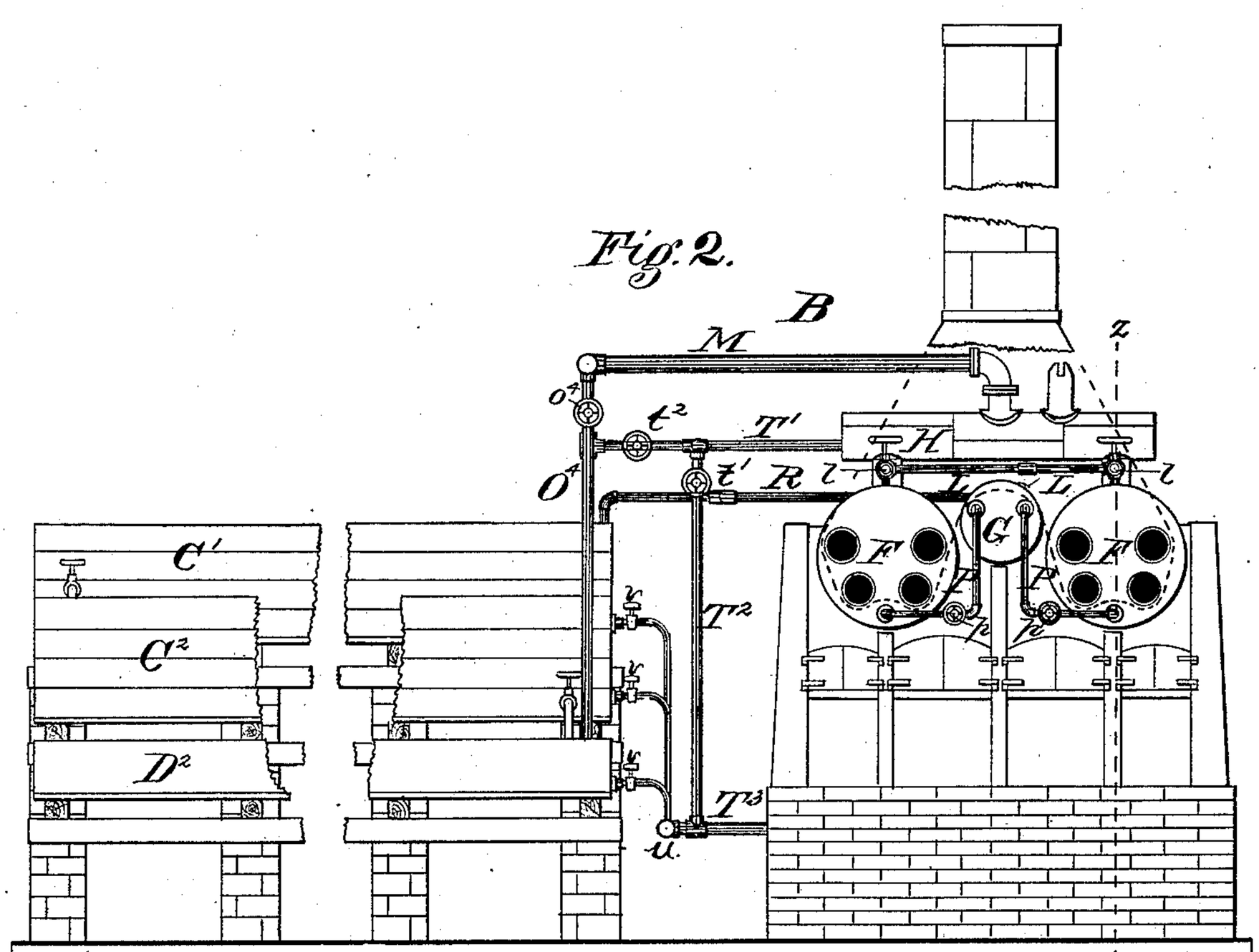


Fig. 2.



Witnesses
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(No Model.) 3 Sheets—Sheet 3.

