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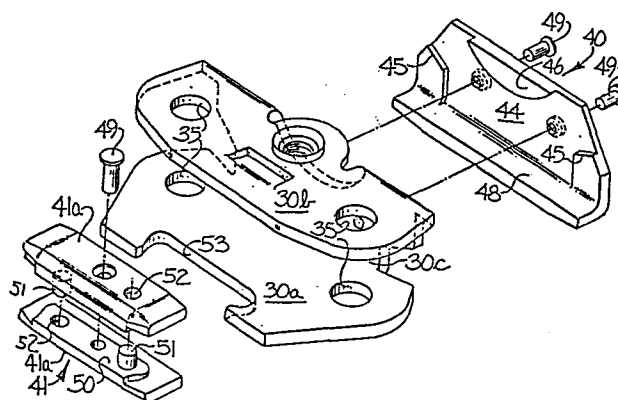
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54 **Nonlubricated tenter frame utilizing low friction polymer wear elements on the chain.**

57 A tenter frame that is free from lubrication requirements along the tenter frame guide rails is disclosed. The tenter frame includes a pair of parallel, relatively spaced guide rails including one or more bearing surfaces. A chain is operatively associated with the guide rails for movement therealong and includes a plurality of links having one or more bearing surfaces that are generally complementary to the bearing surfaces of the guide rails. A block of low friction polymer material is attached to one or more of the link bearing surfaces and is sandwiched between the bearing surface portions of the guide and the links. The block is comprised of low friction polymer material and is substantially the only contact between the link and the guide, so that the tenter frame is free from lubrication requirements.



NONLUBRICATED TENTER FRAME UTILIZING LOW
FRICTION POLYMER WEAR ELEMENTS ON THE CHAIN

Field Of The Invention

Tenter frames are used primarily by the textile industry as an aid in the drying or heat setting of fabrics. The present invention relates to a tenter frame
5 having an endless chain associated therewith, and that is free from lubrication requirements for the tenter frame guide rails and chain, thereby avoiding undesirable staining of the fabrics by the lubricants. The links of the chain include low friction polymer wear elements that
10 do not require lubrication.

Background Of The Invention

A tenter frame is typically used to hold or stretch fabric in a flat sheet and convey it in that condition through a high temperature dryer. This speeds
15 moisture removal and may be used in a heat setting process for synthetic fabrics.

The tenter frame itself usually extends the length of the dryer and includes a pair of spaced parallel guide rails that are supported on both ends and along the length
20 thereof. Each rail usually has two longitudinal channels to guide and support an endless chain therein. The endless chain is looped or threaded around each rail, running the length thereof through the channels. Tenter clips or the like are carried by at least some of the chain links and
25 releasably grip the fabric to stretch it across the space between the parallel rails. The opposite side of the rail is a return for the chain and clips.

The chains are moved by a suitable drive mechanism, such as a driven gear at one end of each rail and a corresponding pulley or idler wheel at the other end.

Thus, the fabric is moved through the dryer stretched from
5 rail to rail as though it were on an endless conveyor.

Due to the length of the chain, the weight of the fabric, the necessity to hold the fabric in tension, the speed of operation, the need to maintain proper alignment, and the weight of the tenter clips, the components of the
10 tenter machine and the chain must be durable and strong. Moreover, due to the length of a typical tenter machine, for example, up to 150 feet, substantially all of the weight of the moving chain and fabric is borne by the stationary tenter guide rail, creating sizeable frictional
15 forces in the direction of the longitudinal axis of the rail. Further frictional forces are established in the direction transverse to the rail due to the horizontal stretching of the fabric, which urges the moving tenter clips and chain against the stationary tenter guide rail.
20 Still further frictional forces of a torsional nature are created by the typical gooseneck configuration for attachment of the tenter clips to the chain.

A variety of methods have been tried to minimize these frictional forces and all are characterized by the
25 need for lubrication along the length of the rail. However, greases, oils, graphite, and other lubricants are the bane of fabric manufacturers because they are difficult to confine to the tenter guide rail or any channels in the rail. Instead, they often come into contact with the

fabric and are extremely difficult to remove, resulting in damaged goods. The problem is exacerbated by the high temperatures generated in the dryer, which tend to set any stains on the fabric.

5 Further problems involve replenishing the lubricant and maintaining uniform lubrication along the entire length of the tenter guide rail. Lubricants are typically applied at several places and spread along the length of the tenter rails by the movement of the endless chain associated with the guide rail. However, excess lubricant
10 often accumulates at the point of application and migrates onto the tenter clips or fabrics. On the other hand, the lubricants do not spread evenly along the rail, leaving dry unlubricated spots, which cause excessive and uneven wear.

