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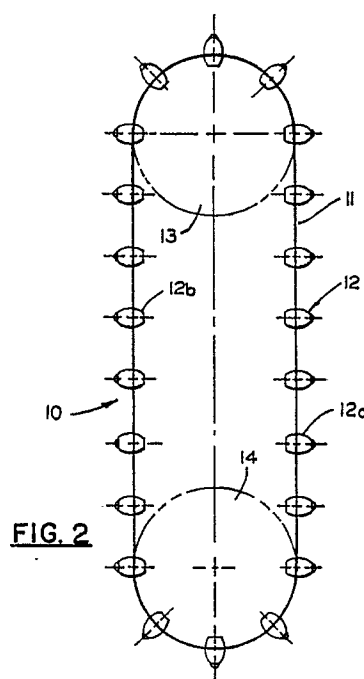
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(54) **Abrasion resistant tractor belt.**

(57) A paper feed tractor for a printer uses an endless feed belt comprising a flexible web with projecting drive elements on opposite sides of the web. The drive elements comprise two pieces, a pin on one side and a gear tooth on the other side of the web. The pins engage feed holes in the paper. The gear teeth are engaged by drive sprockets. In one embodiment of the invention, the web is a thin flexible band of metal, one of the drive element pieces is preformed with wear resistant material such as metal and the other drive element piece is formed by molding which also attaches the preformed piece to the band. In the second embodiment, the pin portion is preformed and the gear teeth and web are formed by molding to the pin portions.



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ABRASION RESISTANT TRACTOR BELT

This invention relates to feed mechanisms and particularly to a feed belt for tractor feed mechanisms of the type used in high speed printers.

Paper feed tractors for printer and other devices use an endless feed belt commonly called a pin feed belt. Such belts have a structure which comprises a flexible web with uniformly spaced drive elements. The drive elements comprise feed pins on the outside of the belt which enter feed holes in a paper forms document and gear teeth or lugs on the inside of the belt which are engaged by openings such as grooves in one or more sprockets or pulleys which are rotated by a suitable drive mechanism.

One method of manufacturing a low cost forms feed tractor is to mold a thermoplastic through perforations in a thin tension member to form paper feed pins and belt drive teeth on opposite sides of the tension member. This technique is described in US Patent 3,825,162 and copending application Serial No. 153,394, filed February 2, 1988. It is also known to produce feed belts in which the entire belt is molded of thermoplastic materials which may include embedded reinforcement strands such as wire. This technique is described in US Patents 3,113,823 and 4,079,633.

A major concern in the design of tractor paper feed belts is abrasion of the pins by the paper. In printers having moderate forms feeding accelerations, the thermoplastic pins can withstand the paper abrasion, but in higher speed printers, excessive wear of the pins occurs which can cause problems in registration of the paper at the print line and in stripping the paper from the pins. The region of wear is part way up the side of the base portion of the pin which can be conical as described in the copending application mentioned above. Ultimately the wear can produce undercutting of the pin surface which can cause tearing of the paper when it is being stripped from the pin and can even result in pin fractures under certain conditions of high acceleration loading and impacting of the pins by the paper.

One solution to the wear problem is to use pins made of wear resistant material such as metal or metal coated plastic pins which are preformed to the desired size and shape and then individually attached to the tension member by some mechanical process such as force fitting, riveting or welding. Similar techniques have been used to attach plastic pins to the the tension member. Such techniques for various pin structures are described in US Patents 3,392,893; 3,507,431; 3,608,801; 3,938,721; 4,193,527 and 4,316,567 as well as in articles published in the IBM Technical Disclosure

Bulletin, Vol. 1, No. 4, December 1958, at p. 2; Vol. 20, No. 4, September 1977, at p. 1339; Vol. 20 No. 11A, April 1978 at pp. 4524 et seq. and Vol. 23 No. 7B, December 1980 at pp 3111 et seq. Metal and metal coated plastic pins were also mechanically attached in belts used in tractors for the IBM 1403, 3203, 4245 and 4248 Printers. In the 1403 Printer, the metal pin is molded to tabs or brackets which are individually assembled and attached to a molded timing belt. In the 3203 and 4245 Printers, the metal pins are pushed through holes formed in a molded timing belt. In the 4248 Printer, the pin elements are plastic plated with a metal coating such as chrome and or nickel and which are individually pressed through holes in a molded timing belt.

The problem with feed belts made by individual attachment of the pins or pin assemblies is that fabrication is costly and it is difficult to maintain the required pin alignment. This is particularly so when the attachment of the pins includes attachment to the lugs or drive teeth and especially where the surfaces of the drive teeth are designed to engage guide surfaces of the tractor body to maintain alignment of the belt and drive pins as described in copending application Serial No. 07/303,707 filed 01/27/89. There is also the problem of high inertia with metal pins where high accelerations are desired.

Broadly stated, the invention corrects the above problems by providing a feed belt in which the feed pins are made at least in part of abrasion resistant material and are locked to the tension member portion of feed belt by molded thermoplastic material. In this way the advantages of both abrasion resistance and molding of feed belts can be realized. In the preferred embodiment, the feed pin comprises an abrasion resistant element which forms at least the base portion of the feed pin and is locked to the tension member by a molded thermoplastic mass. The abrasion resistant element can be either a hollow shell or sleeve element which forms at least the base portion of the feed pin and is locked to the tension member by a core of molded thermoplastic which is integral with either the tension member or drive teeth molded to the tension member. In this manner, the advantage of low inertia and less costly feed belts is realized. In one form in which the invention can be practiced, the tension member comprises a molded web and the core of thermoplastic material is integral with the web. In a second form, the tension member is a thin strip with perforations and the core of thermoplastic material is integral with a molded perforations of the strip in a manner where-

