T. B. FREAS.

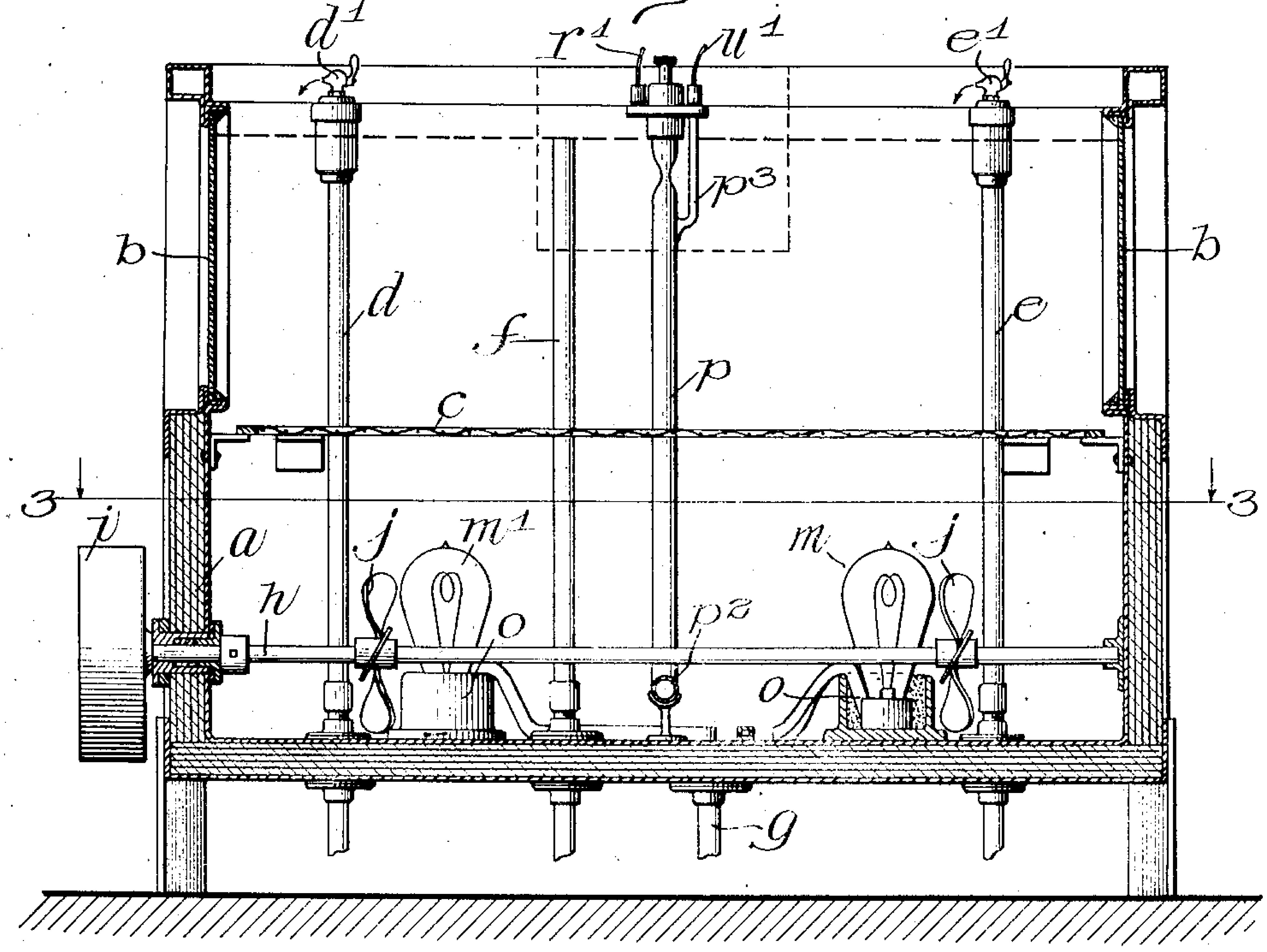
CONSTANT TEMPERATURE BATH.

APPLICATION FILED SEPT. 1, 1909.

999,710. Patented Aug. 1, 1911.

3 SHEETS—SHEET 1.

Fig. 1.



