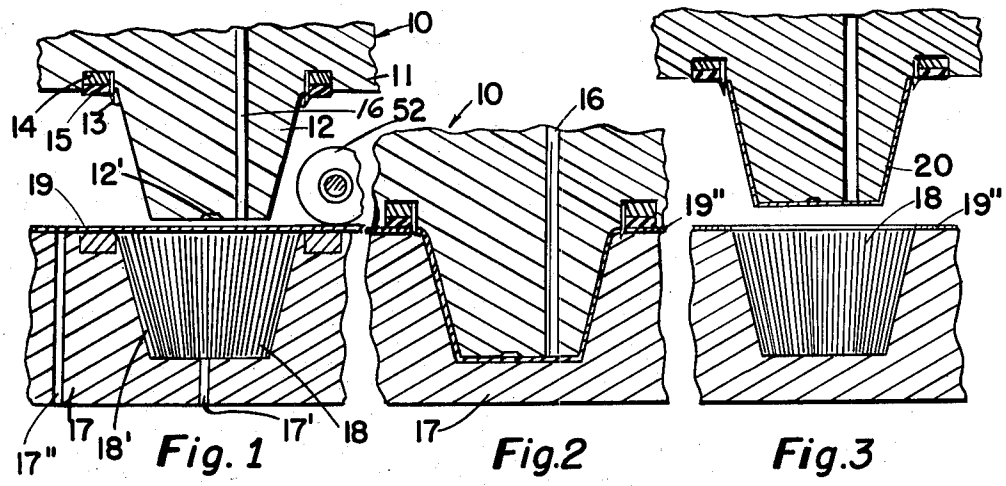
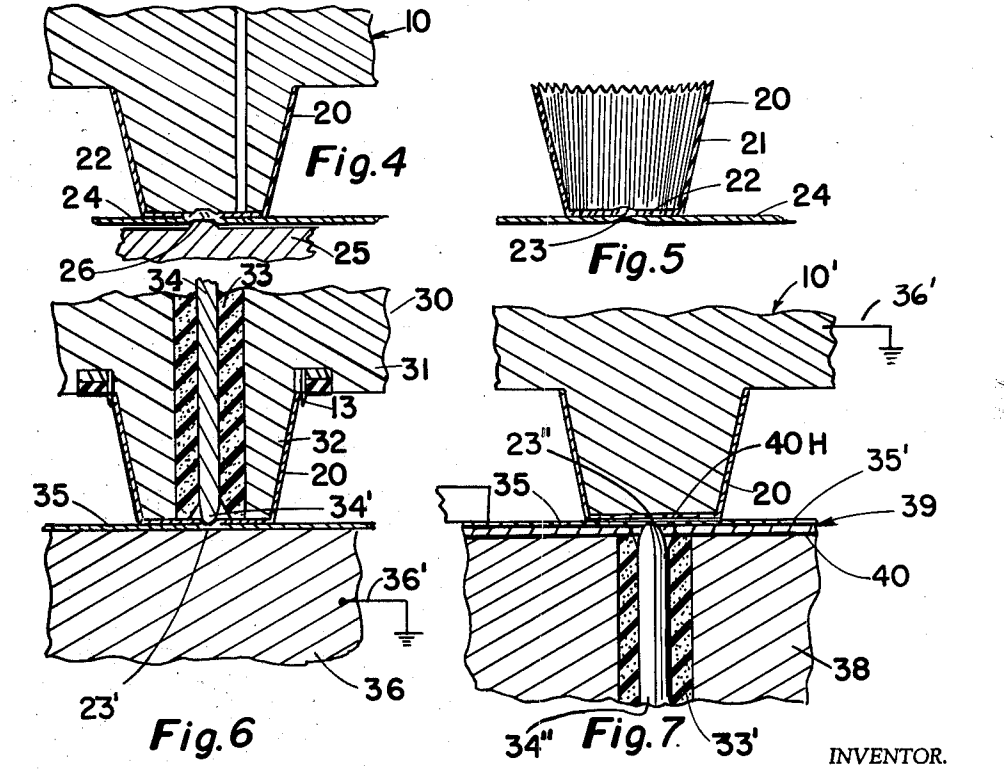
April 5, 1966 J. H. LEMELSON 3,244,082

PACKAGING MACHINERY

Filed May 21, 1962 5 Sheets-Sheet 1





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Jerome H. Lemelson

April 5, 1966 J. H. LEMELSON 3,244,082

PACKAGING MACHINERY

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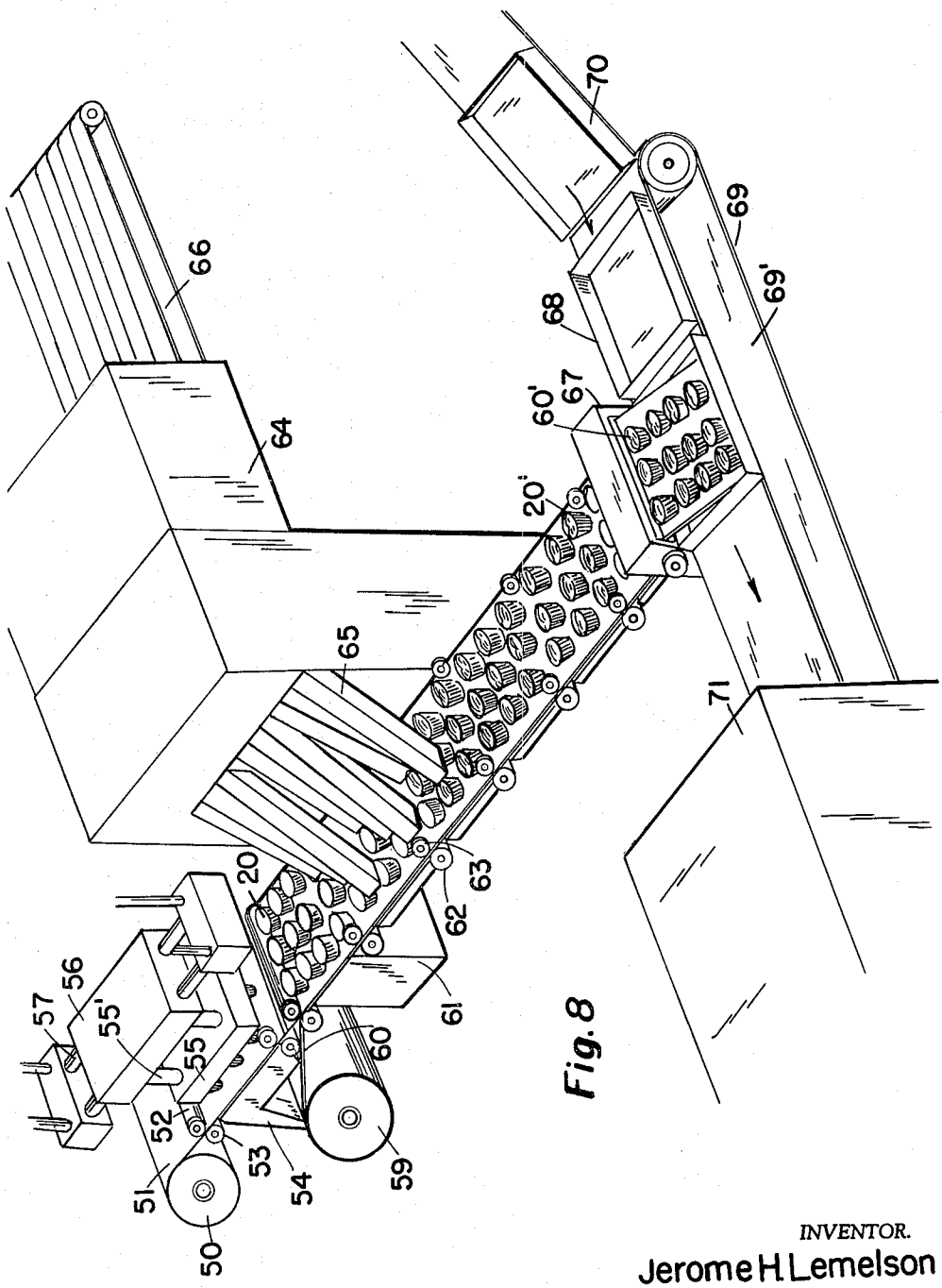