by the core and drive tooth are mechanically to the strip. The interior of the shell is provided with groove like elements which interact with the molded core to lock the shell in place on the tension member. The shell may also be locked in place externally by means of a tip portion of the core material which extends through an opening connecting the interior of the shell with the tip. The external tip portion of the core can be shaped so as to blend with the contoured exterior of the shell and forms the tip of the feed pin. In a third version, the shell has a flared skirt which is embedded in the molded thermoplastic material. In another embodiment, the feed pin is formed entirely of abrasion resistant material and has a projection which passes through the perforations in the tension member strip. The feed pin is attached to the tension member by molding the drive teeth onto the pin projection in various ways whereby a rigid locked assembly is obtained. The benefit obtained from the invention in its various forms is that it allows feed belts to be easily produced by molding multiple pins to the belt in a single operation. It also provides accurate location of the pins and drive teeth with precision surfaces for maintaining alignment of the feed belt and pins during paper feeding operations in a feed tractor. Other benefits and advantages will become apparent from the detailed description which follows.

Fig. 1 is three dimensional view of an endless feed belt of the type used in paper feed tractors; Fig. 2 is a schematic of a portion of a tractor feed mechanism showing an endless feed belt wound on a pair of drive pulleys;

Fig. 3 is a cross section of a portion of a tractor feed mechanism showing the manner in which the drive teeth are guided by surfaces of the groove formed by the side plates of a tractor assembly;

Fig. 4 a side view of a segment of a tractor feed belt for illustrating the wear problem solved by the invention;

Fig. 5 is a segment of a tractor feed belt in cross section showing a first embodiment of the invention;

Fig. 6 is a segment of a tractor feed belt in cross section showing a modification of the invention of Fig. 5;

Fig. 7 is a segment of a tractor feed belt in cross section is another modification of the invention of Fig. 13;

Figs. 8 - 11 show segments of a tractor feed belt in cross section with additional modifications of the invention of Fig. 5;

Figs. 12 - 14 are sections of a segment of a tractor feed belt showing several versions of a second embodiment of the invention;

Fig. 15 is a section drawing of a portion of an

injection molding tool usable for making the embodiment of the tractor feed belt shown in Fig. 5;

Fig. 16 is a section drawing of another injection molding tool illustrating the method for making a tractor feed belt of the type shown in Fig. 10.

Fig. 17 is a plan view of a segment of a tractor feed belt showing another version of a hollow pin molded to a molded tension member;

Fig. 18 is a section taken along line 18 - 18 of Fig. 17;

Fig. 19 is a section taken along line 19 - 19 of Fig. 17.

As seen in Fig. 1, a feed belt 10 of the type usable in tractor feed mechanisms employed in high speed printers and other devices comprises an endless flexible tension member 11 to which is attached a plurality of uniformly spaced drive elements 12. Tension member 11 can be made from a strip of stainless steel, polyimide or some other relatively inextensible material. Drive elements 12 are attached to tension member 11 and comprise feed pins 12a projecting from the outer or feeding surface 11a for engaging feed holes in a paper medium and drive teeth 12b projecting from the inner or drive side 11b for engagement by drive mechanism such as drive pulleys. In one form, tension member 11 is a thin band of stainless steel with a row of uniformly spaced and aligned perforations (11c, Fig. 3) within which the drive elements 12 are attached such as by molding as described in more complete detail in the aforementioned copending application Serial No. 153,394, filed February 2, 1988. In another form, tension member 11 and the drive elements 12 may be molded as a single piece with or without embedded reinforcing elements.

As seen in Fig. 2, belt 10 is entrained around a pair of pulleys 13 and 14 which together constitute the feeding mechanism supported between a pair of support plates (not shown) one of the drive pulleys being connected to a drive mechanism as more fully described in the aforementioned copending application Serial No. 07/303, filed 01/27/89. As seen in Fig. 3, tension member 11 is supported along its edges by guide surfaces 15a and 16a of plates 15 and 16 of a tractor mechanism which together form a channel 17 within which drive teeth 12b travel. Drive teeth 12b have a side edge 12c which bears against a side wall 15b in side plate 15 for at least a portion of the distance between the pulleys 13 and 14. In that manner, feed pins 12a are maintained in alignment with the feed holes in the paper which is also supported on guide surfaces 15a and 16a. Drive teeth 12b, which are molded and integral with feed pins 12a, are preferably made with a low friction thermoplastic material such as nylon to minimize the wear of the drive

teeth surfaces in traveling along the guide walls 15b of side plate 15 and over the drive pulleys. However, nylon is susceptible to considerable wear in higher speed printers as previously discussed. As seen in Fig. 4, feed pin 12a comprises a base portion 12d and a cap portion 12e. Base portion 12d is conical although it could be cylindrical and the cap portion 12e has an involute taper. Cap portion 12e is tapered to enable it to enter and pass through the holes in the paper without engaging the edges of the paper. Edge engagement occurs at the base portion 12d. Due to the abrasive action of the paper, base portion 12d becomes worn so that its surface dimensions become changed. Broken line 12f represents the original surface of base portion 12d whereas solid line 12g shows the degree to which the base portion 12c can wear over a relatively short period of time when used in high speed printers. This wear starts at a distance h above band 11. Given enough time surface 12g becomes concave and forms an undercut which overhangs the edges of the holes in the paper thereby causing tearing at the feed holes when the paper is stripped from the feed pins 12a.

