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[54] **AUTOMATIC PACKAGING METHOD AND APPARATUS WITH HEAT-SEALING ELEMENTS HAVING RESILIENT HEAT CONDUCTING MEMBERS**

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[52] **U.S. Cl.** **53/39**, 53/329, 156/69, 156/583

[51] **Int. Cl.** **B65b 7/28**, B65b 51/14

[58] **Field of Search** ..... 53/39, 329; 100/93 P; 156/69, 583; 219/243

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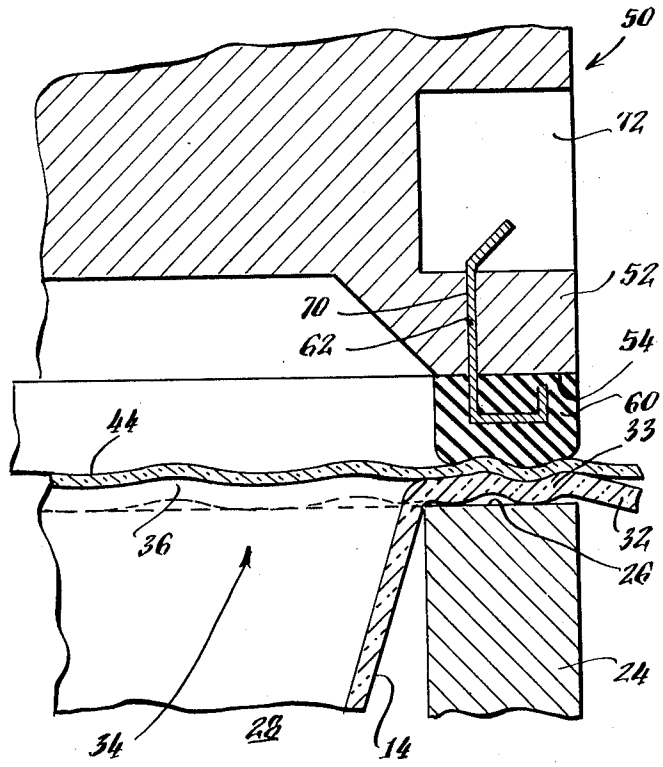
[57] **ABSTRACT**

Packaging apparatus for packaging a product in a container comprising a semi-rigid cup having an open mouth and a flange projecting outwardly from this mouth and a top sealed to the flange around the periphery of the cup. The apparatus includes heat-sealing elements formed of resilient heat-conducting material, adapted to make high-quality, uniform heat seals at high speed to container sealing surfaces having irregular contours.

