

S. Z. DE FERRANTI.
 SPINNING, DOUBLING, AND LIKE TEXTILE MACHINE.
 APPLICATION FILED AUG. 13, 1906.

938,375.

Patented Oct. 26, 1909.

7 SHEETS—SHEET 1.

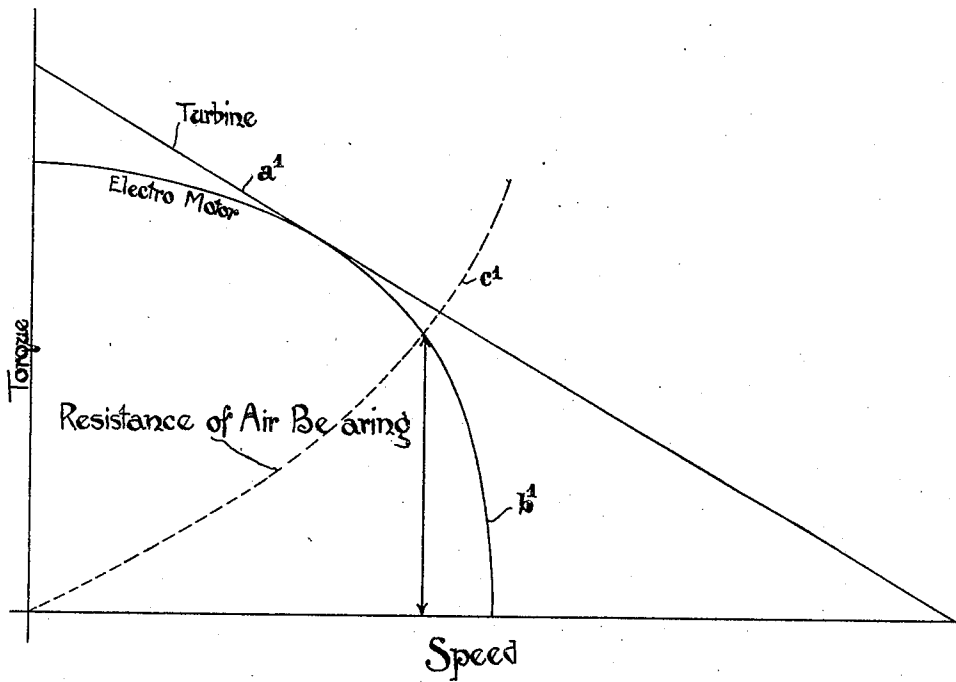


Fig. 1.

ATTEST.

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BY *Spencer Middleton*, *Donaldson* *Spencer*

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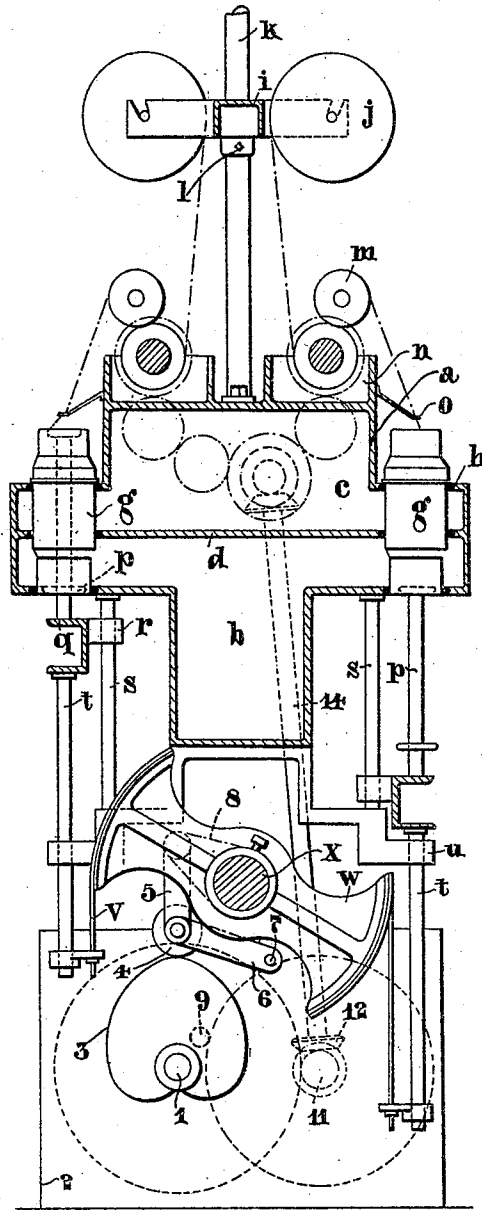