Fig. 8

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PACKAGING MACHINERY

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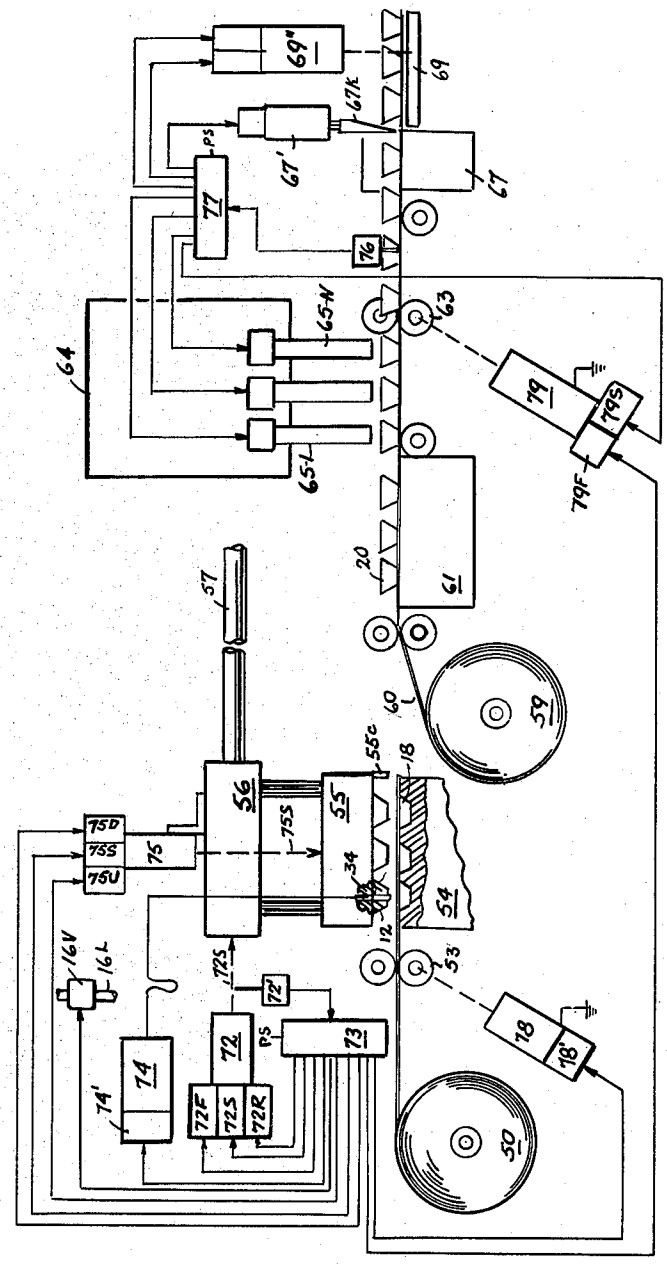


Fig. 8'

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PACKAGING MACHINERY

Filed May 21, 1962 5 Sheets-Sheet 4

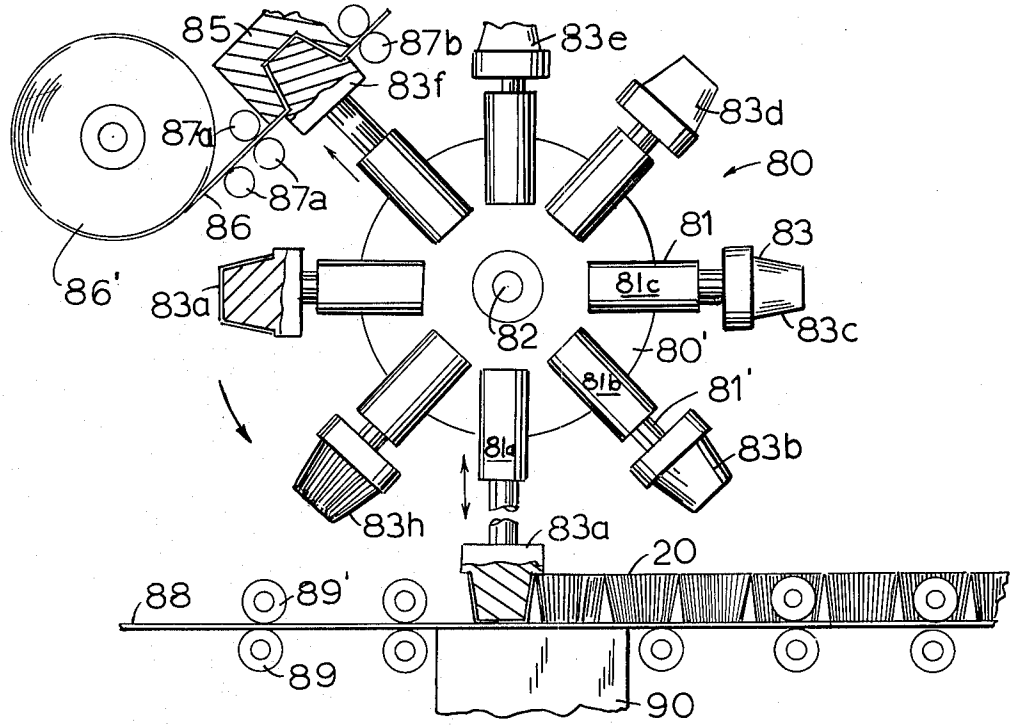


FIG.9

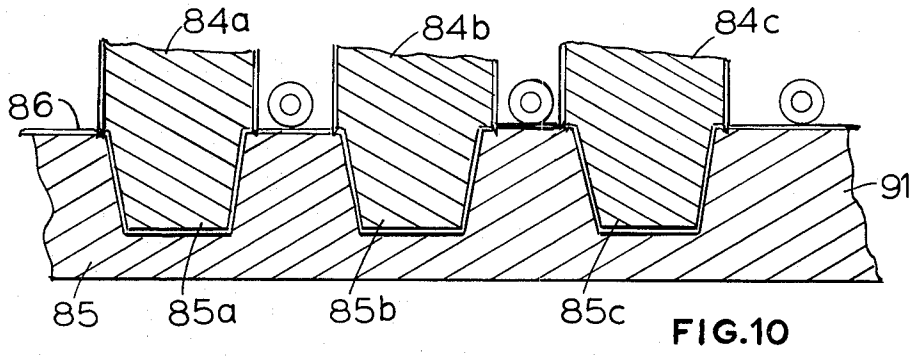


FIG.10

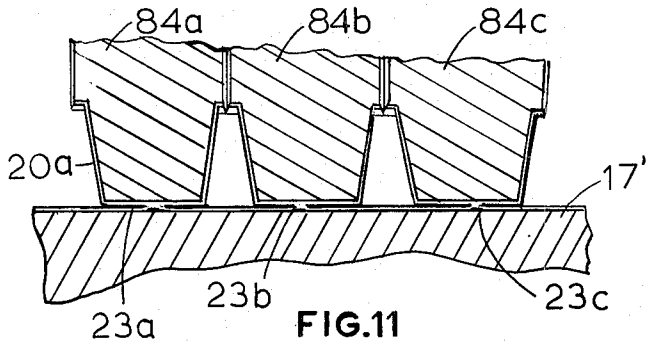


FIG.11

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PACKAGING MACHINERY

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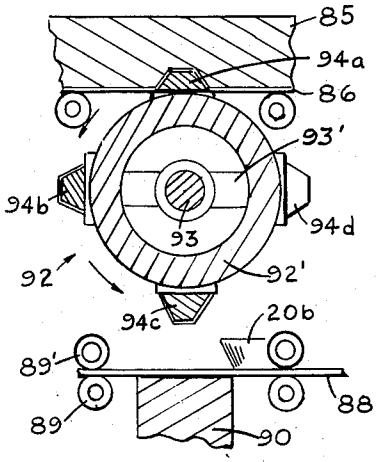


