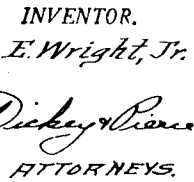


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3 Sheets-Sheet 1



May 13, 1952

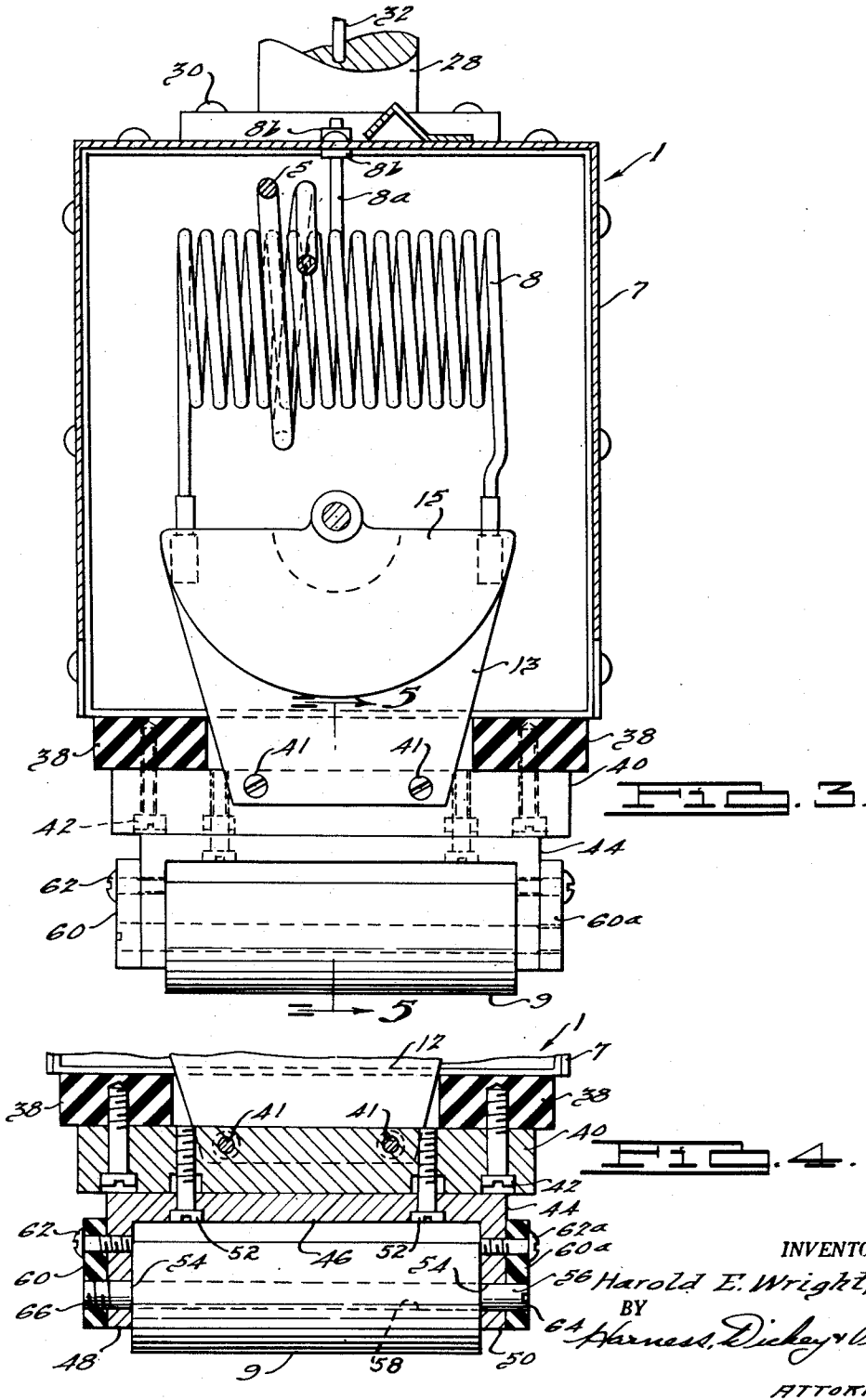
H. E. WRIGHT, JR

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DIELECTRIC HEATING APPARATUS

