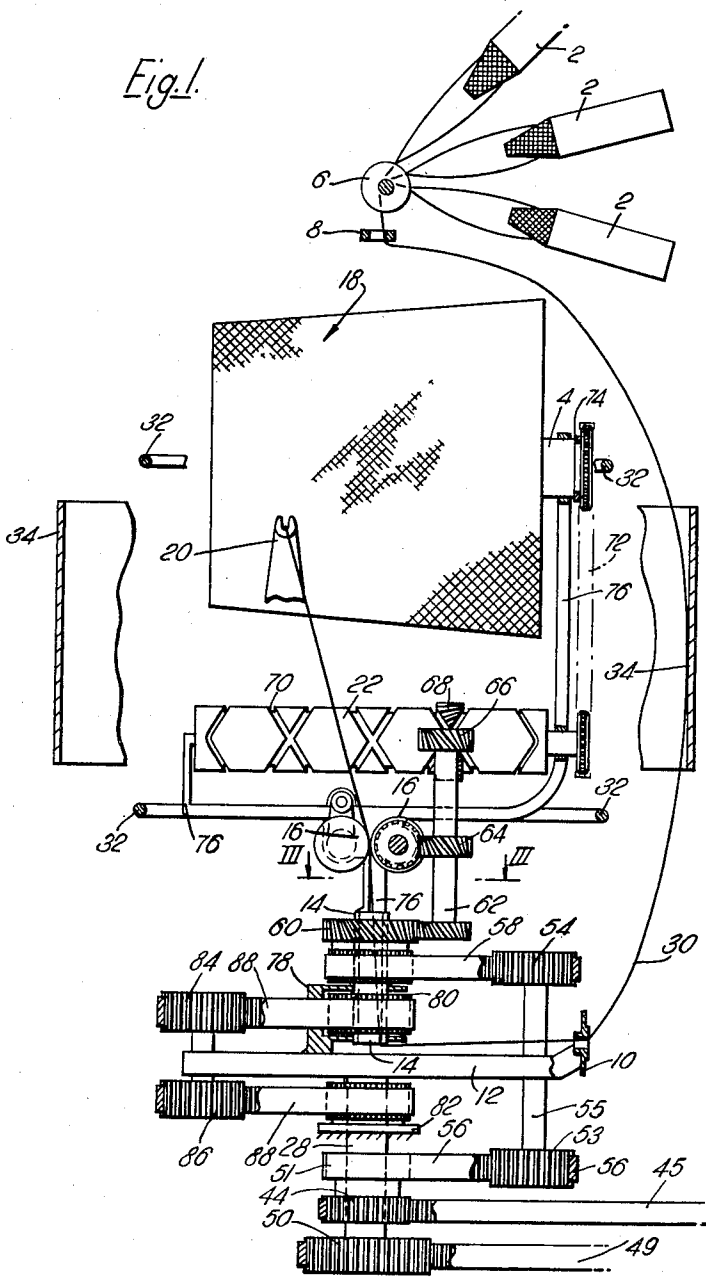
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Fig. 1.



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Fig. 2.

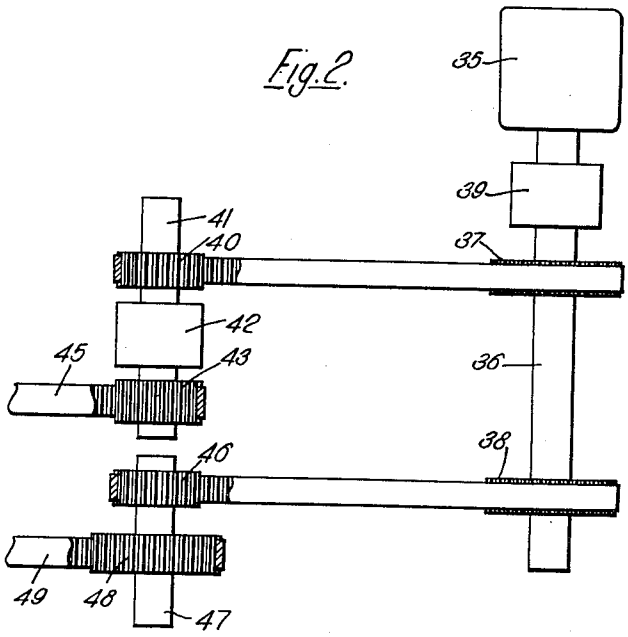
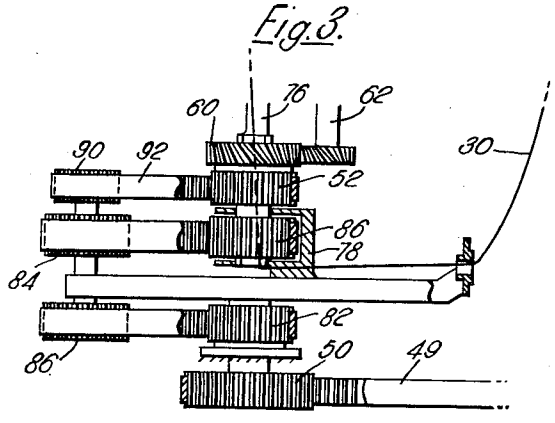


