(No Model.)

5 Sheets—Sheet 1.

H. WILLIAMS & J. L. & L. R. ALBERGER.

APPARATUS FOR THE MANUFACTURE OF SALT.

No. 400,983. Patented Apr. 9, 1889.

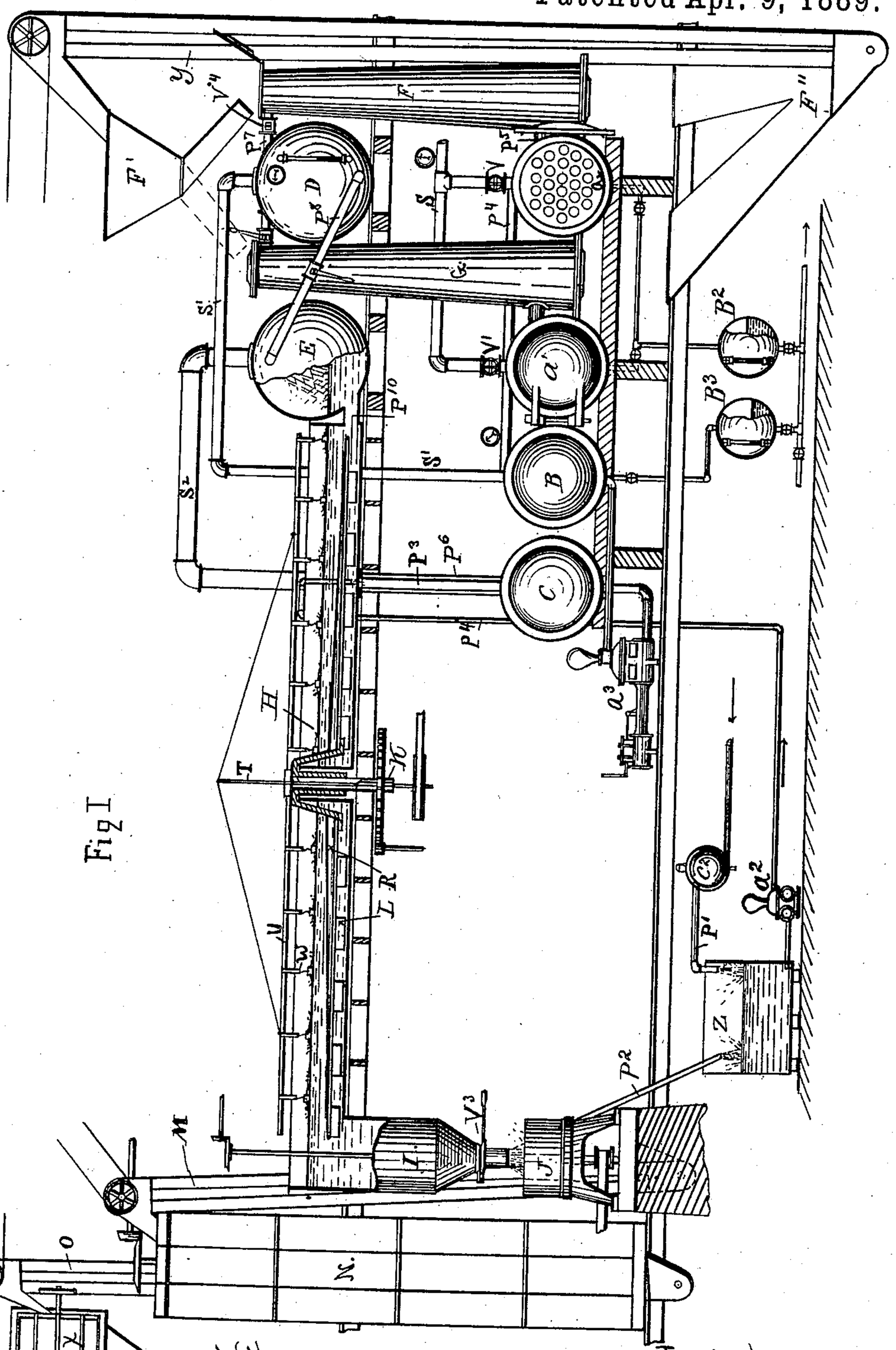

Fig I

Witnesses.
Alvan H. Alberger.
Byron M. Shultz.

Inventors.
Horace Williams
John L. Alberger.
Louis R. Alberger.

(No Model.) 5 Sheets—Sheet 2.

