(No Model.) 4 Sheets—Sheet 1.

J. L. CAMPBELL.

INCUBATOR.

No. 372,115. Patented Oct. 25, 1887.

Fig. 1.

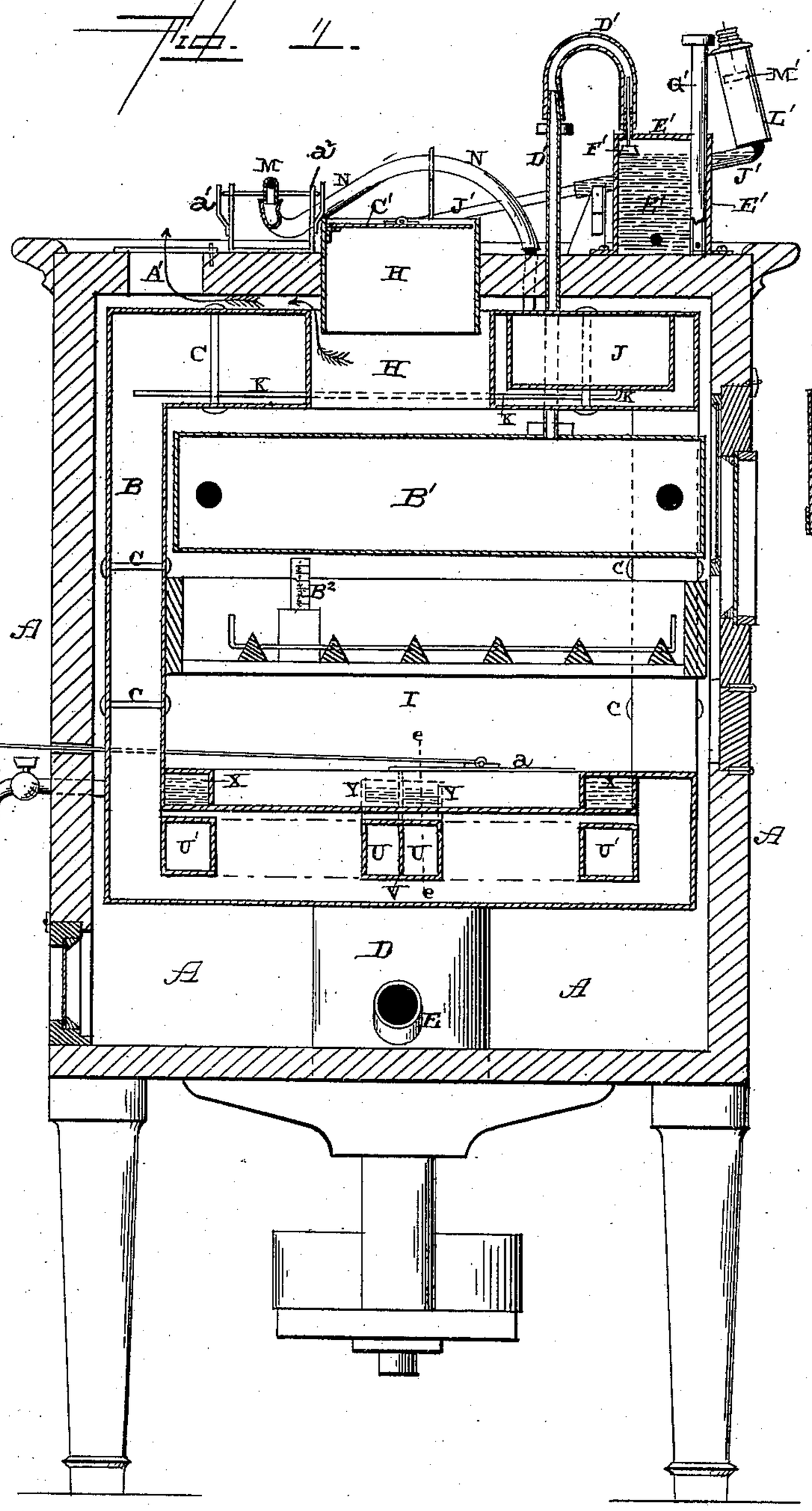
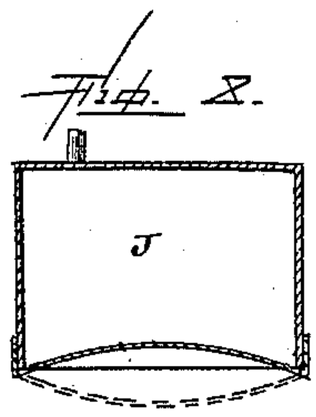


Fig. 2.



