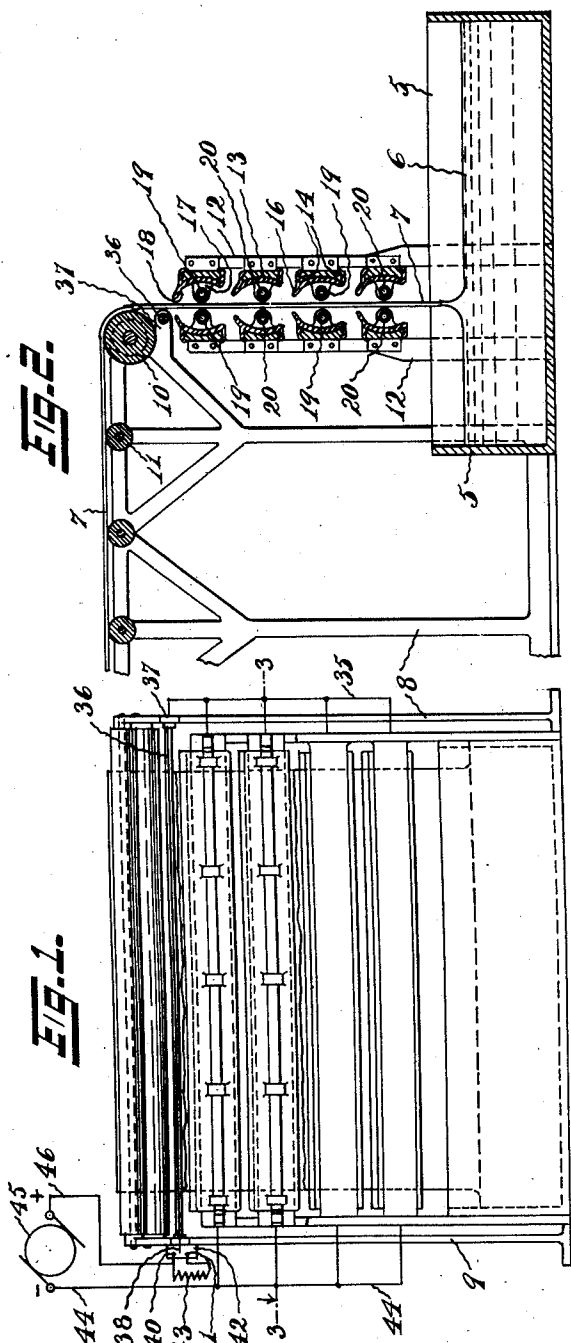
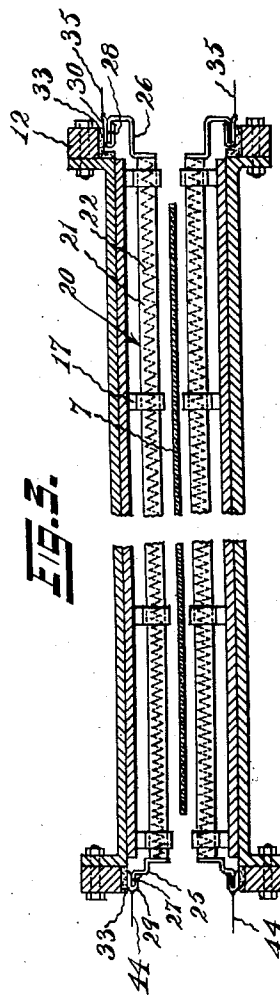


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 AUTOMATIC ELECTRIC HEATING DEVICE FOR GLASS FURNACES.  
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# UNITED STATES PATENT OFFICE.

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AUTOMATIC ELECTRIC HEATING DEVICE FOR GLASS FURNACES.

1,420,181.

Specification of Letters Patent. Patented June 20, 1922.

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*To all whom it may concern:*

Be it known that I, WALTER G. CLARK, a citizen of the United States, residing in New York, in the county of New York and State of New York, have invented certain new and useful Improvements in Automatic Electric Heating Devices for Glass Furnaces, of which the following is a specification.