The wear problem is solved by using feed pins at least partially made of abrasion resistant material and which are attachable to the tension member by a molding process. As seen in Fig. 5, the feed pin 12a, in accordance with one embodiment of this invention, comprises a hollow abrasion resistant shell 20 locked to band 11 by a molded thermoplastic core 30 in cavity 21 which passes through perforation 11c in band 11 and is integral with the molded drive tooth 12b. The exterior surface of shell 20 is contoured to have a conical base portion 22 and a tapered cap portion 23. Cap portion 23 is truncated to form edge 24. The contour of base portion 22 may be conical and the cap portion 23 may be contoured as an involute as more specifically described in copending application Serial No. 153,394. Shell 20 may have a cylindrical base portion as well as other contours. In this embodiment, shell 20 is locked externally to band 11. Core 30 extends from cavity 21 in shell 20 through passage 25 and ends in an external tip portion 31 which overlaps edge 24 of shell 20. The external surface 32 of tip portion 31 is contoured to blend with cap portion 23 of shell 20 to complete the tip of the feed pin 12a. Shell 20 is further locked to band 11 by making cavity 21 large enough at its base so that core 30 overlaps a portion 11d of the upper surface of band 11 surrounding perforation 11c which is preferably non-circular. This locks the molded core 30 to band 11 and prevents rotation of the feed pin assembly. Thus a totally interlocked system is formed which produces a rigid, fixed feed pin and tension member assembly.

In Fig. 6, the mechanical lock is formed by a

machined groove 26 on the inside cavity wall of shell 20. Core 30 has a correspondingly shaped rib 33 which occupies groove 26 and locks shell 20 in place. The external surface of cap portion 23 is completely tapered, preferably as an involute, and has a vent hole 27 which permits air to escape during molding of core 30 into cavity 21. This type of shell 20 is useful where it is desirable to have the entire pin surface abrasion resistant. Locking of the shell 20 to band 11 is internal.

Some abrasion resistant material may also abrade the tension member and thereby cause premature belt failure. One example is the use of a ceramic shell in conjunction with a steel band tension member. To solve this problem, a spacer 36 is provided between the bottom edge of shell 20 and the top surface 11a of band 11 as seen in Fig. 8. Spacer 36 may be thermoplastic and may an extension of core 30 formed when core 30 is formed by injecting thermoplastic into cavity 21 where there is a small separation permitted between the bottom edge of shell 20 and the top surface 11a of band 11. Alternatively, spacer 36 may take the form of a gasket type element attached to the bottom edge of shell 20. A suitable material for such gasket element would be compatible with the molding process and that prevents abrasion or fretting by the shell 20. One suitable material where the shell 20 is made of ceramic and the strip 11 is made of thin stainless steel, a suitable spacer could be made of polyimide. The thickness of spacer 36 could vary depending on the location of the wear region of shell 20 and should not exceed the dimension h in Fig. 4.

In Fig. 9, the abrasion resistant shell 20 is locked to core 30 by an adhesive bonding material. In this case, core 30 and drive tooth 12b are molded in locking relation onto band 11 through perforation 11c as previously described. A bonding agent 40 is then applied to appropriate surfaces and the pin shaped shell 20 applied to the core 30. Bonding agent 40 could be either an epoxy or anaerobic adhesive. Because of low temperatures incurred during bonding, shell 20 could be made from chrome plated ABS or similar materials. The disadvantage of this approach is that the shells 20 applied individually after the molding process instead of during the molding process as for the previous embodiments.

In Fig. 10, core 30, drive tooth 12b and tension member 11 are formed from a single integral molded thermoplastic matrix. In Fig. 11, the drive teeth 12b are located on either side of the shell 20 and the core 30 is integral with the tension member portion of the matrix.

In the embodiment of Figs. 17 - 19, the shell 20 is formed from a thin hollow piece of metal such as steel, brass, or aluminum with a plated surface

of nickel and/or chrome, or unplated stainless steel. The shape of shell 20 is an involute cap portion 23 on a truncated cone base portion 22 as in previous embodiments. In this embodiment, shell 20 is provided with a partial flaring skirt 22a at the bottom edge of the cone or base portion 22. The shell 20 is filled with a molded thermoplastic core 30. The flared skirt 22a is embedded in the core and/or tension member thermoplastic thereby more firmly locking the shell 20 in place on the belt assembly.

Suitable abrasion resistant materials for making the shell 20 can be either ceramic, metallic or polymeric. In general, the harder the material the greater its resistance to abrasion. A suitable metallic material would be an iron or steel that is compatible with machining, forming, forging, sintering or coining to form the shell 20. If a corrosion resistant material is not used, or further wear resistance is desired, then either a chrome or electroless nickel plating of the shell is recommended. For additional abrasion resistance a steel shell could best be treated or carburized and the electroless nickel could be baked. The polymeric material for making the shell 20 could be any polymer that has a higher melting temperature than the temperature of the molding process of the core such as polyimide, PEEK (polyethylene-ethethyleneketone) or phenolic.

The thermoplastic material used for making core 30 and drive tooth 12b is preferably a PAN carbon fiber and PTFE filled nylon 6/10 which has mutually compatible wear characteristics with respect to a PAN carbon and PTFE filled tractor body as described in copending application 07/303,707. However, any suitable filled or unfilled thermoplastic could be used.

The tension member can be made from any strong, thin, flexible relatively inextensible material that can withstand the temperatures encountered during the molding. Suitable materials include polyimide and stainless steel.

In Fig. 12, feed pin 12a is formed entirely of abrasion resistant material. Feed pin 12a has integral projection or post 12c which extends through perforation 11c of band 11. Post 12c contains a mechanical interlock such as groove 12d. Feed pin 12a is locked onto band 11 by molded drive tooth 12b which fills the space between post 12c and the edges of perforation 11c and the groove 12d. In Fig. 14, the drive tooth 12b and tension member 11 are molded together with thermoplastic material and are locked to the post 12c of abrasive resistant pin 12a.

