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[54] **FILM-TRANSPORTING APPARATUS**
18 Claims, 3 Drawing Figs.

[52] **U.S. Cl.** **226/172**
[51] **Int. Cl.** **B65h 29/12**
[50] **Field of Search** 226/172; 271/45, 75, 79

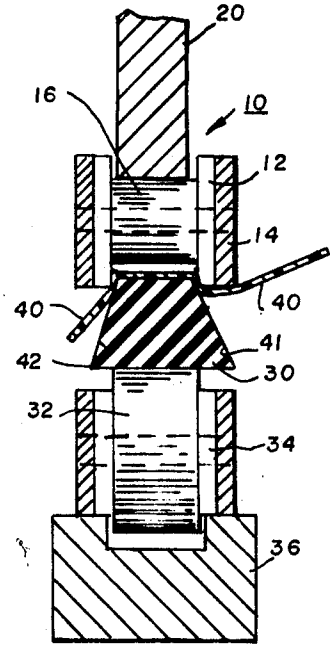
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ABSTRACT: Apparatus is provided for transporting a strip of film through the contiguous engagement of the protruding portions of the inner links of a roller chain and a V-belt adapted to engage the strip of film so as to locally clamp the film between the tapered sides of the V-belt and the protruding inner portions of the inner side links of the roller chain. The roller chain is preferably arranged to ride upon and be supported by a guideway and the V-belt is disposed to be engaged by a plurality of rollers so that the spacing of the V-belt from the roller chain is a determined and substantially consistent distance.



