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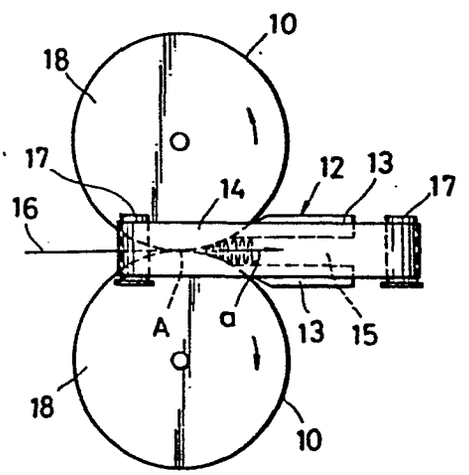
(54) Apparatus for crimping tows of filaments at high speed.

(57) An apparatus for crimping a tow of filaments (16) comprises a pair of cylindrical feed rolls (10, 10) disposed to form a nip (A) therebetween and a stuffer box (12) disposed adjacent to the nip (A), the stuffer box (12) including an inner wall portion (14) confronting to a pair of coplanar end surfaces (18, 18) of the feed rolls (10, 10) across said nip (A) with a slight clearance therebetween for frictional engagement with the filaments (16) as the latter is moved in a region located immediately downstream of the nip (A) and defined jointly by the inner wall portion (14) and respective peripheral surfaces of the feed rolls (10, 10). The inner wall portion (14) is movable in a direction substantially the same direction as the advance of the filaments (16) in the region while renewing with respect to the frictional engagement with the filaments (16). The tow crimping apparatus thus comstructed is durable and performs crimping operation at a high-speed without producing hard lump due to fusion in the tow as the latter is crimped.

FIG. 1



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HIGH-SPEED TOW CRIMPER

The present invention relates to an apparatus for crimping a tow of filaments at a high speed to produce filaments, yarns, staple fibers or the like of various lengths.

The fiber crimper comprising a pair of feed rolls and a stuffer box disposed adjacent thereto has been widely used to crimp a tow of filaments of at least several thousands total deniers. In the conventional crimpers of this type, it has been customary that the tow has been fed by and between the rolls into the stuffer box at about 100 m per minute. However, the recent requirement tends toward a high-speed in the crimping operation.

West German Laid-open Publication (DE-OS) No. 1959863, published on July 9, 1970 shows a tow cirmper which comprises disk-like presser plates held in contact with end surfaces of two rolls to rotate as the latter is rotated. Because of such rotation of the presser plates, the relative velocity of the presser

plates and filaments contacting therewith may be reduced. However, heat is generated in the presser plates as a result of continuous contact with the rolls, so that the fusion of filaments under frictional heat tends to increase on the contrary. Furthermore, the plate portions which are held in contact with the rolls are unavoidable to become worn which would result in considable reduction in durability of the presser plates. Accordingly, the disclosed arrangement is hardly applicable to any stuffer box type crimper that needs to perform a high-speed operation. It is to be understood that the prior crimper is completely different from high-speed crimpers to which the present invention pertains.

In an attempt to develop a novel tow crimper studied for faster operation, the present inventors conducted a variety of experiments previously and proposed improvements operable at a speed of 1000 m or more per minute in feeding a tow of filaments. Such improvements are shown in Japanese Patent Laid-open Publication No. 54-131065, published on October 11, 1979 and Japanese Patent Publication No. 59-5693, published on February 6, 1984. During such studies, it has been found that fusion has occasionally occured in the filaments extruded in the shape of a cake from the stuffer box. In the experiments, fusion was prone to be induced particularly in the fiber of a high friction

coefficient, such as polypropylene fiber. The occurence of such fusion may be attributable to various causes. For example, if there exists slippage between the filaments and the rolls at a nip between the rolls, fusion is induced on the surfaces of the tow of filaments. This slippage can be prevented by diminishing the resistance exerted on the tow immediately before its entracne between the rolls and by reducing the pressure in the stuffer box. As a result of observing and studying the fact that fusion unpreventable even by the above method is sometimes generated on the lateral surfaces of the cake-like filaments, it has been assumed that the tow of filaments immediately after passage through the nip of the rolls is impeded with respect to its advance by the stuffer box and is thereby deviated laterally to be pressed intensely against the inner walls of the stuffer box, so that the filaments of a high friction coefficient is heated and softened to eventually cause partial fusion. Such friction further brings about partial wear of the inner walls of the stuffer box. An examination has been made by the present inventors as to how to alleviate the friction.