8 Claims, 4 Drawing Figures



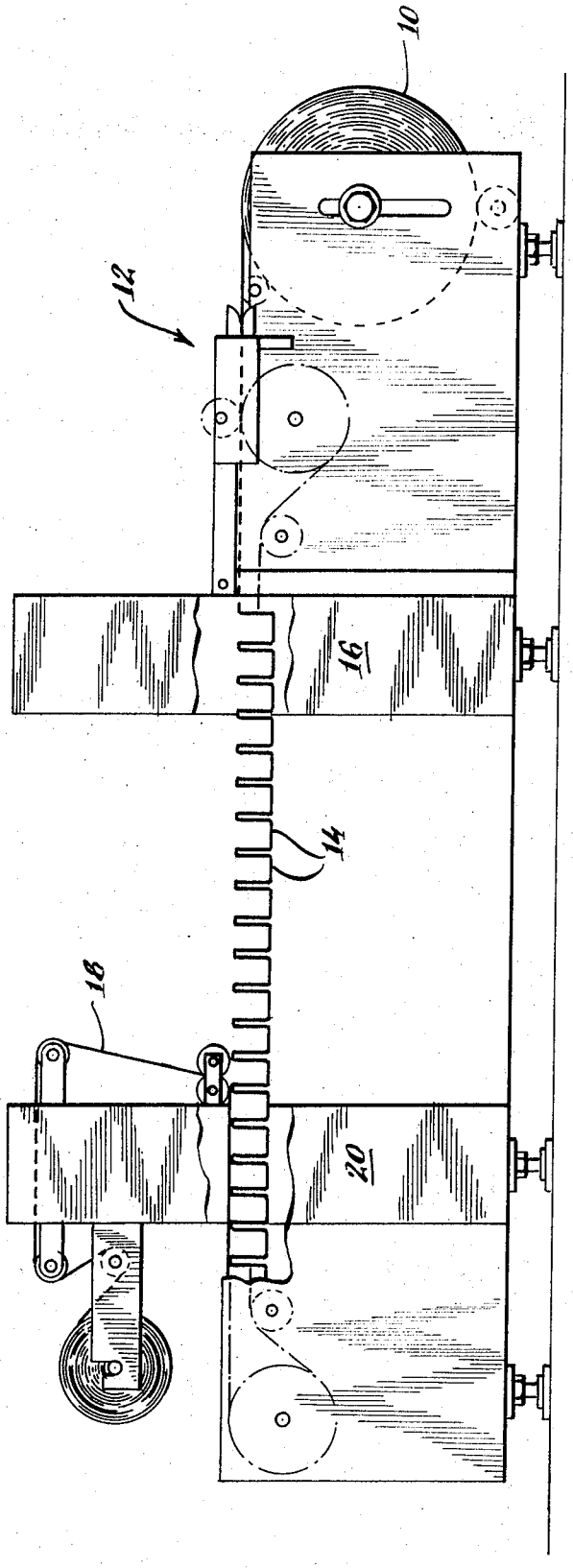
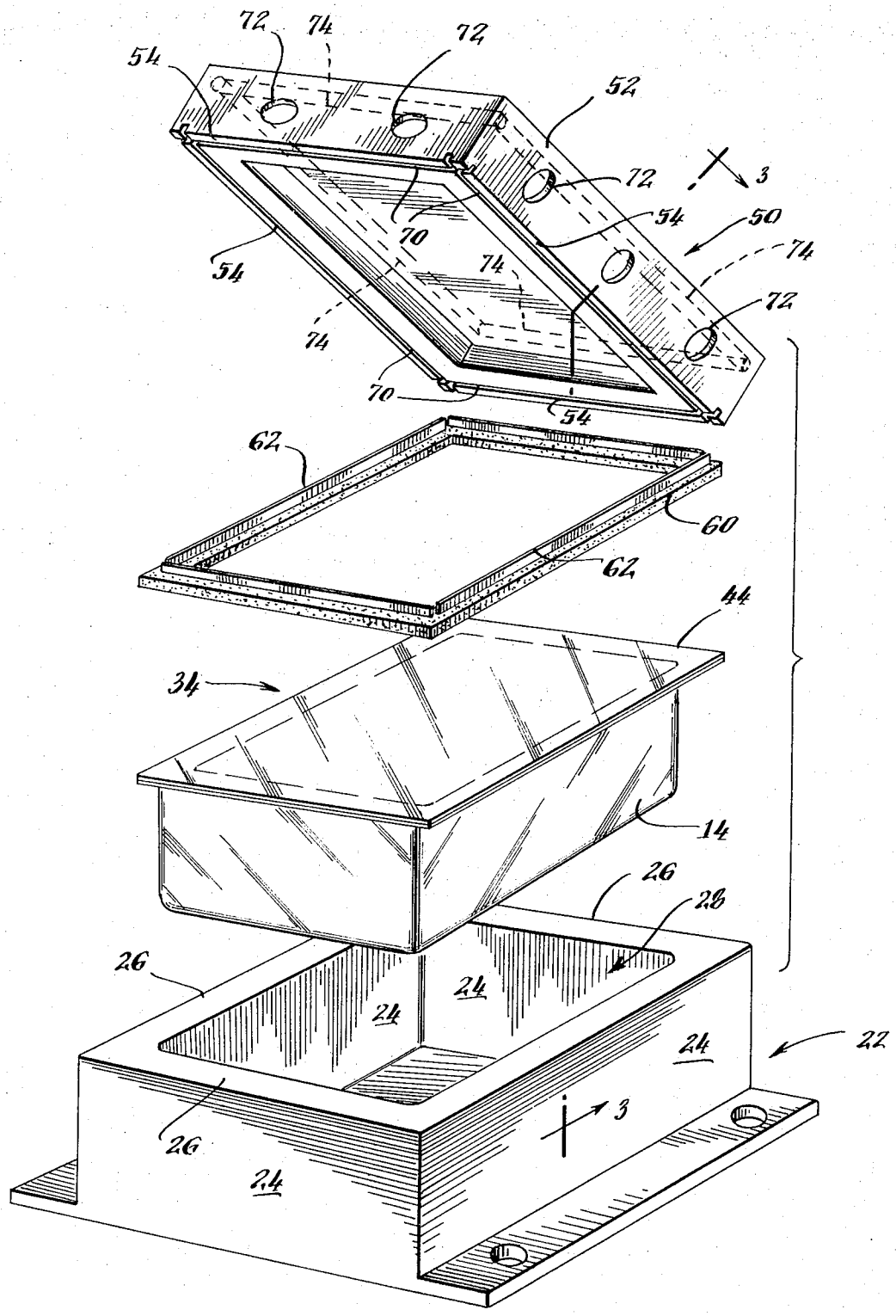