H. WILLIAMS & J. L. & L. R. ALBERGER.

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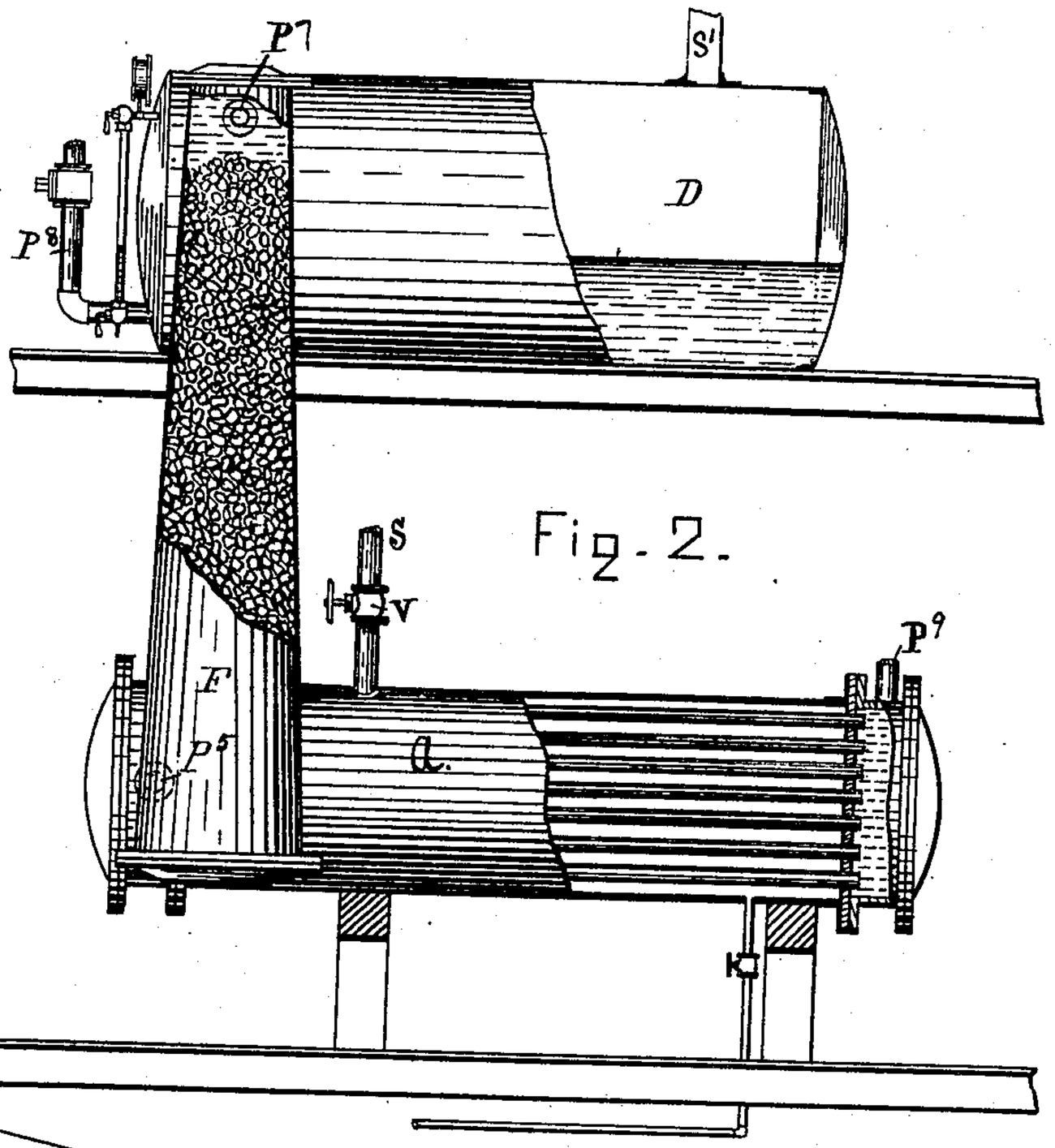

Fig. 2.

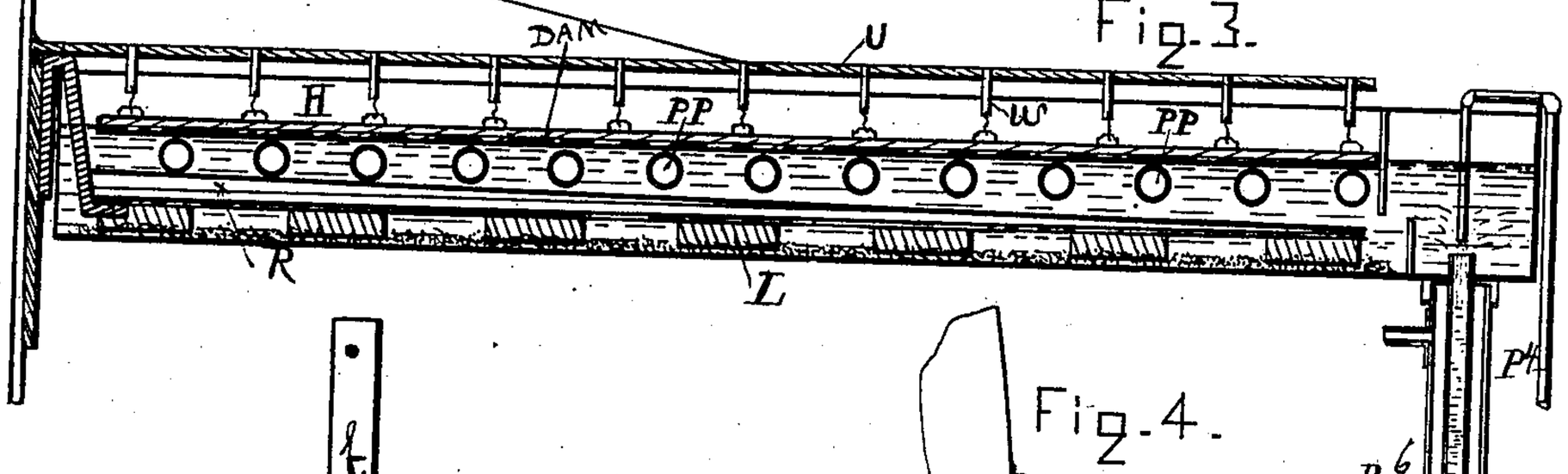

Fig. 3.

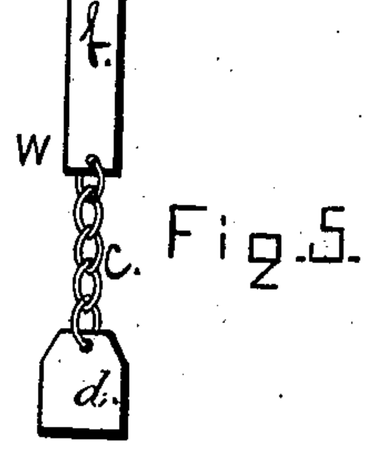

Fig. 5.

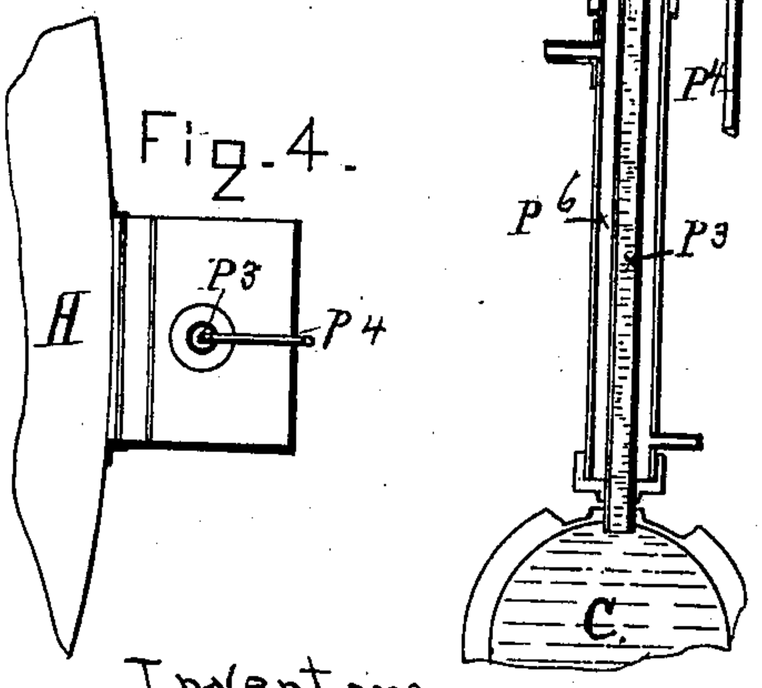

Fig. 4.