FIG.12

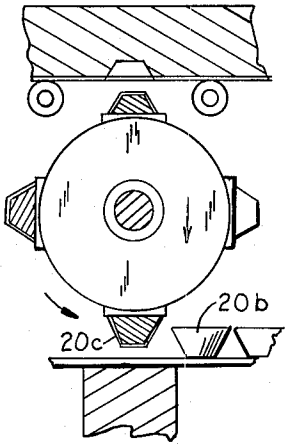


FIG.13

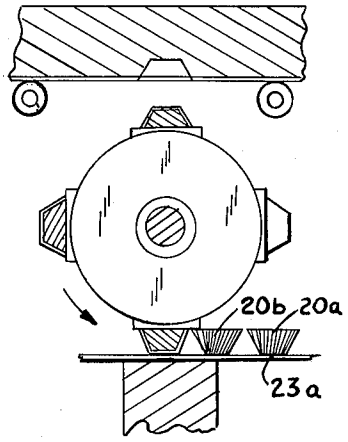


FIG.14

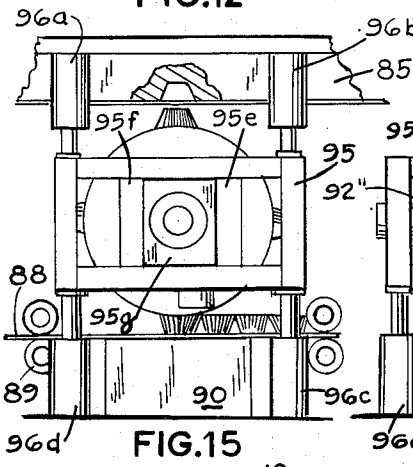


FIG.15

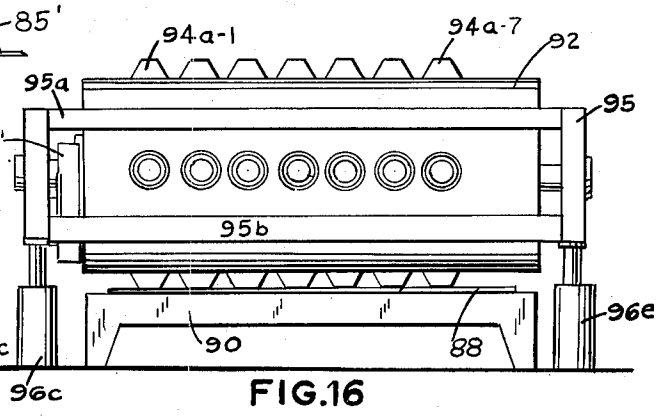


FIG.16

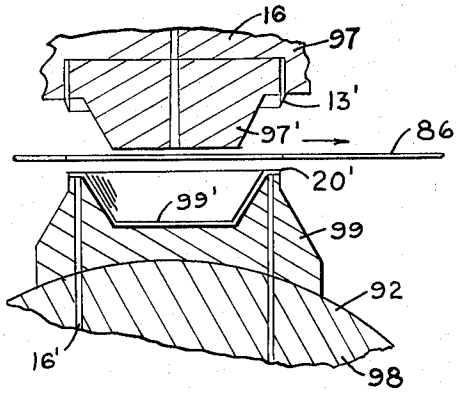


FIG.17

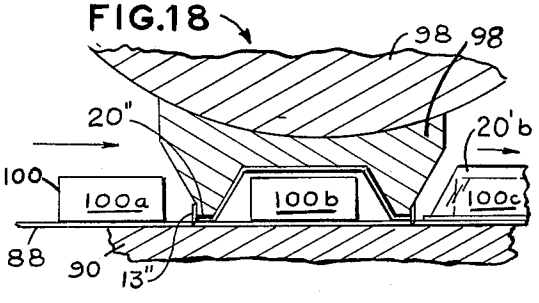


FIG.18

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United States Patent Office 3,244,082 Patented Apr. 5, 1966

3,244,082

PACKAGING MACHINERY

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Filed May 21, 1962, Ser. No. 201,231
15 Claims. (Cl. 93—47)

This invention relates to packaging machinery and is a continuation-in-part of my copending application entitled, Welding Techniques, Serial No. 519,014, filed on June 29, 1955, now abandoned, and application Serial No. 703,523 filed December 18, 1957, now U.S. Patent 3,146,492 issued on September 1, 1964, for Apparatus for Making a Lenticular Display Sheet.

In particular, this invention refers to apparatus for forming packaging structures described in my copending patent application, Serial No. 831,893, now U.S. Patent No. 3,035,382. Specifically, this invention relates to apparatus for forming and securing one or more containers or closures to part of a package or an insert for said package.

It is a primary object of this invention to provide new and improved automatic packaging apparatus.

Another object is to provide new and improved automatic sheet forming apparatus which may be used in the fabrication of improved types of packaging on an automatic basis without the need for human handling.

Another object is to provide improved package forming apparatus which includes means for automatically filling or partially filling containers or the like formed by said apparatus.

Another object is to provide automatic machinery for continuously forming sub-packages or small containers which are generally packaged in a master carton or larger containers, said apparatus including means for welding or bonding the containers to a base sheet or a wall of the master carton and the means for automatically filling or partially filling said sub-containers.

Another object is to provide improved package forming and filling apparatus which may be made to operate continuously without interruption for the manufacture of packages containing a plurality of smaller containers or sub packages which contain different materials which may be filled with said different materials by said apparatus on an automatic basis without the need for human handling of said materials.

Another object is to provide new and improved package forming and filling apparatus which may be programmed to effect the shaping and prepositioning of different sub-containers in different arrays in a master carton without the need for major adjustments to said apparatus.

Another object is to provide a new and improved machine for automatically forming a plurality of small containers of the same or different shapes and for securing said container in predetermined positions on a base sheet or carton insert which serves as a conveyor thereafter for said containers and the means for prepositioning them relative to automatic filling apparatus, said apparatus including means for automatically loading one or more of said inserts with containers thereon into a box or master carton.

Another object is to provide a new and improved design for a sheet forming die which serves the further functions of diecutting sheet formed thereby, transporting said cut and formed sheet to a second member or sheet, and welding at least part of the cut and formed sheet to said second sheet.

Another object is to provide a new and improved apparatus which includes a single fixture which may be used to perform the multiple operations of forming a first sheet of material into a cup-shaped container, diecutting the shaped container from said first sheet of material, transporting said cut container over a second sheet of material, welding said container to said second sheet of material, and at least partially filling said cup-shaped container with a predetermined quantity of another material.

The invention also consists of certain new and original features of construction and combination of parts hereafter set forth as claimed.

The nature of the invention, as to its objects and advantages, the mode of its operation and the manner of its organization, may be better understood by referring to the following description taken in connection with the accompanying drawings forming a part thereof in which:

FIG. 1 is a fragmentary detail in sectioned end-elevation of aligned sheet forming dies comprising part of the invention;

FIG. 2 shows the sheet forming dies of FIG. 1 brought together;

FIG. 3 illustrates the sheet forming dies brought apart with the component formed thereby retained by one of said dies;

FIG. 4 is a sectioned view of one of the dies of FIG. 3 in the act of welding the part formed thereon to another sheet;

FIG. 5 is a fragmentary view of the product formed by the apparatus of FIGS. 1 to 4;

FIG. 6 is an end-elevation of a fragmentary detail of an alternate design for the die of FIG. 4;

FIG. 7 is an end-elevation of a further die design replacing one of the dies of FIG. 4;

FIG. 8 is an isometric view of an automatic packaging machine utilizing components of FIGS. 1 to 7;

FIG. 8′ is a schematic block diagram of a control system for the apparatus of FIG. 8;

FIG. 9 is a side elevation of a further modification to part of the apparatus of FIG. 8;

FIG. 10 is an elevation in section of a plurality of sheet forming dies provided in accordance with the teachings of FIGS. 1 to 7;

FIG. 11 shows the dies of FIG. 10 in closer proximity with the members formed thereby being welded to a base sheet in accordance with the teachings of FIGS. 1 to 7;

FIG. 12 is a fragmentary detail of a sheet forming and welding apparatus shown in the act of forming a container from a first sheet of material;

FIG. 13 is a fragmentary detail of the apparatus of FIG. 12 with the formed sheet component removed from the female die of said apparatus;

FIG. 14 is a fragmentary detail of the apparatus of FIG. 12 shown in the act of welding the component formed thereby onto a second sheet material;

FIG. 15 is a side elevation in partial cross section showing further details of the apparatus of FIGS. 12 to 14;

FIG. 16 is an end elevation of the apparatus of FIG. 15;

FIG. 17 is a fragmentary detail in section of a modified die utilized in the apparatus of FIGS. 12 to 16 and

FIG. 18 shows the dies of FIG. 17 in the act of welding the sheet component formed thereby onto a second sheet.

FIGS. 1 to 3 illustrate in cross-section portions of a male and female die adapted to coact to form a packaging member such as an open cup from a sheet of deformable material such as plastic, metal or foil and FIG. 4 shows the male die member thereof coacting with another die in welding said cup to a second sheet material. In other words, the same die member used to shape the sheet material into a container, is also used to effect welding of said container to a second material. Such apparatus, modified in shape, may also be applied to the forming and welding of articles other than packaging con-

tainers or the simultaneous forming, die cutting and welding of two or more members from sheet metal, plastic or laminates. The resulting welded assembly is illustrated in FIG. 5 which shows a cup shaped container 20 secured by means of a weld 23 to a base sheet 24. If the sheet 24 comprises a portion of the wall of a container or a shelf portion of a box container, the weld 23 will serve to prevent movement or shifting of the cup therein and may serve as a shock absorbing means for the container and contents. The weld 23 may be of any suitable shape, although if provided as a spot weld of small area, it may retain the container 20 on 24, yet be capable of being torn or ruptured to permit removal of the container and its product by hand.

In FIG. 1 a thin sheet 19 of deformable material is provided on the surface of a platen or female die 17 and is preferably held thereon by means of rollers or other clamping means (not shown). A male die 10, part of which is illustrated, has a tapered nose 12 adapted to cooperate with the walls of a cavity 18 in a female die 17 and is adapted to shape sheet 19 therein when member 10 is advanced with nose 12 aligned with 18. Base 10 preferably contains provided thereon a row or rows of male die portions such as 12 which may be frusto-conical or otherwise shaped for forming said cups. The external surface of 12 and wall 18' of the cavity 18 may also be shaped to provide corrugations in the wall of the container 20 formed therebetween for stiffening said walls. The nose 12 and cavity 18 may be formed into any suitable shape and may be rectangular or semi-spherical. If the sheet 19 is made of a metal such as aluminum or aluminum foil, it may be easily deformed into the cavity 18 when the nose 12 advances as in FIG. 2, provided that it is not completely restrained. The sheet 19 may also be made of a plastic material or a lamination of plastic and metal foil. If the material 19 is a thermo-plastic or lamination or a thermo-plastic and foil, it may be formed into the shape illustrated in FIG. 5 by the application of heat either to the female die 19 on which it rests or by means of a radiant heater applied above the die just before 10 advances over cavity 18. In FIG. 3, the die 10 is shown retracted from 17 so that its end clears the upper surface of the female die. The cup 20 is shown held against the surface of the nose 12 and is carried therewith over a bucking member of third die 25 as illustrated in FIG. 4. The two dies 10 and 25 coact to effect a spot weld 26 between the bottom 22 of 20 and the sheet 24. The notation 17' refers to a hole through the female die 17 extending through the bottom wall of the cavity 18 to which suction pressure may be applied, which pressure may be utilized to perform either or both of two functions. The vacuum pressure applied through 17' may be utilized to hold the sheet 19 against the upper surface of die 17 and/or to assist in the formation of the cup. For example, if the sheet 19 is made of a thermo-plastic material which is in a semi-molten condition prior to the advancement of 10, the plastic over the opening in 18 will be drawn into the die, which action may be completed or partially effected before the die nose 12 advances into said cavity. The die nose 12 may therefore either be used to effect the complete formation of the cup or to coact in the final stage of its formation as well as to effect the transfer of the finished article and its welding to the sheet 24.

