Feb. 20, 1968 D. A. E. MATTINGLY 3,369,356

FALSE TWISTING APPARATUS

Original Filed Sept. 14, 1964 2 Sheets-Sheet 1

Fig. 1.

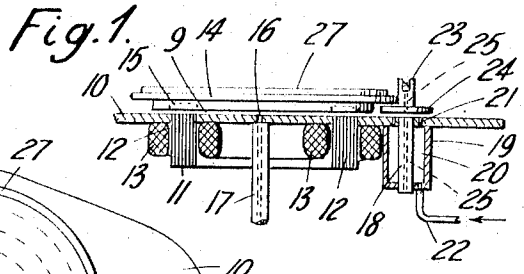


Fig. 2.

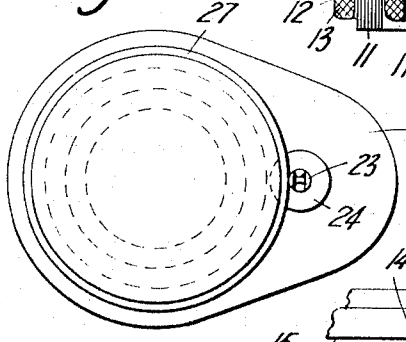


Fig. 3.

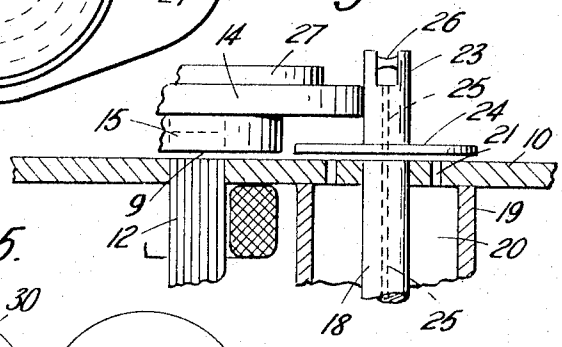


Fig. 5.

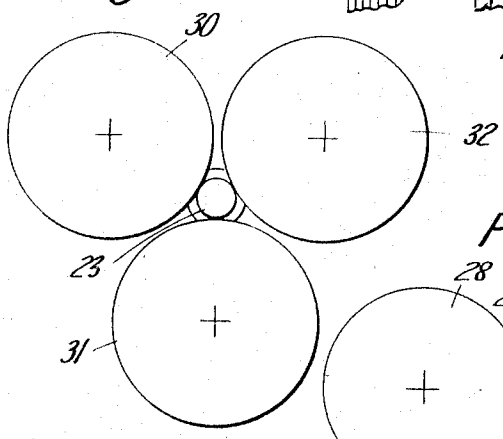
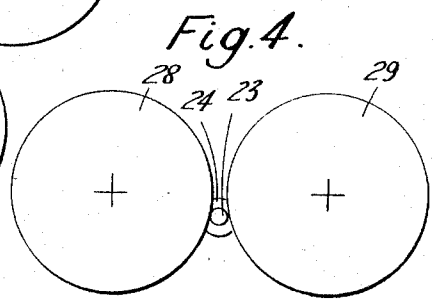


Fig. 4.



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FALSE TWISTING APPARATUS

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Fig. 6.

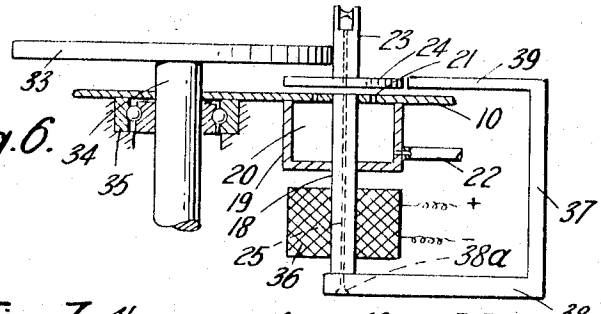


Fig. 7.

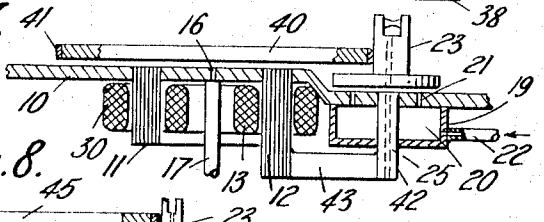


Fig. 8.