Filed March 10, 1949

3 Sheets-Sheet 2



May 13, 1952

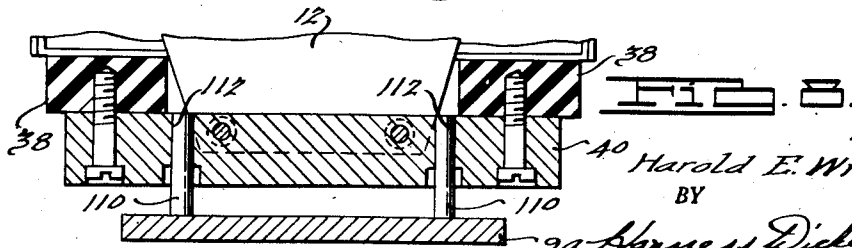
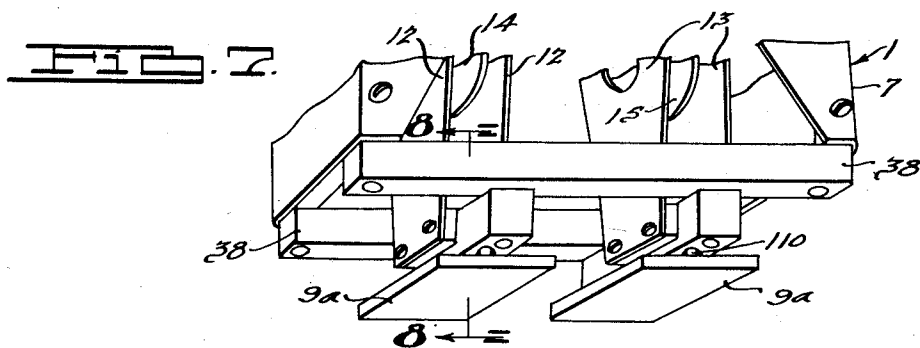
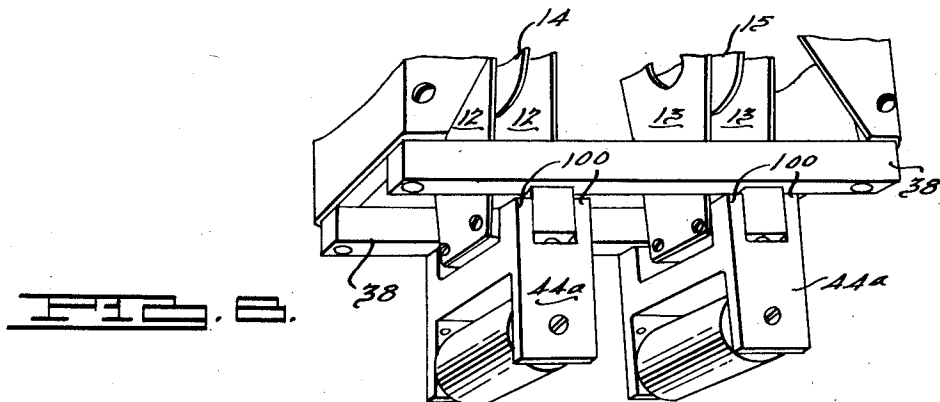
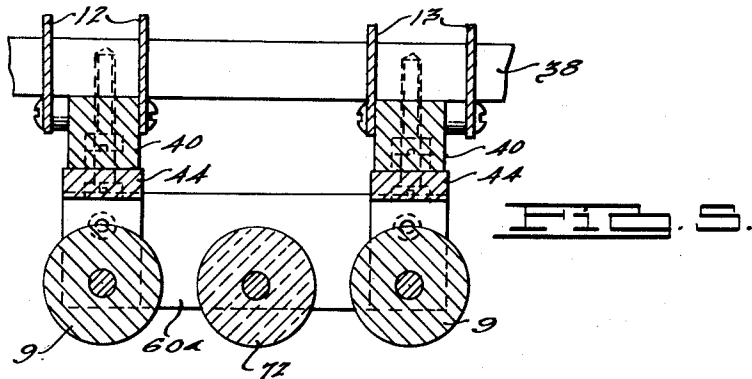
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DIELECTRIC HEATING APPARATUS

