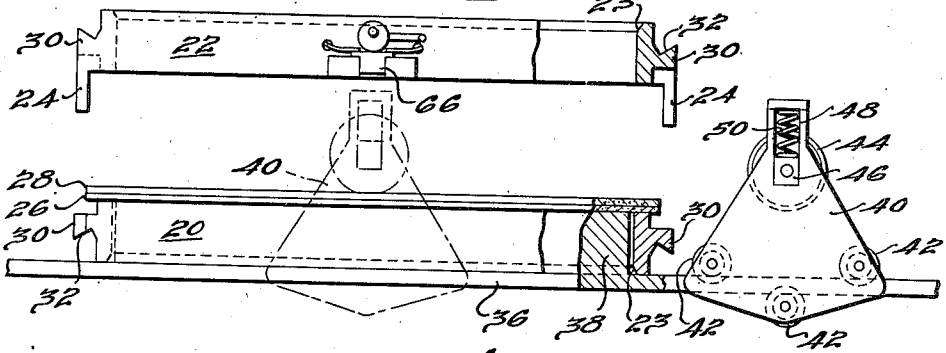
Sept. 12, 1939. C. E. RIEL 2,172,546

METHOD AND APPARATUS FOR FORMING SOFT ELASTIC CAPSULES

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Fig. 1.



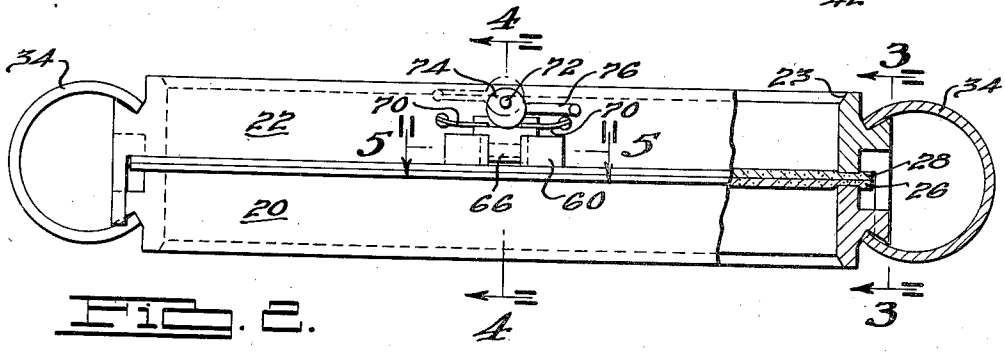


Fig. 2.

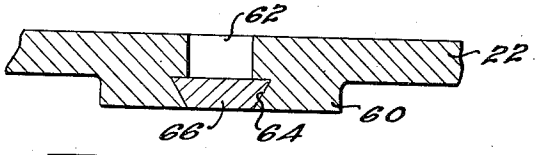


Fig. 5.

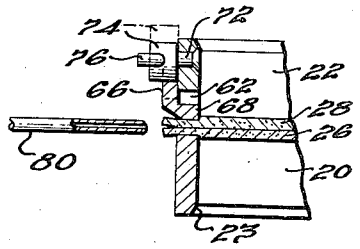


Fig. 4.

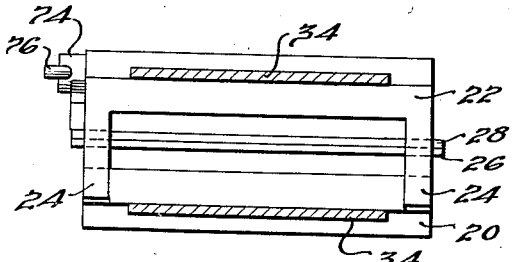


Fig. 3.



Fig. 6.

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FIG. 7.

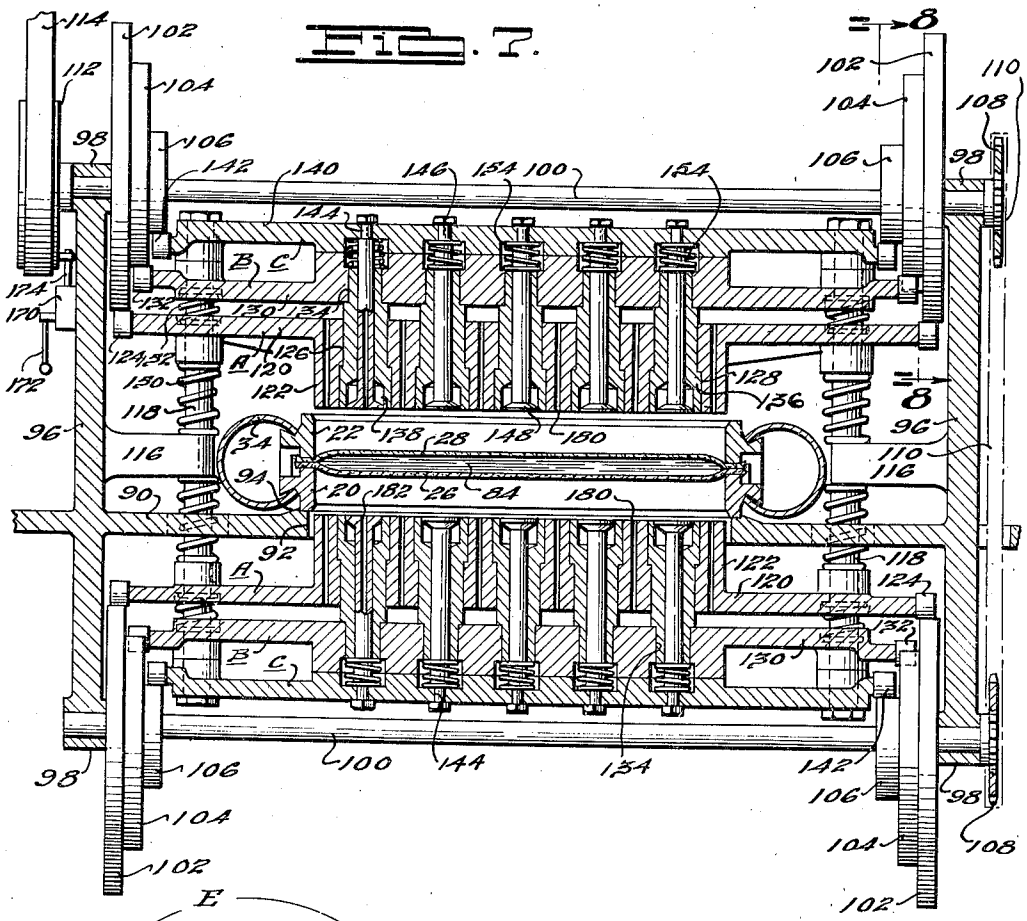
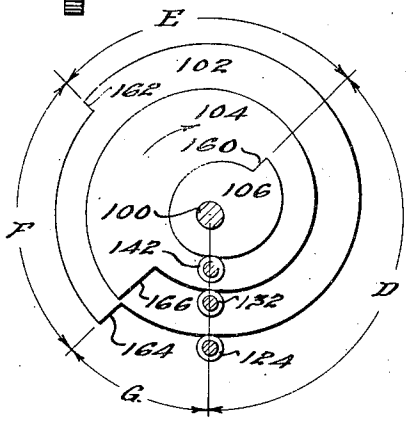


FIG. 8.