Fig. 3.



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TEXTILE MACHINES

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This invention relates to yarn twisting machines of the two-for-one inflow type in which the material to be twisted is caused to be ballooned by a flyer whilst it is being fed to the winding spindle which is situated within the balloon.

In such twisters, drive, for the spindle, yarn take-up means and yarn traversing means, all of which are positioned within the balloon, has to be transmitted from outside to inside the balloon and the invention is primarily concerned with this problem.

According to the invention the drive is transmitted by a transmission train comprising a pair of co-axial sunwheels, one within and one outside, the balloon and a pair of coaxial planets, carried by the flyer and connected so as to rotate in unison, each planet being positioned opposite to, and being connected with, one of the sunwheels respectively.

The outside sun wheel can be driven with a consequent drive being transmitted to the sun wheel within the balloon and this sun wheel can be arranged to drive the take-up means, the spindle and the traversing device. If the outside sun wheel is held stationary the inside sun wheel will be driven if the sun wheels have different diameters or if the planets have different diameters.

In twisters of the type to which the invention relates, the twist per unit length put into the material is dependent on the relationship between the speed of rotation of the flyer and the speed at which the material is taken up for delivery to the package within the balloon. It is normal to drive the take-up means through the flyer and the above-mentioned relationship and, therefore, the degree of twist, can be adjusted by altering the gear ratio between the flyer and the take-up means. This, however, involves the provision within the balloon between each flyer and its associated take-up means, of change gearing or the equivalent, alteration of which can be a long and laborious process, particularly if the number of spindles is great.

If the machine in accordance with the invention is a multi-spindle machine then the take-up means associated with a number of spindles can have a common drive and the flyers associated with these spindles can also have a common but separate drive. The drive for the take-up means is then variable independently of the flyer drive from outside the balloon. The ratio of take-up speed to flyer speed and therefore the degree of twist imparted to the material can therefore be varied at all of a number of spindles by a single operation.

The two drives can be completely separate and distinct but, in general, will have a common origin such as an electric motor from which the two drives proceed in parallel. The motor can be of variable speed type or can be provided with a change-speed gearbox or the like to enable the speed of the two drives to be varied in unison.

In the preferred form of the invention, each flyer is in the form of a disc rotating about a vertical axis and is driven through a pulley on its shaft. The yarn take-up means can be in the form of a pair of rollers, one driven frictionally by the other provided that they are loaded sufficiently to preclude slip. Alternatively they can be constituted by a set of haul pulleys. The sun wheel within the balloon is integral with a gear wheel which drives

a driving shaft which is offset from but parallel to, the axis of the flyer and is held against rotation around that axis. The driving shaft is used to drive the yarn take-up means, the yarn traversing means and the spindle.

By mounting the driving shaft, the take-up means, the traversing means and the spindle on a common bracket they can all be held against rotation about the flyer axis by a common mechanism. This may be in the form of a magnetic holding device, a magnetic field to hold the bracket, existing across the balloon path. Alternatively the mechanism may comprise a pair of coaxial sun wheels of the same diameter one integral with the bracket within the balloon and the other held stationary outside the balloon, and a pair of coaxial planets of the same diameter carried by the flyer and connected to rotate in unison, each planet being positioned opposite to and being connected with, one of the sun wheels respectively.

If the drive to the parts within the balloon is transmitted by a train including a stationary sun wheel outside the balloon then the additional mechanism to hold the bracket within the balloon comprises a sun wheel within the balloon of the same diameter as the outside sun wheel and integral with the bracket and a third planet wheel coaxial with the planets of the drive train and carried by the flyer within the balloon opposite the bracket sun wheel and having a diameter equal to that of the planet outside the balloon.