There are thermoplastics which exhibit good abrasion resistance against paper but cause rapid abrasion of the tractor body. In Fig. 13, a feed pin 12a of abrasion resistant material has a post 12c with interlock grooves 12d. In this case, pin 12a is

molded through perforation 11c of band 11 and the post is interlocked to the band around perforation 11c. Drive tooth 12b is then molded to post 12c. Perforation 11c is preferably non-circular to prevent rotation. For this structure to be made successfully, the material for feed pin 12a must be able to withstand the temperatures for molding drive tooth 12b. Satisfactory materials for pin 12a are PEEK, PPS, or polyimide either glass or carbon filled. Nylon or polycarbonate (carbon or PTFE filled) can be used for the drive tooth 12b.

Fig. 7 shows a variation of the double molded bets described in Fig. 13. Core 30 is integral with drive tooth 12b and has a higher melting temperature than the material of wear resistant shell 20. In this variation, drive tooth 12d and core 30 are first molded through perforation 11c in member 11. Then abrasion resistant shell 20 is molded over and interlocked with core 30. Core 30 has rib 34 and groove 35 locked with groove 28 and rib 29 respectively.

As seen in Fig. 15, a mold for making the feed belt assembly of Fig. 5 comprises a tool block 50 having a series of shell cavities 51. The number of shell cavities 51 equals the number of feed pins 12a to be provided on the belt and the spacing corresponds to the desired spacing of the feed pins. Shells 20 are first made of abrasion resistant material as previously described. An abrasion resistant shell 20 is inserted into each shell cavity 51. Band 11 with perforations 11c is placed onto block 50 with perforations 11c centered with shell cavities 51. Tool block 52 with tooth cavities 53 having the shape of drive teeth to be formed on the belt assembly is placed over the band 11 and block 50. A fluid channel 54 has outlet ports 55 connected to tooth cavities 53 and an inlet port 56. After blocks 50 and 52 are locked together, nozzle 57 injects thermoplastic fluid into port 56, through channel 54 and outlet ports into tooth cavities 53, through perforations 11c in band 11 and through hollow shells 20 and into shell cavities 51. In this way, an entire belt assembly can be made in a simple, efficient and closely controlled process. In practicing the above process, the tension member can be either flat or an endless loop. However, in the latter case, the greater care would be required in maintaining shells 20 in their respective cavities where a curved mold is used.

As seen in Fig. 16, the mold for making the belt assembly with a molded tension member as in Fig. 10 includes channel 58 which connect with tooth cavities 53 and shell cavities 51. The mold of Fig. 16 is essentially the same as in Fig. 15 except that the band 11 is not inserted into the mold. Thus when fluid thermoplastic material such as previously specified is injected into inlet port 56, the fluid passes into channel 58 from tooth cavities 53 to

form the tension member as well as the core 30, tip portion 31 and drive teeth 12b of the belt assembly of Fig. 10.

From the above, it will be readily apparent that a belt assembly is provided which is both simple to make with minimum cost and maximum accuracy in locating the feed pins and controlling the size and shape of the drive teeth which can be used for maintaining alignment of the feed pins for paper feeding. At the same time, it will be readily apparent that an improved feed pin belt is provided which eliminates the problem of paper abrasion and wear of the feed pins. While abrasion resistant elements are shown in the particular shapes of all or most of a feed pin, it is to be understood that such elements could have other shapes and forms which are locked to the core material at the sites where abrasion occurs and need not surround all or most of the core material. While the use of abrasion resistant elements is shown for paper feeding devices, it is to be understood that the invention would have utility in other devices where similar abrasion problems are experienced from the fed material onto the feed element.

Therefore, while the invention is shown and described in particular form, it will be understood that other changes in form and detail may be made without departing from the spirit and scope of the invention.

Claims

1. A feed belt assembly comprising a flexible tension member and at least one feed pin projecting from one surface of said tension member, said feed pin being shaped to engage perforations in a fed material such as paper, said feed pin being made at least partially of a material resistant to abrasion of said fed material, and said feed pin is locked to said tension member by a thermoplastic core molded to said feed pin.

2. A feed belt assembly in accordance with claim 1 wherein said feed pin comprises an abrasion resistant element covering at least a portion of said core, and said abrasion resistant element is mechanically interlocked to said molded core.

3. A feed belt assembly in accordance with claim 2 wherein said abrasion resistant element is a hollow shell element and said molded core is mechanically interlocked to the interior of said shell.

4. A feed belt assembly in accordance with claim 3 wherein said tension member is a molded member, and said molded core is integral with said molded ten-

sion member.

5. A feed belt assembly in accordance with claim 4 wherein

said molded tension member includes at least one molded drive tooth integral with said tension member, and said molded core is integral with said molded drive tooth.

6. A feed belt assembly in accordance with claim 3 wherein

said tension member includes a thin flexible strip element having a perforation for locating said feed pin on one side of said strip element, said belt assembly further includes at least one molded drive tooth of thermoplastic material on the other side of said strip element, and said thermoplastic material of said drive tooth is integral with said thermoplastic core material and passes through said perforation in said strip material.

7. A feed belt assembly in accordance with claim 6 wherein

said thermoplastic material which forms said drive tooth passes through said perforation in said strip element and forms a projection on the opposite side of said strip element for attachment of said shell element to said strip element.

8. A feed belt assembly in accordance with claim 7 wherein

said hollow shell has a cap portion on top of a base portion and said cap portion has a through hole connecting with a cavity within said hollow shell element, and

the thermoplastic material which forms said molded drive tooth and said core is in said cavity and includes a portion which passes through the said hole and terminates in a tip portion which engages said cap portion of said shell element to lock said shell element to said strip member.