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METHOD AND APPARATUS FOR FORMING SOFT ELASTIC CAPSULES

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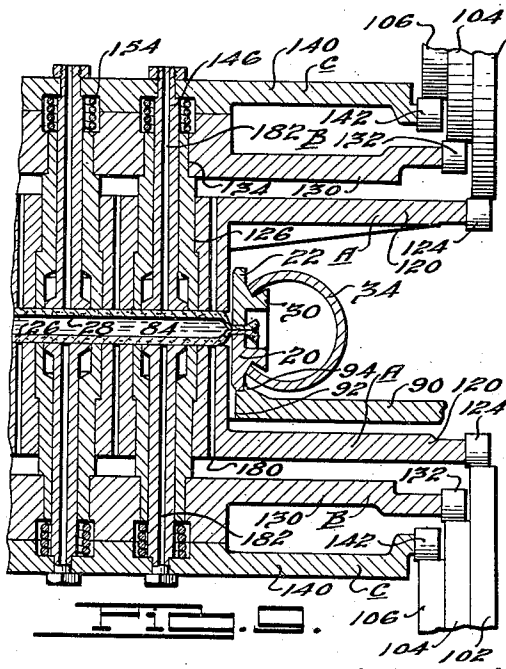


Fig. 9.

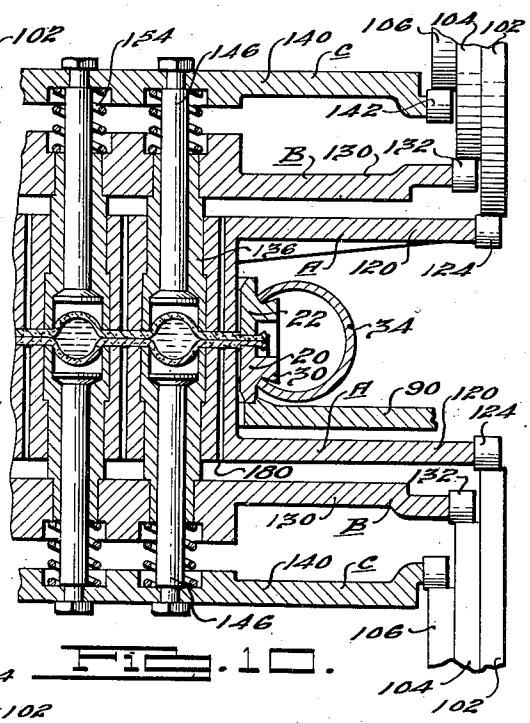


Fig. 10.

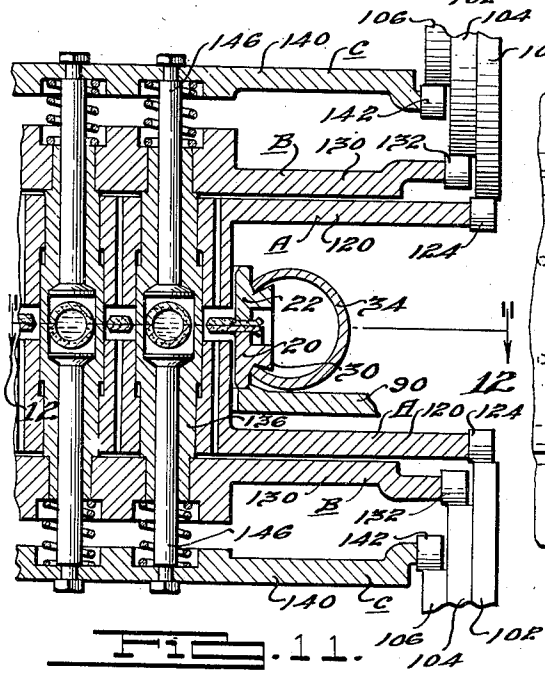


Fig. 11.

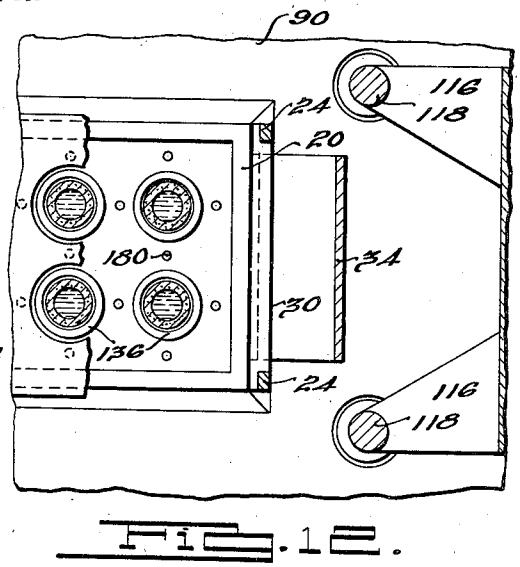


Fig. 12.

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Patented Sept. 12, 1939

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UNITED STATES PATENT OFFICE

2,172,546

METHOD AND APPARATUS FOR FORMING SOFT ELASTIC CAPSULES

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Application December 16, 1936, Serial No. 116,091

7 Claims. (Cl. 18—19)

This invention relates to a method of making soft elastic capsules or liquid filled gelatine globules, and to an apparatus that may be employed in carrying out such method, the principal object being the provision of a method of making such capsules that will eliminate waste in the raw material, will insure a uniform content in all of the capsules, and will permit an increase in the rate of production of such capsules as compared to conventional methods of manufacture.

Other objects of the invention include the provision of a method of making soft elastic capsules including, the steps of assembling a pair of sheets of gelatine or other suitable material in co-operative relationship and containing a predetermined volume of filling liquid between them independently of the press in which the capsules are to be formed, and thereafter inserting the assembled liquid filled sheets in a press and operating upon them to form the desired individual capsules; the steps of assembling a pair of sheets of gelatine or other suitable material in superposed relationship and operating upon them to exclude air from between them, sealing the margins of the superposed sheets, introducing a suitable liquid between the sheets and then operating upon the sheets to form the desired individual capsules; the steps of subjecting a pair of superposed sheets of gelatine or like material having a quantity of liquid or semi-liquid entrapped between them to a uniform pressure over their exposed areas, thereafter relieving the pressure over those individual areas of the sheets from which the capsules are to be directly formed and thereafter pressing said sheets together around each individual area and severing such areas from the remainder of the sheets; the steps of sealing a pair of superposed sheets of gelatine or the like around the margins and thereby confining within said sheets a body of liquid or semi-liquid material, applying pressure to said sheets so as to exclude said liquid from between them except in the immediate areas thereof from which the capsules are to be formed, and then severing the sheets and liquid contained within such areas from the remainder of the sheets; the steps of providing a pair of superposed sheets of gelatine or like material sealed at their edges and confining a body of liquid or semi-liquid material between them, subjecting all exposed areas of said sheets to equal pressures, relieving the pressure on said sheets over those areas thereof from which capsules are to be formed, forcing all of said liquid from between said sheets except over said areas and sealing said sheets together about said areas, relieving the pressure on said sheets except immediately bordering each of said areas, and then severing said sheets around the margins of each of said areas; and the combination of any one or more of the above described steps.

Further objects of the invention include the provision of apparatus by means of which the foregoing steps of operation may be carried out; the provision of a pair of cooperating clamping frames readily insertable in and removable from a capsule press; the provision of a pair of clamping frames between which a pair of sheets of gelatine or like material may be clamped so as to seal the same about their margins and having provision for relieving the clamping pressure over a limited area of the frame temporarily for the purpose of permitting the introduction of a mass of liquid or semi-liquid between said sheets; the provision of a die structure for forming soft elastic capsules from a pair of superposed sheets of gelatine or like material sealed at their edges and confining a mass of liquid or semi-liquid between them including relatively movable die parts so constructed and arranged as to move simultaneously with each other during one phase of operation and independently of one another during another phase of operation; the provision of die parts as above described wherein one of said die parts is provided with a plurality of capsule forming recesses therein and other parts of said die serve as temporary filler blocks for said recesses during one phase of operation of said die; the provision of a die structure of the character above described in which one die part is so constructed and arranged as to provide a plurality of capsule forming recesses therein, another die part is movable relative thereto and provides a temporary filler means for said recesses during a phase of operation of said dies, and a third relatively movable part serves as a temporary filler for the areas of the operated face of the die exterior to but surrounding the margins of the capsule forming opening; the provision of means for operating the above described relatively movable die parts in predetermined relation with respect to each other; and the provision of a device of the type described that is simple in construction, efficient in operation and by the use of which soft elastic capsules may be easily and rapidly formed each with an accurately predetermined volume of liquid or semi-liquid material contained therein.

