W. L. WATERS.

ELECTRIC HEATER SYSTEM.

APPLICATION FILED NOV. 13, 1913.

1,183,925.

Patented May 23, 1916.

3 SHEETS—SHEET 1.

Fig. 1.

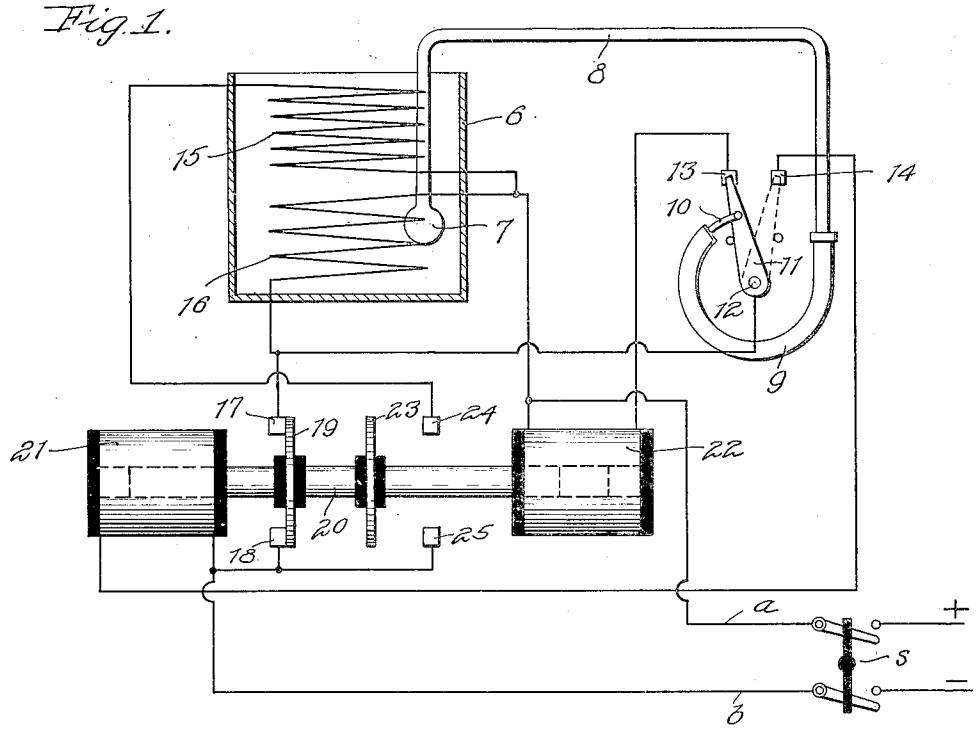
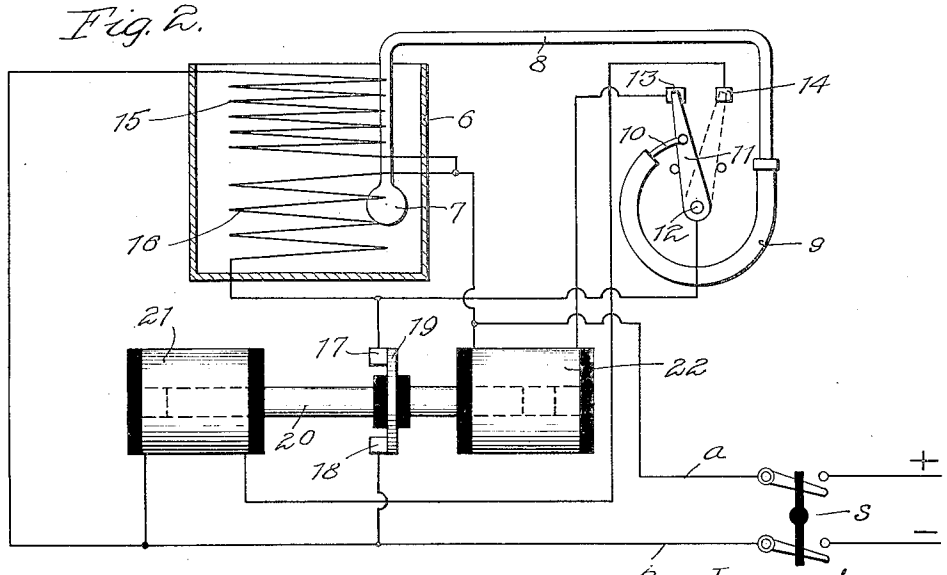


Fig. 2.