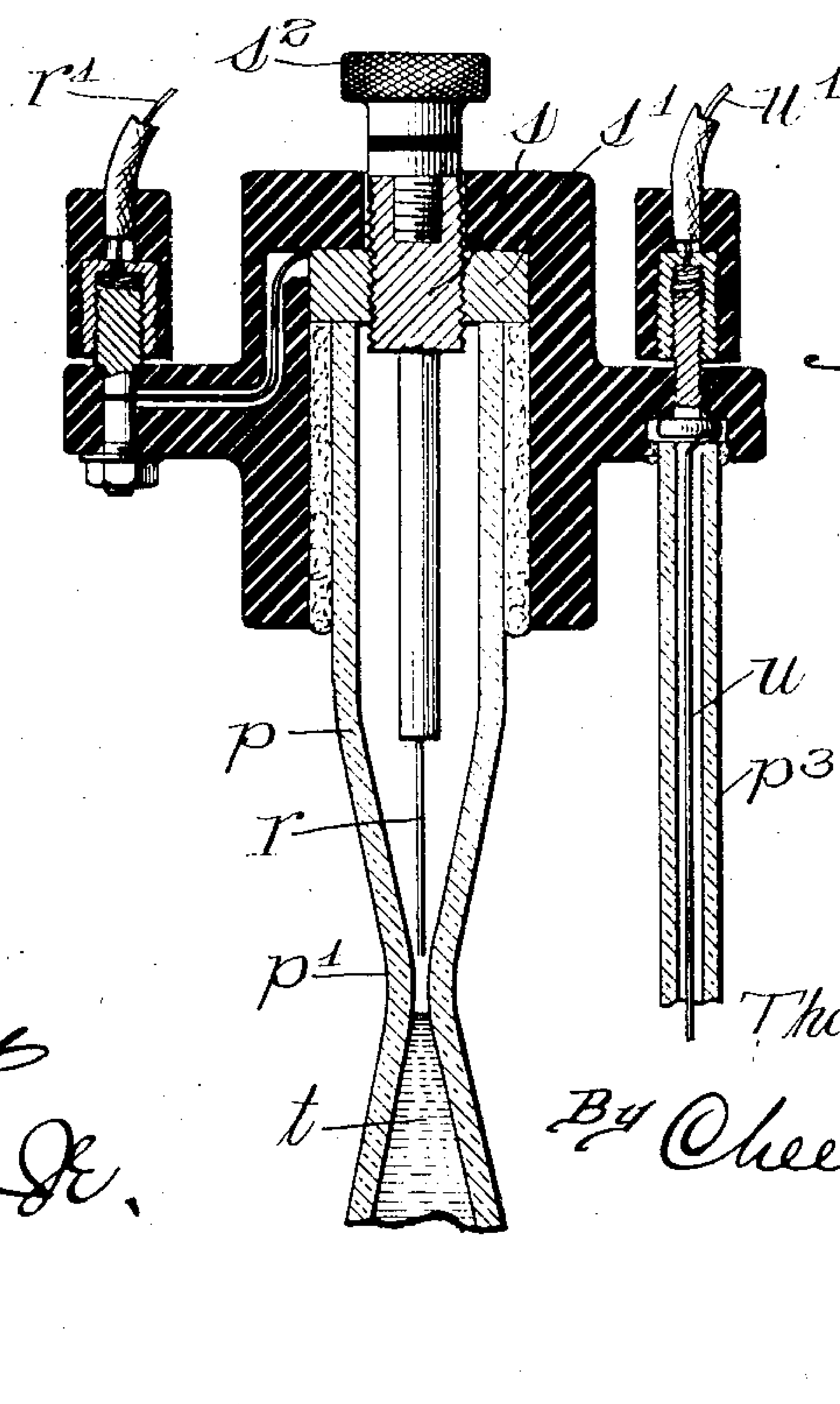


Fig. 2

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3 SHEETS—SHEET 2.