The above being among the objects of the present invention the same consists in certain novel steps of operation, features of construction and

combination of parts and steps of operation to be hereinafter described with reference to the accompanying drawings, and then claimed, having the above and other objects in view.

In the accompanying drawings which illustrate a suitable embodiment of the present invention and in which like numerals refer to like parts throughout the several different views,

Figure 1 is a partially broken, partially sectioned, side elevational view of the clamping frame for a pair of sheets of gelatine or like material such as are employed in making soft elastic capsules, the frames being shown in separated relation and in operative relationship with respect to means employed for excluding air from between the sheets;

Fig. 2 is a slightly enlarged, partially broken, partially sectioned side elevational view of the clamping frame shown in Fig. 1 removed from the air excluding apparatus and arranged in operative relation with respect to each other and to a pair of gelatine sheets confined between them;

Fig. 3 is an end elevational view of the frame shown in Fig. 2, the co-operating clamping member being shown in section taken as on the line 3—3 of Fig. 2;

Fig. 4 is a fragmentary, vertical sectional view taken transversely of the frame shown in Fig. 2 as on the line 4—4 thereof and illustrating the liquid filling needle in the position it may assume immediately prior to insertion between the sheets in order to fill the space between the sheets with the desired liquid or semi-liquid material;

Fig. 5 is an enlarged fragmentary, horizontal sectional view taken on the line 5—5 of Fig. 2 and illustrating details of the gate over that portion of the margins of the gelatine sheets through which the filling liquid is introduced between the sheets;

Fig. 6 is a partially broken perspective view of a soft gelatine capsule or liquid filled gelatine globule of the type formed in accordance with the present invention;

Fig. 7 is a vertical, sectional view taken centrally through a preferred form of die structure and a portion of the cooperating press employed in accordance with the present invention for forming soft elastic capsules, the frames and sheets shown in Fig. 2 being shown arranged in co-operative relationship therewith, and the gelatine sheets being shown as filled with liquid;

Fig. 8 is a vertical, sectional view taken on the line 8—8 of Fig. 7 and illustrating the profiles of the cams employed for actuating the die assembly structures;

Fig. 9 is a view similar to a fragment of the view shown in Fig. 7 but with the various die parts moved to an initial position of operation upon the liquid filled gelatine sheets;

Fig. 10 is a view similar to Fig. 9 but illustrating the die parts in a subsequent position of operation;

Fig. 11 is a view similar to Figs. 9 and 10 but illustrating the die parts in a still further position of operation which completes the formation of the capsules;

Fig. 12 is a fragmentary, horizontal sectional view taken on the line 12—12 of Fig. 11 and presenting a plan view of one of the oppositely movable die part assemblies.

Heretofore in the manufacture of liquid filled globules or soft elastic capsules containing any fluid or semi-fluid substance or medicinal compound such as oil, or the like, it has been the practice to provide two substantially flat gelatine sheets between two opposed and rigid die plates containing a plurality of forming recesses, the sheets confining between them the oil or other substance to be utilized, and subsequently forcing the die plates together. The formation of the capsules in this manner is a relatively laborious procedure inasmuch as it entails careful manipulation by the operator of the gelatine sheets and the resulting product is not only lacking in uniformity by reason of the human element involved, but is very apt to be inferior by reason of the fact that it is almost impossible to prevent the entrance of air into some of the capsules during each of the die stamping operations.

In accordance with conventional procedure the lower die member is provided with a vertically extending marginal flange over which a flat gelatine sheet is laid with its margins resting on the upper surface of the flange. The central portion of the gelatine sheet sags down and rests upon the flanges or so-called cutting edges bordering each of the die recesses and projecting slightly above the remaining surface of the corresponding plate, the marginal portions of the gelatine sheet remaining spaced thereabove an increasing amount by reason of the sag from the marginal flanges. The fluid substance or capsulating fluid with which the capsules are to be filled is then poured into the pocket so formed, the major portion thereof remaining in the central portion of such pocket by reason of the greater depth over that area. The second gelatine sheet is then deposited in superposed relationship upon the first sheet and the liquid contained in the pockets formed thereby. In accordance with conventional practice this upper or second sheet is usually rolled on to the surface of the fluid substance contained in the pocket of the first sheet during this operation with the object to force out the air from between the two sheets and leave only the fluid substance therebetween. From a practical standpoint, however, it is almost impossible to completely eliminate all of the air from between the sheets.

After the two sheets of gelatine with the fluid between them has been assembled in the above described manner, in accordance with conventional practice a similar upper die plate is then forced down upon the superposed sheets to form the capsules. This operation squeezes the fluid substance from the deeper central portion towards the marginal portion of the sheets, but since the respective halves of the capsules are formed and the two sealed together when the projecting die flanges or cutting edges abut one another, the result is that the squeezing action has not, as a rule, forced a sufficient amount of the fluid substance to the marginal portions of the sheets to form as large a capsule at the margins as is formed in the central portion of the die plate when the die parts have been brought into actual contact with each other. There is, therefore, a lack of uniformity in the size of the capsules formed upon each operation in accordance with conventional practice. Additionally, the fact that it is difficult to force out all of the air from between the sheets as the upper sheet is laid upon the surface of the fluid, frequently results in the formation of air bubbles in a portion of the capsules formed during each operation. Furthermore, conventional practice necessitates the use of a fluid substance having a relatively low viscosity so that it will flow uniformly between the

sheets and insure a fair percentage of satisfactorily filled capsules or envelopes.

Additionally, in following out the conventional practice of making such capsules a considerable amount of the fluid substance is trapped between those portions of the gelatine sheets intermediate the various capsule forming recesses. In other words after the two gelatine sheets have been operated on to form capsules from them, the waste portions of the sheets resemble a net and is conventionally known by that name, and inasmuch as the die plates are relieved between the cutting edges or flanges surrounding each capsule forming recesses a certain amount of the fluid substance is trapped between the opposite halves of the net over the entire area thereof except the extreme marginal edges which are clamped together for sealing purposes during the pressing operation. The amount of fluid substance thus entrapped within the opposite halves of the net is material and inasmuch as such fluid substance is usually of a rather expensive character a relatively large amount of waste will occur for this reason unless such fluid can be salvaged. Such salvage, of course, necessitiates the treatment of the net to separate the gelatine from the fluid substance and this step in and of itself is a relatively expensive operation and forms the major waste from the standpoint of operation in conventional methods of forming such capsules.

Inasmuch as the manufacturers of such capsules are required to maintain the volume of the liquid contents of the capsules within predetermined limits, the formation of undersized capsules around the margins of the sheets by conventional methods of manufacture entails a still further waste that adds to the cost of the manufacture for these undersized capsules must be separated into their component parts in the same manner as the net above described unless a greater waste of material is to be endured.