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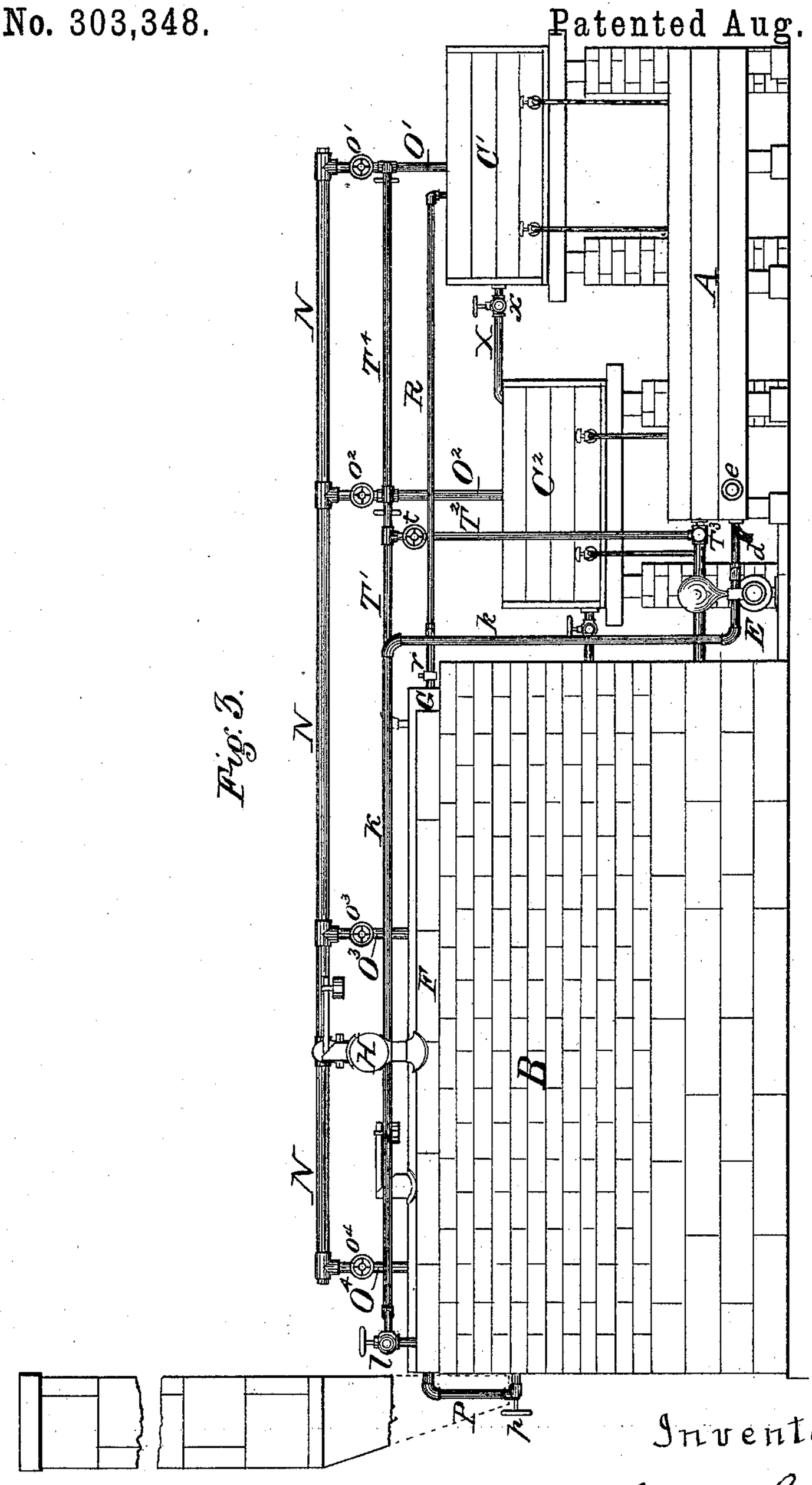

Fig. 3.

Witnesses,
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UNITED STATES PATENT OFFICE.

JAMES E. WEAVER, OF ALLEGHENY, PENNSYLVANIA.

PROCESS OF AND APPARATUS FOR MANUFACTURING SALT.

SPECIFICATION forming part of Letters Patent No. 303,348, dated August 12, 1884.

Application filed April 11, 1884. (No model.)

To all whom it may concern:

Be it known that I, JAMES E. WEAVER, a citizen of the United States, residing at Allegheny, in the county of Allegheny and State of Pennsylvania, have invented certain new and useful Improvements in the Process of and Apparatus for the Manufacture of Salt, of which the following is a specification.

The invention which is the subject of this application is an improvement upon the process and apparatus described in Letters Patent of the United States granted to me, No. 170,791, dated December 7, 1875, No. 180,441, dated August 1, 1876, No. 182,780, dated October 3, 1876, and No. 241,257, dated May 10, 1881.

