Oct. 23, 1962 R. HIPPE ET AL 3,059,408

MAGNETICALLY SUPPORTED FALSE TWIST TUBES AND THE LIKE

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Fig.1

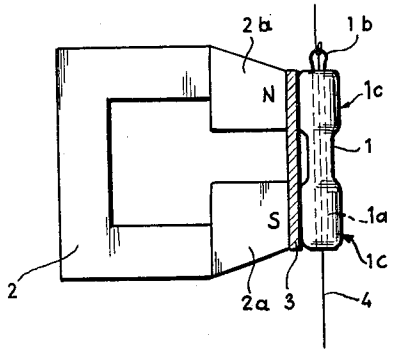


Fig.2

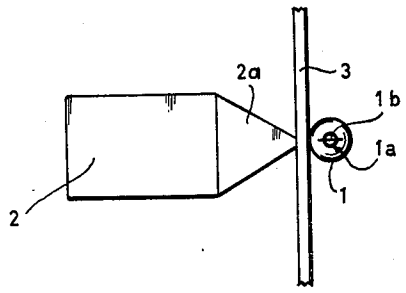
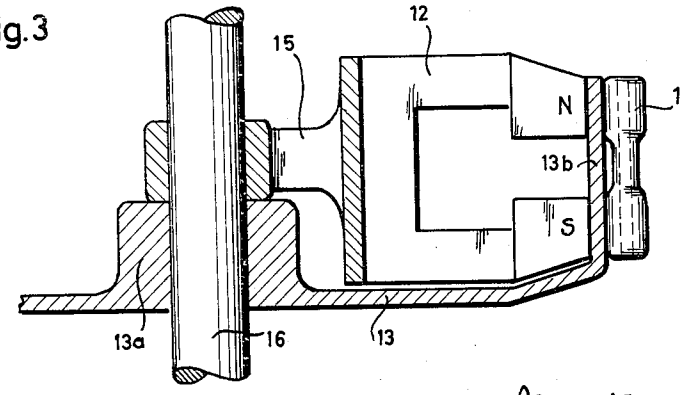


Fig.3



Inventors:
Richard Hippe
Gerhard Schussler.
By Michael S. Striker
Attorney

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Fig.4

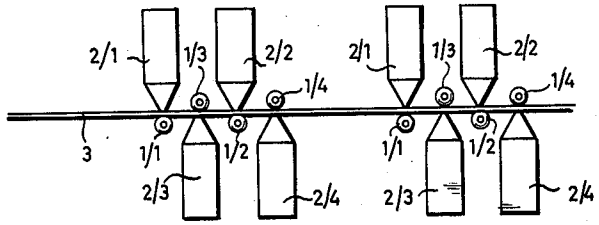
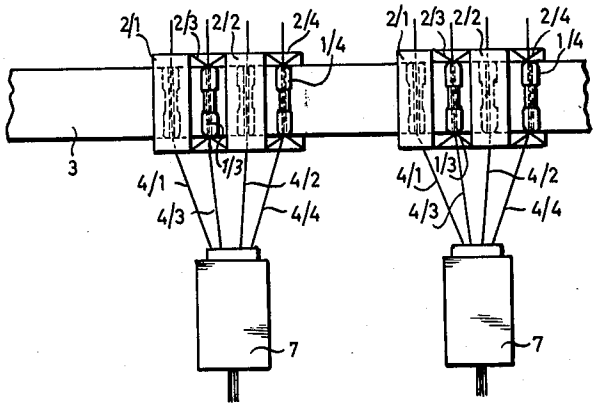


