No. 652,210.

Patented June 19, 1900.

W. W. HARRIS.

REFRIGERATING APPARATUS.

(Application filed Jan. 20, 1899.)

(No Model.)

7 Sheets—Sheet 1.

Fig. 1.

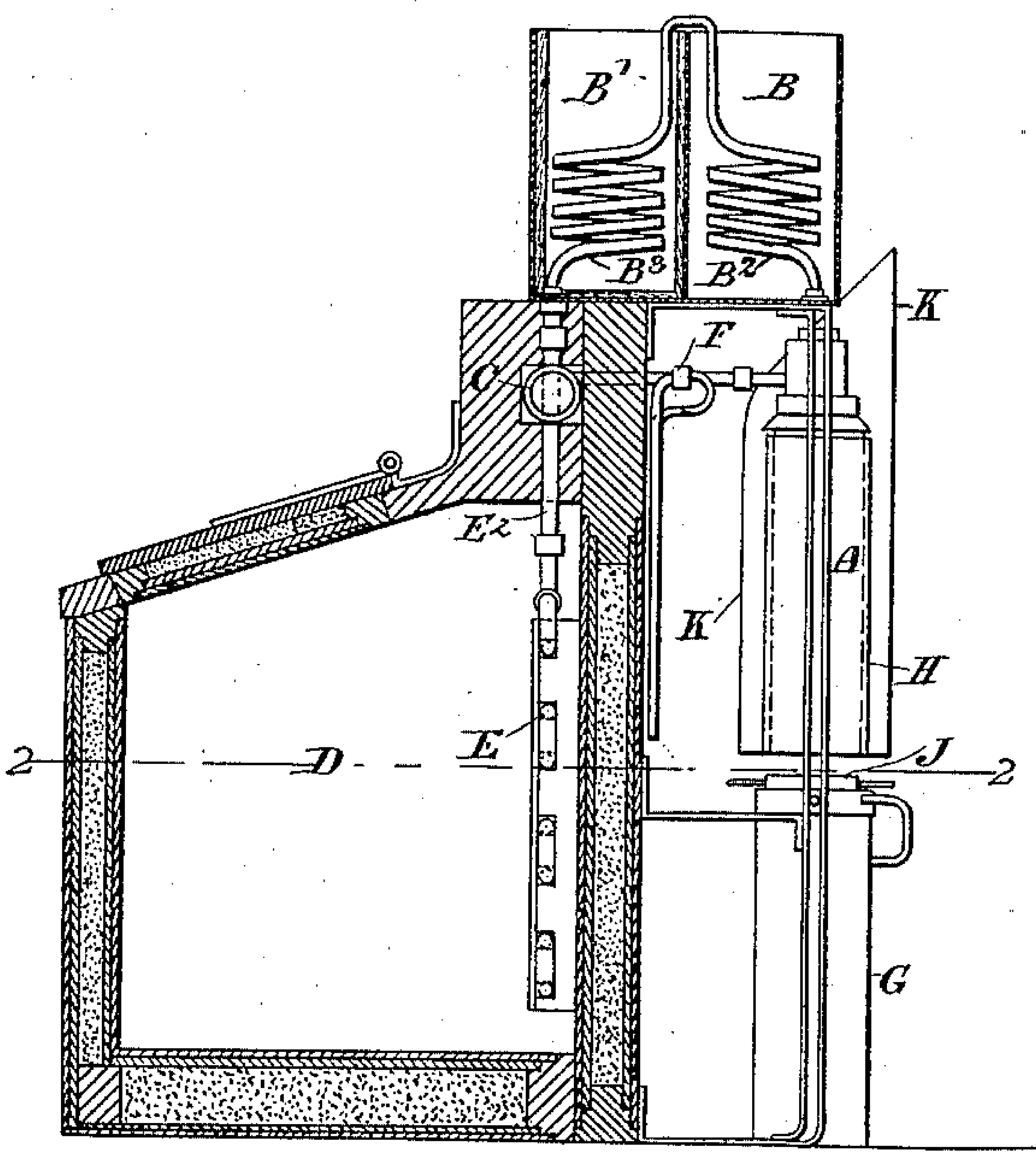

Fig. 3.

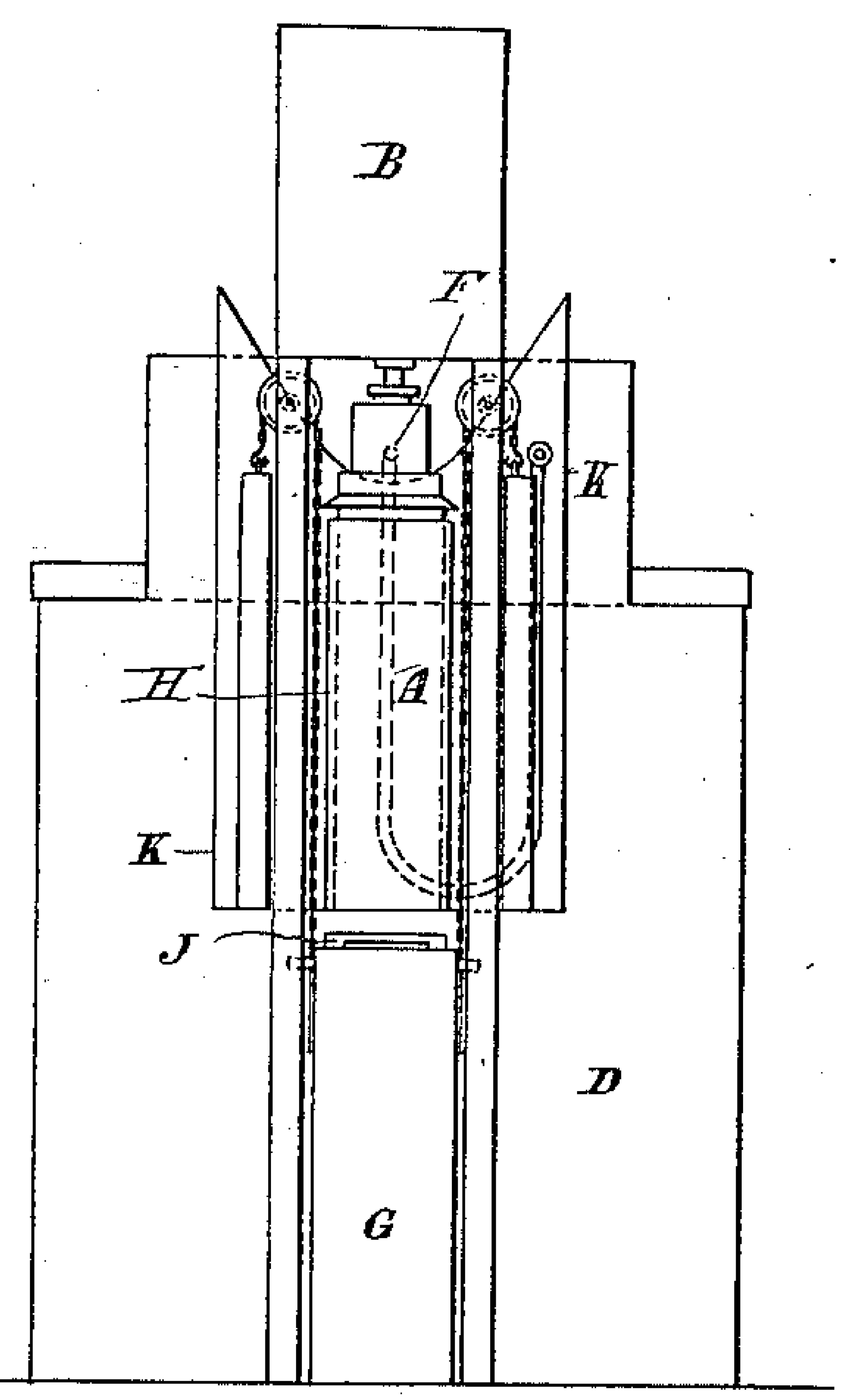

Fig. 2.