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3 Sheets-Sheet 3



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DIELECTRIC HEATING APPARATUS

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9 Claims. (Cl. 219-47)

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This invention relates generally to dielectric heating apparatus and is particularly adapted, among other uses, for the dielectric heating of glue used in securing two members together.

An object of this invention is to provide an improved device of the character described.

A further object of this invention is to provide such a device which may be conveniently and easily handled by the operator for dielectrically drying the glue which adheres two sheets of material together.

Another object of this invention is to provide such a device which may be economically manufactured and easily serviced.

A further object of this invention is to provide such a device in which the coupling between the power supply and the electrode may be adjusted.

Further objects of this invention will be apparent from the specification, the appended claims and the drawings in which preferred embodiments of the invention have been disclosed and in which drawings,

Figure 1 is a view in perspective of an apparatus embodying the invention;

Fig. 2 is a view in side elevation of the apparatus of Fig. 1 with certain of the parts broken away;

Fig. 3 is a view taken substantially along the line 3-3 of Fig. 2 and looking in the direction of the arrows;

Fig. 4 is a view taken substantially along the line 4-4 of Fig. 2 and looking in the direction of the arrows;

Fig. 5 is a view taken substantially along the line 5-5 of Fig. 3 and looking in the direction of the arrows;

Fig. 6 is a perspective view showing a modified form of the electrode;

Fig. 7 is a view similar to Fig. 6 showing a still further modified form of electrode; and

Fig. 8 is a view taken substantially along the line 8-8 of Fig. 7.

The invention contemplates a dielectric heating apparatus 1 which is easily and conveniently manipulated by an operator in a manner similar to the use of a flat iron for dielectrically setting glue G used to secure two member A and B together in very short intervals, thereby obviating the necessity for the use of clamps or other securing means for holding the members together during the interval before the glue or adhesive has set. The apparatus preferably is applied to an outward surface Ao of one of the members, for example A, opposite to the surface Ag having the glue applied thereto and may be used over

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the entire glue area or in selected spots in which latter event the remaining glue area sets normally.

The apparatus 1 is supplied from a suitable source of high frequency energy (not shown) which may be in the order of magnitude of 27.1 megacycles per second, through a flexible power cable fragmentarily shown at 2 which may be and preferably is of the concentric type having a central conductor 3 and a cylindrical outer conductor 4 which is connected to ground potential preferably at the source and which ground connection is diagrammatically shown at 4a. Energy from the cable 2 is supplied to the single turn primary winding 5 of the high frequency air core transformer 6 located within the hollow interior of the housing 7 of the apparatus 1. One terminal of the winding 5 is connected to housing 7, which housing 7 is connected to ground through its connection with the conductor 4. Preferably, the conductor forming the primary winding 5 is of sufficient rigidity that its single connection with the housing 7 will act as the sole support for this winding. A multiturn secondary winding 8 is arranged concentrically within the primary winding 5 for receiving energy therefrom and has end terminals connected to work engaging electrodes 9. The winding 8, midway between its ends, has secured thereto a metallic stud 8a held to the casing or housing 7 as by nuts 8b whereby the winding is positioned with respect to the housing and the winding 5 and also the stud acts to ground the winding 8. In order that the circuit including the electrodes 9 and the transformer 6 may be tuned, the apparatus is provided with condensers 10 and 11 having stationary plates 12 and 13, respectively, cooperable with relatively rotatable plates 14 and 15, respectively. The plates 12 are electrically conductively connected together and one thereof serves as a conductor intermediate one of the electrodes 9 and one of the terminals of the winding 8. The plates 13 are electrically conductively connected together and one thereof serves as a conductor intermediate the other of the electrodes 9 and the other of the terminals of the winding 8. The condenser plates 14 and 15 are electrically connected together and to the grounded housing 7 through the shaft 16. Rotation of the shaft 16 rotates the condenser plates 14 and 15 to vary the capacity of each end terminal of the winding 8 to ground for tuning the output circuit of the transformer 6 into resonance with the frequency supplied by the source.

