S. B. HOWD.

Making Salt.

No. 11,802. Patented Oct. 10, 1854.

Fig. 2.

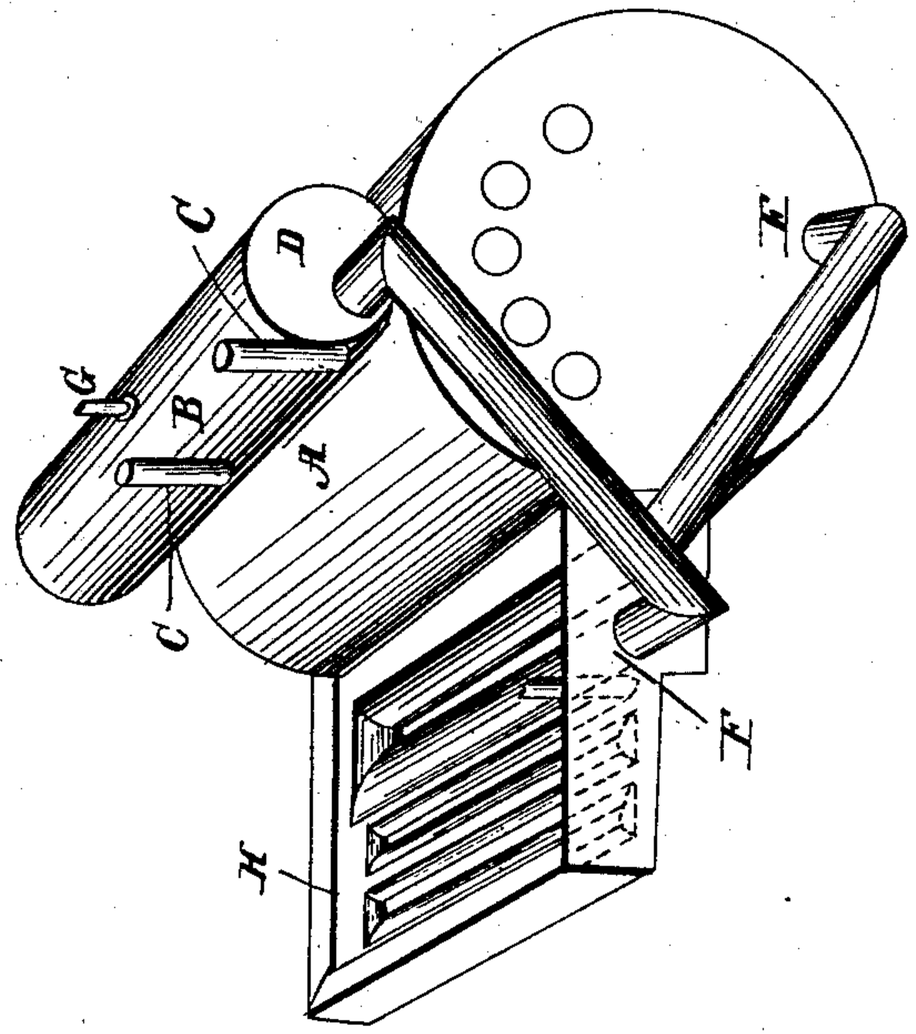
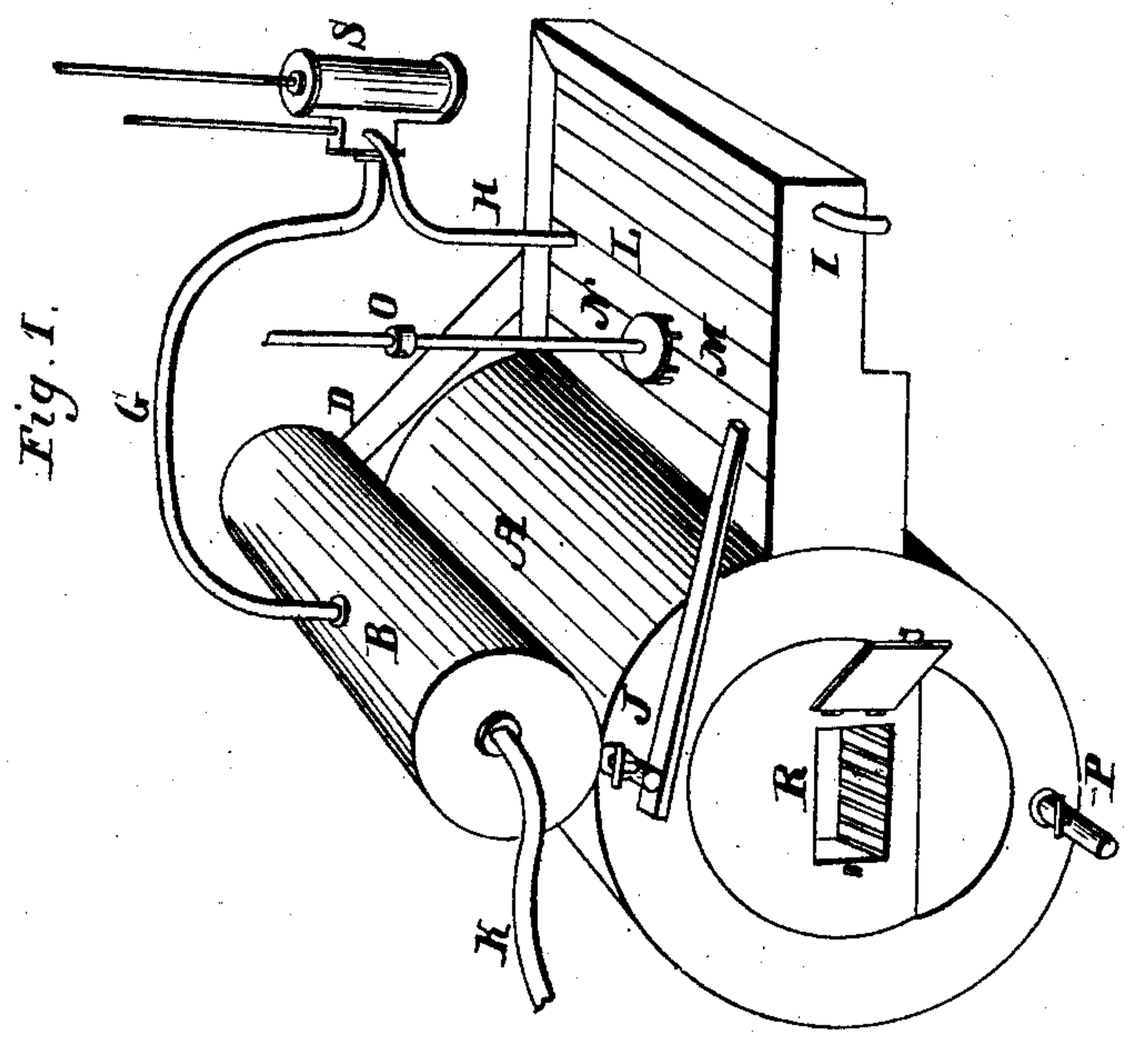