15 Still further problems involve trying to determine if there is sufficient lubrication along the entire length of the guide rail. If the lubrication is insufficient, the rail and chain rapidly wear due to the high speed and frictional loading, necessitating an expensive and time consuming overhaul.
20

 In the past different lubrication techniques have been tried, as well as different techniques for confining the lubricant. However, undesirable and costly cloth contamination has still run as high as thirty percent,
25 reflecting little or no improvement. For instance, different metals, such as bronze, have been tested as replaceable wear plates or bearing surfaces, but they still require lubrication and suffer the aforementioned disadvantages. Graphite materials and graphite impregnated

materials have also been tried, but they leave a dark residue that eventually migrates to the fabric and is very difficult to remove. Still further techniques involved the use of sprayed-on low friction coatings, but these have a short life due, in part, to the harsh environment and high stress factors, making them unacceptable.

Summary of the Invention

The present invention has overcome these problems with a novel and unique tenter frame that incorporates blocks of low friction polymer material on the bearing surfaces between the guide rail and the chain. The polymer blocks conform to the shape of the rail and are substantially the only contacts between the rail and chain. One of the major advantages is the elimination of the need to lubricate the guide rail, which avoids the undesirable staining and cloth contamination due to soiling from lubricants. Other advantages include less down time, less maintenance time for lubrication and repair, higher operating speeds, and higher efficiency. Cost savings result from the significant reductions in fabric contamination, maintenance time, parts costs, and lubricant usage.

In accordance with the present invention, a tenter frame is provided for transporting sheet like material in an open width condition along a predetermined longitudinal axis. The tenter frame includes a pair of parallel, spaced guide rails having bearing surface portions generally parallel to the tenter frame longitudinal axis. An endless

chain is associated with the guide means and includes links having bearing surfaces that are located generally complementary to the bearing surface portions of the guide means. Blocks of low friction polymer material are carried by certain of the links and are disposed between the bearing surface portions of the guide rails and the links. The blocks of polymer material are substantially the only contact between the links and the guide rails and provide essentially all of the lubrication necessary for the operating of the tenter frame. The blocks of low friction polymer material are preferably a carbon/graphite filled polytetrafluoroethylene polymer.

Brief Description Of The Drawings

Some of the features and advantages of the invention having been stated, others will become apparent as the description proceeds, when taken in connection with the accompanying drawings, in which:

FIG. 1 is a simplified top plan view of one end of a non-lubricated tenter frame of the present invention extending out of a drying oven or the like;

FIG. 2 is a perspective view of a portion of one of the tenter guide rails and endless chains of the present invention;

FIG. 3 is a top plan view of the non-lubricated tenter frame of the present invention, in partial cross-section, showing the links joined together to form an endless chain disposed in grooves of a tenter rail;

FIG. 4 is a cross-sectional view of the tenter frame taken along line 4-4 of FIG. 3;

FIGS. 5 and 7. are perspective views of tenter chain links, each view taken from different directions; and

FIGS. 6 and 8, respectively, are exploded perspective views of the links illustrated in FIGS. 5 and 7.

5 Description Of The Illustrated Embodiment

Referring to FIGS. 1 and 2, and using like numerals to identify like items, the reference character 10 generally indicates a tenter frame extending into a dryer 11 through an access slot (not shown). The dryer does not
10 form a part of the present invention and it is omitted from other figures for clarity. The tenter frame 10 includes a pair of relatively spaced parallel guide rails 12 and a driven rotational means 14 at one end of each rail. An
15 endless chain 15 is associated with and guided by each guide rail 12 and is wrapped around the respective rotational means 14 for endless movement as shown by the arrows in FIG. 2, for conveying a sheet material S, such as a textile fabric, longitudinally through the oven 11 in an open width condition.

20 The tenter rails 12 extend for predetermined lengths, which may, for example, exceed one hundred feet, and thereby define a longitudinal axis L (FIG. 2). Each rail 12 may be a composite construction with each section disposed in connected end to end fashion to create butt
25 joints along the length of the rail, or it may be extruded as a single continuous unit. Each rail may be supported as necessary or desirable along its length in a convenient manner.

The illustrated rail 12 of FIGS. 2, 3 and 4 includes a central portion 16 with a hollow core and a pair of side portions 17 disposed on opposite sides thereof.

