Sept. 1, 1931. J. N. WHITEHOUSE 1,821,413

METHOD OF AND MEANS FOR SHAPING SHEETS OF CELLULOID AND THE LIKE

Filed July 10, 1929 3 Sheets-Sheet 1

FIG. I.

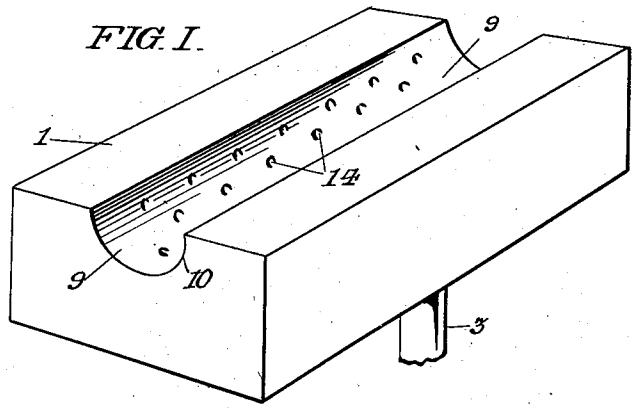


FIG. II.

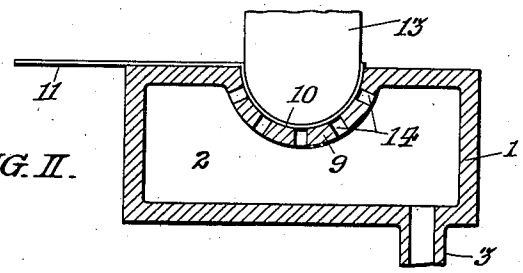


FIG. III.

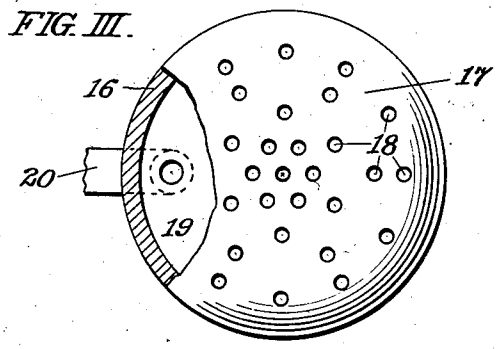
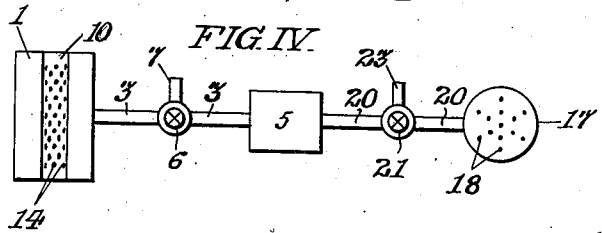


FIG. IV.



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METHOD OF AND MEANS FOR SHAPING SHEETS OF CELLULOID AND THE LIKE

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FIG. V.