Fig. 3

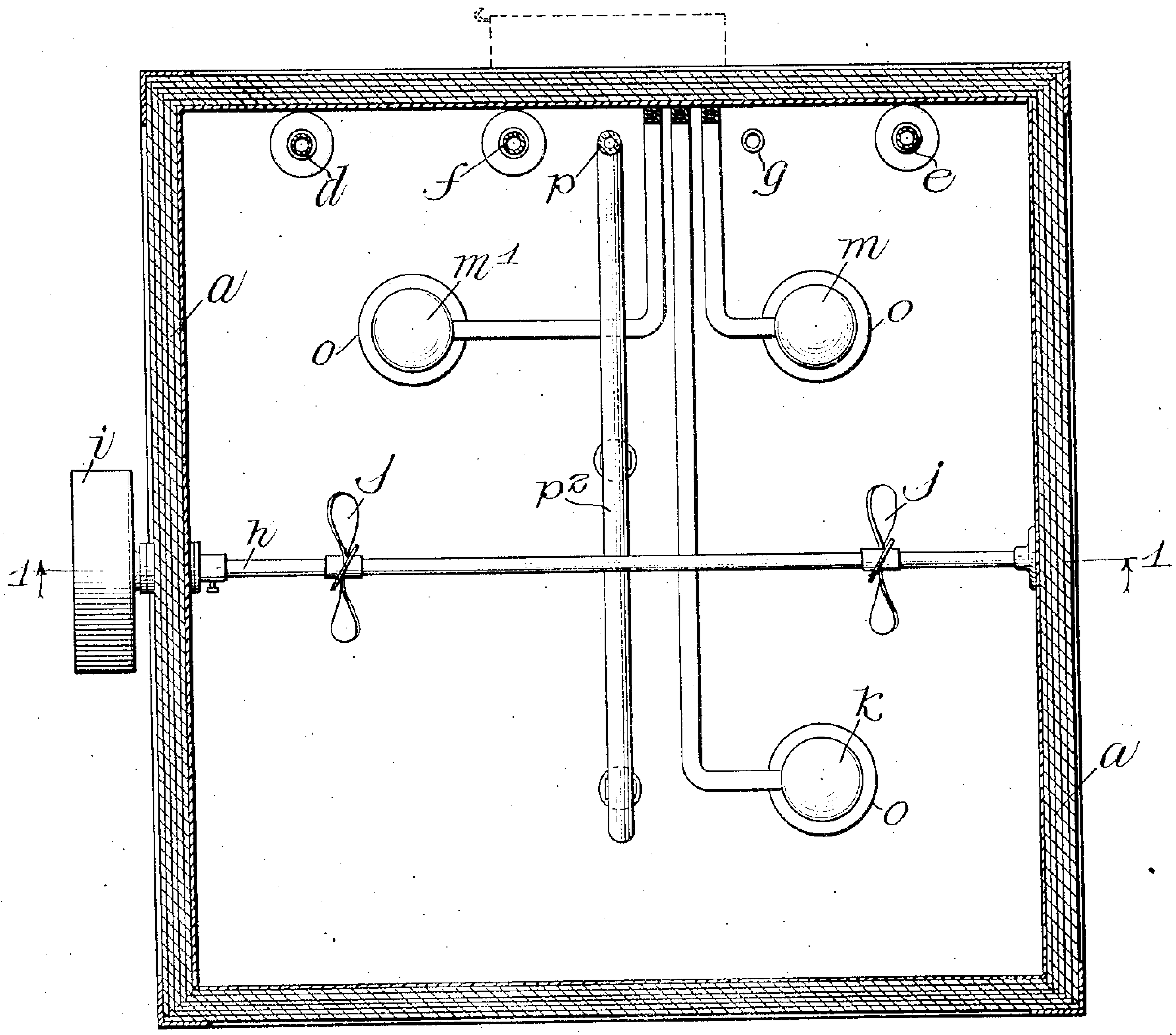