The present invention seeks to provide an apparatus for crimping a tow of filaments at a high-speed without causing any hard lump or fusion in the tow as the latter is crimped.

The present invention further seeks to provide a high-speed tow crimper having durable inner wall portions which are subjected to frictional engagement with a tow of filaments.

According to the present invention, there is provided an apparatus for crimping a tow of filaments, comprising a pair of cylindrical feed rolls disposed to form a nip therebetween and having a pair of coplanar end surfaces on each side thereof and a stuffer box disposed adjacent to said nip and having a stuffing chamber for the passage of the tow of filaments and communicating at one end with said nip, said stuffer box including an inner wall portion for frictional engagement with the filaments as the latter is moved in a region located immediately downstream of said nip and defined jointly by said inner wall portion and respective peripheral surfaces of said feed rolls characterized in that said inner wall portion confronts to said pair of coplanar end surfaces across said nip with a slight clearance therebetween and is movable in a direction substantially the same as the direction of advance of the filaments in said region while renewing with respect to the frictional engagement with the filaments.

Many other advantages and features of the present invention will become manifest to those versed in the art upon making reference to the detailed

description and the accompanying sheets of drawings in which preferred structural embodiments incorporating the principles of the present invention are shown by way of illustrative example.

Figure 1 is a schematic front elevational view of a tow crimper embodying the present invention;

Figure 2 is a side elevational view of Figure 1;

Figure 3 is a plan view of Figure 1;

Figure 4 is a schematic front elevational view of a tow crimper according to another embodiment;

Figure 5 is a side elevational view of Figure 4;

Figure 6 is an enlarged front elevational view of a portion of the crimper shown in Figure 4;

Figure 7 is an enlarged fragmentary side elevational view, partly in cross section, of a portion of the crimper of Figure 4, showing a bearing unit for a presser plate;

Figure 8 is a view similar to Figure 7, showing a modified bearing unit; and

Figure 9 is an enlarged fragmentary side elevational view showing a cooling unit coupled with the crimper.

As shown in Figures 1 through 3, a tow crimper includes a pair of cylindrical feed rolls 10, 10 mounted in superposed relation to form a nip A therebetween, and a stuffer box 12 disposed adjacent to the nip A holding a slight clearance to the peripheral

and end surfaces of the rolls 10, 10. The stuffer box 12 includes a pair of parallel spaced upper and lower plates 13, 13 and a pair of parallel spaced side plates 14, 14 disposed on opposite sides of the upper and lower plates to define therebetween an elongate crimping chamber 15 for the passage of the filaments 16 and communicating at one end with the nip A.

In the illustrated embodiment, each of the side plates 14, 14 comprises a metallic endless belt trained around a pair of vertical guide rollers 17 to travel along the crimping chamber 15. The side plate or belt 14 has a flat portion confronting to a pair of coplanar end surfaces 18, 18 of the feed rolls 10, 10 in the vicinity of the nip A with a slight clearance between such flat portion and the end surfaces 18, 18.

In operation, a tow of filaments 16 is fed by and between the feed rolls 10, 10 into the crimping chamber 15 and is discharged from the stuffer box 12 in the shape of a cake. During that time, the metallic endless belts 14, 14 are driven, by friction with the filaments 16, to move in the direction of the arrow a (Figures 1 and 3). In case the belts 14 fail to be moved by themselves, a separate driving means 11 (Figure 3) may be provided for positively circulating the endless belts 14. The circulation velocity of the belts 14 may be lower than one-fifth of the peripheral speed of the feed rolls 10. Although the metallic

endless belts 14 are cooled naturally during circulating movement thereof, enhanced effect is achievable by the use of an independent cooling means disposed adjacent to the guide rollers 17, 17 or by introducing a coolant, such as water or oil, to the surfaces of the belts 14 for cooling them as well as lowering the friction between the belts 14 and the filaments 16.