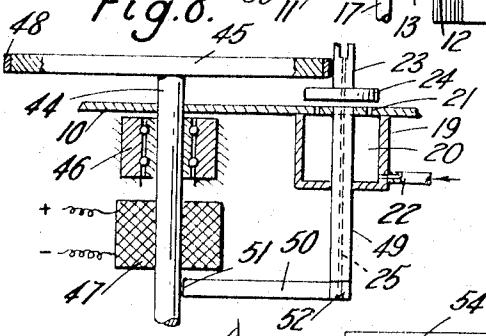
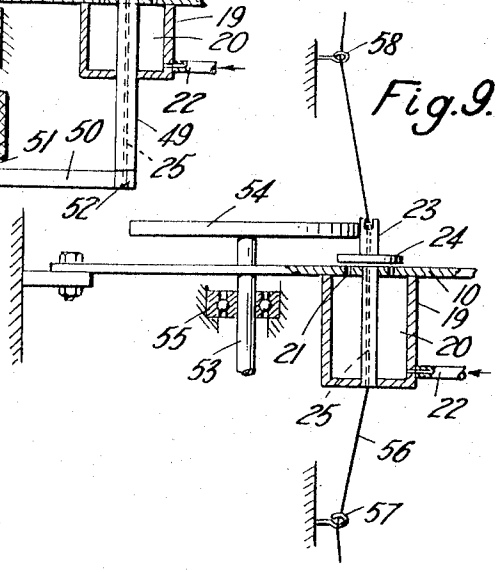


Fig. 9.



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3,369,356

FALSE TWISTING APPARATUS

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Continuation of application Ser. No. 396,061, Sept. 14, 1964. This application Nov. 10, 1966, Ser. No. 593,583

Claims priority, application Great Britain, Sept. 16, 1963, 36,414/63

27 Claims. (Cl. 57—77.45)

ABSTRACT OF THE DISCLOSURE

In an apparatus for false twisting yarn, a spindle, having a bore through which the yarn passes, is supported by air bearing means. The spindle is rotated about its own axis by means of a disc-like driving member having a peripheral surface in frictional engagement with the spindle. The driving member may also be supported by an air bearing. A magnetic system is employed for locating and maintaining the position of the spindle relative to the drive means.

This application is a continuation of application Ser. No. 396,061, filed Sept. 14, 1964, now abandoned.

This invention relates to false twisting apparatus, and more particularly to false twisting spindles or heads and their support and driving transmission means.

It is an object of the invention to improve false twisting apparatus.

It is an important object of the invention to reduce frictional resistance in false twisting apparatus.

According to one aspect of the invention, the twisting head comprises a rotatable part arranged to be supported by an air bearing so that the rotatable part can float in axial and radial directions, such floating movement being limited by magnetic means hereinafter disclosed, there being provided at least one rotary driving element for frictionally engaging and driving said rotatable part, and means for urging said rotatable part into engagement with said driving element.

The rotatable part may be provided with a face transverse to its axis of rotation arranged opposite a face on a stationary element and means for causing an air stream to be directed between said opposed faces so as to provide in operation a space between said faces and maintain the rotatable part in a floating condition.

The transmission preferably includes means which serve to limit the floating movement of the rotatable part, for example, magnetic means may be provided for that purpose.

In one arrangement according to the invention said rotatable part has at least a portion thereof formed from magnetic material which forms part of the magnetic means for limiting the extent of the floating movement of the rotatable part.

The diameter of said driving element may be considerably larger than that of the rotatable part so that the rotatable part rotates at a higher rate than the driving element.

The driving element may have at least a portion thereof formed from magnetic material and may be provided with a face transverse to its axis of rotation, which face

is arranged opposite a face on a stationary part, and including means for promoting a flow of air between those faces, and magnetic means for preventing substantial wander of the axis of rotation of the driving element.

There may be provided in addition to said driving element at least one rotatable idler element for frictionally engaging with the rotatable part.

In this arrangement said idler element may have associated therewith pneumatic means and magnetic means similar to those associated with said driving element.

