J. HODGKINSON.

EVAPORATING BRINE APPARATUS.

APPLICATION FILED MAR. 1, 1909.

979,301.

Patented Dec. 20, 1910.

4 SHEETS—SHEET 1.

FIG. 1.

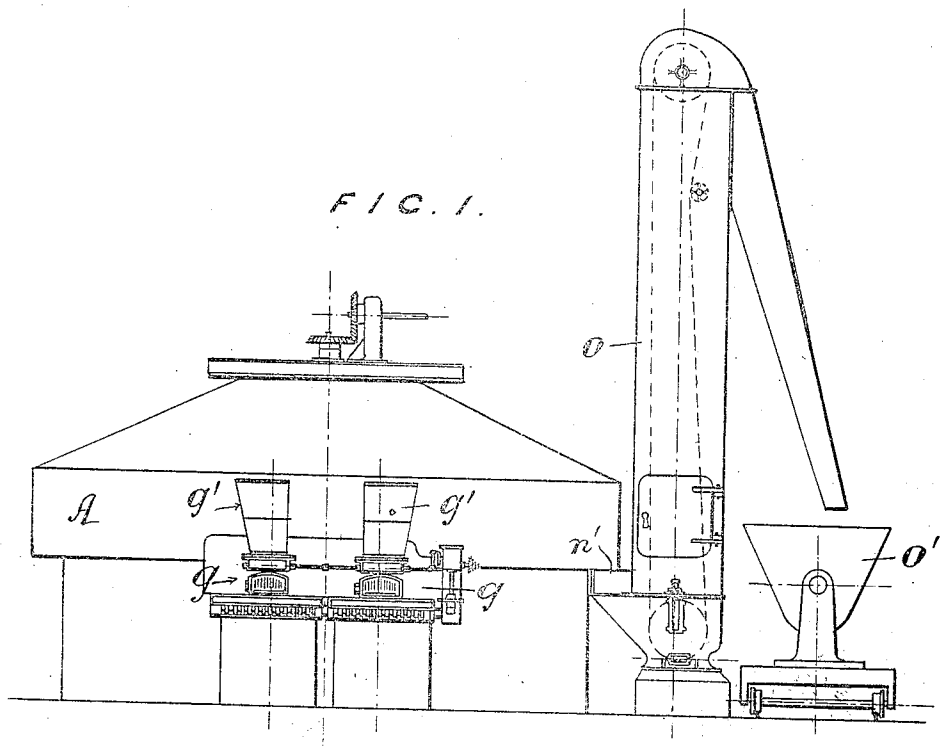
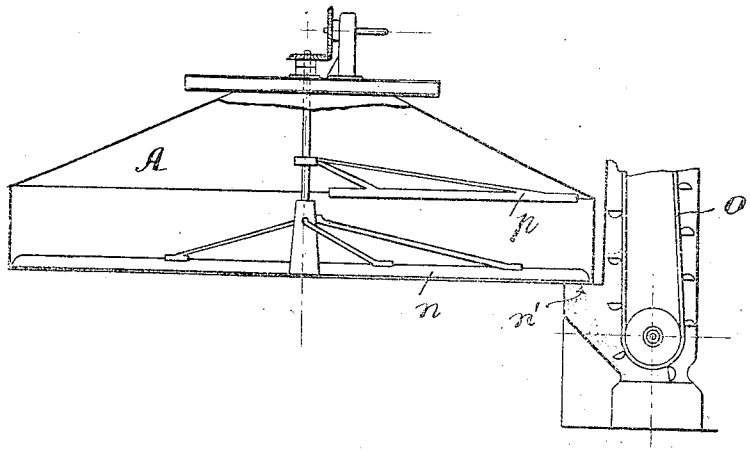


FIG. 2.