A plurality of die-formations similar in shape to 12 or of different respective shapes may be provided in a row or rows or in any required array on a single die-base or block 10 for simultaneous formation of a plurality of containers similar to the container 20 shown in FIG. 3 in abutment with the male die portion 12 upon removal from the cavity. The die-block 17 is provided with plural cavities such as 17 each adapted to mate with a respective male die nose. The male die-portions 12 may be provided on a rectangular block or in a cylindrical array as described hereafter. If the nose portions 12 are rectangular in cross-section rather than tapered as shown, the formed open container 20 will remain thereon due to friction upon removal of 12 from cavity 18 without the need for applying a suction pressure between the die and the cup.

The notation 12' refers to a cavity in the end of the nose portion 12 of the die 10 which may be used to perform either or both of two functions. Said cavity 12' may be utilized to coact with a pressure welding tool tip as hereafter described. It may also be shaped with outwardly tapering side-walls in a manner whereby the cup formation 20 will be held against 12 when the latter is removed from the cavity 18 in 17. The shape of 12' may be such that it will so maintain 20 against 12 when the dies separate, yet will permit the removal of 20 therefrom after the base 22 of 20 is welded or adhered to the base sheet as illustrated in FIG. 5. The cavity 12' in 12 may thus serve the dual functions of coacting in effecting the pressure welding of the base 22 of 20 to a second member and maintaining said container on the die until said weld is effected for transportation over said second member.

The male die 10 is also provided with means for trimming the resulting cup shaped container 20 from the surrounding sheet so that all that remains is a bowl with a circular rim as illustrated in FIG. 3. Said trimming may be effected by means of a circular cutting die or knife 13 which is held in an angular cavity surrounding the die nose 12 by means of a ring 14 and which projects beyond the surface of that part of 10 which surrounds the nose which is referred to by the notation 11. The notation 15 refers to an annular washer of rubber which is bonded to the face of 14 and normally projects beyond the face 11' which serves to separate the scrap material 19'' from the material of the cup 20 when the die is lifted as in FIG. 3. The notation 16 refers to a hole through the nose 12 and base 11 of the die 10 which extends to the face of the nose from a control valve (not shown) which valve is connected to both fluid suction and pressure means. Suction pressure applied on the line 16 will hold the cup formation 20 against the male die 10 as illustrated in FIG. 3 so that it will be removed thereby from the cavity and can be transported through a fastening or welding station such as illustrated in FIG. 4.

In my U.S. Patent 3,035,382, the packaging structure illustrated in FIG. 5 is provided which may comprise a plurality of cup shaped containers 20 each of which has a corrugated side wall 21 and flat bottom 22 with the bottom of each container secured to a base sheet 24 by welding or bonding by means of an adhesive or fusion of one or more heated thermo-plastic materials. The term "bond" where used hereafter shall therefore refer to securing of the container to the base or retaining sheet by means of an adhesive or welding. The base sheet 24 may comprise a wall of a master container against which a number of the smaller containers 20 are held by welding or other means and are each adapted to retain a material or other product therein. If the material contained by the cup shaped containers 20 is a single portion of foods such as a cupcake, it will quite often be desired to remove the container with the product in order to retain said product until it is eaten or otherwise dispensed of. The bottom 22 of each container is therefore removably secured to the base sheet 24 by means of an adhesive placed between the two or a spot weld such as 23 having a characteristic such that the container 20 may be removed from 24 by hand without difficulty by means of a simple pulling action thereon in which the weld 23 is broken or torn. The same male die 10 which formed the container may be utilized to effect said weld 23 in a continuing operation after it is formed without removal from the nose 12 of the forming die.

When the die 10 retracts, the spot weld 23 between the bottom 22 and sheet 24 will retain the cup 20 against 24 and separate the nose 12 of the die from said container 20. For certain applications it may be

desirable to apply a positive pressure to the duct 16 to facilitate removal of the die nose 12 from the corrugated cup 20.

A fast setting adhesive may also be applied as a spot to either or both the abutting faces of 22 or 24 which adhesive will removably retain 20 on 24 when it hardens. If a non-drying pressure sensitive adhesive is utilized, then it will be required to apply a positive pressure to the line 16 in order to separate container 20 from the nose 12 before the die is lifted therefrom, to repeat the cycle of operations.

FIG. 6 shows the design of modified dies for effecting the resistance or ultrasonic welding of the materials of the cup 20 and a base sheet referred to by the notation 35. It is assumed that the male die 30 has been used to form the cup shaped foil container by the method of FIGS. 1–3 or the like and it has thereafter advanced said container held thereon by mechanical or suction means against the upper face of 35 which is shown abutted against a flat surface of the die block 36. A bore is provided through the male die base 31 and the nose portion 32 thereof. Inserted in said bore is an insulating sleeve 33 of any suitable material which holds an electrode 34 therein having a tip 34′ which projects slightly beyond the end of the nose 32 or is movably projectable therethrough in a manner whereby it may be used to compressively engage the upper surface of the bottom of the container 20. Electrical or ultrasonic energy applied between the electrode and the platen 36 which is grounded at 36′ if generated at the correct frequency and intensity while the tip 34′ of the transducer 34 compressively engages the bottom wall of 20 against 35, may be utilized to effect a spot weld 23′ between the materials of 22 and 35. The retaining action of the weld and/or pressure applied through a bore such as 16 may be utilized to separate the die from the cup when the die 10 lifts away from 25.

Resistance or magnetostrictive welding means may also be utilized to effect a spot weld between the sub-container 20 and the base sheet 24 whereupon notations 34 would refer to a resistance or magnetostrictive welding electrode. If the materials of either 20 or 24 are thermo-plastics or are coated or laminated with thermo-plastic materials, the electrode 34 may be a resistance heating element or rod which protrudes from the end of the die nose 12 adapted to apply sufficient heat to the bottom 22 of 20 to melt said thermo-plastic material in the immediate vicinity of the electrode for effecting said spot welding.

A further modification in the apparatus illustrated in FIGS. 1 to 4 is noted, reference being made to the same drawings. It has been proposed that the duct 16 be used as a means for applying a suction or positive pressure to the container formed on the nose 12, for either maintaining it against said nose during removal from the cavity of the die 17 or helping to force it off said nose after said container has been secured to the base sheet 24. The duct 16 may also be used for the passage of a liquid or other fluid material therethrough for partially filling the container 20 after it has been secured to the base sheet 24. The liquid may be any flowable liquid which is gated through a valve which is controlled to operate either while the die 10 is in the act of retraction from the sheet 24 after the weld is effected or when 10 has completely withdrawn from the interior of the container 20. The fluid or liquid passed through 16 to be contained by the corrugated container 20 may also be used as a means for supplementing the action of separating the sheet container 20 from the nose 12 of the die. The single duct 16 may be used to perform two or more of the multiple functions described by the use of a multiple position valve in the line 16 or tubing connected thereto which communicates to a source of pressure, vacuum or pressurized liquid. A plurality of ducts 16 extending through the nose 12 of 10 may also be utilized for faster filling of the container or to each perform a respective and different of the mentioned operations.

In FIG. 1 the notation 17′ refers to a duct or passageway provided through the female die 17 and exiting on the bottom wall of the cavity 18. Positive and/or vacuum pressure may be applied to the duct 17′ for either aiding in the ejection of the container 20 or helping to form said container during the initial phase of the movement of 12 in 18. If the material 19 is a thermo-plastic which has been heated to a semi-molten condition the die 17 may be utilized as a vacuum forming mold by the application of a negative pressure to the line 17′ after the sheet 19 is heated, to draw said material into the cavity 18 prior to or as the nose portion 12 descends therein. The formation of 20 may thus be completed or partially completed by the time 12 advances into the cavity.

In a further proposed embodiment, the die-sections of FIGS. 1 to 4 may comprise injection mold-halves or mold sections for forming the section 20 by injection molding a plastic material. The notation 16 may represent the gate portion of the mold cavity which would be reduced in cross-section where it exits so that the gate will break off after the molded section 20 is secured to the base sheet as in FIG. 5 and the nose 12 is removed therefrom.

The semimolten or soft condition of the base 22 of 20 immediately after being molded or vacuum formed may be utilized in effecting a bond between said formed cup and the base sheet 24 by application of sufficient pressure between the die 10 and the members 20 and 24 against a platen or die such as 25 as shown in FIG. 4. The bottom 22 of 20 may be kept in a semimolten condition after the formation of 20 or may be heated to effect the heat welding of 22 to 24 by heating the end of 12 by conventional means just prior to or after the formation of the cup 20. A resistance heating element may be secured in the nose 12 or an electrode connected to a source of high frequency energy electronically effecting the weld 23. The spot bond may also be effected by applying a spot of pressure sensitive or drying adhesive material to the upper surface of 24 or the bottom of 22 prior to bringing the two together or by providing a heat sealable plastic such as the polyvinyl chloride composition known as Videne A on either of said surfaces and melting said plastic with heat applied to either the bottom surface of 24 or upper surface of 22.