Each side portion 17 defines an upwardly open
5 longitudinally extending channel 18 that is coextensive with the tender rail 12. As shown most clearly in FIGS. 3 and 4, each channel 18 includes a relatively flat, vertical exterior side wall 20 along the outermost portion of the channel. Directly opposite across the channel and parallel
10 thereto is a relatively flat, vertical interior side wall 21. The bottom of the channel is formed by a relatively flat lower surface 22 that is generally perpendicular to the exterior and interior side walls 20, 21. An upper wall portion 23 adjoining the interior side wall 18 defines
15 within the channel 16 a centrally extending side opening groove 24. Some or all of these channel and groove surfaces may function as bearing surfaces upon which the chain or link portions thereof may slide, and the exact configuration of the channel and groove surfaces may vary.

20 The chain 15 extends along the channel 18 and is composed of a series of interconnected links, including alternately arranged carrier links 30 and roller links 31. To each of the carrier links 30 is fastened a suitable fabric holding means of known construction, such as a clip,
25 pin device, or combination. In the arrangement illustrated in the drawings, the fabric holding means comprises a clip means 32. The clip means 32 is removably attached to the upper body portion of the carrier link 30 and includes a fixed yoke shaped clamping portion 33 and a pivoted jaw 34

carried thereby so as to releasably clamp the sheet material S.

The carrier link 30, as shown in more detail in Figures 5 to 8, is of a unitary construction and formed in a generally C-shaped cross section including a laterally extending lower or base portion 30a with a planar lower surface, a laterally extending upper or top portion 30b, and a generally vertical front portion 30c extending between the base portion 30a and the top portion 30b. Apertures 35 are provided in the base and top portions 30a, 30b for receiving a pin for connection to the roller links 31. As best seen in Figures 3 and 4, the link 30 in its operative position in the channel 18, has the vertically oriented outer surface of the front portion 30c disposed in complementary opposing relation to the exterior wall 20 of the channel, while the lower surface of the base portion 30a is disposed in opposing complementary relation to the lower surface 22 of the channel. The rearmost extremity 30d of the base portion 30a is located within the side opening groove 24 of the channel 16.

As is also evident from Figures 3 and 4, the aforementioned portions of the carrier link 30 are maintained out of contacting relation with the bearing surfaces of the channel 18 by blocks of low friction material generally indicated by the reference characters 40 and 41. These blocks 40, 41 are carried by the carrier link 30 at all points of contact with the rail 12 and thus prevent metal to metal contact between the carrier links 30 and the rail 12. Moreover, the very low frictional properties of

the polymer blocks permit the chain 15 to be moved in its course of travel along the channel 18 without the necessity of any additional lubricants.

In the preferred form of the invention
5 illustrated, the low friction polymer blocks 40, 41 are composed of a filled low friction fluorocarbon polymer, preferably polytetrafluoroethylene (PTFE) polymer, and the polymer contains a graphite filler to further contribute to the extremely low frictional properties of the polymer
10 blocks. The graphite filler also contributes significantly to the structural properties of the blocks, and enables them to withstand the high loading and shear forces encountered in this particular environment.

PTFE is produced by controlled polymerization of
15 tetrafluorethylene and contains only carbon and fluorene. The high bond energy between the two elements provides this polymer with certain unique properties. For instance, it is essentially chemically inert to industrial chemicals and solvents, it retains its useful physical properties over a
20 range of temperatures from approximately -250°C to $+250^{\circ}\text{C}$; it has one of the lowest coefficients of friction known for solids; and it has a low degree of wetting. The graphite filled PTFE as used in the present invention is not brittle and has little deformation or creepage under load at high
25 temperatures. Typical physical properties include a bulk density of approximately 2 grams per cubic centimeter, transverse strength of approximately 2200 ft./lbs. per square inch, and thermal expansion in the range of approximately $30\text{-}45 \times 10^{-6}$ inch/inch/ $^{\circ}\text{F}$.

Although the thickness of the block may vary, thicknesses of at least about 1/8 of an inch is preferred because it provides improved mechanical properties under the relatively high loads, high speeds of operation, and
5 harsh environmental factors encountered in a tenter dryer.

The shape of each polymer block may vary as necessary or desirable provided that it has a surface configuration complementary to the opposing surfaces of the tenter rail channel and groove that it slides against, and
10 that it is substantially the only contact between the tenter rail and the link. This permits operation without the need for any lubricants that might contaminate the fabric. However, the particular configuration of blocks 40, 41 as illustrated herein is preferred since this configuration provides a means for reliable securement of the
15 blocks to the carrier link 30 while permitting ready replacement if necessary.

