May 2, 1933. T. H. FORDE 1,907,290

ELECTRIC FURNACE

Filed Dec. 2, 1929 2 Sheets-Sheet 1

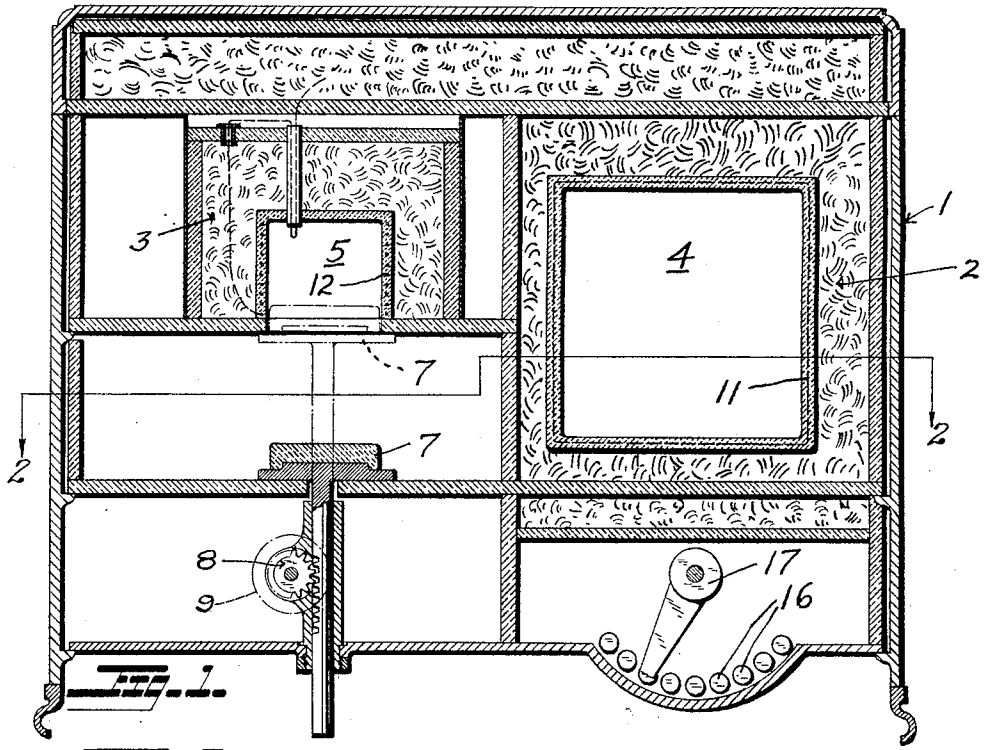


Fig. 1.

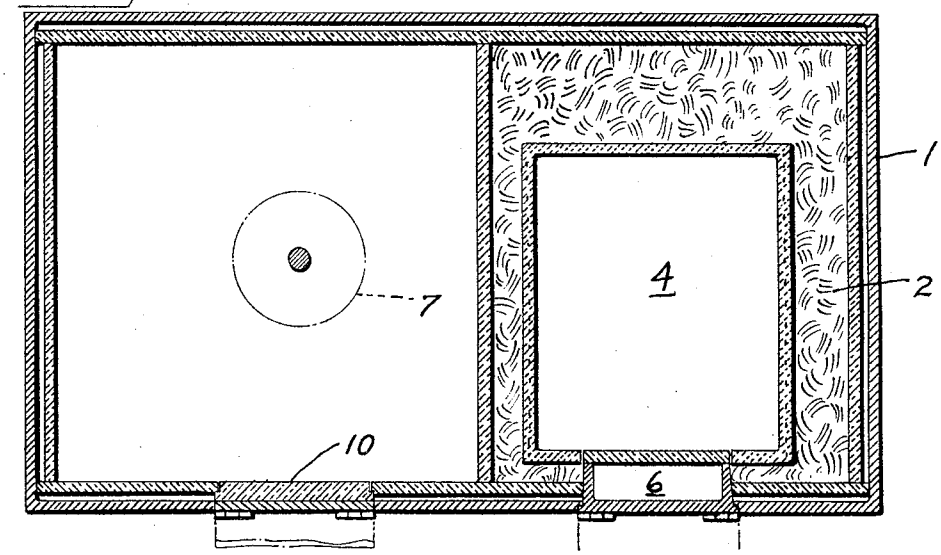


Fig. 2.

