

June 24, 1969

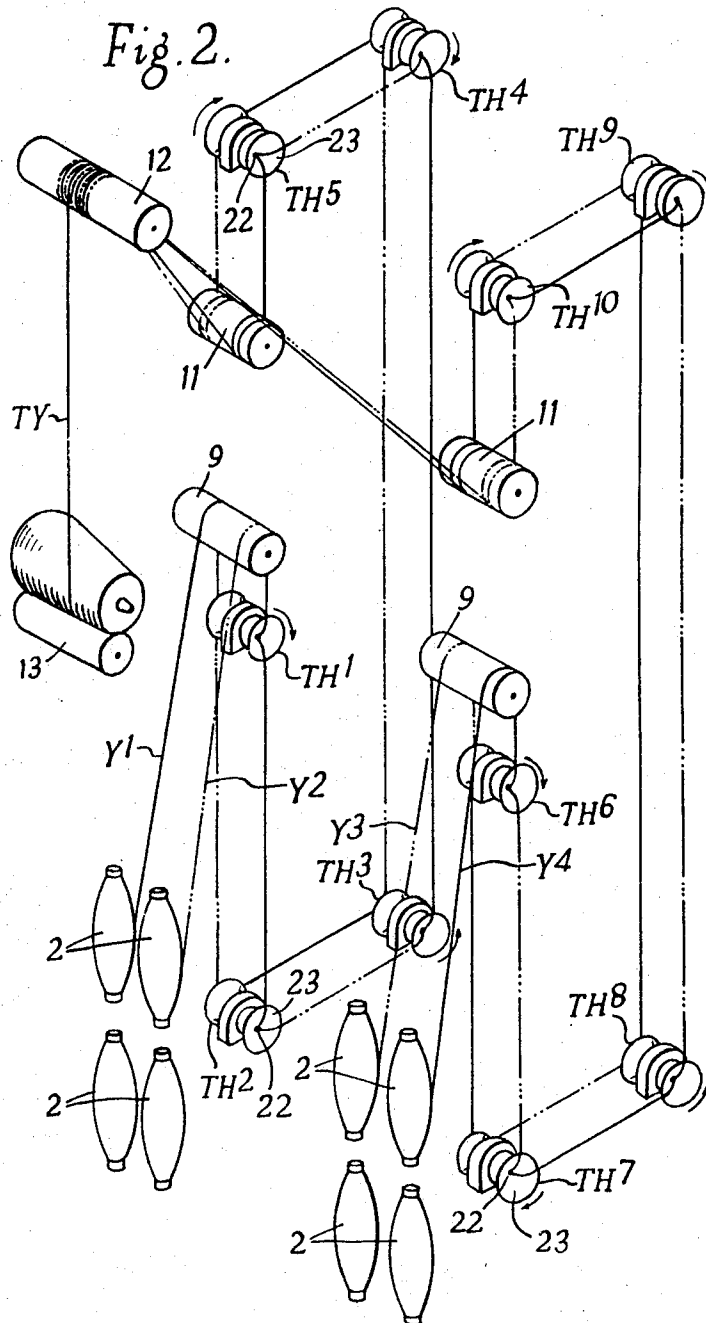
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MACHINES FOR IMPARTING TWIST TO YARNS