9. A feed belt assembly in accordance with claim 8 wherein

said cap portion of said shell element has a tapered exterior surface and said tip portion of said core beyond said cap portion has an exterior surface which blends with the exterior surface of said cap portion to complete the taper of said pin element.

10. A feed belt assembly in accordance with claim 6 wherein

said shell element has an interior sidewall with grooves, and

said thermoplastic core material is injection molded into said cavity and engages said groove means to lock said pin element onto said strip member.

11. A feed belt assembly in accordance with claim 6 which further includes

a spacer of non-abrasive material between said shell element and said strip member.

12. A feed belt assembly in accordance with claim 11 wherein

said spacer is integral with said core.

13. A feed belt assembly in accordance with claim 11 wherein

said spacer is a gasket element.

14. A feed belt assembly in accordance with claim 6 wherein

said shell element is bonded to said core material in said cavity.

15. A feed belt assembly in accordance with claim 6 wherein

said shell element is a thin shell of abrasion resistant material having a flared edge, and said flared edge is embedded in said thermoplastic material which forms said core material in the interior of said shell.

16. A feed belt assembly for a paper feed tractor comprising

a thin tension member having regularly spaced perforations,

pin elements for engaging feed holes in paper moved by said tract projecting from one side of said tension member,

said pin elements being made of material resistant to abrasion by said paper and having a projection extending through said perforations to the opposite side of said tension member,

said projection having groove means on the opposite side of tension member, and

drive teeth of thermoplastic material molded onto said projection and into said groove means of said projection to attach said pin elements to said tension member.

17. A feed belt assembly in accordance with claim 16 wherein

said projection from said pin element is positioned to allow a spacing between the projection and the edges of said perforations in said tension member, and

said thermoplastic material which forms said drive teeth fills said spacing and surrounds said projection thereby locking said pin element to said tension member in a rigid attachment.

18. A feed belt assembly in accordance with claim 16 wherein

said pin element of abrasion resistant material is molded from a highly temperature resistant thermoplastic material, and when molded, forms said projection which passes through said perforations in said tension member and locks itself onto said tension member, and

said drive tooth is a thermoplastic material of lower melting temperature injection molded onto said projection of said pin element of higher melting temperature thermoplastic material.

19. A feed belt assembly in accordance with claim 16 wherein

said projection of said pin element has a non-circular cross section.

20. A feed belt assembly in accordance with claim 1 wherein

5 said abrasion resistant material forming said pin element is metallic.

21. A feed belt assembly in accordance with claim 1 wherein

10 said abrasion resistant material forming said pin element is ceramic.

22. A feed belt assembly in accordance with claim 14 wherein

said abrasion resistant material is polymeric.

15 23. A feed belt assembly in accordance with claim 18 wherein

said pin element is iron or steel, and

said pin element is formed by coining, forming, machining or sintering.

20 24. A feed belt assembly in accordance with claim 1 wherein

said tension member is an endless loop.