In all the arrangements described the sun wheels are preferably connected to their associated planet wheels by means of internally toothed belts and the flyer and outside sun wheel drive is also preferably transmitted by internally toothed belts. This ensures that the various wheels can be driven at very high speed without introducing lubrication difficulties. It will be appreciated that any equivalent arrangement using gears instead of belts would be quite complicated and would place a limitation on the speed of rotation because of the practical impossibility of providing lubrication. The internally toothed belt provides a completely positive drive which also has the advantage of being quiet.

In all the arrangements described above, the planets associated with the sunwheels within and without the balloon are normally separate from each other, if desired they may be provided by separate portions of a single extended planet wheel. In the former case the planet(s) associated with the sun wheel(s) within the balloon may be positioned either within or without the balloon but in the latter case the single planet wheel will be positioned outside the balloon.

The invention will now be described by way of example with reference to the accompanying drawings in which:

FIGURE 1 shows, somewhat diagrammatically, a single spindle of a machine in accordance with the invention,

FIGURE 2 is a diagram illustrating a suitable form of drive for the take-up means of a number of spindles and for the flyers associated with those spindles, and

FIGURE 3 is a diagrammatic view taken on the line III—III of FIGURE 1 but illustrating an alternative form of drive transmission train.

A number of supply packages such as cops 2 are provided for each spindle 4 of the machine (only one spindle being shown in the drawings), the yarn from the cops, after being plied, being wound on to the spindle. The yarn is led from the cops through a tensioning device 6 and a stationary guide eye 8 attached to the machine framework, to the eye 10 of a rotating flyer 12. From the flyer, the yarn passes up a tube 14 arranged coaxially with the flyer axis, to a pair of driven take-up rollers 16 providing a positive nip so that they act to pull the yarn through the flyer eye. The yarn is laid on a pack-

age 18 carried by the spindle 4, by a butterfly yarn guide 20 which is reciprocated by a rotated traverse scroll 22.

The flyer which is in the form of a disc, has a shaft 28 which is rotated about a vertical axis. Rotation of the flyer causes the length of yarn between the flyer eye 10 and the stationary eye 8 to billow into a balloon 30 and be whirled round the spindle 4, the take-up rollers 16 and the tube 14, between the inner and outer balloon guide rings 32 and 34.

For each revolution of the flyer two turns of twist are given to the yarn, one turn being inserted between the eye 10 and tension device 6 and the other between the flyer eye 10 and take-up rollers 16. Thus, if the flyer is rotated at a speed of 3000 r.p.m. there will be 6000 turns of twist inserted in the yarn per minute. The number of turns per inch in the yarn depends, of course, on the speed with which the yarn is taken-up by the rollers 16.

The take-up rollers 16 and the flyer 12 are driven independently of each other by drives such as those shown diagrammatically in FIGURE 2. Therein is shown a driving motor 35 driving a shaft 36 on which there are two pulleys 37, 38 through a change-speed mechanism 39. The pulley 37, which is the power take-off for the take-up means, drives a pulley 40 on a shaft 41 which, through a change speed mechanism 42 drives a pulley 43. The pulley 43 drives a pulley 44 on the flyer shaft 28 through a belt 45. The pulley 38, which is the power take-off for the flyer, drives a pulley 46 on a shaft 47 carrying also a pulley 48 which drives the flyer shaft 28 through a belt 49 and a pulley 50. All the pulleys are toothed and are connected to each other by internally toothed belts so that the two drives are positive.

The pulley 44, which is rotatable on the flyer shaft, is integral with one, 51, of a pair of equal diameter sun wheels 51, 52 the other one 52 of which is carried by the tube 14 on the other side of the flyer and within the balloon. The sun wheels are connected together through a pair of coaxial toothed planet wheels 53, 54 of equal diameter and mounted one on each side of the flyer on a spindle 55 passing through and carried by the flyer. Each sun wheel is connected to the adjacent planet wheel by one of a pair of internally toothed belts 56, 58. Thus, rotation of the sun wheel 51 by its pulley 44 causes an equal rotation of the other sun wheel 52 within the balloon, irrespective of the speed of rotation of the flyer.