More specifically, the dielectric heating apparatus 1 comprises the hollow housing 7 carrying at its open lower side 18 the electrodes 9 connected respectively to condenser plates 12 and 13. The horizontally extending shaft 16 is journaled in opposite end walls 20 and 22 of the housing 7 and is preferably provided with an external adjusting knob 24. A suitable handle 28 is secured to the top wall of the housing 7 as by means of screws 30. The handle 28 may be provided with a push-buttonlike actuator 32 suitably connected by means (not shown) to the radio frequency source for controlling the energization thereof. A pilot light 34 is provided to indicate the condition of energization of the apparatus 1. The housing 7 has its open lower side opposite to the wall to which the handle 28 is positioned and is provided with parallel electrically insulating side members 38, one adjacent each side of the opening. Cross bars 40 of conducting material extend transversely between the members 38 at spaced points, the distance between which is equal to the distance between the electrodes 9, and these bars are secured to the side members 38 as by means of screws 42. The condenser plates 12 and 13 are of generally trapezoidal shape and have the narrower one of their parallel edges secured to opposite edges of the bars 40 by screws 41. In order to provide for the correct spacing between the plates in the set 12 and set 13, spacers 43 may be used. One of the plates 12 is electrically connected to one terminal of the winding 8 and one of the plates 13 is electrically connected to the other terminal of the winding 8 whereby the bars 40 are connected to opposite ends of the winding 8.

Each cross bar 40 is provided with a U-shaped electrode carrying member 44 having a base portion 46 and spaced parallel legs 48 and 50. The base portion 46 is rigidly secured to the bar 40 as by means of screws 52 so that the legs 48 and 50 extend outwardly away from the adjacent surface of the cross bar 40. Each of the legs 48 and 50 is provided with a smooth aperture 54 through which extends opposite ends of an axle shaft 56. The shafts 56 also extend through a longitudinally extending central aperture 58 in the respective one of the electrodes 9 with which it is associated and which electrodes may be, as shown, in the form of a cylinder. The corresponding legs 48 are interconnected by a side member 60 of electrically insulating material which is suitably held at opposite end portions to the legs 48 as by means of screws 62. The side member 60 is provided at its right-hand end, as viewed in Fig. 2, with a smooth bore aperture 64 which aligns with the aperture 54 in the leg 48 of the right-hand one of the carrying member 46. The side member 60 is further provided with a screw threaded aperture 66 which is aligned with the aperture 54 in the leg 48 of the left-hand one of the U-shaped carrying members 44. A similar side member 60a also of electrically insulating material is similarly secured as by means of screws 62a to the legs 50 of the members 44 on the opposite side of the housing 7 and these side members 60a are provided with a smooth bore aperture 64 and a screw threaded aperture 66, but in this case the side member 60a has its screw threaded aperture aligned with the aperture 54 of the right-hand U-shaped member 44 and its smooth bore aperture 64 aligned with the aperture 54 of the left-hand carrying member 44. It will be apparent from the foregoing that the side members 60 and 60a are identical and that by

the simple expedient of arranging them in opposite end-to-end relation with respect to each other, one may be applied to connect the legs 48 and the other to connect the legs 50 whereby the axle shaft 56 associated with the left-hand member 44 may extend in the opposite direction to the axle shaft 56 associated with the right-hand member 44. The axle shafts are threaded at one end for threaded engagement with the screw threaded aperture 66 and are provided with a screwdriver slot at its opposite end which is snugly received within the smooth bore aperture 64. In this manner it is unnecessary to provide right and left-hand side members 60 and 60a.