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3 SHEETS—SHEET 2.

Fig. 3.

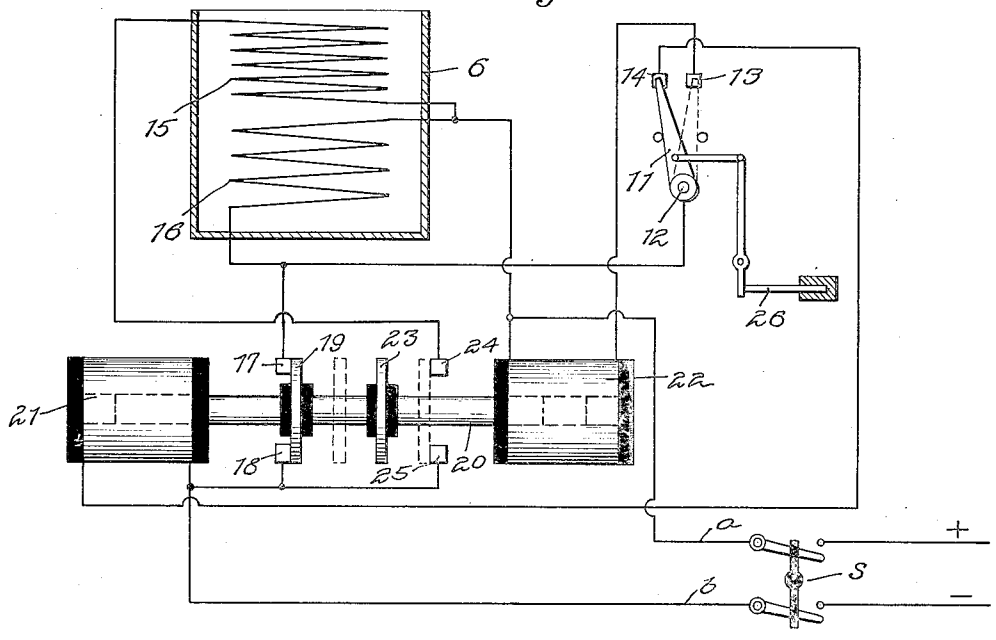
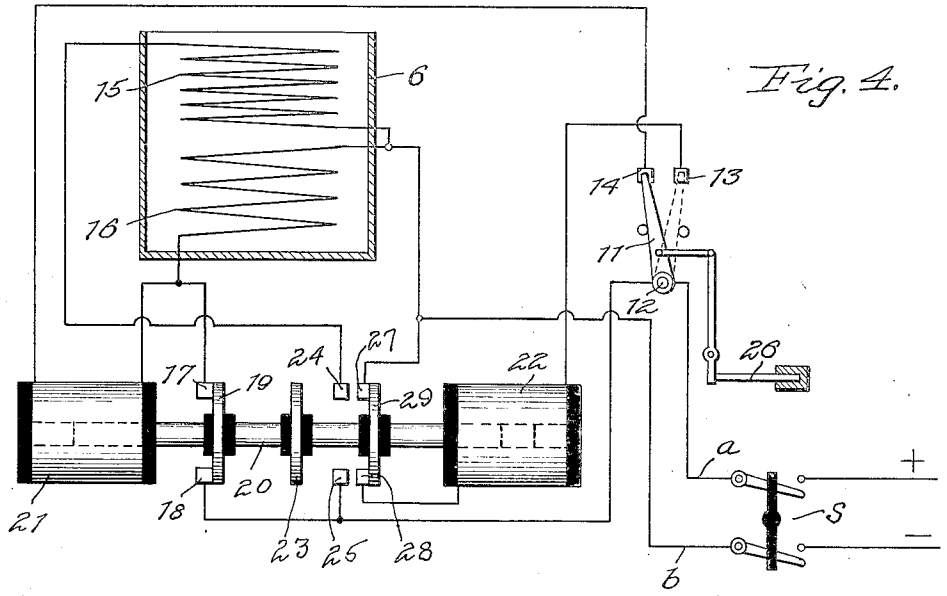


Fig. 4.



