

Dec. 13, 1949

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2,490,781

METHOD AND APPARATUS FOR PREPARING AND UTILIZING
SHEET MATERIAL FOR PACKAGING PURPOSES

Filed Aug. 22, 1946

4 Sheets-Sheet 1

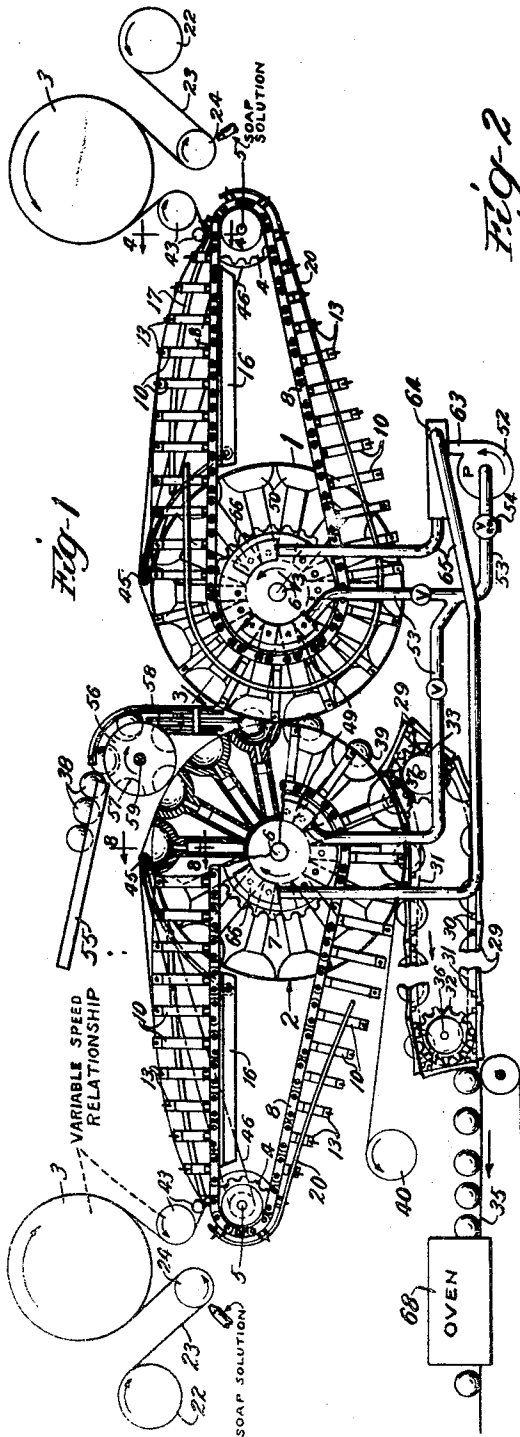
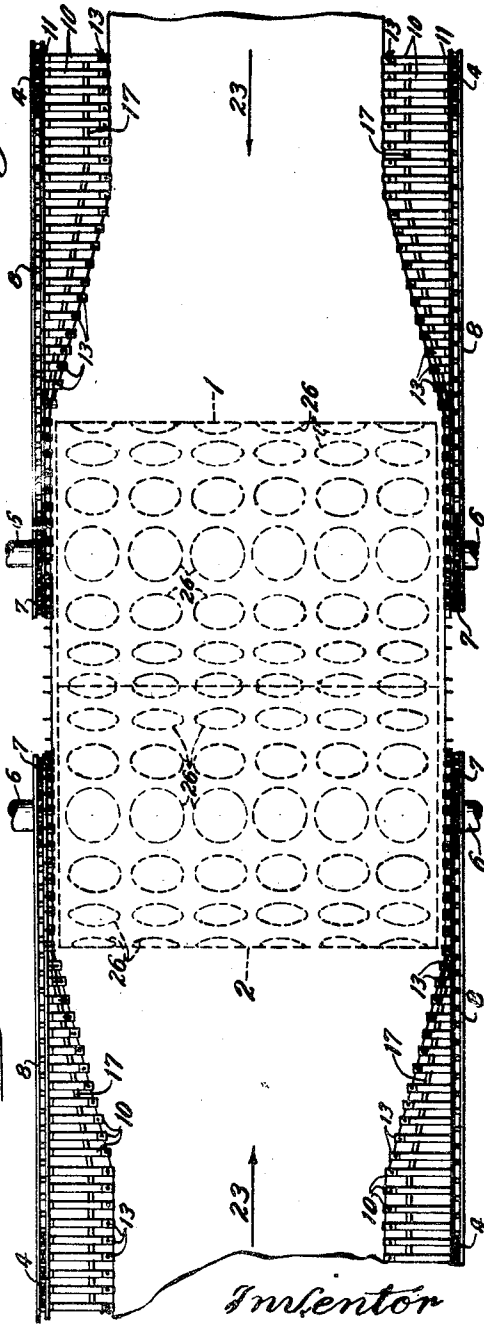


Fig-2



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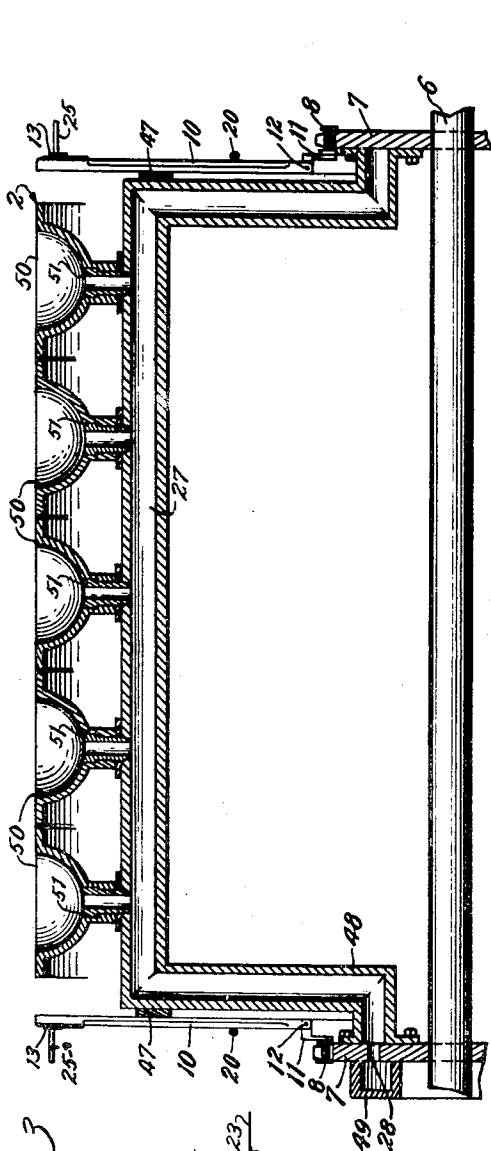
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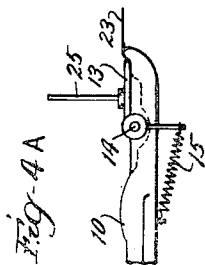
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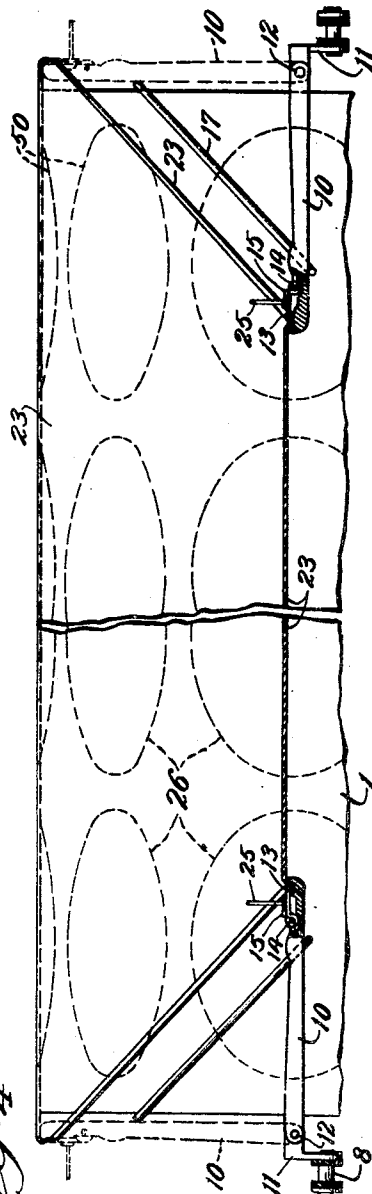
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4 Sheets-Sheet 3