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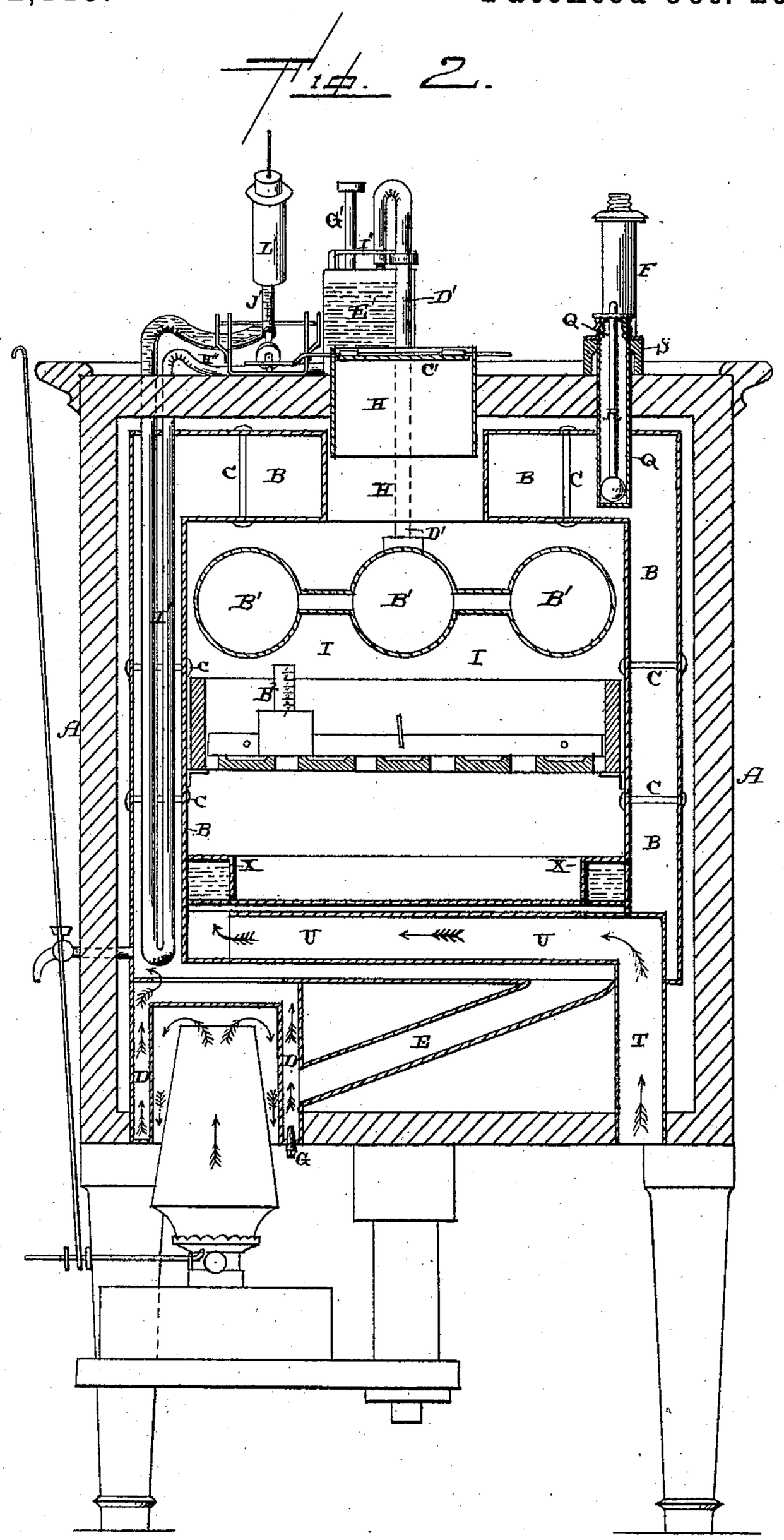
(No Model.) 4 Sheets—Sheet 2.

J. L. CAMPBELL.

INCUBATOR.

No. 372,115. Patented Oct. 25, 1887.

Fig. 2.



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(No Model.) 4 Sheets—Sheet 3.

J. L. CAMPBELL.

INCUBATOR.

No. 372,115. Patented Oct. 25, 1887.

Fig. 3.