With further continuous studies, the present inventors have conducted some experiments of replacing and renewing merely the portion of the structural members which are subjected to the greatest friction with the filaments. The tow of filaments having passed through the nip A is pressed strongly during its advance against the inner walls of the stuffer box that are opposed to the end surfaces 18, 18 of the rolls 10, 10. The velocity of the tow of filaments is reduced in accordance with further advance so that the area of contact between the filaments and the inner walls comes to increase. In view of such phenomenon, the present inventors have contributed the following method on the grounds that a satisfactory result may be achieved by moving, in the average direciton of movement of the filaments, inner wall portions of the stuffer box 12 that are located immediately behind of the nip A and have a length of 10 mm or so.

A modified tow crimper shown in Figures 4 and 5

is similar to the crimper shown in Figures 1 to 3 but differs therefrom in that a pair of rolatable disk-like presser plates 19, 19 is employed for side wall portions of a stuffer box 20. The stuffer box 20 has a conventional structure and no description is necessary. Each of the disk-like presser plates 19, 19 is rotatably disposed on one side of the rolls 10,10 in the vicinity of the nip A and has an inner surface extending parallel to a pair of coplanar end surfaces 18, 18 of the rolls 10, 10 with a slight clearance therebetween as shown in Figure 5. The presser plates 19, 19 have a pair of aligned central axes 21, 21 extending parallel to rotational axes 22, 22 of the respective rolls 10, 10. The central axes 21, 21 are spaced from a vertical plane X - X including the axes 22, 22 toward the filament outgoing side by a distance on the order of 1 to 10 mm as represented by e in Figure 4 and are retained in positions spaced apart by more than 2 mm as represented by b from a horizontal plane passing through the nip A. With this arrangement, a tow of filaments 15 having passed through the nip A comes to advance as indicated by the arrow a in Figure 6 while grazing or rubbing against a triangular region ABC of each presser plate 19. This engagement causes the presser plate to be rotated in the direction of the arrow d. In case the presser plate 19 fails to be rotated by itself due to a high

resistance, a separate driving means 11' (Figure 4) may be provided for positively rotating the disk 19 in the direction indicated by the arrow d. The axes 21, 21 may be positioned in alignment with the vertical plane X - X. However to space the axes 21, 21 toward the filament approaching side from the vertical plane X - X is not preferable. In this case, the tendency takes place that the filaments which contact directly the presser plate are pulled into the clearance between the end surfaces of the rolls 10, 10 and said presser plate, because the component of the surface speed, just behind of the nip A, of the presser plate that is perpendicular to the direction of the arrow a becomes large.

Each of the presser plates 19, 19, as shown in Figure 7, has a central stepped shaft 23 rotatably mounted in a bearing box 24 via a pair of roller bearings 25, the bearing box 24 including an exterally threaded cylindrical portion secured to a bracket 26 by a pair of nuts 27, 28. The bearing box 24 thus constructed is axially movable while the nuts 27, 28 are loosened, so that the clearance between the end faces 18 of the rolls 10, 10 and the presser plate 19 can be adjusted.

A modified bearing unit shown in Figure 8 includes a hollow cylinder 29 fixed to a support 30 and having a longitudinal bore 31 in which a cylindrical

bearing box 32 is slidably fitted. The cylinder 29 has an air supply inlet 33 through which compressed air is supplied into the bore 31 to move the bearing box 32 and hence a presser plate 34 toward end surfaces 18 of rolls 10, 10. The forward movement of the bearing box 32 is prevented by an adjusting nut 35. With this arrangement, when a tow of filaments comes to be pressed against the presser plate 34 with an increased force, the presser plate 34 is moved backward to absorb such force, thereby reducing the friction between the filaments and the presser plate 34. The presser plate 34 and the bearing box 32 have a pair of aligned axial through-holes 36, 37 communicating with each other. A pressurized fluid is introduced through the holes 37, 36 into the clearance between the presser plate 34 and the end surfaces 18 of the rolls 10, 10 to thereby cool the presser plate 34 as well as to enhance lubricating effect between the filaments and the presser plate 34.