Fig-5

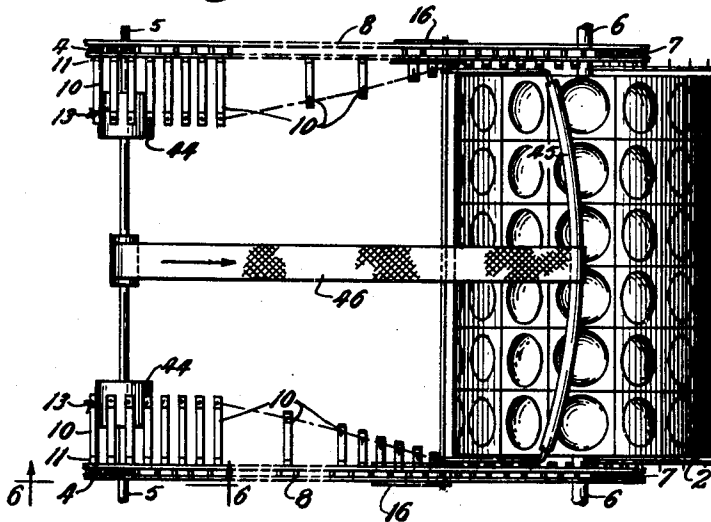
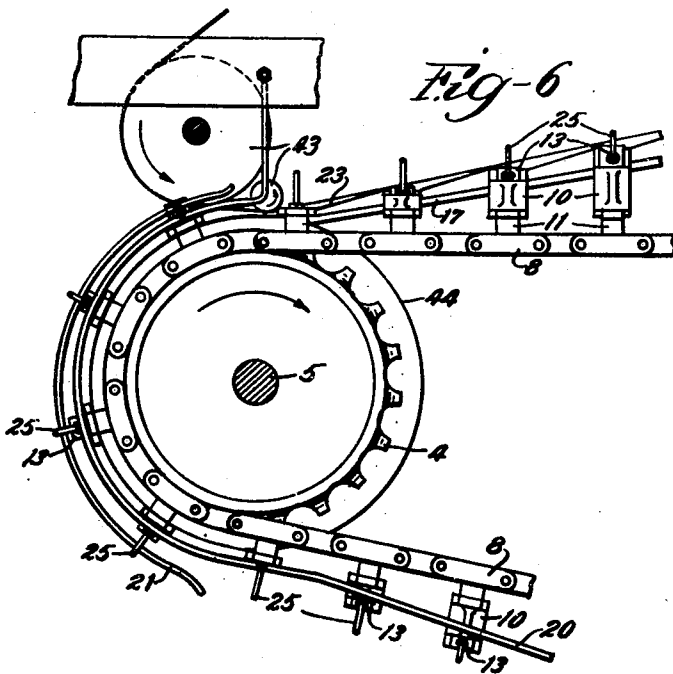


Fig-6



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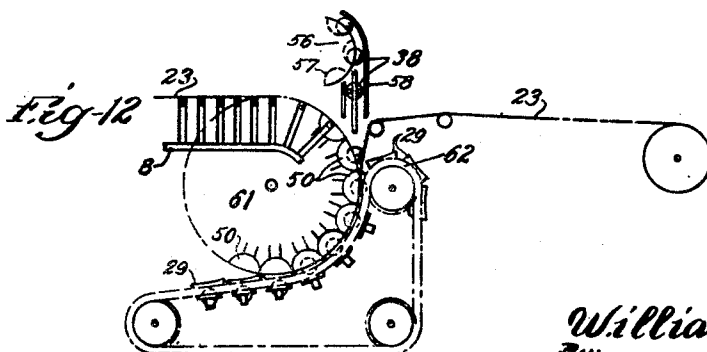
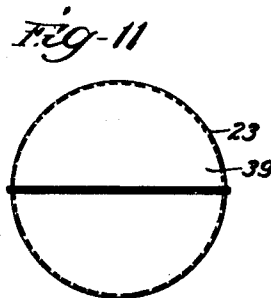
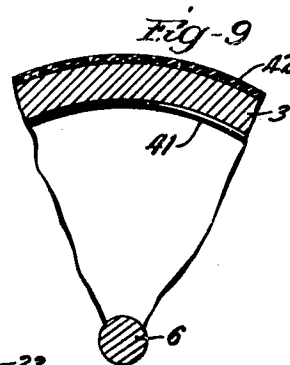
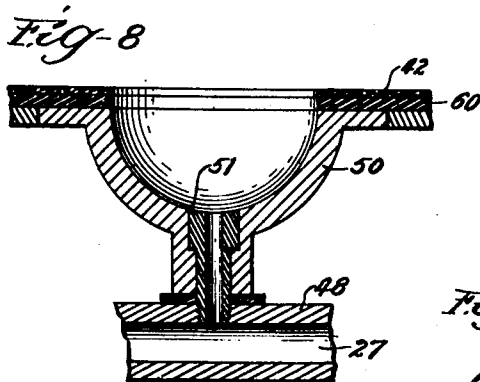
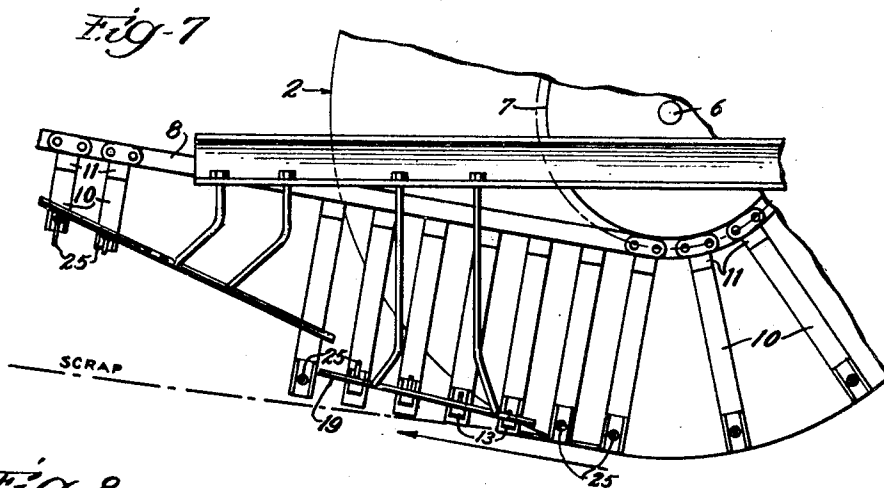
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METHOD AND APPARATUS FOR PREPARING AND UTILIZING
SHEET MATERIAL FOR PACKAGING PURPOSES

Filed Aug. 22, 1946

4 Sheets-Sheet 4



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UNITED STATES PATENT OFFICE

2,490,781

METHOD AND APPARATUS FOR PREPARING
AND UTILIZING SHEET MATERIAL FOR
PACKAGING PURPOSES

William S. Cloud, Wilmette, Ill.

Application August 22, 1946, Serial No. 692,323

51 Claims. (Cl. 18-21)

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This invention relates to a new and improved method and apparatus for preparing and utilizing sheet material for packaging purposes.

There has developed in industry a rather widespread demand for packaging in which the packaging material conforms closely to the shape and size of the various commodities with which it is used and at the same time offers a protective covering therefor. An example of a material that can be made to conform is the rubber hydrochloride product sold by the Goodyear Tire & Rubber Company, Inc., of Akron, Ohio, under the trade name, "Pliofilm."

Although my invention is described herein as relating to the use of Pliofilm, it should be understood that this is illustrative only and the principles of my method can be applied to any sheet material which is or can be made plastic or stretchable and which can be suitably sealed.

Several methods and machines have already been proposed to wrap articles in material such as Pliofilm. Some methods involve little more than hand-wrapping procedure. Others involve the use of a metal frame for suspending the plastic sheet of Pliofilm in horizontal position, forcing the commodity against the sheet to form a pocket therein, then twisting the article and the film by hand to seal the pocket, after which the excess film is cut off by a knife or other cutting means.