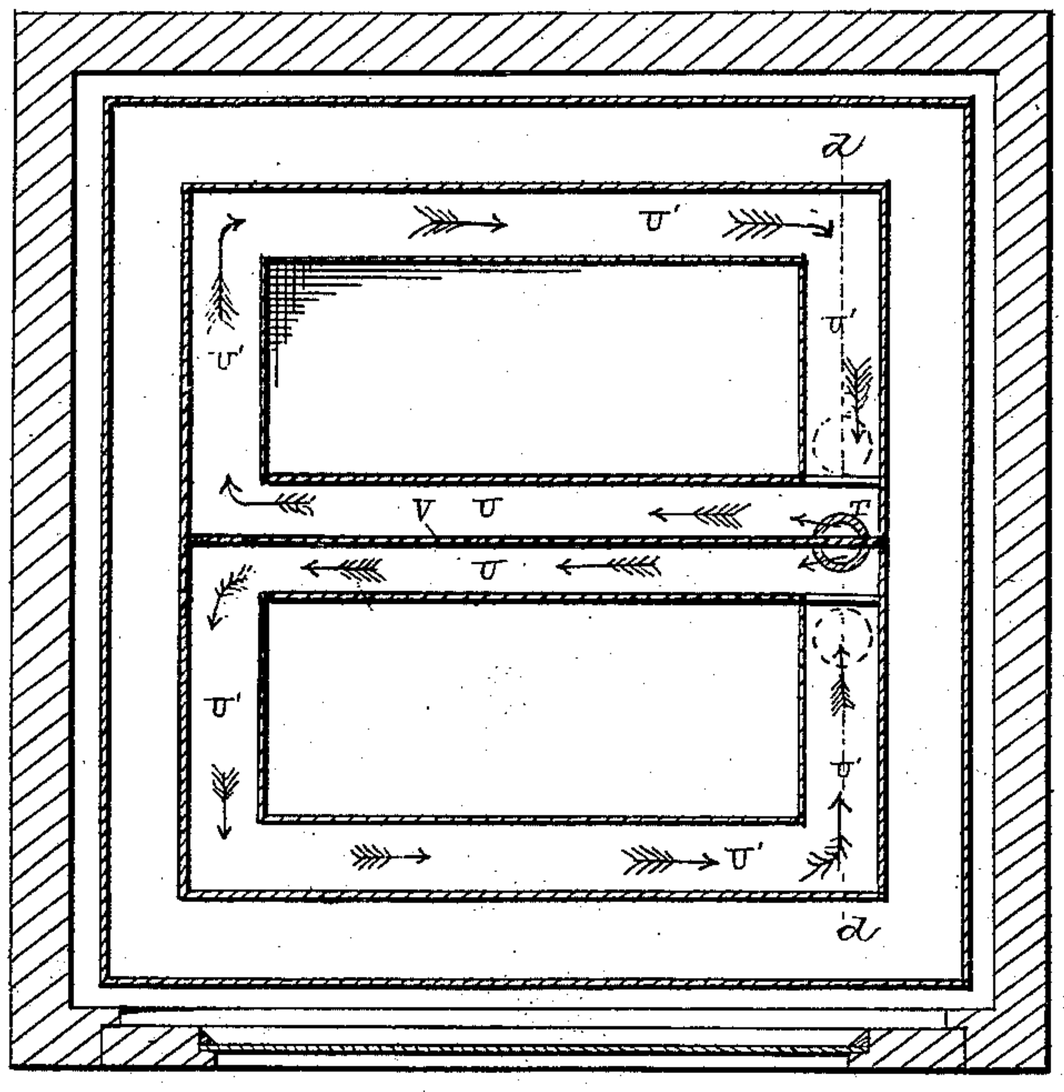
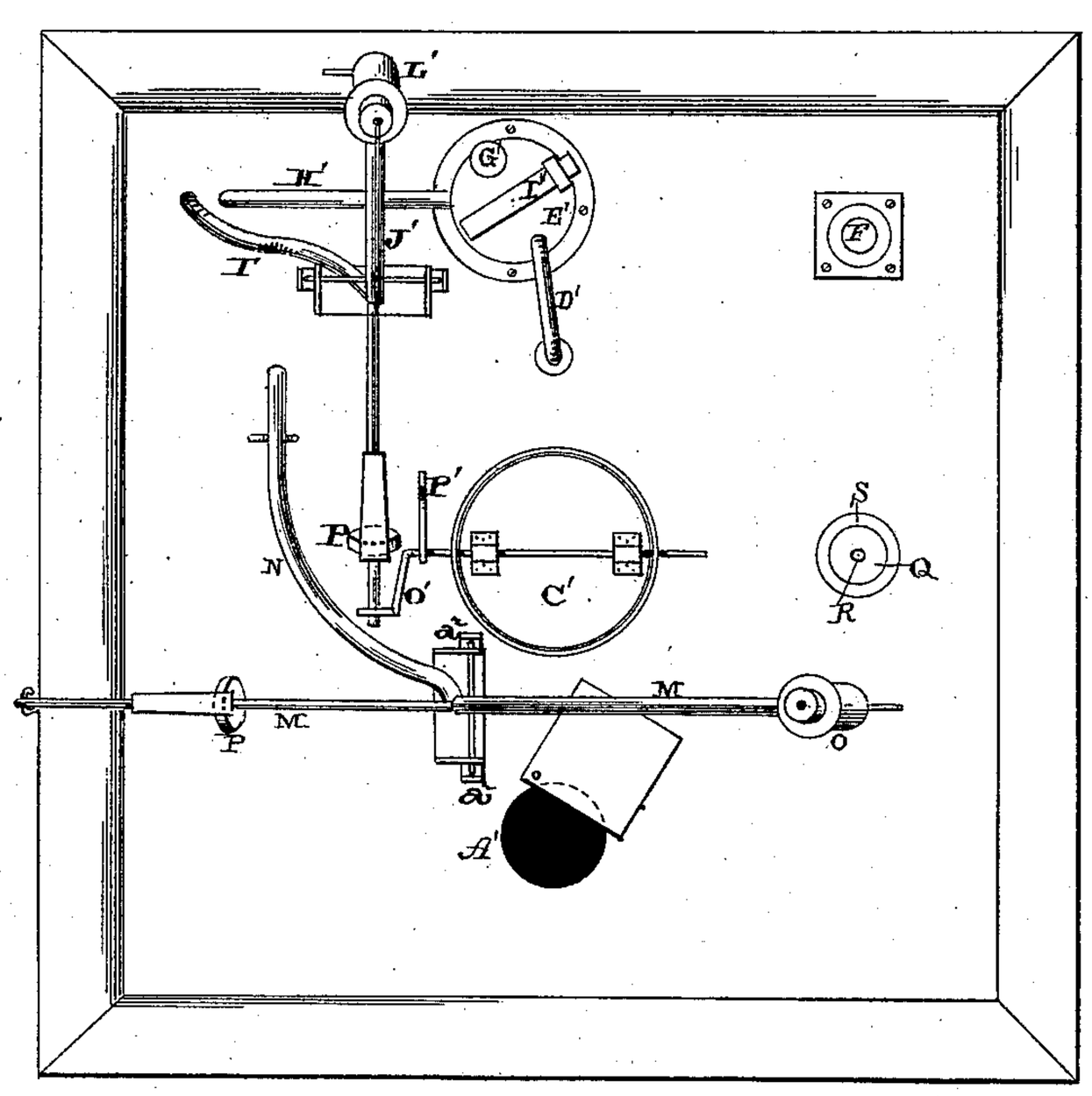


Fig. 4.



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(No Model.) 4 Sheets—Sheet 4.

J. L. CAMPBELL.

INCUBATOR.

No. 372,115. Patented Oct. 25, 1887.

Fig. 5.

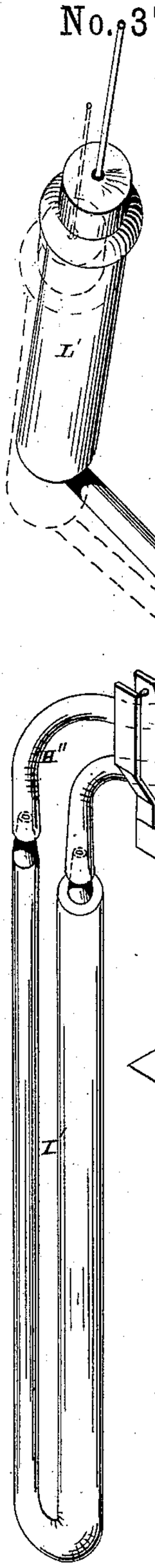


Fig. 7.