Filed Jan. 26, 1967

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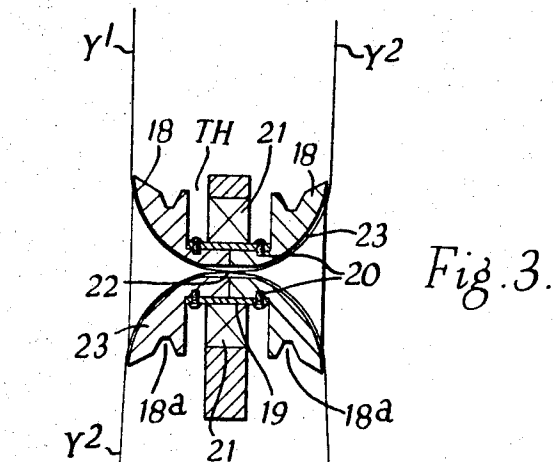
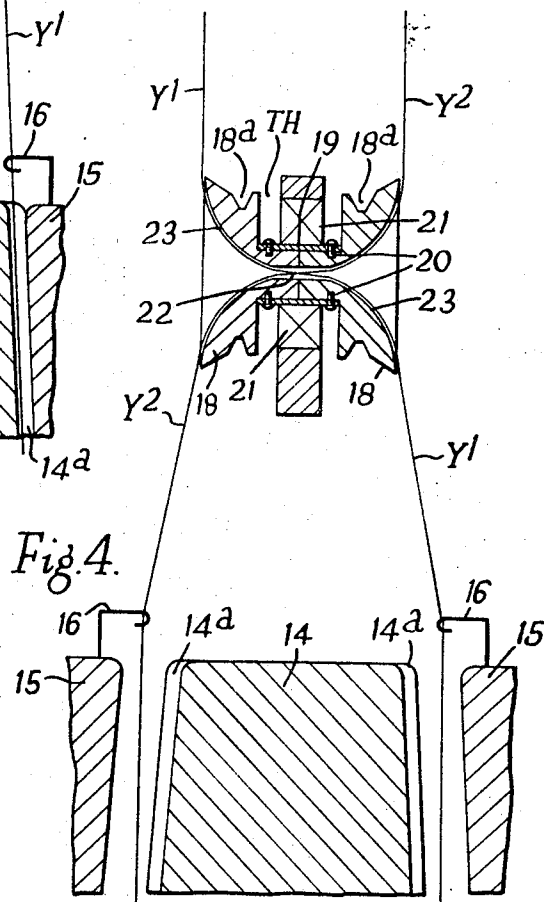
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MACHINES FOR IMPARTING TWIST TO YARNS

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13 Claims

ABSTRACT OF THE DISCLOSURE

A yarn-twisting machine comprising a plurality of yarn twisting heads and heaters for setting the twist in a yarn running through these heads. Each head has a small central opening with trumpet-shaped ends for the passage of yarn, and the heads are arranged in the machine to guide the yarn in a labyrinth path through the heaters within a compact space and with extended heating zones, and to provide it with an uninterrupted increase in twist.

This invention appertains to heating systems included in machines or apparatus for imparting twist to yarns and of the kind including twist heads adapted to impart twist to travelling yarns passing through them.

Although the application is not necessarily limited in this respect, it is principally the intention to embody it in a machine or apparatus for imparting false twist to continuous multi-filament thermoplastic synthetic yarns such, for instance, as the polyamide yarn known as nylon and the polyester yarn known and sold under the trade name "Terylene."

Procedures for the false twisting of such yarns result in converting them into so-called bulk yarns suitable for use in knitting many articles for wear, and other textile purposes.

In any event, the invention is applicable to yarn twisting machines or apparatus of the aforementioned kind adapted to impart a temporary twist to a yarn and, whilst it is continuously travelling in this condition, to apply heat thereto at an appropriate temperature, thus setting the yarn and having the subsequent effect of making it bulk up.

Again, it is primarily the intention to apply the invention to a machine or apparatus of the kind concerned wherein there are provided rotary twist heads which, by frictional contact with travelling yarns passing through them, impart the required twist.

Now in view of the necessity to economise in space, it has not heretofore been practical to install in a yarn twisting machine or apparatus of the kind referred to vertical heating elements of lengths more than about 4 ft. When, previously, attempts have been made to double back the heating zone, by the use of either rollers or of ceramic or other guides, it has been found that the twist imparted to the yarn has been suppressed, so causing uneven setting and generally erratic results.

The object of the present invention is to provide, in a machine or apparatus of the aforementioned kind, means so formed and arranged as to permit of substantially extended heating zones without any suppression of the twist imparted to the yarn.

One aim in this respect is to provide in the extended heating zones heaters which are no longer than is consistent with easy threading up by an operator of average height standing at floor level.

For instance, in a particular arrangement envisaged, the substantially extended heating zones are in a vertical space no higher than that occupied by, say, a 6 ft. heater.

It is, however, to be clearly understood that the inven-

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tion is not necessarily limited to the adoption of heaters of any particular length or lengths.

According to this invention, a machine or apparatus of the kind comprising a plurality of twist heads adapted to impart twist to travelling yarns passing through them, and associated heaters for heating and thus setting the yarns whilst travelling in the twisted condition, is characterised in that each of such heads is so formed that a yarn entering it in one direction and in the course of being twisted by that head can leave the latter either in the same general direction or in a changed direction at an angle with respect to the first direction, as may be required, and in that the heads are so arranged in relation to the said heaters as to cause a yarn leaving a twist head and about to enter and pass through a heater to change direction whilst the twist in the yarn continues to build up in contradistinction to being suppressed.

Advantageously, the heaters associated with the twist heads may be accommodated in a space of minimal height.