Another method of wrapping articles in material such as Pliofilm has been disclosed and claimed in my patent, Number 2,403,482, issued July 9, 1946, wherein the film is suspended over openings, and tubes are forced against the film, creating pockets therein into which the articles to be enclosed are deposited.

In most of these methods, there is a certain amount of stretching of the sheet material. However, in none of these methods is full advantage taken of certain qualities possessed by a material such as Pliofilm. According to the present invention, I attain a package wherein the packaging material conforms more closely and uniformly to the size and shape of the commodity to be wrapped. I also attain greater economy in the use of the packaging material particularly when it is given a two-way stretch before use. The resulting thickness may be accurate within certain predetermined limits according to the use intended.

It is rather generally known that Pliofilm is a substantially moisture-proof, transparent sheet material chemically known as rubber hydrochloride. It is a complex organic compound obtained

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by the reaction of hydrochloric acid with rubber. It possesses peculiar characteristics which are not entirely explainable but which can be useful, and are sometimes troublesome.

For example, it becomes plastic when heated, and, while in this condition, it can be stretched easily to a considerable degree. However, after the film has been stretched and then cooled in the stretched condition, it may be relatively tough and tensilized and may reveal a strong tendency to shrink on being reheated. In this condition, it is rather difficult to handle if it is desired to reheat the film and again make it plastic.

Generally speaking, Pliofilm is manufactured and sold today in sheets of various thicknesses, one of the most commonly used being known as "100 gauge," it being $100/100,000$ of an inch thick. Using known manufacturing processes, there is a practical limit to the thinness to which the sheets can be made. When a thinner sheet is desired, it has been necessary to heat and soften the original film, for example, 100 gauge, stretch it, cool it, and rewind it. This adds to the expense of manufacture and the resulting product is more difficult to handle and use in "stretch-wrapping" than was the original film.

One of the objects of my invention is to provide method and apparatus which, preliminary to forming the wrapping pockets, can accomplish both a lateral and a longitudinal progressive stretch of material in one continuous operation and while being held by the same gripping means throughout the stretching operation.

Another object of my invention is to provide method and apparatus for the formation of pockets in the softened and prestretched sheet material and for the use of such pockets for the reception of articles to be wrapped. Another object of my invention is to provide method and apparatus for the simultaneous use of two sheets of material, softened and prestretched as above indicated, in such a way that the pockets in one sheet are placed in confronting relation with the pockets of the other sheet so as to form complete closures about the articles to be wrapped.

A further object of my invention is to make available to industry a method of stretching in two directions a plastic sheet material, such as Pliofilm, to a predetermined thinness. The control of the stretching operation is of vital importance in certain industries, and in many instances it must be closely regulated.

As an example, I call attention to the experimental work of Dr. A. L. Stahl of the University

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of Florida Experimental Station, described in vol. 4 of No. 4 of the pamphlet "Citrus" published in October 1941, by Florida Citrus Exchange of Tampa, Florida. It is there pointed out that in wrapping articles, such as oranges, with Pliofilm, it is essential that the film be thick enough to protect the article against loss of moisture and thin enough to permit the orange to "breathe," carbon dioxide passing through the Pliofilm.

It has been found that film of a thickness of about 20-gauge, or $20/100,000$ of an inch, is most satisfactory for this purpose. My invention makes possible the two-way stretching of sheet material of considerable thickness, such as $120/100,000$ of an inch, to a predetermined average lesser thickness, such as 20-gauge, or to so stretch the film that the thickness of the finished wrappers will average about 20 gauge. Furthermore, articles are wrapped very efficiently and economically, thus avoiding the tedious labor of wrapping in paper by hand, as has been common heretofore. Other objects and advantages of my invention will appear hereinafter.

This application is in part a continuation of my copending applications Serial No. 436,666, filed March 28, 1942, now abandoned, and Ser. No. 539,971, filed June 12, 1944. The wrapper disclosed herein is claimed in my application Serial No. 532,563, filed April 24, 1944, now abandoned.

In order to illustrate diagrammatically the respective steps of my invention, I have provided the accompanying drawings, all of which are more or less diagrammatic and in which:

Figure 1 is a diagrammatic view of an apparatus for practicing my invention, shown in side elevation and partly in vertical section, some details being omitted for clarity;

Fig. 2 is a top view of the apparatus;

Fig. 3 is a sectional view of a detail on line 3—3 of Fig. 1;

Fig. 4 is a sectional view of a detail taken approximately on line 4—4 of Fig. 1, some parts being omitted for clarity;

Fig. 4A shows a modified form of clamp;

Fig. 5 is a top view of a part of the apparatus illustrating a film-guide roller, its supports and motivating means;

Fig. 6 is a side elevation of a detail illustrating the picking up of the film by the fingers;

Fig. 7 is a side elevation of a detail illustrating the releasing of the excess or scrap film by the fingers;

Fig. 8 is a sectional view of a detail taken on line 8—8 of Fig. 1;

Fig. 9 is a fragmentary sectional view of a heating drum;

Fig. 10 is a detail section of an insulating ring and heating wire as located around the periphery of each recess of the chain-carried cut-off mechanism;

Fig. 11 is an elevation of a spherical object, such as an orange, wrapped and sealed in sheet material which has been stretched according to my method; and

Fig. 12 is a diagrammatic view of an alternative apparatus for practicing my invention, shown in side elevation and partly in vertical section.

In order to illustrate how my method of preparing sheet material is applicable to a packaging operation, attention is directed to Fig. 1 wherein webs of sheet material 23, such as Pliofilm, are fed or unwound from rolls 22, around idler rolls 24, thence around heating drums 3

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where the sheet material is heated, rendered soft and more plastic before it is stretched.

The temperature of drums 3 can be regulated and controlled in a conventional manner so as to heat the sheet material uniformly and maintain uniform plasticity. The heating medium in drums 3 may be steam or hot oil or any other suitable heating agent. As shown in Fig. 9, I prefer to imbed electrical heating elements 41, of the type enclosed in metal tubing, in the drum, being disposed in a helical groove. The drums 3 are preferably at least as wide as the sheet material to heat its full width.

As the heated sheet material is tacky, it is advisable either to use drums 3 with polished metal surfaces such as polished chrome plating or chrome steel or some similar substance, or to cover them or the backs of the films with some substance, such as wax, soap, or paper, which will reduce the tendency for the sheet to stick to the heated drums in case of stopping the machine. As shown in Fig. 9, I prefer to cover the drums 3 and the faces surrounding cups 50, best shown in Fig. 8, with a cotton cloth or spun glass sheet 42. The spun glass or other heat withstanding flexible material is essential on drum 2 because of co-operation with hot cut-off wires. Guide rolls 43 may also be covered but need not be, according to present experience.

Drums 3 and rolls 24 ordinarily are driven in timed relationship with sprocket chains 8 from any suitable source of power (not shown). The timed relationship is preferably adjusted by a variable speed drive capable of minute change, such as a Reeves drive.

From heating drums 3, the webs of sheet material 23 are passed around guide rolls 43, and thence around parallel filling and sealing drums 1 and 2, which face each other at a portion of their peripheries and travel in counterclockwise and clockwise directions respectively. Portions of the opposing surfaces of drums 1 and 2 are in engaged or contacting relation to each other.

Sprockets 4 and 7 are mounted on shafts 5 and 6, respectively, and connected by means of chains 8. The two drums 1 and 2 are connected by gears or a chain and sprockets. Thus, drums 1 and 2 may be driven from any suitable source of power (not shown) applied to any of these shafts. In passing from sprockets 4 to sprockets 7, chains 8 are supported by angle-irons 16 to prevent sag.

Webs 23 are stretched laterally by a series of stretch arms 10 (Fig. 4) pivotally mounted on bracketed side plates 11 of alternate or spaced links of each chain 8.

Each arm carries a spring-pressed clamp or jaw 13 pivotally mounted on pin 14. The spring 15 may be either the form shown in Fig. 4 or that shown in Fig. 4A, the latter having given better service. In Fig. 4A the jaw 13 is fast on shaft 14. The arms and clamps are adapted to be actuated by stationary cams as described below.

