Aug. 11, 1931. H. BERGQUIST 1,818,188

LIQUID TREATING APPARATUS

Original Filed March 29, 1922 3 Sheets-Sheet 1

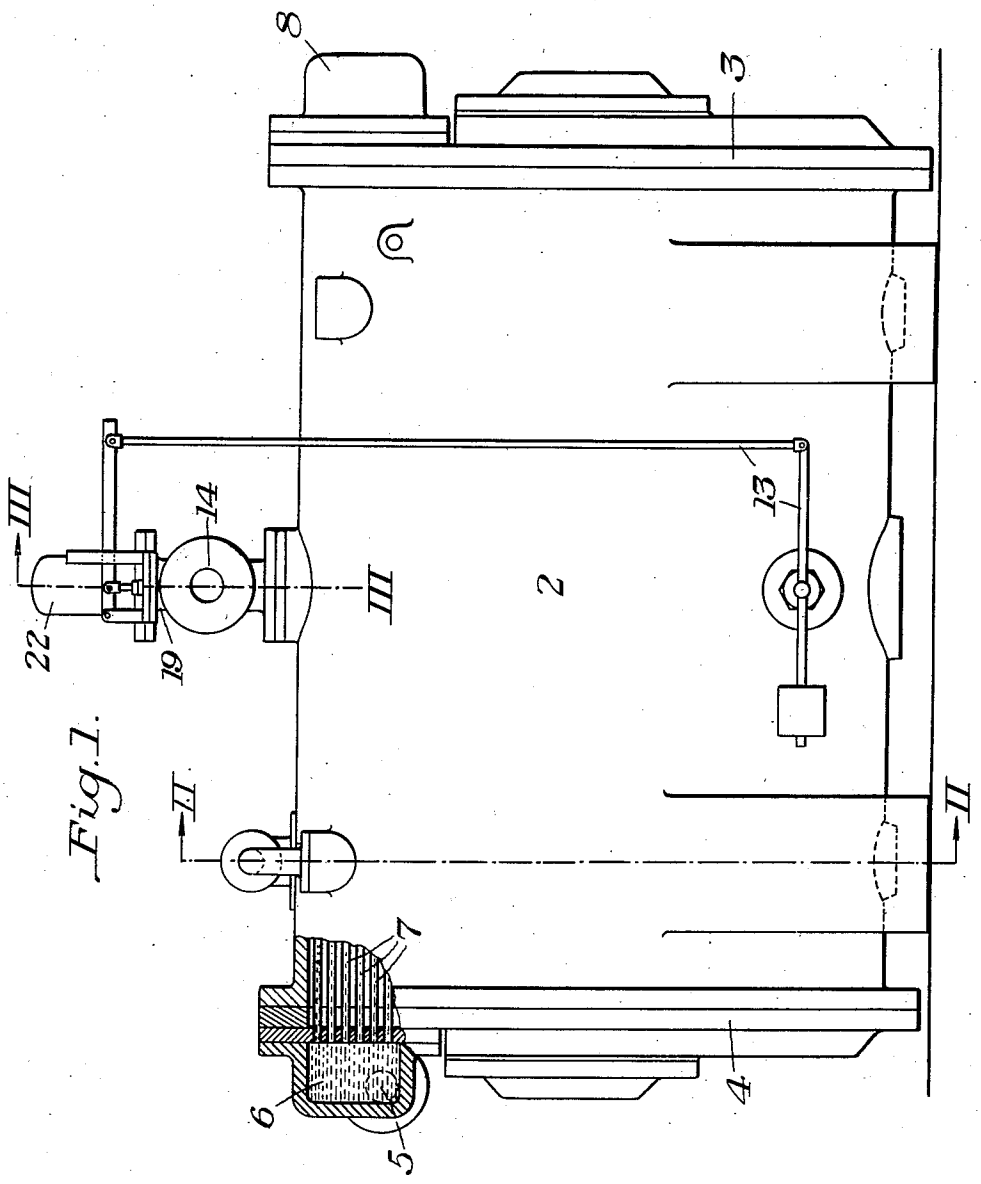


Fig. 1.