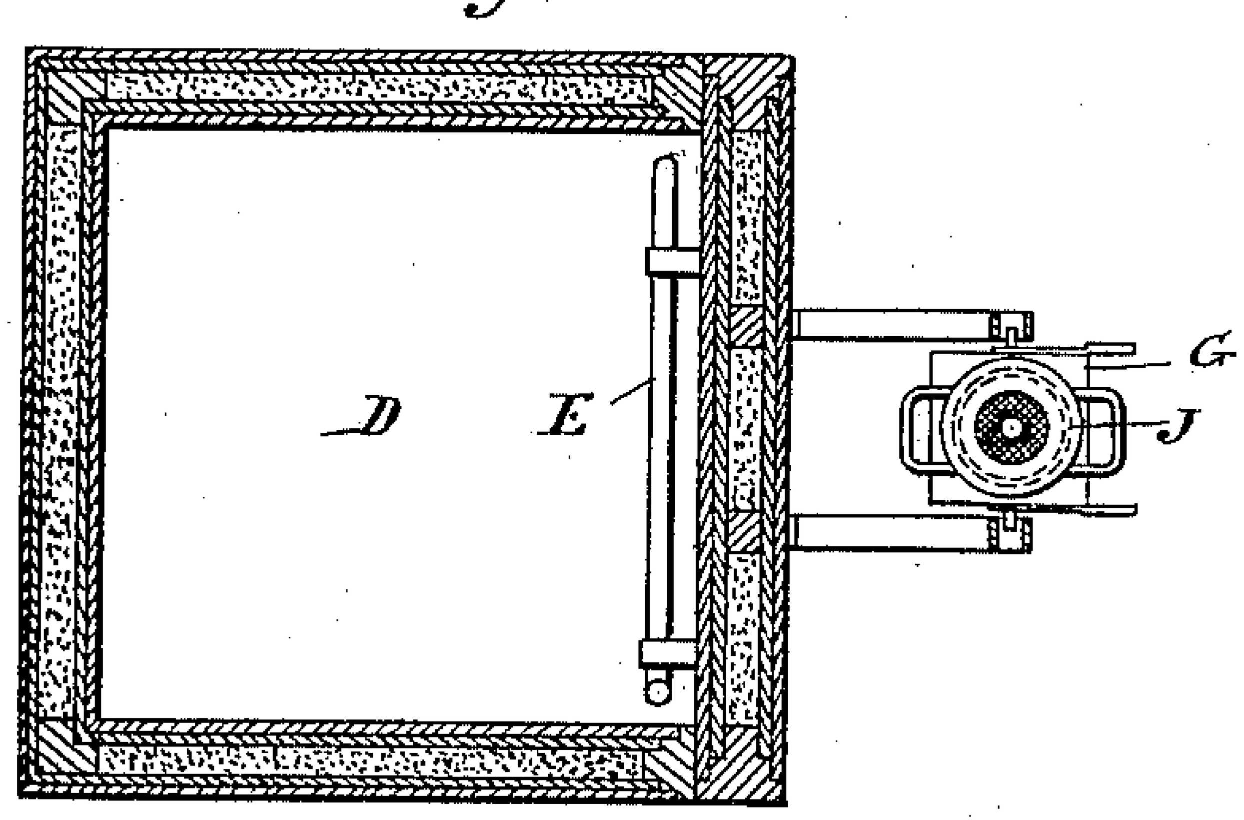

Fig. 4.

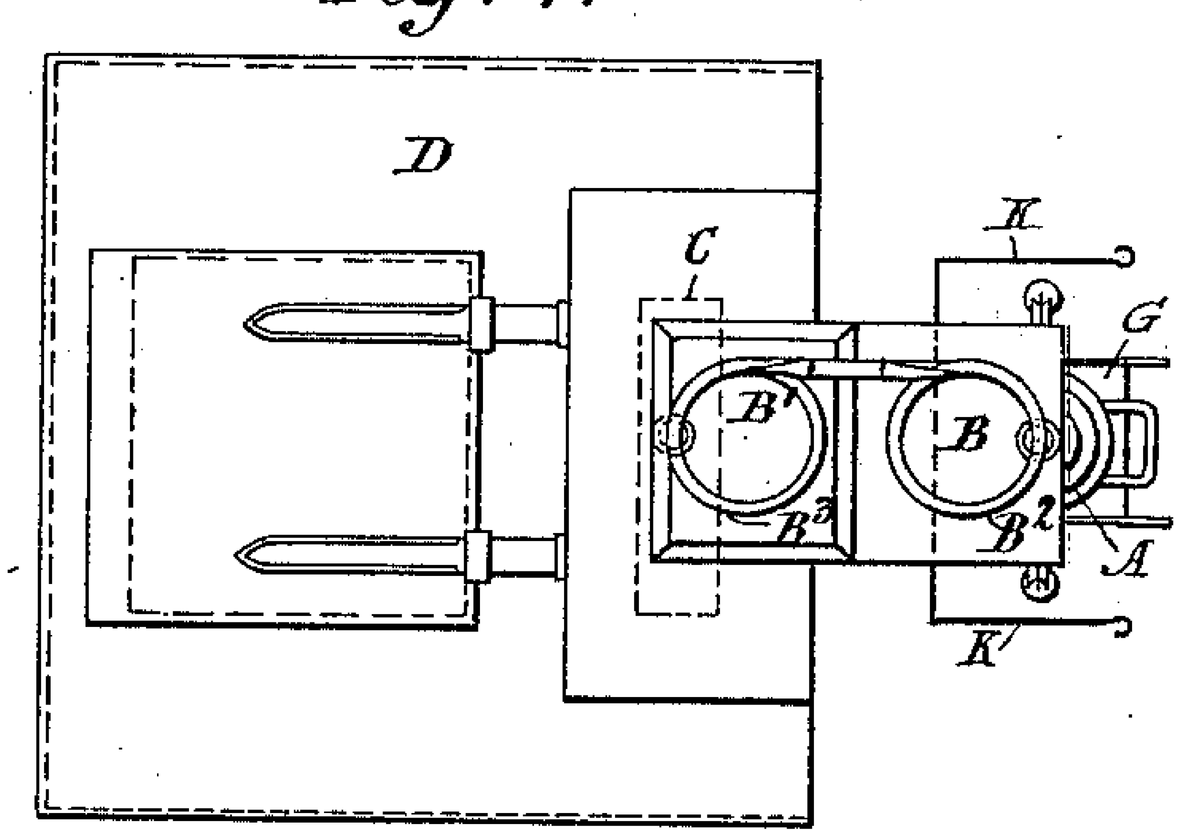

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Fig. 5.