As will be observed from the above described conventional procedure one gelatine sheet is first inserted in the press, it is supplied with a predetermined quantity of the fluid material, the second sheet is then applied to the first sheet and proper precautions taken to exclude as much air as possible from between the sheets and then the sheets are operated upon to form the capsules therefrom. As will be obvious, after the sheets have once been properly positioned with respect to each other and filled with the fluid material the actual operation of forming the capsules therefrom requires only a small percentage of the time required to arrange the sheets for the pressing operation. In accordance with one phase of the present invention the production of number of capsules per hour per press is increased many fold by arranging, filling and clamping the gelatine sheets entirely independent of the press and then inserting the arranged and filled sheets in the press where they may be immediately operated upon by the press to form the capsules without further preparation operations. By this procedure the cost of manufacturing such capsules is materially reduced due to the fact that less money must be invested in machinery than in accordance with conventional practice, considering like quantities of capsules to be produced in both instances.

In accordance with a further phase of the present invention and which may be employed in conjunction with the step of operation above described or with conventional methods of arranging the sheets of gelatine to be operated upon by the press, the waste in conventional construction due to undersized capsules about the margins of the machine is entirely eliminated by subjecting all exposed areas of the sheets to a material and uniform pressure prior to permitting expansion of the sheets into the die recesses, thereby insuring an equal distribution of the fluid material with which the capsules are to be filled over the entire exposed areas of the sheets prior to the actual forming operation. This may be conveniently accomplished in accordance with a further phase of the present invention by providing a die structure in which each of the die recesses is provided with a temporary filler block which will prevent expansion of a gelatine sheet into the die recesses until the sheets have been subjected over their entire area to an equal positive pressure insuring equal distribution of the fluid material over the entire available area of the sheets, and then subsequently withdrawing the filler members so as to expose the die recesses and then advancing the die parts to increase the pressure upon the fluid material and thereby deform the gelatine sheets into the respective die recesses, and subsequently severing the sheets about the margins of each of the recesses.

In accordance with a further phase of the present invention in order to eliminate the trapping of any of the fluid material between the opposite halves of the subsequently formed net and thereby eliminate the expense in conventional methods required in separating the fluid material from the gelatine sheets, the gelatine sheets intermediate the margins of the areas from which the capsules are to be directly formed are placed under pressure during the forming operation until the opposed surfaces of the sheets over such intermediate areas are brought into actual contact with each other, thereby to force all fluid medium from between them, prior to or simultaneously with the moment at which severance of the individual capsules from the sheets of gelatine is actually commenced. This may be accomplished in accordance with a further phase of the present invention by making those parts of the die plates intermediate the cutting marginal edges of the die recesses movable with respect to such marginal edges and so controlling the movement thereof as to advance such intermediate portions simultaneously with the cutting edges against the two sheets until the two sheets have been brought into actual contact with each other over the entire area thereof excepting the die recesses, and then retracting such intermediate portions with respect to the marginal or cutting edges of the die recesses during the operation of actual severance of the various capsules from the plate.

Referring now to the accompanying drawings which illustrate apparatus by means of which the foregoing steps of operation may be suitably carried out, and illustrating a preferred form of apparatus constituting a further part of the present invention, in Figs. 1 to 5, inclusive, is illustrated the clamping frame for the gelatine sheets and the apparatus by means of which they may be suitably arranged and held by the frame. Each set of frames includes a lower frame 20 and an upper frame 22. The sides and ends of these frames are continuous and integral with each other and the frames are completely open at the top and bottom. The upper and lower surfaces of each of the frames are planular and parallel with each other. The frames may be of any desired contour in plan view but are preferably square or rectangular as shown. The lower in-

ner marginal edge of the lower frame 20 and the upper inner marginal edge of the upper frame 22 are preferably outwardly flared or beveled at 23 to better guide the respective die structures thereinto as will hereinafter be more apparent. The upper frame member 22 is shown as being provided with an outwardly offset, downwardly projecting leg 24 at each corner thereof which leg 24 co-operates with corresponding corner portions of the frame 20 when the two frames are assembled together so as to accurately position the two frames in superposed relation with respect to each other. The legs 24 are sufficiently offset outwardly from the outer margins of the frames 20 and 22 so as not to interfere with or require any special configuration of the gelatine sheets 26 and 28 to be clamped therebetween. In this respect it is desired to call attention to the fact that the sheets 26 and 28 may be made of any material suitable for the purpose desired, gelatine being the material commonly employed and, accordingly, these sheets will be referred to as gelatine sheets hereafter in an illustrative and not in a limiting sense.

Any suitable means may be provided for securing the two frames 20 and 22 together in assembled relationship. According to the means shown by way of illustration the lower frame 20 and the upper frame 22 is each provided at opposite ends with an outwardly projecting ledge or flange 30 the lower and upper surfaces respectively of which are slightly undercut or notched as at 32 for reception of a partially cylindrical radially resilient and yieldable clamping member 34 at each end of the assembled frame, the free circumferential edges of each clamping member 34 being received in the corresponding recess 32 of each pair of shelves 30 at opposite ends of the frame. These clamping members 34 are so constructed and arranged as to securely clamp the margins of the gelatine sheets 26 and 28 between them as best illustrated in Fig. 2.

Although any suitable method and means may be employed for positioning sheets of gelatine 26 and 28 between the frames 20 and 22 and excluding the air from between them, the apparatus disclosed in Fig. 1 will be found convenient and will facilitate such operation. This apparatus comprises a rectangular base plate 36 having a filler block 38 arranged thereon. The filler block 38 is of a size to substantially completely fill the interior of the frame 20 when the same is positioned thereabout and of a depth equal to the depth of the frame 20 so that the upper surfaces of the filler block 38 will be flush with the upper edge surfaces of the frame 20. With the frame 20 arranged upon the plate 36 about the filler block 38 the gelatine sheets 26 and 28 are superposed one upon the other over the top of the filler block 38 and upper edges of the frame 20 and, accordingly, are supported in flat relation to one another.

A roller mechanism including a pair of end frame members 40, one arranged each side of the plate 36, each of which is provided with a plurality of rollers 42 carried thereby and engaging the upper and lower marginal edges of the plate 36 outwardly of the frame 20, support between them an elongated roller 44. The roller 44 extends between the plate-like brackets 40 and is rotatably supported in each of them by means of a bearing block 46 vertically slidably received in a vertically extending slot 48 provided in each bracket plate. The bearing blocks 46 are each constantly urged downwardly by means of a coil spring 50 suitably maintained under compression between the corresponding bearing block 46 and the upper margin of the corresponding slot 48. The position of the roller 44 is such that when the bearing blocks 46 are at the lower end of the slots 48 the lower surface of the roller 44 lies below the upper surface of the gelatine sheet 28 when assembled as illustrated in Fig. 1. When the gelatine sheets 26 and 28 have been assembled on the frame 20 as illustrated in Fig. 1, the roller assembly is caused to be moved along the plate 36 until the roller 44 is pressed upwardly against the force of the spring 50 and caused to climb upon the upper surface of the gelatine sheet 28, and the device is then moved back and forth over the gelatine sheets until they have been pressed firmly together and all air excluded from between them. It will be recognized that this operation is similar to putting the gelatine sheets 26 and 28 through a conventional wringer.

After the air has thus been expressed from between the two gelatine sheets 26 and 28 the rolling apparatus is removed from over top of the gelatine sheets, the upper frame 22 is then positioned in operative relation over the gelatine sheets and the clamping members 34 applied to firmly hold the frames 20 and 22 together and securely clamp the sheets 26 and 28 together about their marginal portions only.