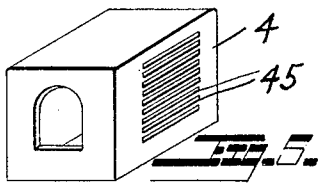


Fig. 5.

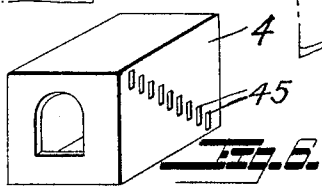


Fig. 6.

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ELECTRIC FURNACE

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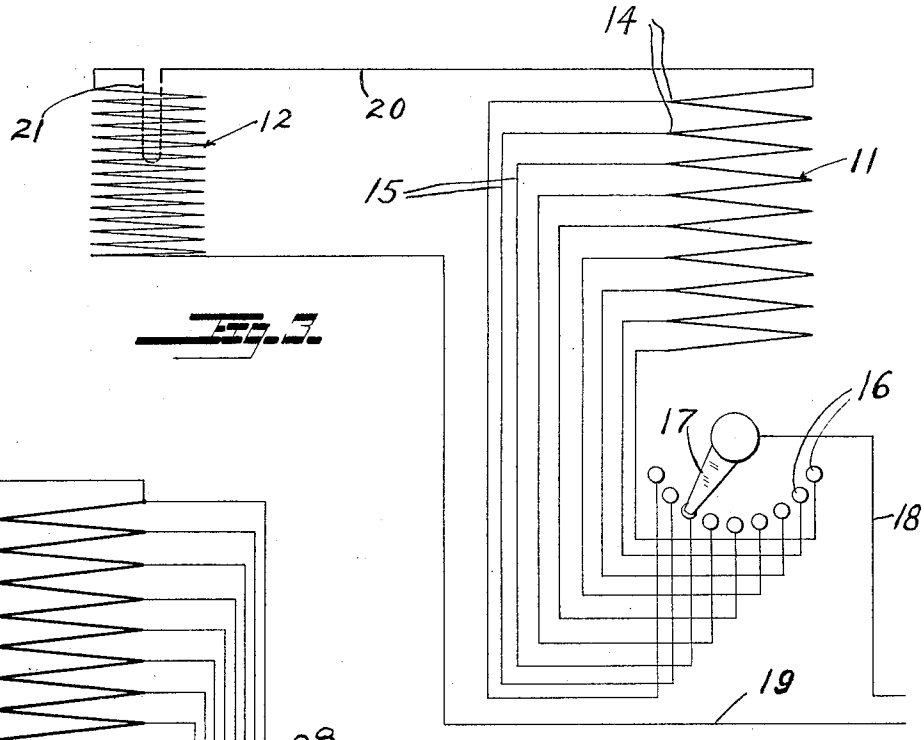


Fig. 3.