Fig. 1a

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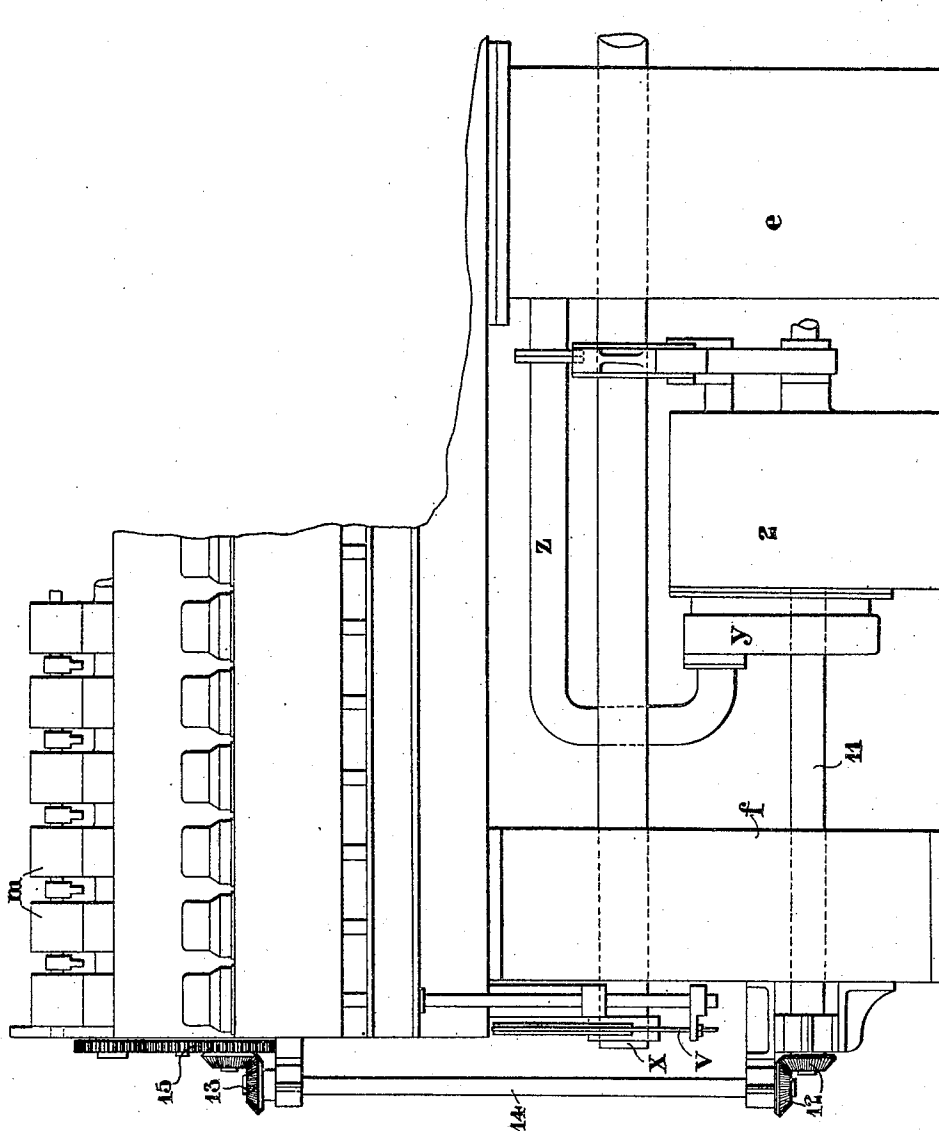


Fig. 2.