The two gelatine sheets having been marginally clamped together with all air discharged from between them, it is now necessary to introduce between the gelatine sheets the fluid medium with which it is desired to fill the capsules and this without puncturing either of the sheets or permitting any air to find its way between them during the operation. A satisfactory method and means for accomplishing this is illustrated in Figs. 1 to 5, inclusive. It will be understood at this point that although the medium with which the capsules are to be filled has heretofore been referred to as "capsulating fluid", "fluid medium", or "fluid material", the term as herein employed will be understood to include material of a highly viscose nature as well as highly mobile liquid, as one advantage of the present invention is that material approaching a plastic condition may be employed as a filler material whereas it would be commercially impossible to use such materials in conventional practice.

To permit filling of the gelatine sheets 26 and 28 while clamped within the frames 20 and 22 one of the frames, shown as the frame 22 by way of illustration, is provided with a thickened marginal portion 60 at one point thereon and this portion is provided with a gateway or opening 62 therethrough opening on to the clamping edge of the frame 22 at that location. The outer walls of this gateway 62, as best illustrated in Fig. 5, are formed to provide a dovetail recess 64 within which a gate or closure member 66 is vertically slidably received. As illustrated in Fig. 4, the lower end of the gate 66 is projected inwardly into the plane of the main wall of such side of the frame, as at 68, so that when pressed downwardly it effects a continuation of the lower edge of the frame 22 over the width of the gateway or recess 62. A pair of suitably anchored leaf springs 70 are mounted on the frame 22 and acts on the upper end of the gate 66 to constantly press it downwardly. The upper end of the gate 66 is preferably outwardly flanged as illustrated in Figs. 1 and 2 in order to limit downward movement of the gate 66 under the influence of

the springs 70 by engagement of the flanges with the upper face of the second portion 60.

Rotatably mounted above the gate 66 as by means of a pin 72 carried by the frame 22 is an eccentric 74 provided with an operating handle 76. As will be readily understood, by suitable rotation of the eccentric 74 the gate 66 may be positively forced downwardly with respect to the frame 22 and securely retained against inadvertent retraction. Rotation of the eccentric 74 through 180 degrees from the position illustrated in full lines in Figs. 1 and 2 to the position illustrated in dotted lines in Fig. 2 will permit the gate 66 to be raised against the force of the springs 70 as will be apparent. As illustrated in Fig. 4 the outer lower corner of the gate 66 is outwardly and upwardly beveled as at 78 for a purpose which will hereinafter be described.

In inserting the filling medium between the gelatine sheets 26 and 28 when in assembled relationship within the frames 20 and 22 as illustrated in Fig. 2, a hollow needle, preferably of a relatively flat nature, such as shown at 80 in Fig. 4 may be employed. The needle 80 may be connected with any suitable or conventional manner to a source of supply of the fluid medium with which it is desired to fill the space between the sheets 26 and 28, such source preferably including some suitable mechanism such as a pump or the like which will deliver predetermined or measured quantities of the fluid when suitably actuated. In inserting the filler fluid between the sheets 26 and 28 the eccentric 74 is rotated to the position shown in dotted lines in Fig. 2, sufficient fluid is passed through the needle 80 to exclude all air therefrom, the needle 80 is inserted between the margins of the sheets 26 and 28 immediately below the closure 66 (the beveled edge 78 of the closure 66 facilitating such entry of the needle 80) and then the needle 80 is forced to the interior of the frames 20 and 22 between the sheets. The gate 66 is forced upwardly against the force of the springs 70 during the above described operation but the pressure of the closure 66 causes the gelatine sheets 26 and 28 to conform to the shape of the needle 80 and eliminate any possibility of the entrance of air to between the sheets during this operation. The supply means is then operated to force the desired amount of fluid material through the needle 80 to between the sheets 26 and 28, and after the desired amount of such fluid has been inserted the needle 80 is withdrawn and the eccentric 74 operated to force the closure 66 downwardly into proper clamping relation with respect to the cooperating marginal portions of the sheets 26 and 28 and to effectively lock it in place. By this means the proper amount of fluid material is inserted between the sheets 26 and 28 and the margins of the sheets are effectively sealed against the escape of fluid therefrom when the material between the sheets is thereafter placed under a material positive pressure as will hereinafter be more fully described. The sheets 26 and 28 filled with fluid as above described are best illustrated in Fig. 7 in which the filler fluid or medium is designated at 84.

It will, of course, be understood that the steps of operation above described are carried out entirely separately and independently of the press and dies which are intended to operate upon the liquid filled gelatine sheets 26 and 28 to form from them a plurality of soft elastic capsules, and while steps of operation thus far described are capable of being used with, and the apparatus capable of being adapted to, existing or conventional press die structures with great advantage, a further improvement in existing die structures is desirable to realize further advantages of the present invention.

Referring now to Figs. 7 to 12, inclusive, my improved press and die structure includes a press table 90 the upper surface of which is substantially flat and which is centrally provided with an opening 92 conforming in plan view to the shape of the frames 20 and 22 but of slightly smaller dimension than the external dimensions of the frames 20 and 22 so that the frames 20 and 22 may be positioned centrally of the opening 92 with the lower edge face of the frame 20 resting on and supported by the upper margins of the opening 92. The upper face of the table 90 about the margins of the opening 92 is provided with a bead or flange 94 forming shoulders within which the lower margin of the frame 20 is received so as to accurately locate the frames 20 and 22 centrally of the opening 92. While any suitable means may be provided for actuating the following described die assemblies hereinafter explained, a particularly simple form of mechanism suitable for effecting the desired movements is shown by way of illustration. The table 90 at each end thereof is provided with a vertical wall 96 projecting both above and below it. The upper extremity of the upwardly projecting portions of the walls 96 and the lower extremities of the downwardly projecting portions of the walls 96 are each formed to provide a bearing 98, and rotatably mounted between each pair of bearings 98 is a shaft 100 extending across the press centrally of the opening 92. Rigidly secured against relative rotation to each shaft 100 adjacent each wall 96 is a cam assembly including three cams 102, 104 and 106 each slightly offset from the next. The shafts 100 may be connected together for equal rotation in any suitable manner, the particular means shown by way of illustration comprising sprockets 108 fixed to corresponding ends of the shafts 100 and suitably connected together by means of a chain 110. One of the shafts 100 may be rotated in any desired manner such, for instance, as the pulley 112 fixed thereto and co-operating belt 114 driven by a suitable source of power. Each wall 96 above the table 90 and preferably centrally of the frames 20 and 22 is provided with a pair of laterally spaced inwardly projecting supporting brackets 116 in each of which is rigidly fixed a vertically extending and preferably cylindrical guide post 118, as best illustrated in Figs. 7 and 12, which serve to guide the various die parts in their vertical movement as will hereinafter be more fully explained. Inasmuch as these die parts are in two main assemblies, one above and one below the central plane between the frames 20 and 22 and both of these assemblies are identical in contruction and are actuated through corresponding cams 102, 104 and 106 simultaneously toward and from one another, the construction of one die assembly only will be described in detail, such description sufficing for a description of both die assemblies. The upper die assembly will be particularly referred to, for ease of description, so that when, for instance, the lower face of a die part is referred to, it will be understood that the corresponding part in the lower die assembly will have a corresponding and opposed upper face.