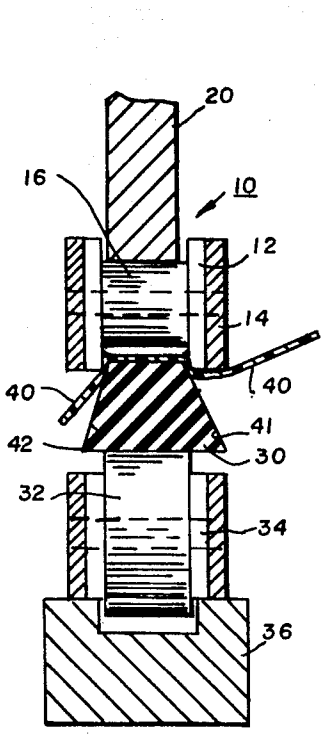


FIG. 1

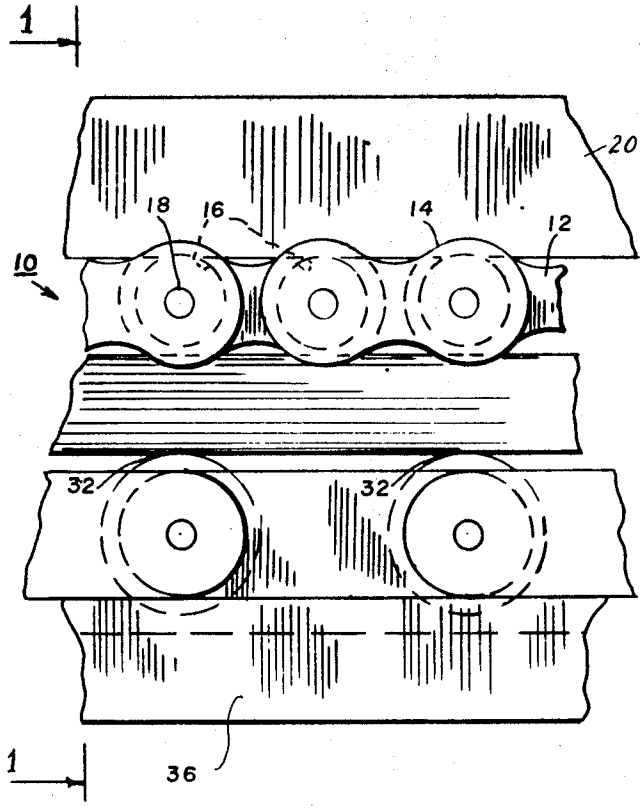


FIG. 2

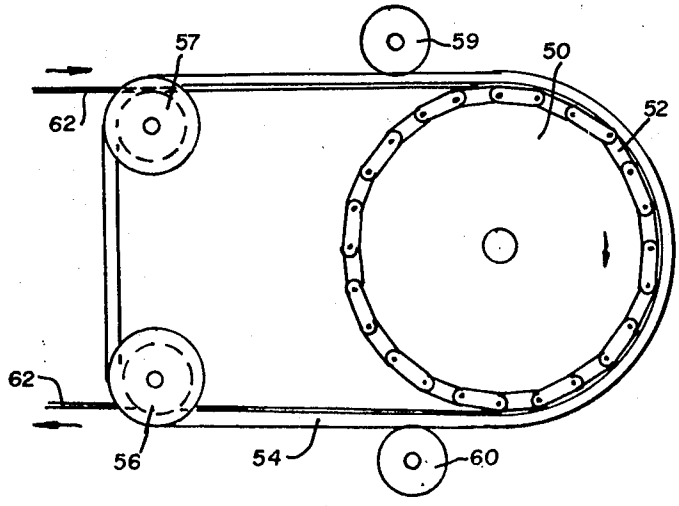


FIG. 3

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FILM-TRANSPORTING APPARATUS

BACKGROUND OF THE INVENTION

1. Field of the Invention

In reference to the classification of art as established in the United States Patent Office, the art to which the present invention pertains is found generally in the class entitled "Sheet Feeding Or Delivering" and more particularly in the subclasses for "Feeding by Endless Conveyors" and also by "-Delivering by Endless Conveyors."

2. Description of the Prior Art

The feeding and transporting of strip film of a very thin gauge such as one- or two-thousandths of an inch or less usually presents a problem in that conventional gripping apparatus has a tendency to permit the film to slip from the clamp mechanism. Many of the conventional and known clamps are both expensive and partially unreliable in that as the film varies in thickness or is pulled by forming action the film slips from the clamps. Bar clamps for films of five-thousandths of an inch or more are also unsatisfactory and permit slipping of the film from the clamp. It sometimes is desireable in the process of gripping and transporting film to retain the film in a determined manner so that there is provided a slight side pull on the film by means of the gripping action. Film so held is more or less taut as it is transported. In addition it is often desirable for the film to be delivered from a supply reel and in other than a direct or straight path to be fed to processing operations in a more or less circuitous route. These devious paths are often necessary to avoid portions of the equipment or to bring the film in way of certain treating or process steps and operations. Film-transporting apparatus has been disclosed in many U.S. Patent, as for example, U.S. Pat. No. 1,858,443 to Fulk which issued May 17th, 1932. Another film-transporting apparatus is seen in U.S. Pat. No. 2,896,943 to Lewis which issued July 28th, 1959 and also in a transporting device for processing film as shown in U.S. Pat. No. 2,899,201 which issued to Pirot on Aug. 11th, 1959. In these and similar U.S. Patents the clamping of the film and transporting of the film is generally by the gripping of the film between or by bars, belts or blocks. These disclosed film-gripping apparatus often fail to provide the desired clamping of the film without slippage of the film. If a positive penetrating grip is used for gripping the film and transporting the film there is usually no ready release from the gripping means at this release station without either tearing or unduly stretching the film.

SUMMARY OF THE INVENTION

The present invention may be summarized at least in part with reference to its objects.

It is an object of the present invention to provide, and it does provide, a film clamping and transporting means wherein film is releasably gripped by means of a V-belt brought into engagement with the larger inner link portions of a roller chain, said V-belt and roller chain being retained by guide and support means so as to maintain a determined positive engagement and alignment of the roller chain and the V-belt during their travel along a prescribed transport path.

In the present invention a roller chain of determined size and pitch is carried by a bar adapted and size to engage the rollers of the roller chain. This bar provides a support for and a positive guide path for this roller chain. A V-belt is supported and guided so that its small or inner face is disposed to enter between the inner links of a roller chain so that the tapered sides of the belt engage the inner edges of the protruding portions of the inner links of the roller chain to provide a gripping action between each protruding portion of the inner link and the tapered sides of the V-belt so as to pinch a film of a determined thickness between the two tapered sides of a V-belt and the edges of the protruding portions of the inner roller chain links.