Fig.5



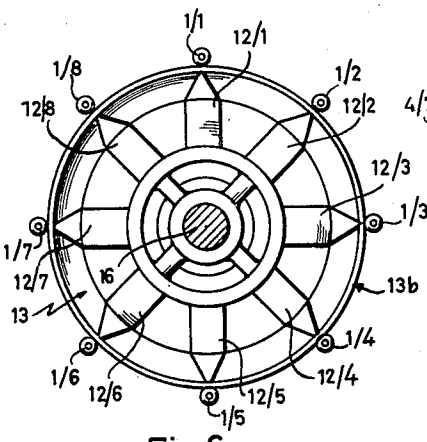


Fig.6

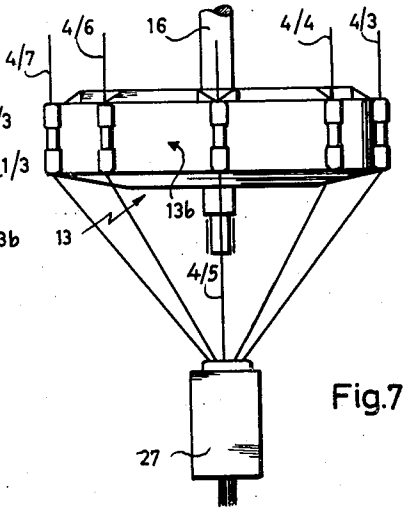


Fig.7

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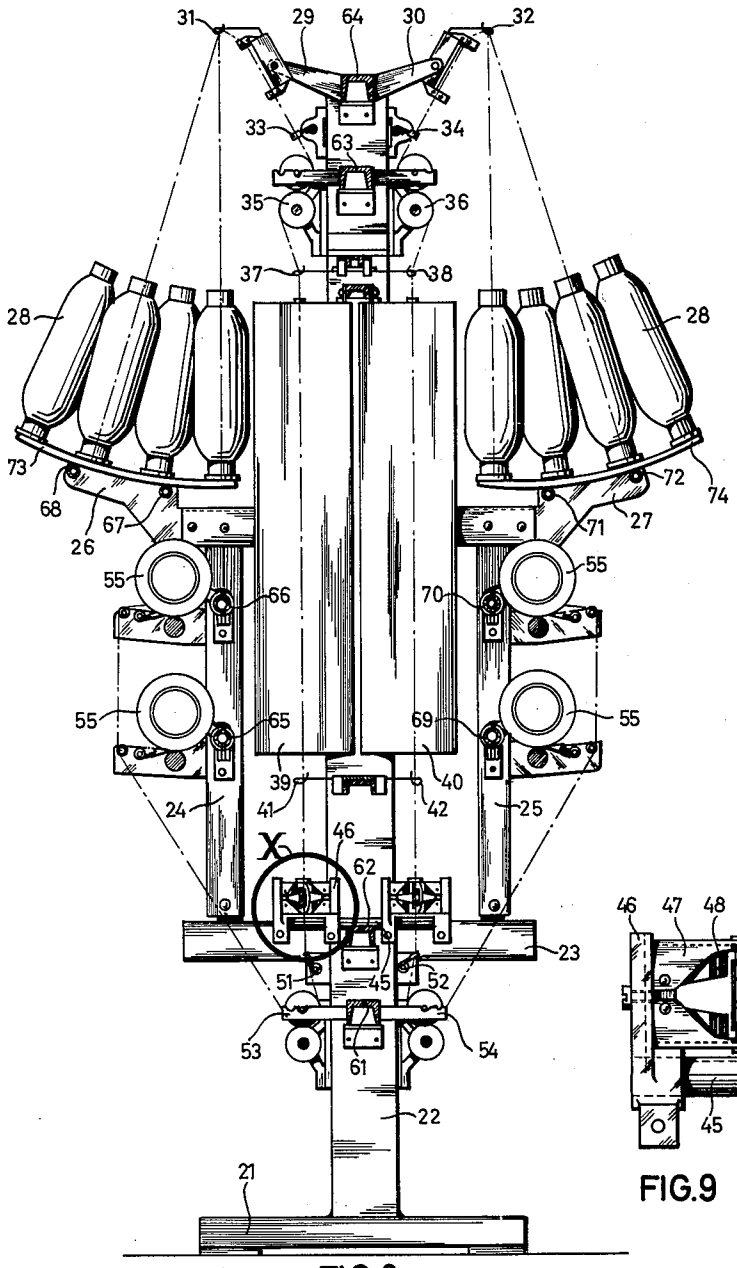


FIG.8

FIG.9

INVENTORS
Richard Hippe
Gerhard Schüssler
BY Michael S. Striker
Attorney.