The aforesaid driving element and said idler element may be so arranged as to provide a bight between them in which said rotatable part is disposed.

In any of the arrangements referred to above there may be provided three rotating elements disposed around and in engagement with the rotatable part, one of which elements can comprise said driving element and the other two can be idler elements, or two such elements can be driving elements and the other can be an idler element.

In the case where magnetic means are provided for limiting said axial and radial movement said magnetic means may be arranged to create pressure between the engaging faces of said rotatable part and driving element or idler element when such are employed.

Also in the case where magnetic means are associated with the driving element or each said driving element it may be so energised as to produce a rotary field which imparts rotation to the driving element.

Said magnetic means may comprise a permanent magnet or electro-magnet.

The driving element which frictionally engages the rotatable part may comprise a permanently magnetised wheel or disc and at least a portion of the rotatable part is formed from low hysteresis metal such as radio metal, disposed opposite the periphery of the wheel or disc and which pneumatic bearing may or may not have associated therewith additional magnetic means for preventing undue wandering movement of said rotatable part.

In an alternative arrangement the driving element may comprise a low hysteresis magnetic wheel or disc having magnetic properties imparted to it by external means, the periphery of which wheel or disc engages a portion of the rotatable part which is formed from low hysteresis metal.

The hysteresis ring or disc may be disposed opposite a stator provided with means for generating a rotating field which ring or disc is arranged frictionally to engage a portion of the rotatable part which is formed from low hysteresis metal and the magnetic properties imparted to said hysteresis ring or disc is arranged to draw said rotatable part into frictional engagement therewith.

In such an arrangement one and the same magnetic means may be associated with a low hysteresis ring on said rotatable part and on said driving element.

In yet a further arrangement the rotatable driving element may comprise a low hysteresis wheel or disc the periphery of which frictionally engages the rotatable part supported by said pneumatic bearing which rotatable part either comprises a permanent magnet or has magnetic properties induced in it by external magnetic means.

In these alternative arrangements where a low hysteresis part is associated with the driving element means

may be provided for generating a rotating magnetic field in a stator opposite the low hysteresis part, which stator comprises cores having appropriate windings for producing said rotating field a part of which core is in magnetic circuit with a pole piece disposed co-axially with the low hysteresis portion of said rotatable part.

In yet a further arrangement a low hysteresis driving wheel or disc is mounted on a driving spindle carried in fixed bearings and driven directly by an electric motor or through a belt drive, which driving spindle is encircled by a coil of an electro magnet the core of which is arranged in magnetic circuit with a magnet pole arranged co-axially with and opposite an end of the air supported low hysteresis rotary part the other end of which is in frictional engagement with said wheel or disc in which a magnetic pole is induced by the electro-magnet.

In a further alternative arrangement the driving element which frictionally engages the rotatable part may comprise a disc or wheel formed from non-magnetic material and the rotatable part, which is supported by the pneumatic bearing, has at least a part thereof formed from low hysteresis metal and external magnetic means are provided for drawing the rotary part against the periphery of the driving disc or wheel. In this case said external magnetic means either comprises a permanent magnet or electro-magnet.

In any of the arrangements referred to above a number of rotary parts may be arranged around the periphery of one and the same driving element with which they are drawn into frictional engagement by magnetic means.

Also in any of the arrangements referred to above there may be bonded to the periphery of said driving element a thin layer of rubber or rubber like plastics so as to increase the frictional grip, or the periphery or peripheries are provided with a skin of hard material such as tungsten carbide.

A false twisting apparatus having a hollow twisting head through which the yarn to be twisted passes may have the twisting head rotated by any of the transmissions referred to above.

In one false twisting apparatus according to the invention the twisting head of the false twisting apparatus comprises a spindle floatingly supported in said air bearing so as to be capable of lateral displacement and is engageable by the periphery of a driving wheel or disc which is rotatable about a substantially fixed axis, and in that guide means are provided for the yarn which guide means is so disposed that tension in the yarn tends to draw it against one side of the passage in the spindle and to urge said spindle against the periphery of said driving wheel or disc.