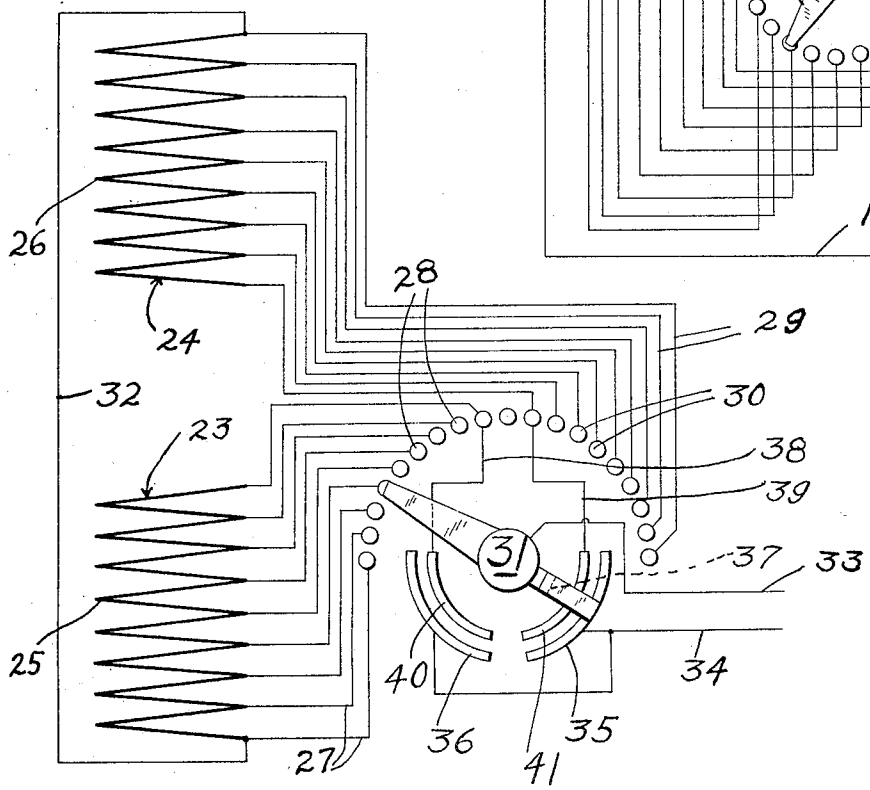


Fig. 4.

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UNITED STATES PATENT OFFICE

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ELECTRIC FURNACE

Application filed December 2, 1929. Serial No. 410,983.

This invention relates to electric furnaces and in its present embodiment more particularly deals with the types of such furnaces that are used in the practise of dentistry, for the preparation of porcelain crowns or the like and in the elimination of wax from dental work.

An object of the invention is to provide in furnaces of the character described a plurality of furnace chambers, commonly called muffles, which are constructed, arranged, interrelated and operated in such manner that the various furnace operations required in the practise of dentistry, to prepare porcelain and other dental work, may be effected in less time, under greater capacity, at a lower cost and with greater ease and efficiency than heretofore.

Another object is to provide a furnace of the character described in which one electrically heated muffle is arranged to serve as the current control or rheostat means for itself as well as for another muffle in such manner that the parts usually required for multi-muffle furnaces are materially reduced in number, the furnace construction is simplified and reduced in cost, an economy of current consumption is effected, and a wide, varied and positive heat control is made possible.

A further object is to provide for an efficient porcelain furnace of the character described in which there may be embodied a large low heat muffle for preliminary drying purposes and a high heat muffle for finishing purposes, the said muffles being electrically connected, constructed and arranged in such manner that the low heat muffle heating element serves as the rheostat for both muffles. Owing to the simultaneous operation of such muffles, the capacity of the oven is materially increased, and a saving in time, effort and operating costs is effected. On the other hand, the particular electrical connection of said muffles including the utilization of the heating element of the low heat muffle as the resistance element of a rheostat which controls both muffles, provides a nicety of heat control, effects an economy in current consumption and reduces the construction and operation costs of the furnace, all in a particularly efficient manner.

A still further object of my invention is to provide for oven construction of the character described in which a plurality, for example two, electrically heated muffles may be arranged to be selectively employed as the rheostat whereby either muffle while in operation may as desired be operated to control the other in a manner which particularly suits the furnace for use in eliminating wax from dental work but which may also be used for treatment of other dental work.

The invention possesses other objects and features of advantage, some of which, with the foregoing, will be set forth in the following description of the preferred form of the invention which is illustrated in the drawings accompanying and forming part of the specification. It is to be understood, however, that variations in the showing made by the said drawings and description may be adopted within the scope of the invention as set forth in the claims.

Referring to the drawings,

Figure 1 is a vertical sectional view of a furnace constructed in accordance with my invention.

Figure 2 is a horizontal sectional view taken on the plane of line 2—2 of Figure 1.

Figure 3 is a diagrammatic view showing the electrical circuit for the furnace.

Figure 4 is a diagrammatic view showing the electrical circuit for a modified form of the furnace of the invention.

Figures 5 and 6 are perspective views of one of the muffles.

In carrying out the present embodiment of my invention I employ two electrically heated muffles in an arrangement whereby the heating element of one muffle serves as the resistance element of a rheostat for controlling the two muffles, or I may arrange the element of each muffle to serve as the resistance element of a rheostat in such manner that either muffle may be operated to control the other. Furthermore I may provide one muffle to deliver a low heat and the other a high heat or may arrange both to give substantially the same heat. Where high and low

heat muffles are provided as a unit, it is preferable to arrange the low heat muffle to serve as the control or rheostat means and to provide a platinum or other highly resistant heating element for the high heat muffle and but an ordinary heating element say of nichrome for the low heat muffle. Such a furnace is particularly well adapted for treating porcelain crowns and other similar dental work. The low heat muffle serves as a preliminary drying chamber and the high heat muffle as a finishing chamber.