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MAGNETICALLY SUPPORTED FALSE TWIST TUBES AND THE LIKE

Richard Hippe and Gerhard Schüssler, Heilbronn-Sontheim, Germany, assignors to Zwirnerei Ackermann Werk der Ackermann-Goggingen A.G., Heilbronn-Sontheim, Germany

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4 Claims. (Cl. 57—77.45)

The present invention relates to drives for rotating driven elements at extremely high speed. The present invention is particularly applicable to false twisting apparatus wherein false twist tubes are required to be driven at extremely high speeds.

In false twist apparatus it is known to subject to false twisting all types of filaments which are capable of receiving a curl which can be permanently set therein. Such filaments may be made of synthetic staple fibers or even from mixtures of such synthetic fibers and natural fibers, and these fibers are spun so as to form the filaments which are thereafter false twisted and then set so as to have a permanent curl therein, thus greatly increasing the stretchability of the filaments, as is well known.

In order to provide a relatively large output with false twisting apparatus of this type, it is necessary to rotate the false twist tubes at extremely high speeds, and the extent of the output is determined by the speed of rotation of the false twist tubes so that the latter are rotated at the highest possible speeds in order to provide the greatest possible output. With false twist tubes of this type which are supported in roller or ball bearings it is possible to obtain maximum speeds of 80,000 r.p.m. However, tubes supported in this way subject their bearings to extremely great wear, and the operation is further undesirable because of the large amount of noise and great amount of heat which is generated.

It is possible at the present time to obtain even higher speeds for false twist tubes, but only at considerable cost. For example, frequency-regulated electric motors are known which are provided with hollow drive shafts which act as a false twist tube, and such drive shafts are supported for rotation on cushions of compressed air. However, installations of this type are extremely expensive and require a particularly large investment. Devices of this latter type can provide revolutions of up to 150,000 per minute, but they are extremely costly and require a relatively large amount of space.

One of the objects of the present invention is to provide a structure capable of rotating a driven element such as a false twist tube at speeds on the order of 150,000 r.p.m. and higher with an extremely simple, inexpensive structure which occupies an extremely small amount of space.

Another object of the present invention is to provide a high speed drive for driven elements such as false twist tubes which enables a relatively large number of the tubes or other driven elements to be driven from a single drive means and which also enables a relatively large number of the driven elements to be located relatively close to each other and also to be rotated in pairs with the driven elements of each pair rotating in opposite directions.

It is also an object of the present invention to provide an inexpensive highly reliable false twisting apparatus whose output is substantially greater than the output of any false twisting apparatus known at the present time.

With above objects in view the present invention includes in a high speed drive an elongated, non-magnetizable drive means movable along a predetermined path, a stationary magnet located at one side of the drive means

so that the latter moves past the stationary magnet, and a magnetic driven element located on the side of the drive means opposite from the magnet and attracted toward the latter so as to be urged by the magnet against the drive means to be rotated by the later. In the case of a false twist apparatus, the invention includes an elongated drive means movable along a predetermined path and a stationary magnet means located closely adjacent to the drive means so that the latter moves past the stationary magnet means. A magnetically supported false twist tube is located at the side of the drive means opposite from the magnet means to be attracted toward the latter and thus pressed against the drive means to be rotated thereby. Because the false twist tube is urged against the drive means exclusively by the magnet means and because this false twist tube is not supported in any way and is only maintained in operative relation with respect to the drive means by the magnet means, there are no bearings or other elements which limit the speed of rotation of the false twist tube and at the same time an extremely small space is occupied by the structure of the invention.