This invention relates to a heating device for maintaining a high temperature within narrow limits of variation in connection with the forming of sheet or window glass by the lifting or continuous process, by which method a continuous sheet of glass is drawn up from a tank containing molten glass. It is necessary to maintain this sheet at a temperature which will permit the sheets to pass over rollers and into the annealing lehr.

The object of this invention is to afford a simple and convenient electric heating device for maintaining the sheet of glass at the desired temperature between the surface of the molten glass in the tank and the surface of the roller over which the glass passes en route to the lehr.

Other objects of the invention will appear as the description proceeds; and while herein minute details of the invention are described, the invention is not limited to these, since many and various changes may be made without departing from the scope of the invention as claimed.

In the accompanying drawings showing by way of example one of many possible embodiments of the invention,

Figure 1 is a diagrammatic elevation of an apparatus embodying my invention, taken from the left of Fig. 2, parts being broken away;

Fig. 2 is a longitudinal vertical sectional view of the apparatus; and

Fig. 3 is a horizontal sectional view showing the heating units.

My improved heating device is shown embodied in a combination window-glass making apparatus comprising a tank 5 for molten glass 6 from which a sheet of glass 7 is vertically drawn. Frame members 8 and 9 support a horizontally disposed bending or supporting roller 10, and additional supporting rollers 11 on a level therewith, over which the sheet of glass 7 is drawn and conveyed to the annealing lehr (not shown).

At each side of the tank are front and rear

standards 12 carrying opposed pairs of inwardly disposed concaved horizontal supporting bars 13 secured at opposite ends to said standards respectively and each provided with upper and lower projecting edges 14, on which are supported horizontally disposed opposed concaved heat reflectors 16 of refractory material, each reflector having an under-cut groove receiving said edges 14 and providing a slidable fit on said bars whereby the reflectors are replaceably mounted on said bars and adapted to be longitudinally removed therefrom. A plurality of longitudinally arranged bracket lugs 17 are integrally disposed on the concaved reflecting face 18 of the reflector and provided with coaxial alined openings receiving heating units 19 and 20 (Figs. 2 and 3) passing through said openings. Between said units the sheet of glass vertically passes to the first roller 10. Each heating unit preferably comprises a quartz or other refractory tube 21 containing the heating element 22; but it is understood that any standard or desired unit capable of withstanding the required temperature may be used.

The refractory reflector 16 may be of any heat resisting and reflecting material, asbestos, magnesia or magnesite being satisfactory for the purpose.

Terminal knife plates 25 and 26 are secured to the opposite ends of each unit and electrically connected with the heating element and provided with offset knife portions 27 and 28 extending longitudinally to the unit and both pointing in the same direction, and received in knife receiving spring contacts 29 and 30 mounted on said standards 12 and insulated therefrom by suitable means 33.

The contacts 26 are connected by conductors 35 to a thermostat bar 36 (Fig. 1) composed of differently responsive upper and lower elements and secured at one end to a bracket 37 on said frame piece 8 and extending under said main roller near said sheet of glass to near the other piece 9 and provided with a projecting contact 38 movable therewith and adapted to engage a pair of fixed contacts 40 and 41 mounted on a contact bracket 42 carried on said frame 9 near the free end of the thermostat bar. A resistance 43 connects said fixed contacts; and conductors 44 connect the spring contacts 25 to one pole of a source of current

45; while a conductor 46 connects the other pole to the terminal of the contact 40, away from which the thermostat bar is moved by heat.