If desired, the side members 60 and 60a may be provided with aligned apertures 68 for receiving an axle shaft 70 upon which may be journaled an idler or presser cylinder 72 which is electrically insulated from each of the electrodes 9 and which preferably is made of some nonconducting material such as "Mycalox." The cylinder 72 serves to exert a force against the member A over which the apparatus 1 is being moved for holding the intermediate section of this member A between the electrodes 9 in tight engaging relation with the corresponding member B to which this member A is being glued.

In the form of the apparatus shown in Fig. 6, the side members 60 and 60a have been omitted and one of the apertures 54 and one of the legs 48 or 50 has been screw threaded for screw threaded reception of one end of the axle shaft 56. Furthermore, in this form the U-shaped electrode carrying member 44a is provided with bifurcated extending portions 100 which straddle the cross bars 40.

In the modification shown in Fig. 7, the roller-type electrodes 9 have been omitted and plate-type electrodes 9a have been substituted therefor. The electrodes 9a are provided with fingers 110 which are received within apertures 112 of the cross bars 40. The electrodes 9a may therefore be frictionally held to their respective cross bars 40.

It is believed that the remainder of details of construction may best be understood by reference to the description of operation of the apparatus 1 which is as follows:

After the adjacent surfaces of the members A and B which are to be glued together have been treated with a suitable glue such as an urea resin, the members A and B are held together as, for example, by the left hand and the apparatus 1 is then brought against the outer surface of one of the members A with the electrodes 9 resting thereagainst. The control buttonlike actuator 32 is then pressed in by the thumb of the right hand energizing the source of high frequency energy for the apparatus 1 whereby an electrostatic field is set up between the two electrodes 9. This field will extend downwardly from one of the electrodes 9 through the thickness of the member A, the glue line between the members A and B, and back up through the thicknesses of member A to the other of the electrodes 9. The knob 24 of the condensers 10 and 11 should be rotated so that the maximum amount of energy is flowing in the system.

With the control button still actuated, the apparatus 1 is then rolled over the desired portion of the surfaces of the member A in much the same manner as a flatiron whereby the urea resin or glue is caused to immediately set thereby securely and firmly adhering the two members A and B together. If desired, the apparatus 1

may be used over the entire surface of the member A whereby all of the glue is electrostatically dried, or if desired, it may be used in spots to electrostatically set only portions of the glue whereby these portions act as clamps to hold the remainder of the surfaces together during normal setting of the glue. It will be apparent that the cylinder 72 acts to maintain firm contact of the sheet member A intermediate the two electrodes 9 and the provision of this roller 72 makes it possible to space the electrodes 9 somewhat further apart if desired. Upon actuation of the actuator 32, high frequency energy flows through the cable 2 into the primary winding 5 of the transformer 6 whereby an induced electromotive force is set up in the secondary winding 8 which causes a potential to be established between the electrodes 9. A circuit which extends from one of the leads of the secondary winding 8, one of the condenser plates 12, one of the bars 40, and the electrode carrying member 44 to one of the electrodes 9 and an opposite potential is set up on the electrodes 9 through a circuit which extends from the other of the leads of the secondary winding 8 through one of the plates 13, the other of the bars 40, and the other electrode carrying member 44, to the other of the electrodes 9.

In order that the secondary circuit of the transformer 6 will be in resonance, the knob 24 is rotated whereby the proper capacity of the condensers 10 and 11 is obtained, which combined with that between the electrodes 9 and the impedance of the rest of the circuit, will cause the secondary circuit of the transformer 6 to be in resonance and thereby the maximum amount of electrostatic heating imparted to the surface be treated.