For instance, in one convenient embodiment of the invention, a yarn may enter and leave a first twister and travel vertically downwards through a 3 ft. heater; then enter a second twist head and leave the same at right angles or any other appropriate angle to its original line of travel; thereupon enter a third twist head and leave that at right angles or any other appropriate angle; then travel vertically, or nearly so, upwards through a 6 ft. heater; next enter a fourth twist head and leave the same at right angles; then travel horizontally, or nearly so, to a fifth twist head which it leaves at right angles; and finally travel vertically, or nearly so, downwards to an output capstan.

In the foregoing arrangement, it is most important that the first two twist heads should rotate in the same direction. The third one should rotate in an opposite direction and the fourth and fifth may rotate in the same direction as the first two. By this means maximum twist will be generated but more important still, all the twist generated (except for an initial temporary forward clearance of twist) will be confined in the zone between the first and the last twist heads. Accordingly, there is virtually no back twist and therefore no need for snubbing at the input end. It will also be found, for certain purposes, than an input capstan can be dispensed with and the yarn allowed to draw freely from the supply packages. In this case the yarn would be steadied by two or three wraps around a post or interlaced between, say, three ceramic (or other suitable) guides. The input capstan would be by-passed by the provision of guides disposed above it.

The twist heads incorporated in the improved heating zone arrangements of this invention may be of any suitable type. It is, however, principally the intention to adopt rotary yarn twist heads each of which comprises a rotary annular component of unitary form having a relatively small central opening which extends axially and merges into and connects ends (constituting opposite sides of the twist head), these ends being trumpet-shaped and each presenting an outwardly flared convex friction-engendering surface of annular form extending around an arc of substantially 90°, the said surfaces and the intermediate central opening connecting them being so related that a yarn or thread caused to travel diagonally through the component in a direction transverse to its axis of rotation not only has its respectively opposite sides frictionally contacted by friction-engendering surface portions moving in respectively opposite directions, but is supported for the major part of the distance both between the outer perimeter of the trumpet-shaped

flare at one side of the head and the geometrical centre of the latter and also between the said centre and the outer perimeter of the similar flare at the opposite side of the head, whereby the yarn is fully controlled within the twist head, and the twist generated in the yarn is prevented from springing through the twist head and so being nullified.

A specific constructional form of an apparatus for imparting twist to yarns and embodying extended heating zones in accordance with the said invention will now be described, with reference to the accompanying diagrammatic drawings, wherein:

FIGURE 1 is a general perspective view of the said apparatus,

FIGURE 2 is a diagram depicting the layout of the magazine feeds, the twist heads, the capstans and the wind-up means of the apparatus and shows the respective paths of travel followed by four flat yarns during the production of a single 4-fold false twist yarn,

FIGURE 3 is a detail vertical sectional view, showing one of the friction-surfaced twist heads, yarn heating tracks and associated heat-retaining covers in closed position, and

FIGURE 4 is a view similar to FIGURE 3 but with the said heat-retaining covers in open position.

Like parts are designated by similar reference characters in the drawings.

The illustrated apparatus includes a skeleton framework F in which is accommodated all the necessary equipment to enable a maximum of at least four flat yarns such as Y¹, Y², Y³ and Y⁴ (see FIGURE 2) to be twisted, heated along extended heating zones and combined to produce in the result a single 4-fold twist yarn TY. The apparatus can, however, also be used for producing single, 2-fold or 3-fold false twist yarns, according to requirements.

As will be seen FIGURE 1, the skeleton framework F is of a unitary box-like form inasmuch as its base, its top and its four sides are all rectangular—without protuberances of any kind. This enables a plurality of these independent units to be conveniently assembled closely, side by side and also back to back. By fitting the bottom of the framework with castors, the unit may be easily withdrawn from and replaced in a side by side or back to back range or assemblage, as occasion demands. A number of the independent units like that shown in FIGURE 1 may advantageously be attached to a central rigid frame designed to carry appropriate services such, for instance, as electric and pneumatic supplies and fume ducting. But, in any event, each unit is independent in that it has independent drive means for the various twist heads and independent heat control means. Although there is no limitation in this respect the overall dimensions of each unit may be about 2' x 2' x 7'.

In the lower front part of the skeleton framework F there is provided, at each side thereof, a magazine M of yarn supply packages such as 2. Each such magazine, of which only one is shown for convenience, consists of a bracket 3 which is arranged to be swung outwards, about a vertical pivot or hinge pin 4, to facilitate threading up. Each bracket 3 is formed with two vertically spaced horizontal shelves 3a furnished with vertical spindles 5 to support the supply packages 2.