The sun wheel 52 is integral with a gear wheel 60 which drives a spindle driving shaft 62 off-set from the axis of rotation of the flyer. The shaft 62 is provided between its end with a spiral gear 64 meshing with a similar gear in driving connection with one of the take-up rollers 16. The other take-up roller is loaded so that the two rollers provide a positive non-slipping nip. The speed of rotation of the take-up rollers determines the speed at which the yarn is taken up by the package 18 and hence, for a given flyer speed, the twist per inch given to the yarn. The twist per inch in fact is dependent on the ratio of flyer speed of the speed of the take-up rollers. For a flyer speed of, for example, 3000 r.p.m. the speed of the take-up rollers can be adjusted to give any reasonable twist to the yarn for example a twist of between two and eight turns per inch can be inserted for one particular use.

The driving belt 45 is shown in FIGURE 1 as passing round the pulley 44 which is outside the balloon. The belt therefore can be made to pass round the corresponding pulleys 44 of a number of spindles. As the take-up rollers of all these spindles have a common drive outside the balloon, the speed of all the take-up means can be varied as a single operation by adjusting, in the case under consideration, the change-speed mechanism 42. Adjustment of the degree of twist is, therefore, a simple matter. Also, the speed of the take-up rollers and the speed of the flyers, can be adjusted in unison by means of the change-speed mechanism 39.

The upper end of the spindle driving shaft 62 is also provided with a spiral gear 66 meshing with a corresponding gear 68 on the traverse scroll 22 so that the traverse scroll is driven directly by the spindle driving shaft. Rotation of the scroll causes a butterfly yarn guide 20, which engages in the traversing groove 70 of the scroll to be reciprocated parallel to the axis of the spindle so that the yarn is laid evenly on to the package 18 carried by the spindle. The spindle is driven from the shaft 62 through the scroll 22 to which it is connected by a chain drive 72 through a slipping clutch 74.

The gearing between the spindle and the take-up rollers is arranged so that the take-up speed of the package, with no clutch slippage, always exceeds the let-off speed of the rollers. In use, therefore, the clutch is continuously slipping so that the spindle is driven only at the correct speed to take-up the yarn delivered to it by the rollers 16. The pressure of the clutch determines the tension of the yarn between the rollers 16 and the package and this pressure is adjustable so that a correct yarn tension can be obtained for any yarn specification.

The spindle 4, traverse scroll 22, take-up rollers 16 and tube 14 together with the drive for the take-up rollers and spindle are carried by a common bracket diagrammatically shown at 76 within the balloon. The bracket is mounted on the tube 14 which in turn is mounted in bearings on a projection 78 extending from the upper side of the flyer. The tube 14 and hence the bracket 76, has to be immobilised or held against rotation with the flyer. This is done here by positively connecting a toothed sun wheel 80, fixed to the tube 14 within the balloon, to a stationary coaxial toothed sun wheel 82 of the same diameter mounted on the flyer shaft outside the balloon, through a pair of equal coaxial toothed planet wheels 84, 86 mounted one on each side of the flyer on a common spindle passing through and carried by the flyer. The sun wheels are connected to the adjacent planet wheels by means of internally toothed belts 88. As the sun wheel 82 outside the balloon is fixed in a stationary position and is of the same diameter as the sun wheel within the balloon and as the two planet wheels are of the same diameter, the sun wheel 80 within the balloon is held stationary when the flyer rotates. Thus, all the parts of the machine carried within the balloon by the bracket are also held stationary.

It will be seen that the planets 84, 86 of the immobilising train are carried on the flyer diametrically opposite to the planets 53, 54 of the drive transmission train. The flyer is thus substantially in dynamic balance. This balance is helped by the fact that the pair 51, 52 of drive sun wheels straddle the pair 80, 82 of restraint sun wheels.

The toothed wheels 51, 52, 53, 54, 80, 82, 84, 86 are all relatively light and small in diameter. They are positively connected by the toothed belts 56, 58, 88 so no slip occurs, the twist per inch imparted to the yarn is kept constant and no lubrication is needed. This construction enables the flyer which is itself relatively light in weight to be rotated at a high speed.

As explained, the flyer and the take-up means have independent drives originating outside the balloon so that the speed of the take-up means of all or of some of the spindles can be varied by a single operation. In other words, the take-up means are driven not in series with the associated flyer but rather in parallel therewith. The twist per inch imparted to the yarn wound on the spindles can be altered for some or all the spindles by a single adjustment, instead of separately adjusting each spindle drive.

The two parallel drives are positively linked so that there can be no slip in the one drive relative to the other. If, as described above, all the belt drives are positive, there will be no slip under any circumstances. The im-

portance of this is that the same twist is imparted to the yarn during starting up as when the machine is running at full speed.