As sprocket chains 8 approach sprockets 4, arms 10 are progressively forced inward and upward from a vertical to a horizontal position by stationary guide cams 20. As the arms approach the top of the sprockets in a substantially horizontal position, they come to rest upon pulleys or drums 44 mounted on shafts 5 which support them in a horizontal position. Meanwhile, the pins 25 are engaged by stationary cams 21 which progressively force them in a direction to open clamps 13.

As webs 23 pass around idlers 43, they pass just above the tip ends of arms 10 which are posi-

tioned to receive them, as seen in Fig. 6. Immediately thereafter, clamp jaws 13 pass beyond cams 21 and, under the influence of springs 15 (Fig. 4), clamp the webs 23 against the tips of arms 10 and a tight grip is obtained on both sides of webs 23. This grip is maintained during the lateral and longitudinal stretching and the sealing operations, and until released as described below.

As webs 23, held by clamps 13, pass beyond sprockets 4, the later pull or stretch is begun. This is accomplished by means of stationary guide cams 17 (Figs. 1, 4, and 6) which contact arms 10 and progressively force them outward and upward from horizontal to substantially vertical positions, said arms 10 pivoting on pins 12.

Arms 10 are carried in substantially vertical positions around drums 1 and 2 and until they are forced to a horizontal position, as explained above, by stationary cams 20, said arms being prevented from going inward toward a horizontal position by stationary guide cams 17 and 47, the latter (Fig. 3) being mounted on manifolds 48, and being prevented by stationary cams 20 (Figs. 1 and 3) from falling outwardly if the web tears.

As arms 10 are raised, the web-holding tips of those mounted on opposing sprocket chains 8 move away from each other, thus pulling or stretching webs 23 laterally (Fig. 2). The degree to which webs 23 are stretched laterally may be controlled in at least four ways: by varying the length of arms 10, by varying the extent to which the relative positions of oppositely-disposed arms 10 are changed by guide tracks 17, by causing opposing sprocket chains 8 to diverge at various degrees thus varying the distance between them, and by varying the original width of webs 23.

Upon completion of the lateral stretch of webs 23, said webs arrive at the top of drums 1 and 2. As they are carried from this position around drums 1 and 2, the distance between the web-holding tips of arms 10, in each of the rows carried on chains 8, is increased longitudinally, thereby stretching webs 23 lengthwise (Fig. 1). The percentage to which webs 23 are stretched longitudinally in this manner may be controlled by varying the ratio of the diameter of sprocket wheels 7 to the length of arms 10.

As the heated webs 23 are soft and plastic, the middle portion thereof tends to sag and may contact the drums 1 and 2 prematurely. This tendency may be eliminated by supporting and controlling the middle portion of each web. As illustrated in Figs. 1 and 5, I prefer to do this by a roller 45 formed of a hose rotatable on a rigid, curved core-rod and driven through a belt 46 by the associated shaft 5. The core-rod extends back and down to a point where it can have access to the frame, by which it is carried.

As best shown in Fig. 3, holes 28 have been formed in sprockets 7. Hollow tubes or castings forming manifolds 48 are mounted on the inside of said sprockets so that the two openings cooperate. At predetermined intervals, cups 50 are mounted over openings in the tops of the said manifolds. As articles to be wrapped by my method can be no larger than the inside dimensions of these cups, I prefer to have these cups easily removable and exchangeable. As best illustrated in Fig. 8, my preferred method of mounting these cups is to have a recess in the necks of these cups, on the shoulders of which sit the heads of hollow screws 51 which are screwed into the manifolds 48, thus forming vacuum conduits 27 extending from the cups 50 through the

hollow screws 51, the manifolds 48, and the holes 28 in sprockets 7.

In sliding contact with sprockets 7 are stationary vacuum chambers 49 (Figs. 1 and 3) which are connected with a conventional vacuum pump 52 by tubes 53. A conventional relief valve 54 together with proper regulation of vacuum pump 52 ensures a vacuum of any desired amount.

Thus, the outer surfaces of drums 1 and 2 are composed of the extended and contacting lips or rims of cups 50 and of the cups themselves which form hemispherical recesses 26, positioned in predetermined locations so that the recesses of drum 1 cooperate with oppositely-situated recesses of drum 2 when brought in opposed relation thereto to form substantially spherical chambers.

As drums 1 and 2 rotate, vacuum conduits 27 intermittently register with stationary vacuum chambers 49, at which time the vacuum is applied. This is clear from Fig. 1. It should be noted that the application of vacuum occurs after the longitudinal stretch of webs 23 has been completed. The vacuum draws portions of webs 23 into recesses 26 so as to line the concave surfaces of cups 50, or it may draw the portions any lesser amount desired.

At this time, articles to be wrapped, as for example oranges, represented by number 38 (Fig. 1), are fed into a position between opposing hemispherical recesses 26. This may be done by hand or by any conventional feeder. I prefer to use a separate feeder unit for each longitudinal row of recesses 26. These units are comprised of troughs 55, positioned at a slight angle so that as the articles at their lower extremities fall therefrom, the next articles are automatically positioned by gravity, wheels 56 containing in their outer surfaces hemispherical recesses 57 positioned in predetermined locations, and circular guards 58. The wheels 56 are all mounted fast on shaft 59, which is driven in timed relation to shaft 6 by any convenient means (not shown). I prefer to do this through a chain carried by sprockets mounted on shaft 59 and one of the shafts 6. If this method is used, any variations not compensated for automatically may be met by adjusting one sprocket or its shaft.

The feed may be made more gentle and more versatile in feeding different orange sizes accurately without adjustment by providing a narrow shelf close to the drums 1 and 2 onto which the oranges drop. The shelf is preferably padded and formed of two vanes sloping downwardly toward each other which are opened downwardly quickly by cam action to release the oranges. This is to be the subject matter of a separate application.

Articles 38 to be wrapped fall onto wheels 56. The overhang of circular guards 58 allow the articles to fall only into recesses 58. The movement of wheels 56 drops the articles within circular guards 58 so that they fall into a position between opposing hemispherical recesses 26. As oppositely-disposed recesses 26 face each other, they form substantially spherical chambers in which articles 38 are placed. The peripheral margins of recesses 26 at this time contact each other under pressure. To ensure a proper contact, I prefer to cover one of these drums with a sponge rubber sheet 60 (Fig. 8) or other cushion. The amount of pressure depends upon the relative positions of drums 1 and 2 to each other, one of the drums preferably being adjustable. The left-hand drum of Fig. 1 is the one chosen for

application of the cushion so that the same cushion may cooperate with the cut-off units 29.

Since these portions of webs 23 are in plastic and tacky condition when the drums are brought into contact, the opposing portions of webs 23 which are brought together under pressure are sealed. One of the common characteristics of sheet material such as Pliofilm is that a seal of two sheets of such material can be accomplished by bringing the same into contacting relation in heated plastic condition under pressure.

Immediately after the sealing operation, the web 23, which passes around drum 1, is released from clamps 13. This is done by the action on pins 25 of a stationary cam (not illustrated), the action being identical to that of cam 19, as illustrated in Fig. 7.

At approximately the same time, the vacuum in conduits 27 in drum 1 is released while the vacuum in conduits 27 in drum 2 is maintained. In this way, the wrapped articles 39 (Figs. 1 and 11) are carried around drum 2, between the two webs 23, to any desired position where they may be separated from the excess or unused portion of the webs 30.

This separation of the wrapped articles 39 from the excess or unused portion of webs 30 may be performed in any suitable manner. However, this excess portion is still plastic and in a stretched condition and, as indicated above, material such as Pliofilm, upon being released in this condition, will tend to shrink. Thus, certain difficulties are encountered if the wrapped articles are cut out in a conventional manner. An apparatus for overcoming these difficulties is described in my copending applications, Serial No. 536,014, filed May 17, 1944, and Serial No. 76,808, filed February 16, 1949, wherein all features of the invention relating to the cut-off itself are claimed.

The apparatus of said application which I prefer to use in separating the wrapped articles from the unused portion of the webs and which is diagrammatically illustrated in Fig. 1 includes a series of severing and holding cups 29, carried upon transverse supports 30 and corresponding in number to and aligned to cooperate with the cups 50 in the transverse rows of packaging drum 2. The opposite ends of each transverse support are mounted in any conventional manner upon oppositely-disposed links of endless chains 31, traveling over sprocket wheels 32 and 33 which are carried on shafts 36 and 37, which are driven in timed relation with shaft 6 in any conventional manner so that cups 50 and cups 29 move together.