Witnesses
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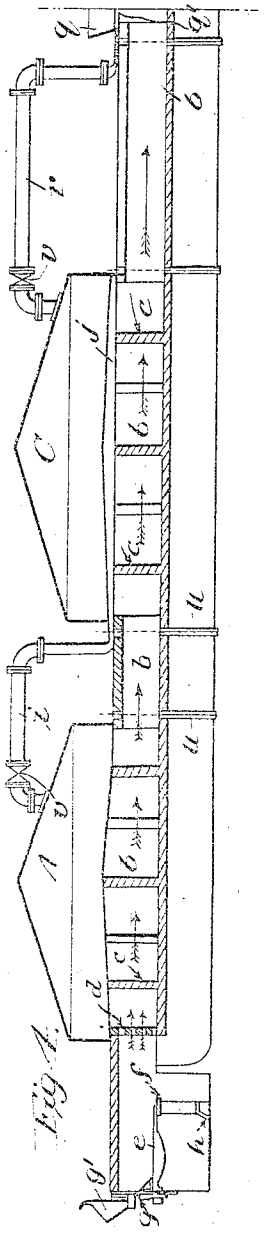

Fig. 4.

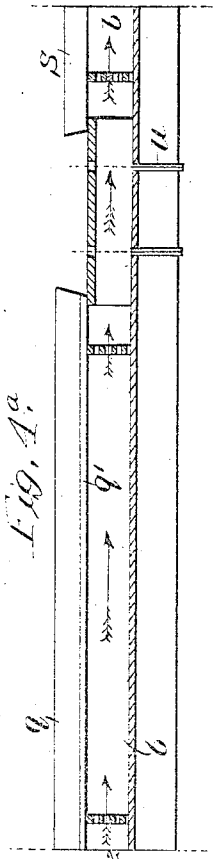

Fig. 4a.

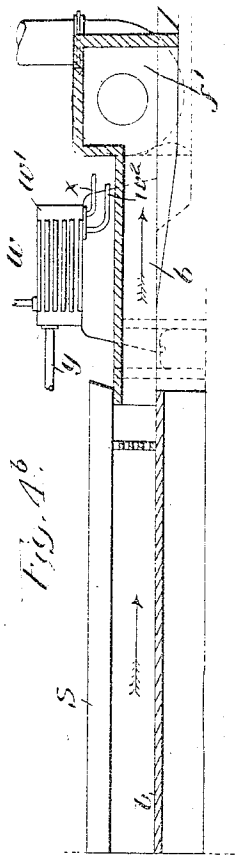

Fig. 4b.

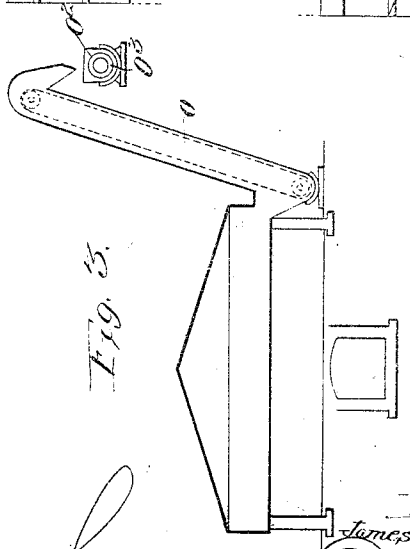

Fig. 5.

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4 SHEETS—SHEET 3.