Witnesses.
Alvan H. Alberger
Byron M. Shelby

Inventors.
Isaac Williams
John L. Alberger
Louis R. Alberger

(No Model.) 5 Sheets—Sheet 3.

H. WILLIAMS & J. L. & L. R. ALBERGER.

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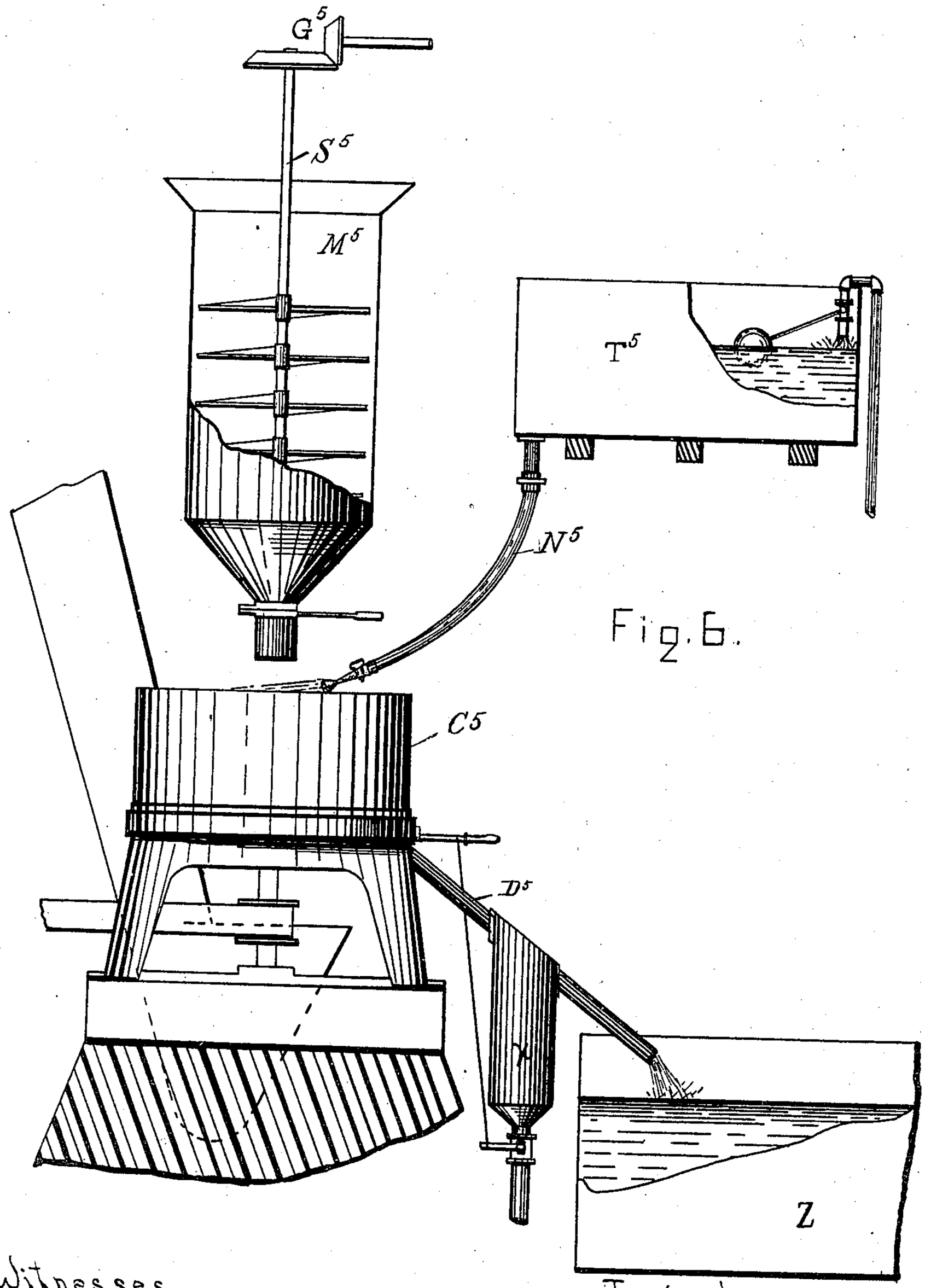

Fig. 6.

Witnesses.
Abram H. Alberger.
Byron M. Shultz

Inventors.
Harry Williams
John L. Alberger
Louis R. Alberger.

(No Model.) 5 Sheets—Sheet 4.