INVENTOR
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LIQUID TREATING APPARATUS

Original Filed March 29, 1922 3 Sheets-Sheet 2

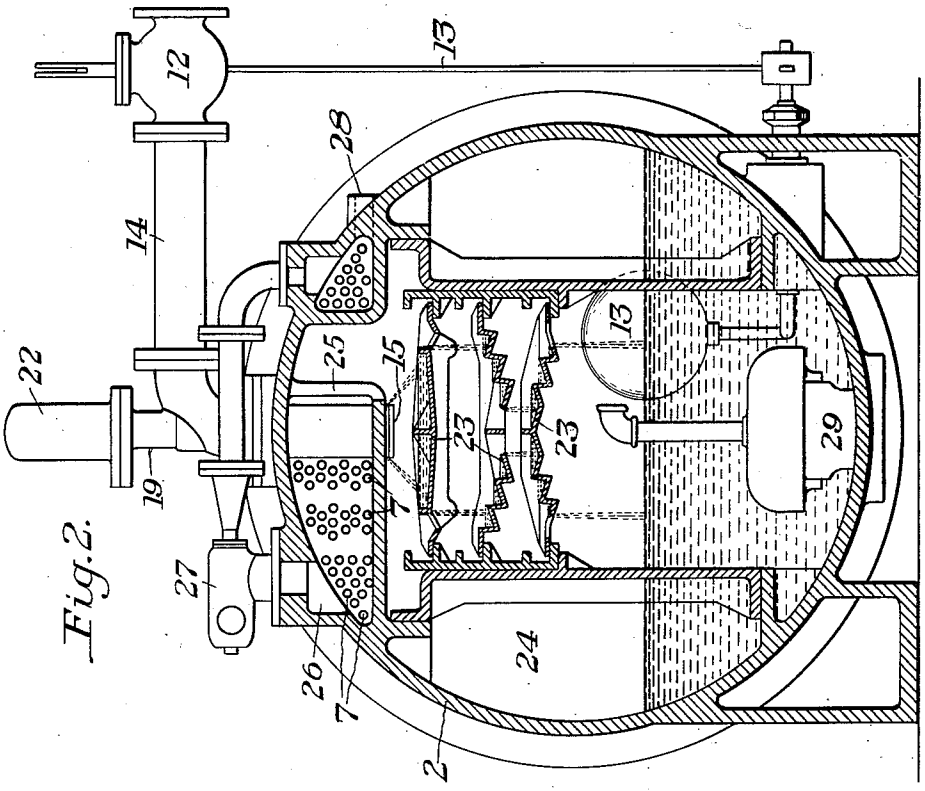


Fig. 2.

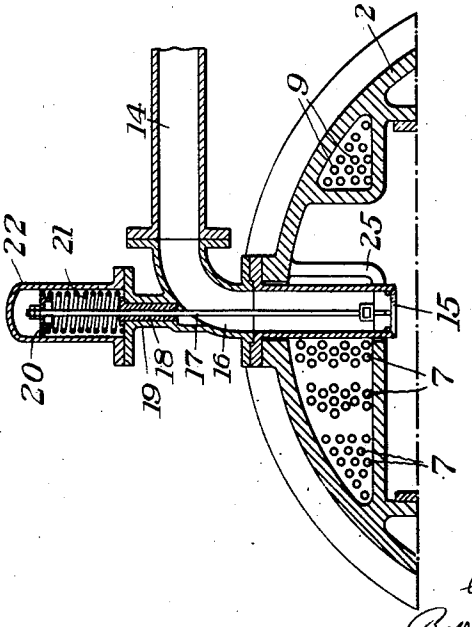


Fig. 3.