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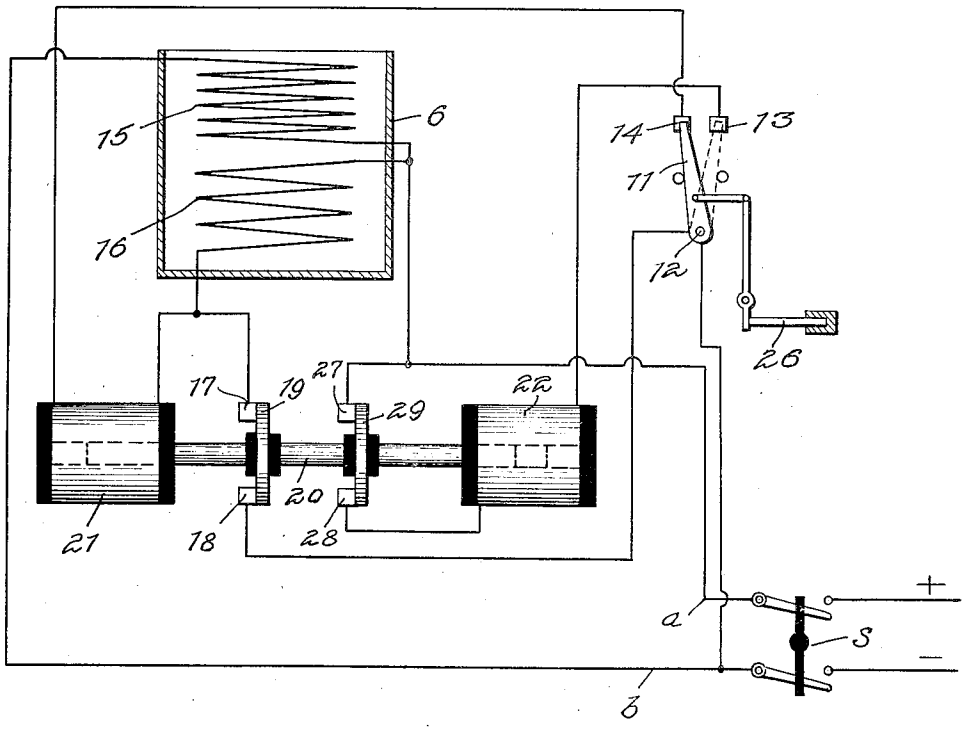
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3 SHEETS—SHEET 3.

Fig. 5.



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UNITED STATES PATENT OFFICE.

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ELECTRIC-HEATER SYSTEM.

1,183,925. Specification of Letters Patent. Patented May 23, 1916.

Application filed November 13, 1913. Serial No. 800,707.

To all whom it may concern:

Be it known that I, WILLIAM L. WATERS, a citizen of the United States, residing at Milwaukee, in the county of Milwaukee and State of Wisconsin, have invented certain new and useful Improvements in Electric-Heater Systems, of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawings, forming a part of this specification.

My invention relates to the art of electric heating, and is concerned with a system adapted to be employed where it is desired to maintain substantially constant the temperature of a body, such as a tank containing molten metal, such as is used for linotype work; or oil, such as is used for tempering steel; or, in fact, solid bodies such as printing dies.

The primary object of my invention is to maintain the substantially constant temperature automatically and to secure this result by means of an efficient, economically operating, and simple arrangement, wherein the necessary circuit-changing devices are not subjected to heavy heating currents, but, on the contrary, are required to carry only light relay currents, and wherein sparking at contact points is avoided.

To the end of efficient and economical operation, it is my preferable plan to provide two or more heating elements of different characteristics, so that certain burdens, such as the steady one of continuously keeping the temperature up to at least a certain point, may be carried by a heating element having a low in-put, while the special services, such as maintaining a constant temperature and raising the temperature rapidly, may be carried out by a heating element of high in-put.

In the accompanying drawings I have illustrated various arrangements coming within the scope of my invention.