INTENT OF THE DISCLOSURE

Although the following disclosure offered for public dissemination is detailed to insure adequacy and aid in understanding of the invention, this is not intended to prejudice that purpose of a patent which is to cover each new inventive concept therein no matter how it may later be disguised by variations in form or additions of further improvements. The claims at the end hereof are intended as the chief aid toward this purpose, as it is these that meet the requirement of pointing out the apparatus in which the inventive concept is found.

There has been chosen two embodiments of the film transporting apparatus showing preferred means for gripping and transporting thin film without tearing the film. These embodiments have been chosen for the purposes of illustration and description as shown in the accompanying drawing wherein:

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 represents a sectional view of the film-transporting mechanism and showing in particular the relationship of the roller chain and the V-belt to the film being transported;

FIG. 2 represents a fragmentary side view of the film-transporting mechanism of FIG. 1, and

FIG. 3 represents a diagrammatic side view of an alternate film-transporting apparatus also employing a roller chain and belt.

In the following description and in the claims various details are identified by specific names for convenience; these names, however, are intended to be generic in their application. Corresponding reference characters refer to like members throughout the three figures of the drawing.

The drawing accompanying, and forming part of, this specification discloses certain details of construction for the purpose of explanation of the broader aspects of the invention, but it should be understood that structural details may be modified in various respects without departure from the concept and principles of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawing in detail there is shown in FIGS. 1 and 2 a preferred embodiment of a film-transporting apparatus wherein a roller chain **10** has inner and outer links **12** and **14** assembled in the usual manner with rollers **16** therebetween carried on pins **18** by which the roller chain is assembled. This roller chain may be of any selected pitch, as for example, a No. 40 roller chain which is a chain having a ½-inch pitch and is of known and conventional construction. This roller chain **10**, for the purposes of clamping a film, requires no additional attachments or the like as for the roller chain is concerned; however, in order to precisely position this roller chain in space as it is transported along, there is provided a backup bar **20** of a determined thickness and contour. This backup bar is adapted to engage the rollers **16** and to freely fit within the two inner side links **12** of the roller chain **10**.

A V-belt **30** of determined cross-sectional configuration and construction is supported by means of rollers **32** carried in side bars **34** mounted to or carried by a base **36**. These rollers **32** are closely spaced along the support path so as to engage the back of the V-belt **30** and maintain the V-belt in a determined path and spacing from the roller chain **10**. An extended pitch roller chain whose rollers are larger than the side plates may also be used to provide the same similar constructional support. A film **40** may be fed from a supply roll and the like and from the roll be brought between the roller chain **10** and the V-belt **30** so that the film is caught between and is engaged by the flank tapered sides **41** and **42** of the V-belt **30** and is pinched between the tapered sides and the inner edges of the protruding portions of the inner side links **12** of the roller chain **10**. The V-belt **30** is selected as to its cross-sectional configuration so that when the flank or tapered sides **41** and **42** grip the film by pinching the edges of the protruding por-

tions of the film against the side plates **12**, that portion of the film **40** between the plates **12** is free of contact of the rollers **16**. This is a desirable condition when the rollers **16** are freely rotatable for as they ride upon the support rail **20** they are rotated with their outer diameters moving at twice the speed of the transported film **40**. In certain installations the use of a rollerless chain or pintle type chain is preferred. Such a chain would have a pin instead of a freely rotatable roller so that if the belt did cause the film to engage the pin, the gripped film would be uneffected by this engagement.