Each die assembly comprises three main parts indicated generally at A, B and C respectively. The die part A comprises a base portion 120 and a body portion 122 preferably but not necessarily

formed integrally therewith. The outer marginal portions of the base plate or portion 120 suitably supports a pair of rollers 124 each of which lies in contact with its corresponding cam 102 and the base portion 120 is formed to suitably and slidably engage the guide posts 118 which serve to guide it in its vertical movement. The body portion 122 is provided with a plurality of vertically extending openings 126 therethrough. The openings 126 may be of any desired contour but will usually follow the contour of the capsule which is to be formed by the die, for instance in the present case, considering the capsule to be formed to be spherical, the openings 126 will be of a cylindrical nature. Inasmuch as the openings 126 correspond with the position of the capsules which are to be formed in the die there will be one opening 126 in each die assembly for each capsule to be formed, and for the purpose of obtaining the greatest number of capsules per die area the various openings 126 will be in regimented relation in the body portion 122. In this respect it may be noted that the particular arrangement of die structures shown is constructed to produce but ten capsules per cycle of operation, this being for the purpose of simplicity in the drawings and explanations, but it will be understood in practice that the number of capsules formed in each cycle of operation of the press will correspond to the number of capsules formed per cycle of operation of a press in conventional construction, usually somewhere between 200 and 300 capsules per cycle, it being understood that the number of capsules formed each cycle of operation is merely a matter of choice. It will be noted that each opening 126 is shouldered midway between its ends as at 128, this being for a purpose which will hereinafter be described.

The die part B comprises essentially a base 130 embracing and suitably guided in its vertical movement by the posts 118. Its outer marginal portions are each provided with a roller 132 which bears against the corresponding cam 104. The central portion of the plate 130 is provided with an opening 134 in axial alignment with each opening 126 in the body portion 122 of the die part A. In each opening 134 is fixed, as by threading or the like, a downwardly projecting tubular member 136 of a contour corresponding to the contour of the corresponding opening 126 and of a size and shape to be closely but vertically slidably received therein. Each tubular member 136 is provided in its central body portion with a shoulder complementary to and engageable with the shoulder 128 in the corresponding opening 126, and when said shoulders are in engagement with each other the operative or lower end of each tubular member 136 lies in substantially flush relationship with the operative or lower face of the main body portion 122 of the die part A as illustrated in Fig. 7. The operative face of each tubular member 136 is provided with an enlarged recess 138 opening on to the operative face thereof, the recesses 138 being of a horizontal section corresponding in contour to the shape of the capsule to be formed and of a size corresponding to the size of such capsule. The recesses 138 in other words correspond to the forming recesses in conventional die structures and during certain phases of operation of the die structure, as will hereinafter be more fully explained, provides for the expansion of a gelatine sheet thereinto during the formation of the capsules.

The die part C comprises a base plate or member 140 suitably guided for vertical movement by the posts 118 and the outer marginal portions of which are provided with a pair of rollers 142 each of which lies in engagement with its corresponding cam 106. The plate 140 is provided with an opening 144 in axial alignment with each of the openings 134 and 136 in the die parts B and A respectively and in each of the openings 144 is fixed a downwardly extending member 146 which closely fits but is vertically slidably received within each tubular member 136. The lower or operative end of each member 146 within the corresponding recess 138 in the tubular member 136 is provided with a head 148 of a size and shape complementary to the cross-sectional size and shape of the recess 138 but of a depth substatnially less than the depth of the corresponding recess 138 as indicated. The heads 148 of the members 146 serve as temporary filler members in the operative ends of the recesses 138 as will hereinafter be more fully explained, and, accordingly, during the initial stages of each cycle of operation of the press the heads 148 are arranged to lie in flush relationship with respect to the operative faces of the tubular members 136 and of the body member 122.

A coil spring 150 surrounding each post 118 is maintained under compression between the base plate 120 of the die part A and the opposed face of the corresponding bracket 116 and these springs 150 constantly maintain the corresponding rollers 124 in contact with the periphery of the corresponding cam 102. Additional coil springs 152 surround each post 118 between the plates 120 and 130 of the die parts A and B respectively and are constantly maintained under compression between such plates. The springs 152 are of less strength than the springs 150 and, accordingly, constantly urge rollers 132 upwardly into constant contact with the periphery of the corresponding cam 104 without disturbing the constantly contacting relationship between the rollers 124 and the corresponding cams 102. The opposed faces of the plates 130 and 140, concentric with each corresponding pair of openings 134 and 144, are counterbored and receive therein a coiled spring 154 maintained under compression so as to constantly urge the rollers 142 into contact with their respective cams 106. The springs 154 being weaker than either the springs 152 or 150 constantly maintain the rollers 142 and cams 106 in contact with each other without disturbing the contacting relationship between the rollers 132 and their cams 104 and the rollers 124 and the cams 102.

In the position of the parts as illustrated in Fig. 7 all of the die parts are withdrawn and in their normally inoperative positions in which the rollers 124, 132 and 142 lie in engagement with the low points of their respective cams, in other words those points of the respective cams having a minimum radius, as best illustrated in Fig. 8. Referring now to Fig. 8 it will be noted that the cam asemblies rotate in the direction of the arrow. The die assemblies and the respective parts A, B and C thereof will, of course, move and be positioned in accordance with the angular movement of the cam assembly and for the purpose of ease of description it may be considered that the first or initial movement of the dies occurs during an angular movement of the cam asemblies equal to the angle D in Fig. 8, the second phase of operation occurs during an angular movement of the cam assemblies represented by the angle E, the third phase of die movement occurs during rotation of the cam assemblies through an angle F,

and the final phase of die movement occurs through rotation of the cam assmblies through an angle G. These angles D, E, F and G may vary in accordance with the desires of the individual designer but as a matter of illustration only in the embodiment shown the angle D is approximately 150°, the angle E approximately 90°, the angle F approximately 90°, and the angle G approximately 30°. The operative surfaces of all the cams 102, 104 and 106 are equally spaced from each other measured radially of the shaft 100 over the angles G and E, the operative surfaces of the cams 102 and 104 are equally spaced from each other radially of the shaft 100 over the angles G, D and E. The operative surfaces of the cams 102 and 104 and of the cams 104 and 106 may be equally spaced from each other radially of the shaft 100 over the angle F if desired, but at least the spacing between the operative surfaces of the cams 104 and 106 should not decrease over such angles nor should the radial distance between the operative surfaces of the cams 102 and 104 materially increase over such angle.

Accordingly, during the first phase of movement of the aparatus, namely that phase during which the cam assemblies turn through the angle D, the cams 102, 104 and 106 operate to advance the die parts A, B and C of each die assembly at a uniform rate towards the opposite or opposed die asembly. As soon as each cam assembly has rotated through the angle D the corresponding roller 142 will have reached the shoulder 160 of such cam and thereupon will permit the springs 154 to retract the coresponding plate 140 and members 146, moving the heads 148 of the members 146 to the bottom ends of the corresponding recess 138 and thus render such recesses operative. Continued movement of the cam assemblies over the angle E, however, will continue to advance each die part A and its corresponding die part B at the same rate of movement so that the operative faces thereof will be maintained in flush parallel relationship during such phase of movement. The cam 106 of each assembly will preferably act upon the corresponding roller 142 to advance the corresponding plate 140 and die part C simultaneously therewith although it will be recognized that this is unnecessary in the broadest sense of the word because bottoming of the heads 148 of the members 146 in the recesses 138 will draw the plates 140 and die parts C simultaneously along with them although now in spaced relation with respect to the corresponding plate 130. It may also be noted at this point that although it is desirable that the cams 102 and 104 be so formed as to insure equal movement of the die parts A and B, control of the movement of the die part A only will cause the corresponding positive movement of the corresponding die part B during the phases D and E because of the inter-engagement of the shoulders 128 in the openings 126 and co-operating shoulders on the tubular members 136 during these phases of movement.