The form of the invention as shown in Fig. 6 or Figs. 7 and 8 is substantially the same as that shown in Figs. 1 through 5, the modification of Fig. 6 omitting the intermediate pressing roller 72 of Fig. 2 and omitting the side members 60 and 60a by which this roller was carried.

In the form shown in Figs. 7 and 8 flat electrode plates 9a are used which engage the adjacent surface of the sheet material and are slid rather than rolled therealong. However, substantially the same electrostatic field is set up between the two electrodes 9a as is set up between the electrodes 9 and the net result upon the surfaces being treated will be substantially the same.

What is claimed and is desired to be secured by United States Letters Patent is as follows:

1. In an apparatus for curing adhesive, a supporting structure, a pair of substantially parallel metallic supports carried by but electrically insulated from said structure, said supports having means for attachment thereto of spaced electrodes, a pair of metallic plates carried by each of said supports and extending inward into said structure, each said plates of said pair being spaced from each other, a rotatable shaft extending transversely of said plates, metallic plates carried by said shaft in spaced relation to each other and to said inwardly extending plates, a radio frequency transformer within said structure and having output terminals electrically connected to certain of said inwardly extending plates, and means for rotating said shaft.

2. In an apparatus for curing adhesive, a supporting structure, a pair of substantially parallel metallic supports carried by but electrically insulated from said structure, a pair of metallic plates carried by each of said supports and ex-

tending inward into said structure, each said plates of said pair being spaced from each other, a rotatable shaft extending transversely of said plates, metallic plates carried by said shaft in spaced relation to each other and to said inwardly extending plates, a radio frequency transformer within said structure and having output terminals electrically connected to certain of said inwardly extending plates, means for rotating said shaft, a U-shaped member carried by each of said supports and opening outwardly therefrom, and a roller carried by each of said U-shaped members.

3. The combination of claim 2 in which said U-shaped members are connected by spaced supports of insulating material, and a roller is carried intermediate said first named rollers by said spaced insulating supports.

4. In an apparatus of the character described, a housing having a first side and an opening through an opposite side, a pair of spaced insulating members carried by said housing adjacent said opening, a pair of metallic bar members carried by and extending transversely of said insulating members, a condenser plate carried by each of said bar members and extending into said housing, a shaft rotatably carried by said housing and extending substantially normal to said condenser plates, additional condenser plates carried by said shaft, means electrically interconnecting said additional plates, means operable to supply high frequency energy to said first named plates, a roller carried by each of said bar members and adapted to rollingly engage a surface outwardly of said opposite side, and a handle for said housing outwardly of said first side.

5. The combination of claim 4 in which said handle has an aperture therethrough, and a control member extends outwardly of said housing through said aperture for actuation when said handle is grasped whereby said source is effective to supply energy to said first named condenser plates.

6. In an apparatus of the character described, a housing having a first side and an opening through an opposite side, a pair of spaced insulating members carried by said housing adjacent said opening, a pair of U-shaped metallic bar members carried by and extending transversely of said insulating members, means operable to supply high frequency energy to said bar members, a roller carried by each of said bar members and adapted to rollingly engage a surface outwardly of said opposite side, a pair of insulating members extending between said U-shaped members, a third roller of electrical insulating material carried by said pair of insulating members and having a surface lying in a plane defined by said first-named rollers, and a handle for said housing outwardly of said first side.