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LIQUID TREATING APPARATUS

Original Filed March 29, 1922 3 Sheets-Sheet 3

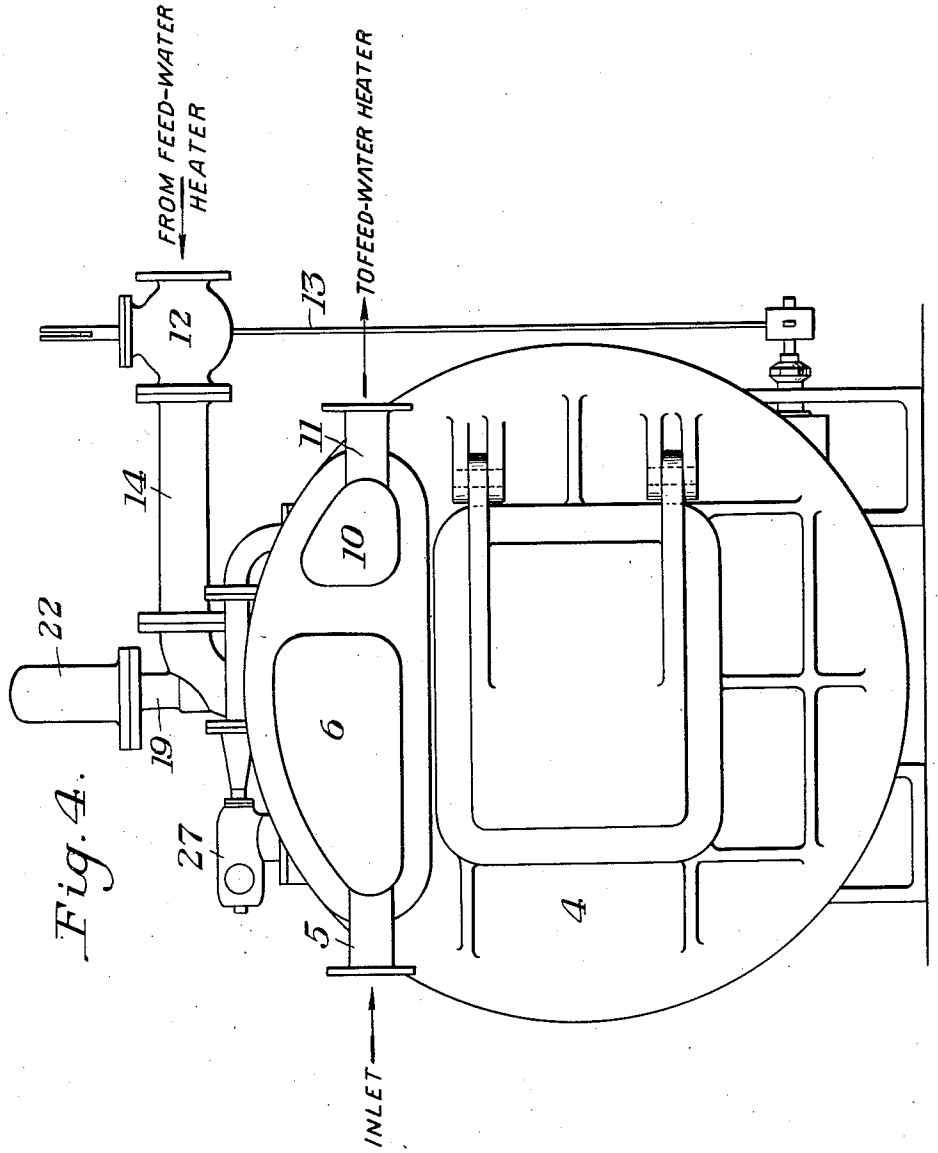


Fig. 4.

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Patented Aug. 11, 1931 1,818,188

UNITED STATES PATENT OFFICE

HUGO BERGQUIST, OF SWISSVALE, PENNSYLVANIA, ASSIGNOR TO ELLIOTT COMPANY, OF PITTSBURGH, PENNSYLVANIA, A CORPORATION OF PENNSYLVANIA

LIQUID TREATING APPARATUS

Original application filed March 29, 1922, Serial No. 547,868. Divided and this application filed June 15, 1927. Serial No. 198,912.

The present invention relates broadly to liquid treating apparatus and more particularly to apparatus of this character adapted to effectively degassify or deaerate water for use in heating systems, boiler installations, economizers and the like, for the purpose of decreasing the incrustation producing or corrosive properties of the water. The invention, however, is not limited with respect to the use to which the water is put.

It has heretofore been customary in apparatus of this general character as illustrated, for example, in the patent to W. S. Elliott, No. 1,321,999 of November 18, 1918, to provide a series of separate organized pieces of apparatus to carry out the various functions contemplated. Such separate pieces are assembled in any desired relationship, one exterior to the other, by the use of suitable piping or connections. Such a construction not only involves a great deal of expense, but it also entails a certain loss of pressure due to the resistance to vapor flow through the connecting piping or passages. Likewise, the amount of room required for such an installation and the possibility of increased air infiltration are both factors of importance.