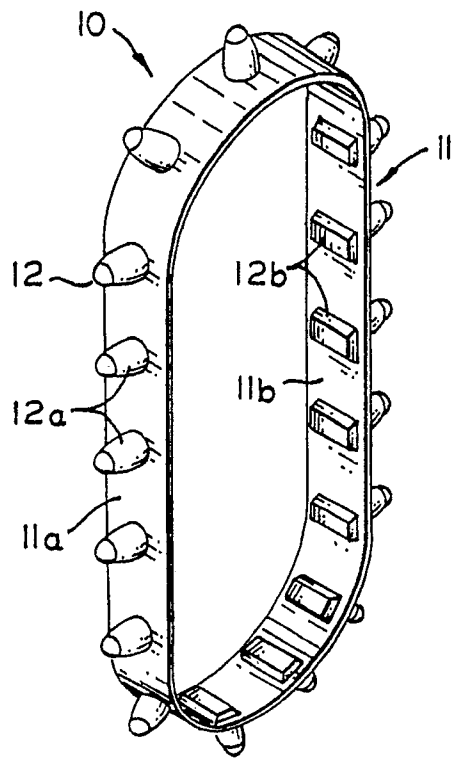


FIG. 1

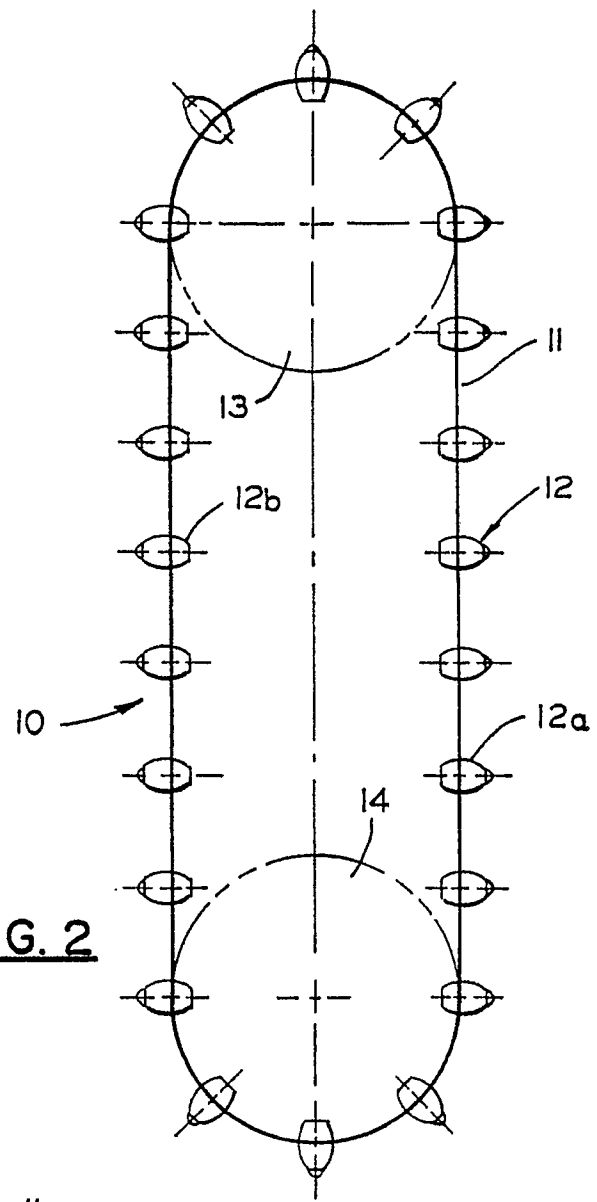


FIG. 2

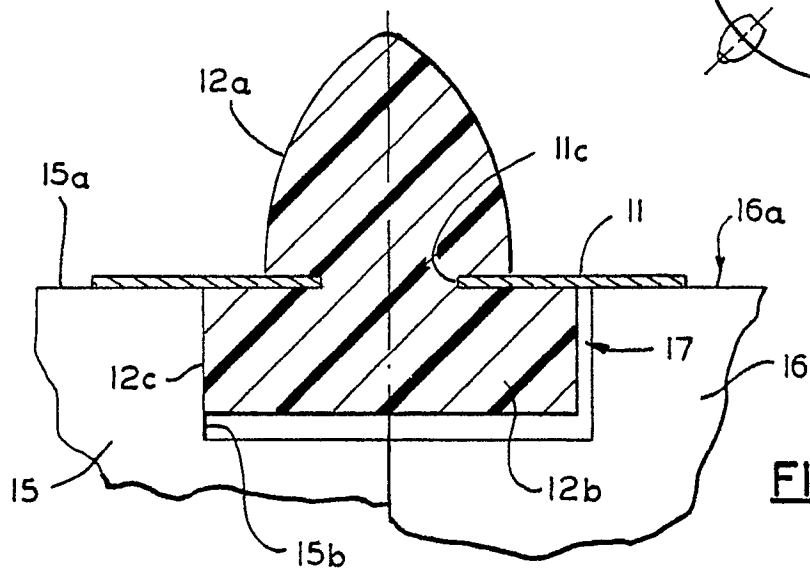


FIG. 3

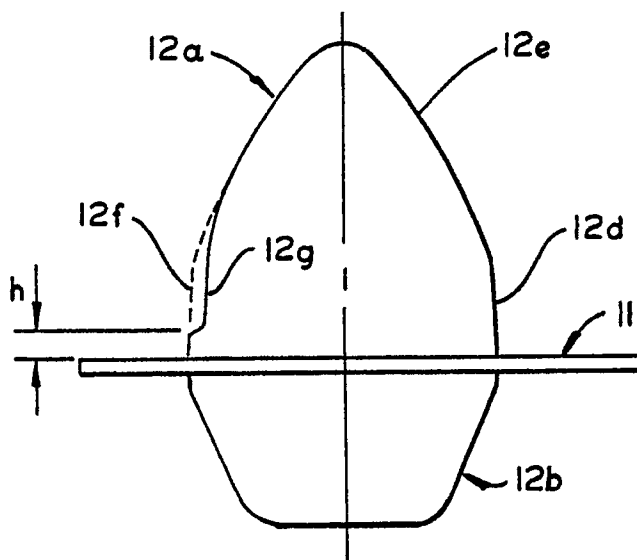


FIG. 4

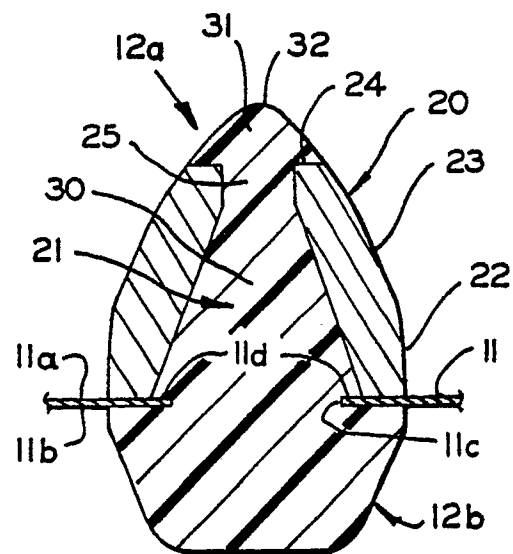


