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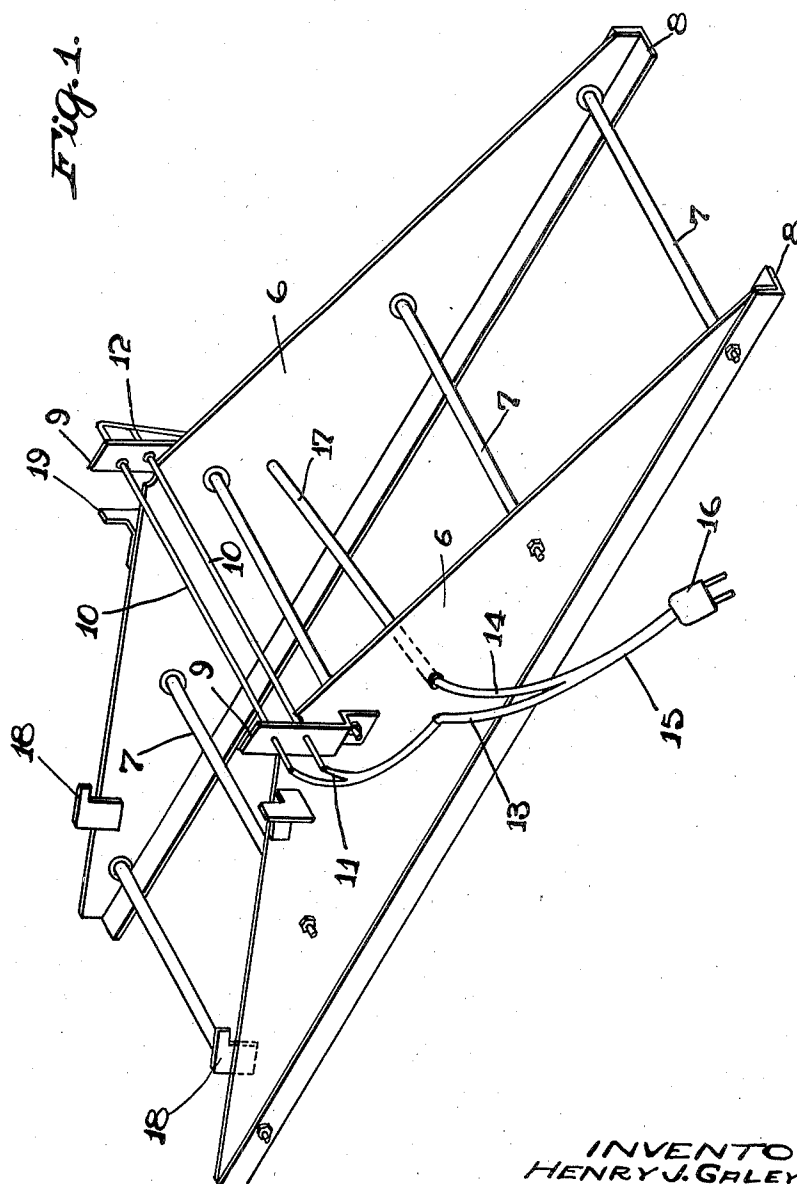
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2,111,392