Use and Operation

In the film-transporting mechanism of this invention it is contemplated that the roller chain **10** will be driven by means of one or more driven sprockets, not shown, which sprockets, of course, are adapted to receive and drive the roller chain **10** in a conventional manner. The support bar **20** has its roller supporting face contoured to provide the exact path desired for the transporting of the film. In like manner the V-belt **30** is supported by a series of rollers **32** which are precisely positioned above the base **36** so that the roller-supported V-belt **30** travels in a precise path determinedly spaced from the roller chain **10**. Film **40**, as it is fed from a supply such as a supply reel, is brought between the roller chain **10** and the V-belt **30** so that the film is pinched between the tapered side flanks **41** and **42** of the V-belt **30** and the edges of the protrusions of the inside side links **12** of the roller chain **10**. When the roller chain and the V-belt approach their divergence point and move apart the film **40**, of course, is released. As they proceed on the return route they are brought together at the transport section or sections whereat the film **40** is caused to be pinched or snugly engaged for a releasable retaining of the film by means of the transporting mechanism.

The pinching of the film **40** is at the enlarged or protruding ends of the inner side links so that a chain having a ¾-inch pitch, as is shown in the drawing, would engage the film at points three-fourth of an inch apart. If the desired engagement of the film is to be at a greater linear frequency, the pitch of the roller chain is made closer, as for example, one-half inch or three-eighths of an inch. When it is desired to make the gripping of the film at a greater spacing than a roller chain having pitches of one inch, an inch and a fourth and greater is used. It is of course, realized that two like transport arrangements, such as is shown in FIGS. **1** and **2**, are usually used so as to grip both edges of a transported film to retain the film in the desired transporting path and in certain instances to cause the film to be lightly stretched to a taut condition as the film is brought over the sides of the roller chain and is impressed slightly into the recess between the inner side plates of the roller chain.

Film-Transporting Apparatus of FIG. 3

Referring finally to FIG. **3** there is shown a diagrammatic side view of a film transport arrangement in which a pulley or sprocket **50** is disposed so as to retain an endless length of roller chain **52**. This chain is mounted on and around the circumference of the pulley and is preferably fixedly attached to the pulley so as to be rotated with and by this pulley. A belt **54**, which may be either a V-belt or a round belt, is disposed so as to be snugly drawn against about one-half of the length of chain **52**. The belt, as shown, has a portion of its length carried on two sheaves **56** and **57**. These sheaves and the belt portion carried thereon are disposed so as to lie out of the plane of the chain **52**. A pair of idler sheaves or pulleys **59** and **60** are carried adjacent to and in the plane of the chain **52** so as to deflect the belt to and from the plane of the chain and to the sheaves **56** and **57**. A film member **62** may be a strip of film and, as shown, is fed to the pulley **50** whereat it is gripped by the chain **52** and belt **54** so as to be transported about 100° around the sprocket or pulley **50**, after which the strip of film is released for further operations or transport.

As thus shown in FIG. **3** it is apparent that the film transporting apparatus of this invention only requires that the roller chain be supported and maintained in a determined path and alignment so that, as it is moved, the belt is brought into gripping engagement with the inner link members of the chain to grip the film. Whether the belt is drawn or pushed into its desired path, it is only necessary that the belt engage and push the film into gripping engagement with the protrusion portions of the inner links of the chain.

Of course, if desired, the relationship of the belt and chain in apparatus such as shown in FIG. **3** may be reversed. In other words, instead of an endless chain being carried on the pulley, the belt may be carried on the pulley. The chain is then carried on sprockets arranged so that a determined length of chain is brought into an unsupported and tightly drawn engagement with a determined arc portion of the belt carried by the pulley. So arranged, the film is still gripped between the belt and chain.

Definitions and Terms

"Film" as above-described contemplates that the film is sufficiently flexible so as to be bent from its normal plane without permanent deformation. Polyethylene film up to about five-thousandths of an inch in thickness is such a flexible film. A more flexible film such as "Surlyn" (T.M. of E.I. DuPont for ionomer resin film) could be one of the slightly thicker films. Film for packaging usually is of thin gauge such as from one-to five-thousandths of an inch in thickness and the gripping action provided by the above-described transport apparatus is quite satisfactory for such films. Films of even twenty- or thirty-thousandths of an inch in thickness are satisfactorily gripped if the film is heat-softened to become as flexible as the thinner more commonly used films. Laminated films can, of course, be accommodated in the above apparatus.