With individual units as referred to, the pressure loss is particularly noticeable between the evaporating chamber and the condenser, and this necessarily results in the loss or decrease of efficiency. By the present invention the objectionable features referred to are obviated and advantageous results are obtained.

I have also found that where vapor enters a condenser through a relatively restricted inlet, there is apt to result a flow through the nests of tubes which flow is localized at a point where the vapor is introduced. This operation results from the use of separate units or pieces of apparatus assembled as generally contemplated and as hereinbefore referred to. By an organization in accordance with the present invention, I am able to produce a uniform flow through the condenser and also to maintain therein the desired vapor velocity.

In the accompanying drawings there are shown for purposes of illustration only, certain preferred embodiments of the present invention, it being understood that the drawings do not define the limits of my invention as changes in the construction and arrangement disclosed therein may be made without departing either from the spirit of the invention or the scope of my broader claims.

In the drawings,

Figure 1 is a side elevation partly broken away, illustrating one form of apparatus for treating liquid in accordance with the present invention;

Figure 2 is a vertical sectional view on the line II—II of Figure 1, looking in the direction of the arrows;

Figure 3 is a partial detail sectional view on a line III—III of Figure 1; and,

Figure 4 is an end elevation of the left hand end of the apparatus as viewed in Figure 1.

The invention is concerned primarily with that class of apparatus in which the liquid to be treated is first heated and then enters the chamber wherein there is maintained a pressure such that a portion of the liquid evaporates. This evaporation is due to an instantaneous boiling or exploding of the liquid resulting from the liberation of heat supplied by the liquid itself. This results in the release of the entrained air and gases, and the condensation of the condensible portion thereof. This condensing is preferably effected in such manner that the heat released by the vapors and gases is utilized. As the invention becomes better understood, however, it will be apparent that certain advantages of the invention are obtainable irrespective of the specific manner of operation of the apparatus provided the operation is such as to result in the release of vapors and gases.

In carrying out the present invention, there may be provided a container 2 preferably of generally cylindrical shape and provided with removable heads 3 and 4. This container, in accordance with the present invention, may constitute a casing within which are arranged all or part of the different units utilized in effecting the desired treatment of the liquid. With this form of my invention the liquid to be treated may be supplied to the

apparatus through a suitable inlet connection 5 communicating with a chamber 6 on the head 4. This chamber is in turn adapted to deliver the liquid to the tubes 7 of a condenser located within the container 2. The opposite ends of the tubes 7 discharge the liquid into a header 8 carried by the head 3. This header communicates in turn with the tubes 9 of a secondary condenser located within the container 2, whereby the liquid after leaving the tubes 7 of the primary condenser flows through the tubes 9 of the secondary condenser and thence into a chamber 10 on the head 4. This chamber may be provided with an outlet connection 11 which may lead to any desired form of feed water heater located at any preferred point with respect to the container 2. In some instances I have found it desirable to position the feed water heater entirely within the container 2.

After leaving the feed water heater in which it is raised to any desired temperature, the liquid is adapted to be delivered to a master control valve 12, the flow through which may be regulated by a suitably arranged float operated mechanism 13 actuated by the level of the liquid within the container 2 in known manner. After leaving the master controlling valve, the liquid is adapted to be delivered through a suitable connection 14 to one or more secondary valves 15. These valves, while they may be of a large number of different constructions, are preferably of the type shown and claimed in my copending application Serial No. 536,371 filed Feb. 13, 1922. In accordance with this form of my invention, the secondary valves each comprise a chamber 16 preferably vertically disposed and of such depth as to permit the accumulation of the desired head of water above the valve. Extending upwardly from each of the valves, and suitably secured thereto, is a valve stem 17 passing through a suitable bushing or packing 18 in a casing 19. The upper end of each of the valve stems is preferably screw threaded to receive an adjustable filler head 20 by means of which the compression of the spring 21 may be varied as required. The upper end of each valve stem, and also the compression spring, may be protected as, for example, by the provision of a removable cap 22.