Alternatively, as shown in Figure 9, an oil cap 38 is disposed above the presser plate 19 for supplying a coolant such as water or finishing oil to the clearance between the end surfaces 18 of the rolls 10 and the presser plate 19 to thereby cool the latter. The coolant also serves as a lubricant between the presser plate 19 and the filaments to diminish the friction therebetween. Supply of water or oil may be executed by any other method on condition that

substantially a fixed amount thereof is fed.

Since the disk-like presser plate is rotated, the movement of its surface is not exactly coincident with the direction of advance of the filaments. However, in the region where the filaments cause the greatest friction, the plate surface is moved substantially parallel to the filaments while being renewed with respect to the friction. Thus, fusion of the filaments can be prevented to eventually bring about uniform wear of the presser plate with resultant remarkably increased durability.

According to the present invention, it becames possible to eliminate occurence of fusion on the lateral portions of the tow of filaments, and any kind of fibers can be crimped adequately by adjusting holding pressure in the stuffer box. For prevention of such fusion, mere introduction of a coolant or the like to the wall of the stuffer box is also allowable to attain required cooling effect. However, it is practically difficult to execute complete cooling at the nip or similar region where structural components are gathered. According to the present invention, the inner wall portion of the stuffer box which confronts the end surfaces of the feed rolls across the nip is self-movable while renewing with respect to the friction engagement with the filaments, so that such inner wall portion is automatically cooled during its

movement. Thus, the durability of the component elements, such as the endless belts or the disk can be enhanced to consequently realize an improved stuffing box type crimper which is capable of performing a stable operation continuously at a speed of 1000 m or more per minute.

CLAIMS:

1. An apparatus for crimping a tow of filaments, comprising a pair of cylindrical feed rolls (10, 10) disposed to form a nip (A) therebetween and having a pair of coplanar end surfaces (18, 18) on each side thereof and a stuffer box (12) disposed adjacent to said nip (A) and having a stuffing chamber (15) for the passage of the tow of filaments (16) and communicating at one end with said nip (A), said stuffer box (12) including an inner wall portion (14; 19) for frictional engagement with the filaments (16) as the latter is moved in a region located immediately downstream of said nip (A) and defined jointly by said inner wall portion (14; 19) and respective peripheral surfaces of said feed rolls (10, 10) characterized in that said inner wall portion (14; 19) confronts to said pair of coplanar end surfaces (18, 18) across said nip (A) with a slight clearance therebetween and is movable in a direction substantially the same as the direction of advance of the filaments (16) in said region while renewing with respect to the frictional engagement with the filaments (16).

2. An apparatus according to claim 1, including means (11; 11) for positively moving said inner wall portion (14; 19) in said direction at a speed lower than one-fifth of the peripheral speed of said feed rolls (10, 10).

3. An apparatus according to claim 1, including means (36, 37; 38) for supplying a coolant into said clearance to thereby cool said inner wall portion (14; 19).

4. An apparatus according to claim 1, said inner wall portion being composed of a metallic endless belt (14) self-circulatable by the friction acting between said belt (14) and the filaments (16).

5. An apparatus according to claim 1, said inner wall portion being composed of a disk (19) self-rotatable about its own (21) axis by the friction acting between said disk (19) and the filaments (16), said axis (21) extending parallel to axes (22) of said feed rolls (10, 10) in a plane including said axes (22) of said feed rolls (10, 10) and said nip (A), said axis (21) of said disk (19) being spaced from said nip (A) at least 2 mm toward one of said feed rolls (10, 10).

6. An apparatus according to claim 1, said inner wall portion being composed of a disk (19) self-rotatable about its own axis (21) by the friction acting between said disk (19) and the filaments (16), said axis (22) extending parallel to axes (22) of said feed rolls (10, 10), displaced out of alignment with a first plane including said axes of said feed rolls and said nip (A) in a direction toward said region, and spaced from said nip (A) by at least 2 mm toward one of said feed rolls (10, 10) in a second plane

perpendicular to said first plane.