Extending from top to bottom of the skeleton framework F are two suitably spaced structural members 6 of hollow form each designed to house drive means for the various rotary parts hereinafter to be specified. Removable panels for enclosing these drive means are indicated at 7 and 8. Within each structural member 6 is rotatably mounted a driveable input capstan 9 the opposite end portions of which project from respectively opposite sides of the said member to enable yarns from supply packages 2 to be passed up over them. Near to its upper end, each of the structural members 6 has attached thereto a forked or liked bracket 10 in which an output capstan 11 is freely rotatable. A further freely rotatable output cap-

stan is provided at 12 to collect, fold and guide yarns on route from the capstans 11 to a wind-up 13 disposed below them. At the wind-up 13 is provided a driven roller arranged to be in contact with the package, e.g. the cone or cheese, of the false twist yarn produced. The distance between the output capstan 12 and the wind-up 13 makes available space for stabilisation and/or automatic doffing.

Rotary twist heads are mounted to rotate about horizontal axes within the hollow structural members 6, these heads being strategically placed in relation to heaters in the extended heating zones. The twist heads mounted in the left-hand member 6 (as viewed from the front of the unit) are designated TH¹, TH², TH³, TH⁴ and TH⁵, whereas the corresponding rotary twist heads in the right hand member 6 are respectively designated TH⁶, TH⁷, TH⁸, TH⁹, and TH¹⁰.

Extending vertically between the twist heads TH¹ and TH² and between the twist heads TH⁶ and TH⁷ towards the front of the apparatus are two 3 ft. heaters. Similarly extending vertically between the twist heads TH³ and TH⁴ and between the twist heads TH⁸ and TH⁹ at the back of the apparatus are two 6 ft. heaters. These heaters are accommodated within the hollow structural members 6 but are omitted from FIGURE 2 for the sake of clarity and convenience of illustration.

Although the apparatus described could incorporate any appropriate type of heat transfer means, it is principally the intention to employ heaters having back to back longitudinally curved or bowed twin heating tracks with which the travelling yarns make direct contact. The heating elements, having built in thermocouples, are readily detachable, as occasion may demand. The upper end portion of such a heater is diagrammatically represented at 14 in each of FIGURES 3 and 4, the heating tracks, arranged back to back, being indicated at 14a. A heat-retaining cover such as 15 is provided at each of the opposite sides of each heater. These covers are movably mounted upon the structural members 6 for closing and opening movements laterally. That is to say, by means of any suitable actuating mechanism (not shown) the covers 15 are closed automatically on the starting of the apparatus, and opened automatically whenever the apparatus stops or in any emergency such as that created by the breakage of a yarn. Yarn guides such as 16 of a character capable of being easily threaded with yarn are provided in line at the tops and bottoms of the heat-retaining covers 15. Thus, threading up is effected with the said covers in their open positions so that the yarns are initially held away from and clear of the heating tracks as shown in FIGURE 4. Consequently, upon the heat-retaining covers being closed, the yarns are automatically displaced laterally into the heating tracks 14a in which they are allowed to run unrestrictedly (see FIGURE 4).

At 17 in FIGURE 1 is indicated an electric motor housing, the motor serving to drive the rotary twist heads through the medium of belt drives.

Each of the twist heads TH¹-TH¹⁰ is of the form hereinafter broadly described. One of such heads is shown in some detail at TH in each of FIGURES 3 and 4. As will be seen, each twist head is initially made in two identical halves 18 which are located within a suitably extended ball bearing bush 19. The two halves are firmly held together within the bush 19 by means of screws 20. Each half 18 is circumferentially grooved at 18a to function as a pulley in a pulley drive from the motor aforesaid. The head, of unitary form, rotates in ball bearings diagrammatically represented at 21. It has a small, axially extended central opening 22 which merges into and connects trumpet-shaped ends each presenting an outwardly flared and convex friction-engendering surface 23 of annular form extending around an arc of 90°. The central aperture 22 in each rotary twist head is as small as possible, consistent with reasonable facility for threading

yarn therethrough. The surface defining the aperture 22 is relieved around the joint between the two halves 18 of the twist head so as to form a circumferential groove (not shown); this ensures that two yarns passing through the twist head do not press against the said surface at the point where they cross. The surfaces 23 are such that yarn passes around an arc of 90° both when entering the head and so travelling from the outer perimeter at one side or end of the head to the geometrical centre of the latter, and also when leaving the head and travelling from the said centre to the outer perimeter at the opposite side or end. This small central aperture 22 connecting the arcuate surfaces 23 thus ensures maximum support for yarn passing diagonally through the head. With a 2" diameter twist head having a small central aperture of 1/16" diameter the yarn is supported for 80° of the distance from the geometrical center to either of the outer perimeters. That is to say, a yarn is supported for 160° in its travel over both convex surfaces 23 from one perimeter to the other. This particular shaping of a head enables a yarn to be held in as firm a grip as possible in order to prevent twist which has been generated from springing through the twist head and so being nullified.