H. WILLIAMS & J. L. & L. R. ALBERGER.

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Fig. 9

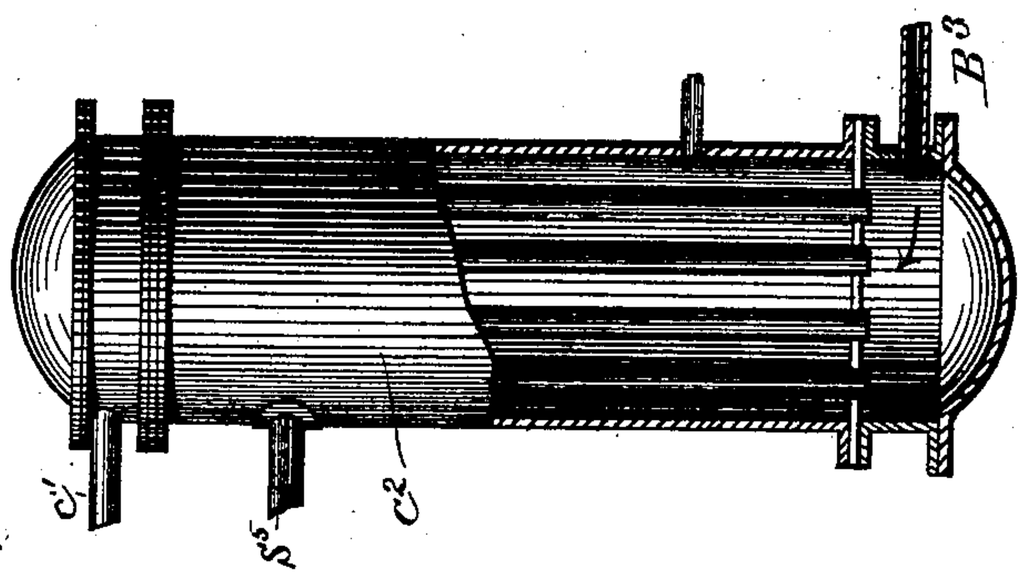

Fig 8

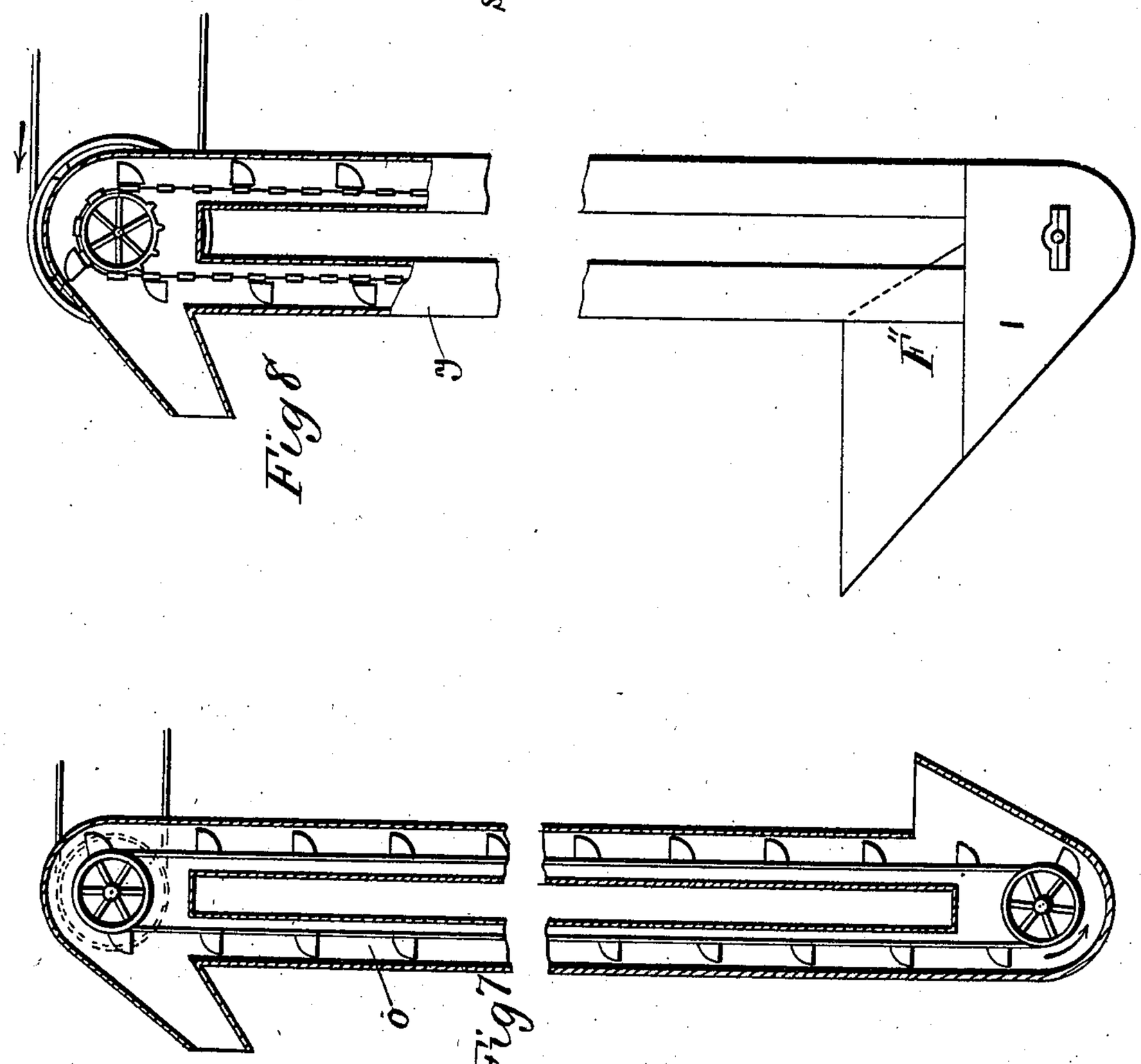

Fig 7

Witnesses.
John Mason.
Johan Larsen.

Horace Williams. Inventor
John L. Alberger
Louis R. Alberger.
per J. L. Alberger atty.

(No Model.)

5 Sheets—Sheet 5.

H. WILLIAMS & J. L. & L. R. ALBERGER.

APPARATUS FOR THE MANUFACTURE OF SALT.