7. An apparatus according to claim 6, said disk (19) including a central axial hole (26) through which a coolant is supplied into said clearance.

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FIG. 1

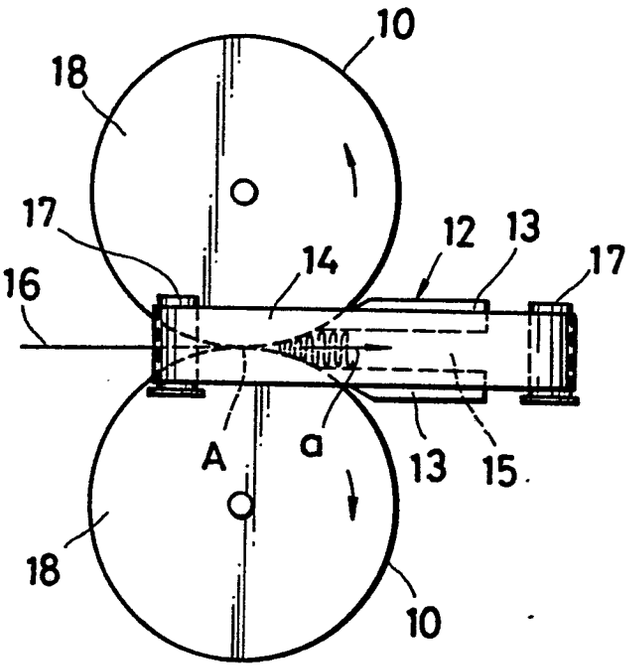

FIG. 2

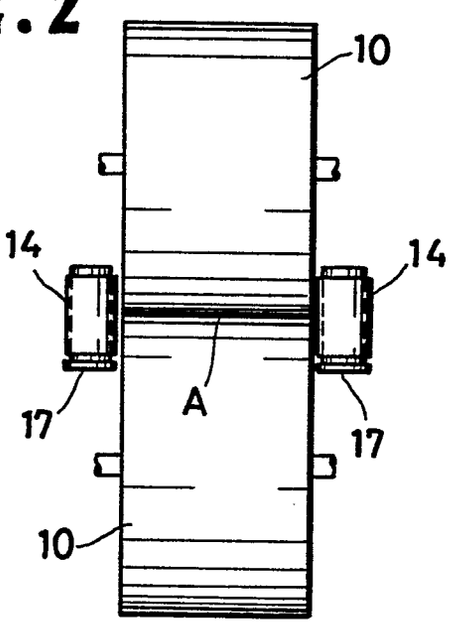

FIG. 3

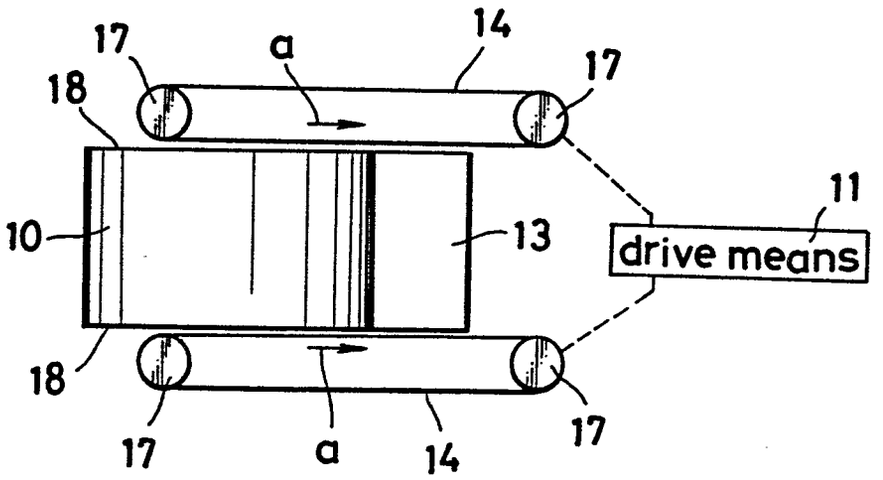
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FIG. 4