The novel features which are considered as characteristic for the invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific embodiments when read in connection with the accompanying drawings, in which:

FIG. 1 is an elevational view of a high speed drive according to the present invention, the drive means of FIG. 1 being shown in section;

FIG. 2 is a top plan view of the structure of FIG. 1;

FIG. 3 is a fragmentary sectional elevational view of another embodiment of a high speed drive according to the present invention;

FIG. 4 is a top plan view schematically illustrating how groups of driven elements may be associated with a single drive means according to the present invention;

FIG. 5 is an elevational view of the structure of FIG. 4, FIG. 5 further illustrating schematically devices for treating the filaments before they are twisted;

FIG. 6 is a partly sectional top plan view of an apparatus for driving a plurality of driven elements from a single drive means, the embodiment of FIG. 6 being different from that of FIGS. 4 and 5 and corresponding to the embodiment of FIG. 3; and

FIG. 7 is an elevational view of the structure of FIG. 6 showing how a single filament treating apparatus is used with all of the driven elements;

FIG. 8 is an elevation of a down-twister which includes the structure of the invention; and

FIG. 9 shows on an enlarged scale, as compared to FIG. 8 the high speed drive of the invention which is included in the structure of FIG. 8.

Referring now to FIGS. 1 and 2, it will be seen that the structure illustrated therein includes a permanent horseshoe magnet 2 which is stationary and fixedly supported in any suitable way not illustrated in the drawing. For example, the permanent magnets 2 may be fixedly carried by the frame of the machine. The permanent magnet 2 is provided with pole shoes 2*a* which are of wedge-shaped configuration and the outer tips or crests of the wedge-shaped pole shoes extend parallel to the north-south direction of the magnet. Directly next to the pole shoes 2*a*, at the crests of the same, is located an elongated drive means in the form of a drive belt 3 which moves in a direction normal to the plane of FIG. 1 and which is of a non-magnetizable and electrically non-conductive material in order to avoid eddy currents. This belt 3 may be an endless belt of plastic which continuously moves

past the stationary magnet means 2, and the belt 3 is driven by any motor or the like and guided on any suitable pulleys.

At the side of the drive means 3 opposite from the stationary magnet means 2 is located the driven element which in the illustrated example is in the form of a magnetic false-twist tube 1 made of soft iron, for example. This tube is supported only by the magnet 2 and is attracted toward the latter so that the magnet 2 presses the false-twist tube 1 against the belt 3 and in this way during movement of the belt 3 the false-twist tube 1 will be rotated around its axis. It will be noted that the axis of the tube 1 also extends in the north-south direction of the magnet. At relatively high speeds of the belt 3 and relatively small diameters of the tube 1 the latter will be rotated at extremely high speeds by frictional engagement with the moving belt 3 while being maintained in the position shown in FIGS. 1 and 2 by the magnetic forces derived from the magnet means 2.

As may be seen from the drawing, the tube 1 is provided with an axial bore 1*a* passing therethrough so that the filament 4 which is to be false-twisted can extend through the tube 1, and the tube 1 carries at its top end, as viewed in FIG. 1, a wire element 1*b* which is fixed to the tube 1 for rotation therewith and which bridges the top open end of the tube 1, this element 1*b* having a U-shaped configuration in the example illustrated in FIG. 1. The filament 4 which is to be false-twisted is looped around the wire element 1*b* so that a false-twist will be imparted to the filament 4 during rotation of the tube 1, as is well known. The tube 1 is provided with portions 1*c* of an enlarged diameter, as compared to the remainder of the tube 1, and these portions 1*c* are respectively lined with the poles of the magnet, so as to provide a reliable support of the tube 1 and a forceful urging of the same against the drive means 3.

According to the embodiment of the invention which is illustrated in FIG. 3, the stationary permanent magnet 12 is fixedly carried by a stationary holder 15 formed with a bore through which a rotary drive shaft 16 passes. This rotary drive shaft 16 is fixed to the hub 13*a* of a disc 13 which fixedly carries at its outer periphery a hollow cylinder 13*b* which may be formed integrally with the disc 13. Thus the parts 16, 13*a*, and 13 form a means connected to the cylinder 13*b* for rotating the latter. This cylinder 13*b* has a relatively thin wall and the entire disc 13 and cylinder 13*b* are made of a non-magnetizable, electrically non-conductive material. It will be noted that as the cylinder 13*b* rotates around its axis it will move past the pole shoes of the stationary magnet 12 which has the same structure as the magnet 2 described above. The holder 15 of the magnet 12 is fixedly carried by any suitable structure so as to maintain the magnet 12 stationary. The false twist-tube 1 is located at the side of the cylinder 13*b* opposite from the magnet 12 and is attracted toward the latter so that the false-twist tube 1 is supported exclusively by the magnet 12 and is urged exclusively by the magnet 12 into frictional engagement with the rotating cylinder 13*b* to be driven during rotation of the latter.