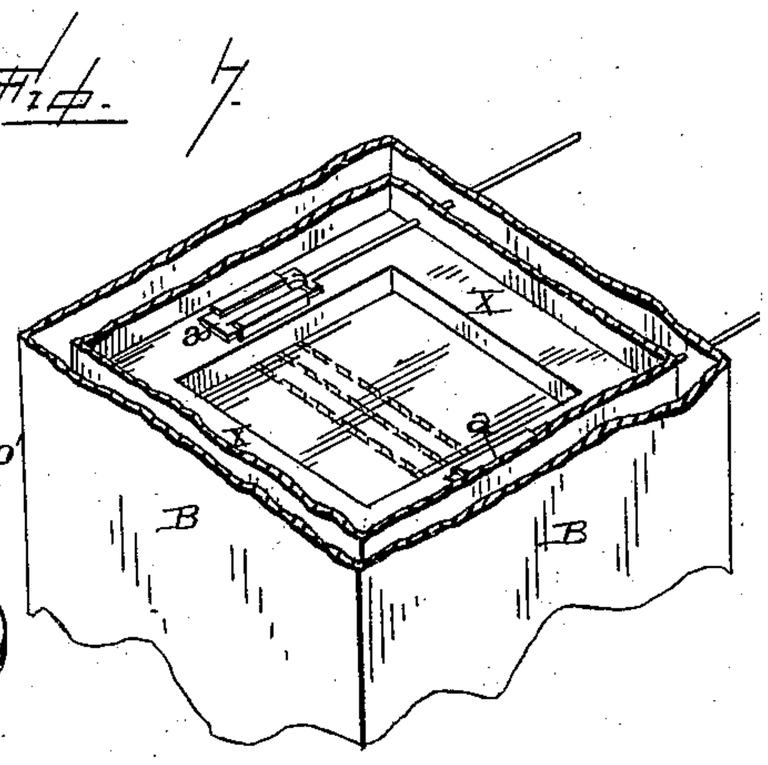
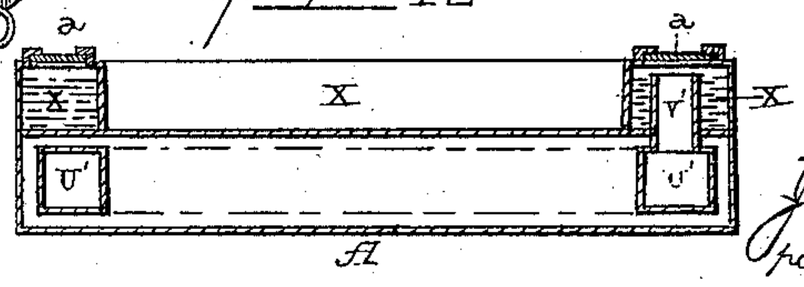


Fig. 6.

Fig. 9.

Fig. 10



Witnesses
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UNITED STATES PATENT OFFICE.

JAMES L. CAMPBELL, OF WEST ELIZABETH, PENNSYLVANIA.

INCUBATOR.

SPECIFICATION forming part of Letters Patent No. 372,115, dated October 25, 1887.

Application filed October 26, 1886. Serial No. 217,261. (No model.)

To all whom it may concern:

Be it known that I, JAMES L. CAMPBELL, of West Elizabeth, in the county of Allegheny and State of Pennsylvania, have invented certain new and useful Improvements in Incubators; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it pertains to make and use it, reference being had to the accompanying drawings, which form part of this specification.

My invention relates to an improvement in incubators; and it consists in, first, the combination of the water-tank with a tube which extends from its top, a pivoted regulating-rod which is hollow at one end and provided with a cup, and which has a lamp-flame regulator for controlling the flame of the lamp which heats the water in the tank connected to its opposite outer end; second, the combination of the tank of an incubator with a tube leading from its top, a pivoted regulating-rod which is hollow at one end and provided with a cup and weighted at its other end, and a flame-regulator which is connected to the weighted end of the rod; third, the combination of the pivoted regulating-rod, which is connected by a tube with the tank, and a flame-regulator connected to this rod, with the air-chamber, a tube connected thereto, a cup containing fluid, a connecting-tube, a pivoted regulating-rod and valve in the top of the incubator; fourth, the combination of an air-holder located in the top of the egg-chamber, a pipe connected to the air-holder, a pressure-cup containing fluid, a regulator which is connected to the cup, and the air-valve in the top of the incubator; fifth, the combination, with an air-holder, a pipe leading therefrom, and pressure-cup containing fluid, and a pipe extending therefrom, of a U-shaped pipe filled with fluid from the cup, a pivoted regulator, and an air-valve in the top of the incubator; sixth, the combination of the tank, the cup placed therein and which is to be filled with a non-freezing fluid, a pipe extending from the top of this cup, a regulator connected to the pipe, and a flame-regulator; seventh, the combination of the air-cylinders, the tube leading therefrom, the pressure-cup containing fluid, a U-shaped tube, the regulator, and air-valve in the top of the incubator; eighth, an incubator provided with a water-tank, and having two air-flues which are separated from each other by a partition, and which flues pass back and forth through the tank; ninth, the combination, with a water-tank placed inside of the egg-chamber, and having openings through its top which are closed by slides, of vertical passages which lead from the air-flue, and the air-flue which extends back and forth through the water-tank which heats the egg-chamber; tenth, the combination of the air-flue which extends back and forth through the tank of the incubator, and which is connected at one end with the atmosphere, with vertical passages at the inner ends of the flues, the water-tank placed inside of the egg-chamber, a partition, and slides for regulating the passage of the air through the water tank; eleventh, the combination of the tank, an air-flue which passes through the tank, the moisture-chamber connected to the flue at its upper end, and slides by means of which the amount of moisture taken up by the air and discharged into the egg-chamber can be regulated at will; twelfth, in the arrangement and combination of parts, which will be more fully described hereinafter.