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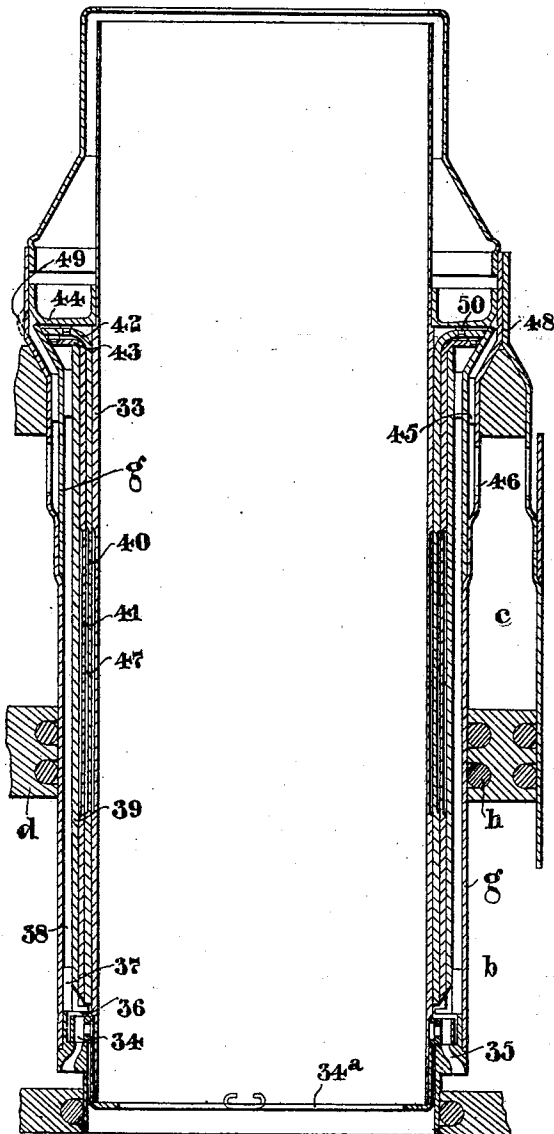


Fig. 3.

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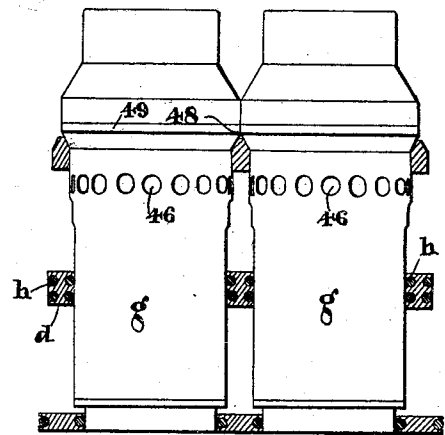


Fig. 4.

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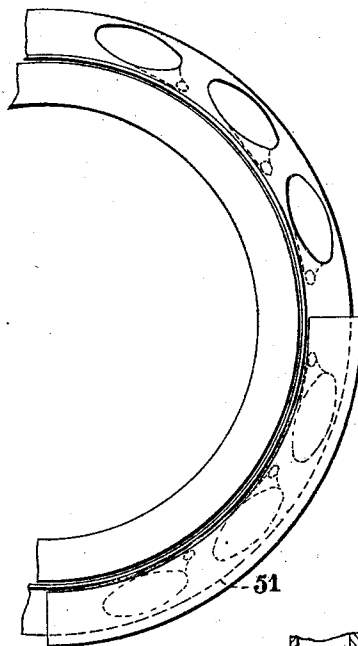


Fig. 6.

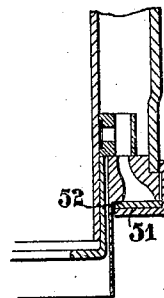


Fig. 5.