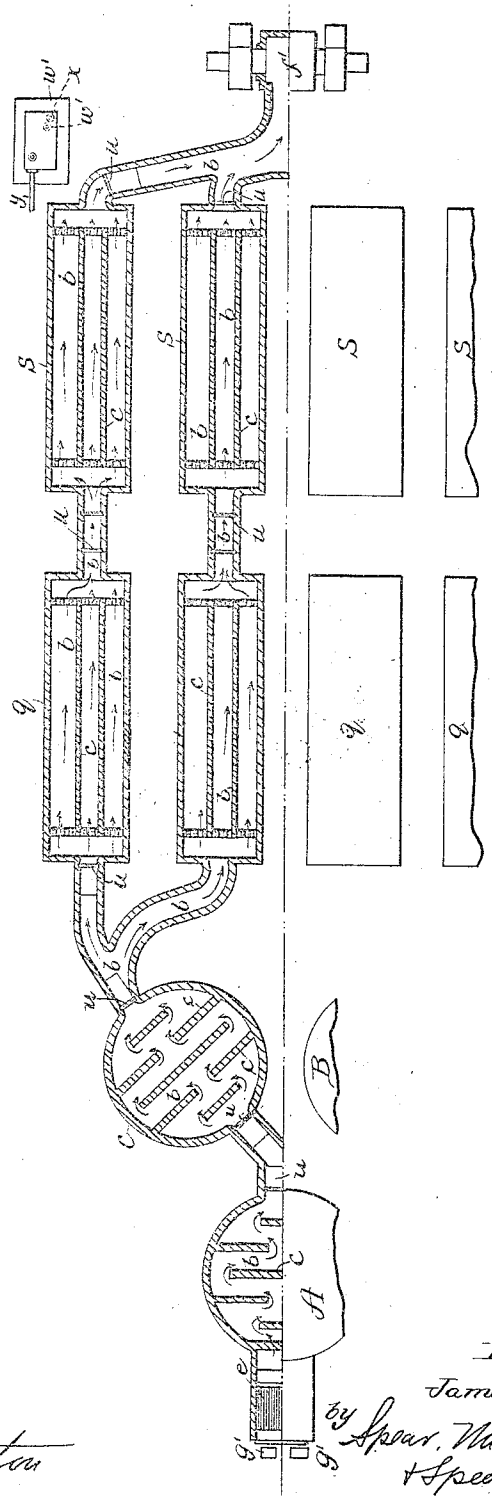

Fig. 5.

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4 SHEETS—SHEET 4.

FIG. 7.

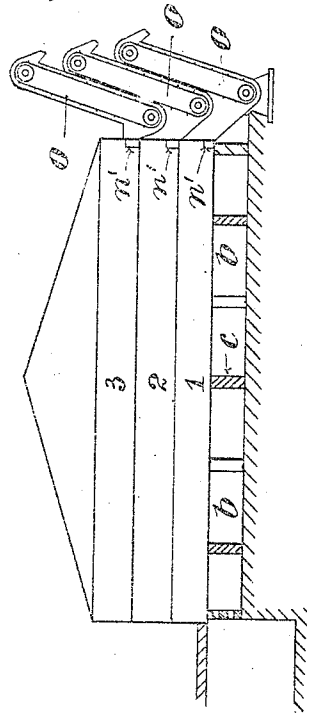


FIG. 9.

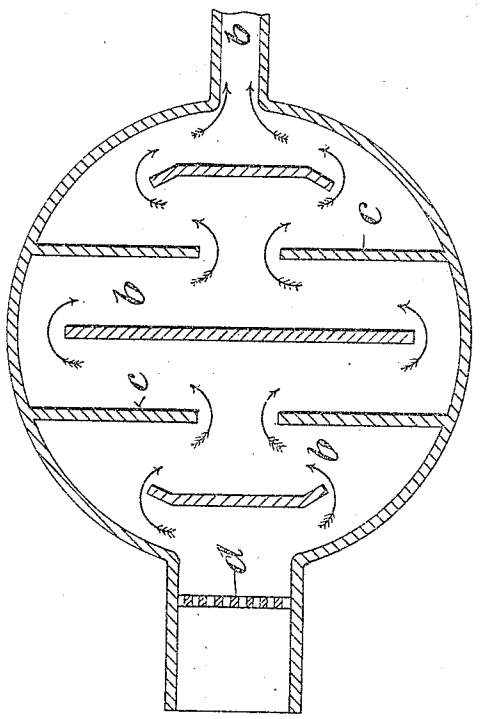


FIG. 6.