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Fig 10

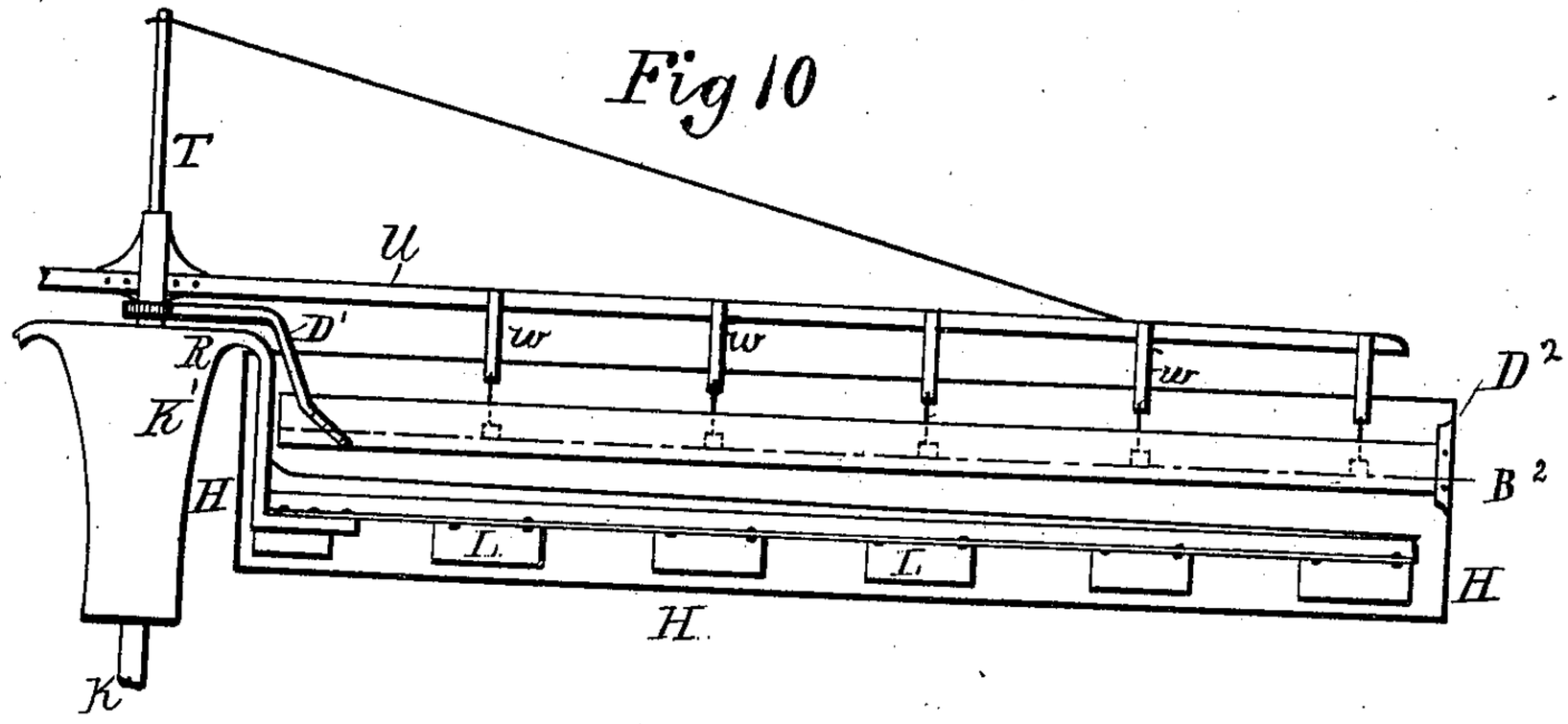


Fig 11.

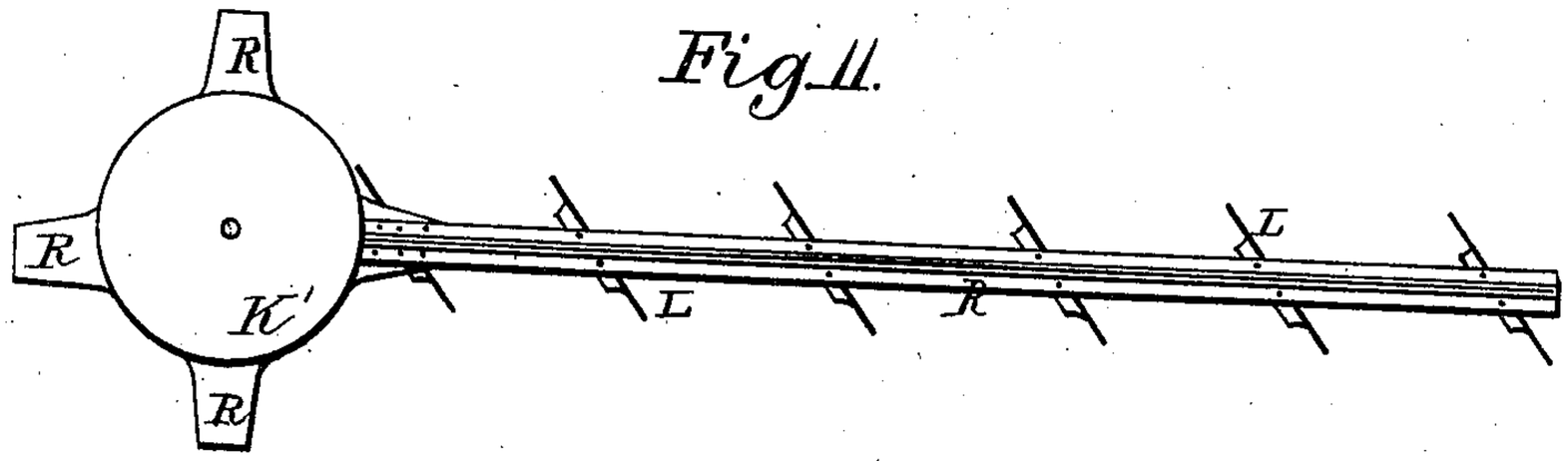
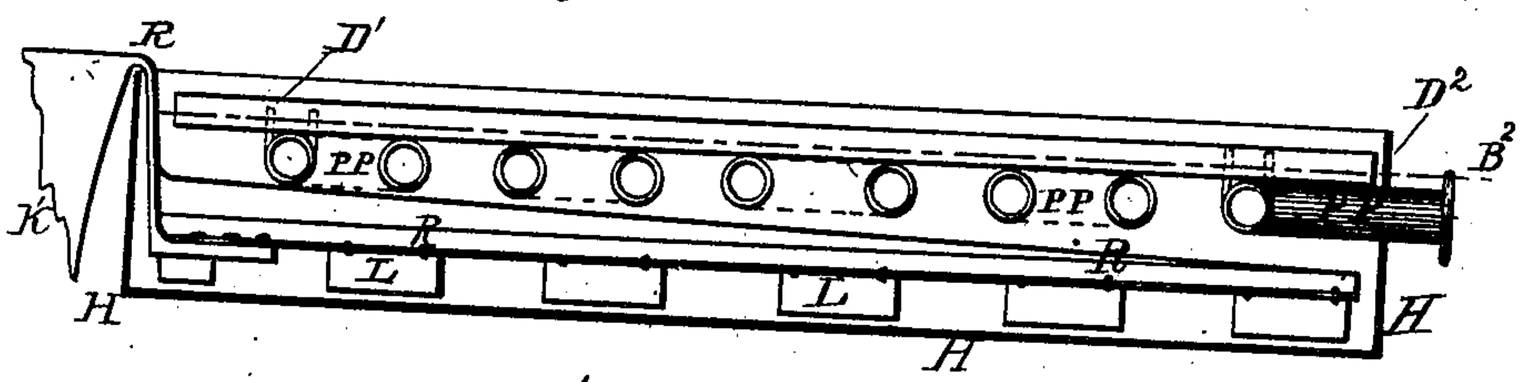