"Roller chain" as shown and described contemplates a chain having a regular spacing of its rollers disposed for the transport of the chain by sprockets. As to whether the side links have their sides conventionally contoured as shown in FIG. **2** or whether the sides are straight or otherwise sloped is merely a matter of design. It is only necessary that the chain be so sized that the small face of the V-belt, as it is caused to enter between the inner side plates of the chain, is spaced from the sloped flanks of the V-belt so as to engage the film and locally pinch the film between the flanks of the V-belt and the side links or plates of the chain without the film being pushed into engagement with the rotating rollers. Rollerless or pintle type chain in which pins are used to provide the separation and drive spacing is also contemplated for use in the apparatus. If the rollers or pins do not rotate during the gripped film transport step, then the bottom of the V-belt may be permitted to push the film into engagement with the pins or rollers.

"V-belt" as above-shown and describes contemplates a conventional V-belt whose flanks or sides lie in planes tapering toward each other. A round belt could also be used in place of the V-belt shown just as long as the film is gripped between the belt the inner side links of the roller chain.

Although it is contemplated that the film transport apparatus is usually provided for the feeding of a strip of film, it is also recognized that sheets of film may also be transported and fed by this apparatus. Two chains spaced a determined distance apart are also considered as the normal feeding arrangement for the film but more chains may be used if desired. Only one chain need be used where only one side of the film is to be gripped as may be found in certain film-folding operations. The number of chains and V-belt film transport apparatus used in a particular installation is therefore only a matter of selection.

The web or film need not go over both inside links of the chain for the belt to grip the film. The amount of gripping force may also be preselected and maintained by spring loading either or both the backup bar **20** or the support for rollers

32. A more sophisticated biasing means may be provided by the use of pneumatic or hydraulic cylinders actuated by a determined pressure supply of air or fluid. The frequency and size of the point contact of the film at the engaging points are merely a matter of selection as is the applied pressure at these points. As slippage caused by shrinkage, heating, forming and the like is the greatest problem in film transport, particularly in vacuum forming and the like, the selection of the chain, belt and pressure permits such problems to be easily solved with the above-described transporting apparatus.

Terms such as "left," "right," "up," "down," "bottom," "top," "front," "back," "in," "out" and the like are applicable to the embodiment shown and described in conjunction with the drawing. These terms are merely for the purposes of description and do not necessarily apply to the position in which the film-transporting apparatus may be constructed.

The conception of the film-transporting apparatus and its applications is not limited to the specific embodiment shown but departures therefrom may be made without sacrificing its chief advantages and protection is sought to the broadest extent the prior art allows.

What is claimed is:

1. Apparatus for gripping, positioning and transporting a strip of film and the like as it is fed between advancing film gripping members, said apparatus including: (a) an endless length of chain such as roller chain, pintle chain and the like, said chain having side links with protruding portions thereon spaced at determined intervals; (b) a flexible endless belt of generally regular cross section and having a contoured surface portion adapted to be brought into film gripping engagement with the inwardly facing edges of the protruding portions of the side links of the endless chain, and (c) means for supporting and positioning the chain and the flexible belt in an aligned and determined relationship to each other for and during the extent of transporting of the film in the apparatus, said aligned and determined relationship providing for the releasable gripping of the film between the contoured surface of the endless belt and the several protruding edges of the side links of the chain as they are brought into said aligned facing and gripping relationship to each other.

2. Apparatus for gripping and transporting film as in claim 1 in which the endless chain is a roller chain having rotatable rollers and in which the support for said chain is a backup bar which is sized and positioned so as to engage and guide the chain in a determined path.

3. Apparatus for gripping and transporting film as in claim 2 in which the backup bar is a metal bar sized so as to enter between the inner side links and engage and support the rollers of the chain.

4. Apparatus for gripping and transporting film as in claim 1 in which the endless chain is a pin-type chain having no freely rotatable rollers and in which the belt is contoured so as to engage and grip the film between protruding side link portions of the chain and the contoured belt so as to grip the film at spaced intervals in at least a single longitudinal line.