5 The thermostat may be of any standard or suitable form and be adjusted easily to control the temperature of the glass between upper and lower limits much closer than is really necessary. The thermostat is so  
10 arranged that when the temperature of the glass approaches said lower limit, the movable contact 38 engages the upper fixed contact 40, whereupon current passes from the source 45 through a circuit comprising conductor 46, contacts 40 and 38, the thermostat  
15 bar 36, conductors 35, contact 30, plate 26, heating element 22, plate 25, contact 29 and conductor 44. This current will cause the heating units to raise the temperature of the glass plate and as soon as said upper  
20 limit is approached, the heat causes the movable contact 38 to engage the lower fixed contact 43, whereupon the resistance 43 is interposed in the above specified circuit  
25 thereby reducing the current and the amount of heat radiated by the elements 22 until the movable contact 38 again engages the fixed contact 40 and causes a repetition of the above described operation. Should  
30 the required degree of heat, through some cause, exceed said upper limit, the movable contact 38 will pass below the lower fixed contact 41, breaking said circuit entirely, thus quickly lowering the temperature and  
35 preventing any harmful excess.

The operation of this device as a whole is as follows:

40 After the sheet of glass 7 is drawn up to the first roller 10, current is caused to pass through the heating elements 22. The current is then controlled by the thermostat 36 and the contacts 38, 40 and 41. The thermostat is adjusted to control the current passing through the heating units so that  
45 the glass on reaching the roller 10 will be sufficiently flexible to pass over said roller without breaking, the thermostat at the same time preventing the temperature from rising to a point which would cause the  
50 sheet of glass to melt and drop back into the tank.

By observing the current required to maintain the temperature at the proper intensity, as indicated by the action of the  
55 thermostat, it is possible to adjust the voltage so that the action of the thermostat can be eliminated under a given set of conditions, for example, if a sheet of glass of uniform thickness be moved at uniform  
60 speed from glass in the tank at a constant temperature. However, if any of these conditions be varied, then the amount of heat required during the passage of the sheet of glass from the tank 5 to roller 10 must  
65 be varied and the thermostat should again

be brought into use in determining and admitting the current necessary to produce the required temperature. Thus it can be seen from the foregoing that for an established set of conditions the electric heating device  
70 may be used without the thermostat, but that the thermostat is desirable for controlling or assisting in controlling the amount of current required under any varying conditions.

75 The heating units 20 and their supporting deflectors are arranged to be longitudinally removed from the apparatus in a rightwardly direction of Fig. 3. The units are arranged in multiple so that in the event of  
80 the failure of any heating unit it may be withdrawn and replaced without interfering with the operation of the other units, during which replacement the remaining elements may be called upon to transform  
85 a greater amount of energy and radiate a greater amount of heat.

As an alternative, heating units 19 may be held in reserve while heating units 20 are operating. Then, in the event of the  
90 failure of units 19, units 20 may be brought into service until units 19 are replaced and again in operation.

I claim:

1. An electrically operated heating device consisting of a multiple of heating  
95 units arranged in close proximity to the sheet of glass between the tank and the first supporting roller on a continuous window glass making apparatus, together with  
100 a thermostat for automatically determining the amount of energy required in order to maintain the glass sheet at the proper degree of plasticity for successful operation, and means for removing and replacing the  
105 said heating elements without interrupting the operation of the glass-making apparatus.

2. In a continuous window glass making apparatus having a glass tank and a plu-  
110 rality of supporting rollers over which a sheet of glass is drawn from the tank, an electrically operated heating device comprising, a multiple of heating units arranged in close proximity to the sheet of glass between  
115 the tank and the first supporting roller; a source of current supply for the units; and a thermostat for automatically determining the amount of energy required in order to maintain the glass sheet at the proper de-  
120 gree of plasticity for successful operation and automatically controlling said supply accordingly.

3. In a continuous window glass making apparatus having a glass tank and a plu-  
125 rality of supporting rollers over which a sheet of glass is drawn from the tank, an electrically operated heating device comprising, a multiple of electric heating units arranged in close proximity to the sheet of  
130

glass between the tank and the first supporting roller, each unit being removable and replaceable without interrupting the operation of the rest of the glass-making apparatus.

4. In a continuous window glass making apparatus having a glass tank and a plurality of supporting rollers over which a sheet of glass is drawn from the tank, an electrically operated heating device comprising, a multiple of heating units arranged in close proximity to the sheet of glass between the tank and the first supporting roller, each unit being removable and replaceable without interrupting the operation of the glass-making apparatus; a source of current supply for the units; and a thermostat for automatically determining the amount of energy required in order to maintain the glass sheet at the proper degree of plasticity for successful operation and automatically controlling said supply accordingly.