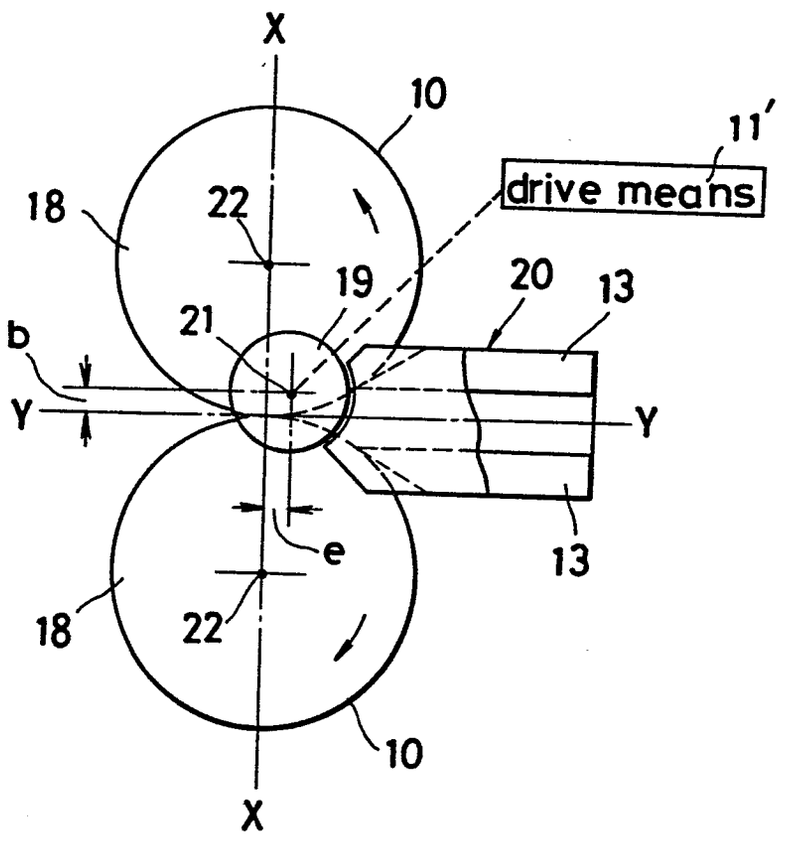
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FIG. 5