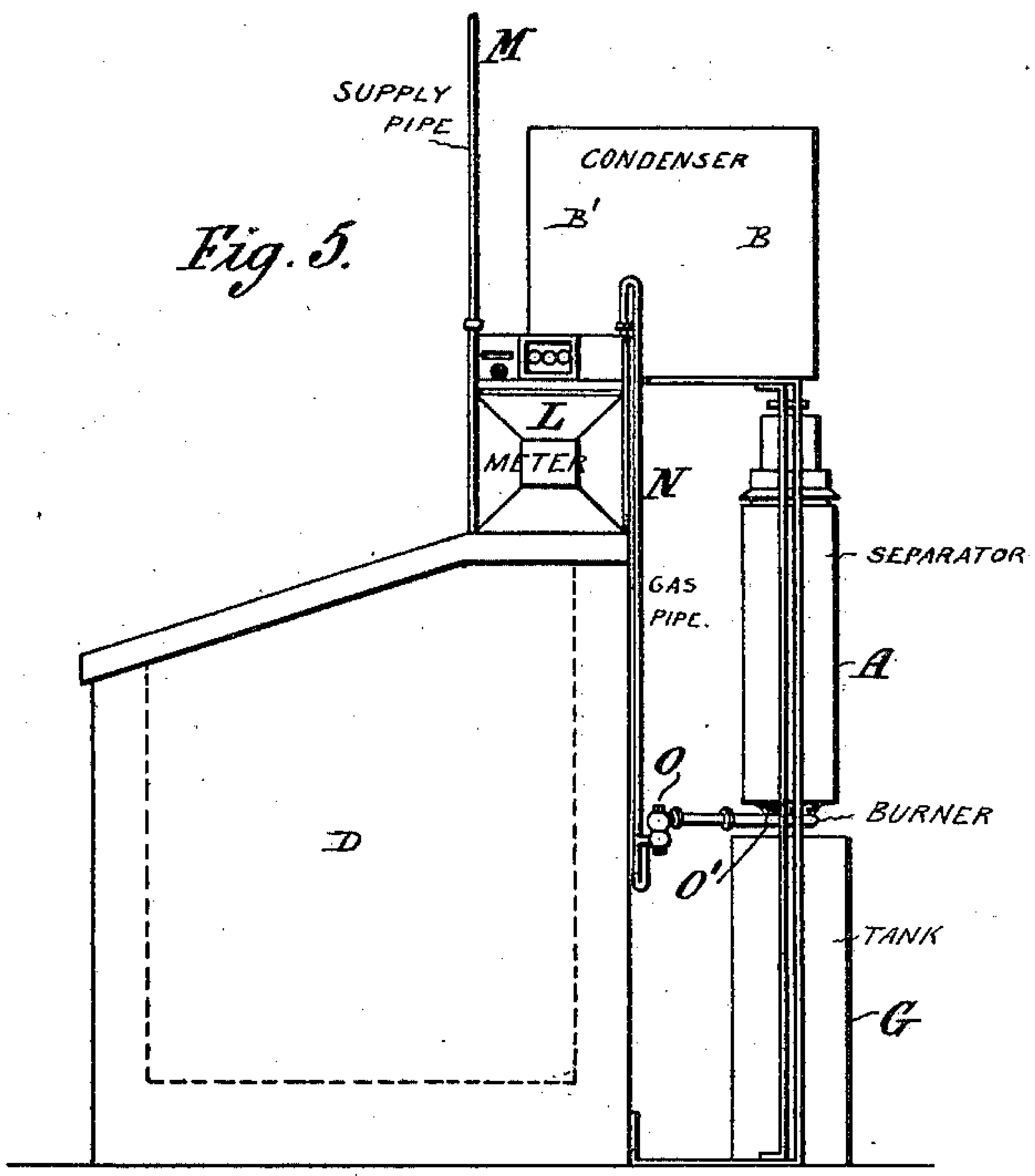
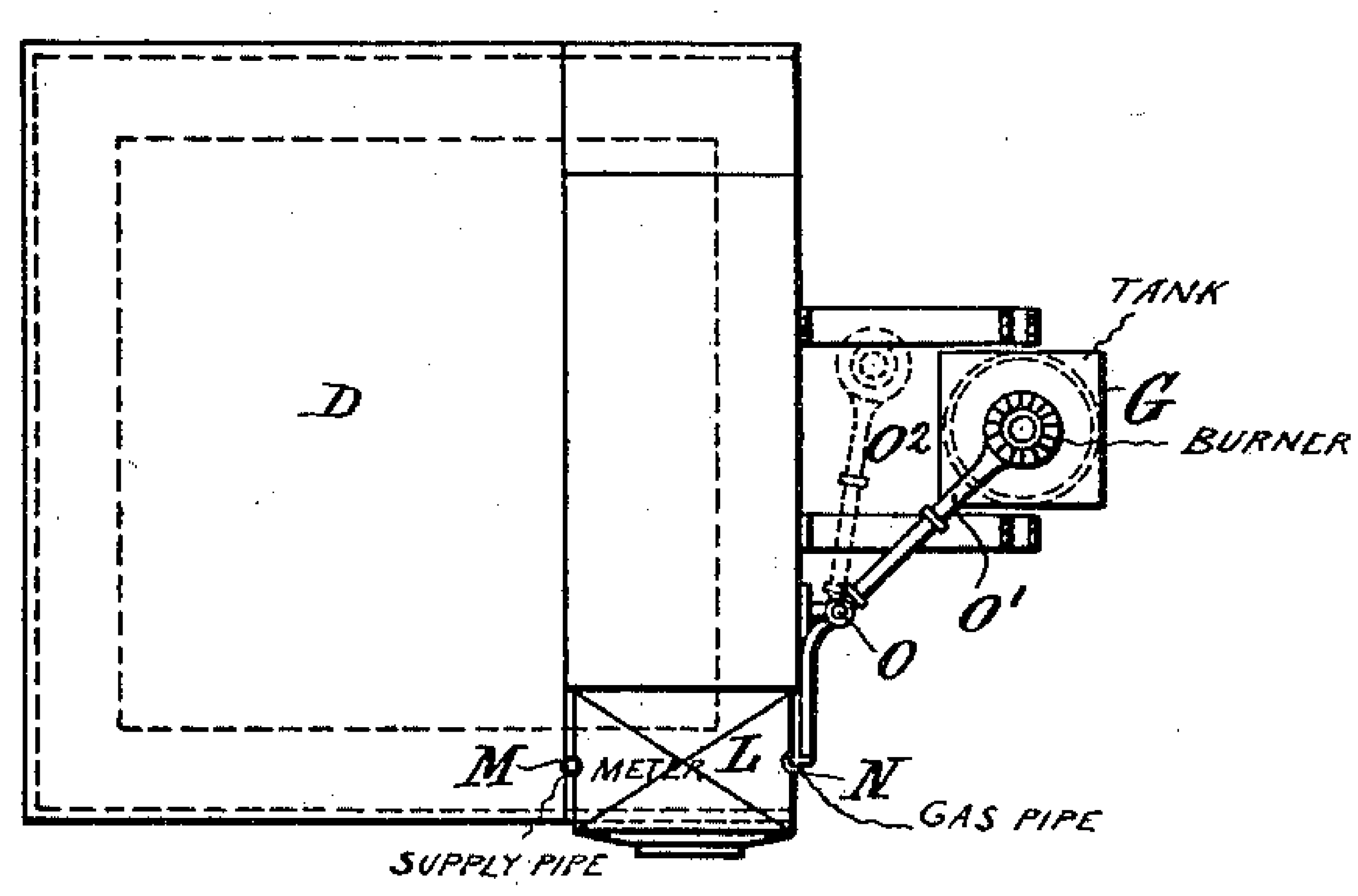


Fig. 6.



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REFRIGERATING APPARATUS.

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(No Model.) 7 Sheets—Sheet 3.

Fig. 7.

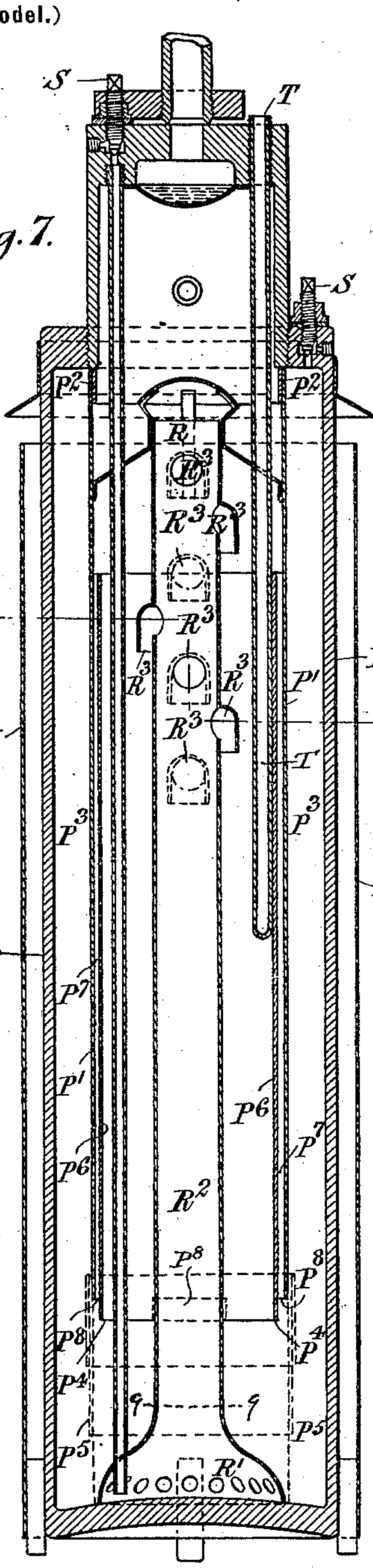


Fig. 8.

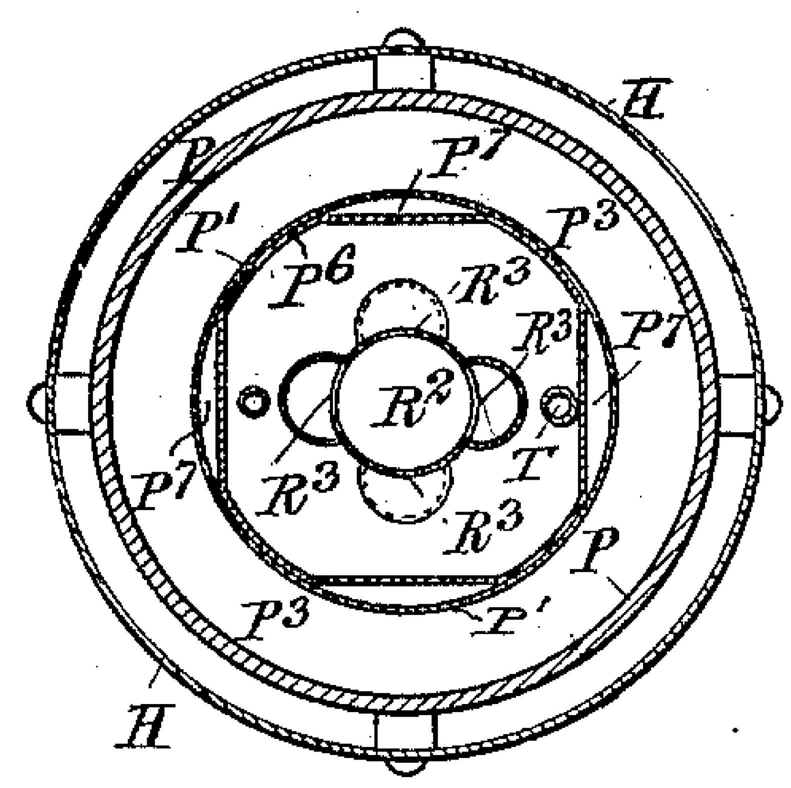


Fig. 9.

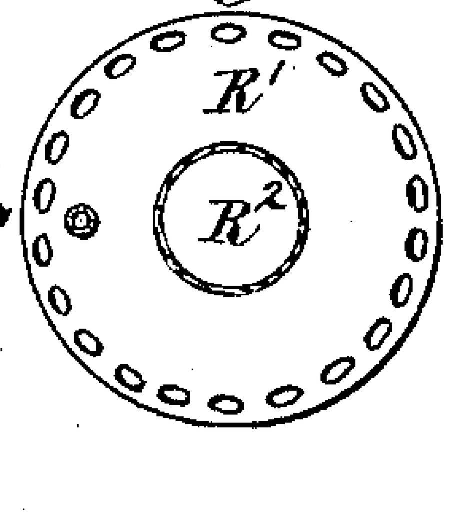


Fig. 10.