As best seen in FIGS. 6 to 8, the block 40 which is located on the front portion 30c of the carrier link 30
20 has an outer sliding surface 42 that is substantially planar and conforms to the side wall 20 of the channel 18. The outer side edge portions of the block are preferably chamfered, as illustrated (FIG. 7). The block inner surface 44 includes projections, as indicated at 45, that fit
25 into complementary openings on the front portion 30c of the carrier link 30 to prevent lateral shifting movement of the block with respect to the link. An additional arcuately-shaped projection 46 cooperates with a corresponding arcuately-shaped cutout in the front portion 30c to assist

in properly locating the block and preventing vertical shifting movement. It will be seen that the block 40 has a depending flange portion 48 along the lower side thereof which underlies the base portion 30a. This provides a lower bearing surface for engagement with the lower wall 22 of the channel 18. The entire block 40 is secured to the carrier link with rivets 49, as illustrated, and preferably with the additional use of an adhesive, such as an epoxy adhesive, disposed between the block inner surface 44 and the carrier link front portion 30c.

The other block 41 is composed of two cooperating interfitting components 41a of similar shape. Each block component 41a includes a raised boss portion 50, a pin 51 integrally formed with and projecting from the boss 50, and a hole or socket 52 for receiving the corresponding pin 51 of the other component or half 41a. When the components 41a are positioned in cooperating assembled relationship, the raised bosses 50 cooperate with and are received within a correspondingly-shaped cutout or recess 53 on the base portion 30a. This secures the block 41 to the base portion 30a. The assembled thickness of the two bosses 50 is approximately the same as the thickness of the base portion 30a so that the components fit snugly against the upper and lower surfaces of the base portion 30a. The two components are further secured together by a rivet 49 as illustrated and are adhered to one another and to the base plate 30a by a suitable adhesive, such as an epoxy adhesive.

The top and bottom bearing surfaces of the block 41 are substantially parallel and spaced from one another a

distance substantially corresponding to the height of the groove 24 such that the block 41 is substantially fully received within the groove 24 as shown in Figure 4.

By this arrangement, the PTFE shrouded links 30 achieve a complementary sliding fit within the tenter rail channel 18 and groove 24 while providing a low friction PTFE surface at all points of contact with the rail.

It will be understood that during operation of the tenter frame, downward forces on the chain 15 are generated by the weight of the links and tenter clips, as well as by the weight of the fabric. Lateral forces are generated by the weight and tension of the fabric, and due to the configuration and orientation of the tenter clips, the fabric also creates torsional forces attempting to twist the link around a generally longitudinal axis. All of these forces, plus any others, are constrained by the unique configuration of the present links 30 and their associated low friction polymer blocks 40, 41, while at the same time achieving a very low coefficient of friction between the chain and the rail and while eliminating the need for lubrication of the tenter rail.

While the invention disclosed herein has been described with reference to a specific preferred embodiment, it is to be understood that this disclosure is to be interpreted in an illustrative and non-limiting sense, and that the benefits and advantages of this invention can be accomplished by other arrangements besides those specifically illustrated and described herein.

THAT WHICH IS CLAIMED IS:

1. A tenter frame for transporting sheet material under tension in an open width condition along a predetermined longitudinal axis, and characterized by being free from lubrication requirements and thereby avoiding

5 undesired staining of the sheet material by lubricants while permitting increased operating speeds and efficiency, said tenter frame comprising:

a pair of elongate guide rails extending in parallel spaced apart relation along the longitudinal axis
10 of the tenter frame, said guide rails having bearing surface portions extending generally parallel to said longitudinal axis;

endless chain means operatively associated with each of said guide rails for movement longitudinally
15 therealong, said chain means including a series of interconnected links having bearing surface portions generally complementary to said bearing surface portions of said guide rails, and including means carried by at least certain ones of said links for engaging and holding the sheet
20 material during said longitudinal movement of the chain means; and

blocks of low friction polymer material carried by certain of said links and disposed between the bearing surface portions of said guide rails and the bearing surface
25 portions of said links, said blocks of polymer material being substantially the only contact between said links and said guide rails and providing essentially all of the lubrication necessary for the operation of the tenter frame.

2. The apparatus of Claim 1 wherein each of said blocks is substantially immovably attached to the bearing surface portions of each of said links.

3. The apparatus of Claim 1 wherein each of said guide rails includes means defining two generally longitudinally extending channels providing respective forward and return paths for said endless chain means, each of said
5 channels including said bearing surface portions.

4. The apparatus of Claim 1 wherein each of said links includes a lower bearing surface portion and a side bearing surface portion, and said blocks of low friction polymer material are carried by each of said lower and side
5 bearing surface portions.

5. The apparatus of claim 4 wherein each of said links further includes an upper bearing surface portion and a block of low friction polymer material carried thereat.