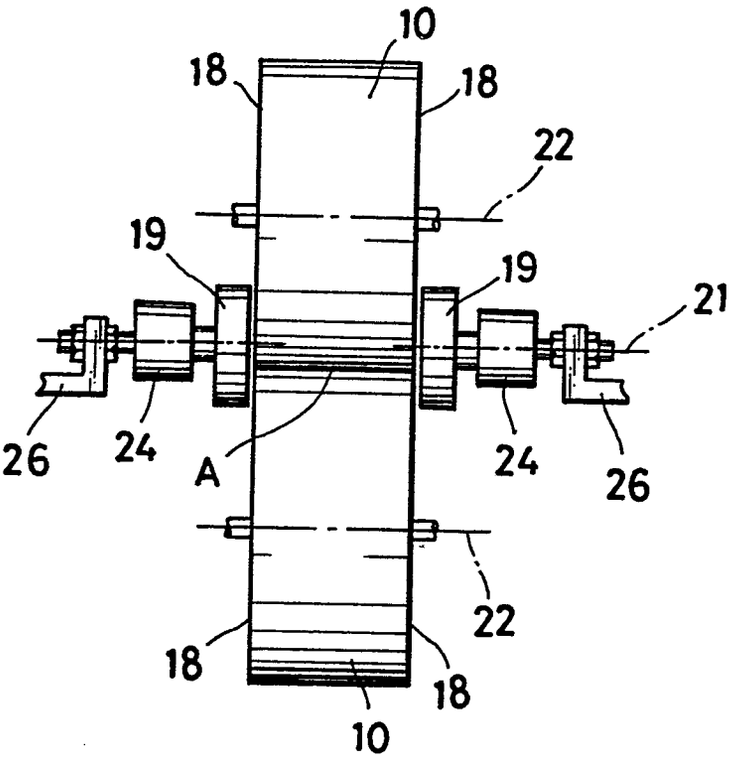

FIG. 6

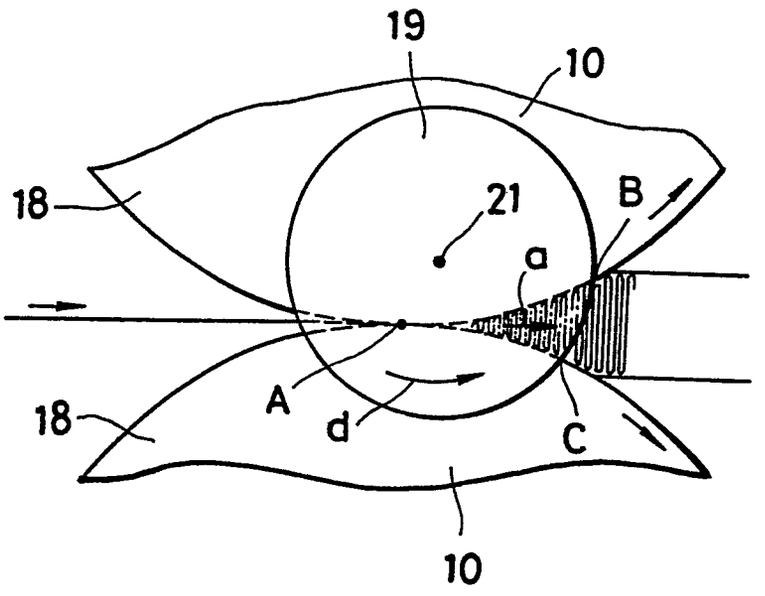

FIG. 7

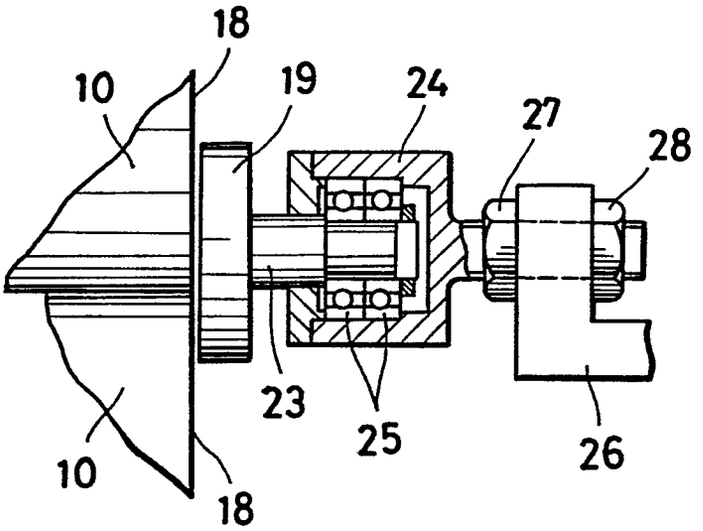

FIG. 8

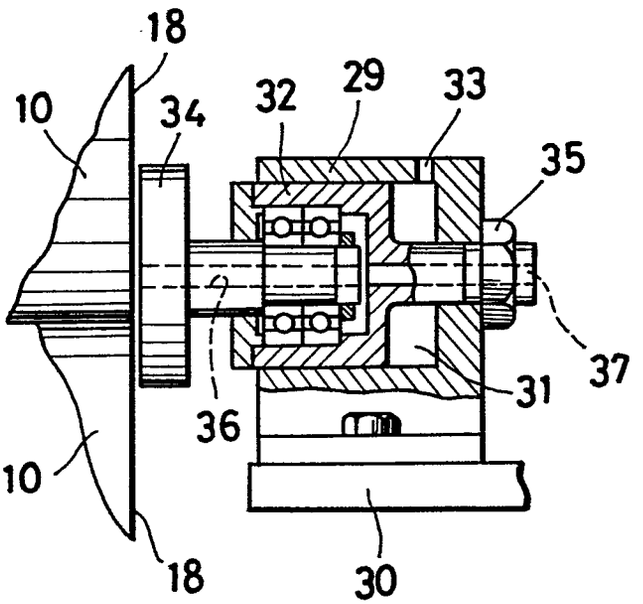

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FIG. 9