The friction-engendering surfaces of the different twist heads may, if desired, vary in character according to the stage of development of the twist in the progress of the yarn through the heating zone.

Individual twist heads may, moreover, be rotated either clockwise or anti-clockwise as may be necessary or desirable to maximise twist and maintain stability in the process.

In FIGURE 2, the recommended directions of rotation of the various twist heads are indicated by arrows. The courses followed by the individual yarns Y¹, Y², Y³ and Y⁴ will now be described, by way of example. Thus the yarn Y¹ after passing up from a supply package 2 over the left-hand end of the left-hand input capstan 9, extends downwardly for a short distance, enters the left-hand side of the twist head TH¹, then emerges from the right-hand side of the same head whereupon it travels vertically downwards through a 3 ft. heater. After next entering the right-hand side of the twist head TH² and emerging from the left-hand side of the latter, the yarn Y¹, having been turned through a right angle, travels horizontally to the twist head TH³. At this stage, the yarn Y¹ enters the left-hand side, and emerges from the right-hand side, of the said twist head TH³ from whence, after being turned through a further right angle, the yarn travels vertically upwards through a 6 ft. heater. Next, the yarn Y¹ enters the right-hand side of the twist head TH⁴ and, after passing therethrough, emerges from the left-hand side thereof at right angles. Thereupon, the said yarn travels forwardly and horizontally to the twist head TH⁵, enters this at its left-hand side, emerges therefrom at its right-hand side, then travels vertically downwards, around the underside of the left-hand output capstan 11, upwards over the output capstan 12 and finally vertically downwards, together with the yarns Y², Y³ and Y⁴, to the wind-up at 13.

The yarn Y², on the other hand, whilst following a very similar path to the yarn Y¹ extends diagonally through each of the twist heads TH¹-TH⁵ from right to left instead of from left to right as does the yarn Y¹. Initially, of course, the yarn Y² passes up from a supply package over the right-hand end of the left-hand input capstan 9. In order to distinguish the yarns Y¹ and Y² and enable their paths to be readily followed, the yarn Y¹ is shown as a continuous full line whereas a line broken at intervals is used to represent the yarn Y².

The yarns Y³ and Y⁴ follow identical paths to the yarns Y¹ and Y² respectively, the only difference being that the yarns Y³ and Y⁴ pass over the right-hand instead of the left-hand input capstan 9, through the twist heads TH⁶-TH¹⁰ (corresponding respectively to the heads TH¹-TH⁵) and beneath the right-hand instead of the left-hand out-

put capstan 11. Whereas the yarn Y³ is represented by a line broken at intervals, the yarn Y⁴ is represented by a continuous line.

With an extended heating zone such as that herein described having 9 ft. of contact heating, it should be practical to process at speeds up to 1,500 ft. per minute. With 70 denier nylon this means that nearly half a pound per hour will be processed per end. As each twist head processes two ends (one of left hand twist and one of right hand twist) production amounts to approximately one pound per hour. If two sets of twist heads are located in close proximity and yarn brought together to one wind-up, two pounds of 4 fold yarn could be processed per hour. This makes it practical to consider independent units for producing 4 fold yarn—each with separate electric motor drive and heat control. These units may be so constructed that they can fit into each other both side by side and back to back and so make a complete range. Such an arrangement facilitates maintenance and repair as units can be withdrawn from the range and replaced with spares.

Even greater speed of processing may, of course, be attained by duplicating heaters and increasing the number of twist heads appropriately.

Alternatively, instead of duplicating heaters and increasing the number of twist heads, yarns may be caused to travel back in reverse directions through the same heaters along duplicate heating tracks therein and to enter and leave the same twist heads but, of course, at different angles, thereby saving space.

