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APPARATUS FOR FORMING MATERIALS

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This invention relates to an apparatus for molding sheet plastics, paper, wood, cloth and the like, and particularly that type of material which may be molded and formed with the application of heat and pressure. It is particularly applicable to forming sheets of plastic, impregnated paper and cloth laminations, wood veneer and the like, which are rendered rigid when compressed in the desired shape or form coupled with the heat transfer treatment.

The invention further contemplates the use of a light sheet metal forming die, such as to permit the metal forming die to be quickly and cheaply fabricated, shaped and reshaped, as may be desired, and wherein it may be quickly and conveniently embodied in a pressure chamber in association with a flexible sheet, such as rubber, for compressing the material therebetween under equalized high fluid pressure, as more specifically set forth and described in an application of Edward C. Sloan heretofore filed March 22, 1943, Serial No. 480,049, entitled "Method and apparatus for forming materials."

The apparatus comprising this invention includes an arrangement for preventing deterioration of the rubber or rubber composition forming the flexible sheet as a result of the direct application of steam and heat. It is, therefore, the purpose of this invention to protect the rubber or similar composition of the flexible sheet by avoiding the direct application of steam or a heated fluid in building up the fluid pressure thereon. This is accomplished by filling the pressure chamber embodying said sheet with a fluid, such as water or oil, and at a temperature such as will have no deleterious effect thereon, and whereby said fluid in turn is placed under a pressure to be transmitted thereby to the sheet. In utilizing this invention the heat transfer to and from the material being formed is accomplished through the medium of the metal forming sheet by reason of its high conductivity.

The full nature of the invention will be understood from the accompanying drawing and the following description and claims:

Fig. 1 is an illustrative sectional view showing the material being compressed between the sheets within a pressure vessel. Fig. 2 is an enlarged section through a portion of the vessel showing the sheets secured to the respective sections thereof.

In the drawing there is illustrated a pressure vessel 10 having a lower section supported by legs 11 and an upper section removably clamped on the lower section by clamps 12. Removably

mounted and sealed within the upper section of the vessel there is a rigid forming sheet which consists of a sheet metal die 13. This forming sheet is given any desired shape to which the material is to be formed. It is only of sufficient strength and rigidity to normally hold its shape while capable of being readily formed by stamping, hammering or casting. However, it does not have sufficient inherent strength to withstand the application of pressure to be exerted on the material. Its lightness and thinness has the advantage of permitting rapid heat transmission to the material formed thereby, as well as the advantage of conveniently and economically forming to various shapes. Thus, said forming sheet in conjunction with the upper section of said vessel encloses a pressure chamber 14.

Removably mounted, but sealed to the lower section to thereby form a pressure chamber 15, there is a flexible conforming sheet 16 which may be of rubber or rubber composition. This sheet is preferably molded substantially in conformity with the metal forming sheet 13.

The material 17 to be formed is placed between said sheets and the sections of the vessel are clamped together for the forming operation. High pressure is then applied to compress the material between said sheets and cause it to take the form and set according to the shape of the forming member 13 by the application of equalizing fluid pressure in the pressure chambers 14, 15. Since the same pressure is exerted in said chambers, it will be neutralized in respect to opposite sides of the forming sheet so that it will not be affected or deformed as a result of extremely high pressure being applied to the material between the sheets, the flexible conforming sheet being adapted to take the form of the forming sheet and iron out the material into the desired form. At the same time the high pressure will compress the material thus formed to give it high density and set it to form.

The metal forming sheet 13 is secured to a ring 18 adapted to be mounted within the upper section of the vessel and removably secured therein in sealed relation with a supporting ring 19 secured to the inner wall thereof. The flexible conforming sheet 16 is secured to a ring 20 adapted to be seated within said vessel on a ring 21 secured to the inner wall thereof. Thus, each of said sheets may be conveniently removed or replaced within their respective sections and sealed therein to provide the fluid tight pressure chambers 14 and 15.