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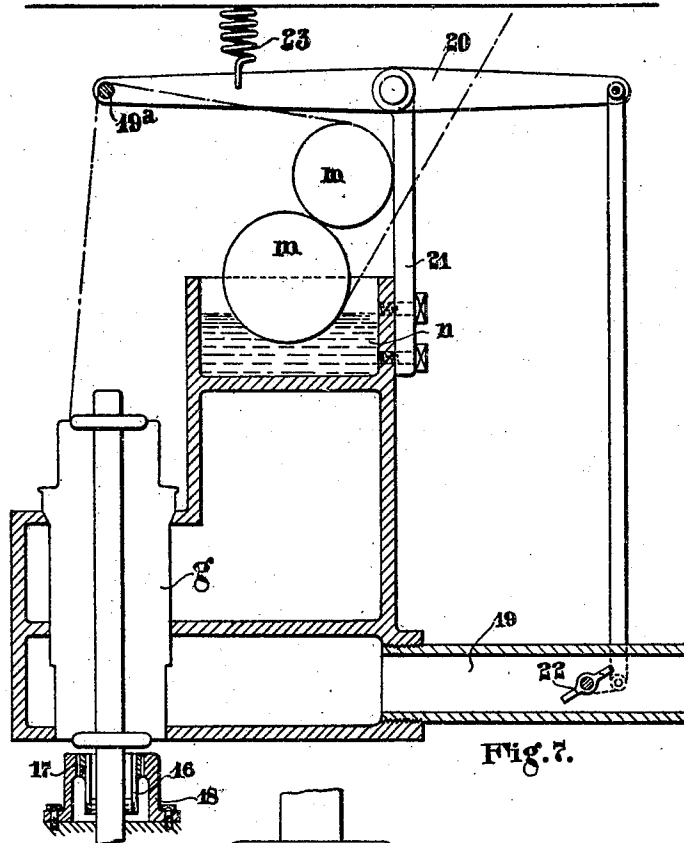


Fig. 7.

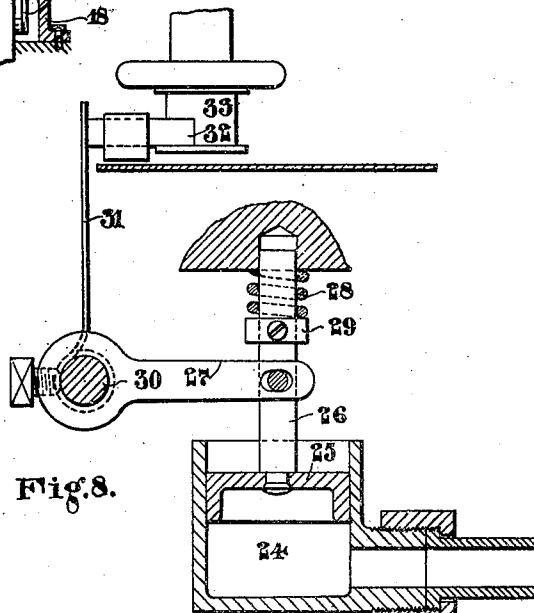


Fig. 8.

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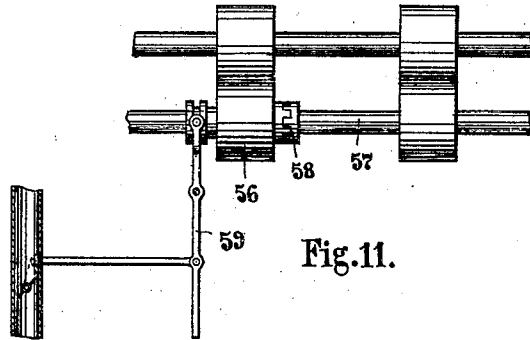


Fig. 11.

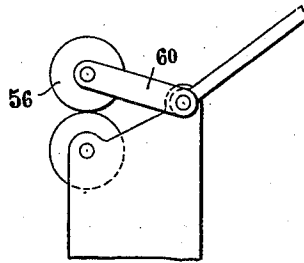


Fig. 12.

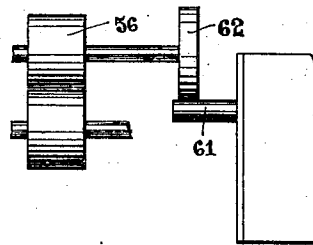


Fig. 13.

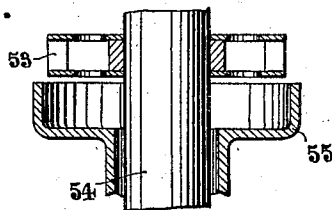


Fig. 9.

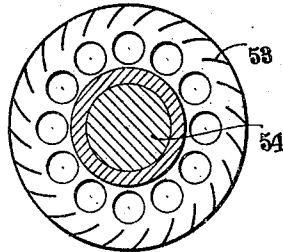


Fig. 10.

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By Spear, Middleton, Donahue & Spear
Attys.

UNITED STATES PATENT OFFICE.

SEBASTIAN ZIANI DE FERRANTI, OF LONDON, ENGLAND.

SPINNING, DOUBLING, AND LIKE TEXTILE MACHINE.

938,375.

Specification of Letters Patent.