It is apparent that with the above-described structure, even when the drive means is idle the false-twist tubes will be maintained in position by the permanent magnets. However, it is also possible to use electro-magnets, and in this case the false-twist tubes are held in position even when the current is turned off by the looped portion of the filament which passes around the wire 1*b*.

FIG. 4 schematically illustrates in a plan view two groups of the devices shown in FIGS. 1 and 2 associated with a single drive means in the form of an endless belt 3, each group including four false-twist tubes 1/1–1/4 and four permanent magnets 2/1–2/4 respectively cooperating therewith in the manner shown in FIG. 4. Thus, it will be seen that the permanent magnets 2/1 and 2/2 are on one side of the belt 3 while the permanent magnets 2/3 and 2/4 are on the other side thereof, and the false-twist tubes 1/1 and 1/2 which cooperate with the magnets 2/1 and 2/2 are located on the same side of the belt as the magnets 2/3 and 2/4 but aligned with the magnets 2/1 and 2/2. It will be noted that with this arrangement the false-twist tubes on one side of the belt 3 will be driven in a direction opposite from the false-twist tubes on the other side thereof, so that pairs of filaments which respectively pass through the tubes on the opposite sides of the belt 3 may be S-twisted and Z-twisted to provide pairs of oppositely twisted filaments which can thereafter be combined together to form doubled filaments and which may be thereafter further twisted so as to prevent the doubled, combined filaments from coming apart from each other.

As may be seen from FIG. 5, which diagrammatically illustrates an up-twister, all of the filaments associated with one group of devices of the invention pass through a single filament treating device 7 of any suitable construction prior to moving upwardly through the false-twist tubes. As is well known the filaments may be derived from any suitable packages after the latter are arranged in suitable creels, and filament tensioning devices may be arranged in advance of the devices 7 and beyond the false-twist tubes suitable take-up spools may be provided to take-up the treated filaments. The devices 7 may provide either a chemical or a thermal treatment of the filaments.

According to the embodiment of the invention which is illustrated in FIGS. 6 and 7, and which has been partly described in connection with FIG. 3, the several magnets 12/1–12/8 are fixedly connected to each other and form part of a spider arranged within the hollow cylinder 13*b*, and on the outside of the cylinder 13*b* are arranged the several false-twist tubes 1/1–1/8 which respectively cooperate with the magnets 12/1–12/8 to be attracted toward the latter and thus urged into frictional engagement with the cylinder 13*b* and rotated thereby, these false-twist tubes being supported exclusively by the magnets and urged exclusively thereby against the rotary cylinder 13*b*. The shaft 16 may be driven from any suitable motor. As is indicated in FIG. 7, this structure also forms part of an up-twister, and a suitable filament treating device 27 is provided for treating all of the filaments prior to the passage of the latter through the false-twist tubes.

The provision of pole shoes which are of wedge-shaped configuration is of advantage since in this way the lines of flux are concentrated on relatively small areas at the crests of the pole shoes. The enlarged portions of the false-twist tubes serve to concentrate the lines of magnetic flux.

It will be noted that the above-described structure of the invention requires a minimum amount of space, a minimum amount of driving energy, and with practically no wear it provides practically any desired speed of rotation.

By providing a single yarn treating device 7 or 27 for a plurality of filaments which will be arranged in pairs with the filaments of opposite pair false-twisted in opposite directions, as indicated in FIGS. 4 and 5, the advantage is provided that the oppositely twisted filaments which are afterwards combined together to form a doubled yarn are subjected to identical heat treatment.