A driving disc may either be provided with a bearing which is engaged by a friction spindle or the disc is provided with a spindle which rotates in a fixed bearing.

The twisting head in addition to being maintained in engagement with the driving wheel by the tension of the yarn may be maintained in engagement by magnetic means as set out above.

The following is a more detailed description of the invention as applied to a false twisting head reference being made to the diagrammatic drawings in which:

FIGURE 1 is a section through one form of the invention;

FIGURE 2 is a plan view of the arrangement shown in FIGURE 1;

FIGURE 3 is an enlargement of the arrangement shown in FIGURE 1;

FIGURE 4 is a diagrammatic plan view showing two rotary driving elements and a twisting head between them;

FIGURE 5 is a diagrammatic plan view showing three rotary elements grouped around a false twisting head, certain ones of which drive it and others of which are idlers;

FIGURE 6 is a diagrammatic side elevation of an arrangement in which a low hysteresis wheel or disc drives a rotatable part supported by pneumatic bearings which part has magnetic properties induced in it by an external magnet;

FIGURE 7 is a similar arrangement to FIGURE 6 in which rotation is imparted to the low hysteresis wheel by a rotating field induced by a stator, which field is also magnetically coupled to the rotatable part;

FIGURE 8 is a diagrammatic side elevation of an arrangement in which the shaft of a driving wheel is rotated directly by a mechanical transmission and engages a rotatable part, which driving spindle and rotatable part are magnetically coupled; and

FIGURE 9 is a diagrammatic side elevation in which a rotatable tubular twisting head is drawn against a driving wheel by tension of the threads passing through the twisting head.

Like reference numerals refer to like parts in the various figures of the drawing.

Referring to the arrangement shown in FIGURES 1 to 3 the base **10** constitutes a part of the main frame of the apparatus and has secured to the underside thereof a stator **11** of an electric motor so constructed as to have a number of poles **12** and associated electric coils **13** which are energized so as to provide a rotary field. A suitable arrangement for this purpose is described in the specification of United States Patent No. 636,141.

Disposed above the plate **10** is a rotor comprising a disc **14** which may be formed from electric insulating material such, for example, as a rubber type polyurethane and to the underside of which is secured a low hysteresis ring **15** to which rotation is imparted by the rotary field of the stator.

The plate **10** is provided with one or more holes **16** with which is associated a compressed air pipe **17** whereby a cushion of air is formed in a space **9** between the disc **14** and plate **10**. Also disposed beneath the plate **10** to one side of the aforesaid stator is a permanent magnet **18** which is encircled by a casing **19** which is spaced from it so as to provide an air chamber **20**. The upper end of the casing is secured to the plate **10** and a number of air holes **21** are formed in the plate and communicate with the air chamber **20**. The bottom of the air chamber is closed and is fed with compressed air through a pipe **22**.

Disposed on the upper side of the plate is a twisting head indicated generally at **23** which is formed with an enlarged base **24** disposed opposite the air holes **21**. The head and base are formed from magnetic material and are influenced by the permanent magnet **18**.

Both the permanent magnet and the twisting head are provided with axially extending bores **25** through which the yarn to be twisted may pass.

The head is provided in known manner with a cross pin **26** around which the yarn is looped.

The magnet poles **12** and the magnet **18** are arranged so as to prevent wander of the disc **14** and head **23** respectively. The disc **14** may be backed by a plate **27** of magnetic material which tends to draw the spinning head against the periphery of the disc **14**. The magnetic properties induced in the low hysteresis ring **15** have the effect of drawing the twisting head **23** into engagement with the disc **14**.

In the arrangement shown in FIGURE 4 there may be provided two driving elements **28**, **29** both engaging the twisting head **23** one or each of which has associated therewith a stator for promoting a rotary magnetic field and means for supplying compressed air between each driving element and the plate **10**. Preferably only one of the engaging elements **28** and **29** is so driven the other being an idler element.

In the arrangement shown in FIGURE 5 the twisting head **23** may be engaged by three rotary elements **30**, **31**, **32** grouped around it, one of which may be a driving element and has associated therewith a stator arranged to promote a rotary field and is also provided with the

means for supplying compressed air spaced between the rotary element and the plate **10**, whereas the other two rotary elements **31**, **32** may be idler elements and each has associated therewith a permanent magnet similar to the magnet **18** of FIGURE 1 and also means are provided for supplying air between parts thereof and the plate **10**.