At the end of the phase of movement through the angle E the rollers 124 will drop off the shoulder 162 on their corresponding cam 102 whereupon the springs 150 will retract the die part A from the position which it has thus far been advanced and will thus leave the operative faces of the tubular members 136 surrounding the recesses 138 projecting outwardly beyond the corresponding operative faces of the corresponding body member 122. Continued rotational movement of the cam assemblies through the phase of angle F will continue to advance the various assemblies A, B and C in the positions which they have thus assumed. The construction and arrangement of the cams and die parts are, of course, so constructed and arranged that when die assemblies have completed their movement through the phase F, or angle F of cam movement, the operative faces of the members 136 of each die assembly will come into matching and contacting relationship with the corresponding faces of the corresponding and aligned members 136 in the opposite die assembly, this constituting the final step of operation necessary to sever the individual capsules from the gelatine sheets as will be readily understood by those skilled in the art. As soon as the phase of operation indicated by the angle F has been completed the rollers 124 and 132 will encounter their respective shoulders 164 and 166 on their respective cams 102 and 104 and will again be projected to the low points on the cams during movement of the cam assemblies through the angle G, thus returning all of the parts to their initial or normally inoperative position.

Means are preferably provided for controlling the operation of the above described press so that when once started it will operate through one complete cycle of operation, and then stop. As illustrative of such means switch 170 shown in Fig. 7 may be provided for controlling the flow of electrical energy to an electric motor (not shown) which, directly or indirectly, drives the belt 114. A suitable handle such as 172 may be provided for closing the circuit through the switch 170 so as to initiate each cycle of operation of the press and the switch may be provided with a headed rod such as 174 engageable with a lug (not shown) on the rim of the pulley 112 so that when the head of the rod 174 is engaged by the lug it will move the switch 170 to open circuit position. Thus each time the operator desires to operate the press he will actuate the handle 172 and as soon as a complete cycle of operation is completed the movement of the various parts will automatically be brought to rest.

With the arrangement of parts as above described and the various cycles of operation of the press understood, the manner in which the die assemblies act upon the gelatine sheets 26 and 28 with the liquid 84 confined between them during the various phases of operation of the die mechanism will now be described. It will be assumed, of course, that the gelatine sheets 26 and 28 have been clamped between the frame members 20 and 22, the frame members clamped together by means of the clamping members 34, and the sheets 26 and 28 have been filled with the fluid medium 84 and the gate 66 securely locked in place and the entire assembly positioned in the press in the manner illustrated in Fig. 7. It will also be assumed that all of the parts of the die assemblies are arranged in a normal inoperative position relative to one another and to the press as illustrated in Fig. 7 as is necessary to permit insertion and/or removal of the assembled frames 20 and 22 and such parts as may be carried thereby. With the die mechanisms in their normally inoperative positions it will be understood that the operative faces of the tubular members 136 and operative faces of the heads 148 of the members 146 lie in flush relationship and the operative faces of the main body portion 122 of each die part A lies in substantially flush relationship with the operative

faces of the members 136 and heads 148, although the operative faces of the portions 122 may, under certain conditions, project slightly in advance of the operative surfaces of the members 136 and heads 148 during certain stages of operation for a reason which will hereinafter be more specifically pointed out. In any event it is to be understood that the operative faces of each die assembly when the die assemblies are in their inoperative positions and during the first phase of movement thereof which ocurs through the angle D of the cam assemblies, are in flush or substantially flush relationship so as to present a substantially flat and unbroken surface.

During the above described first phase of movement of the die parts the operative surfaces of the two die assemblies uniformly approach the central plane dividing the frames 20 and 22 and toward the end of such phase of movement engage the outer faces of the gelatine sheets 26 and 28 and urge them toward one another. Obviously this pressure on the sheets 26 and 28 places the fluid medium 84 therein under pressure and tends to form the liquid 84 into a layer of liquid of uniform thickness throughout the width and length of the central openings in the frame members 20 and 22. Because of the fact that the gelatine sheets 26 and 28 are more or less flexible and stretchable the marginal portions thereof immediately inwardly of the inner surfaces of the frames 20 and 22 are caused to stretch or give to accommodate the shape which the fluid medium 84 is attempting to assume under the pressure of the dies with the result that the gelatine sheets 26 and 28 around their marginal portions are deformed to the shape indicated in Fig. 9 in which, as indicated, the gelatine sheets and their filling liquid are caused to substantially completely fill all of the available space between the two die assemblies over the full cross-sectional areas of the openings in the frames 20 and 22. This operation of the die assemblies thus effects an even and complete distribution of the capsulating fluid or fluid medium 84 over the faces of all of the recesses 138 in which the capsules are to be eventually formed, so that when the capsules are formed there will be available to each and every capsule forming recess an equal amount of fluid medium for the capsule formed therein. This feature overcomes the waste in conventional constructions previously described in which the marginal capsules are often undersized to such an extent as to render them unmarketable, and this feature therefore entirely avoids the waste occasioned by such undersized capsules.

It may be noted that inasmuch as the die assemblies accurately fit the interior walls of the frames 20 and 22 during the above described operation they simulate the action of a piston in a cylinder and in order to avoid any ill effects that might otherwise be occasioned by the entrapment of air between the operative faces of the die assemblies and the gelatine sheets 26 and 28, vent openings such as 180 are preferably formed through the main body portion 122 of each die parts A to permit the escape of such air to the atmosphere. Similar vent openings 182 extending axially through the members 146 may also be provided for the same purpose as well as to permit the escape of air entrapped between the bottom of the corresponding recesses 138 and the capsule being formed therein during the second and third phases of movement as will hereinafter be described. The vent openings 180 are of a sufficiently small size as to prevent any material deforming of the sheets 26 and 28 thereinto during the various phases of operation during each cycle. During the first phase of operation through rotation of the cam assemblies to the angle D previously described the opposing operative faces of the die assemblies have each simulated a flat imperforate surface which engage opposite sides of the gelatine sheets 26 and 28 and apply pressure thereto to evenly distribute the fluid 84 therebetween over the entire cross-sectional area of the openings in the frames 20 and 22, as illustrated in Fig. 9.

It will be understood, of course, that the relation of the parts shown in Fig. 9 occurs upon completion of the phase of movement D of the cam assemblies and that as soon as such phase of movement is completed the various rollers 142 will drop off their corresponding shoulders 160 at the initiation of the second phase of movement through the angle E of the cam assemblies. Immediately the rollers drop off the shoulders 160 the die parts C are retracted by the springs 154 and withdraw the heads 148 of the members 146 in the capsule forming recesses 138 of the various members 136, as illustrated in Fig. 10, and thus render these recesses 138 receptive to the entrance of the corresponding gelatine sheets 26 and 28 thereinto under the pressure to which the capsulating fluid 84 has been subjected, together with a corresponding amount of such fluid.

During this second phase of movement of the die assemblies corresponding to movement of the cam assemblies through the angle E, the operative faces of the die parts A and B of each die assembly will continue to advance in flush or substantially flush relationship, tending to place the fluid 84 under a continually higher pressure. This continuing higher pressure on the fluid 84 serves to squeeze the fluid 84 from between the opposed faces of the die assemblies except over the exposed areas of the forming recesses 138 only, until the opposed faces of the gelatine sheets 26 and 28 are brought into actual contact with each other except over the areas of the recesses 138. This movement of the die assemblies in bringing the opposed faces of the sheets 26 and 28 into contact will squeeze all of the capsulating fluid 84 from between the gelatine sheets 26 and 28 except over the areas of the recesses 138 and into which areas such fluid is expressed and where it continues to expand the gelatine sheets 26 and 28 into the corresponding recesses. It may be mentioned at this point that in some instances at least it may be desirable, as previously mentioned, that the operative faces of the main body portions 122 of the die parts A are slightly in advance of the operative faces of the cooperating members 136 so that the gelatine sheets 26 and 28 will actually contact each other over the operative faces of the main body portion 122 slightly in advance of actual contact of the gelatine sheets 26 and 28 over the operative edge faces of the members 136, but followed by actual contact of the sheets 26 and 28 over the operative edge faces of the members 136, thereby positively insuring against the entrapment of any liquid between the gelatine sheets 26 and 28 over the area of the operative faces of the main body portions 122, or at least facilitating the expression of the capsulating fluid 84 from between such areas. As previously mentioned, as the sheets 26 and 28 expand into the recesses

138 the air in such recesses is vented through the vent openings 182 in the members 146.