Where the two muffles are each arranged to serve as a rheostat the heating elements are preferably of the same capacity and provide for a twin furnace which is particularly well suited for eliminating wax from inlays and other dental work. With both types of furnace and in fact in any type wherein one electrically heated muffle serves as the control or rheostat means for another muffle many advantages are provided compared to an ordinary rheostat controlled furnace. Not only are the parts reduced in number and the construction simplified and reduced as to cost owing to this novel feature of the invention, but the control of the heat is permitted with exceptional nicety, the capacity of the furnace is materially increased, an appreciable economy in fuel consumption is provided for, and the general efficiency of the furnace is manifestly increased. Nicety of heat control provides accuracy in creating and maintaining desired muffle temperature and owing to the presence of that highly desirable characteristic in the furnaces which may be made in accordance with this invention, the proper preparation of porcelain and other dental work may be effected in greater capacity and in much shorter time than has heretofore been possible. The nicety and accuracy of heat control, the saving in time and the economy in current consumption provided for in accordance with this invention are of major importance in the practice of dentistry and mark a noteworthy advance in the art.

The specific embodiment of the furnace of this invention as illustrated in the accompanying drawings comprises a suitable casing or cabinet 1, here shown of rectangular form and provided with thermally insulated walls defining compartments 2 and 3 arranged to removably receive replaceable electrically heated muffles 4 and 5. These muffles may be arranged to open on the top, bottom, or sides. The muffle 4 is comparatively large and in the present instance is arranged so that access is had thereto through a door 6 in the front of the furnace cabinet. Access to the smaller muffle 5 is had through the open bottom thereof which is normally closed by a vertically movable platform 7 operated by a suitable means 8 including a hand wheel 9 at the front of the cabinet. A door 10 below the plane of the muffle 4 permits of access to the platform. By this arrangement the operator does not have to look into the muffle 5 and the objectionable eye strain usually caused by looking into the white heat of the muffle interior is done away with.

Preferably the muffle 4 is arranged to produce a low heat and is used for preliminary drying and kindred purposes in treating dental work of various kinds, especially the drying of porcelain crowns, or jacket or the like. On the other hand the muffle 5 is arranged to produce a high heat suitable for finishing operations on porcelain work and the like. Accordingly, a heating element 11, or nichrome wire or the like, is embedded in walls of muffle 4 to produce a lower heat than the highly resistant element 12 of platinum or the like similarly arranged in the walls of the muffle 5. The differential in the heating capacities of these elements may be effected by varying the relative sizes thereof or by using elements of material having different coefficients of resistance, or by both provisions.

In accordance with this invention I arrange one muffle to serve as the control or rheostat means for the other muffle. As here shown I tap coils of the resistance element 11 for the muffle 4 as indicated by the numeral 14 and through conductors 15 leading from said tap points provide an arcuate series of contact members 16 and thus make a rheostat resistance unit out of said heating element. The movable or control element 17 of the rheostat is connected by a conductor 18 with a source of electrical current not shown. From the other side of said source a conductor 19 extends to and is connected with one end of the element 12 of the muffle 5 and from the other end of said element a conductor 20 leads to the element 12. Thus it will be seen that the two elements, including the rheostat, are connected in series and that the element 11 serves as a rheostat controlling the circuit and both elements. It will now be seen that the resistance energy of the low heat muffle element 12, or in other words the heat generated by the rheostat-heating element unit of said muffle is not wasted but employed to heat the muffle 4 while a control of the energy to the element 12 of the high heat muffle 5 is being effected. When the rheostat is adjusted to reduce to the supply of electrical energy for the high heat muffle to the minimum, or to "idle" the high heat muffle, the maximum resistance is provided in the low heat muffle element 11 and said muffle will give off its maximum heat. Thus it will be seen that but little current is consumed when operating both muffles. As the rheostat is operated to increase the current for the high heat muffle, the heat generation by the low heat muffle is decreased inasmuch as the suc-

cessive movement of the rheostat decreases the length or amount of the resistance element in circuit proportional to the increase in current. When the maximum current flows to the high heat element 12, practically all of the heating element 11 of the low heat muffle is out of the circuit. However, I may provide for the retention of portions of the element 11 in the circuit to the extent as desired, dependent on the amount of heat to be given off in the low heat furnace.