In this latter arrangement although magnetic means may be associated with the three discs **30**, **31**, **32** together with means for supplying air between parts thereof and the plate **10**, no such magnetic means and air support need be associated with the head **23** which may be provided with a circumferential groove into which the peripheries of the three discs project, the inter-action between the three discs thus completely supporting the head.

In the arrangement shown in FIGURE 6 the driving wheel **33** is formed from low hysteresis metal and is attached to a shaft **34** mounted in a fixed bearing **35**. The shaft may be driven directly from an electric motor (not shown) or through gearing such as belt gearing from the motor. The twisting head **23** is supported by a magnetically controlled air bearing in a similar manner to that described with reference to FIGURE 1, for which purpose the upper part of a hollow magnet core **18** is encircled by a casing **19** to provide an air chamber **20** into which is introduced compressed air through a supply pipe **22**. The lower part of the magnet core is encircled by an energising coil **36**. The chamber is disposed beneath a plate **10** having holes **21** through which a stream of air is directed on to the underside of the enlarged base **24** of the twisting head **23**.

The upper end of the magnet core faces the underface of the base **24**. A low hysteresis U-shaped bridge **37** has one of its arms **38** engaging the lower end of the core and the other arm **39** disposed opposite the periphery of the enlarged base **24** of the twisting head. The arm **38** is provided with a hole **38***a* in register with the bore **25** in the core **18**.

The twisting head is formed from low hysteresis metal and thus has magnetic properties induced in it which draws it into engagement with the low hysteresis driving disc.

In the arrangement shown in FIGURE 7 a low hysteresis disc **40** is encircled by a layer **41** of rubber or rubber like plastics material which provides a good frictional grip between it and the twisting head **23**. In this case the low hysteresis disc **40** is rotated in a very similar manner to that described with reference to FIGURE 1 and is disposed above a stator **11** supported by a plate **10** and having a number of poles **12** energised by coils **13** by means of which a rotating field is generated in the stator which rotates the disc **40**.

As in the construction of FIGURE 1 air is directed on to the under surface of the disc **40** through a hole **16** in the plate **10** which is supplied with compressed air from the pipe **17**.

The twisting head **23** is supported by an air bearing in a similar manner to that described with reference to FIGURE 1 and differs mainly in that instead of a hollow magnet core **18** being provided there is a hollow stem **42** formed from low hysteresis metal which is magnetically coupled to one of the poles **12** of the stator through a bridge piece **43**.

With this arrangement both the disc **40** and the twisting head are floating and are drawn together by the magnetic field created in them.

In the arrangement shown in FIGURE 8 the spindle **44** which supports the low hysteresis driving wheel **45** is mounted in a fixed bearing **46**. Both the disc **45** and spindle **44** are formed from low hysteresis metal and the spindle is encircled by an electric energising coil **47** the two together constituting an electro-magnet. As in the construction of FIGURE 7 the periphery of the driving wheel has a thin layer of plastics **48** which engages the twisting head **23**. The twisting head is supported in an air bearing as described with reference to FIGURE 1.

The hollow stem of low hysteresis metal extends up through the air chamber **20** and a bridge piece **50** is supported on a fixed part of the apparatus so that one end thereof **51** is disposed close to the spindle **44** and the other end abuts the end of the stem **49** and is provided with a hole **52** in register with the bore **25** in the stem through which bore and hole the yarn passes to the hollow twisting head **23**. With this arrangement the disc **45** and the twisting head are of opposite polarities so that the twisting head is drawn against the coating **48**.

In the arrangement shown in FIGURE 9 again the driving spindle **53** to which the driving wheel **54** is attached is supported in fixed bearings **55** whereas the twisting head **53** is supported in an air bearing as described with reference to the previous figures, which air bearing may be provided with a permanent hollow magnet **18**.