APPARATUS FOR BENDING GLASS SHEETS

Filed April 27, 1937

4 Sheets-Sheet 1



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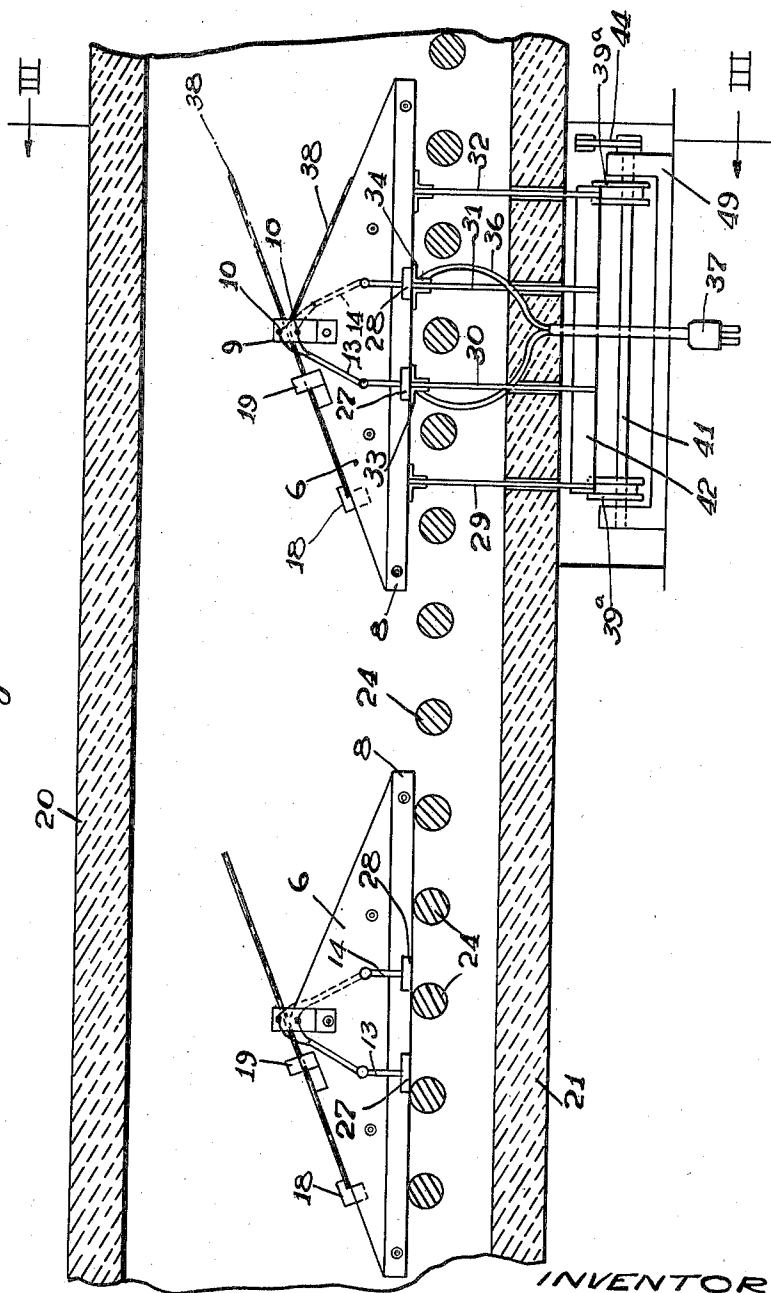
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4 Sheets-Sheet 2

Fig. 2



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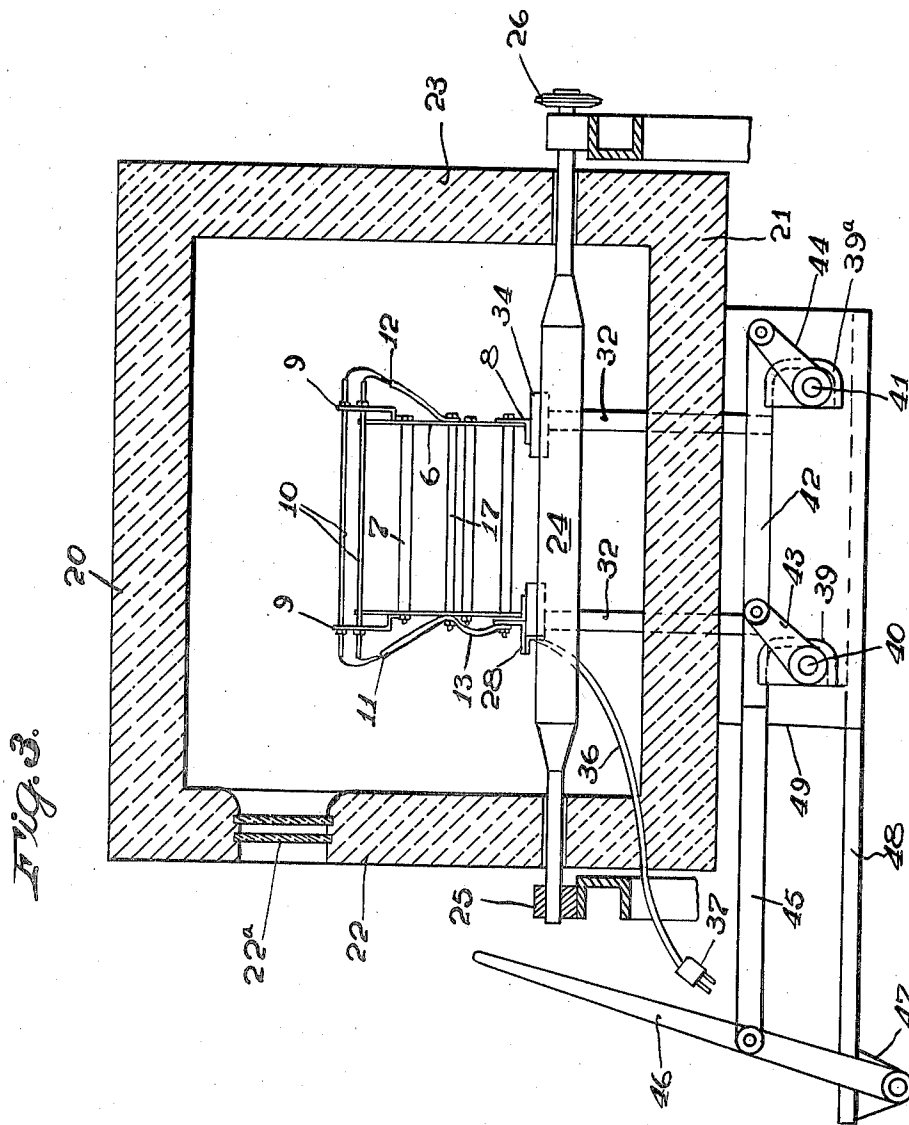
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4 Sheets-Sheet 3