Where a secondary valve of this character is utilized, it will be apparent that the adjustment of the compression spring will determine the static head of water within the chamber 16, and that this may be varied to obtain any static head required for a given operating condition. For example, if the spring is so set that the static head necessary to overcome the tension thereof is equivalent to two feet of water, the valve will immediately begin to open as soon as the water in the chamber above the same rises to a distance of two feet. As this head increases, the extent to which the valve opens likewise increases. In this manner, there is insured at all times, a substantially uniform velocity of discharge whereby the desired rate and manner of distribution are accurately controlled.

For effecting a further breaking up and distribution of the liquid, the secondary valve is adapted to deliver the liquid to suitably arranged distributors 23 in the chamber 24 within the container 2. The spring of the secondary valve naturally restrains the opening of the valve, whereby the liquid will issue into the chamber 24 with considerable velocity. This, in combination with the distributing means provided, effectively breaks up the liquid into fine particles or thin sheets, enabling the entrained gases and vapors to immediately free themselves from the liquid.

Within the chamber 24 I maintain a pressure having such a value that the heated liquid sprayed thereinto will be instantly boiled or exploded due to the release of a portion of its contained heat, thereby resulting in the partial evaporation of the liquid and the instantaneous release of its entrained air and gases. For example, if I maintain within the chamber 24 a pressure of five pounds per square inch absolute, water would boil in this chamber at a temperature of approximately 162° F. If the temperature of the water immediately before it passes the valve 15 is in excess of 162° F., a portion of it will be evaporated in the chamber 24 in the manner described.

The vapor released during this evaporation, together with the released gases, will enter the primary condenser and pass around the tubes 7 therein. Due to the location of this condenser within the container 2, it may be formed with an opening 25 extending the entire length, or major portion of the length, of one of its sides. This permits a uniform flow through the nests of tubes within the condenser of a character which cannot be produced when the vapor and gases are locally supplied to the condenser through a restricted inlet. Furthermore, with a condenser of the construction illustrated, it will be apparent that the area available for the flow of vapor and gases therethrough, decreases toward the outlet 26 of the condenser. This arrangement permits a proper proportioning of the flow areas for the vapor and gases therethrough. It is desirable to have the available flow area diminish as the vapor penetrates into the condenser for the reason that the vapor is condensed by the first tubes against which it impinges, whereby the volume of flow decreases as penetration into the condenser increases. In order to maintain a constant velocity, or a velocity of such nature that the tubes are swept clear of any accumulation of gas or vapor, it is desirable that the flow area should decrease in the manner referred to.

During the passage of the vapor and gases through the primary condenser, it will be apparent that the heat thereof is absorbed by the incoming liquid passing through the tubes 7. In this manner, the heat of the vapor and gases is utilized in effecting a partial preheating of the liquid. The primary condenser also serves the purpose of establishing and maintaining a definite pressure in the chamber 24, whereby the results hereinbefore set forth may be produced.

In order to remove the non-condensible gases from the primary condenser, I may make use of a suitable pump 27 of any well known type. This pump, however, is preferably of the steam ejector type. The entraining steam may be delivered thereto in any desired manner, and preferably exhausts from the ejector into the secondary condenser from which it may escape to the atmosphere through a suitable outlet 28.

By this arrangement the heat of the exhaust steam is also utilized for further raising the temperature of the liquid flowing from the primary condenser through the tubes 9 of the secondary condenser. In this manner it is possible to retain practically all of the heat utilized in the operation of the organized apparatus. It will be apparent that, if desired, the flow of liquid may be reversed in the apparatus, whereby it will flow first through the tubes of the secondary condenser and then through the tubes of the primary condenser.

Where the apparatus is operated under atmospheric pressure conditions, the use of exhausting means of the character referred to is made unnecessary and the primary condenser may discharge directly to the atmosphere.

The deaerated or degassified liquid may be withdrawn from the container through a suitable outlet connection 29, from which it may be lead to any point for use as desired.

The present application constitutes a division of my copending application Serial No. 547,868 filed March 29, 1922, and in which I have disclosed and claimed a construction of the general character herein described together with the provision of means for reducing the temperature of the liquid after it has been treated in the chamber 24.

By the present invention, there is provided an apparatus which utilizes to advantage the spaces within the chamber of the container, thereby reducing the cost of independent containers and heat exchangers necessary for the practice of this system of liquid treatment. The apparatus is compact, accessible and may be inexpensively installed and operated. It thus possesses many advantages over apparatus as heretofore provided for this general purpose.