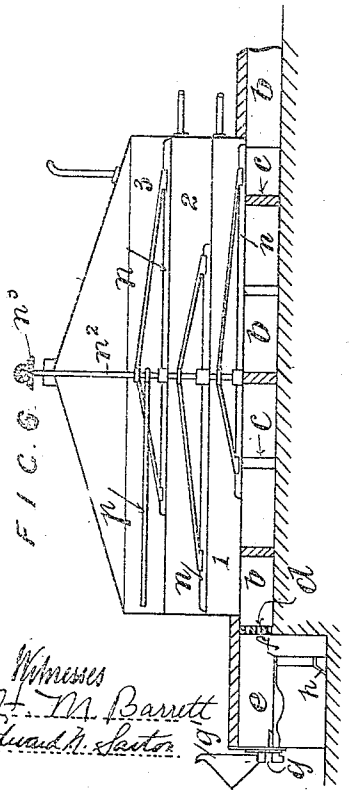
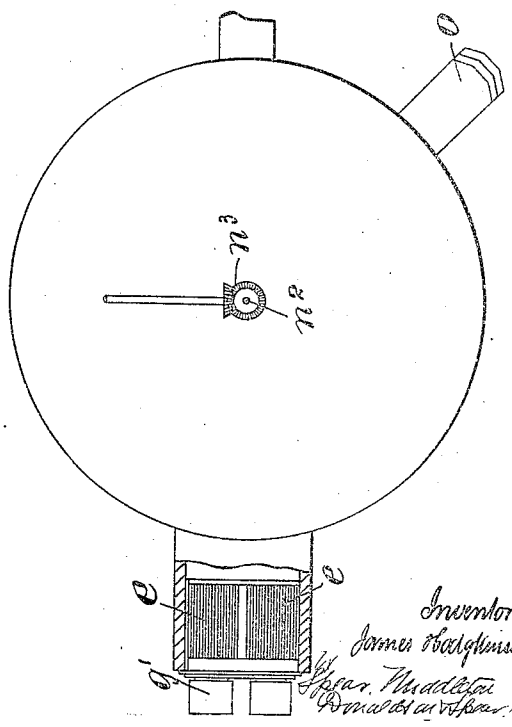


FIG. 8.



Witnesses
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UNITED STATES PATENT OFFICE.

JAMES HODGKINSON, OF PENDLETON, MANCHESTER, ENGLAND.

EVAPORATING BRINE APPARATUS.

979,301. Specification of Letters Patent. Patented Dec. 20, 1910.

Application filed March 1, 1909. Serial No. 480,606.

To all whom it may concern:

Be it known that I, JAMES HODGKINSON, a subject of the King of Great Britain and Ireland, residing at 4 Halton Bank, Eccles Old Road, Pendleton, Manchester, in the county of Lancaster, England, engineer, have invented new and useful Improvements in Evaporating Brine Apparatus, of which the following is a specification.

In treating brine for the production of salt, (aside from the vacuum process) it is the practice to evaporate the liquor in tanks by means of furnaces which are banked up from time to time, and vary greatly in the heat supplied, according to the condition of the fires. As a consequence of this variation in the furnace heat, the size of the granules varies, those produced at the highest heat being the smallest and those produced at lower degrees being greater, the granules or crystals increasing inversely with the heat. It has therefore been necessary to grind the product of the pans to bring it to a uniform grade. It has also been suggested for obtaining this uniformity of heat to regulate the flow of heated brine into different settling tanks, in different amounts or degrees of flow, to produce in different tanks salt of different degrees of fineness. Instead of these and various other methods and apparatus of various degrees of complexity and difficulty, I have aimed to simplify the whole, and have simplified the whole system, by first regulating the heat, and have applied this regulated and uniform heat (preferably through the products of combustion and generated steam) successively to the pans of a series, the steam generated in the first pan, and the products of combustion applied thereto, being then used, (both or one, but preferably both,) to the second pan of the series, and so on in succession to the end of the series. As the higher degree of heat acting to evaporate the brine, produces a finer grade of salt, and a lower degree of heat a coarser grade, and where the heat of the furnace varies, as in the methods and apparatus heretofore used, the different grades of fineness are intermixed in all the pans unless special and complicated apparatus be used, as for example, in the U. S. patent of Weaver No. 303,348 of Aug. 12th 1884. As I produce a uniform grade of salt in the pan by direct application of the products of combustion thereto, uniform in heat, during the whole operation, I can and do produce in the first pan, the finest grade of salt, in respect of granulation, and by passing these products of combustion on to the second and third or further, I produce, in these successive pans, successive grades, coarser and still coarser, but each uniform in itself and unmixed, as to size of granules, since the passing products, though constantly less in temperature remain always uniform at each successive pan. I thus avoid the great expense of subsequent handling and grinding. At the same time I utilize all the heat, and gain greatly in economy of fuel. In connection with this economy gained by continuous use of the products of combustion, I use another method auxiliary to the first, and working always in harmony therewith, to wit, the application of steam generated by evaporation in the first pan, to the next, and of that of the next to the third, and so on, as long as heat remains in the products of combustion, sufficient for practical operation. I further use the heat units remaining after this point is reached, by causing the steam to heat the brine before it is fed to the pans, and the apparatus for this purpose is so arranged as to cause a partial vacuum, whereby the steam is drawn backward without the use of a fan. I use also, as auxiliary to the invention and conducive to the end thereof, and in combination therewith, scrapers, film breakers and salt removers which in themselves I do not claim as new.