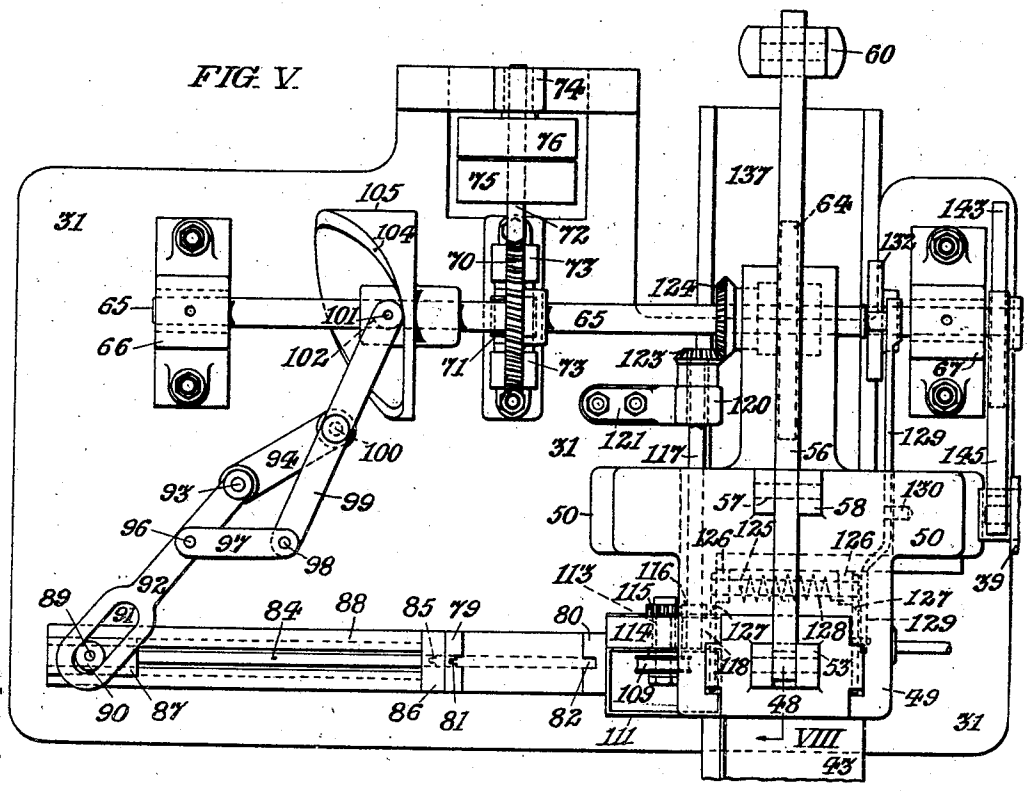
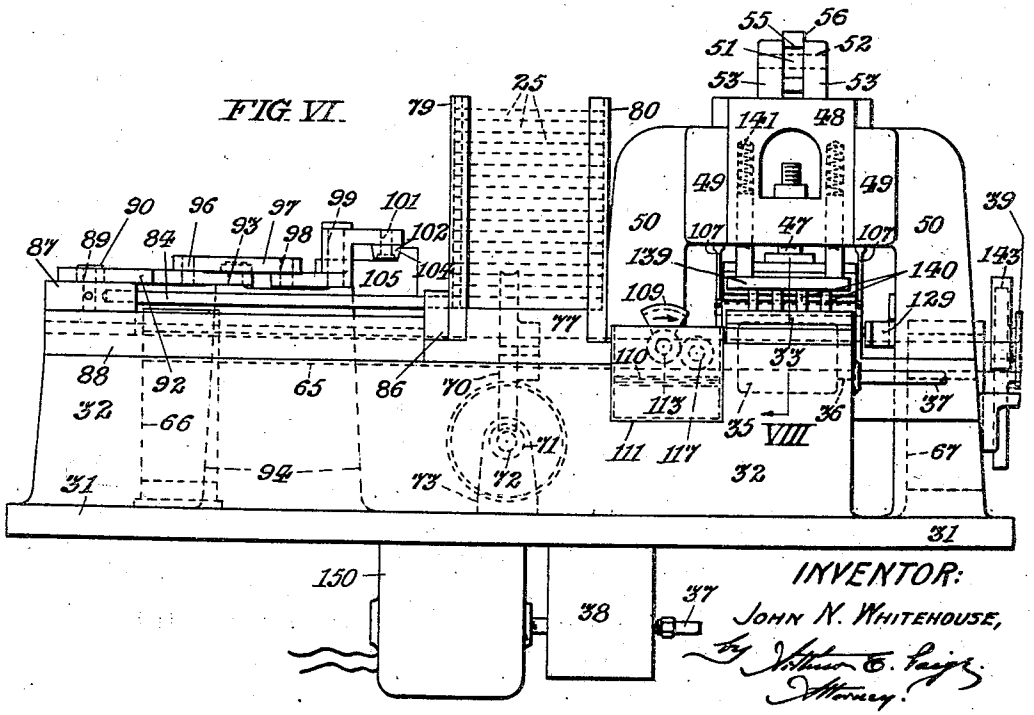


FIG. VI.



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METHOD OF AND MEANS FOR SHAPING SHEETS OF CELLULOID AND THE LIKE

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FIG. VII.