6. The apparatus of Claim 1 wherein said low friction polymer material comprises carbon filled polytetrafluoroethylene.

7. A tenter frame for transporting sheet material under tension in an open width condition along a predetermined longitudinal axis, and characterized by being free from lubrication requirements and thereby avoiding undesired staining of the sheet material by the lubricants while permitting increased operating speeds and efficiency, said tenter frame comprising:

a pair of elongate guide rails extending in parallel spaced apart relation along the longitudinal axis of the tenter frame, each of said guide rails having a predetermined cross-sectional configuration defining a plurality of longitudinally extending bearing surface portions;

endless chain means operatively associated with each of said guide rails for movement longitudinally therealong, said chain means including a series of interconnected links having a respective plurality of bearing surface portions oriented generally complementary to said bearing surface portions of said guide rails, and said endless chain means including means carried by at least certain ones of said links for engaging and holding the sheet material during longitudinal movement of said chain means; and

blocks of carbon filled polytetrafluoroethylene material carried by each of said bearing surface portions of said links and being so disposed as to be substantially the only contact between said links and said guide rails and providing essentially all of the lubrication requirements necessary for the operation of the tenter frame.

8. The apparatus of Claim 7 wherein said plurality of guide rail bearing surface portions includes a lower bearing surface portion, a side bearing surface portion, and an upper bearing surface portion.

9. The apparatus of Claim 7 wherein said plurality of link bearing surface portions includes a lower bearing surface portion, a side bearing surface portion, and an upper bearing surface portion, said blocks of low friction polymer material being carried by each of said
5 lower, side, and upper bearing surface portions.

10. The apparatus of Claim 9 wherein each of said links includes a head plate, a side plate connected to said head plate, and a foot plate connected to said side plate in a predetermined configuration, wherein said link
5 side and foot plates collectively define said lower, side and upper bearing surface portions.

11. A tenter frame for transporting sheet material under tension in an open width condition along a predetermined longitudinal axis, and characterized by being free from lubrication requirements and thereby avoiding
5 undesired staining of the sheet material by the lubricants while permitting increased operating speeds and efficiency, said tenter frame comprising:

a pair of elongate guide rails extending in parallel spaced apart relation along the longitudinal axis
10 of the tenter frame, each of said guide rails having a predetermined crosssectional configuration defining a pair of longitudinally extending channels, each of said channels including a lower bearing surface portion, a side bearing surface portion, and an upper bearing surface portion;

15 endless chain means operatively associated with each of said guide rails for movement along a forward path in one of said two channels and along a return path in the other one of said channels, said chain means including a series of interconnected links having respective lower,
20 side and upper bearing surface portions oriented generally complementary to said lower, side and upper bearing surface portions of said guide rails, and said endless chain means including means carried by at least certain ones of said links for engaging and holding the sheet material during
25 longitudinal movement of said chain means in said forward direction; and

blocks of carbon filled polytetrafluoroethylene material carried by each of said lower, side and upper bearing surface portions of said links and being so

30 disposed as to be substantially the only contact between
said links and said guide rails and providing essentially
all of the lubrication requirements necessary for the
operation of the tenter frame.

12. The apparatus of Claim 11 wherein each of
said links includes a head plate, a side plate connected to
said head plate, and a foot plate connected to said side
plate in a predetermined configuration, wherein said link
5 side and foot plates collectively define said lower, side
and upper bearing surface portions.

13. The apparatus of Claim 11 wherein each of
said links includes a foot plate having a joining edge and
a distal end opposite therefrom, a head plate substantially
parallel to and superposed said foot plate and having a
5 joining edge, and a side plate generally perpendicular to
both said head plate and said foot plate and connected to
the joining edges of each to form a generally hook shaped
link.

14. The apparatus of Claim 12 wherein said blocks
are attached to said side plate and said foot plate.

15. The apparatus of Claim 13 wherein said blocks
comprise a first block unit of one configuration substan-
tially covering the outer surfaces of said side plate and
said side plate joining edge and a second block unit of
5 another configuration substantially covering both surfaces
and the edge of said foot plate distal end.

16. The apparatus of Claim 15 wherein said second
block unit is generally channel shaped, the interior of
said channel corresponding to the configuration of said
foot plate distal end.

17. The apparatus of Claim 11 wherein each of
said blocks includes a generally planar bearing surface
portion and chamfered edge portions.

18. The apparatus of Claim 15 wherein said second
block unit comprises a plurality of mating sub-blocks that
collectively form the channel shape.

19. The apparatus of Claim 11 wherein each of
said blocks includes a non-bearing surface portion having a
projection, and wherein each of said links includes a por-
tion receiving a projection from said non-bearing surface
5 portion of the block for joining the block to the link.