Fig. 1.

Fig. 2.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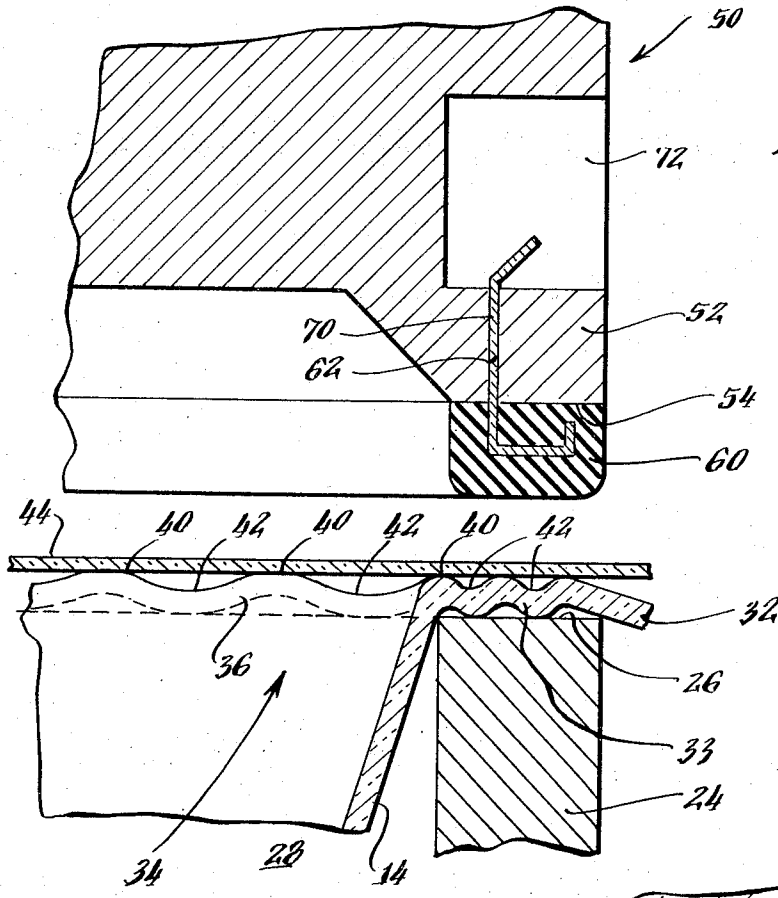
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Fig. 3.