Another welding arrangement is illustrated in FIG. 7. The cup 20 is shown formed on the nose of a male die 10′ and is shown in abutment with a sheet of material 35. The sheet 35 is shown laminated to a sheet 40 of greater thickness, the assembly or combination being referred by the notation 39. The notation 35′ refers to an adhesive between 35 and 39 provided for holding the two together as a lamination or sandwich construction. The material 40 may be cardboard or plastic and a hole 40H is provided therethrough so that an electrode 34″, which is mounted in a tubular insulator 33′ will reach the bottom surface of the sheet 35. The electrode 34″, which is secured to the press platen or die bed 38, has its tip projecting sufficiently above the upper face of 38 or is projectable therefrom so that it will compress the sheet 35 against the bottom face of 20. When electrical or ultrasonic energy is applied by means of 34″ to the face of 35 it will effect a weld between 35 and 20 and the assembly may be lifted off 38 to clear the end of the electrode 34″, or the latter retracted after welding.

It is noted that the laminated assembly or sheet 39 may be used for the base sheet of the configurations of FIGS. 4 and 6 if, where necessary, said openings 40H are provided in the sheet 40 to permit each die or welding pool to pass to the metal portion of the combination. If the material comprising 20 is a thermo-plastic mate-

rial or is coated with a thermo-plastic material then the electrodes 34 and 34'' preferably contain the necessary heating elements to effect a spot weld between two surfaces which are in abutment with each other.

The welding apparatus illustrated in FIGS. 1–7 may be applied in an integrated assembly and filling machine for the automatic assembly and filling of such products as boxed candies, baked goods such as cupcakes and the like, various types of foods such as individual portions of fresh fruits, cooked or semi-cooked foods such as vegetables, desserts, ice cream or the like. In FIG. 8 the basic components of an automatic package forming and filling machine are illustrated which utilizes part of the eventual package as a means for conveying a plurality of small containers past filling apparatus and into a shipping or master carton. In FIG. 8 a plurality of the heretofore described foil or sheet containers are simultaneously formed and are simultaneously positioned on and welded to a base sheet which is continuously fed from a roll, said base sheet acting as a conveyor for thereafter moving and prepositioning said containers relative to product filling apparatus. The base sheet with the filled or partially filled product contained in the containers welded thereon may then be passed through further processing apparatus such as a heating oven or zone, whereafter it may be further processed by cutting into a predetermined length and/or shaping it into at least part of a container. In FIG. 8 the predetermined lengths of the base sheet are automatically loaded into open boxes as they are cut, their operation eliminating substantially all of the manual operations presently required for a similar type of packaging operation.

Before more fully describing the apparatus of FIG. 8, it will be noted that the supply of the base sheet from the large roll has a continuous sheet which is provided in FIG. 8, may be replaced by a plurality of shorter sheets of the same material with an intermittent feed thereof on to a conveyor to effect substantially the same function of the apparatus in FIG. 8.

FIG. 8 illustrates automatic packaging machinery for forming, assembling and filling containers of the type hereinabove described such as apparatus illustrated in part in FIGS. 1 to 7. A sheet 51 of a first material such as metal foil, plastic or laminate of these two per se or with paper board, or paper is fed from a supply roll 50 into a forming press having a bed 54 against which a portion of the sheet 51 is compressed and deformed into cavities therein by means of dies such as heretofore described which are secured to a base 55. The bed 55 is adapted to be moved up and down on tracks, arms or guides 55' extending downward from an overhead carriage 56 which is adapted to be moved longitudinally along tracks or guides 57 which are supported from above. Respective servo means such as hydraulic actuators (not shown) are interlocked in their operation and automatically controlled to advance and retract the die assembly 55 to form cup shaped containers from sheet 51 and to transfer the containers so formed on the male die portions to a position over a bed 61 of a fastening or welding press. A plurality of powered rollers, two of which 52 and 53 are shown, are automatically controlled in their operation to feed and preposition lengths of the sheet 51 beneath forming press 55, to hold said sheet in place against said press and to effect removal of the scrap from the press.

A second sheet of material 60 feeding from a second supply roll 59 is advanced over the press bed 61 onto which a plurality of the containers 20 are placed when the press bed 55 aligns with and advances towards 61. The containers or cups 20 are secured in a predetermined array of rows on 60 by one of the hereinabove described means. The base sheet or laminate 60 is then power driven as an elongated belt by aligned pairs of power rotated drive rolls represented by the notations 62 and 63 which are mounted on bearings supported by a frame (not shown) and driven by conventional chain drive means at constant speed to advance sheet 60 at a constant speed. The movement of sheet 60 may be continuous if the press carriage 56 is controlled in its movement to move at the same speed as 60 for a short distance while the bed member 55 is advanced and bonding or welding is being effected between the bases of the containers 20 held thereby and the sheet 60. The means for driving sheet 60 may also be intermittently operated and interlocked in its operation to cause a predetermined length thereof to remain stationary over 61 while one or more rows of the cups 20 are prepositioned over said length or portion thereof and are welded or bonded thereto.

The sheet 60 is adapted to be guided past an automatic machine 64 for filling or placing predetermined quantities of materials or articles in respective of the containers 20 through chutes 65 or other means extending over respective lanes of the sheet 60. The release of material(s) or objects from the machine loader 64 may be effected by means of valves or the like operated by solenoids or motors which are interlocked in their operation to the movement of the sheet 60 or are synchronized or otherwise controlled to release said material(s) at predetermined times during the cycle. The notation 66 refers to a plurality of belt conveyors which may be kept loaded by conventional means, the movement of each of which may be controlled to automatically effect the deposition of material or objects into respective of the chutes 65 for loading into respective of the containers. Various known designs for intermittently operating filling apparatus may be employed for the loading machine 64.

The belt or sheet 60 continues in its movement beyond 64 whereafter the contents of the containers 20 may be further processed by heating, refrigerating or the additional of other materials thereto. The contents of the containers may be baked or otherwise cooked, frozen or otherwise treated.

At its end, belt 60 with the filled containers thereon passes through a cutting machine 67 which is operative to cut 60 into predetermined lengths 60' which may individually and automatically be loaded into cartons 68 which pass in front of 67 on a belt conveyor 69. The movement of the belt 69' of the conveyor 69 may be intermittent and synchronized to the operation of 60 so that one or more lengths 60' of the cup mounted vase 60 will be deposited in each container.

The notation 71 refers to a machine for further operating on the container and/or product therein. For example, the container 68 may be closed or capped in 71, stacked or cartoned.

The operation of the servo-motors driving the sheets 51 and 60, those advancing and retracting 55 and 56, the servos releasing or delivering predetermined quantities of product to or from chutes 65, the shear or rotary cutting mechanism of 67 and the movement of the belt of conveyor 69 may be controlled by an automatic sequencing controller such as a self-recycling multi-circuit timer or any other control means of known design which is preferably interlocked by limit and/or other switches to effect the mentioned fabrication and filling functions.

It is noted that the base sheet material 60 may be driven either continuously or intermittently past the filling machine 64 which action will depend on the material being conveyed thereby into the individual containers, its rate of flow from the spouts 65 and the lineal speed of 60. In other words, filling may be accomplished on the fly with 60 in motion or while 60 is momentarily stopped with respective of the sub-containers 20 prepositioned relative to respective of the filling chutes or spouts 65. The means for operating the roller drives 62, 63 may be a stopping motor or conventional electric motor having the desired acceleration and stopping characteristics. The filling spout 65 may also be adapted to move

short distances back and forth along the conveyor while discharging material while the sheet **60** is in constant motion past **64** to effect said filling.

FIG. 8' illustrates schematically a system for controlling the apparatus of FIG. 8 including basic servos and controls shown in block notation. The notations **78** and **79** refer to motor drives or gear motors for respectively effecting the drive of sheet materials **51** and **50** through respective sets of roller drives **53** and **63**. A lineal motor or hydraulic cylinder **72** advances and retracts carriage **56** and a second lineal motor **75** mounted on **56** lowers and raises male die-bed **55**. The control apparatus will be described by reference to a cycle of operation. It is assumed that the proper power supplies are provided on the correct side of all switches and controls.

Assuming that die **55** is retracted with the containers retained by the die formations **12** thereof, and that servo **72** is operating to drive **56** to position **55** over bed **61** and sheet **60**, when shaft **72S** of cylinder **72** is fully projected a limit switch **72'** having an arm riding on said shaft is actuated when said arm rides in an indentation therein. The operation of limit switch **72'** effects the energization of a self-recycling multi-circuit timer **73** which respectively effects the following actions during a cycle of its operation.

The timer **73** energizes the stop control **72S** of lineal motor **72** stopping **56** over **61**. The forward drive control **75F** of lineal motor **75** is next energized to cause **55** to be advanced to cause the formed parts retained by the male die portion **12** to be compressively engaged against the upper surface of base **60** and welded or bonded thereto as described. If ultrasonic, resistance, or magnetic-resistance welding is to be effected, the timer **73** may operate a generator **74** of the necessary electrical energy when the die-block **55** is advanced, for the time necessary to energize the transducers **34** and effect said welds by supplying the necessary power to the input of **74** or energizing the controller **74'** of **74**.