In order to insure a safe and positive circuit opening operation incident to the creation of an excessive temperature in the high heat muffle 5, I arrange a thermo-fuse 21 interiorly of the muffle whereby the automatic operation of said fuse will take place whether or not the door or closure of the muffle is closed. Owing to the fact that the muffle 4 opens at its lower side or bottom, the fuse is arranged to be suspended from the top of the muffle, whereby the molten metal from the fuse will drop onto the platform or closure 7 rather than on portions of the muffle carrying the heating element. Otherwise, the element would be short circuited and destroyed by the contact of the molten metal therewith. I wish it understood that any arrangement of the fuse interiorly of the muffle whereby the fuse will operate with the muffle open as well as closed and the arrangement is such that the molten fuse metal will not short circuit and destroy the element, to be within the scope of my invention.

It will now be clear that a precise and accurate heat control of the dual furnace, or better, of the two muffles, is provided for with an infinite nicety which will materially speed up the proper preparation of porcelain and other dental work while at the same time effecting an appreciable economy in such operations.

I may construct a furnace particularly for the purpose of eliminating wax from inlay matrices, inlays and other dental work, although such operations may be carried out in the furnace previously described. However, to best suit the furnace for wax elimination work, the arrangement is as shown in the diagram in Figure 4, the main difference being in the electrical current and equipment rather than in the structural details of the furnace. In this special wax furnace the two muffles 23 and 24 include heating elements 25 and 26 which latter as here shown are of equal capacity. The coils of the heating elements 25 and 26 are tapped and conductors 27 lead from the tap points of the element 25 to a row of spaced contact points 28 whereas conductors 29 lead from the tap points of the element 26 to a similar and contiguous row of contacts 30. Thus the two elements comprise separate resistance units of a two-way rheostat which has a single movable contact member 31 having one end arranged to engage either set of the contacts 28 and 30. A conductor 32 electrically connects certain ends of the elements 25 and 26. A conductor 33 leading from a source of electrical energy not shown is connected with the contact member 31. A similar line conductor 34 is connected with spaced contact members 35 and 36 which are arranged to be selectively engaged by a bridge contact member 37 carried on the end of and insulated from the movable contact 31. The contact members 28 and 30 which are connected with the ends of the heating elements 25 and 26, are connected by conductors 38 and 39 with contact members 40 and 41 arranged to be engaged by the contact 37.

With this arrangement it will be seen that when the rheostat is adjusted as shown in Figure 4 so that one of the contacts 28 is engaged by the member 31 which then disposes the contact 37 to engage the contact members 35 and 41, the circuit is then established so that the element 25 becomes the rheostat for controlling the current to the element 26. Current then flows from the conductor 33 through movable contact member 31, the coupled part of the resistance element 25, conductor 32, element 26, the conductor 29 which leads from the other end of element 26 to the contact member 30 at one end of the row of said contacts; then through conductor 39 connected with said contact 30, to the contact 41; bridge contact 37, contact 35, and from thence back to the source through conductor 34. Thus it will be seen that the heating element 25 of one muffle serves as a variable resistance current control element for the element 26 of the other muffle. When the resistance is high the heat in the muffle heated by element 25 is maximum, while a minimum heat is provided in the muffle heated by the element 26. As the resistance of the muffle element 25 is decreased the heat in the muffle therefor is decreased, whereas the heat produced by the muffle element 26 is increased. This arrangement may be reversed, if desired, and the heating element 26 made to serve as the rheostat. In this event the movable contact 31 is moved to engage the contacts 30 of the element 26. Current then flows through conductor 33, contact 31, one of the contacts 30, through the then coupled portion of the heating element 26, conductor 32, the full element 25, conductor 38, contact 40, bridge contact 37 then bridging contacts 40 and 36, and contacts 36 and conductor 34 back to the source. By this reversible arrangement, either muffle may be operated to produce a higher heat than the other, selectively as desired. This is advantageous in removing wax from dental work, as it does away with the necessity of transferring the work from one muffle to another when a change of temperature is required for

a given batch of work. Furthermore this selective arrangement permits a quick change from low to high heat and permits of a nicety and accuracy of heat control.