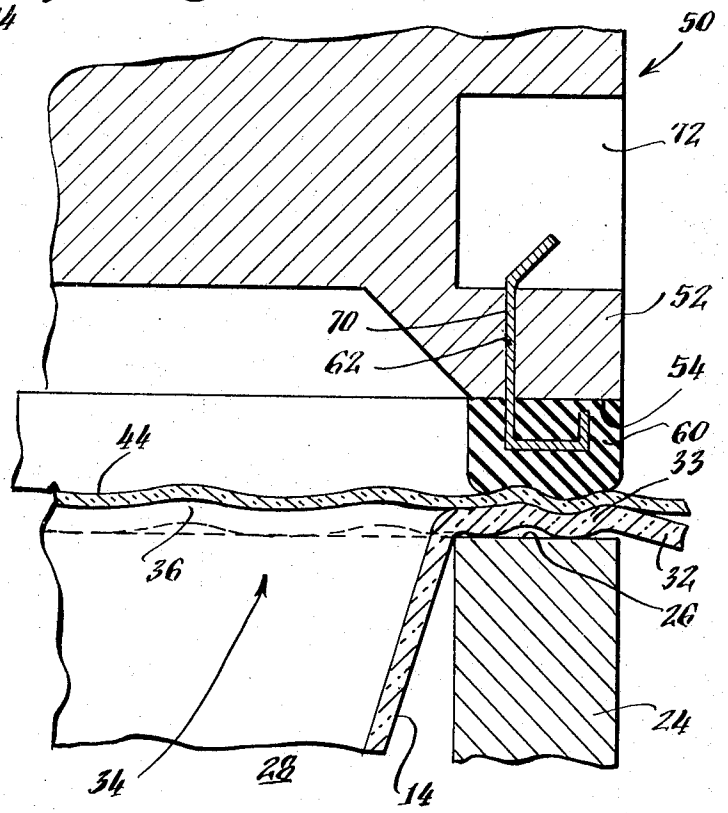
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Fig. 4.

AUTOMATIC PACKAGING METHOD AND APPARATUS WITH HEAT-SEALING ELEMENTS HAVING RESILIENT HEAT CONDUCTING MEMBERS

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to an automatic packaging apparatus having heat-sealing elements for sealing a cover to a cup-lilke container.

2. Description of the Prior Art

A wide variety of automatic packaging machines are in use commercially to package various products in hermetically sealed containers. Such sealed containers are especially advantageous for food products, since the hermetic sealing aids in preserving the contents for relatively long periods of time. However, to insure that this preservation function is successfully performed, it is of course important that the container seal be leakproof and of uniformly high quality.

Automatic packaging apparatus of the general type referred to herein typically forms the containers from a continuous sheet of plastic packaging material and similarly forms the container covers from a second continuous sheet of plastic packaging material. The containers generally are produced by a thermoforming procedure wherein the heated plastic sheet material is drawn into a die to produce a cup having planar flanges around the open mouth thereof. These integral flanges serve as the sealing surfaces to which the cover sheet is heat-sealed to produce the hermetically-sealed package.

When the container cup is made from a rigid or semi-rigid material, e.g., of heavy-gauge plastic 0.010 inchs or more in thickness, the sealing surfaces frequently exhibit irregular contours. Such irregularities especially occur in a form referred to as "puckering." When an attempt is made to heat-seal the continer top to such an irregular non-planar surface by using prior art techniques, the seal may leak. The number of "leakers" is a critical factor in the commercial viability of a packaging oeration, and even a very tiny percentage can in some cases be unacceptable.

Another factor in the problem is that when container cups made from relatively rigid and tough packaging material are transported through the sealing station of a packaging machine of the type having a conventional sealing die with resilient die covers, the packaging material tends to abrade the die covers and cause rapid deterioration thereof.

The use of heavy metal sealing bars both above and below the container being sealed, combined with very large sealing pressures, can provide seals to puckered surfaces, and can also avoid any problem with abrading a resilient die cover since there is no die cover present. Such an arrangement, however, requires the application of enormous force, sufficient to effectively flatten out the puckered areas during the sealiing oeration. It is difficult to construct such a machine capable of applying adequate force to heat-seal typical heavy-gauge packaging materials, and the machine would in any event be quite expensive to manufacture and maintain in operation.

The present invention is aimed at solving or minimizing the above problems encountered in sealing tops to container cups of rigid or semi-rigid material.

SUMMARY OF THE INVENTION

In a preferred embodiment of the invention, to be described in detail below, automatic packaging apparatus is provided of the type having a sealing station which includes a sealing die comprised of side walls presenting flat upwardly-facing top surfaces. The die defines a cavity adapted to receive a cup-shaped container having sealing flanges which rest on the top surfaces of the die. A cover sheet of flexible plastic film is placed over the container to be sealed to the flange region thereof to form a hermetically sealed package.