FIG. 8 shows the structure of the invention incorporated into a down-twister apparatus. The structure of FIG. 8 includes the creels 73 and 74 which are carried by the frame portions 26 and 27, respectively. Each creel is carried directly by a pair of bars of the frame portions 26 and 27. Thus, the creel 73 is carried by the bars 67 and 68, while the creel 74 is carried by the bars 71 and 72. Each creel carries a plurality of packages 28, and these yarn packages are arranged in pairs having their free ends tied together, so that as soon as one package of each pair is empty the structure will continue to

operate with the yarn from the other package of each pair, and in the meantime the empty package may be replaced with a full package and tied to the remaining package so that in this way continuous operation is provided. Of course, a plurality of such pairs of packages are carried by each creel on opposite sides of the machine, and the yarns from the packages pass upwardly around and through the yarn guides **31**, **32** which may be conventional pig-tail guides. From the guides **31** and **32** shown at the top of FIG. 8, the yarns or filaments pass through the thread or yarn tensioning devices **29** and **30** which are of any conventional construction such as meshing combs whose position may be adjusted so as to adjust the tension on the filaments. These filament tensioning devices **29** and **30** are carried by the stationary frame portion **64**. Below the beam **64** of the machine is located a beam **63** which carries the brackets for supporting pairs of yarn or filament transporting rollers **35** and **36** on the opposite sides of the machine, and the yarn guides **33** and **34** serve to guide the yarn or filament from the tensioning devices to the transporting rollers **35** and **36** which nip the yarn and guide the same to the guide eyes **37** and **38** which may be pig-tail guides in the same way as the guides **31** and **32**. The lower rollers of the pairs of rollers **35** and **36** may be driven from any suitable source of power while the upper rollers simply rest on the lower rollers by gravity to nip the yarn and transport the same. From the guides **37** and **38** the filaments pass downwardly through the yarn treating devices **39** and **40** which may, for example, heat the filaments in the event that they are made of thermoplastic material so as to place them in a condition suitable for false-twisting. After passing through the treating devices **39** and **40** the filaments are guided through the pig-tail guides **41** and **42** to the structure of the invention, this structure conforming generally to structure shown in FIGS. 1, 2 and FIGS. 4, 5. This structure is shown on an enlarged scale in FIG. 9, and includes the stationary rail **45** which is fixedly carried by the beam **62** and extends crosswise of the latter. The rail **45** serves to slidably support a carriage **46** which fixedly carries a magnet holder **47**, the latter providing a support for the stationary permanent magnet **48** which has the structure described above. The magnet **48** is located next to the drive belt **49**, which corresponds to the belt **3** described above, and this is an elongated endless belt driven from any suitable motor. It is to be understood that FIG. 8 is a transverse view of a long false-twisting apparatus which may have the length on the order of 15 or 20 feet, for example. The drive belt **49** extends along the entire machine and pulleys for the belt are located at the ends of the machine and one run of the belt is located at the left side of the machine as viewed in FIG. 8, while the other run is located at the right side thereof, and the magnets **48** are distributed along both runs of the belt on opposite sides thereof in the manner indicated in FIG. 8. The carriages **46** can respectively be fixed to the rails **45** at any desired position thereof, so that it is possible to adjust the positions of the magnets **48** with respect to the driving belt **49**. The false-twist tubes **50** correspond to the tubes **1** described above and are respectively aligned with the permanent magnets on the opposite side of the belt therefrom, this arrangement conforming to that illustrated in FIG. 4.

This, it will be seen that the several yarns of filaments moving downwardly through the false-twist tubes **50** are false-twisted thereby. These yarns or filaments then move through the yarn guides **51** and **52** and from the latter to the transporting pairs of rolls **53** and **54** which may be identical with the rolls **35** and **36** described above. Of course, it is to be understood that there are a large number of filaments moving simultaneously downwardly through the false-twisters and there are a large number of guides such as the guides **33**, **34**, **37**, **38**, **41**, **42** and **51**, **52** respectively guiding the several filaments. All of these filaments are nipped by the transporting rolls **53** and **54** and pass around the upper transporting rolls of the pairs of transporting rolls **53** and **54** to move upwardly to the two decks of take-up spools located at the opposite sides of the machine beneath the creels. The machine includes the base **21** as well as the frame part **22** extending upwardly therefrom and supporting the various other frame parts in the manner shown in FIG. 8. Some of the filaments which move upwardly from the lower transporting rolls **53** and **54** are guided to the take-up spools **55** of the two lower decks located on the opposite sides of the machine, as indicated in FIG. 8, these spools being supported by the frame parts **65** and **69** and the filaments are guided onto the take-up spools with conventional guides. The take-up spools are driven by lower driving rollers on which the take-up spools rest by gravity so as to take-up the yarn, these take-up spool driving rolls being driven from any suitable motor in a known way. In the same manner, as is evident from FIG. 8, the remaining filaments are guided to the upper decks of take-up spools **55** to be wound thereon, the upper decks being supported by the frame parts **66** and **70**, as indicated in FIG. 8.