The starting point is the application of uniform heat to the brine. The means for this may perhaps be varied, but the use of a hand fed furnace, or the ordinary stoker fed furnace is not available in my system, since the opening of the furnace door, or the material, through temporary variation of the heat, would cause variation in the size of the granules in the pan, so that in the same pan some would be coarser, and thus fitted for one kind of use only, while others would be finer and better adapted for another use. I have therefore taken for the heat generating apparatus a stoker fed furnace, such as that shown in my patent hereinafter specified, though I do not wish to confine myself to this furnace, as it may be possible to get even heat during the whole process, by other practical means, or by other stoker fed furnaces, with proper care.

As in the practical application of my invention it is necessary to obtain a uniform

temperature varying only about two or three degrees during the entire production, and to rely upon this alone for uniformity of product, I have selected and used, a stoker fed furnace in which the feeding is mechanical, and therefore necessarily and uniformly constant, and the drafts also uniform and constant; and as fulfilling these conditions I have used the form of stoker feed shown in my U. S. Letters Patent No. 869708, of date October 29, 1907, in which the fuel is fed on to reciprocating fire-bars the same being self-cleaning and in which the fuel as it is consumed is traversed from the front to and over the back of the furnace grate and the furnace doors of which need never be opened during evaporation and thus the temperature will only vary a degree or two if the stoker has proper attention.

I take steps to prevent interior incrustation the same appliance sweeping the product to an outlet from which it is mechanically lifted, and I also agitate the liquid to assist evaporation and to break-up any surface film.

The entire heat both of steam and furnace gases due to working of the main or other pan is or may be beneficially utilized to impart heat to brine in auxiliary or successive pans; or to heat a supply of brine for passage to the evaporating pan or pans. The steam produced in one pan is superheated by the furnace gases when being utilized to heat an auxiliary pan.

I will now fully ascertain and disclose my invention by describing the same in detail with the aid of the attached drawings, wherein:—

Figure 1 is a front elevation of one form of my new uniform and controllable temperature salt making plant, the figure indicating one pan or evaporator, the adjacent furnace with Hodgkinson or like fuel stokers, and the lifting apparatus for dealing with the discharged product. Fig. 2 is a detail section showing the discharge outlet in the pan or tank, the lifting buckets, tank scraper, and agitator film breaker. Fig. 3 indicates a modified method for lifting and transporting the product. Fig. 4 shows a diagram in sectional side elevation of a portion of an evaporating plant in which the steam and furnace gases are advantageously employed to heat auxiliary tanks. Fig. 4^a is a continuation of Fig. 4. Fig. 4^b is a continuation of Fig. 4^a. Fig. 5 is a sectional plan of Figs. 4, 4^a and 4^b. Fig. 6 is a sectional elevation of a modified construction of closed brine evaporator. Fig. 7 is a similar section showing automatic brine removing means. Fig. 8 is a plan of Fig. 6, and Fig. 9 is a sectional plan showing the flues for the furnace gases.