While the timer **73** may be used to control the servos for effecting the filling of the individual cups **20** further down the conveyor, the cutter in **67** and the operation of conveyor **69**, another technique is illustrated which employs a second multi-circuit, self-resetting or repeat-cycle timer **77**. The die block **55** is provided with a notching blade **55***c* which provides a position indicating cut-out or edge notch in sheet **60** when it advances thereagainst, which cut-out is provided in advance the group of containers welded to **60** in the same action. A limit switch **76** is adapted with its actuator positioned to ride in or against the cut provided by **55***c* and, when actuated thereby, energizes the timer **77** which, at predetermined time intervals, during which respective containers are beneath respective of the filling spouts **61–1** to **65–N**, energizes respective solenoids **61S–1, 61S–N** which operate valves permitting predetermined quantities of the materials conveyed to the chutes to pass through to the containers below.

The programmed controller **77** also effects the operation of the cut-off mechanism **67** by energizing a solenoid or servo **67'** at the proper instant to cause a blade to sheer sheet **60** near its end. The blade **67K** may be a rotary or lineal cutter operated by **67'**.

After the containers held by **55** are bonded to **60**, the timer **73** energizes the reverse control **75R** of servo **75** causing **75** to retract **55** leaving the cups **20** on **60**. Timer **73** then energizes the forward control **79F** of motor **79** which drives sheet **60** forward until **76** energizes **77** which controls **79** to stop at the proper instant by energizing the stop control **79S** of **79**. If it is desired to intermittently move **60**, while **55** is retracted and forming new containers, to effect the filling of those containers on **60** in the area of the filling spouts, timer **77** may alternately control **79** to start and stop the desired number of times between which actions respective of the product release controls **65S–1** to **65S–N** may be energized by **77**.

The forward drive control **79F** of servo **79** is shown energized by timer **73** although, as stated, it may be controlled by **77**. Timer **73** is operative to effect the energizing of the retract control **72R** of **72** and, thereafter the advance and retract controls **75D** and **75U** of cylinder **75** to effect the formation of the sub-containers as well as the forward drive and stop controls **78F** and **78S** of motor **78** to position a new length of sheet **51** in the press for the next forming action prior to the advance of **55** thereagainst. The cycle then repeats as described with modifications to the control system of FIG. 8' which will be obvious to those skilled in the art, the packaging apparatus described hereafter may be similarly controlled.

Other features of the control system of FIG. 8' include the energization of one or more solenoid operated valves such as **16V** by the multi-circuit timer controller **73** at the proper time interval in the cycle for providing a vacuum and/or pressure on lines such as **16**, **17'** and **17''** associated with the forming dies to effect the functions heretofore described, the energizing of controls effecting the starting and stopping of motors for controlling other conveying apparatus associated with the machinery of FIG. 8 such as motor **69''** for moving the belt **69'** of conveyor **69** for feeding and prepositioning cartons such as **68** in front of the cut-off mechanism **67**, or one or more of the feed conveyors **66** as shown in FIG. 8 to maintain the storage and/or delivery chutes of **64** stocked or filled with material. If forming press represented by components **54** to **57** is a compression or injection molding machine for forming the cups **20**, the multi-circuit timer **73** may be utilized to control the cyclic operation of the press by controlling the movement of the mold or die components, the injection valves and the further operation as described for effecting the transfer of the molded cups to the base sheet **60**. The components illustrated in FIG. 8' could essentially be applied to an injection molding of the containers **20** with the die components **54** and **55** representing respective injection mold halves, the male half **55** being used to remove the molded components from the female mold half **54** and transfer them to the sheet **60** where they may be removed from the mold portions **12** when they are bonded or welded thereby to **60** and/or by the use of positive air pressure applied through the lines **16** of the base **55**, which pressure is controlled by timer **73** operating valve **16V**, at the proper instant, which valve is in a line **16L** connecting **16** with the necessary pressure system. In such a molding apparatus, the servo **78** would drive the screw of the injection mold and/or operate the inlet gate to effect the admittance of the liquid plastic into the mold at the proper time in the cycle.

FIG. 9 illustrates apparatus for fabricating cups or the like from sheet material by means of a plurality of rotating dies which replace the track mounted, flying press **55** of FIG. 8. The rotating machinery **80** consists of a base disc or drum **80'** rotationally mounted on a shaft **82** which is rotationally supported by bearings (not illustrated) and is power operated. The drum is controlled by an indexing mechanism which is adapted when actuated to rotate the base **80'** through a predetermined angle and to pause thereat while one or more tools mounted thereon cooperatively engage the work. In FIG. 9 the tools consist of dies **83**, shaped in accordance with one of the die formations illustrated in FIGS. 1 to 7 for forming cup containers from a sheet **86** of foil, plastic or laminate supplied from a coil **86'** and a power driven by means of power operated friction rollers, a plurality of which **86***a*, **87***a'*, and **87***b*, **87***b'* are illustrated positioned along female die member **85**. A cavity **85'** in the die **85** cooperates with each of the forming die portions **84** of the male dies **83** in forming the sheet **86**, which action may also include die-cutting the cup and retaining it on the nose **84** of the die as heretofore described.

Eight dies are illustrated, each of which may consist of a single die nose 84 or a row of said dies, each of which will form a respective cup when it is advanced into a respective cavity 85' in the female die block 85. Each of the dies is mounted on the shaft 81' of a respective ram 81 which may be fluid or electrically operated to advance and retract the die automatically relative to the female die 85 and a table 90 over which the sheet 88 to which the formed cups are to be secured, is driven. When retracted, each die will clear the apparatus and packaging adjacent the fixture 80.

It is noted that other apparatus or dies associated with fabricating or finishing the articles 20 may also be spaced about the apparatus 80 and interlocked in their operation with the operation of the apparatus of FIG. 9. When advanced, the die may be used to either form a cup or to effect its positioning and securing by any of the means heretofore described to a sheet of material such as 88. The die 83*f* is shown advanced against the sheet 86 to form it into a cup in the cavity 85' of the die 85. During the cycle of operation, die 83*f* retracts permitting it to clear the die 85 and the fixture 80 indexes one position, whereupon the next die positioned over the press bed 90 which has a cup formed on its nose, advances against the sheet 88 and effects the welding or bonding of said cup to the upper surface of 88 by compressively engaging it against the press bed 90 in the manner heretofore described. A die 83*a* is shown in the act of securing a cup to the upper surface of 88 after which it retracts so that the fixture may be indexed to the next position. The movement of the sheet of foil or laminated material 88 is controlled by the intermittent rotation of the upper and lower groups of power operated rollers referred to respectively by the notations 89' and 89 which are power operated by servo motors which are controlled to intermittently advance 88 predetermined distances such that each newly secured cup will be positioned against 88 immediately behind the cup previously secured to 88 as illustrated in FIG. 9. Suction and/or pressure means may be utilized for removing the cup from the die 85 and retaining it on the nose of the male die 84 by providing respective fluid conducting means extending to each die from the central drum 80', which lines are each connected to a respective solenoid or cam operated valve, which is automatically controlled to open and close to effect said actions by known means. If fastening is effected by means of heat sealing or ultrasonic welding, the respective transducers may be secured either to the head 84 or the correct portion of the press bed 90, the action of which is automatically controlled and synchronized to the intermittent movement of the sheet 88 and the operation of the fixture 80.

For certain packaging functions a plurality of different shaped dies provided in the positions of the illustrated die-heads 83*a* to 83*h* may be provided on the packaging fixture 80, which dies may be selectively positioned relative to a plurality of female dies of which 85 would be one and selectively positioned relative to the table or press-bed 90 for providing different shaped containers on the sheet 88 in any predetermined array or order. Apparatus of this type is extremely flexible in that, if it is desired to shift from one packaging or assembly arrangement, said action may be effected by programming the rotation of the wheel or drum 80' the action of which is interlocked to the radial movement of respective of the dies. Thus, depending on the particular sequence of the programming means, any array of sub-containers may be provided in any order or spacing on sheet 88 provided that if the movement of 88 is synchronized to the operation of the rest of the apparatus. These functions may be effected by means of a multi-circuit, repeat cycle timer which controls solenoids effecting the operation of the servos for indexing the wheel or drum 80', operating the rams or lineal motors 81 and operating the drive wheels 89 and 89'.

It is further noted that the containers 20 may also be automatically filled by the apparatus of FIG. 9 after being welded or bonded to the sheet 88 if a flowable material is introduced through each die nose 83 into each container during its retraction away from the container or after it has fully retracted and clears the container. If the sheet 88 is guided in a radial path around the perimeter of the fixture 80, the bonding or welding and filling of the individual containers may be accomplished on the fly without stopping the movement of 88.