To carry out this sealing operation, there is above the cover sheet a sealing head comprised of side walls presenting flat downwardly-facing bottom surfaces. This sealing head is arranged for relative reciprocating motion with respect to the sealing die to clamp the cover sheet and the cup flange regions tightly together. The downwardly-facing (bottom) surfaces of the sealing head carry a continuous (non-interrupted) pad of resilient, compressible, heat-conducting material which is maintained at an elevated temperature sufficient to effect heat-sealing of the cover sheet to the container flange.

When the sealing head is moved down against the flexible cover sheet, this heated resilient material presses that sheet down against the container flanges. The contacting or "working" surface of the resilient pad flexes, to whatever extent is necessary, so as to conform closely to any irregular contours presented by the container cup flanges. The cover sheet similarly is flexed to follow those contours. Thus, the cover sheet is forced fully into contact with the cup flange, and the close, intimate, heat-sealing contact established between the resilient pad, the cover-sheet and the cup flange, extending entirely around the cup mouth, produces a uniformly high-quality heat seal regardless of irregularities in the cup flange surfaces.

Other objects, aspects, and advantages of the present invention will be pointed out in, or apparent from, the detailed description provided below, considered together with the followig drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a schematic illustration of an automatic packaging machine;

FIG. **2** is an exploded perspective of heat-sealing elements incorporating a resilient heat-conducting pad as one pressure element thereof;

FIG. **3** is a cross-sectional view taken along the line **3—3** in FIG. **2** and illustrating the sealing head and die in their open position with the container cup and top arranged to be sealed; and

FIG. **4** is a cross-sectional view of the apparatus again taken along the line **3—3** in FIG. **2,** but showing the container cup and top being sealed between the closed sealing head and de.

DESCRIPTION OF THE PREFERRED EMBODIMENT

FIG. **1** illustrates schematically the basic elements of a packaging machine of one type with which the present invention may be used. This machine includes a first roll of plastic packaging material **10** which is drawn out and transported through the machine by conventional means such as side edge grippers indicated at **12.** The continuous sheet of material **10** is

formed into cups **14** at a forming station **16** having conventional cup-drawing means (not shown herein). As the sheet **10** advances beyond station **16,** products are loaded into the cups, and a cover sheet **18** of plastic packaging material is applied over the cup mouths to be carried along therewith into a sealing station **20.** In this station, the cover sheet is heat-sealed to the peripheral flanges of the cups, in a manner now to be explained in detail.

Referring now to FIG. **2,** the sealing station **20** includes a sealing die **22** having four side walls **24** which terminate in flat upwardly-facing surfaces **26.** The die **22** defines a cavity **28** which is adapted to receive the cup-shaped container **14** filled with the product to be packaged, and which is to be closed by a cover sealed to the flanges thereof. (Note: In an actual commercial machine, the sealing station may include a number of such dies, and associated components, to permit sealing of a corresponding number of packages simultaneously, but to simplify the presentation, only one such die is shown.)

As shown in detail in FIG. **3,** the container cup **14** is formed with an integral, laterally-projecting flange **32** which rests on the die surfaces **26** when the cup is placed in the die cavity **28.** The cup is also formed with an open mouth **34** through which the product to be packaged is inserted.

The container cup **14** disclosed herein is generally rectangular in shape, but the invention can be used effectively with a variety of different shapes. The shape of the sealing die **22** would in such event be modified to suit the particular cup shape.

When the container cup **14** is made of a generally rigid or semi-rigid material, such as heavy plastic, the integral flange **32** is frequently characterized by non-planar, irregular contours, e.g., presenting a hill-and-dale appearance, or a waviness, which is sometimes referred to as "puckering. Examples of such irregular contours are illustrated in FIG. **3.** Such deviations typically may extend in both the longitudinal direction, as shown in cross section **33,** and in the lateral direction as shown in elevation **36.** In the illustrated examples, both the lateral and longitudinal puckering is comprised of a series of alternate peaks **40** and valleys **42.**

The container cup **14** is covered by a container top **44** made of relatively thin, flexible plastic film **18.** When the container components are arranged in this manner, they are ready to be heat-sealed together to form a hermetically sealed package.