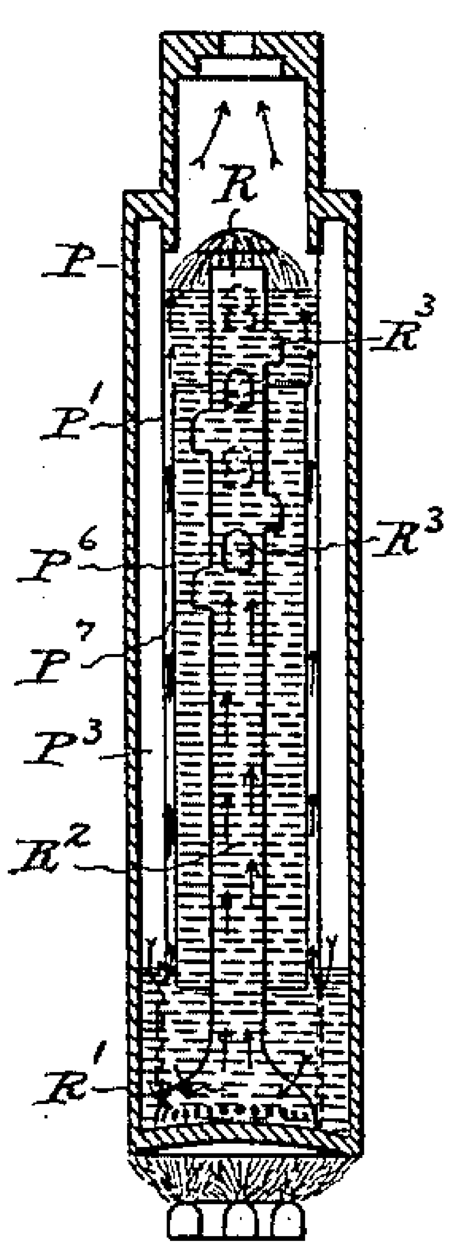


Fig. 11.

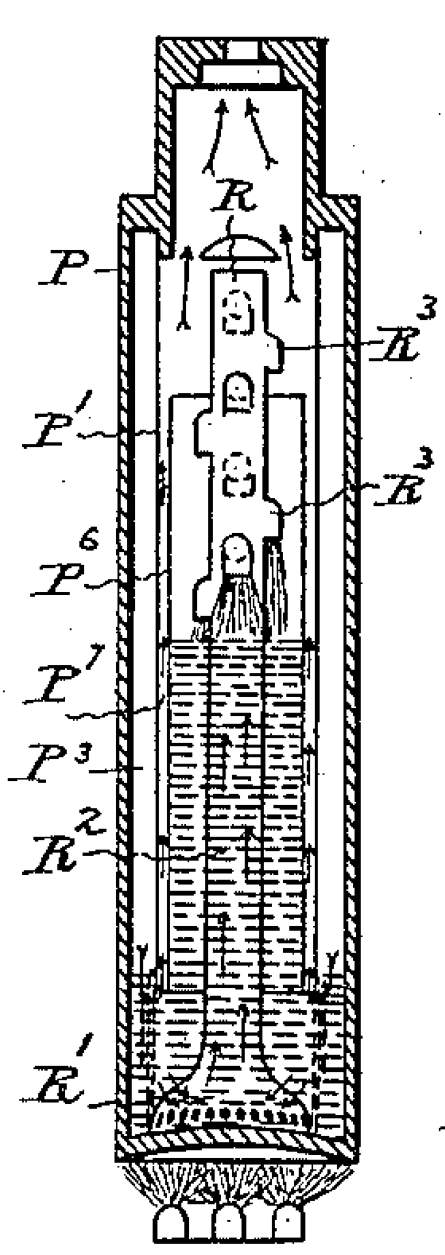
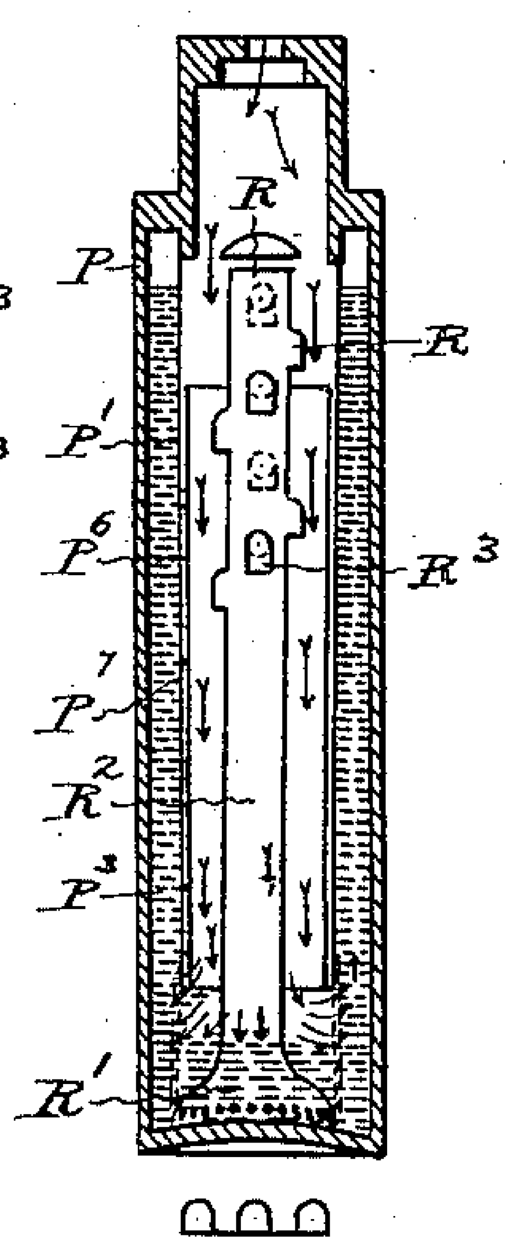


Fig. 12.



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THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

No. 652,210. Patented June 19, 1900.

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Fig. 13.

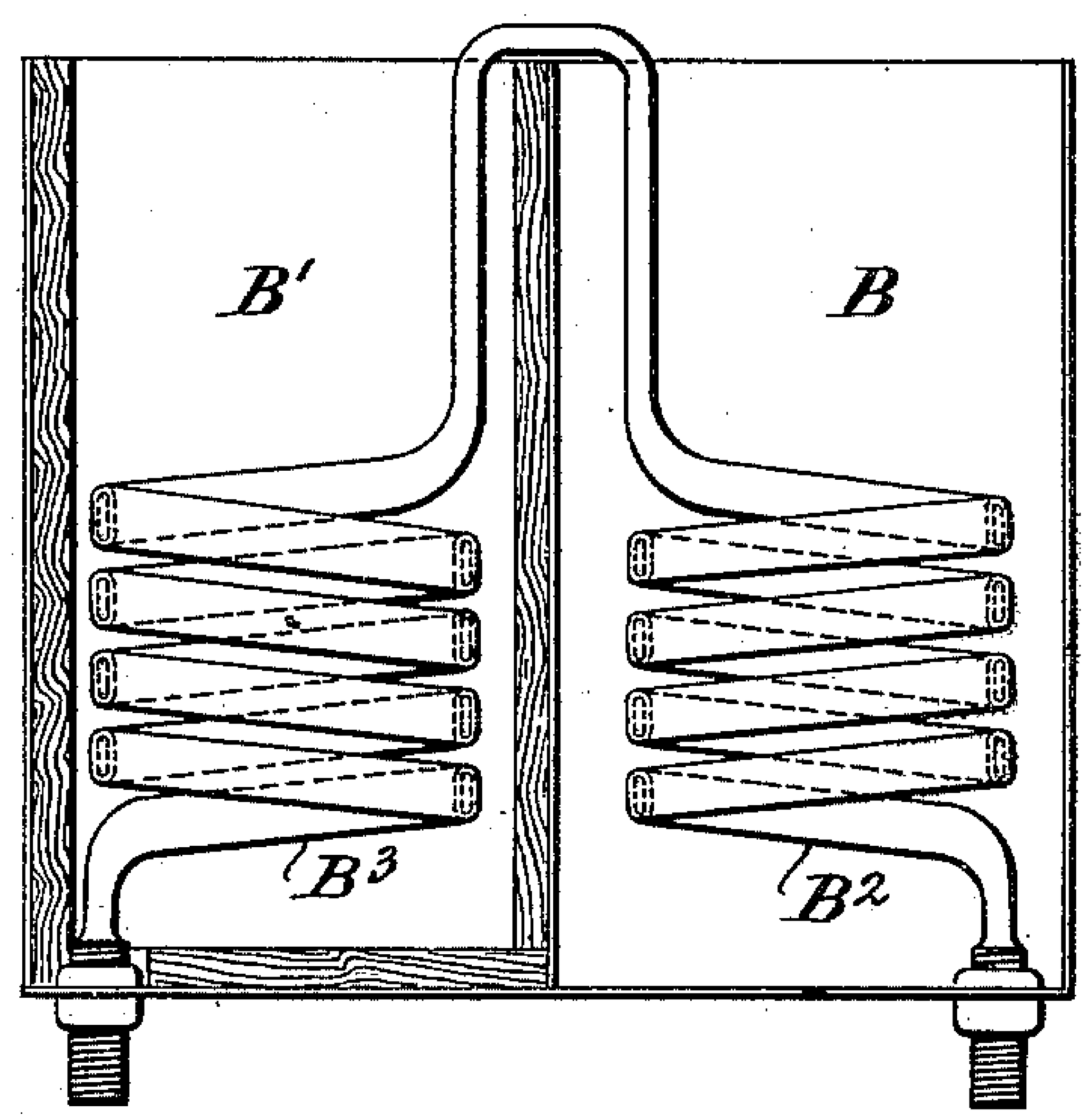


Fig. 14.