In the accompanying drawings, Figure 1 is a diagrammatic illustration of one embodiment of my invention. Fig. 2 shows a modification having one heating element permanently connected to the mains. Fig. 3 illustrates the system of Fig. 1, employing a different type of thermostat. Fig. 4 illustrates a modification in which the relay current is broken by the main switch. Fig. 5 illustrates a modification similar to Fig. 4 but having one of the heaters constantly in circuit.

Referring first to Fig. 1, it will be seen that at 6 I have indicated a vessel, for the purpose of showing an example of my invention, and it may be considered as a tank for containing molten metal or the like. This tank contains or has otherwise associated therewith a heat responsive device in the form of a bulb 7, which may contain some liquid having a rather rapid rate of expansion, said bulb being connected by means of a tube 8 with the expansible member 9 of a Bourdon gage. The end of this expansible member is connected by means of a link 10 with a pointer 11 pivoted at 12. This pointer is adapted to make engagement with either one of the two contacts 13 and 14. The arrangement is merely diagrammatically illustrated and it will be seen that I have illustrated a winding 15 and a winding 16 in association with the vessel 6, it being understood that these windings are so related to the vessel that when currents pass therethrough they heat the vessel and the contents thereof. I shall refer to the coil 15 as the constant temperature coil and to the coil 16 as the high temperature coil, and it is an important feature of my invention that the coil 15 is of comparatively high resistance and low wattage while the coil 16 is of comparatively low resistance and high wattage. These coils are diagrammatically illustrated as being disposed in different parts of said heating vessel 6 but may be placed in any preferred location. The coil 16 is adapted to be connected across the line limbs *a*, *b* by connecting together two contacts 17 and 18. This is done by means of a contact maker 19 carried by the solenoid core 20 mounted so as to be subject to the influence of a solenoid coil 21 and another solenoid coil 22. It will be seen that when the contact maker 19 simultaneously engages the contacts 17 and 18 the coil 16 is connected directly across the line limbs *a* and *b*.

The solenoid core 20 carries another contact maker 23 which is adapted to close the circuit between the contacts 24 and 25. This action closes the circuit of the coil 15 across

the line limbs *a* and *b*. The arrangement is such that when the switch 17—18—19 is opened the switch 23—24—25 is closed and vice versa. The line may be provided with the hand switch *s*.

It will now be understood that when the vessel 6 is cold the pointer 11 is in the position shown in dotted lines in the figure under consideration. When, under these conditions, the switch *s* is closed, the circuit is closed through the solenoid winding 21 and the contact maker 19 is drawn up into engagement with the contacts 17 and 18 so as to close the circuit through the high temperature winding 16. This operation brings the vessel and its contents up to the desired temperature and it does this quickly so that no time is lost in getting the operation under way. The calibration of the Bourdon gage is such that when a definite figure, say 500 degrees centigrade, is reached, the contact pointer 11 will have reached the contact 13 and this operation closes the circuit through the solenoid winding 22. This brings contact maker 23 into engagement with the contacts 24 and 25, so that the winding 15 is thrown into the circuit and this winding is practically sufficient to maintain a constant temperature by supplying the radiation losses. However, if the winding 15 should not be sufficient to completely supply the radiation losses or if the addition of cold objects should lower the temperature of the bath of melted material the decrease in temperature causes the pointer 11 to travel back toward the contact 14, and when a predetermined minimum temperature, say 450 degrees centigrade, is reached, the pointer 11 will make engagement with the contact 14 and will throw the solenoid 21 into circuit so as to substitute the high temperature winding for the constant temperature winding to bring up the temperature to the proper point. Here, again, when the maximum temperature is reached, the solenoid 22 operates to make the substitution of the windings. In this way the temperature is maintained between 450 degrees and 500 degrees centigrade, and in securing this result the main burden is carried by the winding of low in-put while the winding of high in-put is arranged to perform other services in the way of initially bringing up the temperature and being periodically brought into circuit to raise the temperature to the required point.