Patented Oct. 26, 1909.

Application filed August 13, 1906. Serial No. 330,470.

To all whom it may concern:

Be it known that I, SEBASTIAN ZIANI DE FERRANTI, a subject of the King of Great Britain and Ireland, and residing at 31 Lyndhurst road, Hampstead, London, N. W., in the county of London, England, have invented certain new and useful Improvements in and Relating to Spinning, Doubling, and Like Textile Machines, of which the following is a specification.

This invention relates to improvements in the construction and working of spinning, doubling and like machines of the type in which the individual twisting elements are rotated by turbines, electro-motors or the like.

In the specifications of my applications Nos. 221295, 260120 and 272560, I have described certain improvements in textile processes, and in the construction of machines in which, among other things, very high twisting speeds are obtained from turbine or electric motor driven parts, each of which units drive their own feed or drawing rolls.

My invention consists in a spinning, twisting or doubling machine in which the individual air-borne twisting elements are rotated by a "pure couple" drive such as a turbine, electric motor or the like and the feed or draw rolls are driven in common with one another and independently of the said twisting elements, so that self governing is effected.

A spinning, twisting or doubling machine constructed according to my present invention comprises the following essential elements. 1. Means for governing the speed of the twisting elements so that they rotate at the same speed throughout the machine. 2. Means for driving the feed rolls at constant speed. 3. Means for varying the speeds of the feed rolls and the twisting elements in relation to one another so as to vary the number of twists per inch in the material. 4. Means for insuring that the air-borne twisting elements start and stop at the same relative rates. 5. Means for stopping the feed of material to an individual twisting element on the breaking of a thread. 6. Means for releasing the brake mechanism on all the twisting elements simultaneously by the pressure of the working fluid when admitted to operate the twisting elements.

The turbine driving of rotating elements of various kinds is fully described in my prior applications above mentioned and ref-

erence is hereby made to these for further details.

In a spinning, doubling or twisting machine in which the feed rolls are driven independently of the twisting elements and in common with one another it is essential that the speed of the twisting elements should remain substantially constant to attain uniformity of twist in the material produced. I have found that air borne turbine or electric motor driven twisting elements are peculiarly adapted to attain this end as the driving and retarding forces vary in such a manner as to promote uniformity of speed in twisting elements which are constructed with the same mechanical characteristics, *i. e.* as closely identical in dimensions and disposition of parts as are practically possible. Further, in the case of a turbine of the types which I have indicated in the above specification, the torque on the driven element diminishes as the speed increases; the resistance of the air bearing, however, and consequently the power required to drive it, increases as some power of the speed. The curves due to torque and resistance in relation to the speed cross one another, as shown by the curves *a'* and *c'* in Figure 1 of the accompanying drawings and by so arranging that the speed is adjusted to correspond to that where the curves cross the twisting units will be practically self-governing. Similarly, when the air-borne twisting elements are driven by means of multiphase induction motors, the torque in this case is a maximum at starting, and falls to zero when the speed of the rotor is equal to the velocity of the rotating magnetic field. The curves of resistance and torque in relation to speed in this case also as shown by the curves *b'* and *c'* in Fig. 1 of the accompanying drawings cross one another, and if the conditions are arranged so that the speed of the rotor is maintained about that corresponding to the crossing point of the curves, the speed of the motors throughout the machine will be practically uniform, and remain so under normal conditions of working. Also as the air-borne twisting element is driven by a motor which gives a practically "pure couple" drive the side thrust on the rotary part is insufficient to cause rupture of the air film between the bearing surfaces. So long as the above conditions are maintained, an air-borne twisting element driven by motors of the type indicated

becomes practically self-governing when associated with the conditions which prevail in spinning.

Where I perform the operation of spinning, doubling or the like by means of the cup or cylinder method in which a single high speed rotating element driven by its own motor forms each individual twisting unit, I govern the speed of the said element in one of several ways.