7. In an apparatus of the character described, a housing having a first side and an opening through an opposite side, a first and second of spaced insulating elements carried by said housing adjacent said opening, a pair of identical U-shaped bar members each having a connecting portion and a pair of substantially parallel portions, means for securing said connecting portion individually to said spaced insulating elements, each said pair of parallel portions being provided with aligned smooth bore apertures, a first platelike insulating member extending between corresponding ones of said parallel bar member portions and provided with a smooth bore

aperture aligned with said smooth bore apertures of one of said bar members with which it is associated, said first insulating member being provided with a threaded aperture aligned with said smooth bore apertures in the other of said bar member with which it is associated, a second platelike insulating member identical to said first member and similarly positioned adjacent the opposite corresponding ones of said parallel bar member portions with its said threaded aperture aligned with the said aligned smooth bore apertures in the opposite one of said bar members from the said smooth bore aperture aligned with said threaded aperture in said third member, and a pair of axle shafts threaded at one end portion, one of said shafts extending through said first member smooth bore aperture, and said smooth bore apertures in said one bar member and having its threaded end portion screwthreaded into said second insulating member screwthreaded aperture, and a second of said shafts extending through said second member smooth bore aperture and said smooth bore apertures in said other bar member and having its threaded end portion screwthreaded into said first insulating member screwthreaded aperture.

8. In an apparatus of the character described, a housing having a first side and an opening through an opposite side, a first and second of spaced insulating elements carried by said housing adjacent said opening, a pair of identical U-shaped bar members each having a connecting portion and a pair of substantially parallel portions, means for securing said connecting portion individually to said spaced insulating elements, each said pair of parallel portions being provided with aligned smooth bore apertures and aligned internally threaded apertures, a first platelike insulating member extending between corresponding ones of said parallel bar member portions and provided with smooth bore apertures aligned with said threaded apertures of the ones of said parallel portions with which it is associated, and further provided with a third smooth bore aperture aligned with said smooth bore apertures of one of said bar members with which it is associated, said first insulating member being provided with a threaded aperture aligned with said smooth bore apertures in the other of said bar member with which it is associated, a second platelike insulating member identical to said first member and similarly positioned adjacent the opposite corresponding ones of said parallel bar member portions with its said threaded aperture aligned with the said aligned smooth bore apertures in the opposite ones of said bar members from the said smooth bore aperture aligned with said threaded aperture in said third member, screws extending through the ones of said first and second member apertures aligned with said bar member threaded apertures for securing said members together, and a pair of axle shafts threaded at one end portion, one of said shafts extending through said first member third aperture, and said smooth bore apertures in said one bar member and having its threaded end portion screwthreaded into said second insulating member screwthreaded aperture, and a second of

said shafts extending through said second member third aperture and said smooth bore apertures in said other bar member and having its threaded end portion screwthreaded into said first insulating member screwthreaded aperture.

9. In an apparatus of the character described, a housing having a first side and an opening through an opposite side, a first and second of spaced insulating elements carried by said housing adjacent said opening, a pair of identical U-shaped bar members each having a connecting portion and a pair of substantially parallel portions, means for securing said connecting portion individually to said spaced insulating elements, each said pair of parallel portions being provided with aligned smooth bore apertures, a first platelike insulating member extending between corresponding ones of said parallel bar member portions and provided with a smooth bore aperture aligned with said smooth bore apertures of one of said bar members with which it is associated, said first insulating member being provided with a threaded aperture aligned with said smooth bore apertures in the other of said bar member with which it is associated, a second platelike insulating member identical to said first member and similarly positioned adjacent the opposite corresponding ones of said parallel bar member portions with its said threaded aperture aligned with the said aligned smooth bore apertures in the opposite one of said bar members from the said smooth bore aperture aligned with said threaded aperture in said third member, and a pair of axle shafts threaded at one end portion, one of said shafts extending through said first member smooth bore aperture, and said smooth bore apertures in said one bar member and having its threaded end portion screwthreaded into said second insulating member screwthreaded aperture, a second of said shafts extending through said second member smooth bore aperture and said smooth bore apertures in said other bar member and having its threaded end portion screwthreaded into said first insulating member screwthreaded aperture, said first and second insulating members having aligned apertures spaced intermediate their respective said first and second named apertures, an axle carried in said last-named apertures, and rollers of substantially the same diameter carried by each said axle.

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