Fig. 12



Witnesses
John H Grason
Johan Larsen

Horace Williams.
John L. Alberger. Inventor
Louis R. Alberger
per J. L. Alberger
atty.

UNITED STATES PATENT OFFICE.

HORACE WILLIAMS, JOHN L. ALBERGER, AND LOUIS R. ALBERGER, OF BUFFALO, NEW YORK.

APPARATUS FOR THE MANUFACTURE OF SALT.

SPECIFICATION forming part of Letters Patent No. 400,983, dated April 9, 1889.

Application filed August 22, 1887. Serial No. 247,573. (No model.)

To all whom it may concern:

Be it known that we, HORACE WILLIAMS, JOHN L. ALBERGER, and LOUIS R. ALBERGER, citizens of the United States, residing at Buffalo, in the county of Erie and State of New York, have invented new and useful Improvements in Apparatus for the Manufacture of Salt, of which the following is a specification.

This invention relates to the manufacture of salt. It has reference to the machinery and apparatus shown and described, including that used for making fine natural-grain salt without grinding and that used for abstracting the salt from the evaporating-vessel, the result being the production of a practically pure salt, all of which is done in a new and useful manner and at a reduced cost.

To carry out our invention we employ the machinery and apparatus shown in the drawings and described herein.

In the drawings, Figure 1 is a general elevation of the machinery combined to carry out the invention, parts being shown in section and parts being broken away. Figs. 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, and 12 are enlarged details of parts of the apparatus. The drawings are shown partly in section and partly with the sides broken away to show the internal arrangement.

The method of heating the brine in tubular heaters under hydraulic pressure, evaporating it partly in open and partly in closed evaporators, utilizing the steam from the brine to aid the work, and operating by a continuous current of circulating brine through the apparatus is similar to that described in Patent No. 351,082, October 19, 1886, issued to us, and to which reference is made. The operation of this apparatus, or a part of it, may be so modified as to dispense with the through-circulation, and will be described hereinafter.

A, A′, B, and C are tubular heaters, one of which is shown partly in section.

In Fig. 2 heaters A and A′ are supplied with steam from a boiler, conducted thereto by pipes S, provided with valves V and V′ to supply and cut off the steam. Heaters B and C are heated by steam from the evaporators D and E through the pipes S′ and S^2, the latter shown and marked above and below the grainer and passing to the rear of it. These evaporators D and E receive the highly-heated brine coming from the gravel-boxes F G and deliver it through the pipe P^{10} into the circular grainer H, which may be of any size. A practical one would be forty-one feet diameter, made of iron or other suitable material. This size will be ample to produce from one hundred and twenty-five to one hundred and fifty barrels salt per twenty-four hours, varying according to the quality and dryness required. Attached to the bottom of the grainer and opening into it is a mixer, I, into which the salt is swept from the bottom of the grainer by the revolution of the shaft K and arms R and the scrapers L. The valve V^3 is operated to draw out the mixed brine and salt into the centrifugal J, where the salt is retained, the brine being driven out and carried by a pipe into the tank Z. Through the center of the shaft K is a small shaft, T, which at its top, above the grainer, carries four arms equidistant from each other and reaching over the surface of the grainer from the center to the outside of it. These arms sweep over the surface of the brine in the grainer when rotated and agitate completely every part of said surface by means of pendants of chain or metal and small agitators, marked W, which we call "flippers" and which are shown in enlarged detail in Fig. 5. The shafts K and J are driven in any convenient manner and at suitable speed. The arms carried by K are rotated once in six minutes and those carried by J six times a minute. Our object is to avoid stirring up the entire contents of the grainer by the rakes, so they revolve slowly near the bottom and are entirely submerged. For the same reason the flippers touch only the surface of the hot brine at the top of the grainer, thus avoiding mixing the hot brine at the top with the colder at the bottom, producing more evaporation as a result and avoiding the ordinary action of self-acting rakes. M is an elevator of the ordinary kind, which takes the salt after it leaves the centrifugal and deposits it in the drier, which may be of any ordinary construction. The elevator O carries the dry salt from the drier to the bolts X X, in which it is separated into the necessary sizes. Y is an elevator to carry gravel from a receiving-hopper, F″, below the gravel-

boxes to a delivery one, F′, above them. P′ is a pipe supplying brine which comes through the exhaust-heater C^2, and in which it is heated by the exhaust-steam from the pumps and engine before entering the apparatus. A^2 is a pump which takes brine from tank Z and elevates it through a pipe, P^4, into the suction-pipe P^3, leading from the grainer H, through the heater C, to the pump A^3, as shown in detail in Fig. 3. B^2 and B^3 are hot wells, receiving hot water condensed from the steam supplied from the boiler or generator in heaters A A′ and from the vapor from the brine in evaporator D, condensed in heater B, all of which is utilized for feed-water to the boiler supplying steam to the apparatus. In Fig. 1 the circular grainer is set up so as to be operated by a through continuous current like that described in our patent of October 19, 1886, before referred to.

In Figs. 3, 10, and 12 the grainer is shown in detail, being a section of one-half. In these views R are the arms; L, the scrapers; W, the flippers; U, the agitator-arms, which carry the flippers W. P are a series of pipes placed in the grainer, about four inches below the surface of the brine in it, extending across and around it, and supported outside of it, so as to require no support in the interior of the grainer to interfere with the rotation of the rakes. The superficial area of these pipes should be equal to two-thirds the superficial area of the surface of the brine covering them. These pipes are supplied with steam from any source, and the water of condensation may be used as feed-water. D A M is a strip of wood or metal reaching from the center of the grainer to the outside of it. If the pipes are used, it may be secured to them; if not, it may be secured at the two ends. It is of such width as to project about four inches above the surface of the brine and the same distance below it. It may also, when the pipes are omitted, be secured to one of the submerged arms and revolve slowly with it.