The art of manufacturing salt from natural brines such as are obtained from borings into the earth in many parts of the United States is in the main simply a process of evaporating the water from the brines by artificial heat until the salt granulates and falls to the bottom of the vessel containing the liquid. In doing this the great objects are economy in the process and purity of the salt obtained. It is also of advantage to be able to produce the salt of any fineness or grain desired.

To enable others to make and use my improvement, I will proceed to describe it.

Figure 1 is a top view or plan of my apparatus. Fig. 2 is a front end elevation of the same. Fig. 3 is a side elevation of said apparatus. Fig. 4 is a vertical longitudinal section taken in the plane of the line *z z*, Fig. 2.

The part marked A, Figs. 1 and 3, is a wooden vat, called a "receiving-tank."

The part marked B, Figs. 1 and 3, is called the "battery," it being the part of my apparatus under which the fire is placed.

The parts marked C′ and C², Figs. 1, 2, and 3, are settling-vats, the one marked C² being sometimes called the "draw-settler."

The parts marked D′ and D², Figs. 1 and 2, are graining-vats. Said graining and settling vats are made of wood.

The part marked E, Figs. 1 and 3, is a steam-pump.

The receiving-tank, part A, Figs. 1 and 3, is divided into longitudinal compartments 1, 2, 3, 4, and 5, &c., as shown in Fig. 1, there being an opening, *a′*, of the width of one of the compartments and of the height of the tank at the one end of the first compartment, into the second, and a like opening, a^2, at the opposite end of the second, into the third, and so on throughout the series. Lines of pipe J J, entering at *c*, are laid near the bottom of said tank. They traverse the length of the first compartment and turn through the opening *a′* into the second, then traverse its length and turn through the opening a^2 into the third, and so on throughout the tank to the opening *d* outside of said tank. Steam from the chamber G of the battery B, hereinafter described, and the steam and hot water discharging from the heating-pipes of the settling-vats C′ C² and the graining-vats D′ D², enter these pipes J J at *c*, and pass along them to the place of discharge, *d*. The brine from the salt-well, entering by the pipe *e*, fills the tank, and then the whole body of the brine moves slowly through the compartments in the opposite direction to the flow of steam and hot water in said pipes, and passes out of the tank by the suction-pipe *f*, leading to the steam-pump E. While moving through the tank the brine takes up the heat of the steam and hot water in the pipes J J, and is raised thereby to a temperature approaching the boiling-point before entering the suction-pipe *f*, while, on the other hand, the steam and hot water entering said pipes at *c* are deprived of nearly all their heat before being discharged at *d*. By this method of heating the brine the greater part of the oxide of iron and other impurities contained in it are deposited on the bottom of the tank A, and thus not only prevented from discoloring and injuring the salt produced, but are also kept out of the settling and graining vats, where they are hurtful, and out of the battery, the action of which they retard, as sediment and scale retard the action of ordinary steam-boilers; and, further, by heating the brine in the tank A in the manner described, the heat of the vapor evolved from the brine in the chamber G of the battery, which has a temperature but slightly above the boiling-point, and the heat of the vapor and hot water discharged from the heating-pipes in the graining and settling vats are utilized. The battery B consists of two boilers, F F, and a chamber, G, Figs. 1, 2, 3, and 4. The boilers for

a salt-works composed of a single battery and other parts to correspond, having a capacity of fifty barrels of salt per day from an eight per cent. brine, may be about twenty-eight feet long, five feet in diameter, and should have four flues placed as shown in Figs. 2 and 4, for convenience in cleaning. The chamber G, which is a cylinder-boiler without flues, may be about thirty feet long and two feet six inches in diameter. Grate-bars and furnaces of the ordinary forms used for steam-boilers are employed under the battery. The flame of the fire passes from the grate-bars back along the under surfaces of the boilers and of the chamber, and then comes forward through the flues of the boilers to the smoke-stack. The boilers and chamber should be made of steel, and have the strength and tightness of the ordinary steam-boilers. Both boilers and chamber are supported by hangers attached to beams or other supports. (Not shown in the drawings.) The boilers are connected together by a steam-drum, H, and its legs. Upon the steam-drum H are the ordinary steam-gage and safety-valve. Each boiler is provided with the usual gage-cocks, man-hole, &c.