It will now be seen that when the switch 19 is closed the coil 21 and the contact between the pointer 11 and the member 14 are short-circuited so that as the temperature rises and the Bourdon gage causes the pointer to move from the contact 14 there will be no arc resulting with the consequent destructive spark. It will also be noted that when the engagement between the pointer 11 and the contact 13 is made to close the circuit of the coil 22 the circuit is completed through the switch 19 and thus when this switch is opened the circuit controlled by these contacts is also opened so that no sparking can result as the temperature drops again and the pointer leaves the member 13. Thus in both cases when the gage pointer leaves the contacts the circuit conditions are such that no sparking can result at these contacts and any destructive arcs are entirely eliminated. The heavy heating currents are controlled alone by the relay contacts, which are separated quickly and which may be constructed to carry the proper amount of current.

In Fig. 2 I have provided the various parts with reference characters which are analogous to those of Fig. 1, so far as they apply, and it will be seen that the only difference between the arrangement of Fig. 2 and that of Fig. 1 lies in the fact that the constant temperature coil 15 is placed permanently across the line limbs *a* and *b* so that the constant heat is given by the winding 15 alone and the special heat is given by the windings 15 and 16 acting conjointly.

Fig. 3 will be seen to be like Fig. 1, except that the Bourdon gage 9 is replaced by a thermostatic element 26, which is to be considered to be under the influence of the heat of the vessel 6. This thermostatic element 26 is designed to have a high rate of expansion and contraction, and it will be seen that as this element expands the pointer 11 is moved from the minimum contact 14 to the maximum contact 13 and as it contracts the reverse movement takes place.

In Fig. 4 it will be seen that the same elements are present as in Fig. 3 in which a separate switch is introduced to open the circuit through the pointer 11 and contact 13 when the heater 16 is thrown into circuit, so that there will be no spark when the pointer leaves the stop. This additional switch is illustrated at 27, 28 and 29, and it will be seen that when the coil 22 is energized at the time the pointer 11 reaches the maximum stop 13 the circuit of the coil and the contacts controlling it is opened, so that when the temperature falls again and the pointer 11 leaves the contact 13 there will be no possibility of a spark.

In Fig. 5 I have illustrated a form similar to Fig. 4, except that the constant temperature winding is always in circuit so that one of the switches is dispensed with.

In every instance the heating is secured by the coöperation of two coils, with the constant temperature coil being either always in the circuit or in the circuit most of the time so as to maintain a substantially constant temperature nearly equal to the desired temperature and particularly adapted to counteract the radiation losses. The coil

of high in-put, which throws a large amount of heat into the object quickly, comes into service either in substitution for the other coil or in addition thereto and is put out of service immediately after it has performed its function—that of either primarily bringing up the temperature when the apparatus is first set into operation or of supplying a deficiency to bring the temperature between the prescribed limits. Since this coil of high in-put is automatically brought into service at the times when more heat is required, as has been described, it will be clear that the temperature will automatically be maintained between the two prescribed limits.

In addition to claiming the more comprehensive features of my invention, I also claim the more specific features, which are none the less important, whereby the controlling contacts are effectively protected from the heavy currents which will necessarily be required to effect the proper heating. This I do without serious complicating the circuit which I propose and without the employment of expensive switching or additional relay apparatus, the relay currents being controlled by the same electromagnetic mechanism which is required to bring the proper coils into active service.

I have described in detail a specific embodiment of my invention, but in order to secure certain advantages of my invention it is unnecessary to follow exactly the specific construction set forth in the description of the illustrations.

While it is preferable to use a heating element of high input and another heating element of low input it will be possible, and novel and advantageous in some instances, to use heating elements of equal input or heating elements of a reverse relation. It is essential, however, that two heaters are employed, one of which can be substituted for the other or can be added to the other in its heating effect, and I have drawn the appended claims with this in mind.

I claim as new and desire to secure by Letters Patent:

1. In a heating system, a heating unit of high in-put, a heating unit of low in-put, and thermostatically controlled means for automatically substituting either of said coils for the other.

2. In a heating system, in combination, a heating coil of low electrical in-put, an independent heating coil of high electrical in-put applied to a body to be heated, a thermostat responsive to the temperature of the heated body, and electromagnetic means controlled by said thermostat for substituting one of said coils for the other.