Fig. 1.



UNITED STATES PATENT OFFICE.

SAMUEL B. HOWD, OF SYRACUSE, NEW YORK, ASSIGNOR TO THOS. T. DAVIS, JAMES S. LEACH, AND RICHARD F. STEVENS.

IMPROVEMENT IN PROCESSES FOR THE MANUFACTURE OF SALT.

Specification forming part of Letters Patent No. **11,802**, dated October 10, 1854.

To all whom it may concern:

Be it known that I, SAMUEL B. HOWD, of the city of Syracuse, in the county of Onondaga and State of New York, have invented a new and useful Improvement in the Process of Manufacturing Salt; and I do hereby declare the following to be a full, clear, and exact description of the process and of the construction, arrangement, and operation of the apparatus connected therewith, reference being had to the annexed drawings, making a part of this specification.

My invention embraces, first, a method of purifying brine; second, of running steam machinery with steam generated in the art and process of manufacturing salt; third, of preventing the contact of salt with steam-pipes used in evaporating brine in open vats.

I construct a steam-boiler of wrought-iron in any form suitable for raising steam, having the well-known arrangements for the application of fire. The boiler A is furnished with a steam-chamber, B, at its upper part, which is connected with the boiler by two or more tubes, C, passing upward through the bottom of the steam-chamber to near its upper part.

D represents a large tube connected with the lower part of the steam-chamber and passing into the lower part of the salting-vat at E. This tube or chamber extends to the opposite end of the vat, returns and passes out near the point where it entered, giving a large extent of tube or chamber with the vat. The other extremity of the tube is connected with the lower part of the boiler at F.

G is a steam-pipe to be connected with a steam-engine, *s*.

H is a steam-pipe that receives the escape-steam from the engine and passes several times the length of the salting-vat, and finally emerges therefrom at I.

J is a discharging-pipe placed in the upper part of the boiler above the fire-surface, which allows a portion of the purified brine to be discharged into a conductor connected with the salting-vat.

K is a pipe connected with the force-pump, by which the boilers are fed with crude brine.

L is a platform in the vat, placed sufficiently above the bottom to afford space for the steam-pipes for heating and evaporating the purified brine after it has been discharged from the boiler into the vat. A small space is left between the edge of the platform and the side of the vat.