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4 Sheets-Sheet 4

Fig. 4.

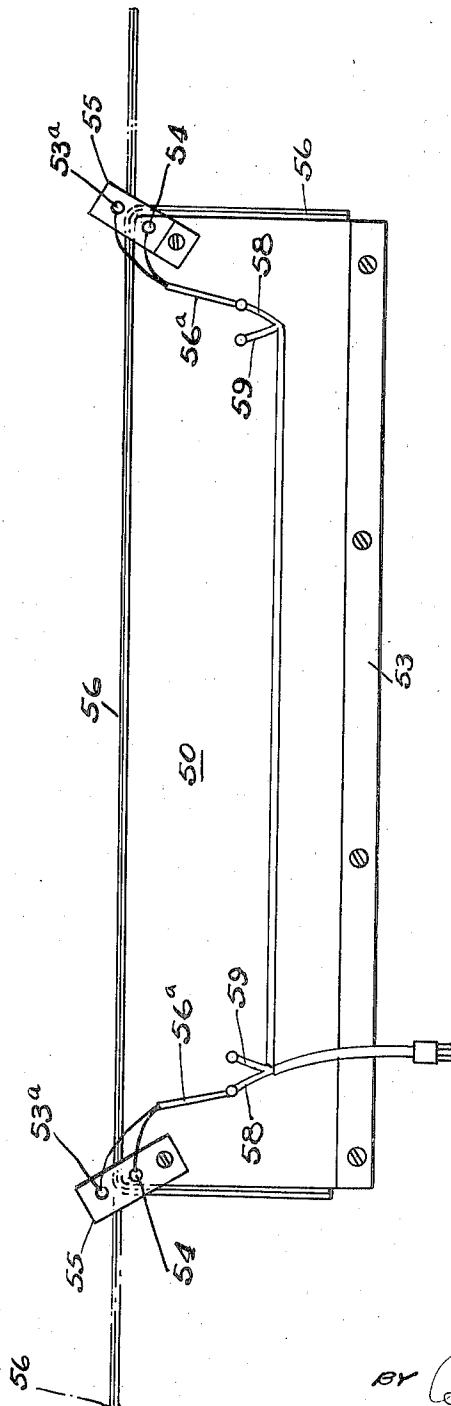
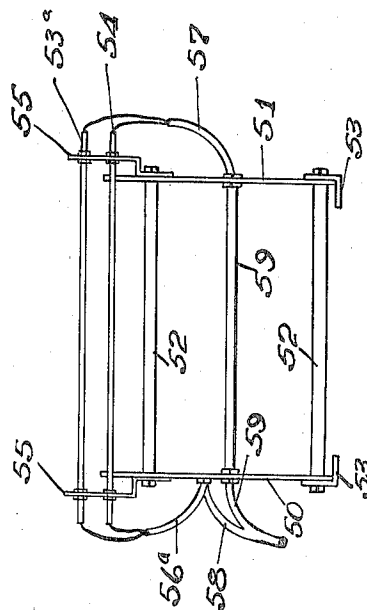


Fig. 5.