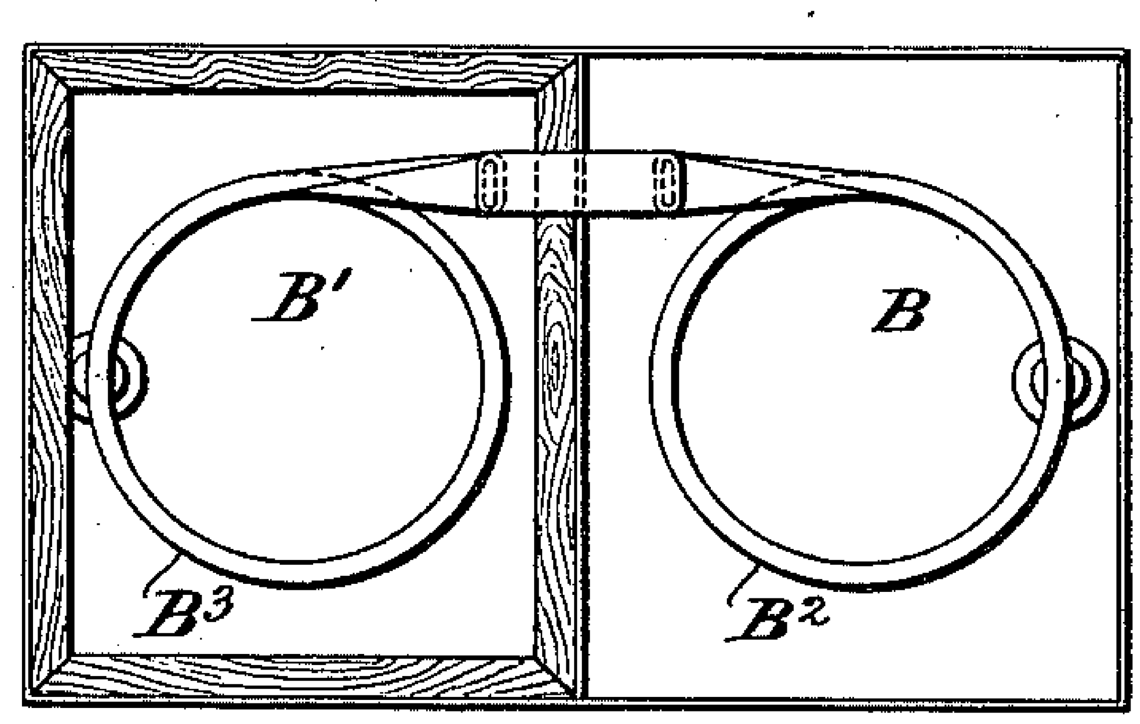
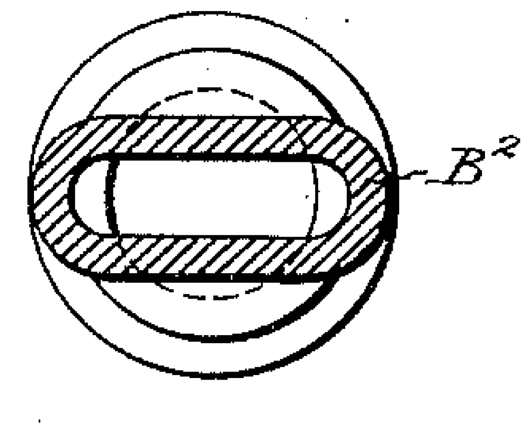


Fig. 15.



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(No Model.) 7 Sheets—Sheet 5.

Fig. 17.

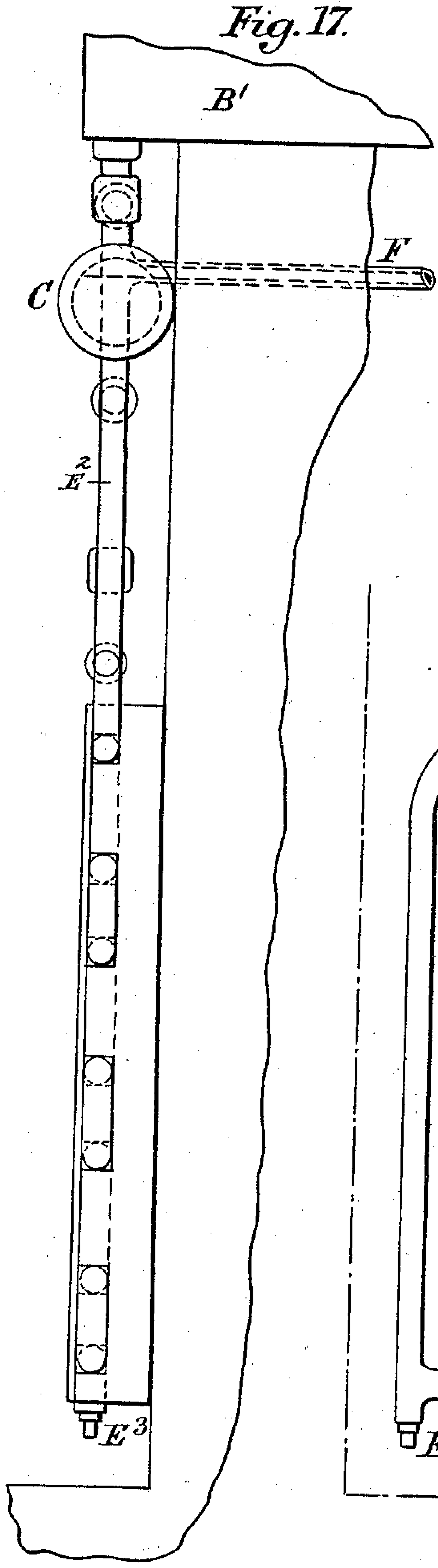


Fig. 16.