According to one method in which the cup runs in an air bearing, and is either supported by a pivot which gives very small mechanical friction, or by means of an air ring support, and in which the cup is sufficiently well balanced to run upon a cushion of air, I then have to deal with a very certain retarding force in the form of air friction, this air friction increasing rapidly with the speed of rotation. I prefer to drive these cups and like parts by means of an air turbine in which the maximum efficiency is obtained when the speed of the turbine buckets is nearly half that of the issuing air jet. At starting, the torque produced by the jet is approximately twice that which it is at the point of maximum efficiency, and when the speed of the wheel reaches the same speed as the air, there is no torque left. With this motor I therefore have the torque diminishing as the velocity increases. When these two elements are combined, viz:—the driving element whose torque diminishes as the speed increases and the driven element the air friction of which increases as the speed increases, I have conditions which will give an approximately constant speed, as the curve of torque and the curve of resistance to rotation in relation to the speed cross each other and if the conditions are adjusted so that the speed corresponds to the crossing point of the curves the twisting units will be practically self-governing. The same is true of any turbine driven element using an inelastic fluid, such as water, and retarded by means of fluid friction and therefore serves my purpose of obtaining constant speed of the twisting element.

I may supplement the above arrangement by the addition of an automatic governor which works to vary the air pressure according to the drag on the yarn, which for this purpose may be passed through or over guiding eyes fixed to a common rod along the machine, and on which the tension of the yarn is balanced against a weight or a spring, the common rod acting through an equilibrium valve to give greater or less supply of air to the turbines driven thereby. It is clear that this system may be applied in various ways the above, however, being a good illustration of how it may be put into practice usefully.

According to another method, I govern the leading part by any of the methods that

I have described in relation to cup operation, and retard the lagging part by any suitable means such as described in my previous specifications. The more perfectly the lagging part is retarded that is to say, the better the law of the retarding element, the more will it conduce to the maintenance of correct speed in the rotatable parts and consequent accuracy of twisting.

According to another method, I may effect the governing of the rotating part by means of a centrifugal governor attached thereto. This, for example, may be applied in the form of a ring on the spindle of the cup, or upon the cup itself, with several springs rigidly attached thereto and dependent therefrom, upon which weights are attached which run around inside a standing cup. After a certain critical speed is reached, the centrifugal force of the weights overcomes the power of the springs which retain them, and the weights move out slightly and come into more or less contact with the inside edge of the standing cup, thus putting great drag upon the rotating part. I may shorten or lengthen the springs and so alter their stiffness and speed at which they act by means of a ring outside them which can be screwed or otherwise adjusted up and down so as to produce this result. This ring, of course, rotates with the rest of the running part.

Any form of centrifugal governor of simple construction may be easily modified to govern the speed of the rotating part either by introducing frictional resistance or by regulating the supply of working fluid to the motor.

Referring now to the accompanying drawings which illustrate my invention and form part of my specification:—Fig. 1 is a diagram showing the curves of torque and resistance in relation to the speed. Fig. 1^a is a cross sectional elevation and Fig. 2 is a front elevation of a twisting machine constructed according to my invention. Fig. 3 is a sectional elevation of one form of ring flier suitable for a twisting machine illustrated in Fig. 1^a. Fig. 4 is an outside elevation to a reduced scale of the ring flier shown in Fig. 3. Fig. 5 is a cross sectional elevation and Fig. 6 is an inverted plan illustrating one method of reversing the ring flier shown in Fig. 3. Fig. 7 shows arrangements of governing devices, suitable for machines constructed according to my invention. Fig. 8 shows an arrangement of brakes coöperating with the pressure of the working fluid arranged according to my invention. Fig. 9 is an elevation and Fig. 10 is a plan of a retarding device for regulating the speed of the twisting elements. Figs. 11, 12 and 13 show arrangements for stopping the feed rolls of individual twisting units.

In carrying my present invention into

effect according to one form and as applied to a machine having leading and lagging parts, I construct (Figs. 1^a and 2) a spinning or doubling frame with a central trunk, *a*, forming one of the main structural elements of the machine which trunk is divided into a supply chamber, *b*, and an exhaust chamber, *c*, for the working fluid by a partition plate, *d*, extending longitudinally the whole length of the machine. The trunk, *a*, is supported at convenient intervals by columns the central one, *e*, of which may be used as the supply pipe to the chamber, *b*, while the end ones, *f*, may preferably be utilized to lead away the exhaust fluid from the chamber, *c*. On each side of the trunk, *a*, holes are formed into which the ring flier casings, *g*, are inserted leakage of the working fluid around the casing *g*, being prevented by inserting rings of resilient packing, *h*, at such parts. This method of mounting the flier casing allows of its ready withdrawal and provides at the same time a resilient means of support. The ring flier may preferably be of the air-born turbine driven type and be provided with running bearing parts inserted between the ring flier and the stationary air bearing element, and also with suitable means for reversing the direction of rotation of the ring flier.