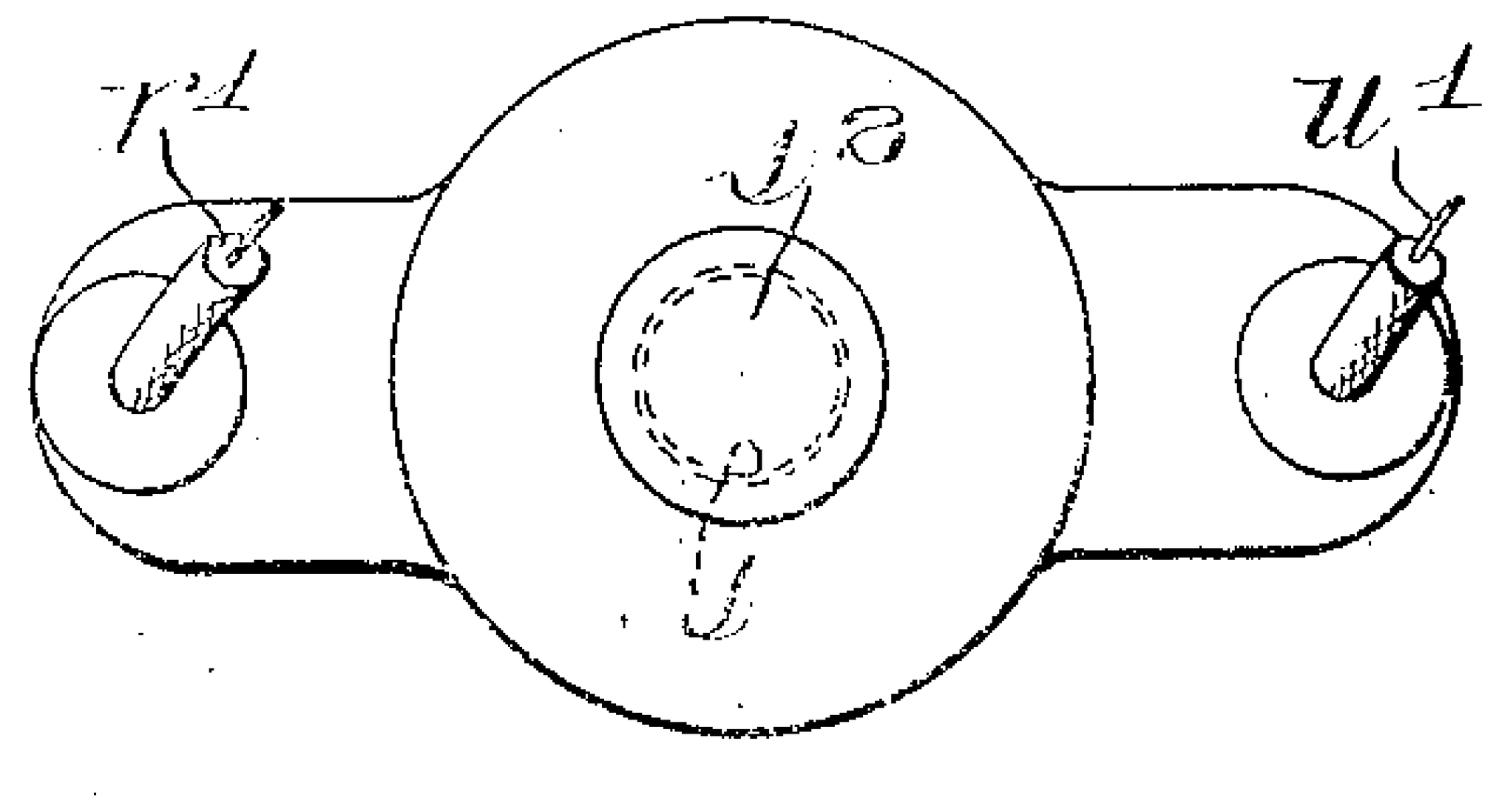