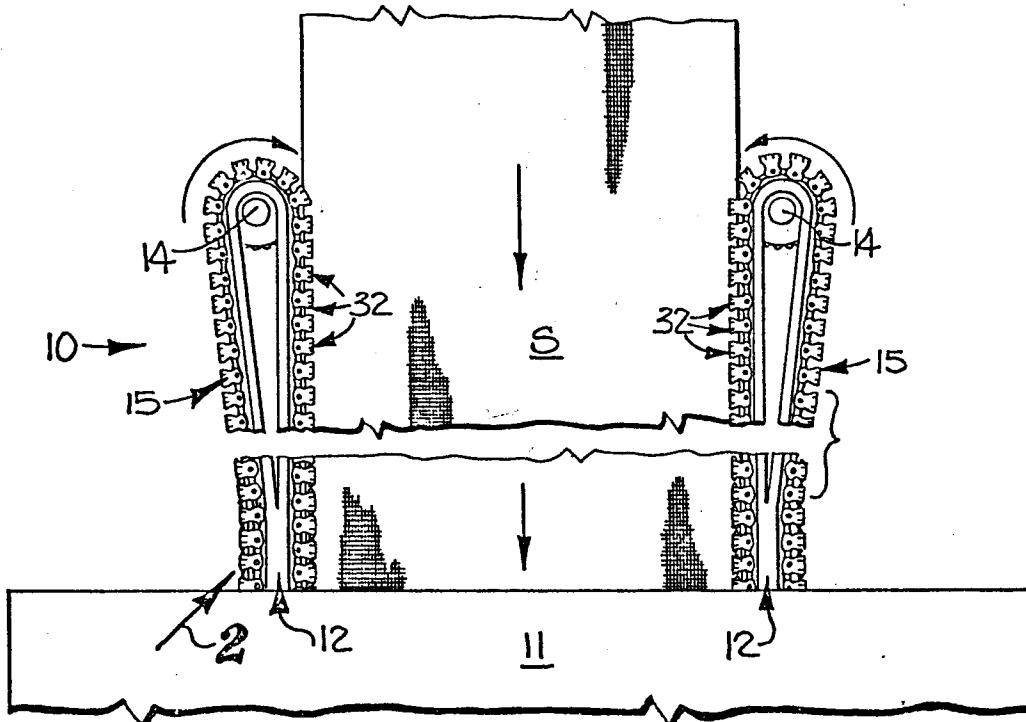


Fig-1

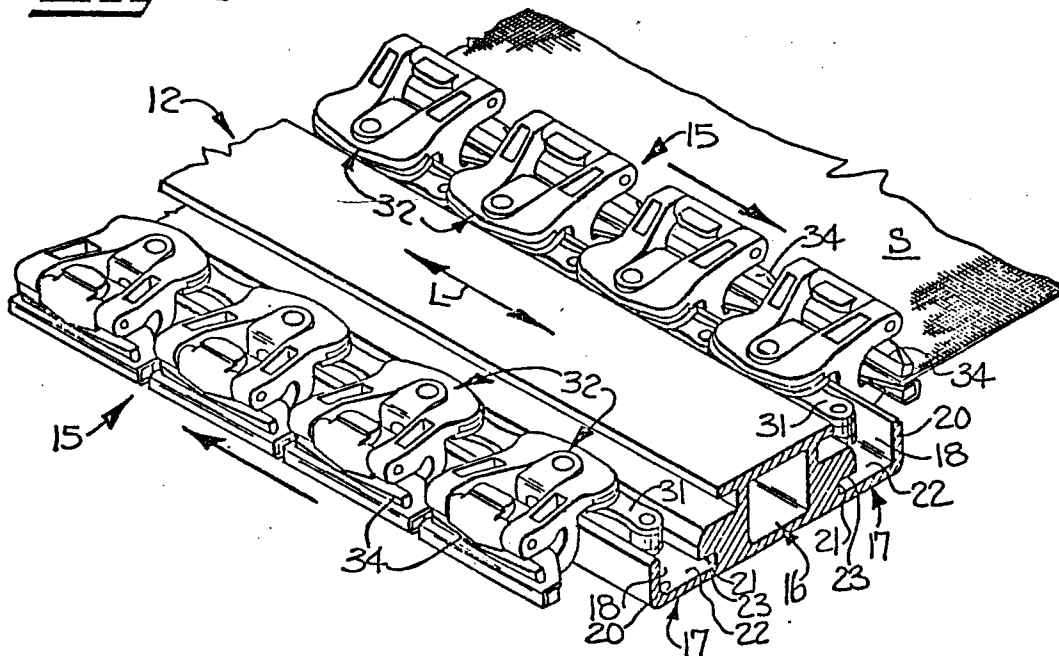