The objects of my invention are to combine in an incubator two separate regulators, one for controlling the heat of the water in the tank and the other the heat of the air in the egg-chamber, the regulator for the heat of the air being separate from the one for controlling the lamp; to heat the air which passes into the egg-chamber by means of the heat of the water in the tank, so as to prevent the overheating of the eggs; to regulate the flame of the lamp by means of the expansion and contraction of the water in the tank, and to so construct the tank that the water is given a free circulation and the tank produced more cheaply.

Figures 1 and 2 are vertical sectional views of the incubator taken at right angles to each other. Fig. 3 is a horizontal vertical section taken through the moisture-chamber. Fig. 4 is a plan view of the incubator. Figs. 5 and 6 are detail views of the two regulating devices. Fig. 7 is a detail view of the moisture-chambers and the valves connected therewith. Fig. 8 is a modification of the cup J. Fig. 9 is a vertical section of air-flue and moisture-

tank taken on the dotted lines *d d* of Fig. 3. Fig. 10 is a section of the same taken on the line *e e* of Fig. 1.

A represents the frame of the incubator, and B the tank, which is placed inside thereof in the usual manner. This tank is made of the shape shown in Figs. 1 and 2, and the inner and outer shells are connected together by means of braces or rivets C, which are passed entirely through both shells, so as to enable them to resist the pressure of the water. These braces or bolts are passed both horizontally and vertically through the two shells, as shown, making the tank much stronger and preventing it from springing outward with the expansion of the water and the hydrostatic pressure caused by the water rising in the regulating tube or cup, and enabling the tank to be constructed much more rapidly and cheaply than can be done where no braces are used. The pressure of the water against the sides to the tank causes the sides to bulge outward, and hence the bolts or rivets C are necessary to connect the sides together. The hydrostatic pressure being in direct proportion to the height of the column of water, it is impossible to keep this column of a uniform height if the sides of the tank are allowed to bulge outward, as is always the case where the sides are not rigidly fastened together. In proportion as the water rises in the regulating-tube N, caused by expansion, the pressure becomes greater upon the sides of the tank than where the water has not become expanded by the heat and risen in the tube N.

If the tank is not well braced and made rigid, the hydrostatic pressure will use up the expansion of the water much faster than it will run in the regulating-cup, thereby requiring a large quantity of water to make it act on the regulator with a small variation of heat in the water; but if the tank is made very rigid almost all the increased bulk of water made by the expansion will run in the regulating-cup, making it possible to use quite a small tank.

Upon the lower portion of the tank at one side is formed the boiler D, up inside of which the top of the lamp-chimney is placed, as shown. All of the heat from the lamp is caught inside of this boiler, and hence, both as it rises upward and as it passes downward to escape, it comes in contact with the boiler, thereby heating the water therein. As shown in Fig. 2, this boiler is shaped like an inverted cup, so that as the heat rises from the upper end of the lamp-chimney it strikes against the boiler, and then the heated current of air passes downward, as is shown by the arrows. Extending from the bottom of the boiler and to the opposite side of the bottom part of the tank, or to any suitable distance toward the opposite side, is placed the return-pipe E, through which the water returns to the boiler. The water in the tank immediately above the boiler rises as rapidly as it becomes heated, circulates across the top part of the tank and sinks down to the bottom on the side opposite the boiler, and returns through this return pipe to the boiler again, where it is again heated. By this construction the water is made to constantly circulate through the tank, and thus an equal heat is maintained in all parts at once. This tank is filled with water through the stand-pipe F, which projects upward a suitable distance above the top of the frame, and which is provided with an air-tight cover, so as to hold the air which is in the stand-pipe and prevent it from escaping when the water in the tank expands from heat. The water in the tank can be drained off by means of the screw-plug G, which is placed in the bottom of the boiler D. It is only necessary to remove the plug G, when the water contained in the tank will flow down through the boiler D, and out through the opening in which the plug is placed. Through the top of the tank and the top of the frame is made the opening H, for the free escape of the heated air from the egg-chamber I.

In case the incubator is to be used in a very cold place, where the water that rises into the cups of the two regulators would be likely to freeze, a non-freezing cup, J, is placed inside the upper portion of the tank, as shown. This cup is closed at its bottom, sides, and top, with the exception of the small pipe K, extending out from the bottom and for some distance from the cup. This non freezing cup is to be filled with alcohol or any other suitable fluid that will not freeze, which alcohol is poured into the cup J through the top of the cup O on the lamp trip M. It is only necessary to pour the alcohol in the cup O, when it passes down through the hollow portion of the trip M and the tube N directly into the cup J.

The operator first makes sure that enough water is poured into the tank B to make it rise high enough to cover the mouth of the pipe in the bottom of the cup O, then enough alcohol is poured in the cup O to fill it. Then an equal amount of water is drawn off by means of the plug G, when the alcohol in the cup O will run into the cup J. Then more alcohol is poured into the cup O and more water drawn off, and so on until the desired amount of alcohol is poured into cup J. If there should not be enough water in the tank to cover the mouth of the pipe in the bottom of cup O, some air will be caught in the pipe and the alcohol will not run in; but by having it full of water first the air will all be out, and as the alcohol runs in it forces the water out of the cup J through the pipe K until the cup is full. The outer end of the pipe K being open, the expansion and contraction of the water in the boiler causes the water to pass back and forth through the pipe K, so as to cause a corresponding movement of the alcohol in the cup, and thus cause the alcohol to flow back and forth in the tube N to the cup O for the purpose of operating the lamp-trip. Were the end of the tube K closed no water could pass back and forth from the cup, and hence there would not

be sufficient expansion and contraction of the alcohol to operate the trip. The alcohol will mix very slowly with the water in the tank by passing through this tube K, so that it will be necessary to pour a few drops in the cup from time to time to keep it full. This cup will only be used, however, in a very cold place.