5. In a continuous glass-making apparatus having a glass tank and a roller over which a sheet of glass is drawn from the tank, a multiple of heating units arranged in close proximity to the sheet of glass between the tank and the roller; and a thermostat for automatically determining the amount of heat supply required in order to maintain the glass sheet at the proper degree of plasticity for successful operation and automatically controlling said supply accordingly.

6. In combination, a tank; a bending roller above the tank and over which a sheet of glass is vertically drawn from said tank; superposed pairs of opposed heating units disposed on each side of said sheet and under the roller; a thermostat near said roller and having a movable contact; a fixed contact adapted to be engaged by the movable contact; a source of current; a conductor connecting the thermostat with one end of said units; conductors connecting the other ends of the units with one pole of said source; and a conductor connecting the other pole with said fixed contact.

7. In combination, a roller over which a sheet of glass is drawn; a heating unit disposed near said sheet; a thermostat disposed near said sheet between said unit and roller and having a movable contact; a fixed contact adapted to be engaged by the movable contact; a source of current; a conductor connecting the thermostat with one end of said unit; conductors connecting the other ends of the units with one pole of said source; and a conductor connecting the other pole with said fixed contact.

8. In combination, a tank of molten glass from which a sheet of glass is vertically drawn; a frame comprising side pieces supporting a horizontally disposed bending roller over which a sheet of glass is verti-

cally drawn from said tank; superposed pairs of opposed heating units disposed on each side of said sheet and under the roller; a thermostat bar composed of differently expansive elements secured at one end to one of said side pieces and extending under said roller near said sheet of glass to near the other side piece and provided with a projecting contact; a contact bracket carried on said other piece near the thermostat, and provided with a pair of fixed contacts adapted to be engaged by said projecting contact; a resistance connecting said fixed contacts; a source of current; conductors connecting the thermostat to the ends of the units at one side of the frame; conductors connecting the other ends of the units to one pole of said source; and a conductor connecting the other pole to the fixed contact away from which the thermostat bar is moved by heat.

9. In combination, a tank of molten glass from which a sheet of glass is drawn; heating units disposed near said sheet; a thermostat bar near said sheet with a movable contact; a pair of fixed contacts adapted to be engaged by said movable contact; a resistance connecting said fixed contacts; a source of current; conductors connecting the thermostat to one end of the units; conductors connecting the other ends of the units to one pole of said source; and a conductor connecting the other pole of the source to the fixed contact away from which the thermostat bar is moved by heat.

10. In combination, means by which a sheet of glass is drawn; a heating unit disposed near said sheet; a thermostat near said sheet and provided with a movable contact; a fixed contact adapted to be engaged by said movable contact; a source of current; a conductor connecting the thermostat to one end of the unit; conductors connecting the other end of the unit to one pole of said source; and a conductor connecting the other pole to the fixed contact.

11. In combination, a tank; a bending roller above the tank and over which a sheet of glass is vertically drawn from said tank; supporting standards under the roller at each side of the tank; pairs of heating units between which the sheet of glass vertically passes, to the roller, each unit comprising a refractory tube and a heating element passing therethrough; terminals secured to the opposite ends of each unit and electrically connected with the heating element; contacts mounted on said standards and insulated therefrom and engaging said terminals respectively; a source of current; conductors connecting one pole of said source with said contacts at one end of said units; and conductors connecting the contacts at the other end of the units with the other pole of said source.

12. In combination, a support; a heating

unit comprising a tube containing a heating element; terminal knife plates secured to the opposite ends of each unit and electrically connected with the heating element and each provided with an offset knife portion extending longitudinally to the unit and both pointing in the same direction; and knife receiving spring contacts mounted on said supports and insulated therefrom and receiving said knife portions respectively.