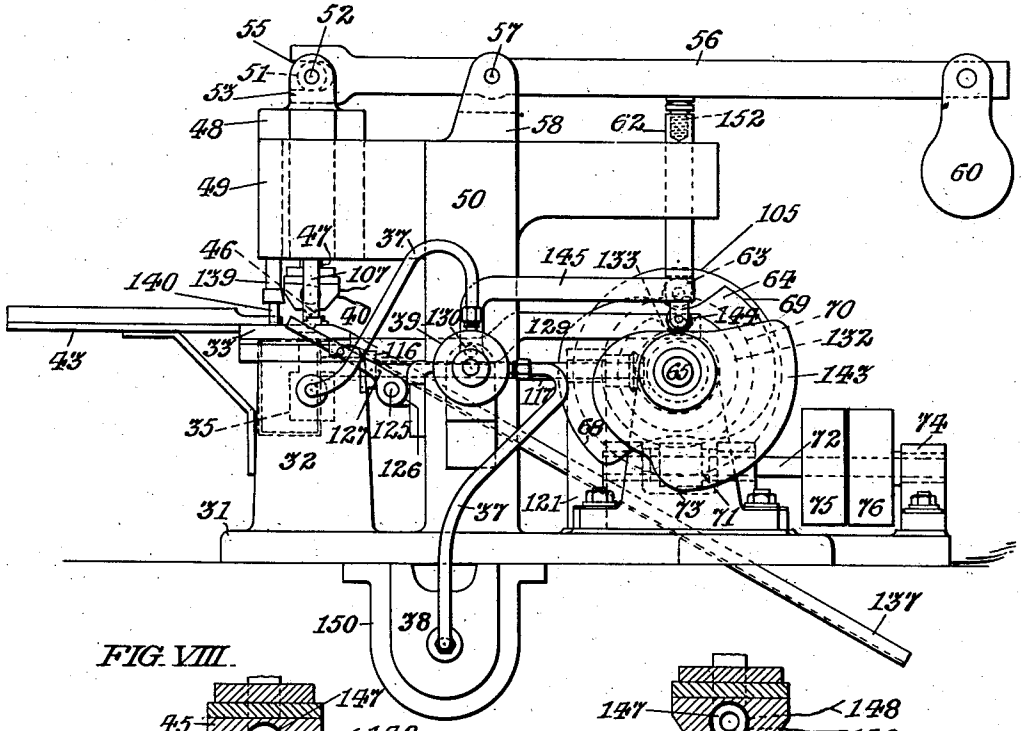
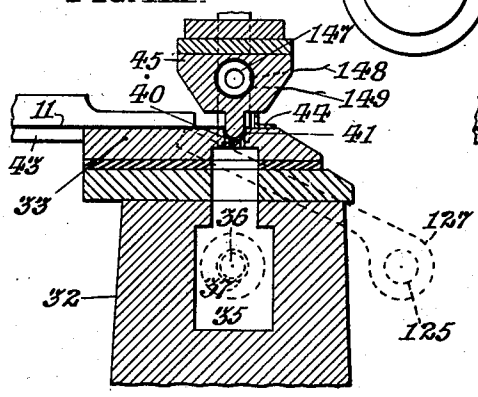


FIG. VIII.



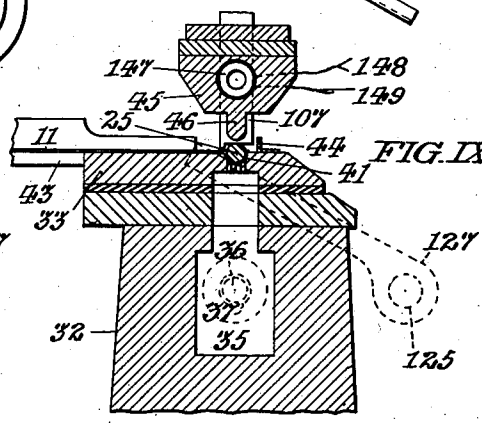
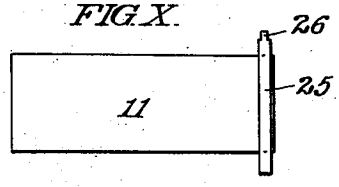


FIG. IX.

FIG. X.



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Patented Sept. 1, 1931

1,821,413

UNITED STATES PATENT OFFICE

JOHN N. WHITEHOUSE, OF NEW YORK, N. Y., ASSIGNOR TO SANITE CORPORATION, OF BURLINGTON, NEW JERSEY, A CORPORATION OF NEW JERSEY

METHOD OF AND MEANS FOR SHAPING SHEETS OF CELLULOID AND THE LIKE

Application filed July 10, 1929. Serial No. 377,141.