The yarn **56** is arranged to pass through yarn guides **57**, **58** on opposite sides of the plate **10** and so disposed that the tension of the yarn draws the twisting head against the driving wheel **54**. The engagement of the spinning head with the driving wheel may be supplemented by a permanent magnet **18** arranged in a similar manner to that described above, or the driving disc **54** may be permanently magnetised and the twisting head formed from low hysteresis metal.

It will be appreciated that this thread guide arrangement can be employed with any of the alternative arrangements referred to above.

In yet a further arrangement, somewhat similar to that shown in FIGURE 9 the driving wheel could be formed from nonmagnetic material and the twisting head could be formed from magnetic material and an external fixed permanent or electro magnet could be arranged to force it into engagement with the driving wheel.

In any of the arrangements referred to above a number of rotating parts arranged in any of the ways described above may be arranged around the periphery of one and the same driving disc or wheel with which they are drawn into frictional engagement by magnetic means.

In the case where magnetic means are not provided for example in FIGURE 9 the additional means for limiting relative movement between the driving and driven parts other than rotary movement consists in arranging the space between the air bearing and rotary part in such a manner that the rotary part is biased towards the driving element or elements, and there is also provided a space between a face on the rotary part transverse to the axis of rotation and a face on a fixed part between which faces a flow of air is promoted.

In an alternative to the arrangement of FIGURE 8, a bearing in the disc **45** may be rotatable on a fixed spindle encircled by the coil **47**.

What I claim is:

1. False twisting apparatus wherein the axis of rotation of the twisting head is maintained substantially in alignment with a predetermined desired axis, the combination comprising a hollow magnetizable rotatable twisting head through which yarn to be twisted passes and which has a face transverse to its axis of rotation, a stationary element having a portion opposite said face which is apertured to pass air therethrough and which forms an air bearing with said face, means for directing an air stream through said apertured portion of said stationary element to said face so as to provide during operation a space between said stationary element and said face and to maintain the twisting head in a floating condition, magnetic means for maintaining the axis of rotation of said twisting head substantially in alignment with said predetermined desired axis, said magnetic means having a portion which is in alignment with said predetermined desired axis and which is mounted adjacent said stationary element and opposite the entrance to said twisting head to link said head and said portion with mag-

netic flux, a rotary driving member having a magnetizable portion and means for linking said twisting head and said driving member with magnetic flux to urge said head and said driving member into engagement.

2. False twisting apparatus according to claim 1, wherein said driving member is supported by an air bearing.

3. False twisting apparatus according to claim 1, wherein there is provided a low hysteresis rotor which comprises said driving member, a stator and winding means associated with said stator adapted upon energization to produce said flux which links said twisting head and said driving member.

4. False twisting apparatus according to claim 3, wherein said driving member is supported by an air bearing.

5. False twisting apparatus comprising a hollow rotatable twisting head through which yarn to be twisted passes, said head having a face transverse to its axis of rotation, a stationary element having a portion opposite said face which is apertured to pass air therethrough and which forms an air bearing with said face, means for directing an air stream through said apertured portion of said stationary element to said face so as to provide during operation a space between said stationary element and said face to maintain the twisting head in a floating condition, magnetic means for limiting the floating movement of said twisting head, at least one rotary driving member, and means for urging said twisting head and said driving member into engagement.

6. False twisting apparatus wherein the axis of rotation of the twisting head is maintained substantially in alignment with a predetermined desired axis, the combination comprising a hollow magnetizable rotatable twisting head through which yarn to be twisted passes and which has a face transverse to its axis of rotation, a stationary element having a portion opposite said face which is apertured to pass air therethrough and which forms an air bearing with said face, means for directing an air stream through said apertured portion of said stationary element to said face so as to provide during operation a space between said stationary element and said face and to maintain said twisting head in a floating condition, a magnetizable member mounted in alignment with said predetermined desired axis and having one end which is adjacent said stationary element and which is opposite the entrance to said twisting head, a magnetizable rotary driving member, and magnetic means for creating a flux both in said first-mentioned magnetizable member which tends to center the axis of rotation of said twisting head on said predetermined desired axis, and also in said driving member which urges said driving member and said twisting head into engagement.

7. False twisting apparatus according to claim 6 including a U-shaped bridge magnetically linking the periphery of said face and the end of said first-mentioned magnetizable member remote from the face, and energizing coil means which upon energization produces a flux in said first-mentioned magnetizable member, and in said U-shaped bridge and in said head, the flux in said head inducing flux in said driving member.