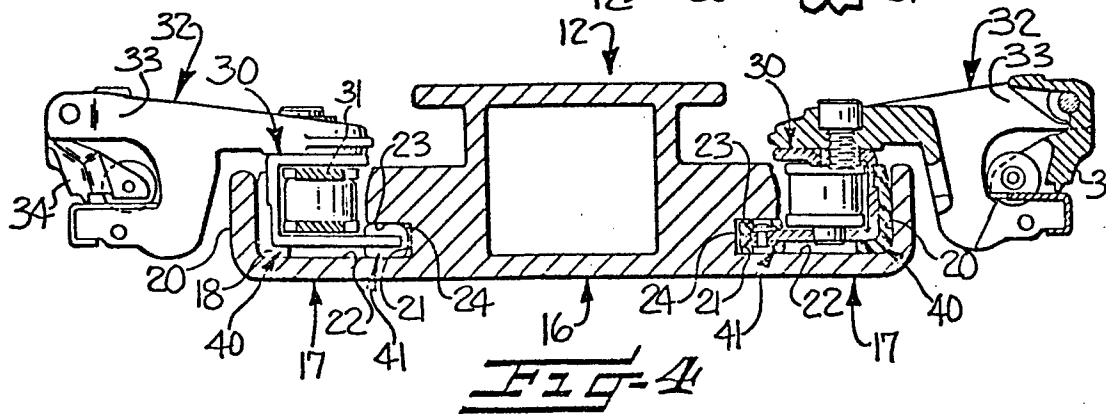
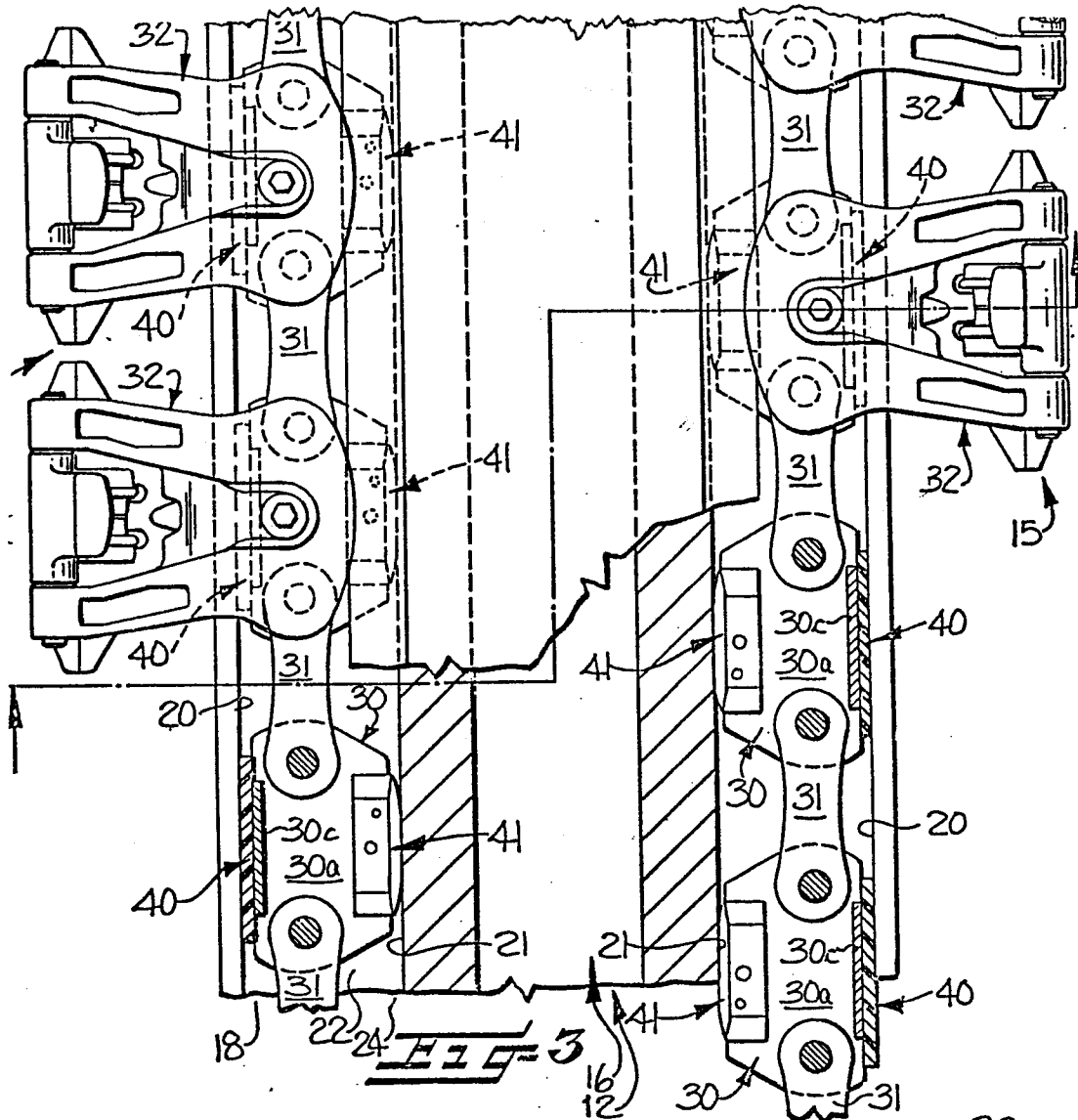