Fig. 4 is a top view of the suction-box through which brine flows out of the grainer into and through the suction-pipe P^3, which has a casing around it filled with steam, into and through the heater C to the circulating pump A^3. In this detail is also shown the pipe P^4, bringing the partially-heated brine from tank Z, passing the pump A^2, into the upper end of the suction-pipe.

Fig. 5, Sheet 2, is a detail of one flipper or pendent agitator. It is composed of the top supporting-piece, *b*, connected to the metallic pieces by chain C, and also to the arm W, as shown in Figs. 1, 3, and 10. These flippers are hung so that when revolved with the arms they just touch the surface of the brine in the grainer and forcibly strike and pass over the upper edge of the dam.

In Sheet 3 is shown our arrangement for purifying the salt of soluble non-crystallizable impurities. T^5 is a tank to hold the washing solution; N^5, a hose with stop-cock and nozzle to supply it to the salt in the centrifugal C^5. M^5 is a mixer, the contents of which are agitated by the arms on the shaft S^5, rotated by gear G^5. D^5 is a pipe leading from the centrifugal into and out of a vessel, X′, to a tank, Z. It is obvious, if the mixer M^5 be attached to the grainer H in place of the mixer I, (shown in Fig 1,) this apparatus could be used in connection with our system, as there shown; but it is evident that salt may be treated by these appliances when made by any other apparatus.

Fig. 7 shows enlarged view of the elevators O and M.

Fig. 8 is the gravel-elevator with the receptacle from the gravel-boxes, marked F^2.

Fig. 9 is a side view of the heater C^2, with apertures as follows: S^5, exhaust-steam inlet; B^3, brine-inlet; C′, brine-exit. The elevators and heater are drawn with the sides cut away to show the internal construction.

Fig. 10 is a section through one-half the grainer. In this H H is the grainer; R, the scraper-arms; L L, the scrapers; K′, the center piece to shaft K and supporting the arms R′. D′ is the support at center for one end of the dam, and D^2 the outside support on the pan for the other end. U are the agitator-arms. T is the agitator-shaft. B^2 is the brine-level.

Fig. 11 is a top view of the center piece, K′, also of one arm R and of the scrapers L, R R R being the ends of the remaining arms.

Fig. 12 is a section through the center of one-half the pan. P P are the heating-pipes; R, the scraper-arms; L L, the scrapers; H H, the pan; B^2, the brine-level; K′, the center piece. D′ is the support of the dam on the pipes, (if used,) and D^2 to outside of pan.

The operation of the apparatus is as follows: The grainer being filled one foot deep with brine, the closed evaporators partly filled, and the heaters and gravel-boxes filled, the pumps A^2 and A^3 are started. Steam is applied from a steam-boiler to either of the heaters A A′, which ever is in use, it being the intention to use one heater and gravel-box while the other is opened for cleaning. The brine, highly heated in the heater A to about 300° Fahrenheit, passes into and through the gravel-box under hydraulic pressure made by the pump A^3 and regulated by the valve V^4, usually of fifty pounds to the square inch. It then passes into the evaporator D, and from it into E, and from thence into the grainer, in which it circulates around the circle. The dam prevents cross-currents, as the hot brine, entering at 226° Fahrenheit, flows rapidly and spreads over the surface of the grainer, and would pass out at the discharge-pipe without proper time to evaporate and cool if the dam did not hold it back. As the salt forms on the surface of the brine in small crystals, the flippers strike it, making it sink to the bottom of the grainer, thus preventing it from enlarging, while retaining the natural crystal of the salt and making it the proper size for

table and dairy use. Such salt would be known to the ordinary salt-maker as "mush-salt," and cannot be successfully drained excepting by a centrifugal. Months of standing in a bin have no effect on it, except to form a hard crust on its surface. Salt also will form in small crystals on the surface of the flipper-plates, and, if not prevented, would soon accumulate and load down the plates. Then their action would be different, causing a different kind of agitation as their weight gradually increased, and thus change the kind of salt made in the apparatus; but as the agitator-arms and the flippers are revolved rapidly the latter strike the dam forcibly, and so continuously knock off the salt as fast as formed, keep the plates clean, and thus secure a regular and complete action and a smooth, even, and regular product, which in a factory is of great importance. If it be desired to change the size of the crystals, it may be done by increasing the rapidity of the rotation of the arms carrying the flippers or by increasing or decreasing their number. We have described the dam as a device for cleaning the flippers. A rod would answer as well if in the same place, the necessity being simply an obstruction placed slightly above the brine, so as to make a forcible impact with the flippers. Ninety-eight per cent. of the salt produced is made of the proper and desired grade by this means. The scrapers and arms attached to them revolve slowly and aid the circulation of brine around the grainer, and as soon as salt is formed they sweep it from the center to the outside of grainer sidewise and ahead into the mixer continuously, the scrapers being so placed as to act like a screw or scroll. From the mixer the salt goes into the centrifugal, and, if containing no insoluble impurities, it is passed along through drier and bolts until finished. The elevators, drier, and bolts may be of any ordinary construction.