The holding and severing cups 29 are preferably made of refractory or other heat and electrical insulating material and of a diameter sufficient to receive the packaged article 39. The top of the side walls or rim of each cup 29 is curved to conform to the curved surface of the packaging cups 50 and mounts an electrical resistance wire 34, which either by itself or in cooperation with similar wires mounted on adjoining cups 29 substantially surrounds the rim of the cup.

As the wrapped articles 39 are brought to the bottom of drum 2, they are still held together by the stretched, unrecessed portion of webs 23. This excess web is firmly gripped between the rims or lips of packaging cups 50 and those of holding and severing cups 29, the packaged articles 39 being contained in the substantially spherical chambers formed by the joinder of these cups. As these cups move, and while the excess film surrounding the packaged articles is firmly

held, all around the article, and the following portion held so it will not snap back, the electrical resistance wires 34 are activated in any conventional manner (not shown). The heated wires sever the sheet material, the wrapped articles falling by their own weight into cups 29 which carry them to hopper or conveyor belt 35, depositing them therein as the cups pass around sprocket 32.

The unused, perforated portions of the laminated webs 23 are released from clamps 13 by the action of guide cam 19 on pins 25, as best shown in Fig. 7. This unused portion is then rewound on roll 40 to be sold as scrap. This unused portion is preferably rendered as small as possible (or perhaps eliminated) by the placement of electrical resistance wires 34. Thus the wires 34 may form squares, or other shapes in which a wire 34 partly around one cup 29 extends approximately to wires on adjacent cups, leaving no scrap between articles.

An oven 68 may be provided for the separated oranges to pass through if desired. This seems to ensure that the film will be satisfactorily shrunk around the article and to relieve any strains which might leave a tendency for subsequent tearing. The heat permits any entrapped air to escape, as would pricking with a needle. The needle may be heated to cause resealing, but a tiny hole in a skin tight film is sometimes not very objectionable.

An alternative form of my invention is illustrated in Fig. 12. Here, instead of having two filling and sealing drums 1 and 2 (Fig. 1), I use only one such drum 61 (Fig. 12) which is identical in all respects to drum 2. I replace drum 1 with a continuation or extension of that part of the apparatus described above which was used for separating the wrapped articles from the unused portion of the webs. This continuation or extension is created by lengthening chains 31 and passing them around a higher sprocket 62.

The operation of this alternative apparatus is similar to that of the apparatus first above described, it being identical as to drum 61. As before, the web 23 is passed over a horizontal heating drum (not shown). Thence it passes over severing and holding cups 29. As the articles 39 to be wrapped drop into the semispherical recesses caused by the vacuum's pulling the web passing over drum 61 into packaging cups 50, the articles themselves push the web passing over the holding and severing cups 29 into those cups. The two webs are then sealed by the contact of drum 61 and the lips or rims of cups 29, and the operation is identical from this point. The second web may be prestretched and held in the same manner as in the other figures, or held at the edges in any desired way. It need not be held at the edges if the articles being wrapped are small enough to lie within one of the cups 50.

If it is desired to stretch the sheet material 23 more than is accomplished by either form of my apparatus as above described, this can be accomplished by an additional longitudinal stretch created by causing heating drums 3 to move at a slower rate than do chains 8. This is also a convenient way to regulate the amount of stretch, the relative speeds being easily adjusted by any convenient means. If smaller articles are being wrapped, an increase in pre-stretching may be required to provide the same thickness of the final wrapper. The guide rolls 43 are preferably driven at the same peripheral speed as the chains 8.

Although where the sheet material 23 has not been previously stretched, I prefer the apparatus illustrated in Fig. 1 or in Fig. 12, that apparatus may be modified so that the sheet material is gripped by clamps 13 before it is heated and thus rendered plastic. For example, heating drums 3 could be mounted on shafts 5 (Fig. 1), the web passing partially around the drum but being gripped before engaging it; or heating drums 3 could be eliminated entirely, the heating being done by hot air blowers adjusted to heat the webs immediately after the gripping. This gripping of the sheet material prior to its heating is of assistance in the handling of material which has been previously stretched, due to the tendency of such material to shrink.

It is desirable to keep the sheet material at a sufficiently-high temperature after it has been heated and rendered plastic and during the stretching and packaging operation to maintain the necessary qualities including plasticity and tackiness. There are at least the following four ways of doing this: adjust the general room temperature, provide hot plates spaced below the web, cover the apparatus with a hood, or blow hot air on the material. In Fig. 1, I illustrate one method of blowing hot air on the material. The exhaust from vacuum pump 52 is passed through tubes 63 into a heater 64, thence through tubes 65 into manifolds 66 which direct the hot air through the cups 50 to pass along the said sheet material. Relief valve 54 supplies an adequate supplementary supply of air to the pump. At present it is preferred to use this method of heating and also have the room temperature around 85° F.

In describing my first form of apparatus for performing my invention, I have indicated that portions of webs 23 may be drawn into recesses 26 by vacuum so as to line the concave surfaces of cups 50, or the portions may be drawn down any lesser amount desired. In describing my alternative form of apparatus, I have indicated that, rather than using a vacuum, the articles themselves may be made to push the webs into the cups. It may be desirable in some situations to utilize a particular one of these two methods, or to combine them.

For example, it may be desirable to wrap articles using cups which were made for a larger size of articles without changing to smaller cups. In this case, to ensure a package in which the packaging material conforms closely to the shape and size of the articles, rather than merely relying upon obtaining this result due to the tendency of the material to shrink, it is preferable to have the articles themselves push the webs at least partially into the cups.

Also, it may be desirable to have the cover of the wrapped articles of constant thickness throughout, or thicker at some places than at others.

It has been found that when heated thermoplastic material is stretched over the top of a semi-spherical vacuum mold and suction sufficient to stretch the material to engage the sides and bottom of the mold is applied, the stretching reduces the thickness of the material to a greater extent at the center than at the sides so that the covering of articles wrapped on my machine when the film is forced into the cups in this manner might be of greater thickness adjacent the circumferential seal with thinner and weaker covering at points more distant therefrom.

It has also been found that when articles are

forced into the center of sections of heated thermoplastic material held about the edges, the material is stretched, reducing the thickness of the material to a greater degree at the portions adjacent the held edges than at the point of contact with the article, so that the covering of articles wrapped on my machine when the film is forced into the cups in this manner might be of greater thickness at points distant from the circumferential seal with thinner and weaker covering at points adjacent thereto.

If the cover of packaging material is somewhat larger than the article wrapped therein during the time the material is following its natural tendency to shrink, it may itself form a cover of uniform thickness conforming closely to the article, the thinner portions of the material being under a relatively higher tension and shrinking proportionately more than the thicker portions. By forcing the material into the cups partially by vacuum and partially by the article, uniform thickness of the wrapper is ensured, as described and claimed in my copending application, Ser. No. 539,971, filed July 12, 1944. It is particularly desirable to be able to regulate the degree of suction to minimize the trapping of air in the wrappers. The relief valve 54, being adjustable, supplies this need for adjustability.

Although the invention has been described especially as with respect to Pliofilm, it will be obvious that other elastic films may be used, especially those which are thermoplastic in the sense that they become plastic, at least during the continuation of the process, by the application of heat. Of course, with any type of film, the manufacturer should be asked to supply the type best suited for this process. In the case of Pliofilm, for example, some Pliofilms have given better results than others. That which seems best among those now being furnished by the Goodyear Corporation is that which they designate Pliofilm P2h, 140 gauge.

Although I have described my invention in detail and, therefore, utilized certain specific terms and language herein, it is to be understood that the present disclosures are illustrative, rather than restrictive, and that changes and modifications may be resorted to without departing from the spirit or scope of the claims appended hereto.