To carry out this sealing operation, the packaging apparatus of the present invention includes a sealing head **50** having four vertical walls **52** presenting flat downwardly-facing surfaces defining a rigid platen **54.** These surfaces **54** are aligned with and opposite to the corresponding die surfaces **26.**

As shown in FIG. **2** and in detail in FIGS. **3** and **4,** the sealing head platen **54** carries a continuous, moderately thick pad **60** of resilient, heat-conducting material, advantagiously a silicone rubber composition containing additive material to enhance its heat conductivity. Preferably, the resilient pad **60** contains an internal metal strip **62,** which aids in conducting heat directly to the bottom "working" surface of the pad, and also assists in anchoring the pad in place on the sealing head, as by means to be explained hereinbelow.

As illustrated in FIG. **4,** the heated resilient pad **60** of the sealing head **50** is arranged to move down towards the cover sheet **18** and tightly clamp it and the flange **32** against the die top surfaces **26.** Because of the resilience of the pad **60,** the moderate pressure of its engagement with the cover sheet **18** causes it (and the flexible cover sheet) to be deformed to match any undulations of the flange **32.** Thus, the cover **18,** and the flange **32** are both compressed tightly together in an intimate, close contact, so that the heat from the pad effects proper heat-sealing around the entire periphery of the cup.

It should be noted that the concept of using resilient rubber as the heat-sealing element raises a serious question as to whether adequate heat flow could be achieved to effect a proper heat-seal, since rubber is known basically as having relatively poor heat-conducting qualities. However, tests have shown that the arrangement described herein provides desired high quality performances. The use of silicone rubber, with additives such as powdered aluminum or silver, is especially advantageous in providing adequate heat conductivity as well as other desired characteristics of resiliency, resistance to damage from heat, and toughness.

Referring now to FIGS. **3** and **4,** the bottom portion of the anchor strip **62,** embedded in the resilient pad, is U-shaped in cross section to insure tight bonding engagement between the pad **60** and the stip. The upper portion of the anchor strip extends through slots **70** milled in the sealing head side walls **52.** These side walls also have respective spaced holes **72** which extend inwardly to communicate with the top of the slots **70** which provide access to the top end of the inserted anchor strips **62.** A tool, such as a screwdriver, may then be inserted into the holes **72** to bend the respective strip tops sufficiently to prevent dislodgement of the pad **60.** With such an arrangement, the pad **60** can readily be removed for routine maintenance, or replacement, as required.

The sealing head **50** also is provided with suitable means **74** for supplying heat to the head **32,** the anchor strip **62** and the pad **60,** to assure that the pad is maintained at an adequately high temperature to provide effective heat-sealing.

Since the resilient pad **60** is located on the sealing head **50,** not the sealing die **22,** transporting the cups **14** through the sealing station does not result in damage to the resilient material, since the semi-rigid material does not come into contact with the pad. This semi-rigid material does strike the upper surfaces of the die **26,** but since these surfaces are made of stong heavy-gauge metal, no damage is done to the machine.

This invention greatly reduces the force required to make a heat seal between container cups and tops, relative to the forces required using metal-to-metal sealing elements. The heat-seals may in many cases actually be superior when using this invention. Moreover, the invention makes possible the sealing of materials of non-uniform thickness, which could not be sealed by metal-to-metal arrangements under any normal conditions.

Although a specific preferred embodiment of the invention has been disclosed in detail herein, it is to be understood that this is merely for purposes of illustration. The disclosure should not be construed as necessarily limiting the scope of the invention, since it is apparent that many changes can be made to the described structures by those skilled in the art to suit particular applications.

I claim:

1. In automatic packaging apparatus of the type including means for supporting cup-shaped containers having peripheral flanges around the open mouths thereof; a sealing station; means for transporting said supported container into and through said sealing station; means for supplying to each container a sheet of material to serve as a top for the container; and means at said sealing station for heat-sealing the top to the container flanges to produce hermetically sealed packages, said heat-sealing means including first means to engage and support the under surface of the container flange during the heat-sealing operation;

that improvement of said packaging apparatus wherein the sealing station further comprises:

resilient means mounted for relative reciprocal movement towards and away from said first means and arranged to press the top and the adjacent portion of the cup flange together against said first means with at least a moderate degree of sealing pressure;