The brine is fed into the boilers from the pump E through the pipe K (shown in Figs. 1, 3, and 4) and its branches L L. (Shown in Figs. 1, 2, and 4.) Valves *l l* on the branches L L regulate the flow of the brine into each boiler. From the boilers the brine passes through the pipes P P to the chamber G. These pipes leave the boilers near the bottom and enter the chamber near its top, and have upon them valves *p p*, to control the flow of the brine from the boilers to the chamber G. The pressure of steam in the boilers forces the brine into the chamber. The brine leaves the chamber by the pipe R, attached to it above its center, and enters the settling-vat C′. Stop-cock *r* on this pipe controls the flow of the brine. Steam-pipes T′, Figs. 1, 2, 3, and 4, T^2, Figs. 2 and 3, and T^3, Figs. 1 and 2, carry the steam evolved in the chamber G to the pipes J J in the tank A, already described. A valve, *t*, on the pipe T^2, Figs. 1, 2, and 3, controls the flow of the steam from the chamber into pipes J J.

From the drum H of the boilers F F a steam-pipe, M, (shown in Figs. 1 and 2,) conducts the steam created in the boilers to the pipe N, which, with its branches O′ O^2 O^3 O^4, Figs. 1 and 3, conducts said steam to the heating-pipes *s′* s^2 s^3 s^4 in the settling and graining vats C′ C^2 D′ D^2. Valves *o′* o^2 o^3 o^4 regulate the flow and pressure of steam in the heating-pipes of the settling and graining vats. The pipe T, which conducts the steam from the chamber G to the pipes J J in the tank A, is extended, T^4, and has branches T^5 T^6, which connect with the pipes O′ O^2, leading to the heating-pipes in the settling-vats *c′* c^2, so that, when it is of advantage to do so, steam can be used from the chamber G in the heating pipes in the settling-vats. Valves t^2 t^3, Fig. 1, control the flow. The settling-vats C′ C^2 and graining-vats D′ D^2 are constructed in the usual way. The heating-pipes in the graining-vats should be of copper, those in the settling-vats may be of galvanized iron. At the discharges of these heating-pipes are placed stop-cocks or steam-traps *v v*, to check the discharge from them. All the steam and hot water coming from these heating-pipes are carried by the pipes *u* and T^3 to the pipes J J in the tank A, as already stated. The pump E, Figs. 1 and 3, may be of any convenient form, but should have its water-cylinder or plunger-barrel lined with brass or other material not readily destroyed by the corrosive action of the salt-water. Steam to operate it is taken from the drum H of the boilers F F by a suitable pipe. (Not shown in the drawings.)

The operation of the foregoing-described apparatus is as follows: The tank A is filled and the boilers F F and the chambers G are each filled above the second gage-cocks with brine. Fire is then started in the furnace, and as soon as the steam-gage on the chamber G indicates a slight pressure the valve *t′* on the pipe T^2, Figs. 2 and 3, is partially opened and the steam evolved in the chamber G let into the pipes J J of the tank A; and when the steam-gage on the drum H of the boilers indicates a sufficient pressure the pump E is started and begins forcing the brine into the boilers F F from the tank A. At the same time the valves *p p* on the pipes P P are opened slightly, and the brine begins flowing from the boilers to the chamber, and the stop-cock *r* on the pipe R, Figs. 1, 3, and 4 being opened, the brine begins flowing from the chamber G to the settling-vat C′. When the vat C′ is partially filled with the brine, valve *o′* on the branch pipe O′, Figs. 1 and 3, leading to the heating-pipes S′ S′ S′ in the settling-vat C′, is opened, and steam from the boilers F F begins evaporating the water from the brine therein. The waste steam (if any) and hot water from the heating-pipes in vat C′ pass through the pipes *u* and T^3 to the pipes J J in the tank A. When the brine in the settling-vat C′ has been brought to or nearly to the point of saturation, a valve, *x*, on a pipe, X, leading from vat C′ to vat C^2, Figs. 1 and 3, is opened and the brine allowed to fill the latter. When it has been sufficiently settled in this vat, the valve *y* on the pipe Y, leading to the graining-vat D′, is opened and the brine allowed to flow into that vat. The valve o^3 on the pipe O^3 is opened, and the steam from the boilers F F enters the heating-pipes S^3 S^3 S^3 of the graining-vat D′. The boiling of the brine in the vat D′ is proceeded with until the salt has granulated and fallen to the bottom of the vat. The pipes *u* and T^3 carry the waste steam and hot water from the heating-pipes S′ S′ S′ S^2 S^2 S^2 S^3 S^3 S^3 S^4 S^4 S^4 to the pipes J J in the tank A. The whole apparatus being in operation, the brine is flowing into the receiving-tank A, is being heated therein, and is depositing the greater part of its impurities, is being forced by the pump E into the boilers F F; thence by the

pressure in said boilers to the chamber G; thence is flowing into settling-vat C′, thence at intervals to vat C^2, thence at intervals to vat D′. The steam evolved from the brine while in the chamber G and the steam and hot water discharging from the heating-pipes in vats C′ C^2 D′ are heating the brine in tank A, and the steam evolved from the brine while in the boilers F F is heating the brine in vats C′ C^2 D′ D^2, all simultaneously and continuously. Vat D^2 is to be used alternately and concurrently with and in the same manner as vat D′.