My invention may be conveniently employed in tube forming methods and means of the general class claimed in Letters Patent of the United States, No. 1,661,451 granted to me March 6, 1928 and in my copending application Serial No. 342,719, filed February 26, 1929, for Letters Patent of the United States; whereby sheets of cellulose products such as celluloid, cellulose nitrate, cellulose acetate or any suitable substance may be rolled upon respective mandrels while in a softened state, so that successive convolutions thereof are rendered coherent and merge in a solid tube.

In said copending application, successive sheets of such products are pressed into semicylindrical form at their forward ends, in a heated die, to receive respective mandrels which are thrust therein from a magazine, over a grooved roller which dips into a solvent of the material, so that the mandrel is coated with the solvent before it is placed in the recessed end of the sheet. The mandrel is then pressed upon the recessed end of the sheet so as to become adherent thereto by reason of the solvent coating, and the sheet with the mandrel attached thereto is discharged from said heated die.

Ordinarily, to effect such shaping, it is necessary to either press the sheet material into a hot die, as in said copending application, or to preheat said material and press it with a cold die to chill it in the form required. In either case, successive operations are delayed by the necessity for retaining the pressed material in the die until the necessary interchange of temperature is effected. That is to say, there is considerable loss of time in production of the desired articles incident to the delay between successive operations to permit the hot die to soften the celluloid which is introduced thereto cold or to permit the preheated celluloid to cool and harden.

Therefore, the object and effect of my present invention is to avoid such delays by providing means to hold the bent sheet in the desired bent position, while the mechanism moves to position for the next operation, and to permit such movement in less time than heretofore required. For instance, in the operation of the machine shown in said copending application, it is necessary to allow the opposed die elements to hold the pressed celluloid in position for fifteen seconds, whereas, in accordance with the present invention a bending operation may be effected every six seconds.

As hereinafter described, the method and means by which such shaping operations are thus greatly facilitated include subjecting the sheet to atmospheric pressure upon one side in opposition to a vacuum upon the other side; so that the shaped sheet may be held in the desired bent position, solely by atmospheric pressure, while the mechanism releases the sheet and moves away therefrom; the bent sheet being released from its bent position to permit its discharge from the machine, only when the vacuum aforesaid is relieved.

Although such a vacuum device may be advantageously employed in the tube forming mechanism above contemplated and hereinafter described; my invention is applicable to the shaping of sheets of celluloid and the like by any other method or means.

My invention includes the various novel features of such method and means hereinafter more definitely specified.

In said drawings: Fig. I is a perspective view of a die member adapted to receive the sheet material to be bent and having perforations leading to a vacuum chamber.

Fig. II is a transverse sectional view of said vacuum die member indicated in Fig. I and showing a sheet of material pressed and held therein by the atmospheric pressure in opposition to said perforations.

Fig. III is a plan view of a modified form of die member having perforations leading to a vacuum chamber.

Fig. IV is a diagram showing such a vacuum device connected with a vacuum pump and a valve controlling communication between said chamber, pump, and the atmosphere.

Fig. V is a plan view of a tube forming machine of the general character described and claimed in my copending application

Serial No. 342,719 aforesaid, but embodying a convenient form of my present invention.

Fig. VI is a front elevation of said machine shown in Fig. V.

Fig. VII is an elevation of the right hand end of said machine shown in Figs. V and VI.

Fig. VIII is a fragmentary sectional view taken on the line VIII in Figs. V and VI, showing the pair of dies and their appurtenances in position to form a semicylindrical recess in the forward end of a sheet of celluloid or the like.

Fig. IX is a view similar to Fig. VIII but showing the dies in position to press a mandrel into engagement with the recessed end of the sheet.

Fig. X is a plan view of one of said sheets with a mandrel thus attached thereto.

Referring to the form of my invention shown in Figs. I, II and IV; the casing 1 incloses the vacuum chamber 2 which is connected by the conduit 3 with the vacuum pump 5, under control of the two-way valve 6 which may be turned, manually or otherwise, to alternately establish communication between said vacuum chamber 2 and said pump 5, and between said vacuum chamber 2 and the outer atmosphere, through the branch conduit 7.