Fig. 4



Witnesses:

[signature]

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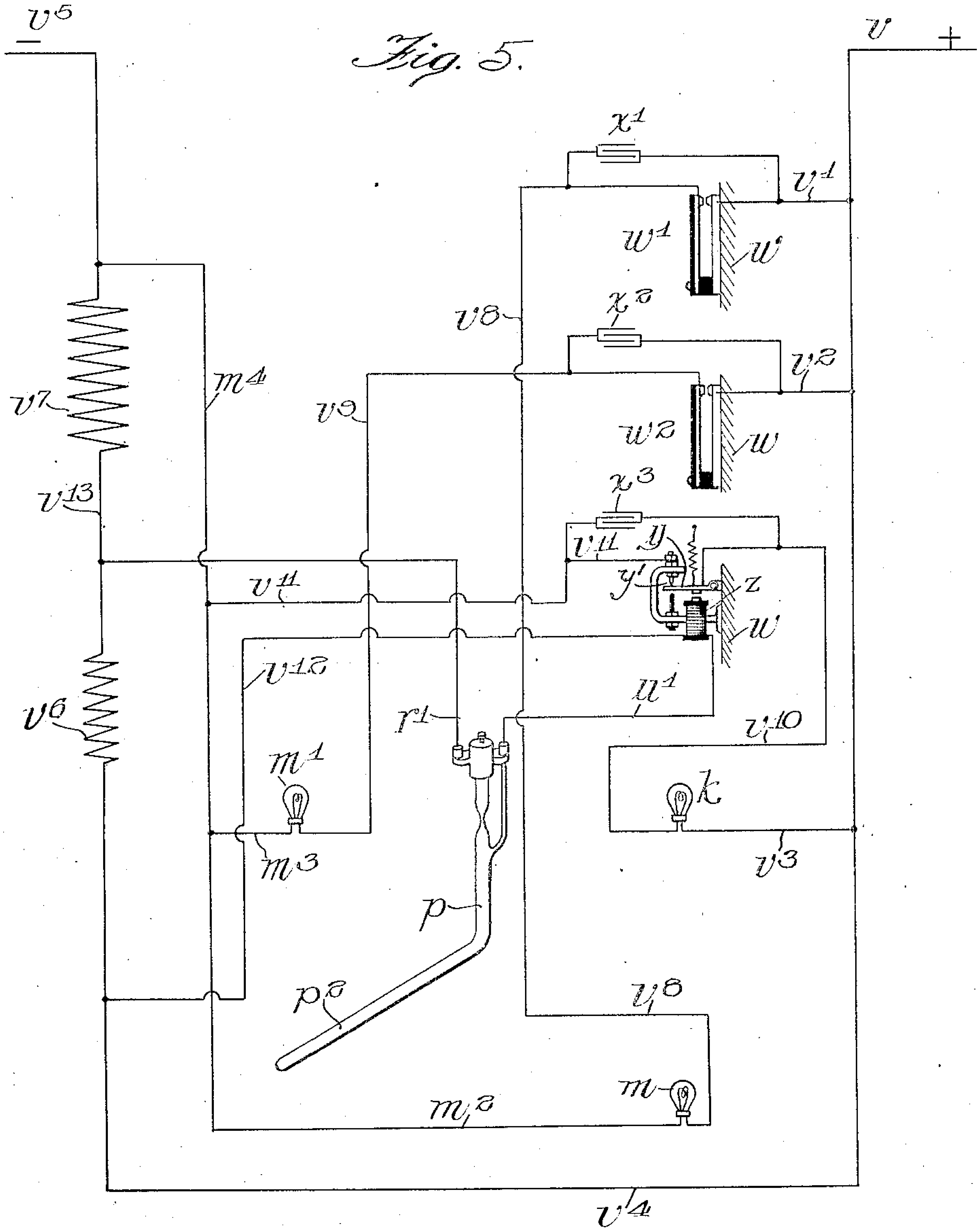
3 SHEETS—SHEET 3.

Fig. 5.



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UNITED STATES PATENT OFFICE.

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CONSTANT-TEMPERATURE BATH.

999,710. Specification of Letters Patent. Patented Aug. 1, 1911.

Application filed September 1, 1909. Serial No. 515,714.

To all whom it may concern:

Be it known that I, THOMAS B. FREAS, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a certain new and useful Constant-Temperature Bath, of which the following is a specification.

My invention relates to constant temperature baths, for example, those employed in chemical laboratories and elsewhere, and the object of the invention is to provide reliable and sensitive means for maintaining the bath liquid at the required temperature, whether such required temperature be above or below that of the room or surrounding atmosphere.

It is also my object to insure uniformity of temperature throughout the various portions of the bath liquid.

In addition to these general objects, it is my purpose to provide mechanism which shall be simple, durable and efficient throughout wide ranges of temperature of the room.