Should it be desired to entirely prevent the alcohol from mixing with the water in the tank, the water may be saturated with carbonate of potassa, or the pipe K may be done away with and a rubber cap be placed over the bottom of the cup. This cap being flexible, the alcohol will be acted on by the expansion and contraction of the water in the tank quite as freely as if the cup were open, and the alcohol will be entirely prevented from mixing with the water. If the cap is used, when the water expands it will force the cap upward into the cup and force the alcohol into the cup O, and when the water contracts in cooling the alcohol will run back into the cup J, thus causing the lamp-trip M to turn off and turn on the flame of the lamp. If no non freezing cup is used, then the water in the tank will be forced through the tube N, which extends from the top of the tank into the tube portion of the trip M.

The boiler is filled just to that point where, when the heat of the lamp has raised the temperature of the water to 103° or 104°, the water will expand just sufficiently for a portion of it to pass through the tube N into the trip M, and by running into the trip M cause the end provided with a cup, O, to sink downward. This trip M is journaled or pivoted in suitable bearings, a^2, and is hollow from the bearings to the cup and is solid from the bearings outward toward the other end, where the rod which operates the mechanism for turning off and turning on the flame of the lamp is connected to it. Upon the solid portion of the rod is placed a weight, P. The use of this weight is for balancing the trip M to the best point for working properly, and the trip M is so balanced that just as soon as the water in the tank contracts sufficiently for the water in the cup O to run back into the tank the solid end of the trip M will sink downward and turn on the flame of the lamp.

The cup O is provided with a removable cover through which an air-hole is made, so that as the water expands and passes into the hollow portion of the trip and the cup O the air can freely escape and thus offer no resistance to the expansion of the water.

Should it ever be desired to pour a little more water in the tank without removing the air-tight cap from the stand-pipe F, it will only be necessary to depress the cup O as far as it can be done, and then pour the additional water into this cup. When the cup O is depressed into the position shown in dotted lines in Fig. 6, water poured into the cup will pass directly through the tube N into the tank. The water will pass from the cup through the hollow portion of the trip M and through the pipe N into the tank.

It is to be understood that the whole operation of this regulator for controlling the flame of the lamp is as follows: When the temperature of the water reaches the desired point, the expansion of the water causes a portion of it to pass through the pipe N into the hollow trip M until the water forces that end of the trip which is provided with the cup O to sink downward and thus raise the opposite end so as to shut off the flame of the lamp. As soon as the heat of the water falls and the water contracts, all of the water which was forced by expansion into the trip M flows back into the tank, and then weight P causes the solid end of the trip to drop downward and turn on the flame of the lamp. This regulator acts independently of the regulator which controls the heat of the air in the egg-chamber. The construction here shown is preferred; but it is evident that this expansion of the water can be made to operate a regulator in many other ways than the one here shown, and I do not, therefore, limit myself to the exact construction of the devices here shown in this connection, for they may be varied at will without departing from the spirit of my invention.

The mechanism for controlling the flame of the lamp will be substantially the same as shown in my Patent No. 316,738, granted April 28, 1885, and hence need not be more fully described in this connection. I do not limit myself to any particular mechanism for controlling the flame of the lamp in connection with this regulator, for any mechanism which will answer the purpose may be used.

For the purpose of determining the temperature of the water at any time, the tube Q, which is closed at its lower end, is passed down through the top of the frame A and through the top of the tank, as shown, and which is provided with a screw-cap at its top, having an opening through it large enough for the stem of the thermometer to be passed through. In order to prevent the outside air from affecting the temperature of the water which is in the upper part of the tube Q, the wooden block S is placed over the upper end of the tube, as shown. This tube Q is filled with water from its upper end, and the water in the tank heats this water, so that the water in the tube is always of the same temperature as the water in the tank. By drawing up the thermometer R, which has its upper end to project above the top of the cap of the tube Q, the temperature of the water in the tank can be seen at once. All of the air which is admitted to the egg-chamber I passes up through the vertical tube T, which projects downward any suitable distance, and which connects at its top with the air-flue U, which extends across through the lower portion of the tank to the opposite side thereof, and which flue is divided by the partition V into two parts. This partition is used to divide the incoming air into two currents, as shown in Fig. 3.

Cold air enters at the lower end of the pipe or flue T, passes through the flue U across to the opposite side of the tank, as shown in Figs. 2 and 3, and then the two currents are caused to pass in opposite directions around through the flues U′ nearly back to the starting-point, and then pass up through the pipes V′ into the moisture-chamber X above. Through the top of this moisture-chamber, upon opposite sides of the egg-chamber, are made openings for the escape of the air into the egg-chamber, and these openings are controlled by the slides *a*. (Shown in Fig. 7.) To each slide is connected an operating rod which extends through the tank and frame, so as to operate the slides without having to open the doors to the egg-chamber, and thus let the heat escape. One of these slides is placed just over the pipes V′, so that should this slide (shown in Fig. 9) be opened the air will escape directly into the egg-chamber without taking up any special amount of moisture. If, however, this slide is closed and the other one opened, then the air must pass around over the top of the water in the chamber to the other opening before it can escape. In its passage over the water the air takes up all the moisture that is necessary. If both slides are left partially open, the air escapes through both sets of openings. If there is too much moisture taken up, then one slide is closed a little more and the other one correspondingly opened, and in this manner the proper amount of moisture is regulated. In between the two pipes V′ is placed a small vertical partition, which rises above the top of the water and separates the two currents of air.