Said casing 1 has a die portion 9 in the top wall thereof which, if the device is to be used for forming cylindrical tubes, may form a semicylindrical recess 10 in which the sheet 11 may be pressed to semicylindrical form, by any suitable means, for instance the die 13. Said die portion 9 is provided with a plurality of perforations 14 leading into said chamber 2 so that, when the latter is exhausted by the operation of said pump 5, the atmospheric pressure upon the upper surface of said sheet 11 holds the latter in the form in which it has been shaped by the die 13, after the latter has been withdrawn, and until said valve 6 is turned to establish communication between said chamber 2 and the outer atmosphere through the main conduit 3 and branch conduit 7.

However, it is to be understood that my invention is applicable to sheet shaping devices of any suitable form, other than the cylindriform indicated in Figs. I and II. For instance, as indicated in Fig. III, a casing 16, of circular configuration, may have a convex die portion 17 with a plurality of perforations 18 leading into the vacuum chamber 19 which is connected with said pump 5 by the conduit 20, under control of the valve 21 which is similar to the valve 6 and may be turned to alternately establish communication between said pump 5 and said vacuum chamber 19 or between that chamber and the outer atmosphere through the branch conduit 23. The vacuum device shown in Fig. III may be used to hold a disk of celluloid or the like in concavo-convex form, as the bottom of a powder puff box or other article, while the other parts of that article are cemented thereto.

In the form of my invention shown in Figs. V to X inclusive; I have shown an embodiment of such a vacuum device in a machine for attaching sheets of celluloid or the like 11 to respective cylindrical mandrels 25 as in Fig. X; each such mandrel having one end flattened as indicated at 26, or otherwise shaped so that it may be engaged and turned to wind such sheet 11 evolutely thereon to form a tube; said sheet being moistened with a solvent of the celluloid or other material thereof, during such winding operation, so that the successive convolutions will coalesce.

In said Figures V to X inclusive; the base 31 has the pedestal 32 supporting the normally stationary but removable female die 33 which is secured at the top thereof, by any suitable means. Said pedestal 32 includes the vacuum chamber 35 having the port 36 connected by the conduit 37 with the vacuum pump 38, under control of the valve 39.

Said die 33 has the semicylindrical recess 40 in the top thereof to receive the forward end 41 of the sheet 11 of celluloid or the like which is fed to the machine, by hand or otherwise, over the table 43 which is conveniently supported in rigid relation with said die. Said die is conveniently provided with a pair of upwardly extending studs 44 which serve as gauge stops for the forward ends 41 of the successive sheets 11 to properly position the latter preparatory to the operation of pressing the sheet.

The upper die 45 has the semicylindrical projection 46 complementary to said recess 40 in the die 33, and is operatively connected, by the hangers 47, with the slide 48 which is mounted to reciprocate in the bracket 49 supported by the standards 50 of said base 31. Said slide 48 is adapted to be vertically reciprocated in said bracket 49 by its roller 51 mounted on the shaft 52 extending between the lugs 53 at the top thereof and engaged in the notch 55 in the forward end of the lever 56. Said lever is fulcrumed at 57 in the bracket 58 of said standards 50 and said slide 48 and lever 56 are normally uplifted to the position shown in Fig. VII by the stress of the weight 60.

Intermediate of said fulcrum 57 and weight 60, said lever 56 rests upon the vertical reciprocatory plunger 62 carrying the roller 63 in cooperative relation with the cam 64 which is rigidly connected with the shaft 65 journaled in the bearings 66 and 67 on said base 31. Said cam 64 has crests 68 and 69, of different radial extents, which are successively operative to press the die 45

down to the respectively different extents indicated in Figs. VIII and IX.

Said shaft 65 is adapted to be turned by the worm gear 70 which is fixed thereon and engaged with the worm 71 on the countershaft 72, the latter being journaled in the bearings 73 and 74 on said base 31 and provided with the tight and loose pulleys 75 and 76.

Said pedestal 32 supports the magazine 77 for said mandrels 25, which magazine comprises the opposite vertical channels 79 and 80 having respective grooves 81 and 82 in which the opposite ends of said mandrels 25 are adapted to slide. The groove 81 in the channel 79 is so shaped as to receive such flattened ends 26 of the mandrels 25 only when they are inserted vertically and thus insures the delivery of the successive mandrels in the same position with respect to those ends thereof.