It is believed that the term "stretched" wherever used in this application is intended to mean more than merely being drawn taut or drawn out to the film's natural length. Where a term broad enough to cover the latter condition is desired, the word "outstretched" is sometimes used. When reference is made to an increase in an overall dimension, this indicates stretching by pulling whether or not there may also be stretching by forming pockets. The term "non-stretchable" is, of course, not used in an absolute sense, since any material can be stretched infinitesimally and cold Pliofilm can be stretched appreciably even though its stretchability is not comparable to that of heated Pliofilm.

It is also desired to note that the term "progressively" has been intended to connote the performance of a step on successive parts of a sheet whether or not specific reference is also made to successive parts of the sheet. In like manner, in stating that one step is performed after another, reference is, of course, to a particular part of the machine, even though the first step is continuing as to another part of the sheet.

At present it is preferred that the final wrappers

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have an invisible coating resulting from drying film of soap solution, to prevent adhesions between wrappers. This may be accomplished by spraying or otherwise coating the under surfaces of the webs before they reach the heating drums 3 so that the water is evaporated by the heat of the drums.

Although some reference has been made to oranges, it should be recognized that this is typical of all citrus fruits, with which the invention is especially advantageous. Of course the invention is also highly useful in packaging other articles, including loose or fluid material.

I claim:

1. In the method of preparing sheet material for packaging purposes, the step of stretching said material, which comprises gripping the edges thereof by opposed rows of fingers carried by pivotally-mounted arms, softening said material by application of heat thereto, increasing the lateral distance between oppositely-disposed rows of said fingers and, beginning at a predetermined point, increasing longitudinally the distance between the material-gripping portions of said fingers located on each side of said sheet.

2. The method of stretching plastic sheet material, which comprises gripping the edges of said material by opposed rows of fingers carried on pivotally-mounted arms, increasing the lateral distance between oppositely-disposed rows of said fingers by raising said arms from horizontal to substantially vertical positions and, beginning at a predetermined point, increasing longitudinally the distance between said fingers carried by said arms located on each side of said sheet.

3. The method of stretching plastic sheet material, which comprises gripping the edges of said material while in motion by opposed rows of gripping members carried on pivotally-mounted arms, increasing the lateral distance between oppositely-disposed rows of said gripping members by raising said arms from a substantially horizontal to a substantially vertical position and, beginning at a predetermined point, accelerating the forward movement of said gripping members by passing the same through an arcuate path of greater radius than that followed by said pivotally-mounted arms.

4. The method of stretching rubber hydrochloride sheet material both laterally and longitudinally, which comprises gripping the edges of said sheet material by fingers carried on pivotally-mounted arms, passing said sheet material around a heated drum, stretching the sheet laterally by forcing said arms on either side of the said sheet away from the center thereof, and stretching said material longitudinally by carrying said fingers and said sheet material around a portion of the periphery of a circle larger in radius than that followed by said pivotally-mounted arms.

5. The method of stretching rubber hydrochloride sheet material both laterally and longitudinally, which comprises gripping the edges of said material by fingers carried on pivotally-mounted arms, passing said sheet material around a heated drum, stretching said material laterally by forcing said arms from a substantially horizontal to a substantially vertical position, and stretching said sheet longitudinally by carrying said fingers around a portion of the periphery of a circle larger in radius than that followed by said pivotally-mounted arms.

6. A method of preparing flexible, normally non-stretchable sheet material for packaging

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purposes, comprising gripping opposite edges of the sheet at a plurality of spaced points, softening at least a portion of the sheet, then stretching the sheet laterally by gradually pulling the edges of said sheet in opposite directions at said points while moving the sheet lengthwise, and then pulling both edge portions of the sheet longitudinally thereof by increasing the distance between said points at which the edges of said sheet are held, thereby increasing the length of the laterally-stretched sheet.

7. A method of packing articles comprising softening at least portions of a plurality of sheets of flexible material which is substantially non-stretchable at atmospheric temperature, exerting force on the softened sheets and thereby increasing the width and length of the sheets, then exerting pressure on each sheet in a direction substantially perpendicular to the surfaces thereof to form confronting cavities in the sheets, enclosing an article in the cavities and causing portions of the sheets surrounding the cavities to adhere to one another to seal the articles within the cavities, and finally severing the enclosed article from the unused portion of said sheets.

8. In an apparatus of the character described, first means for moving a web of flexible, normally non-stretchable material, means for softening at least a portion of said web while propelled by said first means, means for gripping the edges of said web, means for stretching said softened portion of said web longitudinally and laterally while being held by said gripping means, means for forming a cavity in said softened portion after it has been stretched, and means for depositing an article in said cavity.

9. In an apparatus of the character described, first means for moving a web of flexible, normally non-stretchable material, means for softening at least a portion of said web while propelled by said first means, means for stretching said softened portion of said web longitudinally and laterally, and means for forming a cavity in said softened portion after it has been stretched.

10. In an apparatus of the character described, means for preparing sheet material for packaging purposes, comprising opposed rows of gripping elements adapted to grip opposite edges of sheet material, each element having a pivotally-mounted arm, means for moving the gripping elements of the rows in unison in the same general direction, means for softening the sheet material as it is propelled by said gripping elements, means for increasing the lateral distance between the gripping portions of oppositely-disposed gripping elements as they travel, and means for increasing longitudinally the distance between the gripping portions of the gripping elements of each row for stretching the sheet longitudinally.

11. In an apparatus of the character described, first means for gripping and moving a plurality of webs of flexible, normally non-stretchable material toward one another, means for softening at least a portion of said webs while held by said first means, means cooperating with said first means for stretching said softened portions of said webs longitudinally and laterally while being held by said first means, means for forming opposed cavities in the softened portions of the webs after they have been stretched, and means for depositing an article in said cavities.

12. In an apparatus of the character described, first means for gripping and moving a plurality of webs of flexible, normally non-stretchable material toward one another, means for softening

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at least a portion of said webs while held by said first means, means cooperating with said first means for stretching said softened portions of said webs longitudinally and laterally while being held by said first means, means for forming opposed cavities in the softened portions of the webs after they have been stretched, means for depositing an article in said cavities, and means for severing the enclosed article from said webs.

13. The method of stretching plastic sheet material, which comprises gripping the edges of said material by opposed rows of fingers carried on pivotally-mounted arms, increasing the lateral distance between oppositely-disposed rows of said fingers by moving said arms about their respective pivots, and beginning at a predetermined point, increasing longitudinally the distance between said fingers carried by said arms located on each side of said sheet.

14. The method of stretching plastic sheet material, which comprises gripping the edges of said material while in motion by opposed rows of gripping fingers carried on pivotally-mounted arms, increasing the lateral distance between oppositely-disposed rows of said fingers by moving said arms about their respective pivots, and beginning at a predetermined point, accelerating the forward movement of said fingers by passing the same through an arcuate path of greater radius than that followed by the pivots of said pivotally-mounted arms.

15. The method of stretching rubber hydrochloride sheet material both laterally and longitudinally, which comprises gripping the edges of said material by fingers carried on pivotally-mounted arms, passing said sheet material around a heated drum, stretching said material laterally by moving said arms about their respective pivots and stretching said sheet longitudinally by carrying said fingers around a portion of the periphery of a circle larger in radius than that followed by the pivots of said pivotally-mounted arms.

16. In an apparatus of the character described, first means for moving a web of flexible, normally non-stretchable material, means for softening at least a portion of said web while propelled by said first means, means for gripping the edges of said web, means for continuously stretching said softened portion of said web longitudinally and laterally while being held by said gripping means throughout the stretching operation, means for forming a cavity by further stretching said softened, stretched portion, and means for depositing an article in said cavity.

17. The method of reducing the thickness of plastic material in web form which comprises advancing a web of such material, progressively holding the web at spaced points along the longitudinal edges thereof, progressively moving the opposed points laterally away from one another to stretch the web transversely, and progressively longitudinally stretching the portion of the web between said points while said portions of the web are being held against lateral contraction.

18. The method of reducing the thickness of plastic material in web form which comprises advancing a web of such material, progressively holding the web at spaced points along the longitudinal edges thereof, progressively moving the opposed points laterally away from one another to stretch the web transversely, progressively longitudinally stretching the portion of the web between said points while said portions of the web are being held against lateral contraction, and deforming the web in a direction perpendicular

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lar to its face to form a pocket and further stretch the web, and depositing an article in said pocket.