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UNITED STATES PATENT OFFICE

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APPARATUS FOR BENDING GLASS SHEETS

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3 Claims. (Cl. 49-7)

The invention relates to apparatus for making relatively sharp bends in glass sheets. It is particularly adapted for bending glass sheets in pairs for making safety glass and is so illustrated, but it will be understood that the apparatus is equally applicable in the bending of single glass sheets. It has for its principal objects the provision of improved means for bending the sheets which is applicable in connection with a tunnel leer or kiln; which requires a minimum of labor and attention; and which will not break or mar the glass. Certain embodiments of the invention are illustrated in the accompanying drawings, wherein:

Figure 1 is a perspective view showing one form of bending frame. Fig. 2 is a section through a tunnel kiln and shows in side elevation a modified form of bending frame. Fig. 3 is a transverse section on the line III-III of Fig. 2. And Figs. 4 and 5 illustrate a modified form of bending frame designed to produce right angle bends, Fig. 4 being a side elevation and Fig. 5 an end elevation.

Referring to the construction of Fig. 1, the bending frame consists of a pair of side plates 6, 6 connected by a series of cross ties 7 and having at their lower edges the angles 8, 8 which constitute the base of the device. A pair of clips or brackets 9, 9 are secured to the upper edges of the plates which carry the heating elements 10, 10 for giving a local heating effect along the line at which the glass sheet is bent. These elements are of resistance material, such as nickel chromium and are connected at their ends to the wires 11 and 12, these wires being connected to the leads 13 and 14 of the cable 15 which is provided at its end with a suitable plug 16. The lead 14 is carried across the frame in an insulating tube 17 and connected to the wire 12.

To use the device, the sheet of glass is placed upon the edges of the plates 6, 6 to the left of the heating elements 10, 10 with its edges beneath the clips 18, 18 so that the sheet is supported, as indicated in Fig. 2. When thus supported, the portion of the glass which is to be heated locally and bent lies between the elements 10, 10 and out of contact therewith. The frame may be carried through a tunnel kiln, as indicated in Fig. 2, to heat the body of the sheet to a temperature below the bending point, or it may be placed in an individual kiln and brought up to temperature. After the glass has reached a temperature two or three hundred degrees below the bending point, current is supplied through the heating elements 10, 10 and quickly brings the

narrow band of glass therebetween to the bending point, at which time the unsupported end of the sheet bends down onto the edges of the plates 6, 6 to the right of the heating elements. The glass is then annealed by reducing the temperature either in the tunnel kiln or the individual kiln to a point at which the sheet may be removed and handled. It is necessary to bring the sheet as a whole to a relatively high temperature before the local heating is applied, as otherwise breakage will occur. The foregoing description applies to the bending of a single sheet, but the device is applicable to the bending of two sheets at one time, such sheets being placed one upon the other. The two sheets as thus bent are suitable for use together in the production of a sheet of laminated safety glass. In order to hold the sheet on the plate 6, 6 against undue lateral movement, the clips 19, 19 are provided, preferably located as shown.

Figs. 2 and 3 illustrate the use of the bending frame in connection with a tunnel kiln or leer, in which 20, 21, 22 and 23 are the walls of insulating material, and 24 are the rolls mounted in suitable bearings 25 (Fig. 3) and driven by means of a chain passing over sprocket wheels 26 in a manner well known in the art. The bending frame employed is similar to that heretofore described in connection with Fig. 1, except as to the method of making the connections for the heating elements 10, 10. In this construction, the leads 13 and 14 connected to the two ends of the elements 10, 10 are connected at their other ends to a pair of shoes 27 and 28 fastened to one of the angles 8, as indicated in Fig. 3 and insulated from each other. When the bending frame arrives at that point in the kiln where it is necessary to apply local heating by the elements 10, 10 a lifting frame made up of the bars 29, 30, 31 and 32 moves up and raises the frame off of the rolls 24 so that its movement through the leer is stopped. This lifting movement brings two contact angles 33 and 34 into engagement with the angles 27 and 28 to complete an electric circuit, including the leads 35 and 36 provided with a plug 37 for making connection with a source of current supply. The lifting of the bending frame, therefore, stops the movement of the frame and provides for the application of current through the elements 10, 10, so that the glass sheets 38 are heated to the bending point along a line or band opposed to the heating elements and the sheets move down under the influence of gravity until they engage the inclined surfaces of the plates 6, 6. The lift-