FIG. 5

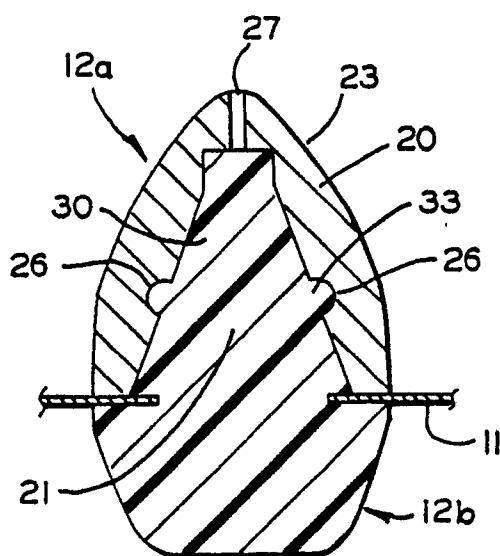


FIG. 6

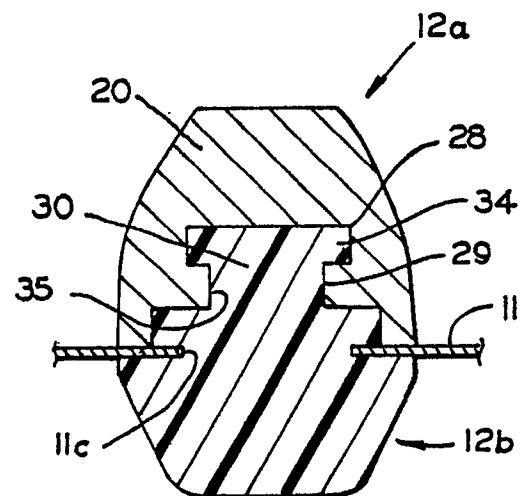


FIG. 7

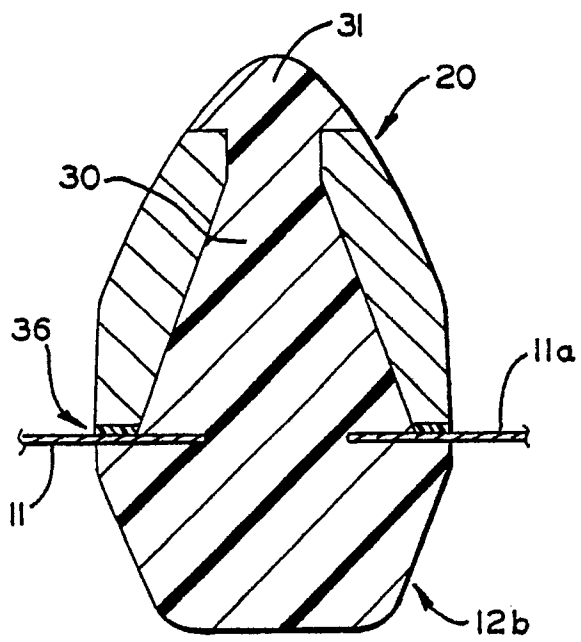


FIG. 8

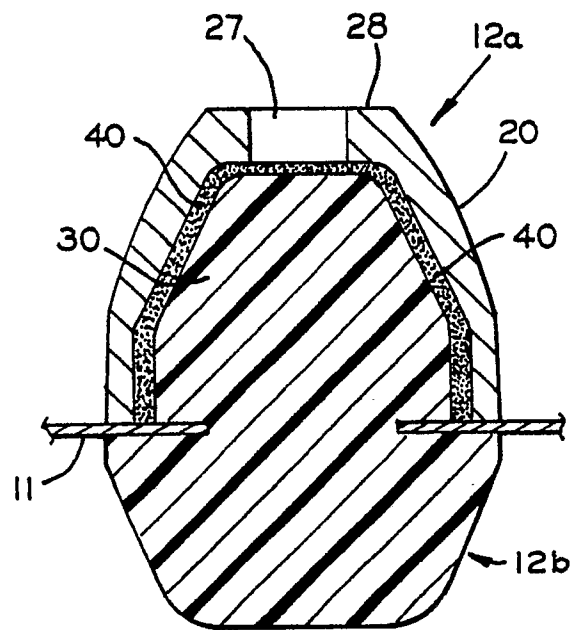


FIG. 9