I provide means for discharging said mandrels 25, one at a time, in proper sequence with the other operations of the mechanism shown in Figs. V to IX inclusive, including the horizontally reciprocatory plunger 84 which, as indicated in Fig. V, has the notch 85 in the right hand end thereof, adapted to engage the flattened end 26 of the lowermost mandrel 25 in said magazine. Said plunger is fitted to slide through the bearing 86 of said pedestal 32 and is supported at its left hand end by the slide block 87 which is mounted to slide in the bed 88 which is rigidly secured on said pedestal 32. Said block 87 has the stud shaft 89 carrying the roller 90 for engagement in the slot 91 in the lever 92 which is fulcrumed at 93 upon the standard 94. Said lever 92 is pivotally connected at 96 with the link 97 which is pivoted at 98 upon the lever 99 which is fulcrumed at 100 on said standard 94 and has, at its opposite end, the stud shaft 101 carrying the roller 102 in cooperative relation with the cam face 104 on the rotary cam 105 which is rigidly connected with said shaft 65.

Said cam 105 is so coordinately positioned on said shaft 65, in relation to the cam 64, that the mandrels 25 are delivered in succession in proper time to be received by said dies 33 and 45, as indicated in Figs. VI and IX, so that when said die 45 is pressed downwardly by the portion 69 of said cam 64, the flanges 107 on said die 45 bear upon the mandrel 25 and firmly press the latter into the forward recessed end 41 of the sheet of celluloid or the like 11. Of course, the application of mechanical pressure to the end of the sheet 11 in the semicylindrical recess 40 does not interfere with the continued application of fluid pressure thereto, (incident to the continued operation of the vacuum pump 38 in communication with the vacuum chamber 35,) until it is desired to uplift the mandrel 25 with the end of said sheet attached thereto. At the time for such uplifting movement, the valve 39 is operated to shut off communication between the vacuum chamber 35 and the vacuum pump 38 and then release said sheet from fluid pressure.

In order to insure that the mandrel 25 thus pressed upon the recessed end 11 shall firmly adhere to the latter, I provide the grooved roller sector 109, in the path of the mandrel, in its movement from the magazine to position upon said sheet, and means for maintaining said sector continually wet with a suitable liquid solvent 110 of the sheet material; so that each mandrel 25 is coated with such solvent only to the extent necessary or desirable before it is applied to the sheet, as above described.

In my copending application aforesaid I employed a circular roller having a continuous circumferential groove, in lieu of the sector aforesaid, but found it objectionable because it applied too much of the solvent to the mandrel. Said sector is advantageous, compared with such roller, not only in economy of the solvent but in avoiding coating the mandrels with the solvent where they must be ultimately grasped by the operator.

Any suitable solvent may be employed; for instance, acetone is a suitable solvent for celluloid and cellulose nitrate; and ethyl acetate, or a mixture of alcohol and ether, are suitable solvents for cellulose acetate.

The solvent 110 is conveniently supplied in the tank 111 supported by said pedestal 32 so that the sector 109 dips therein at each revolution.

Said sector 109 is positively turned by its rigid connection with the shaft 113 which is journaled in the bearing 114 and provided with the gear wheel 115 in mesh with the gear 116 on the countershaft 117 which is journaled in the bearing 118 on said pedestal 32 and in the bearing 120 in the bracket 121 on said base 31.

Said shaft 117 has the bevel gear 123 rigidly connected therewith and in mesh with the bevel gear 124 on said shaft 65; so that said sector 109 is continually turned in the direction indicated by the arrow in Fig. VI, during the operation of the machine, by rotation of the shaft 72.

The circumferential extent of the cam crest 69 is sufficient to press the mandrel 25 in contact with the recessed end of the sheet 11, as indicated in Fig. IX, until it is firmly attached to said sheet. As said crest 69 passes beneath the roller 63 to the position shown in Fig. VII, the weight 60 is permitted to uplift said lever 56 and the slide 48 to the position shown in that figure.