8. False twisting apparatus according to claim 6, wherein there is provided a low hysteresis rotor comprising said driving member, said machine including a stator and stator energizing coils, and an arm magnetically linking said stator with the end of the first-mentioned magnetizable member remote from said face, whereby upon energization of said coils flux is induced both in said driving member and in said first-mentioned magnetizable member.

9. False twisting apparatus according to claim 8, wherein said driving member is supported by an air bearing.

10. False twisting apparatus according to claim 6 including a driving member-supporting shaft, an arm magnetically linking said shaft and the end of said first-mentioned magnetizable member remote from said face, and energizing coil means surrounding the shaft which upon energization produces a flux in said driving member and in said first-mentioned magnetizable member.

11. In combination, a magnetizable spindle, frictional means for rotating said spindle and comprising peripheral surface means of a rotating member, means for supporting said frictional means for rotation about a single axis, said supporting means including magnetic means for retaining said spindle and said frictional means in relative oriented and driving engagement.

12. The combination of claim 11, wherein said magnetic means includes a magnetizable portion of said rotating member and means for magnetically orienting said portion and said member along the axis of rotation thereof.

13. The combination of claim 12, wherein said means for magnetically drawing said portion and said member further comprise a low hysteresis rotor and stator means for creating a rotating rotor driving field.

14. The combination of claim 11, wherein the axis of said spindle extends perpendicularly to said peripheral surface means and said magnetic means include means for orienting said spindle relative to said peripheral surface means.

15. The combination of claim 14, wherein said magnetic means includes a magnetizable portion of said rotating member and means for magnetically orienting said portion and said member along the axis of rotation thereof.

16. The combination of claim 15, wherein said supporting means further include air bearing means for supporting said disc and said spindle.

17. In combination, a rotatable magnetizable spindle, a rotating member having peripheral surface means extending generally perpendicularly to the general plane of said rotating member for frictionally engaging a portion of said spindle, means supporting said member for rotation about a single axis parallel to said peripheral surface means, and a magnetic element extending on either side of the axis of rotation of said rotating member to adjacent said spindle and in planes parallel to said rotating member and inwardly toward a plane which intersects the axes of rotation of said rotating member and said spindle, said element retaining said spindle in relative oriented and driving engagement with said surface means.

18. The combination of claim 17 wherein said rotating member is a single disc, the periphery of which comprises said surface means.

19. In combination, a rotatable magnetizable spindle, a rotating member having peripheral surface means extending generally perpendicularly to the general plane of said rotating member for frictionally engaging a portion of said spindle for rotating the same, magnetic means for retaining said spindle in relative oriented and driving engagement with said surface means, said magnetic means extending round the axis of rotation of said rotating element and towards said spindle, and means for supporting said rotating member and said magnetic element about the axis of rotation of said rotating member.

20. The combination of claim 19, wherein said rotating member is a single disc, the periphery of which comprises said surface means.

21. Apparatus for false twisting yarn, said apparatus comprising: (a) a hollow spindle having means for receiving and imparting a false twist to the yarn; (b) drive means arranged to frictionally engage and rotate said spindle about the axis thereof; and (c) air bearing means floatingly supporting said spindle during rotation thereof.

22. The apparatus in accordance with claim 21 wherein said drive means is angularly movable and including air bearing means floatingly supporting said drive means.

23. The apparatus in accordance with claim 21 including fixed bearing means rotatably supporting said drive means.

24. The apparatus in accordance with claim 21 wherein said spindle has at least one magnetic portion and further including magnetic means acting on said spindle and main-

taining said spindle in alignment with a predetermined axis.

25. The apparatus in accordance with claim 24 including magnetic means associated with said drive means to maintain said spindle in engagement therewith.

26. The apparatus in accordance with claim 21 including yarn tensioning means acting on the yarn as it travels through said spindle whereby said spindle and said drive means are maintained in frictional engagement.

27. The apparatus in accordance with claim 21 wherein said drive means comprise at least two discs having rotational axes parallel to the longitudinal axis of said spindle.

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