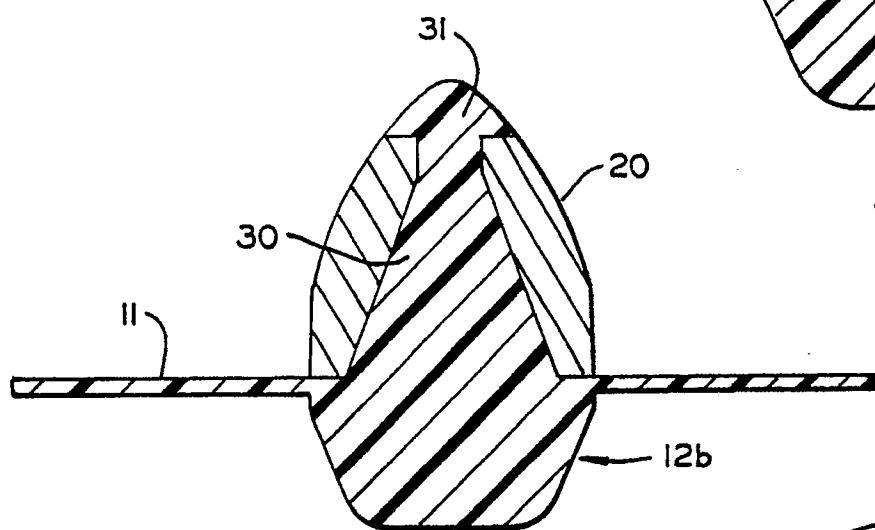


FIG. 10

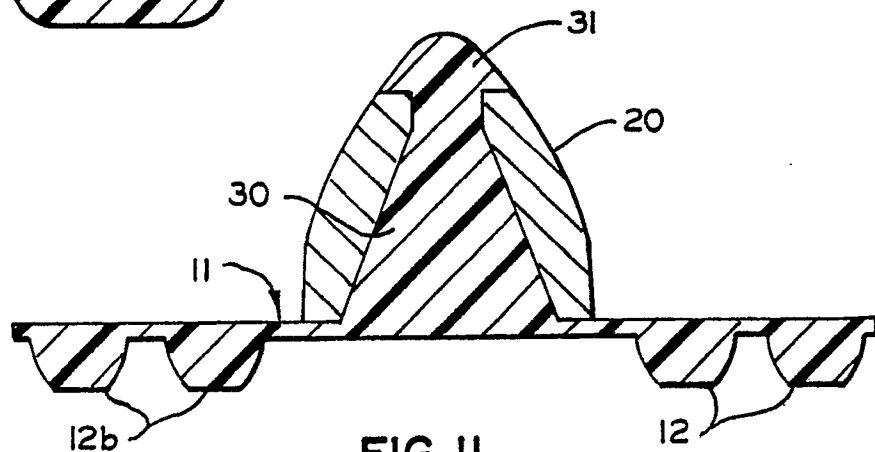


FIG. 11

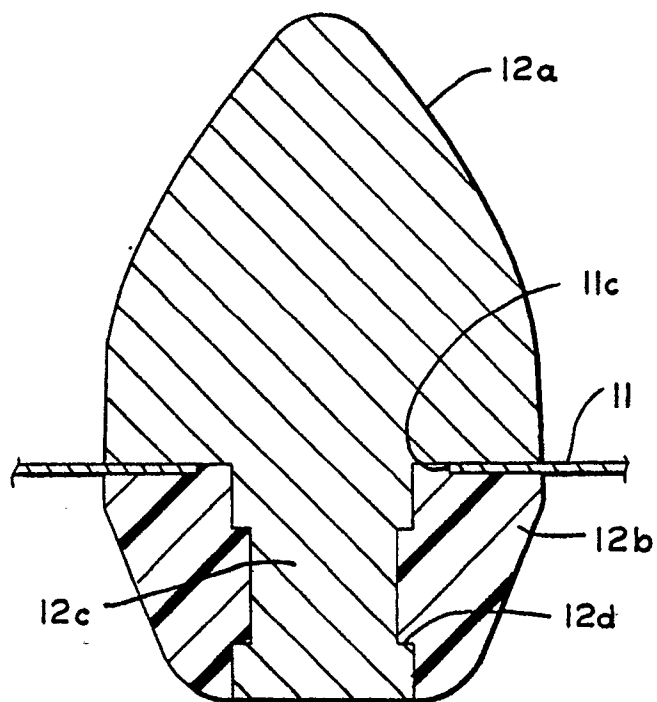


FIG. 12

FIG. 13

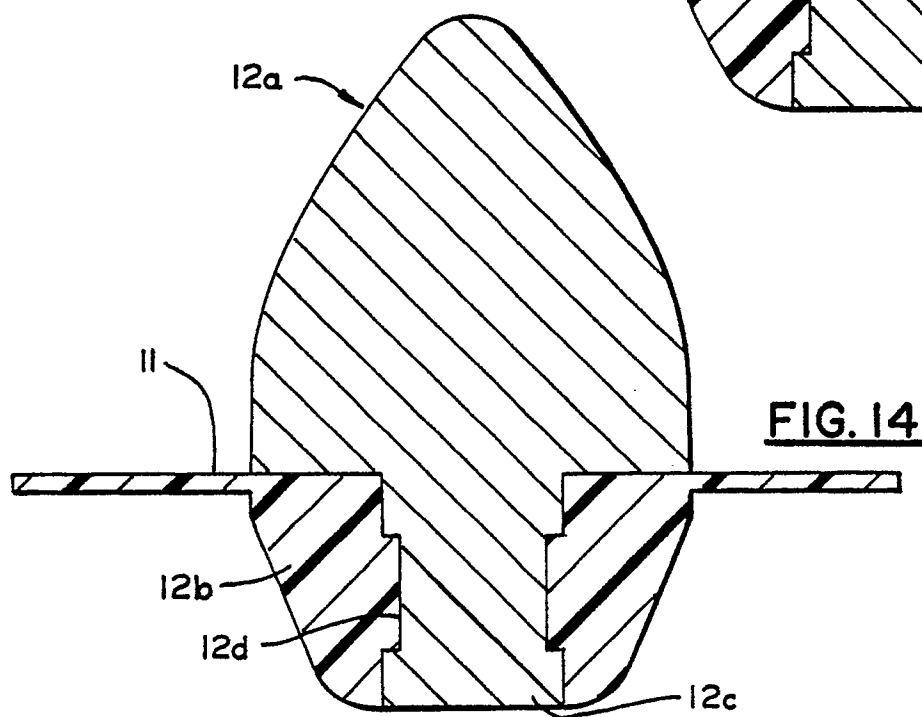
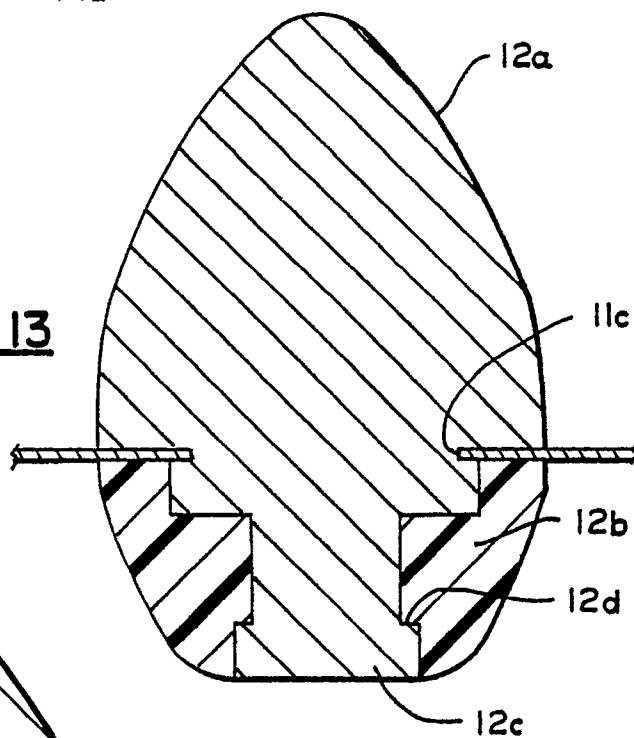


FIG. 14