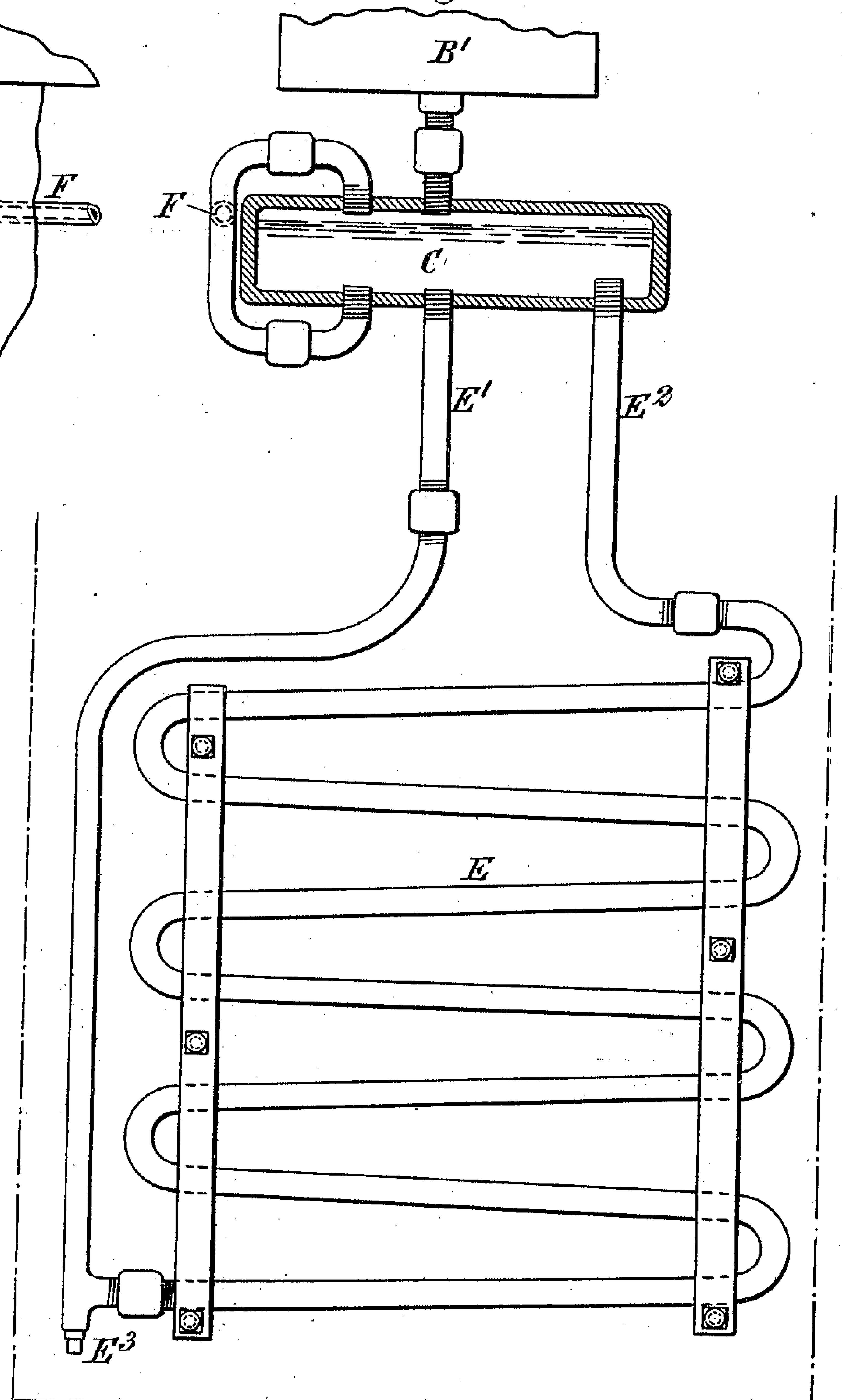
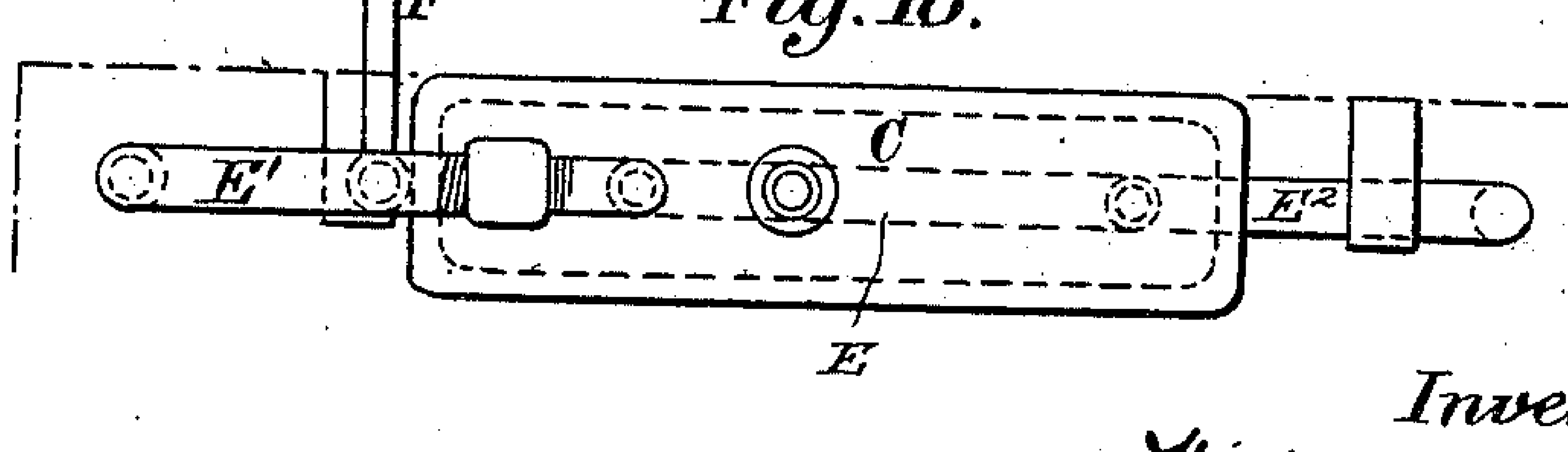


Fig. 18.



Witnesses

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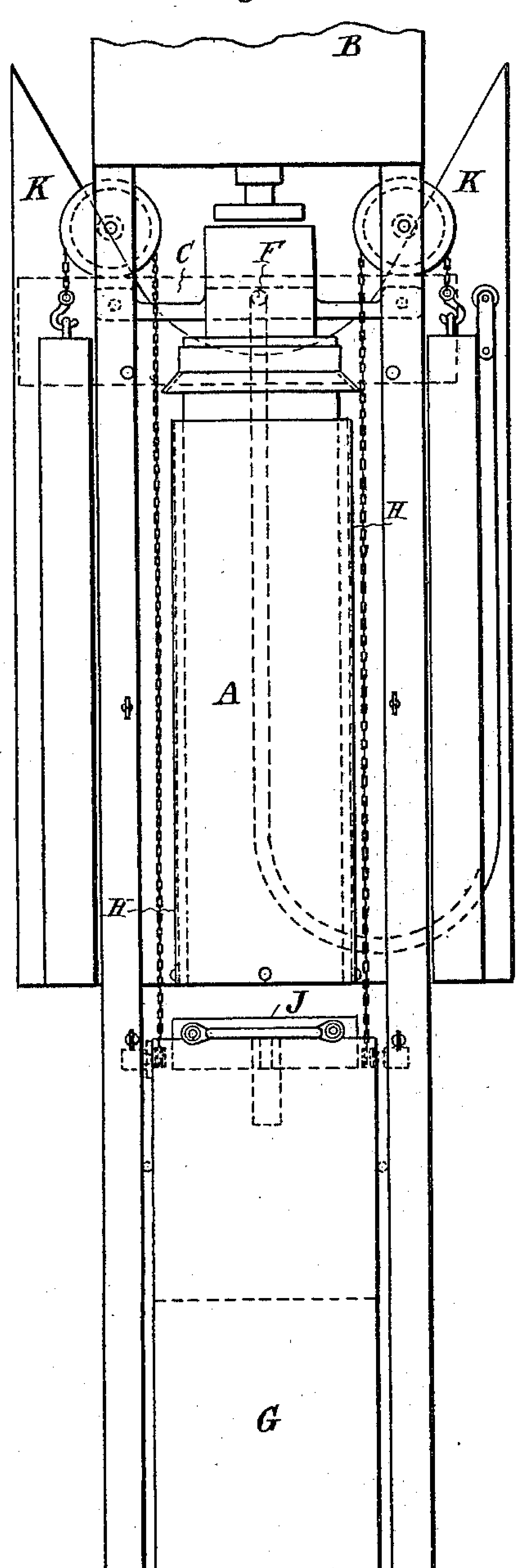
REFRIGERATING APPARATUS.

(Application filed Jan. 20, 1899.)

(No Model.) 7 Sheets—Sheet 6.

Fig. 19.



Witnesses
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(No Model.)

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Fig. 20.