In the plant or apparatus shown for carrying out the invention I use, as shown in Fig. 1, a tank or pan A of round or other shape and which I hereafter refer to as a primary evaporator and this primary evaporator is suitably supported to allow furnace gases to come into contact with its base, and sides if desired. Conveniently it is seated upon brickwork or on a bed or support, the brick-work being so built-up as to produce flues or channels *b* which are well seen in Fig. 5 where the brick-work partitions producing the flues and helping to support the primary evaporating pan are marked *c*. These partitions divide up the furnace gases, baffle the same, and cause the heat to be distributed over the greater part of the base surface of the primary evaporating pan A as shown by the arrows. The brick-work seating or container is illustrated as being round in the drawings and has inwardly projecting walls or partitions with other independent walls. The way of seating the pan A and causing the gases to traverse below the same may vary very considerably as is obvious.

To heat the primary evaporator A I use automatic stoking devices such as the Hodgkinson or a similar type of stoker to feed fuel on to furnace bars which furnace bars are reciprocated by mechanism and which are self-cleaning. The Hodgkinson or like type of stoker is not arranged below the pan but adjacent thereto and thus the flames cannot contact directly with the evaporator base. I find it best to use a perforated wall *d* through the passage ways in which the hot gases find outlet from the furnace. I have two sets of furnace bars *e e* in the furnace, but may have one set, or more than two sets. The coal is burned on the furnace bars *e e*, and under my invention I employ as stated, any such type of automatic stoker as will insure the feed of fuel from the front to the back of the furnace the clinker and ash being discharged at the point *f* at the back. In the drawings, I indicate at *g g* in Figs. 1 and 4 a Hodgkinson stoker which I use and which is perhaps the best type to give the desired automatic and continuous feed of fuel to the furnace and traverse the same along the grate bars as described. Automatic means may be used to feed coal into the hoppers *g'*, *g'*, of the stoker in well known fashion. A clinker or ash door *h* allows of removal of clinker or cinder pushed over the grate end (see Fig. 4). Owing to its uniform and high temperature the closed primary pan A nearest the furnace produces continuously the same quality of fine salt throughout the working. In order to utilize as fully as possible all the heat of the furnace in conjunction with the primary closed evaporator A I use one, two or more secondary closed evaporators or pans having false bottoms, the steam from the primary pan being conducted to these

false bottoms. In the drawings two such secondary closed evaporating pans B C are shown, the steam pipes *i* conducting steam out of the primary pan A to false bottoms *j* of the pans B C. The secondary closed pans B C may if desired be heated by furnace gases alone. Flues *b* are arranged also to conduct the products of combustion from the furnace as they leave the primary pan A to beneath the false bottom *j* of the secondary pans B C and by means of baffles *c* to circulate the hot gases over the entire area of the pans. The steam within the false bottoms *j* is thus superheated and a uniformity of temperature imparted to the brine within the pans so as to obtain a continuous production of salt of even quality although coarser than that produced in the primary pan A owing to lower temperature. Rotary scraping devices *n* are or may be used in conjunction with the primary and secondary pans to discharge the product automatically through a discharge or settling outlet *n'* as shown in Fig. 2 from which it is automatically removed by means of an elevator *o* or the like. In Fig. 1 the elevator *o* is shown discharging into a wagon *o'*, Fig. 3 indicating how the elevator may discharge the product into a trough o^2 from which it is conveyed to any desired point by a worm o^3. A rotary surface paddle or film breaker *p* is or may be used to agitate the surface of the brine, break up film and assist precipitation.