I accomplish my object by the apparatus shown in the accompanying drawings, in which—

Figure 1 is a sectional elevation of the complete apparatus taken on the line 1—1, Fig. 3. Fig. 2 is a sectional elevation of the upper portion of the mercury tube which forms part of the heat regulator. Fig. 3 is a plan section of the apparatus taken on the line 3—3, Fig. 1. Fig. 4 is a plan of the parts shown in Fig. 2. Fig. 5 is a diagram illustrating the principle of operation.

Similar letters refer to similar parts throughout the several views.

The liquid which constitutes the bath proper, and will be hereinafter referred to as "water", is contained within the vessel a, which in the preferred form is provided with glass panels b in the sides to afford a view of the immersed articles within the bath. The vessel is provided with a screen or perforate shelf c for supporting the immersed articles, a cold water inlet d having a cock d^1, a hot water inlet e having a cock e^1, an overflow pipe f for maintaining the water at the proper level, and a drain pipe g. A shaft h journaled in the vessel, preferably near the bottom thereof, is driven by a band wheel i or other suitable power mechanism, and is provided with stirrers j, which, in the preferred construction, are both arranged to force the water in the same direction so as to produce a circulation throughout the entire vessel to equalize the temperature at all parts.

Within the vessel, preferably near the bottom, is a main heater k and one or more auxiliary heaters m, m^1. These heaters consists preferably of ordinary incandescent electric lamps, wired in any suitable manner to exclude water from the connections. For example, the wires may lead into caps o filled with bituminous water-proof material or other suitable substance. The heater k is controlled by apparatus, part of which is shown in detail in Figs. 2 and 4. It consists of a mercury tube p, which, in the preferred construction, is contracted at the point p^1 and has a foot p^2 extending along or near the bottom of the vessel to thereby expose a greater length of tube to contact with the bath water. The exact form of the fittings at the upper portion of the tube p is nonessential except that the terminal r is vertically adjustable and maintains constant electrical connection with the conductor r^1. In the preferred form, terminal r is carried by a metallic plug s which may be screwed up and down in the stationary plate s^1 which remains in electrical connection with the conductor r^1. The plug s is provided with a cap s^2 of rubber or other insulating material which may be grasped by the operator. The other terminal of the control circuit is formed by the mercury t contained in the lower portion of the tube p and contacting the lower end of the conductor u which leads upward in the branch p^3 of tube p. The branch p^3 of tube p contains mercury to substantially the same level as tube p, and the mercury in the two parts is in electric connection by reason of the fact that the branch p^3 communicates with tube p as shown in Fig. 1. The conductor u is electrically connected with the exterior conductor u^1 in any suitable manner.

I will now describe the electrical connections shown in the diagram Fig. 5. From the positive terminal v lead four branches, v^1, v^2, v^3, v^4, the branch v^4 being connected to the negative terminal v^5 through the resistances v^6 and v^7. Two thermostats w^1 and w^2 are connected in the branches v^1 and v^2 respectively at points where they will be exposed to the atmosphere of the room. For convenience these may be mounted on the wall w of the room and a number greater

or less than two may be employed, as desired. The function of the thermostat w^1 is to make or break the circuit through the conductor v^8 and heater m, depending upon the temperature of the room. Similarly the function of the thermostat w^2 is to make and break the circuit through the conductor v^9 and heater m^1. Ordinarily these thermostats will be set to respond at different temperatures so that the circuit through one of the heaters will be closed when the temperature of the room drops to a certain point, and the circuit through the other heater will be closed if and when the temperature drops to a still lower point. The heaters m and m^1 are connected to the negative terminal v^5 through the conductors m^2 and m^3 respectively, each leading to the conductor m^4 connecting with said negative terminal.