In order to lift the mandrel 25 and sheet 11 attached thereto, from the recess 40 in the die 33, and discharge it over the stop studs 44, I provide the U-shaped discharg-

ing frame which comprises the rock shaft 125 journaled in bearings 126 and having arms 127 at respectively opposite ends thereof, which are continually stressed upwardly by the spring 128 encircling said shaft. However, said frame is normally held down by the lever 129 which is fulcrumed at 130 on one of said standards 50 and adapted to be rocked by the cam 132 having the notch 133, which in the position shown in Fig. VII permits said discharging frame to be uplifted by said spring 128, to the position shown in Fig. VII, and thus lift the mandrel 25 over the studs 44 and permit the weight of said mandrel to drag said sheet 11 down the chute 137 and thus discharge the completed article shown in Fig. X.

I also find it convenient to attach to said die slide 48 means for holding the successive sheets 11 during the operation of pressing the forward ends thereof into said die recess 40; so that said sheets may not be pulled forwardly by such pressing operation and will be all pressed alike. Such means may include the presser frame 139 carrying the series of fingers 140 which are conveniently formed of rubber to afford sufficient frictional engagement with said sheets 11. Said frame 139 may be lifted clear of the path of such sheets when said slide 48 approaches the upper limit of its stroke, but is preferably connected with said slide by springs 141 so as to permit said fingers to engage and hold said sheets before and during the pressing operation by differential movement of said presser frame and slide.

As indicated in Figs. V and VII; said shaft 65 is provided with the valve cam 143, in cooperative relation with the roller 144 on the lever 145 by which said valve 39 is operated, with the effect above described, to wit, when the forward end of the sheet 11 is pressed into the die recess 40 the vacuum chamber 35 is in communication with the vacuum pump through said valve 39 so that said chamber is exhausted and the sheet held by atmospheric pressure; but, in time for the discharge of the sheet from said die recess, said vacuum is relieved by opening said chamber 35 to the atmosphere through the valve 39.

Although, as above noted, said sheets 11 may be preheated and pressed by a cold die; I prefer to supply the sheets to the machine above described in a substantially cool condition and to heat the upper die 45 so as to soften the sheets by contact therewith. As indicated, said die 45 is provided with an electric heating unit 147 provided with conductors 148 and 149. Said conductors may be included in an electric circuit with the motor 150 for operating said vacuum pump 38. However, it is to be understood that said conduit 37 from the vacuum chamber 35 may be exhausted by any convenient means.

I also find it convenient to render the effective length of said plunger 62 adjustable to properly press sheets 11 of different thickness and, for that purpose, provide said plunger with the screw plug 152 in the upper end thereof; so that the effective length of said plunger may be varied by rotation of said plug.

Although I find it convenient to employ all of the means above described for effecting my improved method of shaping sheets of celluloid and the like; it is obvious that various modifications may be made therein, without departing from the essential features of my invention as defined in the appended claims.

I claim:

1. A method of shaping sheet material which includes subjecting said material to fluid pressure upon one side thereof, in opposition to a vacuum upon the opposite side thereof, and heating the sheet material during the application of fluid pressure thereto.

2. A method as in claim 1; including pressing said material, by mechanical means, during pressure thereof by said fluid.

3. A method as in claim 1; including pressing said material, by mechanical means, during pressure thereof by said fluid and removing said mechanical pressure before removing said fluid pressure; whereby said material is permitted to set in the shape to which it has been pressed while the mechanical pressing means is removed therefrom.

4. A method as in claim 1; wherein the shaping of said material is limited by a mold surface opposed to said fluid pressure.

5. A method as in claim 1; wherein the shaping of said material is limited by a mold surface opposed to said fluid pressure, and, during the application of said fluid pressure, said material is mechanically pressed against said surface.

6. A method as in claim 1; wherein the shaping of said material is limited by a mold surface opposed to said fluid pressure, and, during the application of said fluid pressure, said material is mechanically pressed against said surface, and heated.

7. A method as in claim 1; wherein the shaping of said material is limited by a mold surface opposed to said fluid pressure, and, during the application of said fluid pressure, said material is mechanically pressed against said surface, and heated, by said mechanical pressing means.

8. In means for shaping cellulose products; the combination with a pair of complementary, relatively movable dies adapted to receive and press sheet material between them; of means arranged to exhaust the atmospheric pressure from one side of said die members; and means arranged to relieve

the vacuum and restore atmospheric pressure to the side of said material previously subjected to the vacuum; whereby such sheet material may be held in the perforated die and permitted to set to the shape thereof, while the other die is removed therefrom and progressing through part of its cycle of operation; heating means for said movable die, including an electrical resistance unit; and means, including a cam, adapted to press said dies upon a sheet of such a product and thereby form a recess in such sheet.