Following the closed secondary evaporator or evaporators are arranged a number, say four, of open pans *q q q q* side by side, which are also made with false bottoms *q'*, into which steam from the secondary closed evaporators B C is conducted by pipes *r*, flues *b* being also provided to conduct the hot gases from the secondary evaporators beneath the open pans to superheat the steam and impart a uniform temperature to the brine to continuously produce salt of even quality, although still coarser owing to the units of heat being gradually extracted from the hot gases as they pass through the flues. The flues *b* are continued to direct the gases for the extraction of the remaining heat units beneath one or more, say four open pans *s s s s* within which the coarsest quality of salt is produced. These pans are shown as being heated solely by hot gases or they may be provided with false bottoms for steam. To insure the circulation of the hot gases from the furnace throughout the system of flues I provide an exhausting fan or fans *f'* or the like at the outer end of the flue. Dampers *u* are arranged in conjunction with the various flues so that any one, or more than one, of the various pans may be cut out of the circulation of the hot gases so as to stop the working of any one of the pans. The steam pipes conducting the steam from one pan to the other are also provided with valves *v* to regulate or cut off the supply.

The number of evaporating pans may be varied, as many being preferably used as is necessary to exhaust as completely as practicable the heat units of the steam and the products of combustion of the furnace. The waste steam is conducted from the last of the steam jacketed pans through pipes *w* contained in an elevated chest *w'* similar to a surface condenser. Brine is passed through the chest through the feed pipe *x* and is heated by the steam pipes *w* the steam being thereby condensed, and discharged through the pipe w^2 the heated brine being then conducted by gravity through the feed pipe *y* to continuously replenish the various pans in desired quantities. The condensed water is drawn off through the pipe w^2 and a slight vacuum is thereby produced in each of the closed pans and steam jackets so that the steam is continuously drawn forward without the need of vacuum pumps. The hot water from the condenser is or may be also used to heat the brine supply along with the residual furnace gases.

One or more than one of the closed evaporators may be constructed with several superimposed chambers say three in all as shown in Figs. 6 to 9. In the arrangement shown in these figures the lowest chamber 1 is heated by furnace gases, the intermediate chamber 2 being heated by steam in the chamber 1, the chamber 3 being similarly heated by steam in the chamber 2. Each chamber 1, 2, 3 is provided with a scraper *n* to sweep the product to settling outlets *n'* where it is removed automatically by elevators *o*. The scrapers *n* are all mounted on a common shaft n^2 driven by gear wheels n^3 and the shaft may also carry film breakers or agitators *p* as shown in the chamber 3.

The great advantages of the invention are, uniformity of temperature, even grade of salt produced, automatic supply of fuel to furnace and self-cleaning fire bars and absence of smoke, automatic supply of brine and automatic removal of salt from the closed evaporators, increased production of salt per ton of coal consumed, and greater economy of labor.

I declare that what I claim is.

1. In an apparatus for evaporating brine, and in combination, a covered pan adapted to contain the brine, and a regulated heat generating apparatus arranged in the described relation to the pan and adapted to maintain the pan and its contents at a uniform and high temperature, and a second pan arranged to be heated by the products of combustion of the heat generating apparatus, all substantially as described.

2. In an apparatus for evaporating brine,

and in combination, a covered pan adapted to contain the brine, a regulated heat generating apparatus arranged in the described relation to said pan and adapted to maintain the pan and its contents at a uniform high temperature and a second pan adapted to be heated by the products of combustion of the heat generating apparatus and arranged also to receive the steam from the first pan, substantially as described.

3. In an apparatus for evaporating brine, and in combination, a plurality of covered pans adapted to contain brine and arranged in order, one after the other, a regulated heat generating apparatus adapted to maintain the first pan and its contents at a uniform high temperature, flues arranged to conduct the hot gases or products of combustion to the pans in succession, a chamber underneath the pans following the first, and steam pipes from the preceding covered pans leading into said chamber or chambers, all substantially as described.

4. In an apparatus for evaporating brine, and in combination a plurality of covered pans adapted to contain brine and arranged in order, one after the other, a regulated heat generating apparatus adapted to maintain the first pan and its contents at a uniform high temperature, flues arranged to conduct the hot gases or products of combustion to the pans in succession, a chamber underneath the pans following the first, and steam pipes from the preceding covered pans leading into said chamber or chambers, and an open pan following the plurality of covered pans, said open pan having the chamber underneath it and a pipe leading from the last covered pan to the chamber last specified, all substantially as described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

JAMES HODGKINSON

Witnesses:
JOSHUA ENTWISLE,
ALFRED YATES.