19. The method of stretching plastic material in web form to reduce its thickness, which comprises progressively grasping successive portions of the web by individual gripping means disposed in rows along the opposed longitudinal edges of said web and then progressively increasing the lateral distance between the opposed rows of said gripping means and increasing the longitudinal distances between the individual gripping means on each edge of said web.

20. The method of stretching plastic material, which can be softened by heat, in web form to reduce its thickness, which comprises progressively heating said material to soften it, progressively grasping successive portions of the web by individual gripping means disposed in rows along the opposed longitudinal edges of said web and then progressively increasing the lateral distance between the opposed rows of said gripping means and increasing the longitudinal distances between the individual gripping means on each edge of said web.

21. Packaging apparatus comprising means for progressively stretching a web of elastic material sufficiently to reduce its thickness and holding it stretched, and means effective while it is still held stretched for stretching the material further to form pockets and then enclosing successive articles in said pockets.

22. Apparatus for progressively stretching web material to reduce the thickness thereof including traveling holding means for the opposite longitudinal edges of the web, the holding means for at least one edge comprising a series of holders each being carried by a traveling arm pivoted at a point substantially spaced from the holding means on each arm, said arm being pivotal to move the holder in a direction to stretch the web transversely, and means for thus pivoting the arm as it travels.

23. Apparatus for progressively stretching web material to reduce the thickness thereof including traveling holding means for the opposite longitudinal edges of the web, the holding means for at least one edge comprising a series of holders each being carried by traveling arms pivoted at a point substantially spaced from the holding means on said arm, said arm being pivotal to move the holder in a direction to stretch the web transversely, and means for thus pivoting the arm as it travels; said holding means including a member about which the web inwardly from the held portion is wrapped as the arm pivots, whereby the holding of the web is aided by a snubbing action.

24. The method of wrapping articles in a strip of thermoplastic material comprising progressively stretching successive portions of the material at least to one-half of its original thickness, forming pockets in said portions of the material for further stretching the said portions, depositing successive article to be wrapped in said pockets, closing and sealing said pockets about the retained articles, and severing the wrapped articles from the strip.

25. The method of preparing elastic film for packaging purposes comprising progressively stretching successive portions of the film to decrease its thickness, holding said stretched portions of the film against contraction, then further stretching the said portions of the film while held against contraction to form pockets to receive the article to be wrapped.

26. The method of preparing a continuous web of material which may be made more stretchable by softening, comprising progressively softening successive portions of said material, then exerting pulling forces on the softened portions thereof in more than one direction and thereby increasing the overall length and width of the successive portions of the web, and afterwards exerting pressure against one face of the successive portions of the web in a direction substantially perpendicular to said face to further stretch said material in a direction substantially perpendicular to said face, while it is still in such softened condition, and thereby form a cavity in the web adapted to partially enclose an article.

27. Apparatus for progressively stretching successive portions of sheet material including spaced rows of traveling holding means including sheet-engaging portions for holding the longitudinal edges of the sheet material at spaced points, means for progressively feeding sheet material to said holding means in generally outstretched condition longitudinally, and means for progressively longitudinally separating from one another the sheet-engaging portions of each row while the sheet is held thereby, to stretch the sheet.

28. Apparatus for progressively stretching successive portions of sheet material including spaced rows of traveling holding means including sheet-engaging portions for holding the longitudinal edges of the sheet material at spaced points, means for progressively feeding sheet material to said holding means in generally outstretched condition, and means for progressively separating the rows laterally and progressively longitudinally separating from one another the sheet-engaging portions of each row while the sheet is held thereby, to stretch the sheet.

29. Apparatus for progressively stretching web material to reduce the thickness thereof, including spaced rows of holders, each carried by a traveling arm pivoted at a point substantially spaced from the holder on said arm, said arm being pivotal to move the holder in a direction to stretch the web transversely, means for thus successively pivoting the arms as they travel, and means for successively swinging the arms of each row angularly away from the following arm to progressively separate the holders in each row from one another.

30. The combination of spaced rows of holders for holding a web therebetween, each holder being carried by a traveling arm, means for progressively feeding sheet material to said holders in generally outstretched condition, means for successively swinging the arms of each row angularly away from the following arms to progressively separate the holders in each row from one another, and means effective on the portion of the web held by the holders which have thus been separated for further stretching the web by forming pockets therein.

31. The combination of spaced rows of holders for holding a web therebetween, each holder being carried by a traveling arm pivoted at a point substantially spaced from the holder on said arm, said arm being pivotal to move the holder in a direction to stretch the web transversely, means for progressively feeding sheet material to said holders in generally outstretched condition, means for thus successively pivoting the arms as they travel, means for successively swinging the arms of each row angularly away from the fol-

lowing arms to progressively separate the holders in each row from one another, and means effective on the portion of the web held by the holders which have thus been separated for further stretching the web by forming pockets therein.

32. Apparatus for progressively stretching web material to reduce the thickness thereof including traveling holding means for the opposite longitudinal edges of the web, the holding means for at least one edge comprising a series of holders each being carried by a traveling arm pivoted at a point substantially spaced from the holding means on each arm, said arm being pivotal to move the holder in a direction to stretch the web transversely, means for thus pivoting the arm as it travels, and means for feeding web material to said holding means but retarding it at a point spaced from the holding means to a speed less than that of the holding means to preliminarily stretch the web longitudinally.

33. Apparatus for progressively stretching successive portions of sheet material including spaced rows of traveling holding means including sheet-engaging portions for holding the longitudinal edges of the sheet material at spaced points, means for progressively feeding sheet material to said holding means in generally outstretched condition and for controllably retarding the sheet material at a point spaced from the holding means to preliminarily stretch the sheet material longitudinally, and means for progressively separating the rows laterally and progressively longitudinally separating the sheet-engaging portions of each row while the sheet is held thereby, to stretch the sheet.

34. Apparatus for sealing an article in a film of predetermined thickness, thinner than film presented to the apparatus, including opposed rows of traveling holders adapted to hold opposed edges of a film, means for moving the holders apart to stretch the film a predetermined invariable amount, suction means effective on the stretched film to suck pockets into the film, and including means for regulating the strength of the suction to correlate the size of the pocket to the size of the article, means for enclosing the article in the pocket, and means for feeding a web of material to the holders and for adjustably retarding the movement thereof at a point spaced from the holders to adjustably pre-stretch the film and adjust the net total strength thereof.

35. Apparatus for sealing an article in a skin-tight film of thermoplastic material including a pair of cooperative rims, vacuum cup means associated with at least one rim, means for applying a strip of heated thermoplastic material over each rim, means for partially exhausting the air in the cup means to draw the film drawn thereover partially into the cup means to form an undersized pocket in the cup means, the effective strength of the exhausting means being such that the total pocket depth of the two films will not be as great as the corresponding dimension of the article, means for inserting an article in the pocket in contact with the center portion of the pocket and pressing it further into at least one film to stretch the film, said apparatus including means for bringing the rims together to seal the two films together about the article.

36. The method of sealing an article in a skin-tight film of thermoplastic material, including stretching strips of the heated thermoplastic film over the lips of approaching rims of greater

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diameter than that of the article, applying a partial vacuum to the back of at least one film to draw the center of the films stretched over the rim rearwardly, said vacuum being so applied and of such force that combined cavity depth of the films across the two rims is less than the corresponding dimension of the article, embracing the article between the advancing rims, engaging the opposite sides of the article with the center of the film drawn into each mold, and closing the molds upon each other, thus further stretching at least one of the films and pressing the films stretched over the rims into engagement with each other to form a heat-sealed skin of film.

37. In an apparatus of the character described, means for moving a plurality of webs of flexible, normally non-stretchable material toward one another and curving them to bring their faces into contact, means for progressively softening successive portions of said webs, means for progressively stretching said softened portions of said webs longitudinally and laterally, means for forming opposed cavities in said softened stretched portions, and means for releasing articles above said cavities in timed relation to their movement to cause the articles to drop into a cavity as it is about to be sealed.

38. Apparatus for stretching web material including a drum, means for carrying web material to and around the drum including gripping means adapted to grip the opposite edges of the web and move apart to stretch the web, and sag preventing means adjacent the drum to hold the web away from the drum during stretching.