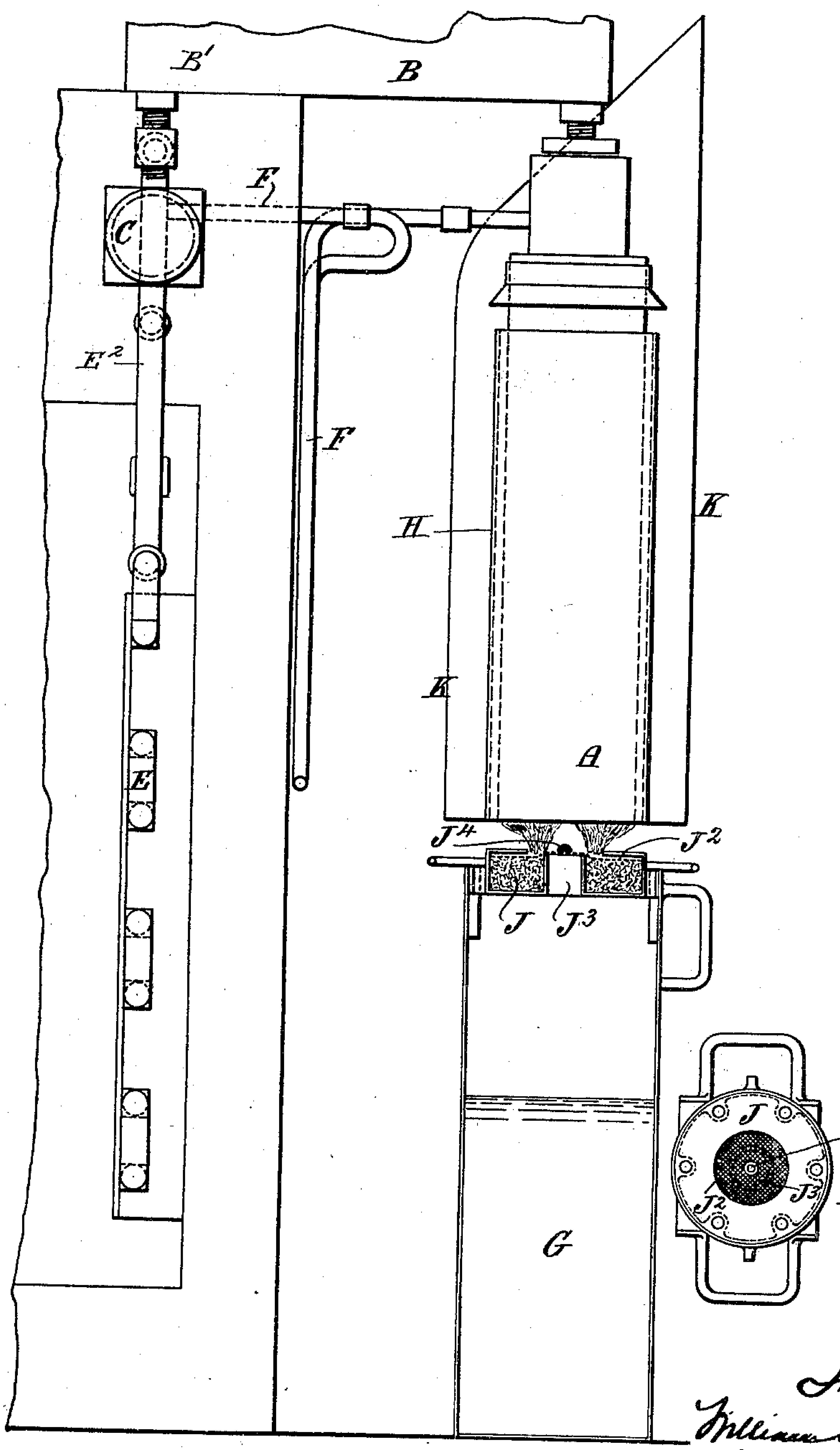

Fig. 21.

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A. M. Parkins.

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By his Attorneys,
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UNITED STATES PATENT OFFICE.

WILLIAM WALLINGTON HARRIS, OF LONDON, ENGLAND, ASSIGNOR TO PAUL PFLEIDERER, OF SAME PLACE.

REFRIGERATING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 652,210, dated June 19, 1900.

Application filed January 20, 1899. Serial No. 702,764. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM WALLINGTON HARRIS, engineer, a subject of the Queen of Great Britain, residing at 24 Alexandra road, Hornsey, London, in the county of Middlesex, England, have invented certain new and useful Refrigerating Apparatus, of which the following is a specification.

This invention relates to apparatus constructed to work by gravitation on the absorption principle--that is to say, is charged with a liquid which contains a gas, which gas can be separated by the action of heat and be reabsorbed when the water or fluid from which it was originally driven is cool enough to receive it—and has for its object improvements in the construction of the apparatus, the cooling effect of which is produced in a simple and automatic manner, one of the principal objects being to obviate altogether the necessity for using skilled labor in producing the result and in the case of apparatus designed for household and domestic use to reduce the manual acts of working to the simplest possible proceeding and such as can be easily performed by any ordinary domestic servant who has not had any previous training for the task.

The apparatus is constructed in such a way that the cooling medium is hermetically sealed in a series of tubes which are capable from their great strength of resisting a very high pressure. This strength, however, is employed mainly for the purpose of obtaining absolute soundness of the joints and by this means prevents any escape of the cooling medium with which the apparatus is primarily charged. This soundness enables the cold-producing power to be used over and over again without intermission, leakage, or deterioration of any sort for many years.

The parts of the apparatus are proportioned each to perform the peculiar function required of it, either for separating, absorbing, condensing, or collecting, and this is particularly so as regards the surface condenser, where the water used for cooling is so proportioned in quantity that it does not need to be circulated or changed at all, but remains quiescent between the periods when it is heated and cooled. It rises a few degrees when separation is being effected and drops back again to the normal temperature in the intervening period between the workings. By this means the water used for condensing and cooling only requires replenishing at long intervals, and this is done by simply keeping the tanks filled to the water-lines by any convenient vessel.

The operation of producing the cold is confined to the simple act of heating and cooling the separator, and this is done by applying a measured amount of heat, the total quantity of which is just sufficient to raise the separator to the required temperature. For a small apparatus this can be done by using a spirit or oil lamp, which is charged with a definite quantity of spirit or oil, which when burned gives off the exact amount of heat that will effect the separation of the gas and which is arranged to burn out when the proper amount of heat has been generated and passed into the separator. The separator may then be left to cool down naturally, or if quicker cooling effect is desired it can be obtained by submerging the separator in water by raising a balanced tank. This balanced tank is filled with a given quantity of water of sufficient amount to reduce the temperature of the separator down to the point where rapid combination takes place. The remaining heat in the separator will then pass away through the sides of the tank into the atmosphere and the temperature of the water drop to the normal before it is again required for cooling purposes. Thus the same cooling-water can be used over and over again, which does away with the necessity for connecting the apparatus to either a water service or drain. In a larger apparatus where a much greater quantity of heat is required to do the work and where a lamp would not be suitable the heating may be effected by gas controlled by an automatic meter which measures out a given quantity of gas and then shuts off the supply, or the same action may be obtained by employing a lamp of known heating power for a given length of time; but this requires the attention of some one to look after it, which is avoided when the lamp is allowed to burn out or the meter itself shuts off the supply. The cooling medium preferred and with which the separator is charged is ordinary commercial ammonia, consisting of one-third ammonia-gas and two-thirds water of a specific gravity of .87°; but any suitable combination of gas and fluid may be used if its absorbing affinity is sufficiently good and its liquefied gas has a boiling-point low enough to make it effective.

The apparatus consists principally of seven members—first, a separator for separating and absorbing the ammonia or other gas from the fluid in which it is contained, together with a movable water-tank for cooling the same; second, a condenser for cooling the gas on its way to the receiver; third, a receiver where the liquefied gas is collected; fourth, cold-producing tubes which are charged with a permanent quantity of anhydrous ammonia for the purpose of absorbing heat from the chamber; fifth, an overflow for the purpose of returning to the separator any surplus ammonia or watery vapor that may have been passed over accidentally; sixth, a lamp of measured heating power, and, seventh, an insulated cold box or chamber.

Figure 1 is a longitudinal section of a refrigerating apparatus and cold-chamber which are adapted to work with a spirit or oil lamp. Fig. 2 is a sectional plan on the line 2 2 of Fig. 1; Fig. 3, an end elevation, and Fig. 4 a plan, of the same. Fig. 5 is an elevation, and Fig. 6 a plan, of a refrigerating apparatus adapted to work with gas. Fig. 7 is a vertical section of the separator and absorber. Fig. 8 is a transverse section on the line 8 8, Fig. 7. Fig. 9 is a local section on the line 9 9, Fig. 7. Figs. 10, 11, and 12 are diagram views illustrating the action of the separator and absorber apparatus. Fig. 13 is a sectional elevation of the condenser, and Fig. 14 a plan of the same; Fig. 15, a section of a flattened tube for the condenser. Fig. 16 is an elevation of the refrigerating-pipes. Fig. 17 is an end elevation, and Fig. 18 a plan, of the same. Fig. 19 is an elevation of the separator and balanced tank; Fig. 20, a sectional elevation showing the lamp in position; Fig. 21, a plan of the lamp.

In Figs. 1 to 4, A is the separator and absorber. B is the condenser; C, the receiver; D, the cold-chamber; E, the refrigerating-pipe; F, the overflow from receiver to separator; G, the balanced tank for cooling the separator; H, a casing surrounding the separator for the double purpose of keeping the heat in close contact with it while it is being heated and to assist in circulating the water in the balanced tank when it is being cooled. K is a light shield or covering to the separator for the purpose of deflecting the heated air and preventing it from impinging against the bottom of the condenser-tank or radiating in the direction of the cold-chamber. J is the lamp.

In Figs. 5 and 6, L is an automatic coin-freed gas-meter. M is the supply-pipe from the main, and N the pipe to gas-bracket O′, which is pivoted at O and is fitted with an atmospheric burner. The meter is intended to measure out exactly the quantity of gas required to perform one operation of producing cold. When the burner goes out, the separation has been effected, and all that remains to do is to swivel the gas-bracket into the position shown by dotted lines O^2 and raise the balanced tank, so as to submerge the separator in water. The quantity of water contained in the balanced tank G and condenser B and B′ is sufficient in each case to deal with the heat put into the separator, and neither require to be connected to either cold-water supply or drain, which would be the case if it were necessary to change the water during the operation of producing cold or between the times when the apparatus was worked.