In the assemblies and package constructions of FIGS. 1 to 9 which provide limited area welding or bonding between surfaces to effect the temporary securing of the components, various techniques of spot welding or the like have been proposed as have means for effecting spot adhesive bonds therebetween. Adhesive bonding may be effected by the provision of an applicating machine for automatically printing or otherwise applying spot areas or drops of suitable adhesive to the container base 86, or both the container and the base sheet 86. If the adhesive is of the self-drying type, the surfaces to be bonded must necessarily be abutted and compressed together shortly after the application of the adhesive. If a pressure sensitive non-drying adhesive is used it may be applied either just prior to assembly of the sub-containers or at some time prior to the assembly operation, for example, before the base sheet must be synchronized to the movement of the means for applying the containers thereon or photoelectric scanning means may be used to detect the containers and control the operation of cylinders or rams 81.

The use of a heat sealable plastic may be used per se for the base sheet or coated as a thin film on either or both surfaces of the base sheet or coated on predetermined spot or band areas of the base sheet. Heat sealable plastic, such as Videne A, a vinyl chloride, may be coated on the base sheet as a series of parallel longitudinally or laterally extending bands on the base sheet, or as spots of limited areas of said plastic which will effect the conservation of said plastic since only a small area or patch of said plastic film is required to effect a spot weld with the base of the container. The spots or bands of said plastic may be applied prior to coiling the base sheet. The movement of the base sheet past the dies used to effect the spot welds will necessarily be synchronized to the operation and movement of said dies, which synchronization may be effected by means of position indicating marks or cutouts provided at spaced intervals in 86 and a detection relay such as a photoelectric cell adapted to actuate cylinders 81.

FIGS. 10 and 11 illustrate a modified form of the die apparatus of FIG. 8 which permits the formation of a plurality of cup shaped containers from a single sheet of material and the securing of said containers to a base sheet in closer proximity than that in which they were formed. If a plurality of shapes or containers as described are formed from a single sheet of material, they must necessarily be spaced sufficiently far apart to provide enough material for fabricating each container. Since the metal or plastic is drawn or forced into the cavity of a mold, there must be sufficient sheet material beyond the perimeter of the cavity from which the container may be shaped. In FIG. 10 the male dies are referred to by the notations 84*a*, 84*b*, and 84*c* each of which is shown advanced into a respective cavity of the group 85*a* to 85*c* of the female container forming die 91.

As formed, each container is thus positioned apart from the other and in certain packaging structures, such as the boxing of candy, it may be desirable to position the containers closer together. In FIG. 11, the dies have been moved close to each other whereby the walls of each abut each other so that the respective containers 20*a*, 20*b*, and 20*c* are positioned closer to each other than when they were formed. The apparatus may include means for moving the dies or die portions 84*a* and 84*c* towards the central die portion 84*b* just prior to positioning said dies with the containers thereon in abutment with the sheet 88 which

is shown resting on the die or press platen 17'. Welding or bonding may be effected by any of the heretofore described processes whereafter the three die portions are adapted to automatically lift out of the respective containers leaving them on sheet 86 and thereafter automatically spread apart as in FIG. 10 and position over the forming die 91.

FIGS. 12 to 15 illustrate sheet forming and bonding apparatus 92 adapted to perform essentially the function of the apparatus of FIG. 9 without the need for said plurality of lineal actuators or hydraulic cylinders 81 as described. The sequence of operations during a single forming and bonding or welding cycle are illustrated in FIGS. 12 to 14 and further details of a modified form of said apparatus are illustrated in FIGS. 15 and 16. In FIG. 12 a plurality of forming and welding dies, referred to by the notations 94*a* to 94*d*, are shown secured to the surface of a disc or drum having a heavy casing 92', the assembly 92 being rotatable on a shaft 93 and adapted to index in each of its four positions. The apparatus 92 includes means for lineally moving said base 92' towards a die-forming platen or bed 85 to engage with sheet material 86 driven thereacross and to shape said material as heretofore described into cup-shaped containers whereafter the base 92' is adapted to retract and move towards a second sheet 88 of material against which a previously formed container such as 20*b* is compressibly engaged and bonded or welded to the upper surface thereof by one of the methods described. Power operative rollers drive the sheet 88 across a platen 90. A single cycle of operation comprises the advancement of base 92' towards bed 85 in a manner to form a cup on the upper male die portion 94*a*, the retraction of base 92' from 85 with the cup thereon and the further movement of 92' with a container formed on diametrically opposite die 94*c* until said container engages the upper surface of the sheet 88 as illustrated in FIG. 14. After the container is welded or adhesively bonded to sheet 88 the base 92' moves upward a sufficient distance for die portion 94*c* to clear the cup 20*c* which it had just secured to 88. The base 92' then rotates and indexes one position which in FIGS. 12 to 14 is approximately 90 degrees since dies are spaced 90 degrees apart thereon. The base then advances the upper die member into the cavity over which a new section of the sheet material has been advanced by the intermittent drive therefore. A new cup is thus formed while the sheet 88 is advanced so that the last cup 20*c* to be welded thereon will clear the next die to be advanced by the movement of 92' towards the sheet 88.

The apparatus of FIGS. 12 to 14 may comprise an elongated drum as illustrated in FIGS. 15 and 16 which has respective rows of said frusto-conical die portions secured thereto each of which will form a respective cup. The drum 92 is mounted on a shaft 93 which is rotationally supported by a bearing 95*g* which is secured to the end cross members 95*e* and 95*f* of a frame 95 or rigid beams.

A power operated indexing mechanism 92'' is secured to the frame inside the bearing 95*g* and is operative to cause the drum 92 or base 95 to rotate 90 degrees each time it indexes. The frame 95 and die drum 92 is moved up and down to engage respective die portions in the cavities of the upper die block 85' and secure the cups formed by a prior operation, onto the surface of sheet material 88 which is driven over the base platen 90 as described. The lineal motion of the frame and die is effected in FIGS. 15 and 16 by means of eight fluid cylinders referred to by the notations 96*a* to 96*h*. The bottom four cylinders are controlled to operate simultaneously to advance and retract the frame of the upper four cylinders. In FIGS. 17 and 18 the dies have been reversed, that is, the stationary die block of the apparatus which may be designed as heretofore described, is replaced by a die block 97 having a protruding male nose 97' and the movable or rotating die is replaced by a die portion 99 having a cavity 99' therein adapted to the shape of the male die portion 97' of 97. Since the sheet 86 cannot be provided in direct abutment with the stationary die 97, it is driven in close proximity to the extreme portions of the male die protrusions 97' and when the movable die 99 is advanced by movement of its base or drum 98 towards 97, the material of sheet 86 to be formed is shaped into a container or open shell by forcing it over the nose portion 97'. A circular cutting die 13' circumscribes nose 97' and cooperates with an annular surface of 99 to cut the sheet 86 around the flange of the shaped container portion 20'. The base 98 then rotates and the die shaped member 20' remains in the cavity 99' of 99 either by friction or by suction pressure applied to one or more ducts 16' which extend to the surface of the cavity in 99 against which the wall of cup abuts after it is formed. Eventually the die 99 is positioned over the base sheet 88 riding against the plate 90. Objects or products to be packaged, referred to by the notation 100, are automatically placed on the surface of sheet 88 as in FIG. 18 and are carried therewith immediately below the die base 98 by the intermittent motion of 88 and are totally enclosed in a pocket or package, one wall of which comprises material of 88 and the other walls of which comprise the cup shaped container 20' the rim 20'' or which is abutted against the upper surface of sheet 88 and welded thereto by one of the heretofore described methods. The base 98 then retracts after which the sheet 88 is advanced with the next product in alignment with 98 followed by a rotation of base 98 and the indexing thereof to position the next die 99 in alignment with the male die 97' after which the described cycle repeats.

In a further embodiment, it is noted that the die-members 99 may each be provided with a cutting die 13'' as shown in FIG. 18 which may be operative to perform either or both of two functions. The cutting die portion 13'' may be used to coact with die 13' or act per se in severing the formation 20' from sheet 86 from which said formation is shaped. It may also be utilized, when advanced against sheet 88 to perforate or sever said sheet into sections defined by said cutting die which sections will include the product 100, the covering or encompassing means 20' therefore and that section of 88 to which 20' is bonded or welded. The assembly so described may comprise a unit package to be presented as a product per se or further packaged in a master carton.

It is also noted that cutting dies in the form of lineal knife blades may be provided to sever or perforate predetermined lengths of sheet 88 which lengths each contain a plurality of the formations 20' in side-by-side array. Such blades or dies may be secured directly to the base or drum 92 of the apparatus of FIGS. 12 to 16 extending the width of the sheet 88.

The apparatus illustrated in FIGS. 10 and 11 may be modified and used to retain and transfer preformed containers or cups from a supply thereof to a sheet or against the wall of a container such as a box in an automatic transfer device or assembly. The transfer members designated 84*a*, 84*b*, 84*c*, etc., may be provided with passageways such as 16 of the male die 10 in FIG. 1 for retaining said preshaped containers on each and/or for supplying fluid or fluent material to fill each cup as or after it is transferred and positioned on a base or sheet as illustrated in FIG. 11.

The apparatus illustrated in FIG. 17 may be utilized to form and fill pockets or indented formations in sheet material. The member 99 may be similar in design to member 17 of FIG. 1 and may be provided with one or more passageways such as 16 therein which extend from a vacuum forming pump for drawing the sheet into the cavity with or without the assistance of male die 97' which may also be used as a filling spout per se adapted to be fed material through passageway 16 for at least partly filling the formation or indented sheet portion retained in the female die or cavity of 99.