39. Apparatus for stretching web material including a drum, means for carrying web material to and around the drum including gripping means adapted to grip the opposite edges of the web and move apart to stretch the web, and sag preventing means adjacent the drum to hold the web away from the drum during stretching, including rotary means extending transversely of the web and driven with approximately the peripheral speed of the drum.

40. Apparatus for heating and stretching web material, including a heating drum, means for running the web around the drum with the full width of the web in contact therewith, series of gripping means, and means for applying the successive gripping means to the opposite edges of the web after the web leaves the drum, and means for moving the gripping means along each edge apart from each other lengthwise of the web while the sheet is gripped thereby.

41. Packaging apparatus comprising means for progressively stretching a web of elastic material sufficiently to reduce its thickness and holding it stretched, means effective while it is still held stretched for stretching the material further to form pockets larger than the articles to be wrapped and then for enclosing successive articles in said pockets, and means for heating the closed pockets to allow the escape of any entrapped air holding portions of the pockets away from the enclosed articles.

42. Packaging apparatus comprising means for progressively stretching a web of elastic material sufficiently to reduce its thickness and holding it stretched, means effective while it is still held stretched for stretching the material further to form pockets larger than the articles to be wrapped and then for enclosing successive articles in said pockets, and means for shrinking the closed pockets to conform to the size and

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shape of the articles enclosed therein by allowing the escape of any entrapped air.

43. Means for wrapping fills including means for stretching a film to reduce its thickness while maintaining it substantially unpocketed, means for stretching it further by forming pockets therein, means for sealing the pockets with additional film, and means for inhibiting adhesions of the wrappers including means for applying soap solution to the surface of the film forming the outer surface of the wrapper, and means subjecting the coating to heat to dry the coating before forming pockets therein.

44. Means for wrapping fills including means for applying soap solution to the surface of a web of film as it moves, means for heating the web to which said solution has been applied to dry the coating and soften the film to permit it to be stretched and sealed, means for thereafter stretching the web to reduce its thickness while maintaining it substantially unpocketed, means for thereafter stretching it further by forming pockets therein, and means for thereafter sealing the pockets around a fill in said pockets.

45. The method of sealing a spherical article in a skin tight film of thermoplastic material of uniform thickness throughout its entire surface including stretching strips of the heated thermoplastic film over the lips of approaching similar semi-spherical molds of slightly greater diameter than that of the article, partially exhausting the air in each of the molds to draw the center of the films stretched thereover substantially halfway to the bottom of each mold, thus reducing the thickness of each film at the center, embracing the article between the advancing molds, engaging the opposite sides of the article with the center of the film drawn into each mold, and closing the molds upon each other further stretching the films between the lips of the molds and the article, thus reducing the thickness of each film at the sides, while the lips press the films stretched thereover into engagement with each other to form a heat sealed skin of film of uniform thickness about the article.

46. The method of sealing a generally spherical article in a skin tight film of thermoplastic material stretched to uniform thickness throughout its entire surface including stretching strips of heated thermoplastic material over lips of approaching similar suction cups of slightly greater diameter than the article, partially exhausting the air in at least one of the cups to draw the center of the film engaging the lip thereof substantially halfway to the bottom of the cup, thus reducing the thickness of the film especially at its center, embracing the article between the advancing cups, engaging the opposite sides of the article with the centers of the film engaging each cup, and closing the cups upon each other thereby further stretching the films between the lips of the cups and the article, thus reducing the thickness of each film at the sides while the lips press the films stretched thereover into engagement with each other to form a heat-sealed skin of film of uniform thickness about the article.

47. The method of sealing an article in a skin tight film of thermoplastic material including stretching a strip of the heated thermoplastic film over the lips of a vacuum cup of slightly greater diameter than the article, partially exhausting the air in the cup to draw the center of the film stretched thereover substantially halfway to its ultimate depth, thus reducing the thickness of the film especially at the center, in-

serting the article in the pocket of the film thus formed in the cup and engaging the article with the center of the film, pressing the article further into the cup thereby further stretching the film between the lip of the cup and the article, thus reducing the thickness of the film at the sides, and sealing another strip of thermoplastic material covering the other side of the article to the first-named strip at the lip of the cup.

48. The method of sealing a generally spherical article in a film of thermoelastic material having predetermined distribution of thickness including stretching strips of heated thermoelastic material over lips of approaching similar suction cups of greater diameter than the article; drawing the center of the film engaging the lips of at least one of the cups into the cup a predetermined depth and reducing the thickness of the film, with greater reduction at its center than adjacent the lip, by partially exhausting the air in the cup; embracing the article between the approaching cups by engaging the opposite sides of the article with the centers of the films engaging the lips of the cups; and, by closing the cups upon each other around the article, stretching the films between the lips of the cups and the article and reducing the thickness of each film, with greater reduction adjacent the lips than at the centers, to such an extent that the wall thickness of the film previously drawn partially into the cup is made substantially more uniform, while the lips press the films stretched thereover into engagement with each other to form a heat-sealed skin of film about the article.

49. The method of sealing a generally spherical article in a film of plastic material, which may be rendered stretchable by heating it, having predetermined distribution of thickness including heating strips of said material; stretching said strips over lips of similar suction cups of greater diameter than the article; drawing the centers of said strips into the cups a predetermined depth and reducing the thickness of said strips, with greater reduction at their centers than adjacent the lips, thereby forming initial hollow shapes having predetermined distribution of thickness, by partially exhausting the air in the cups; substantially maintaining said shapes until further stretching begins; engaging the opposite sides of the article with the centers of said shapes while said material is readily stretchable; and, by closing the cups upon each other around the article, enlarging said initial hollow shapes and reducing their thickness, with greater reduction adjacent the lips than at the center, to such an extent that their wall thickness is made substantially more uniform, while the lips press the strips stretched thereover into engagement with each other to form a heat-sealed skin of film about the article.

50. The method of sealing a generally spherical article in a film of thermoelastic material including stretching heated strips of said material over lips of approaching similar suction cups of greater diameter than the article; drawing the center of the film engaging the lip of at least one

of the cups toward the bottom of the cup and reducing the thickness of the film, with greater reduction at its center than adjacent the lip, by partially exhausting the air in the cup; embracing the article between the approaching cups by engaging the opposite sides of the article with the centers of the films engaging the lips of the cups; and, by closing the cups upon each other around the article, stretching the films between the lips of the cups and the article and reducing the thickness of each film, with greater reduction adjacent the lips than at the centers, to such an extent that the wall thickness of the film previously drawn partially into the cup is made substantially more uniform, while the lips press the films stretched thereover into engagement with each other to form a heat-sealed skin of film about the article.

51. The method of sealing an article in a wrapper forming a taut elastic skin of sheet material including stretching heated strips of elastic, heat-sealable sheet material over lips of approaching similar suction cups of greater diameter than the article; drawing the center of the film engaging the lip of at least one of the cups toward the bottom of the cup and reducing the thickness of the film, with greater reduction at its center than adjacent the lip, by partially exhausting the air in the cup; embracing the article between the approaching cups, by closing the cups upon each other around the article, stretching the films between the lips of the cups and the article and reducing the thickness of each film, with greater reduction adjacent the lips than at the centers, to such an extent that the wall thickness of the film previously drawn partially into the cup is made substantially more uniform, while the lips press the films stretched thereover into engagement with each other to form a heat-sealed skin of film about the article; and releasing the said elastic skin to cause it to contract until it has drawn itself tightly about the article.

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December 13, 1949

WILLIAM S. CLOUD

It is hereby certified that errors appear in the printed specification of the above numbered patent requiring correction as follows:

Column 3, line 30, strike out the comma and words ", now abandoned" and insert the same after "1944" and before the period in line 28; column 5, line 11, for the word "later" read *lateral*; column 6, line 61, for "recesses 58" read *recesses 57*; column 10, line 75, for "is is" read *it is*; column 11, line 18, for "by", second occurrence, read *on*; column 14, line 63, for "for" read *by*; line 64, for "article" read *articles*; column 18, line 10, for "surfance" read *surface*; line 61, for "furthed" read *further*;

and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 18th day of April, A. D. 1950.

[SEAL]

THOMAS F. MURPHY,
Assistant Commissioner of Patents.