ing frame is then lowered so that the frame rests upon the leer rolls and the contacts at 27—33 and 28—34 are broken. The bending frames with its glass sheets are now carried through that portion of the leer which has a gradually decreasing temperature so that the sheets are annealed and reduced to a temperature at the outlet end of the leer permitting them to be removed safely and handled.

Any suitable means may be employed for operating the lifting frame. As shown, this comprises a pair of cams 39 and 39a mounted upon the shafts 40 and 41 and engaging a horizontal frame 42, to which the lower ends of the bars 29, 30, 31 and 32 are secured. The shafts 40 and 41 carry at their ends the cranks 43 and 44 connected to the link 45, and such link is moved to raise and lower the frame by means of a handle 46 pivoted at its lower end to a bracket 47. This bracket is carried by a bar 48 secured to the framework 49, in which the shafts 40 and 41 are pivotally supported. The leer wall may be provided with a window 22a (Fig. 3) for observing the bending operation.

Figs. 4 and 5 illustrate a modified form of bending frame for producing right angle bends. In this case, the side plates 50 and 51 which correspond in function to the plates 6, 6 of the Fig. 1 construction are secured together by suitable cross ties 52 and are provided with angles 53 at their base corresponding to the angles 8 of the Fig. 1 construction. At the upper corners of the frame at each end thereof, a pair of transverse heating elements 53a, 54 are provided, such elements being supported upon the brackets 55. The elements are suitably spaced apart so as to receive the ends of the glass sheets 56 therebetween, such ends projecting out a substantial distance, as illustrated in dotted lines. When the layers of glass lying between the heating elements are brought to a bending temperature, the ends of the sheets bend down to the full line position, as shown, so that the sheets are each provided with two right angle bends. Current is supplied to the heating elements by the connections 56a and 57. The ends of these connections are attached to the leads 58 and 59, the arrangement being similar to that heretofore described except as to the increased number of electrical connections required for the two sets of elements. The procedure in bending with this form of frame is the same as heretofore described, the body of the sheet being brought up to a temperature below the bending point preliminary to the application of local heat by means of the electrically heated elements 53 and 54.

What I claim is:

1. Apparatus for bending glass sheets comprising a skeleton frame adapted to be carried through a tunnel kiln and comprising a pair of spaced parallel members lying in vertical planes, such members being similar and each having its upper edge formed in two planes which are inclined to each other and meet at the top of the members, a pair of spaced resistance elements one above the other extending horizontally across the frame at its peak, means for securing the glass sheet to be bent to the members on one side of said peak so that it extends between the elements but out of contact therewith, and means for supplying electric current through the elements to heat them and bring the temperature of the band of glass lying between the elements to the bending point.

2. Apparatus for bending glass sheets comprising a skeleton frame made up of two parallel similar triangular plates lying in vertical planes with one edge of each plate in a horizontal plane and two edges thereabove inclined toward each other and meeting at an angle, so that a glass plate may be supported on the two inclined edges of the plates lying to one side of the angle with a portion thereof projecting over the other two inclined edges of the plates, a pair of parallel resistance elements extending across the plates horizontally one above the other at the intersection of the edges forming said angle, and means for supplying electric current through the elements to heat them and bring the band of glass lying therebetween to bending temperature.

3. In combination in glass bending apparatus, a horizontal tunnel kiln provided with transfer means extending therethrough, a bending frame of triangular form having a pair of bending faces meeting at a peak so that when a glass sheet to be bent is clamped to one face of the frame, it extends over the other face in position for bending by gravity, means for securing the glass sheet against the first mentioned face of the frame a pair of resistance elements extending along the peak of the frame in spaced parallel relation on opposite sides of the plane of the glass sheet, means intermediate the ends of the kiln for lifting the bending frame from the transfer means, contact members on the frame connected to the resistance elements, and contact members on the means for lifting the bending frame connected to an electric circuit which engage the first contact members when the frame is lifted from the transfer means.

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