Although this arrangement is primarily intended for use in a wax eliminating furnace, it may also be used with efficacy in other types of furnaces. In this connection it is to be noted that the furnace developments of the invention are not limited for use in dental furnaces but are of general application in electric furnaces and will provide advantageous features owing to the nicety of heat control and the economy of construction and operation thus made possible.

An important feature of the furnace construction of this invention is the provision for ready and easy removal of the muffles and for a quick replacement of a new muffle, in case a muffle burns out or becomes otherwise inoperative or unfit for use. It will be noted that the cabinet or casing 1 is arranged to form suitable seats or sockets for said muffles, which seats or sockets permit of said ready and easy withdrawal and replacement. As shown in Figure 5, the muffles may be provided with contact members 45 arranged on the exterior thereof in such manner that they will engage similar casing carried contacts not shown, when the muffles are properly inserted into place in said casing. The use of such contacts makes for a quickly detachable electrical connection of the muffles in the operating circuits therefor and does away with the necessity of rewiring the furnace each time a muffle replacement is made. Without these contacts each muffle would have to have the several conductors leading therefrom disconnected or removed and then replaced on the new or replaced muffle.

It is important to note that the muffles of my invention are complete units including the heat control or rheostats which are built in and form parts of the muffles. This complete unit arrangement is a decided advance in the art inasmuch as ordinarily rheostats suitable for use with the muffles of dental furnaces are not usually available on the market and must be especially made for each furnace and installed as separate units.

I claim:

1. In an electric furnace, a plurality of muffles, an electric heating element for each muffle, spaced contact points electrically connected at spaced points of and with each heating element, a movable contact member disposable into position to engage the contact points of either element, and an electrical circuit arranged to permit operation of the movable contact to selectively electrically connect in the circuit either a part or the whole of either of said elements, with the other of said elements in series therewith.

2. In an electric furnace, a plurality of heating chambers, a resistance element arranged to heat each chamber, and switch controlled means to supply current to either resistance element and connect a variable portion of such element in series with the other resistance element, the arrangement being such that either resistance element may serve to heat its chamber while it is functioning as a rheostat element for controlling the flow of current to the other resistance element.

3. In an electric furnace, a plurality of heating chambers, a resistance element arranged to heat each chamber, and switch mechanism to supply current to either resistance element and connect a variable portion of such element in series with the other resistance element, the arrangement being such that either resistance element may serve to heat its chamber while it is functioning as a rheostat element for controlling the flow of current to the other resistance element.

4. In an electric furnace, a plurality of electrically heated muffles, a power circuit therefor, a switch mechanism in said circuit operative to simultaneously and inversely vary the heats liberated in said muffles whereby upon actuating said mechanism the heat of one muffle may be selectively increased to a maximum heat while the heat in a second muffle is proportionately decreased to a minimum heat, and upon further actuation of said mechanism the heat of said first muffle may be selectively reduced from a maximum to a minimum heat while the second muffle is simultaneously and proportionately increased from a minimum to a maximum heat.

5. In an electric furnace, a plurality of muffles, an electric heating element for each muffle, spaced contact points electrically connected at spaced points of one of said elements, a movable contact member disposable into position to selectively engage said contact points, and an electric circuit arranged upon movement of said member to simultaneously and inversely vary the heat liberated by said elements, whereby upon movement of said member in one direction the heat in one muffle may be increased to a maximum heat while the heat in a second muffle is proportionately decreased to a minimum heat, and upon a reverse movement of said member the heat of said first muffle may be reduced to a minimum heat while the heat in said second muffle is simultaneously and proportionately increased to a maximum heat.

6. In an electric furnace, a plurality of muffles, an electric heating element for each muffle, contact members electrically connected at spaced points of and with a pair of said elements, a plurality of electric circuits for connecting said elements to a source of electric power and terminating on additional contact members, one of said circuits connecting a fixed portion of one of said pair of elements in series with a variable portion

of the other of said pair of elements, a second circuit connecting a fixed portion of said last element in series with a variable portion of the first element of said pair, and other contact members arranged for selective engagement with the aforesaid contact members to thereby select either of said circuits and to vary the portion of one of said elements in said circuit.

In testimony whereof, I have hereunto set my hand at Oakland, California, this 25th day of November 1929.

THOMAS H. FORDE.