9. In means for shaping sheet material; the combination with a pair of relatively movable, complementary dies, one of which has a semicylindrical recess with perforations extending through its surface opposed to the other die; of means arranged to form a partial vacuum extending through said perforations to said surface; whereby a sheet of material in contact with said perforated surface may be held in recessed position, by atmospheric pressure in opposition to such vacuum; means adapted to automatically place a mandrel in the recessed portion of such sheet, between said dies; means, including a cam, arranged to effect relative movement of said dies and press said mandrel into said shaped sheet; a vacuum valve arranged to control the vacuum in said die; and, means operatively connecting the die moving means with said vacuum valve; whereby, said vacuum is maintained during the shaping of said sheet and pressing of said mandrel therein, but thereafter relieved to permit withdrawal of the shaped sheet and mandrel.

10. A method of shaping sheet material which includes subjecting said material to fluid pressure upon one side thereof, in opposition to a vacuum upon the opposite side thereof, and softening said sheet material upon the side thereof subjected to pressure, during the shaping operation, by application of a solvent of the sheet material.

11. A method as in claim 10; wherein the solvent material is carried to the sheet by a body fitted to the shaped portion of the sheet.

12. A method as in claim 10; wherein a mandrel is pressed into the shaped portion of the sheet, and thereby attached thereto, before the vacuum is relieved.

13. A method as in claim 10; wherein the solvent is carried to the sheet by a mandrel fitted to the pressed portion of the sheet; the vacuum is relieved after said mandrel is attached to the sheet by such solvent; and the discharge of such sheet with the mandrel attached thereto is automatically initiated by uplifting said mandrel and sheet, and the discharge thereof is completed by gravitative movement, due to the weight of the mandel.

14. In means for shaping sheets of cellulose products; a cylindrical mandrel; means for applying a solvent of the sheet material to a limited portion of said mandrel, intermediate of the length of the latter, including a rotary sector having a toric groove in its face fitted to the mandrel, and means for automatically progressing the mandrel axially, and said sector arcuately, in contact therewith, during the coating operation.

15. In means for shaping cellulose products; means for applying a solvent of such products to a mandrel, intermediate of the length of the latter, including a container for such solvent, a rotary sector adapted to dip into the solvent in such container, during part of each of its revolutions; and means adapted to automatically progress said mandrel in contact with said sector during another part of the revolution of the latter; and means cooperatively connecting said sector with the means for moving said mandrel; whereby they are relatively moved in coordinated relation; to apply a solvent intermediate of the length of the mandel and exclusive of the ends of the latter.

16. In means for shaping sheet material; the combination with a die having perforations therethrough, at the surface adapted to contact with said sheet material; of means arranged to form a partial vacuum extending through said perforations to said surface; whereby a sheet of material may be held in contact with said perforated surface by atmospheric pressure in opposition to such vacuum; a vacuum valve arranged to control the vacuum in said die, and relieve said vacuum, and thus permit the shaped sheet to be discharged; means normally tending to discharge said sheet, including a spring pressed frame; means normally detaining such discharging means from operation, including a cam and a lever connecting said cam with said discharging frame; and means cooperatively connecting said cam and valve, whereby they are operated in coordinated relation.

17. In means for shaping sheet material; the combination with a die having perforations extending through its surface adapted to contact with the sheet material; of means arranged to form a partial vacuum extending through said perforations to said surface; means adapted to temporarily hold a sheet in position to be shaped in said die, including a plunger; whereby, a sheet of material may be first held in cooperative relation with said die, by said plunger, and be thereafter held in shaped position with respect to said die by atmospheric pressure in opposition to such vacuum; means arranged to remove said plunger from said sheet and relieve said vacuum, in succession; whereby, said sheet is released to be discharged.

18. In means for shaping sheet material, as in claim 17; a second die, adapted to co-

operate with said perforated die; and means arranged to relatively move said dies into engagement with said sheet after the engagement thereof by said plunger and before the engagement of said sheet by the atmospheric pressure, and to remove said second die from said sheet, before such vacuum is relieved.

In testimony whereof, I have hereunto signed my name at Burlington, New Jersey, this 22nd day of June, 1929.

JOHN N. WHITEHOUSE.