The proper amount of moisture is determined by means of the glass gage B². This glass gage is placed in the egg-chamber and filled with water. If the air is too dry for hatching eggs successfully, the water in the gage will evaporate too rapidly, and if the air is too moist it will not evaporate fast enough. The proper amount of evaporation will reduce the water in the gage to the depth of about one-fourth of an inch in twenty-four hours, and if it varies greatly from this either way the slides over the moisture-tank can be changed so as to remedy it and make it right. By the use of this gage it can always be determined to a certainty if the air in the egg-chamber is just moist enough for the successful hatching of eggs.

It will be seen that all of the air which is made to pass up into the egg-chamber is first passed through the flues that are placed inside of the tank itself, and thus the air is heated to the temperature of the water in the tank, and can never be heated to any higher degree. The air that passes through the egg-chamber and the water being of the same temperature, overheating of the eggs is impossible under any circumstances. The air being admitted to the egg-chamber just under the egg-tray, passes up around the eggs and escapes through the opening in the top of the tank and along under the top of the frame A and escapes at the opening A′. A constant current of air being passed through the egg-chamber all the time, the eggs are kept constantly ventilated, and thus obviates the necessity of having to take the eggs out every day for the purpose of airing them.

Suspended in the top of the egg-chamber are a number of cylinders or vessels, B′, which are connected together, or a single vessel for holding air, which air becomes heated from the air in the egg-chamber, and by the expansion and contraction of the air in these cylinders B′ the regulator for operating the valve C′, placed in the opening in the top of the frame above the opening H in the tank, is operated. Connected air-tight to one of the cylinders B′ is the tube D′, which extends up through the top of the frame, and which is connected at its upper end with the top of the pressure-cup E′. Inside of this pressure-cup, which is to be partially filled with fluid, is placed a guiding-wire, and upon this wire is placed a float, F′, which is intended to rise and close the mouth of the pipe D′, should the fluid rise up high in the pressure-cup E′, and thus prevent any water being forced into the cylinders. As long as the fluid in the cup E′ is at its proper level the mouth of the pipe D′ is left open, so that the air from the cylinders can pass back and forth through it. The cup E′ is filled with water, alcohol, or other suitable fluid by means of the pipe G′, which has openings in it made near the bottom of the cup for the escape of the fluid, so that when filling the fluid will rise above these openings and thus prevent the pressure of the expanded air from the cylinders being interfered with as it presses on the top of the fluid in the cup E′. If these openings were made above the level of the fluid in the cup E′, and the cap upon the tube G′ were not tightly closed, the expanded air from the cylinders would escape through the tube G′ and thus fail to exert a pressure on the top of the water for the purpose of operating the regulator. Any surplus air in the cup may be allowed to escape through the tube H′, which is closed by a suitable spring-cover, I″, which is applied thereto as shown.

When the air in the cylinders B′ becomes too much heated by the heat from the tank B, the expanded air passes through the pipe D′ and presses upon the top of the fluid in the cup E′, and a portion of this fluid is forced through the pipe H″ and through the long bent tube I′ into the tube portion of the valve-trip J′. Upon one end of this trip J′ is placed a cup, L′, which is provided with a perforated cap, and inside of this cup is placed a small float, M′. The opening in the cap allows the air which is displaced by the fluid which flows into the trip to escape, and the float M′ serves to close this opening in the cap in case too much fluid should ever be forced into the cup L′.

The trouble with air as a heat-regulator has always been the difficulty of overcoming the variation caused by the rise and fall of the barometric pressure. As long as the temperature of the egg-chamber was kept up so that it did not fall over four or five degrees, the long bent tube I′ would not be needed. As the temperature in the egg-chamber, and consequently all of the air in the cylinders B′, does vary at times to a considerable extent, the long bent tube I′, which extends almost to the bottom of the tank, is used to prevent any more air entering the cylinders than what is allowed to go in at the will of the operator. If the temperature never fell more than four or five degrees, the pipe H″, leading from the bottom of the cup E′, would be connected directly to the trip J′, so that when the air in the cylinders expanded it would force the fluid from the cup E′ directly into the cup L′ on the trip. Where the cup and trip are thus connected directly together and the temperature of the air in the cylinders should cool ten degrees, the air in that case would enter the opening in the cap of the cup L′ and force itself through the cup, the tube portion of the trip, and the pipe H″ directly into the cup E′, and thence into the cylinders B′, thus necessitating the resetting of the machine each time that it cooled down. The long bent tube I′ serves to prevent this resetting of the machine, no matter how great the variations may be.

The cup E′ and tube I′ are both full of fluid, and the fluid never gets lower in either than the level of the fluid when it is at rest. If the regulator is set at 103° there is no pressure in the fluid-cup, and consequently it remains level in both cup and bent tube, as shown in Fig. 2. As soon as the heat rises in the egg-chamber, the air in the cylinders expands and presses on the top of the fluid in the cup E′, forces a portion of it out through the tube H″ and down through the bent tube I′ up into the cup L′ on the valve-trip J′. As the water rises in the cup L′, the cup causes that end of the trip to descend and the other end to rise upward, thereby opening the valve C′, which allows the heated air in the egg-chamber to escape. As soon as the heat falls in the egg-chamber, the air contracts in the cylinders B′, the pressure is removed from the top of the fluid in the cup E′, and the fluid then flows back from the cup L′ into the cup E′.