5. Apparatus for gripping and transporting film as in claim 1 in which the endless belt is a V-belt, said V-belt being supported by a plurality of like-sized freely turning rollers carried in a determined path.

6. Apparatus for gripping and transporting film as in claim 5 in which the rollers supporting the V-belt are rollers carried by pins of an extended pitch roller chain, said rollers being freely rotating rollers and supporting the V-belt in a determined path and spacing from the endless chain.

7. Apparatus for gripping and transporting film as in claim 1 in which the endless belt is a round belt of determined cross section, said round belt being supported by a plurality of spaced and suitably contoured freely turning rollers carried by a support means in a determined path.

8. Apparatus for gripping and transporting film as in claim 1 in which the endless chain is a roller chain having rotatable rollers, said chain being supported by a backup bar of metal which is sized so as to enter between the inner side links of the chain to engage and support the rollers of the chain to thus guide the chain in a determined path; and in which the endless belt is supported by a plurality of like-sized freely turning rollers disposed in a determined path to maintain the belt a determined distance from the roller chain, the endless belt having its contoured surface shaped so as to grip the film between the belt and the protruding side portions of the chain and at these spaced intervals absent engagement of the film with the rotatable rollers of the roller chain.

9. Apparatus for gripping and transporting film as in claim 8 in which the endless belt is a V-belt whose tapered sides adjacent the narrow end of the belt are sized so as to push the film into engagement with only the inner edges of the protruding portions of the side links of the roller chain.

10. Apparatus for gripping and transporting film as in claim 1 in which the endless chain in a pintle-type chain having its side members connected by a pin and absent rotatable rollers, said chain being supported by a backup bar of metal which is sized so as to engage and support the links of the chain to guide the chain in a determined path and in which the endless belt is supported by a plurality of like-sized freely turning rollers carried by side plates on a support so that the rollers are disposed in a determined path to maintain the belt a determined distance from the pintle-type chain, the endless belt having its contoured surface so as to grip the film between the contoured surface of the belt and the protruding side portions of the chain, said belt and chain being driven at a like surface speed.

11. Apparatus for gripping and transporting film as in claim 10 in which the endless belt is a V-belt whose tapered sides adjacent the narrow end of the belt are sized so as to push the film into engagement with only the inner edges of the protruding portions of the side links of the chain.

12. Apparatus for gripping and transporting film as in claim 1 in which there are at least two like endless chain and endless belt assemblies, said assemblies positioned so that during their extent of film transport the transport paths are in substantially parallel arrangement and in which the assemblies are driven at like linear speeds.

13. Apparatus for gripping and transporting film as in claim 1 in which the endless chain and endless belt are cooperatively disposed so that the transport of the film is at least in part in a curved path with one of the gripping members carried on a convexly curved support member and the other gripping member is urged into a tight concave engagement with the convexly disposed gripping member during the extent of transport of the film through the curved transporting path.

14. Apparatus for gripping and transporting film as in claim 13 in which the convexly curved gripping member is the endless chain member and in which the concavely curved other gripping member is the endless belt.

15. Apparatus for gripping transporting film as in claim 14 in which the endless-belt-gripping member is disposed during a portion of its transcribed path to be moved into a plane not in the plane of the endless chain.

16. Apparatus for gripping and transporting film as in claim 13 in which the convexly curved gripping member is the endless belt member and in which the concavely curved gripping member is the roller chain which is carried in substantially the same plane as the curved film-transporting path of the endless belt.

17. Apparatus for gripping and transporting film as in claim 1 in which the roller chain is carried on a circular support and in a common plane and in which the endless belt is made taut and is disposed so as to be urged into a gripping engagement with the chain for a determined extent of arc.

18. Apparatus for gripping and transporting film as in claim 1 in which the endless belt is carried on a circular support and is disposed in a common plane and in which the roller chain is made taut for its period of engagement with the belt so as to be urged into gripping engagement with the belt for a determined extent of arc.