When the parts have completed the second phase of operation just described it will be understood that they have assumed the positions indicated in Fig. 10 and it will also be understood that at the completion of this phase of operation all the capsulating fluid 84 has expressed to within those areas of the sheets 26 and 28 located within the various individual areas of the forming recesses 138, and the opposed operative faces of each pair of members 136 have clamped the gelatine sheets 26 and 28 together about the margin of each opposed pair of recesses 138 with sufficient pressure to thereafter prevent the escape of the capsulating fluid 84 from such recesses.

At the completion of the second phase of operation above described and at the initiation of the third phase of operation represented by movement of the cam assemblies through the angle F in Fig. 8, the rollers 124 drop off the cam shoulders 162 and accordingly the operative faces of the main body portions 122 of each die part A are retracted relative to the operative faces of the corresponding members 136 and at the same time the die parts B continue to move inwardly toward one another until at the completion of this third phase of movement the opposed faces of opposed members 136 squeeze those areas of the gelatine sheets 26 and 28 from between them and sever such gelatine sheets about each opposed pair of recesses 138, this operation as is well understood by those skilled in the art, causing those portions of the gelatine sheets 26 and 28 now expanded in each opposed pair of recesses 138 to be welded together about their contacting margins and confining the entrapped body or capsulting fluid 84 therein, thus completing the formation of the capsules. The reason that the die parts A are withdrawn during this third phase of movement is that the operative faces of the members 138 in squeezing the gelatine sheets from between them require space for that portion of the gelatine sheets not actually going into the various capsules to be received during the final phase of operation. It will be understood by those skilled in the art that in retracting the die parts A during this last described or third phase of operation the same effect is provided as in conventionally formed dies by the relief which surrounds the marginal flanges or cutting edges provided about each die recess.

As will be readily understood, upon completion of this third phase of operation represented by movement of the cam assemblies through the angle F indicated in Fig. 8, and previously described, the rollers 124 and 132 drop off their corresponding shoulders 164 and 166 and the various springs are thus free to move both die assemblies back to their normally inoperative position. This is accomplished during movement of the cam assemblies through the angle G illustrated in Fig. 8 at the end of which the cycle of operation is completed and the movement of the press stops, upon which the frames 20 and 22 with the waste net carried thereby may be removed from the machine, and formed capsules which now rest upon the flat face of the lower die assembly may be swept off, another set of frames 20 and 22 with the liquid filled gelatine sheets assembled between them as illustrated in Fig. 7 inserted in the press, and the cycle of operation repeated.

It will be understood from the above described operations during the various phases of movement of the die assemblies described upon the liquid filled gelatine sheets to form the completed capsules two separate and distinct phases of the present invention are realized, either one of which may be used independently of the other with great advantage, although it is preferable to combine both. The first of these phases is the blocking of the forming recesses until such time as the body of capsulating fluid between the gelatine sheets has been placed under a material pressure whereby to evenly distribute the capsulating fluid throughout the full effective areas of the sheets 26 and 28. The second phase of the invention is accomplished by maintaining those areas of the operative faces of the dies outside of the actual cutting edges for the individual die recesses in flush or substantially flush relationship until all of the liquid between the sheets, except over the die recesses, has been expressed from between the sheets. The first phase of the invention just described insures uniformity of liquid content of all of the capsules throughout the length and width of the dies and including the marginal capsules, and the second phase of the invention just described eliminates the entrapment of any of the capsulating fluid in the net resulting in the forming operation and eliminating the necessity of thereafter separating capsulating fluid from the gelatine sheets in the net. Both of these phases of the present invention effect a material saving in the manufacture of the capsules described. It will also be understood that these two phases of the invention just described are also independent of that phase of the present invention involving the arrangement, sealing and filling of the gelatine sheets entirely independent of the press in which the capsules are to be formed and which, as previously described, enables the production capacity of a given press to be increased many fold over conventional methods of manufacture.

Formal changes may be made in the specific embodiment of the invention described without departing from the spirit or substance of the broad invention, the scope of which is commensurate with the appended claims.

What I claim is:

1. In the manufacture of soft fluid filled elastic capsules by confining a body of fluid medium between a pair of soft elastic sheets of such character as to be self-sealing under pressure and subjecting said filled sheets to a die pressing operation, the steps of assembling a pair of said sheets in superposed and matching relationship, excluding all air from between said sheets, sealing the marginal portions of said sheets together, inserting a desired amount of fluid medium between said sheets, all at a point relatively remote from the point of actual die pressing operations, and then transporting said assembled, sealed and filled sheets to the actual point of die pressing operation and subjecting them to a die pressing operation.

2. In the manufacture of soft fluid filled elastic capsules by the use of relatively soft elastic sheets of such character as to be self-sealing under pressure; the steps of subjecting a pair of such sheets confining a body of fluid medium therebetween to pressure from opposite sides thereof by a pair of opposed substantially flat surfaces, then relieving the pressure over certain areas of

said surfaces, and thereafter forcing said sheets together except over said areas and severing them about the margins of said areas.

3. Apparatus of the type described comprising a frame member, means for supporting said frame member, means providing a surface substantially flush with and filling the internal area of said frame member, roller means movable over the upper surface of said frame member and said filler means, and means for guiding said roller means in its movement.

4. Apparatus for use in the manufacture of soft fluid filled elastic capsules or the like comprising, in combination, a pair of movable die parts each provided with a plurality of forming recesses in the face thereof, a filler member positioned in each of said recesses having a face movable to a position substantially flush with the margins of the corresponding recess and to a position out of flush relationship therewith, and means for effecting relative advancement of said die parts toward one another so constructed and arranged as to position said faces of said filler members in flush relationship with respect to the margins of said recesses, during said advancing movement and until said die parts are in closely adjacent relationship with respect to each other, then automatically retracting said filler members out of flush relationship with said faces, and then automatically further advancing said die parts to contact with each other.

5. Apparatus for use in the manufacture of soft fluid filled elastic capsules comprising a die assembly including three relatively movable die parts one of said die parts formed to provide a plurality of forming recesses in the operative face thereof each marginally surrounded by a cutting edge, a second of said die parts being formed to provide a plurality of members operable in said recesses each providing a temporary filler means for the corresponding of said recesses, and the third die part formed to provide a filler means between the marginal cutting edges of the various recesses, and means to operate said die parts so as to render all of said filler means effective or ineffective during various phases of operation of said die assembly.

6. In the manufacture of soft fluid filled elastic capsules by subjecting a body of fluid confined between a pair of gelatine sheets to a die pressing operation between a pair of forming dies; the steps of assembling, filling and sealing the marginal edges of the sheets together independently of said forming dies and thereafter inserting the assembled, filled and sealed sheets between said forming dies and subjecting them to a die pressing operation therebetween.

7. In the manufacture of soft fluid filled elastic capsules by subjecting a body of fluid confined between a pair of gelatine sheets supported in a multi-part clamping frame to a die pressing operation between a pair of forming dies permanently associated with a press; the steps of assembling and filling said fluid filled sheets and clamping the margins thereof together between said frame parts independently of said forming dies, and thereafter placing said frame parts with said fluid filled sheets clamped therein between said forming dies and subjecting said fluid filled sheets to a die forming operation therebetween.

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