When the air in the cylinders expands, it has only to raise the level of fluid in the cup L′; but should the air in the cylinders contract from cold and create a partial vacuum the air entering at the little opening in the cap of the cup L′ would have to force the fluid entirely out of the bent tube I′ before any air could pass through it to enter the cup E′. To force all of the air out of the tube I′ is impossible; but even if it were possible to do so the float F′ in the cup E′ would close the mouth of the tube D′, and thus prevent any passage of the fluid in the cup E′ into the cylinders. Thus it will be seen that it is impossible for any air to enter the cup E′, so as to pass in the cylinders B′, unless so desired by the operator.

To entirely overcome the effects of the barometric variations of temperature, it is necessary to make the cylinders relatively so much larger than would be necessary if there were no variation of the barometer, so that the expansion and contraction is so much more than the increased and diminished pressure of the outside air by the rise and fall of the barometer. To overcome this defect entirely, with the variation of only a fraction of a degree of the heat in the egg-chamber, the cylinders require about twenty quarts of air. The expansion and contraction of that amount, with only one degree or less of heat, will overcome all ordinary variations of the barometric pressure.

The inner end of the trip J′ catches under the crank O′, which is loosely connected to the valve C′ in the opening H. The valve and the crank are loosely connected together, so that the valve can be turned into any desired position, and thus the trip be made to close or only partially close the valve, as may be desired. Rigidly secured to this crank O′ is the stop P′, which, by striking against the top of the frame-work A, prevents the valve from being moved too far in opening. When the air in the cylinders B′ expands and forces a portion of the fluid in the cup E′ through the bent tube I′ into the cup L′ on the trip J′, the outer end of the trip J′ tilts downward, and as the inner end of the trip rises the crank turns the valve C′, so as to cause it to open. As soon as the air contracts in the cylinders the pressure is relieved from the fluid in the cup E′. The fluid in the cup L′ runs back into the cup E′, thus allowing the inner end of the trip J′ to drop down, thus permitting the valve C′ to automatically close.

When the eggs contain live chickens, the heat from these chickens tends to raise the temperature of the egg-chamber, and were there no means for controlling this heat it would on a warm day rise beyond the temperature of the water in the tank. For this reason two separate regulators are necessary—one for the water in the tank and the other for the air in the egg-chamber.

Having thus described my invention, I claim—

1. The combination of the tank with the tube or connection N, extending therefrom, and a pivoted regulating-rod, M, which is hollow at one end and provided with a cup, O, and which has a lamp-flame regulator, for controlling the flame of the lamp, connected to its opposite outer end, whereby, when the expansion of the water in the tank takes place, a portion of the water will be forced into the hollow end of the rod and thus cause the flame to be shut off, substantially as shown.

2. The combination of the tank of an incubator with a tube, N, leading therefrom, a pivoted regulating-rod which is hollow at one end

and provided with a cup, O, so as to receive the water which is forced through the tube by expansion within the tank, and weighted at the other, and a flame-regulator which is connected to the weighted end of the rod, substantially as described.

3. In an incubator, the combination of a pivoted regulating-rod which is connected by a tube with the tank, and flame-regulator connected to this rod, with the air-chamber, a tube connected thereto, the cup E′, a connecting-tube, and pivoted regulating-rod which is operated by the water forced by the pressure of the air from the cup E′, and which operates the valve C′, the two regulating-rods being adapted to operate together, but independently of each other, substantially as set forth.

4. In an incubator, the combination of an air-holder which is located in the top of the egg-chamber, a pipe connected at its lower end to this air-holder, a pressure-cup containing fluid and to which the upper end of the pipe is connected, a regulator which is connected to the cup, and an air-valve in the top of the incubator, and which is controlled by the regulator, substantially as specified.

5. In an incubator, the combination of an air-holder placed in the top of the egg-chamber, the pipe D′, leading therefrom, the pressure-cup E′, containing fluid, the pipe H′, extending therefrom, the U-shaped pipe I′, which is filled with fluid from the cup, a pivoted regulator which is connected to the pipe I′, and an air-valve in the top of the incubator, and which is operated by the regulator, substantially as shown.

6. The combination, in an incubator, of the tank, a cup, J, which is placed therein, and which is to be filled with a non-freezing fluid, a pipe, N, extending from the top of this cup, a regulator connected to the pipe N, and a flame-regulator which is connected to the regulator, substantially as described.

7. The combination of the cylinders containing air, the tube leading therefrom, the pressure cup containing fluid, a U-shaped tube, the regulator, and the valve, a portion of the fluid being forced from the pressure-cup by the expansion of air in the cylinder through the U-shaped tube into the regulator, substantially as set forth.

8. In an incubator provided with a water-tank for heating the egg-chamber, the two air-flues U U′, and the partition V, for separating the two inflowing currents of air, the flues being in connection with the outer atmosphere at one end and the egg-chamber at the other, substantially as set forth.

9. The combination, with the water-tank X, having openings through its top closed by the slides *a*, of the vertical passages V′, and the air-flue, which extends back and forth through the water-tank which heats the egg-chamber, the air-flue being in connection with the outside air at one end and the egg-chamber and water-tank at the other, substantially as described.

10. In an incubator provided with a water-tank for heating the egg-chamber, the combination of the air-flues U U′, which extend back and forth through the tank and connect at one end with the atmosphere, with the vertical passages V′ at the inner ends of the flues, the water-tank X, partition *g*, and the slides *a*, substantially as specified.

11. In an incubator, the combination of the tank, an air-flue which passes through the tank, a moisture-chamber connected to the flue at its upper end, and slides by means of which the amount of moisture taken up by the air and discharged into the egg-chamber can be regulated at will, substantially as specified.

12. In an incubator, the combination of the tank, the air-flues T U U′, the pipes V′, the moisture-chambers X, provided with openings in their tops, and the slides *a*, by means of which the escape of the air in the egg-chamber is regulated, as shown.

In testimony whereof I affix my signature in presence of two witnesses.

JAMES L. CAMPBELL.

Witnesses:

SARAH SHOAF,

J. M. SHOAF.