The pressure chamber 15 is filled with a suit-

able liquid, such as water or glycerin, from a liquid storage tank 22 having a connection with said chamber 15 through an inlet pipe 23. A valve controlled vent 24 is also provided for communication with the upper part of said chamber through a flexible tubing 25 so arranged as to be floated or suspended with its intake in the upper part of the chamber for venting entrapped air. The liquid storage tank 22 contains sufficient liquid to more than fill the chamber while still retaining a high level of the liquid therein. The top of said storage chamber is connected with a stream and water supply line 26 to which the upper pressure chamber 14 is connected by a flexible hose 27. Similarly, the upper chamber may be exhausted of the fluid under pressure through a flexible hose 28 connected with a vent 29 and drain 30. The lower portion of the chamber 15 is also connected with the drain 30 through a pipe 31.

By reason of the flexible hose connections with the upper section of said vessel, it may be readily removed from the lower section to permit placement of the material therebetween and removable therefrom after forming. In forming the material placed between the two sheets, and with the lower pressure chamber 15 substantially but not entirely filled with liquid from the storage tank 22, steam may be applied to the storage tank and the upper pressure chamber 14. The steam pressure so applied may be raised to any desired amount, such pressure venting any air in the chamber 15 and forcing the conforming flexible sheet and the material engaged thereby against the forming sheet. The equalized pressure on the forming sheet will act to maintain its shape and prevent collapse while the steam introduced transmits the required heat to the material therethrough. However, by reason of introducing the liquid storage tank 22 between the steam pipe and the chamber 15, such steam and heat will not be directly applied to the flexible rubber sheet. Thus, it will be protected from the effects of the steam and heat by the interposed liquid in the chamber on the one side and the insulating characteristics of the material being formed on the other side.

The invention claimed is:

1. Apparatus for forming material involving the application of pressure and heat exchange, including a forming die comprising a thin preformed rigid forming sheet, a complementary rubber conforming sheet, said sheets being adapted to embrace the material to be compressed to the form of said forming sheet, a liquid returning receptacle associated with said conforming sheet, a liquid containing storage tank in communication with said receptacle, and means for applying equalized fluid pressure to said forming sheet and the liquid in said tank.

2. Apparatus for forming material involving the application of pressure and heat exchange, including a forming die comprising a thin pre-

formed rigid forming sheet, said sheet forming a closure portion of a pressure chamber, a rubber conforming sheet adapted with said forming sheet to compress and form said material therebetween, a pressure chamber adapted to contain a liquid and associated with said conforming sheet, a liquid storage tank communicating with said last-mentioned chamber, and means for applying equalized fluid pressure to said first-mentioned chamber and tank.

3. Apparatus for forming material involving the application of pressure and heat exchange, including a vessel of opposed separable sections, a forming die comprising a thin preformed rigid forming sheet sealed within one of said sections to enclose a pressure chamber, a rubber conforming sheet sealed within the opposed section to enclose an equalizing pressure chamber adapted to contain a liquid unharmed to the rubber of said conforming sheet, a storage tank for said liquid in communication with said last-mentioned chamber, and a steam pressure line connected with said tank and first-mentioned pressure chamber for transmitting heat to said forming sheet and equalized fluid pressure to said chambers.

4. Apparatus for forming material involving the application of pressure and heat exchange, including a vessel of opposed separable sections, a sheet metal forming die, means for removably mounting said forming die in one of said sections to enclose a pressure chamber, a rubber conforming sheet, means for removably mounting said rubber sheet in the opposed section and sealing it therein to enclose an equalizing pressure chamber, means for securing said separable sections of the vessel together with the material to be formed extending between said die and conforming sheet, said last-mentioned pressure chamber being adapted to contain a liquid unharmed to the rubber of said conforming sheet, a storage tank for said liquid in communication with said last-mentioned chamber, and a steam pressure line connected with said tank and first-mentioned pressure chamber for transmitting heat to said metal die and equalizing the fluid pressure within said chambers.

5. Apparatus for forming material involving the application of pressure and heat exchange, including a forming die comprising a thin preformed rigid forming sheet, a complementary rubber conforming sheet, said sheets being adapted to embrace the material to be compressed to the form of said forming sheet, a liquid retaining receptacle associated with said conforming sheet with the liquid in direct contact therewith, and means for applying equalized fluid pressure to said forming sheet and the liquid retained in said receptacle, whereby said pressure will be transmitted through the medium of said liquid to the conforming sheet.

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