3. In a heating system, a heating unit of low in-put, a heating unit of high in-put, both applied to a body to be heated, a thermostat subject to the temperature of said body, a switching arrangement arranged to close one heater circuit when a prescribed maximum temperature is reached and to close another heater circuit when a prescribed minimum temperature is reached, a relay winding in each of said circuits, and relay contacts controlled by said windings and controlling the circuits of said heater units.

4. In a heating system, a heating unit of low in-put, a heating unit of high in-put, both applied to a body to be heated, a thermostat subject to the temperature of said body, a switching arrangement arranged to close the circuit of said first unit when a prescribed maximum temperature is reached and to close the circuit of said second unit when a prescribed minimum temperature is reached, a relay winding in each of said circuits, and relay contacts controlled by said windings and controlling the circuits of said heating units, the circuits of said relays being made by said thermostatically controlled means and being broken by their own contact mechanism.

5. In an electric heating system, a heating element, an electromagnetic device controlling the circuit of said heating element, and thermostatically controlled contact mechanism to govern the circuit of said electromagnetic device, said electromagnetic device being arranged to short-circuit the thermostatically controlled contacts when energized.

6. In a heating system, in combination, a body to be heated, a heating unit of low resistanc and high wattage and a heating unit of high resistance and low wattage applied to said body, contact mechanism controlling the circuits of said units, electromagentic means for controlling said contact mechanism, thermostatically controlled means for governing the circuit of said electromagnetic means, said thermostatically controlled means being adapted to make the circuit of one electromagnetic means when a prescribed minimum temperature has been reached so as to bring the unit of low resistance and high wattage into circuit and to open the circuit of the other unit, said thermostatically controlled means being also adapted to close the circuit through the electromagnetic means for bringing the unit of high resistance and low wattage into circuit and cutting the other unit out of circuit when the temperature has reached the prescribed maximum.

7. In a heating system, heating units, relays controlling said units, thermostatically controlled contacts for controlling said relays, and means for short-circuiting said thermostatically controlled contacts when they have closed their circuit.

8. In a heating system, heating units, relays controlling said units, thermostatically controlled contacts for controlling said re-

lays, and means for interrupting the current flowing through said contacts by opening the circuit at another point.

9. In a heating system, a heating unit, an auxiliary heating unit, and means for automatically substituting either of said units for the other.

10. In a heating system, a heating unit, an auxiliary heating unit, both applied to a body to be heated, a thermostat subject to the temperature of said body, a switching arrangement arranged to close a circuit for said heating unit when a prescribed maximum temperature is reached and to close a circuit for said auxiliary heating unit when a prescribed minimum temperature is reached, a relay winding in each of said circuits, and relay contacts controlled by said windings and controlling the circuits of said heating units.

11. In a heating system, a heated element, a plurality of heaters of different heating capacities for heating said element, automatic heat controlled switching means, said means substituting a heater of higher wattage for a heater of lower wattage when the temperature of said element, as a whole, falls to a predetermined value, and substituting a heat of lower wattage when the temperature rises to a predetermined value.

12. In a heating system, a body to be heated, a heating coil of low in-put, an independent heating coil of high in-put, said coils being disposed in different parts respectively of said body to be heated, a thermostat, responsive to the temperature of said body, electromagnetic means controlled by said thermostat for opening and closing the circuits of said units, and of said thermostat.

13. In an electric heating system, a heating element, an electro-magnetic device controlling the circuit of said heating element and thermostatically controlled contact mechanism to govern the operating circuit of said electromagnetic device, operation of said electro-magnetic device, changing the flow of current through said thermostatic contact mechanism to prevent sparking upon the separation of the thermostatic contacts in response to the temperature changes.

14. In a heating system a plurality of heating units, thermostatic contact means, relay means controlled by said thermostatic contact means, said relay means having a pair of operating coils and contact means for changing the connections of said heating unit relatively to each other, circuits connecting said thermostatic contact means, said heating units and said relay means, the coils of said relay means being supplied with current only during the period of movement of the contact mechanism controlled thereby.

In witness whereof, I hereunto subscribe my name this 8th day of November, A. D. 1913.

WILLIAM L. WATERS.

Witnesses:
C. A. LAPPÉ,
JABEZ E. SMITH.