M is a paddle-wheel placed so as to revolve in or over a hole in the platform L, the paddles to revolve horizontally, and their upper edges covered by a round plate, N. A band-wheel, O, is placed upon the upper end of the shaft of the paddle-wheel, which is revolved by a band from the steam machinery.

P is a discharge-pipe for blowing off the contents of the boiler.

The operation of the above-described arrangement of apparatus is as follows: The boiler is first filled with crude brine, and fire applied in the arch R. Steam passes up through the tubes C into the steam-chamber. As soon as the steam has sufficient pressure the engine is set in motion, and thereby also the force-pump for feeding the boilers, and the paddle-wheel for causing a circulation of brine in the vat. The force-pump throws the brine into the steam-chamber through the pipe K, where it is heated by contact with the steam and falls into the bottom of the steam-chamber. The strength of the brine in the boiler is increased by evaporation, and a quantity is thrown by ebullition over the top of the tubes C, and mixes the strong with the weak brine. This increasing the strength of the brine in the steam-chamber causes the separation of the impurities contained in the brine.

The brine of this locality and of most others contains such other matters than salt as are usually termed "impurities," viz: first, iron; second, sulphate of lime; third, muriate of lime, and fourth, muriate of magnesia. The first (iron) commences to be deposited shortly after evaporation commences. The second (sulphate of lime) is deposited in crystalline form after a still further evaporation of the water from the brine. The iron and sulphate of lime are separated or deposited from brine before the crystallizing of the salt in all the ordinary processes of making salt. This is not the case with the muriates of lime and magnesia, two deliquescing salts that remain in solution while the salt is crystallizing. A solution of these two salts forms what is called by the workmen "bitter water," and is known to greatly retard the process of evap-

oration of water from the brine in the ordinary modes of salt-making. In solar-works this bitter water floats upon the surface of the brine when it (the brine) is of sufficient strength for salt to cyrstallize, and retards evaporation by its affinity for water. In works where the brine is boiled by artificial heat, the bitter water, combined with salt in crystals, adheres to the surface of the kettles or boilers and forms what is known as "bitterns," frequently found incrusted three inches in thickness, causing a rapid destruction of the boilers and lessening the effects of the heat upon the water. Increasing the strength of brine by evaporation causes the separation and deposit of such ingredients as are contained in the same solution which have a less affinity for water than the salt. This separation is caused by depriving them of the water which held them in solution, no more water remaining than is required or appropriated by the salt. In the methods of manufacture of salt now in use—that is, with open kettles and vats—the salt crystallizes before the muriates of magnesia and lime, and the bitter water increases in amount as the boilers or vats are replenished with brine until the whole has to be thrown away and the kettles cooled down to remove the bitterns, which is the most serious difficulty in the manufacture of salt.

According to authors, water will hold but a very little more salt in solution when heated than when cold. This is true in open vessels or when subjected to the pressure of the atmosphere only. In the air water can only be heated to 212° and brine to 226°, consequently that is the limit to which the solution of salt can be carried.

My invention depends in part upon the discovery that water may be may be heated under pressure of steam to a sufficient extent, and the evaporation carried so far before the crystallizing of the salt as to cause the separation or crystallization and deposit of the muriates of lime and magnesia, while the salt remains in solution. I have described such an arrangement as that the impurities will all be crystallized and deposited in a part of the boiler distant from the fire-surface. It is therefore obvious that if the salt is prevented from adhering by reason of being kept in solution that no trouble can arise from incrustation. It contemplates the removal of the brine from the boiler after the impurities are all removed and deposited in the settling-chamber, the brine being perfectly pure. No other impurities than those enumerated are found to any injurious extent in the brines of the United States.

By keeping the force-pump constantly at work a current is kept up through the steam-chamber, and the brine thus heated and mixed passes from the chamber into the large tube D and thence into the settling tubes or chamber beneath the platform in the vat. From there it passes into the boiler near the bottom, and thus the boiler is kept supplied with brine. The pressure in the boiler is regulated by a safety-valve. This process of evaporation is continued until the brine in the boiler is brought to near saturation. The current through the settling tubes or chamber is so slow as to allow the impurities to deposit before the brine passes into the boiler, where it comes in contact with the fire-surface. The steam raised in the boiler actuates the steam-engine, and then escapes into the heating-pipes extended several times the length of the salting-vat and under the platform, the object being to have sufficient length of heating-pipe to use all of the heat in the escape-steam for crystallizing the salt in the vat. The force-pump is made to throw brine into the boiler slightly faster than it is evaporated, by which means the boiler is filled and the steam-chamber is nearly filled with brine. As soon as it is ascertained that the brine is near the strength when salt would begin to form, the pipe J is opened, and all the brine contained in the boiler above the discharge-pipe is blown out and into the salting-vat, where the salt rapidly crystallizes and falls upon the platform. This process of filling and alternately discharging brine from the boiler may be continued until the settling-chamber is filled with impurities deposited from the brine, when the chamber may be opened and the impurities removed.