The heater k is connected on one side to the branch conductor v^3 and on the other side to a conductor v^{10} which leads to the switch arm y of an electromagnetic switch which, like the thermostats w^1 and w^2 is mounted upon the wall of the room or in any other convenient location. The stationary contact y^1 of said switch is connected to a conductor v^{11} which leads to the negative terminal v^5 through the conductor m^4 or otherwise. The switch arm y is normally spring urged into contact with the terminal y^1 so that the heater k will normally be energized. The electromagnet z of the switch is adapted, when energized, to act upon the switch arm y and draw it away from the terminal y^1, thus breaking the circuit through heater k. One end of the coil of said electromagnet is connected to the conductor w^1 and the other end is connected to the conductor v^{12} which leads to the branch v^4. The conductor r^1 is connected to the conductor v^{13} which connects the two resistances v^6 and v^7. It will be noted that in this, the preferred arrangement of wiring, the main resistance v^7 is in series with the tube p and electromagnet z, thus cutting down the amperage to within the proper limits. It will also be noted that the lesser resistance v^6 is in parallel with the mercury tube and electromagnet and thus cuts down the voltage in said tube and magnet to within the proper limits. Another result of the arrangement of the resistances v^6 and v^7 is that they render it possible to employ a single source of supply both for feeding the heater k and for operating the devices which control it. Condensers x^1, x^2 and x^3 are connected in shunt around the thermostats w^1 and w^2 and the switch y respectively and thus facilitate their operation.

In operation, let it be assumed that the bath is to be maintained at 25° centigrade. The terminal r will be raised or lowered to such a point that it will just contact the top of the mercury when the latter is at the level produced by a temperature of 25°. As the area of the contracted portion p^1 is small, a very slight difference of temperature, for example, one-thousandth of a degree will be sufficient to make or break the contact between the mercury and the terminal r.

Let it be supposed that the room is at a summer temperature of, say 28°, and that the cold water supply is at a temperature below the desired bath temperature. The cold water cock d^1 will be opened sufficiently to permit the steady flow of a small stream for the purpose of holding the temperature of the bath down to or below 25°. If, now from any cause, the temperature of the bath drops below 25° the level of the mercury will fall below the lower end of terminal r and the circuit through the electromagnet z will be broken. This deënergizes the latter and permits the switch arm y to close and thus establish a circuit through the heater k. The heater thus remains active until the temperature of the bath is brought back to twenty-five degrees, whereupon the mercury reaches the lower end of the terminal r and establishes a circuit through said electromagnet. As soon as the electro-magnet becomes energized it attracts the switch arm y and thus breaks the circuit through the heater k. Thus the heater is turned on or off, depending upon whether the temperature of the bath is above or below the required temperature of 25°.

In winter when the temperature of the room is below the selected temperature of the bath the cold water cock d^1 will remain closed and if desired the hot water cock e^1 may be opened to a greater or less extent to counteract the cooling tendency of the atmosphere; but ordinarily the hot water cock will remain closed, its proper function being to enable the operator to quickly bring the bath up to temperature when the vessel is being filled. If desired, the hot water pipe may be omitted, for the temperature can be maintained by the mercurial regulator taken in connection with the auxiliary regulators w^1, w^2.

It may sometimes happen that the temperature of the atmosphere is so low that the heater k will be insufficient to maintain the proper temperature. Under such conditions the auxiliary regulators come into operation; for example, the thermostat w^1 may be set to close the circuit through heater m when the temperature of the room drops to 22° centigrade and the thermostat w^2 may be set to close the circuit through the heater m' when the atmosphere in the room drops to 18°. Thus, it will be seen that if the temperature of the room is only slightly below the required temperature of the bath the heater k with its controlling means will be the only part of the apparatus called into

play but if the temperature of the atmosphere in the room descends, one or more of the auxiliary heaters will be called into play, depending upon the extent to which the temperature descends. The auxiliary heaters are all smaller units than the main heater *k* and thus avoid the possibility of overheating the bath.

It will thus be evident that in its most complete embodiment, my invention includes two kinds of thermoresponsive regulators, one kind being responsive to the temperature of the bath, and the other kind, which is in the nature of an auxiliary regulator, being responsive to the temperature of the air of the room. As a result the heater *k* may be comparatively small so that when turned on or off it will not produce great fluctuations in the temperature of the bath. The heater *k* acts only at or near the selected temperature and regulates the bath within exceedingly narrow limits, while any additional heat, if required, is supplied by the auxiliary heaters. Of course, one or more auxiliary heaters and thermostats may be employed, if desired, without exceeding the scope of my invention.