The condenser structure is also such as to receive and condense vapors under conditions tending to higher efficiency.

I claim:

1. In a liquid treating apparatus, a container having a liquid space and a vapor space, a primary condenser in said vapor space and enclosed within said container, an ejecting means therefor, a secondary condenser within said vapor space and enclosed within said container, said ejecting means discharging into said secondary condenser, and means for passing the liquid to be treated in series through said condensers.

2. In a liquid treating apparatus, a container having a series of units enclosed therein, means for passing liquid in series through such units and delivering it to said container and causing a partial evaporation thereof, means for automatically controlling the supply of liquid, at least one of said units constituting a condenser, and means cooperating with said condenser for effecting the withdrawal of non-condensible gases from said container.

3. In a liquid treating apparatus, a container having a series of units enclosed therein, means for delivering liquid to said container and bringing the same into pressure equilibrium with the pressure conditions obtaining therein, means for automatically controlling the supply of liquid, at least one of said units constituting a condenser, and ejecting means cooperating with said condenser for effecting the withdrawal of non-condensible gases from the container, said ejecting means discharging into another of said units.

4. In a liquid treating apparatus, a container having a series of units enclosed therein, means for delivering liquid to said container and bringing the same into pressure equilibrium with the pressure conditions obtaining therein, means for automatically controlling the supply of liquid, at least one of said units constituting a condenser, and means cooperating with said condenser for effecting the withdrawal of non-condensible gases from the container, there being a second condenser cooperating with said last mentioned means for receiving the discharge therefrom.

5. In a liquid treating apparatus, a container comprising a chamber forming an evaporating chamber and having a plurality of condensers therein having separate vapor spaces, means for passing the liquid to be treated serially through said condensers during its passage to said evaporating chamber, and gas withdrawing means interconnecting the respective spaces.

6. In a liquid treating apparatus, a container having a liquid space and a vapor space, a plurality of heat exchange units of different capacities in said vapor space, means for passing the liquid to be treated in series through said units, means for controlling the flow of liquid through said units in accord-

ance with the demands in said apparatus for treated liquid, and means for effecting the passage of gases through said units at a different pressure for each unit.

7. In a liquid treating apparatus, a container comprising a chamber forming an evaporating chamber and having a plurality of condensers therein, means for passing the liquid to be treated serially through said condensers during its passage to said evaporating chamber, at least one of said condensers having a vapor inlet extending longitudinally thereof throughout the major portion of its length to provide a uniform vapor flow into and through the condenser, and means for withdrawing vapors and gases from the condenser having the elongated vapor inlet and discharging them into another condenser.

8. In a liquid treating apparatus, a container providing an evaporating chamber having a vapor space and a liquid space, a plurality of condensers within said chamber and each having a vapor space and a liquid space, said condensers being of such construction that the cross sectional area thereof in the direction of vapor flow gradually decreases, and means for withdrawing vapors and gases from adjacent the flow terminus of one condenser and discharging them into the other condenser.

9. In a liquid treating apparatus, a container having a liquid space and a vapor space, a primary condenser in said vapor space and enclosed within said container, a restricted discharge conduit therefor, a secondary condenser within said vapor space and enclosed within said container, said conduit discharging into said secondary condenser, means insuring the discharge of non-condensible gases from said condensers, and means for passing the liquid to be treated in series through said condensers.

10. In a liquid treating apparatus, a container having a liquid space and a vapor space, a primary condenser in said vapor space and enclosed within said container, a secondary condenser within said vapor space and enclosed within said container, means including a relatively small conduit for conducting vapors from the primary to the secondary condenser, means for passing the liquid to be treated in series through said condensers, and means for automatically controlling the flow of liquid through all of said condensers in accordance with the demands on said apparatus for treated liquid.

11. In a liquid treating apparatus, a container having a series of units enclosed therein, means for delivering liquid to said container through a series of said series of units enclosed therein and bringing the same into pressure equilibrium with the pressure conditions obtaining therein, means for automatically controlling the supply of liquid, at least one of said units constituting a condenser, and means cooperating with said condenser for effecting the withdrawal of non-condensible gases from the container, there being a second condenser cooperating with said last mentioned means for receiving the discharge therefrom.

In testimony whereof I have hereunto set my hand.

HUGO BERGQUIST.