Numerous other modifications of the present inven-

tion will be appreciated by those skilled in the art and accordingly the appended claims should be construed broadly as is consistent with the appended claims and in certain instances, some features of the invention will be used without a corresponding use of other features.

I claim:

1. Apparatus for forming and assembling sheet metal components comprising in combination with a first pair of dies adapted for forming a sheet of metal into a first article, a first die of said pair of dies being shaped to retain said first article formed thereby and the other die, means for separating said first dies after forming said sheet with the article retained on said first die, a second sheet metal article, welding die means, means for prepositioning and retaining said second sheet metal article against said welding die, means for guiding said first die in a predetermined path and for engaging the sheet metal article held thereby against said second sheet metal article in alignment with said welding die, said first die adapted to cooperate with said welding die thereafter in welding said two articles together, and means for separating said first and said welding dies and removing the welded assembly therefrom.

2. Apparatus in accordance with claim 1, including means for removing said welded article from said first die comprising means retaining said article against said welding die while removing said first die from the vicinity of said welding die to detach said article therefrom, said dies also adapted to cut said article prior to welding said two articles together.

3. Packaging apparatus comprising in combination with a plurality of container handling dies, means for feeding a first sheet material adjacent said dies, means for providing and retaining individual containers on each of said dies, means guiding said dies in fixed paths relative said first sheet to position the containers held by each against said sheet, means for moving said dies to engage the containers held by each against said first sheet material, means for retaining said containers on said sheet and for retracting said dies from the vicinity of said sheet, means for providing a new individual container on each die, and means for moving said sheet to advance the portion thereof containing said containers retained thereon away from said dies and to provide a new section of said sheet aligned with said dies.

4. Apparatus for forming sheet material into articles comprising in combination a first die and a second die adapted to cooperate in forming sheet material at a first stage of said apparatus, means for feeding a sheet material between said dies, means for moving said first die to engage and form said sheet against said second die, cutting means having a cutting edge supported by one of said dies and operative to engage and sever the formed portion of the sheet from the remainder of the sheet to define a shaped article, means for retaining said article against said first die, means for separating said dies while retaining said article against said first die, said apparatus having a second manufacturing stage, means at said second stage for operating on said article, means for moving said first die to said second stage to transfer said article to said second stage, means for removing said article from said first die, and means operative thereafter for returning said first die to said first stage to cooperate with said second die in forming and cutting another article from said sheet material.

5. Apparatus in accordance with claim 4, including means for guiding and feeding a second sheet material past said second stage, said means for removing said article from said first die including means securing said article to said second sheet material in a manner to retain it thereagainst while returning said first die to said first stage.

6. Apparatus for forming and cutting sheet material comprising in combination with a plurality of sheet forming dies including a first die and a second die, means for feeding sheet material between said dies, said first die having a nose portion protruding therefrom, said second die having a cavity adapted to cooperate with the nose portion of said first die in forming said sheet material, means for moving said first die to engage said sheet and to effect deformation of a portion thereof into said cavity of said second die, cutting means including a cutting edge supported by one of said dies and operative to engage and sever the portion of the sheet deformed between said dies from the remainder of the sheet during the same stroke employed to deform said sheet to define a separate sheet article, means for separating said dies, means for retaining said article against said second die, means ejecting said deformed sheet portion from said second die upon separation of said dies, said ejecting means including a passageway extending through said second die and communicating with the cavity therein, and means applying sufficient fluid pressure to said passageway upon separation of said dies to force the article off said second die and eject it therefrom.

7. Apparatus for forming and cutting sheet material comprising in combination with a plurality of sheet forming dies including a first die and a second die located at a first work station and adapted to cooperate in forming articles of sheet material, means for feeding sheet material between said dies, means for advancing said first die towards said second die in a first stroke whereby the two cooperate in engaging and forming the portion of sheet material disposed therebetween, cutting means including a cutting edge supported by one ofsaid dies operative to engage and sever a portion of the sheet including the portion deformed by said dies from the rest of the sheet during the same stroke employed to deform said sheet to define a separate article, means for separating said dies in a second stroke, means for retaining the article against one of said dies when it separates from the other, and means for moving the die retaining the article in a third stroke different from said first and second strokes to transfer the shaped article to a second work station, and means operative at said second work station for removing the article from said die against which it is retained.

8. Sheet forming apparatus comprising:

(a) a base,

(b) means rotationally supporting said base,

(c) a plurality of first sheet forming dies supported by said base and defining peripheral sheet forming surfaces,

(d) a further die disposed adjacent to the periphery defined by said first dies,

(e) means for feeding sheet material between said further die and the periphery of said first dies,

(f) means for rotationally indexing said base to selectively position said first dies in alignment with said further die,

(g) means operative upon alignment of a first die with said further die for cooperatively engaging said sheet material between the two and deforming a portion thereof into a predeterminedly shaped article,

(h) means for retaining said articles in position against respective of said first dies on which they are formed as said first dies rotate,

(i) means for feeding a second sheet material adjacent the periphery of said first dies beyond said first sheet material in the direction of rotation of said base,

(j) means for removing articles from said first die as they move into alignment with said second sheet material and,

(k) means for tandemly disposing articles removed from said first dies on said second sheet material.

9. Apparatus in accordance with claim 8, said sheet material being supplied from a coil formation thereof, and means cooperating with said first dies for die cutting and severing portions from said sheet and retaining same thereafter on said first dies.

10. Sheet forming apparatus comprising in combination, a sheet deforming means including a rotationally mounted base, means for rotating said base, a plurality of first male dies supported by said base in a circular array, each of said first dies having sheet cutting and forming surfaces extending peripherally outward from said base, means feeding first sheet material across the face of a first of said male dies and engaging said sheet material at a first station thereon, means for deforming a length of said sheet material into cup-shaped articles and causing same to conform to said forming surface of said first die, means retaining the deformed sheet material on said first die, a supply of a second sheet material, transfer of said first sheet material to said second sheet material past said rotatably mounted base and defining a second station, means transferring the deformed cup formations of said first sheet material to said second sheet material at said second station when each of said first dies is ailgned with said second station, and means for bonding said formations of first sheet material to respective portions of said second sheet material to form composite assemblies of said first and second sheet materials.

11. Appartus for die forming articles of sheet material and transferring said formed articles comprising:

(a) an endless rotary array of sheet forming and transfer dies,

(b) means for rotating said dies,

(c) means for die cutting and disposing corresponding cut portions of a sheet of material against each die at a first stage of said apparatus,

(d) means for deforming said die cut portions of sheet material into articles against corresponding dies,

(e) means for retaining said articles in place as formed on the rotary die as the die rotates,

(f) a conveying means disposed adjacent said rotary array of dies beyond said first stage and operative for receiving said formed sheet articles,

(g) means for transferring each article from the die on which it is formed when said die is aligned with said conveying means and disposing said article onto said conveying means, and

(h) means for operating said conveying means to carry the articles away from said dies in tandem array thereon.

12. Apparatus in accordance with claim 11, including means for retaining said severed sheet formation against said conveying means comprising welding means operative for welding said formation against said conveying means.

13. Apparatus for forming and transferring formed articles comprising:

(a) a first die defining a first stage of said apparatus,

(b) means for feeding first sheet material adjacent said first die,

(c) a second die movable in a first stroke into cooperative relationship with said first die to form said sheet material between the two dies,

(d) means for retaining the deformed material against said second die,

(e) means retracting said second die from said first die with said formed sheet material retained thereon,

(f) means moving said second die in a rotary stroke lateral to said first die to transfer said formed sheet material to a second stage of said apparatus,

(g) a third die,

(h) means for feeding a second sheet material adjacent said third die,

(i) means for rotationally moving said second die into alignment with said third die and said second sheet material,

(j) means compressively engaging said die deformed material held on said second die against said second sheet material by relative movement of said second and third dies together and

(k) means including said second and third dies for welding the formed sheet material against said second sheet material.

14. Sheet forming apparatus comprising in combination:

(a) a first base,

(b) a second base,

(c) means for rotationally supporting said first base on said second base,

(d) a rotary series of first dies supported by said first base,

(e) each of said dies disposed at a different radial location on said first base,

(f) second die means disposed adjacent said first base,

(g) means for feeding deformable sheet material between said first base and said second die means,

(h) means for rotating said first base in a manner to successively bring each of said first dies into alignment with said second die means,

(i) means for radially moving each of said first dies into cooperative relation with said second die means upon alignment therewith to form sheet material disposed therebetween,

(j) means operative after forming said sheet material for retracting each first die from said second die means,

(k) means for removing the formed sheet material from between said second die means, and

(l) means for feeding new sheet material and rotating said first base to bring the next in line of said first dies into alignment with said second die for forming said new sheet material therebetween.

15. A sheet forming apparatus comprising a plurality of dies adapted to advance and retract relative to each other and cooperate in forming a thin sheet material into articles of irregular shape, a first of said dies having a die nose protruding therefrom, a second die having a cavity therein adapted to cooperate with the nose of said first die in forming said sheet, cutting means including a cutting die formation surrounding at least one of said dies and positioned to engage and sever the formed portion of said sheet from the remainder of the sheet during the same stroke employed to form said sheet, and means for retracting said dies and retaining the formed, severed articles against said nose of said first die, so as to be removed from said die cavity when said first die is retracted.

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