I claim:

1. A machine of the type comprising a plurality of twist heads mounted to rotate about an axis and having means for imparting twist to travelling yarns passing through them and associated heaters for heating and thus setting the yarns while in the twisted condition, the improvement wherein, at least some of said twisting heads include means for continuing buildup of twist in the yarn as the yarn leaves the twist head, while concurrently permitting the yarn to change its direction of travel as it passes through the twist head, such that the plane defined by the said axis and the line of the yarn arriving at the twist head is different from the plane defined by the said axis and the line of the yarn as it leaves the twist head, and said heaters being positioned on said machine to receive the twisted yarn leaving a twisting head to set the yarn while travelling in the twisted state.

2. A machine according to claim 1 wherein said heaters are elongated but are confined in an overall space not exceeding approximately six feet in height.

3. A machine according to claim 1 wherein some of the twist heads are spaced vertically from other twist heads to form vertically spaced groups of twist heads, and the heaters are located between vertically spaced twist heads of a group, so that a yarn, during its passage through the machine, travels substantially upward between the twist heads of one group of spaced twist heads and substantially downwards between the twist heads of another group of twist heads and travels at right angles to the vertical direction from one group of twist heads to another by leaving the last twist head of a group at right angles with respect to its direction of entry therinto.

4. A machine according to claim 1 including a first twist head mounted to receive a yarn in a downward direction and deliver the said yarn in said downward direction, a relatively short heater located below said first twist head, a second twist head below the said short heater mounted to receive the said yarn passing downwardly from the short heater and delivering the same at an angle to the said downward line of travel of the yarn, a third twist head mounted to receive the yarn from the second twist head and deliver the yarn in an upward direction, a second heater longer than the first heater and located above the third twist head, a fourth twist head located above the longer heater and mounted to receive the yarn

from said longer heater and deliver it at right angles to said upward direction, a fifth twist head mounted to receive yarn from the fourth twist head and deliver it at right angles from the direction of delivery from the fourth twist head, and an output capstan mounted to receive yarn from the fifth twist head, the first two twist heads rotating in the same direction, the third twist head rotating in an opposite direction, and the fourth and fifth twist heads rotating in the same direction as the first two twist heads.

5. A machine according to claim 4 wherein the said relatively short heater is three feet in length and the longer heater is six feet in length.

6. A machine according to claim 1 wherein each twist head comprises a rotary annular component presenting at respectively opposite sides thereof two co-axial circulating friction engendering surfaces of circumferential form, these surfaces sloping inwardly in opposite directions towards the geometrical center of the component, which surfaces permit two yarns entering the head from its respective opposite sides to pass diagonally through the head in opposite directions and to cross one another at the said geometric center.

7. A machine according to claim 1 wherein the twist heads are spaced vertically from other twist heads to form groups of vertically spaced twist heads, a heater located between the vertically spaced twist heads of a group such that the yarn can travel back in the reverse direction through the same heater along a duplicate heating track therein and enter and leave the same twist heads but at different angles.

8. A machine according to claim 1, wherein each twist head comprises a rotary annular component of unitary form having a relatively small central opening which extends axially and merges into and connects ends (constituting opposite sides of the twist head), these ends being trumpet-shaped and each presenting an outwardly flared convex friction-engendering surface of annular form extending around an arc of substantially 90°, the said surfaces and the intermediate central opening connecting them being so related that a yarn or thread caused to travel diagonally through the component in a direction transverse to its axis of rotation not only has its respectively opposite sides frictionally contacted by friction-engendering surface portions moving in respectively opposite directions, but is supported for the major part of the distance both between the outer perimeter of the trumpet-shaped flare at one side of the head and the geometrical centre of the latter and also between the

said centre and the outer perimeter of the similar flare at the opposite side of the head, whereby the yarn is fully controlled within the twist head, and the twist generated in the yarn is prevented from springing through the twist head and so being nullified.

9. A machine according to claim 1, which is in the form of an independent unit comprising a skeleton framework and incorporating rotary twist heads, heaters, capstans and wind-up means, the said unit having its own power source, drive-transmitting means and heat control system.

10. A machine according to claim 9, wherein there is provided in the front part of the framework at least one magazine of yarn supply packages which is movable outwardly from the framework to facilitate threading up.

11. A machine according to claim 1, wherein the heaters are provided with openable and closeable heat-retaining covers.

12. A machine according to claim 11, wherein the said heat-retaining covers are provided with threading devices by which yarns are held clear of heating tracks in the heaters at such times as the covers are open, the construction being such that closure of the covers moves the yarns into the tracks for running unrestrictedly therealong.

13. An assemblage of independent units as claimed in claim 9 which are so constructed as to fit together both side by side and back to back.

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