Fig. 7 is a vertical section of the separator and absorber and shows the construction of its internal parts. P is the outer shell, and P′ an inner tube which practically divides the separator into two chambers. The inner tube P′ is made of sound but light material for the first portion, extending downward, such as tin well soldered, and is so constructed and attached to the upper part P^2 that no gas can possibly pass from the inner tube P′ to the annular space P^3 formed by it and the outer shell except at the lower end P^4, where the sound and solid portion of the tube ceases. From this point to the bottom the remainder of the tube, P^5, is constructed of porous material, such as wire-gauze, two or more thicknesses being used to form the upper part and tapering to a single thickness near the bottom. The object of this gauze is to compel the gas to depress the liquid in the center tube to as low a level as possible and so enter the fluid in the annulus through the pores in the mesh in a finely-divided condition at innumerable points, and thus insure a rapid combination. As an alternative method of construction the inner tube might be prolonged to the bottom, the lower end being perforated with a number of suitably-sized holes. This inner tube P′ is provided with a lining P^6, which starts from the point where the mesh is attached to the solid portion and extends upward to a point corresponding with about the level of the liquid when it is heated and has been deprived of about half its volume of gas. This lining is for the purpose of constructing easily one or more small passages P^7 for the escape of gas which accumulates from time to time in the annular space P^3 during the period when separation is being effected. These passages facilitate the escape of gas from this chamber without disturbing the body of the liquid, which when heated is collected in the center tube, as is shown by diagram Fig. 10. The discharge of gas from the annulus to the bottom of the mass of heated liquid when in a condition unfavorable to its reception would undoubtedly cause immediate priming. These small passages, however, prevent this action taking place by making a way for the gas to escape as soon as the liquid in the annulus sinks low enough to uncover the top of the entrances to these passages P^8. The gas from that moment is free to pass gradually to the surface of the liquid in the inner tube without coming in contact with it, and at the same time this escape of gas prevents the liquid in the annulus from falling sufficiently low to uncover the bottom of the tube itself, P^4. By this means a permanent liquid seal is maintained. Figs. 10 and 11 show the positions of the liquid in the inner tube when separation is being effected, and Fig. 12 that in the annulus when absorption is taking place. In the center of the inner tube is placed an arrangement R for the purpose of circulating the liquid which is being separated. It consists of a dome-shaped bottom R′ with a vertical stem R^2. The dome is perforated around its outer edge near the bottom with a number of small holes to allow the fluid to enter freely and when heated pass up the vertical stem, which is open at the top and covered by a shield. The stem is provided with a series of holes R^3 at intervals in its height to allow of its accommodating itself to the varying levels of the liquid as it is deprived of its gas. The heated fluid rises up the center and pours out first from the top, as shown by Fig. 10, and afterward at the holes R^3 in the sides of the tube as the level sinks. As the liquid becomes exhausted each hole is covered by a shield to throw the spirting liquid downward, the gas being then free to pass through the apparatus to the receiver. The valve S is for discharging air, and S′ for the purpose of withdrawing exhausted liquid and inserting solution while the apparatus is being charged. T is a tube for inserting a thermometer should it be desired to ascertain the temperature of the boiling liquid.

The condenser, Figs. 13 and 14, is divided into two parts B and B′. The heated gas from the separator rises in coil B^2 and parts with its first heat in tank B. It then descends coil B^3 in a cooler condition and parts with its remaining heat in tank B′. This latter tank is lined with an insulating material, as it receives less heat than tank B during the process of separation and is afterward cooled by the cold gases from the receiver returning to the absorber. It is desired to conserve this cooling effect as much as possible to assist the liquefaction when the process is reversed. Tank B is not insulated, but is allowed to part with its heat as soon as possible by radiation from the sides, as in a general way this tank will be hotter than the atmosphere surrounding it.

Fig. 15 is a section of a flattened tube for the condenser, the object of flattening being to reduce the volume of the contents to assist liquefaction of the gas, it being liquefied by its own pressure. The reduced volume allows this pressure to be obtained more easily, and at the same time the full amount of the cooling-surface is retained, which is most essential.

Fig. 16 is an elevation of the refrigerating-pipes E and shows their connection to the receiver, where the liquefied gas is collected. The end of pipe E′ is fixed nearly flush with the bottom of the inside of the receiver; but pipe E^2 is allowed to stand a short distance above the bottom, the object of this difference of levels being to induce the current of anhydrous ammonia or other liquefied gas to flow in one direction through the refrigerating-tubes—viz., down pipe E′ to the bottom of the coil and up through pipe E^2—after its temperature has been raised by heat abstracted from the cold-chamber, and by this continuous flow, due to gravitation, insure a perfect mixing of the contents of the refrigerating-tubes with the anhydrous ammonia or other liquefied gas in the receiver, and by this means bring the whole mass of the contents up to a uniform degree of strength. F is the overflow-pipe, which is connected to the receiver by a branch pipe which is in communication with the top and bottom of the receiver. This arrangement makes it impossible for the pipe F to set up a siphon action and empty the receiver, its function being that of an overflow, pure and simple, which returns from time to time any surplus liquid in the receiver, and by this means passes back to the separator any water or watery vapor that may have gone over to the receiver during working. E^3 is a screw-valve for allowing the proving-water to be drawn from the apparatus after its soundness has been ascertained by hydraulic pressure.

In Figs. 20 and 21, J is the container, which is made of suitable size to hold the measure of combustible required to produce the amount of heat necessary. The container J is made of metal the body of which must be sound to prevent the escape of spirit or vapor anywhere except through the burner. The center is provided with an air-passage J^3, and over it and part of the container, as shown by Fig. 21, is stretched a piece of wire gauze J^2, which forms the burner. The quantity of air passed into the center of the flame is regulated by a button J^4 at the center, which adjusts the inlet to the required amount. The body of the container J is packed with silicate, cotton, or other suitable non-combustible material to absorb the spirit or other combustible and convey it to the surface, where it is consumed.

It will be observed that in this apparatus all gages to indicate either heat or pressure that would be usually necessary to determine when the operation of separating the gas is over are obviated and rendered unnecessary. The lamp burning out or the meter shutting off the supply indicates at once that the process has been effected.

In order to produce cold, all that is necessary is to light the lamp or the gas and allow it to burn itself out. If it is desired to hasten the operation, the lamp or burner may then be removed and the tank G raised, so as to immerse the separator A; but this is not essential.

What I claim is—

1. The combination of a combined separator and absorber comprising a vertical annular chamber completely closed at the top, a central chamber within it and in communication with its lower end, a condenser in communication with the upper end of the central chamber, and a receiver in communication with the condenser.

2. The combination of a combined separator and absorber comprising a vertical annular chamber completely closed at the top, a central chamber within it and having numerous fine perforations at its lower end, a condenser in communication with the upper end of the central chamber, and a receiver in communication with the condenser.

3. The combination of an annular chamber, a central chamber within it and in communication with its lower end, a perforated pipe within the central chamber extending from near its bottom to about the highest liquid-level, deflecting-plates above the pipe and perforations, a condenser in communication with the upper end of the central chamber, and a receiver in communication with the condenser.

4. The combination of an annular chamber, a central chamber within it and having numerous fine perforations at its lower end, a perforated pipe within the central chamber extending from near its bottom to about the highest liquid-level, deflecting-plates above the pipe and perforations, a condenser in communication with the upper end of the central chamber, and a receiver in communication with the condenser.

5. The combination of an annular chamber, a central chamber within it having its lower end formed of wire-gauze, a perforated pipe within the central chamber extending from near its bottom to about the highest liquid-level, deflecting-plates above the pipe and perforations, a condenser in communication with the upper end of the central chamber, and a receiver in communication with the condenser.

6. The combination of an annular chamber, a central chamber within it and having numerous fine perforations at its lower end, a lining forming a passage within the central chamber and extending from just below the bottom of its solid part up to a point at some distance below the highest liquid-level, a condenser in communication with the upper end of the central chamber, and a receiver in communication with the condenser.

7. The combination of an annular chamber, a central chamber within it having its lower end formed of wire-gauze, a lining forming a passage within the central chamber and extending from just below the bottom of its solid part up to a point at some distance below the highest liquid-level, a condenser in communication with the upper end of the central chamber, and a receiver in communication with the condenser.

8. The combination of an annular chamber, a central chamber within it and having numerous fine perforations at its lower end, a perforated pipe within the central chamber extending from near its bottom to about the highest liquid-level, deflecting-plates above the pipe and perforations, a lining forming a passage within the central chamber and extending from just below the bottom of its solid part up to a point at some distance below the highest liquid-level, a condenser in communication with the upper end of the central chamber, and a receiver in communication with the condenser.

9. The combination of an annular chamber, a central chamber within it having its lower end formed of wire-gauze, a perforated pipe within the central chamber extending from near its bottom to about the highest liquid-level, deflecting-plates above the pipe and perforations, a lining forming a passage within the central chamber and extending from just below the bottom of its solid part up to a point at some distance below the highest liquid-level, a condenser in communication with the upper end of the central chamber, and a receiver in communication with the condenser.

10. The combination of a vessel used alternately as a separator and an absorber, a tank of conducting material, a tank of non-conducting material, a receiver, and coils in the tanks having their upper ends connected together and their lower ends connected respectively to the absorber and receiver.

11. The combination of a vessel used alternately as a separator and absorber, a counterbalanced water-tank which is beneath the vessel when in its lower position and has the vessel immersed in it when in its higher position, a burner adapted to be brought under the vessel when the tank is lowered and to be moved away when the tank is raised, a condenser connected to the vessel and a receiver connected to the condenser.

12. The combination of a vessel used alternately as a separator and absorber, a condenser connected to it, refrigerator-pipes, a receiver having its top connected to the condenser and its bottom to the refrigerating-pipes, a pipe arranged outside the receiver and having its two ends open to the bottom and top respectively of the receiver, and a branch pipe connecting this pipe to the separator and absorber.

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Witnesses:
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