The settling-chamber may be opened by a man-hole, which is usually made in boilers for the purpose of entering and removing incrustations or deposits.

By the use of the platform in the vat the salt is arrested in its descent from the surface of the brine where crystallization commences, and consequently none is formed underneath the platform or in contact with the iron steam-pipes; otherwise the salt would become stained by the iron-rust.

The paddle-wheel serves when revolving to draw the brine from below the platform to the upper surface. The paddle-wheel gives a centrifugal motion to the water, and draws it upward through the opening under the wheel, causing a rapid circulation of the water from the upper to the lower surface of the platform, and vice versa. After being partially cooled by evaporation it passes down past the edge of the platform, and is again heated by coming in contact with the steam-pipes. If more brine is purified in the boiler than can be evaporated by the escape-steam in the vat, it may be drawn into open solar-vats and the crystallization completed.

This process may be continued under any pressure of steam that may be required for actuating powerful steam machinery.

Heretofore the contact of such impurities as sulphate of lime, iron, muriate of lime, and muriate of magnesia with the fire-surface of boilers has incrusted the surface to such an extent as to greatly retard the evaporation of the brine, to cause the rapid destruction of the iron, and require the frequent cooling down of boilers for removing the bitterns or

incrustation. In the process described no incrustation forms on the fire-surface or within the boiler, and it may be continued without interruption for months, or until the settling-chamber is filled with impurities.

The crude brine is poured into the steam-chamber of the boiler, in order that it may become highly heated by the steam, causing rapid evaporation and consequent increase of its strength, and by being mixed with a portion of strong brine, which is thrown into the steam-chamber from the boiler below, its strength is raised sufficiently to cause the crystallizing or separation of its impurities while the salt remains in solution—that is, before the brine has reached the point of saturation. It is then passed into the settling-chamber, which may be made of any convenient form or size, where it is sufficiently free from the currents caused by the fire in the boiler to allow the impurities to deposit. The boiler is supplied with pure brine from the settling-chamber, and a large portion may be drawn into the salting-vat before crystallization commences. By the rapid working of the forcing-pump, the boilers are again filled, the engine kept constantly in motion, and the escape-steam completes the evaporation in the salting-vat. In all other processes the impurities adhere to the fire-surface in the form termed "bitterns," and greatly retard the effect of the heat in the evaporation of the water, and render it necessary to frequently cool down the works to remove the incrustations. In the above process the impurities do not come in contact with with the fire-surface, and the fire may be run so as to hold the steam at a high pressure for months without interruption, giving the full power of steam, as in ordinary steam-boilers, the prominent object of the invention being the procuring of pure salt. The brine is brought to sufficient strength in the steam-chambers to cause the crystallization of all the impurities before it passes into the settling-chamber. They remain mixed with the brine until it becomes quiet, when the crystals are deposited in the settling-chamber and the pure brine passes on into the boiler, where it comes in contact with the fire-surface. If, however, some of the impurities get into the boiler by reason of the process being hurried, they do not adhere to the fire-surface, but are found in the bottom of the boiler.

The apparatus described is to illustrate the process of purifying brine by artificial heat in such a manner as that neither the salt or its impurities become incrusted upon the fire-surface of the boiler, and also a method by which boilers used in the manufacture of salt may be used for generating steam to propel the steam-engine for any desirable length of time without detriment from either salt or its impurities, and also a method of preventing the contact of crystals of salt with iron pipes in the bottom of salting-vats.

The process of purifying brine is indispensable to the use of brine in steam-engine boilers, and the engine in turn works the pumps and paddle-wheel, by which the described process of making pure salt is made complete.

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

1. Mixing weak with strong brine in the steam-chamber of the boiler for the purpose described, and passing the brine thus mixed into a settling apartment or chamber connected with the lower part of the boiler, and thereby causing the separation and deposit of impurities from the brine before it comes in contact with the fire-surface of the boiler, substantially as set forth.

2. The method described of purifying brine—viz., by evaporating it in closed boilers to such an extent as to cause the separation and deposit of its impurities while under pressure of steam, in combination with vats for crystallizing the salt from the brine thus purified.

SAMUEL B. HOWD.

Witnesses:
GEORGE D. REDFIELD,
Z. CHAS. FOOT.