The pressure and consequently the temperature of the steam evolved from the brine in the boilers F F may be varied at the will of the operator, and a high pressure and temperature may be maintained in the boilers and the steam used in that condition in certain of the vats, while at the same time, by partially closing the valves leading to the heating-pipes in other of the vats, a low temperature of the steam may be had in those vats. Thus one graining vat may be evaporated rapidly and fine salt made, while another is evaporated slowly and coarse salt made. From thirty to fifty pounds is about the proper range of steam-pressure for said boilers in the ordinary operation of the works. From one to three pounds is a proper pressure to maintain in said chamber, since the steam from it is used to heat the brine below the boiling-point only. By reason of the difference of pressure in the boilers and in the chamber, a considerable quantity of the water in the brine vaporizes as it is discharged into the chamber, the quantity being proportional to the difference in the pressure.

I do not confine myself to the precise construction of the apparatus herein described. I might, for instance, employ three boilers and two chambers in one battery. Ordinarily a works will consist of two or more batteries, with the receiving-tank and settling and graining vats in size and number to correspond. The advantage in having two or more batteries in one works is that when it becomes necessary to clean or repair the boilers one battery can be stopped and the others kept in operation, thus avoiding the cooling of the brine in the settling and graining vats. Whether one or a number of batteries are employed, I regard the size herein specified as the best to use.

Having thus described my improvement in process of and apparatus for manufacturing salt, what I claim as of my invention is—

1. In apparatus for manufacturing salt, the battery B, consisting of a combination of two or more boilers, F F, and one or more chambers, G, placed in relation to the fire and to each other, and the pipes K, L L, P, M, N, O′ O^2 O^3 O^4, R, and T′ T^2 T^3, connecting said boilers and chambers together and to other apparatus, and the valves *l p r o′ o² o³ o⁴ t′ t²* upon said pipes, controlling the operation of said boilers and chambers, all constructed substantially and operated as herein described.

2. The apparatus for manufacturing salt herein described, consisting of the combination of the receiving-tank A, the steam-pump E, the battery B, the settling and draining vats C′ C^2 D′ D^2, and the pipes and valves connecting and controlling the operation of the whole, and all being constructed and intended to be operated substantially as hereinabove set forth.

3. In the manufacture of salt, the operation of heating the brine in a battery consisting of two or more boilers and one or more chambers, placed in relation to the fire and to each other and connected and operated substantially as herein set forth, the brine being first, by means of a steam-pump, forced into said boilers, where a portion of the water present is converted into steam under pressure, and being then, by means of said pressure, forced into said chamber or chambers, where another portion of the water in said brine is converted into steam under a slight pressure, and being then conducted to other apparatus for further heating and manipulation, and using the steam evolved in said boilers and chambers to do heating in other stages of the work.

4. The herein-described process of manufacturing salt, consisting of first heating the brine in a receiving-tank divided into compartments and supplied with steam-heating pipes, as herein set forth; then, by means of a steam-pump, forcing it into the boilers of a battery consisting of two or more boilers and one or more chambers, placed in relation to the fire and to each other and connected and operated as herein set forth, and heating it in said boilers and converting a portion of the water present to steam under pressure; then, by means of said pressure, forcing said brine into the said chamber or chambers, and there further heating it and converting another portion of the water in it to steam under slight pressure; then conducting said brine to a settling vat or vats, and there further heating it; then conveying it to a graining vat or vats, and there further heating it until the salt granulates, and using the steam evolved in the said boilers to do the heating required in the said settling and graining vats, and using the steam evolved in said chamber or chambers and the steam and hot water discharged from the heating-pipes in said settling and graining vats to do the heating required in the said receiving-tank.

In testimony that I claim the foregoing as my own I affix my signature in the presence of two witnesses.

JAMES E. WEAVER.

Witnesses:

HARVEY THOMPSON,

A. CUMMINS.