13. In combination, a tank; a bending roller above the tank and over which a sheet of glass is vertically drawn from said tank; front and rear standards at each side of the tank; opposed pairs of inwardly disposed concaved horizontal supporting bars secured at opposite ends to said standards respectively and each provided with upper and lower projecting edges; horizontal inwardly disposed opposed concaved heat reflectors of refractory material each having an under-cut groove receiving said edges and providing a slidable fit on said bars whereby the reflectors are removably mounted on said bar and are adapted to be longitudinally removed therefrom; a plurality of longitudinally arranged bracket lugs integral on the concaved reflecting face each provided with an opening longitudinal to the reflector and alined with the other openings of such reflector; pairs of heating units passing through said alined openings of the respective reflectors and between which the sheet of glass vertically passes; a source of current; and conductors connecting poles of said source to opposite ends of the units.

14. In combination, a tank; pairs of removable and replaceable horizontally disposed opposed heat reflectors between which a sheet of glass is vertically drawn from the tank; superposed pairs of removable opposed heating units disposed on each side of said sheet and each mounted at the inner face of one of the reflectors; and conductors connecting the poles of said source with opposite ends of said units.

15. In combination, a tank; a bending roller above the tank and over which a sheet of glass is vertically drawn from said tank; supporting standards; pairs of horizontally disposed opposed heat reflectors mounted thereon and provided with longitudinally arranged bracket lugs each provided with an opening; pairs of heating units passing through said alined openings, and between which the sheet of glass vertically passes; terminal knife plates secured to the opposite ends of each unit and electrically connected with the heating element thereof and each provided with an offset knife portion extending longitudinally to the unit and both pointing in the same direction; knife receiving spring contacts mounted on said standards and insulated therefrom and re-

ceiving said knife portions respectively; a source of current; and conductors connecting poles of said source to the contacts at opposite ends of the units.

16. In combination, a tank, a bending roller above the tank and over which a sheet of glass is vertically drawn from said tank; supporting standards under the roller; superposed pairs of horizontally disposed opposed heating units removably mounted thereon; a source of current; conductors connecting one pole of said source with one end of said units; and conductors connecting the other end of the units with the other pole of said source.

17. In combination, a heating means within the influence of which a sheet of glass is passed; and a thermostat influenced mainly by heat from said sheet for controlling said heating means.

18. In combination, a heating means near which a sheet of glass is drawn; and a thermostat substantially free of influence by radiations from said heating means for controlling the heating means.

19. In combination, a tank; a pair of heating units between which a sheet of glass is drawn from said tank; and a thermostat influenced substantially entirely by the heat from said sheet for controlling said units.

20. In combination, a tank; a pair of heating units between which said sheet of glass is vertically drawn from said tank; and a thermostat remotely above said units and influenced by the heat from said sheet for controlling said units.

21. In combination, a tank from which a sheet of glass is vertically upwardly drawn; an opposed pair of electric heating units between which said sheet of glass is drawn; a source of current supply for said units; and a thermostat near said sheet and controlling said current.

22. In combination, a tank from which a sheet of glass is vertically upwardly drawn; a pair of opposed electric heating units between which said sheet of glass is drawn; a source of current supply for said units; and a thermostat remote from said units and near said sheet and controlling said current.

23. In combination, pairs of opposed removably mounted heat reflectors between which a sheet of hot glass is drawn; said reflectors serving to reflect heat of the glass back upon the glass.

24. In combination, a tank; pairs of opposed heat reflectors between which a sheet of hot glass is vertically upwardly drawn from the tank; and heating units disposed respectively between said sheet of glass and the inner face of the reflectors; said reflectors serving to reflect back upon the glass the heat of the glass and the units.

25. In combination, a tank; pairs of op-

posed heating units between which a sheet of glass is vertically upwardly drawn from the tank; and removably mounted heat reflectors disposed respectively near each face of said sheet of glass and near the heating units for reflecting heat from the units and the sheet back upon the sheet.

26. In combination, a tank; pairs of opposed removably mounted heat reflectors between which a sheet of glass is vertically

upwardly drawn from the tank; and heating units disposed respectively near each face of said sheet of glass and the inner face of the reflectors between the reflectors and the glass.

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