Fig-2



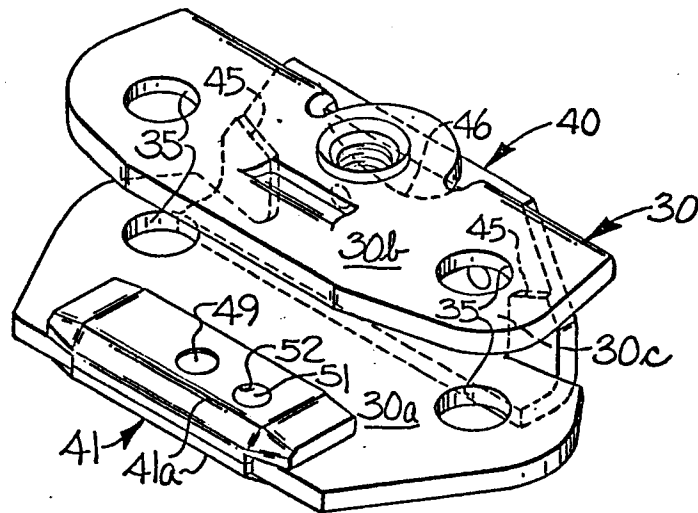


Fig-5

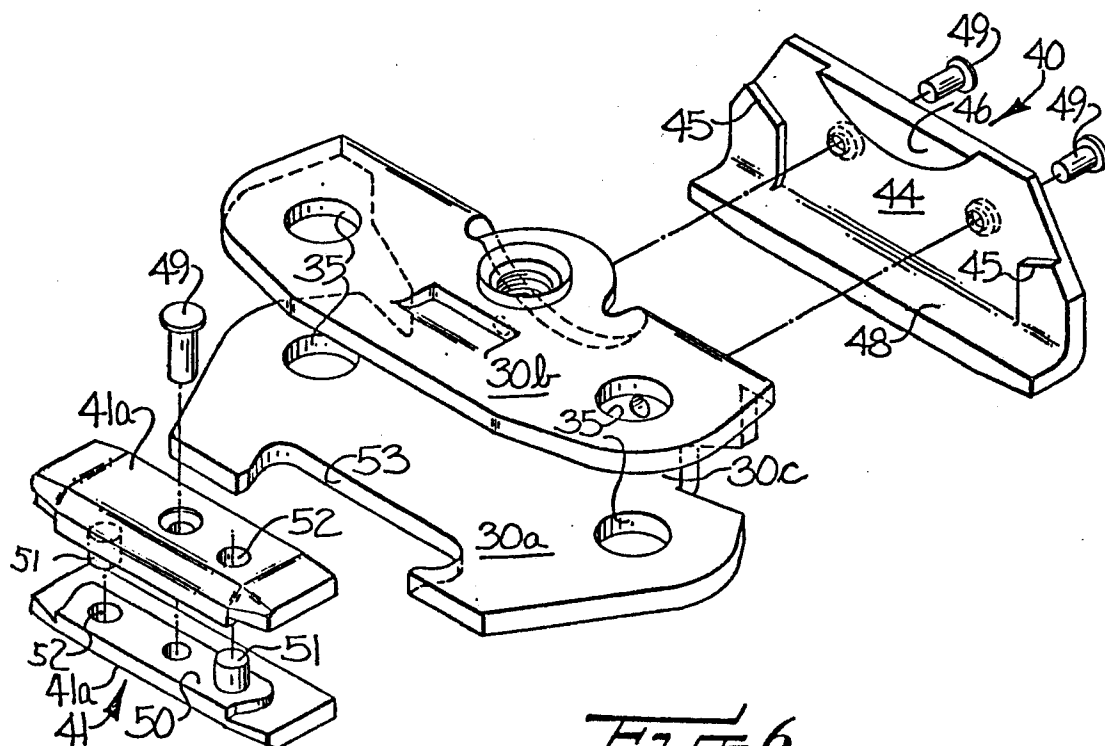


Fig-6

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