The simplicity and relatively small space occupied by the structure of the invention is evident from FIG. 8.

It will be understood that each of the elements described above, or two or more together, may also find a useful application in other types of high speed drives differing from the types described above.

While the invention has been illustrated and described as embodied in a high speed drive for false-twist tubes or spindles, it is not intended to be limited to the details shown, since various modifications and structural changes may be made without departing in any way from the spirit of the present invention.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can by applying current knowledge readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the following claims.

What is claimed as new and desired to be secured by Letters Patent is:

1. A high speed rotary drive, comprising the combination of a cylindrical driven element comprising a body of magnetically permeable material extending axially thereof, stationary magnet means having a pair of poles spaced apart in a direction axially of said element and tapered outwardly terminating in wedge shaped tips, each of which extends a substantial distance axially of said element and in substantial parallel alignment with the axis of said element, and a non-magnetic driving element movable in one direction transverse the axis of said driven element continuously along a predetermined path passing over and substantially bridging the space between said magnet pole tips, said driving element having an inner surface contiguous with said pole tips and an outer driving surface against which said driven element is held in driving engagement conjointly by said magnetic means and said magnetically permeable driven element body, the length across said pole tips in a direction axially of said driven element being substantially at least as great as the length of said magnetically permeable body axially of said driven element.

2. In a false twist apparatus, the combination of a false twist tube comprising a body of magnetically permeable material extending axially thereof, stationary magnet means having a pair of poles spaced apart in a direction axially of said tube and tapered outwardly terminating in wedge shaped tips, each of which extends a substantial distance axially of said tube and in substantial parallel alignment with the axis of said tube,

and a non-magnetic driving element movable in one direction transverse the axis of said tube continuously along a predetermined path passing over and substantially bridging the space between said magnet pole tips, said driving element having an inner surface contiguous with said pole tips and an outer driving surface against which said tube is held in driving engagement conjointly by said magnetic means and said magnetically permeable tube body, the length across said pole tips in a direction axially of said tube being substantially at least as great as the length of said magnetically permeable body axially of said tube.

3. In a false twist apparatus, the combination of a false twist tube comprising a body of magnetically permeable material extending axially thereof, stationary magnet means having a pair of poles spaced apart in a direction axially of said tube and tapered outwardly terminating in wedge shaped tips, each of which extends a substantial distance axially of said tube and in substantial parallel alignment with the axis of said tube, and a non-magnetic driving belt movable in one direction transverse the axis of said tube continuously along a predetermined path passing over and substantially bridging the space between said magnet pole tips, said belt having an inner surface contiguous with said pole tips and an outer driving surface against which said tube is held in driving engagement conjointly by said magnetic means and said magnetically permeable tube body, the length across said pole tips in a direction axially of said tube being substantially at least as great as the length of said magnetically permeable body axially of said tube.

4. In a false twist apparatus, the combination of a

false twist tube comprising a body of magnetically permeable material extending axially thereof, stationary magnet means having a pair of poles spaced apart in a direction axially of said tube and tapered outwardly terminating in wedge shaped tips, each of which extends a substantial distance axially of said tube and in substantial parallel alignment with the axis of said tube, and a thin-walled cylinder having a non-magnetic peripheral driving portion movable in one direction transverse the axis of said tube continuously along a predetermined path passing over and substantially bridging the space between said magnet pole tips, said driving portion having an inner surface contiguous with said pole tips and an outer driving surface against which said tube is held in driving engagement conjointly by said magnetic means and said magnetically permeable tube body, the length across said pole tips in a direction axially of said tube being substantially at least as great as the length of said magnetically permeable body axially of said tube.

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