Having thus described my invention, what I claim as new, and desire to secure by Letters Patent, is:

1. In apparatus of the class described, the combination with a water bath of a plurality of independent heaters therefor, one controlled by the temperature of the bath itself and the other by the temperature of the surrounding atmosphere.

2. In apparatus of the class described, the combination with a water bath of two independent heaters therefor and two thermoresponsive devices adapted to control said heaters, one of said thermoresponsive devices being responsive at the desired temperature of the bath and the other at a point considerably lower, for the purpose described.

3. In a constant temperature bath, the combination of a heater, thermoresponsive means subject to the temperature of the bath for controlling said heater, an auxiliary heater independent of the first and thermoresponsive means subject to the temperature of the surrounding air for controlling said auxiliary heater.

4. In a constant temperature bath, the combination of an electric heater, a switch for controlling the current through said heater, electromagnetic means for operating said switch, thermoresponsive means subject to the temperature of the bath for controlling the circuit through said electromagnetic means, an auxiliary heater, and thermoresponsive means subject to the temperature of the surrounding air for controlling said auxiliary heater.

5. In a constant temperature bath, the combination of a heater, thermoresponsive means subject to the temperature of the bath for controlling said heater, a plurality of auxiliary heaters and a separate thermoresponsive controlling device for each of said auxiliary heaters, the last mentioned controlling devices being subject to the temperature of the surrounding atmosphere and being set to respond at different temperatures.

6. In apparatus of the class described, the combination, with the water bath of an electric supply circuit having two branches, a heater for the bath and a heater switch in one of said branches, and in the other of said branches an electromagnet for operating said switch, a mercurial thermostat located within the bath in series with said electromagnet, and adapted to operate it, and interposed resistance in series with said electromagnet and thermostat, whereby the heater obtains the full drop in potential and the thermostat and electromagnet only a partial drop in the potential of the supply circuit.

7. In a constant temperature bath, the combination with a water bath of an electric supply circuit, an electric heater in said circuit, electromagnetic means for making and breaking the circuit through said heater, said heater and said electromagnetic means being connected in parallel in said supply circuit, and said electromagnetic means having resistance arranged in series therewith, and thermoresponsive means for controlling the circuit of said electromagnetic means.

8. In a constant temperature bath, the combination with a water bath of an electric supply circuit, an electric heater in said circuit, electromagnetic means for making and breaking the circuit through said heater, said heater and said electromagnetic means being connected in parallel in said supply circuit, and said electromagnetic means having resistance arranged in series therewith, and thermoresponsive means for controlling the circuit of said electromagnetic means, said thermoresponsive means including a mercury tube within the bath connected in circuit with said electromagnetic means for making and breaking the circuit therethrough.

9. In a constant temperature bath, the combination with a water bath of an electric supply circuit having two parallel paths arranged therein, an electric heater arranged in the first of said paths, heat controlled electromagnetic means arranged in the second of said paths for controlling the circuit through said heater, said second path having a resistance arranged in series with said electromagnetic means and a second resistance arranged in shunt with said electromagnetic means and in series with the first mentioned resistance.

10. In a constant temperature bath, in combination, an electric heater, electroresponsive means for controlling the current through said heater and thermoresponsive means for controlling the current which operates said electroresponsive means, said thermoresponsive means including a mercury tube within the bath, a terminal connecting with the mercury in the tube below the point of lowest level and a vertically adjustable terminal mounted in the tube above the level of the mercury and adapted to make contact with the mercury when the temperature of the bath reaches a predetermined point.

11. In a constant temperature bath, the combination of an electric heater, a switch for controlling the circuit through it, electromagnetic means for operating said switch, thermoresponsive means subject to the temperature of the bath for controlling the circuit through said electromagnetic means and a condenser connected in parallel with said switch.

12. In a constant temperature bath, the combination of an electric heater, a switch for making and breaking the circuit through said heater, thermoresponsive means subject to the temperature of the surrounding atmosphere for operating said switch and a condenser in shunt relation with said switch.

In witness whereof, I have hereunto subscribed my name in the presence of two witnesses.

THOMAS B. FREAS.

Witnesses:
HOWARD M. COX,
MARGARET D. ROBB.