If the salt is made from brine containing the chlorides of lime or magnesia in such quantities as to impair the value of the product, or if the brine under treatment contains them in such quantities as to, by accumulation in the grainer, compel its contents to be thrown away from time to time, in many cases as often as once in three days, and in order to make our apparatus operate continuously, avoiding such stoppage, we arrange, by the tank T^5 and perforated pipe and hose N^5, to wash the salt while in the centrifugal with brine directly from the spring or well or with depurated brine made by melting salt. This we do in the centrifugal, or we discharge it into another mixed from the centrifugal, and again mix and wash and separate it in like manner. To prevent the accumulation of the chlorides, we provide apparatus, as shown in detail in Sheet 3, at each charge of the centrifugal, the vessel X′ is filled with brine from the centrifugal, flowing to the tank Z, and at each such charge the contents of X′ are let run to waste by means of a valve and handle, as shown. The vessel X′ should be of such size that its contents being thrown away, as above described, will prevent the excessive accumulation of the chlorides in the grainer. If the salt need the treatment of chemicals, they can be supplied to the tank T^5 and applied while the salt is in the centrifugal. The brine, having circulated round the grainer, depositing salt by evaporation and also by cooling, goes into the steam-heated pipe connecting the suction-box and heater C, and from the heater to the pump A^3, from which it is again put through the heaters B and A or A′ into one of the gravel-boxes and evaporators to the grainer continuously. Our object in heating the brine after it leaves the grainer, by passing it through the incased pipe and heater C, is that the brine cannot be pumped if allowed to cool. Salt will form in the pipe and also in the pump and prevent its action; but by heating the brine its capacity for salt is increased, and a small amount of cooling from this increased heat while passing the pump is permissible. For the same reason we supply the fresh brine partly heated from the tank Z into the mouth of the suction-pipe, because it will take up and absorb any salt carried over mechanically.

The purification of the brine from crystallizable impurities—such as the sulphate and carbonate of lime—is effected as follows: By heating the brine in the heaters A A′ to about 300° Fahrenheit the lime is made insoluble and crystallizes in characteristic crystals. These adhere to surfaces presented to them, and from this arises the difficulty usually experienced in the manufacture of salt. The heating-surfaces become covered, action is thereby impaired, and the apparatus burns out or requires to be stopped for cleaning out or renewal. The purifiers or gravel-boxes are made of boiler-plate, secured at top and bottom by hinged doors made to open and close easily. They are tapering and largest at the bottom, so as to easily drop out the gravel with which they are filled. This we use because it furnishes a nucleus for the small crystals, and they deposit evenly upon its surface in successive layers. If the brine contains one-half of one per cent. of lime and the factory makes one hundred and fifty barrels per day, the gravel-box will have to be opened and the contents taken out once in about thirty-six hours to prevent its solidifying completely. This is conveniently done by opening the hinged door at the bottom, letting the stones fall into receiver F″, to be elevated into the upper receiver, F′, from whence they again put into the gravel-box for further use. The gravel is effective from one-half inch to two inches diameter. When larger, the lime-enveloper may be knocked off and its pieces used with the gravel. The brine, being under pressure, pervades all parts of the purifier around and between the pieces of gravel. There is no

possibility of a stoppage, as would often occur with a porous filter or one composed of fibrous materials. The action is certain and positive. Salt made in this apparatus analyzes 99.700 per cent. chloride of sodium, .044 lime, and .256 water. Two gravel-boxes are provided, so that one can be used while the other is opened for cleaning, making the action continuous. A small proportion of lime is deposited in the tubes of the heater, which is removed from time to time.

Referring to the detail of the grainer in Fig. 2, the same arrangement of coil in the grainer may be used in connection with our method of through-circulation and heated currents and simultaneous with them. Usually, however, we prefer to use the apparatus without the coils in the grainer, when the through-currents of circulation are used through heaters, evaporators, purifiers, and grainers; and if the coils be used for heating we prefer to use them as the sole heating medium, evaporating the brine in the grainer entirely by them, using, however, in connection the rakes and scrapers, agitators, mixer, centrifugal washing apparatus, driers, and bolts, with or without the purifiers, as desired.

We are aware that agitators have heretofore been used for agitating brine in evaporating-vessels; but we are not aware that they have been used in the combination we have described, or that any self-cleaning automatic agitator has heretofore been produced. We are also aware that scrapers have been used to scrape out the contents of salt-grainers; but we are not aware that any such scrapers have been heretofore used in the connection invented by us. We are aware that attempts have been made to purify brine by blowing live steam into it to heat it. We entirely disclaim such an arrangement, as our method requires the brine to be heated in tubular heaters in which the brine and steam are kept separate.

Having thus fully described the nature of our invention, what we claim, and desire to secure by Letters Patent, is—

1. The combination of the gravel-box F with the closed evaporators D and E, the open grainer H, the pipes P, the shaft K, and the rotating arms R, provided with scrapers L, in the manner as and for the purpose described.

2. The combination of the grainer H with the pipes P, the rotating arms R, having scrapers L, the shaft K, the shaft T, and the agitator-arms U, provided with flippers W, in the manner as and for the purpose described.

3. The dam, in combination with the grainer H, the pipes P, and the inlet and exit pipes P^{10} and P^3, in the manner as and for the purpose described.

4. The dam, in combination with the grainer H, the flippers W, the arms U, and means for supporting and rotating them, in the manner as and for the purpose described.

5. The combination of the tubular heaters A B, the gravel-box F, the evaporators D and E, the grainer H, and the heater C with the pump A^3 and connecting-pipes, in the manner as and for the purpose described.

6. The combination of the grainer H with the agitator-arms U, the pendent parts *b c d*, and the shaft T, in the manner as and for the purpose described.

7. The combination of the heaters A A′ with the gravel-boxes F G, the heater B, the pump A^3, and connecting-pipes, in the manner as and for the purpose described.

8. The combination, in a grainer, of a series of arms provided with scrapers submerged in the brine, a series of agitator-arms above the brine, provided with flippers, and shafts T and K, in the manner as and for the purpose described.

9. The combination of the grainer H with the suction-pipe P^3, the jacket-pipe P^6, inclosing it, the heater C, and the pump A^3, together with means for returning the brine through the apparatus to the grainer, in the manner as and for the purpose described.

10. The combination of the pump A^2, the grainer H, and the pipe P^4 with the pipe P^3, the heater C, pump A^3, and connecting-pipes, and means for conveying the brine through the apparatus to the grainer, in the manner as and for the purpose described.

11. The combination of the grainer H with the inlet-pipe P^{10}, the exit-pipe P^3, the pipes P, the dam, the rotating arms having scrapers, and the agitating-arms provided with flippers, in the manner as and for the purpose described.

12. The combination of the heaters A A′, the gravel-boxes F G, evaporators D and E, grainer H, heating-pipes P, suction-pipe P^3, and heaters B and C with the pump A^3 and connecting-pipes, in the manner as and for the purpose described.

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ALVAN H. ALBERGER,
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