In some circumstances the drive to the flyer need not be positive because little or no slip would occur at the high speed of rotation, but in such cases it is still advantageous to have a positive drive to the take-up means after the change speed gear box **42** when the speed is relatively low.

It is possible to drive the take-up means and to hold the support bracket stationary within the balloon by a transmission train including only a single sun wheel outside the balloon. Such an arrangement is shown in FIGURE 3.

The immobilising of the bracket is achieved by a transmission train which is the same as that described with reference to FIGURE 1 but the drive transmission train differs.

The drive sun wheel **52** is connected to a planet **90** by an internally toothed belt **92**, which planet is coaxial with the planets **84**, **86** and is carried on the same shaft passing through the flyer. The diameter of the planet **90** differs from that of the planet **86** connected to the fixed sun wheel **82** outside the balloon. Thus as the flyer is rotated the sun wheel **80**, which has the same diameter as the fixed sun wheel **82**, is held stationary but the sun wheel **52** is driven at a speed dependent on the flyer speed and the ratio of the diameter of the planet **90** to that of the planet **86**. It will be appreciated that a drive will be imparted to sun wheel **50** provided that either the planet **90** has a diameter different from planet **86** or the sun wheel **52** has a diameter different from sun wheel **82**.

It will be realised that this alternative does not have the advantage of being able to vary the drive to the take-up means independently of the flyer drive as is the case of the machine illustrated in FIGURE 1. However it is convenient when the yarn speed is controlled by let-off rollers outside the balloon, or in the case of a spinning machine, by the delivery rollers of a drafting head.

The mechanism for immobilising the bracket from movement as described with reference to FIGURES 1 and 3 is not essential. Any alternative mechanism may be used in a machine in accordance with the invention. For example the framework of the machine outside the balloon may be provided with a magnet aligned with a second magnet carried by the bracket within the balloon. The force of attraction between the magnets holds the bracket stationary, when the flyer rotates, with the material in the balloon passing through the magnetic field between the magnets.

The means for transmitting drive from outside to inside the balloon in accordance with the invention can be employed not only in a twister as has been described in detail, but also in a two-for-one spinning machine such as that described in our co-pending patent application No. 205,383, filed June 26, 1962.

I claim:

1. A two-for-one yarn twisting machine of the inflow type having a number of winding assemblies, each assembly comprising a bracket, take-up means including a winding spindle, mounted on the bracket, a flyer at one end of the bracket to balloon yarn around the bracket, the take-up means being driven by a transmission train comprising a pair of coaxial sun wheels, one on each side of the flyer and a pair of coaxial planet wheels carried by the flyer and connected so as to rotate in unison, each planet wheel being positioned opposite to and being connected with one of the sun wheels respectively, all the sun wheels of the winding assemblies which are located on that side of their corresponding flyers remote from the brackets, having a common drive and all the flyers having a common but separate drive so that the drive to the sun wheels and hence the drive to the take-up means is variable independently of the flyer drive from the side of the flyers remote from the brackets.

2. A yarn twisting machine as claimed in claim 1 in which the common drive for the take-up means, and the common drive for the flyers emanate from a common source, the ratio between the drives being variable by a change speed device.

3. A two-for-one yarn twisting machine of the inflow type having a number of winding assemblies, each assembly comprising a bracket, take-up means including a winding spindle, mounted on the bracket, a flyer at one end of the bracket to balloon yarn around the bracket, the take-up means being driven by a transmission train comprising a pair of coaxial sun wheels, one on each side of the flyer and a pair of coaxial planet wheels carried by the flyer and connected so as to rotate in unison, each planet wheel being positioned opposite to and being connected with one of the sun wheels respectively, all the sun wheels of the winding assemblies which are located on that side of their corresponding flyers remote from the brackets, having a common drive and all the flyers having a common but separate drive so that the drive to the sun wheels and hence the drive to the take-up means is variable independently of the flyer drive from the side of the flyers remote from the brackets, the bracket of each assembly being held against rotation with the corresponding flyer by a mechanism comprising a second pair of coaxial sun wheels of the same diameter, one integral with the bracket and the other held stationary on the other side of the flyer and a second pair of coaxial planet wheels of the same diameter carried by the flyer one on each side thereof, each planet being positioned opposite to and being connected with one of the sun wheels of the said second pair of sun wheels respectively.

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