heat conducting means forming part of said resilient means to provide substantially enhanced conduction of heat through said resilient means to the engaged surface thereof pressed against said top;

the engaged surface of said resilient means being sufficiently flexible to conform under said sealing pressure to irregularities presented by the flange surface of the container and to effect a close, intimate, heat-transferring contact between said resilient means, said top, and said container flanges throughout a region extending entirely around said flanges; and

means to supply heat to said resilient means for conduction through said heat conducting means to raise said engaged surface to an elevated temperature, said heat supply means and said heat conduction means cooperating to supply through said resilient means all of the heat required to seal said top to said flanges and providing effective heat-sealing thereof.

2. The improvement to said automatic packaging apparatus as claimed in claim 1 wherein the sealing station in said improved apparatus further comprises:

second means mounted for relative reciprocal movement towards and away from said first means, and being aligned with and opposite said first means,

said resilient means being carried on said second means, and

said heating means being adapted to heat said second means to thereby conduct heat to said resilient means for elevating the temperature thereof.

3. The improvement to said automatic packaging apparatus as claimed in claim 2 wherein:

said first means is a sealing die having side walls which terminate in flat upwardly-facing surfaces for engaging and supporting the under surface of the container flange during the heat-sealing operation and wherein

said second means is a sealing head having side walls which terminate in flat downwardly-facing surfaces aligned with and opposite said upwardly-facing die surfaces, said sealing head being mounted for relative reciprocal movement towards and away from said sealing die,

said resilient means being carried on said sealing head downwardly-facing surfaces, and

said heating means being adapted to heat said sealing head to thereby conduct heat to said resilient means for elevating the temperature thereof.

4. The improvement to automatic packaging apparatus as claimed in claim 3 wherein:

said sealing die is a rigid structure and said flat upwardly facing surfaces are similarly rigid to resist abrasion and consequent deterioration due to transport of said containers thereover.

5. The improvement to said automatic packaging apparatus as claimed in claim 2 wherein said resilient means is a resilient, heat-conducitng continuous pad, and wherein said improved sealing station in said packaging apparataus further comprises:

a heat-conducting strip having a bottom portion embedded in said pad and a top portion adapted to be engaged with said second means for mounting said resilient pad on said second means and for conducting heat generated by said heating means from said second means to said resilient pad.

6. The improvement to said automatic packaging apparatus as claimed in claim 1 wherein said resilient means is a resilient, heat-conducting continuous pad impregnated with a heat-conducting additive.

7. An improved heat-sealing method for use in an automatic packaging apparatus of the type including means for supporting semi-rigid cup-shaped containers having peripheral flanges around the open mouths thereof; a sealing station; means for transporting said supported containers into and through said sealing station; means for supplying to each container a sheet of relatively thin and flexible material to serve as a top for the container;

said method being for heat-sealing the container top to the container flanges to produce hermetically sealed package, and comprising the steps of:

engaging and supporting the under surface of the semi-rigid container flange at said sealing station during the sealing operation with first means;

pressing the top and the adjacent portion of the cup flange together between said first means and reciprocally mounted resilient means containing heat conducting means to provide for good heat conduction therethrough, said resilient means being sufficiently flexible to conform to irregularities presented by the semi-rigid flange surfaces of the container, with at least a moderate amount of pressure to thereby conform the engaged surface of said resilient means, under said pressure, to irregularities presented by the flange surfaces of the container to effect a close, intimate, heat-transferring contact between said resilient means, the top, and the container flanges throughout a region extending entirely around said flanges; and

heating said resilient means with a heating means to an elevated temperature to provide transfer through said heat conducting means and into said top of all of the heat energy required to provide effective heat-sealing of said top to said container flange.

8. The improved heat-sealing method for use in automatic packaging apparatus to heat-seal the container top and the container flange together to form a hermetically sealed package as claimed in claim 7 wherein

said sealing station further includes second means mounted for relative reciprocal movement towards and away from said first means, said second means

being aligned with and opposite said first means; said resilient means being carried on said second means; and

said method further comprises the step of:

heating said second means to thereby conduct heat to said resilient means for elevating the temperature thereof to provide effective heat-sealing of said top to said container flange.

* * * * *