A ring flier embodying the above features will now be described but which however forms no part of the invention claimed herein.

Referring to Figs. 3 and 4 the ring flier, 33, carries at its lower extremity turbine blades, 34, of the Leval type as described in Patent No. 522,066 or other suitable type, the working fluid being led to the blades from the fluid supply chamber *b* by nozzles, 35, sets of which may be provided for either direction of rotation. The ring of blades 34 is held in position by a ring 34^a which is provided with winding hooks and is attached to the flier, 33, by means of a bayonet joint or other suitable means. The length of the nozzles as shown is considerably shortened owing to the manner in which they are cut by the sectional plane. The turbine blades are shielded by a ring, 36, which however has a sufficient number of passages formed therein in adjacent positions to the discharge from the nozzles so as to allow a free path for the exhaust. The ring, 36, incloses the turbine blades as much as possible so as to reduce the losses due to the fanning action of the blades. The casing, *g*, is formed in two parts as shown and has projections, 37, attached to its inner surface so as to form an annular chamber, 38, between the casing, *g*, and the stationary part, 39. Between the stationary part, 39, and the high speed rotating part, 33, which constitutes the ring flier, running bearing parts, 40 and 41 are disposed having flanges, 42

and 43, which rest on an angled seat formed on the casing, *g*. The part, 33, is also provided with a flange, 44, which is arranged above the flanges, 42 and 43. The exhaust from the turbine passes through the chamber, 38, lifts and supports the flanges, 42 and 43, and is thereby introduced below the flange, 44, upon which it acts in a similar manner and finally escapes to the exhaust chamber, *c*, by the ducts, 45, and the holes, 46. It will thus be seen that the dead weight of the rotating parts is supported on a cushion of elastic fluid. Clearance spaces, 47, are provided in the running parts and the bottom of the parts, 39, 40 and 41, as well as the shielding ring, 36, are cut away as shown in Fig. 3 so as to allow a free path for the exhaust.

In order to economize space as much as possible, the outside of the casing is flattened at the point 48, Figs. 3 and 4, where it adjoins the adjacent casings, the section at other points being indicated by the dotted lines at 49. Between the various flanges cushions, 50, of rubber or other suitable material are inserted which act as buffers and allow the flanges, 43, 42 and 44, to be lifted silently and together.

In the above construction of ring flier I prefer to effect reversing by withdrawing ring flier 33, from its casing, removing the ring 34^a, inverting the bladed ring 34, the ring 34^a being then replaced and the flier 33 returned to its casing. Sets of opposite handed nozzles, 35, Figs. 5 and 6, are required in this case and a blanking valve or washer, 51, having a rubber face, 52, is disposed at the entrance of the nozzles which washer is arranged to be rotated so as to cover the set of nozzles which it is desired to render inoperative.

It will be obvious that the above device is of exceedingly simple construction and one in which the fanning losses occurring in the case where opposite sets of blades are provided for each direction of rotation are eliminated. Holders, *i*, on which the bobbins, *j*, containing the material to be twisted is disposed, are attached to the standards, *k*, the holders being clamped in the required position by means of screws, *l*. The material to be twisted after being unwound from the bobbins, *j*, passes around the feed rolls, *m*, the lower one of which is partially immersed in water contained in the troughs, *n*, formed integrally with the trunk, *a*, thence to the guide eye, *o*, in the manner indicated by the dotted lines. After leaving the guide eye, *o*, the material is wound on the bobbins, *p*, in the usual manner by the ring flier, which may preferably be provided with winding hooks at each end to prevent fouling of the material. The bobbins, *p*, are disposed on the rails, *q*, which are provided with guide eyes, *r*, sliding on the rods, *s*. At each end

of the bobbin rails, *q*, rods, *t*, are attached which slide in bearings, *u*, to which rods one end of the flexible chains, *v*, are connected. The other end of the chains are attached to
 5 quadrants *w*, rigidly fixed to the shaft, *x*, the motion of which imparts the reciprocating motion of the bobbin rail. An air turbine, *y*, is supplied with working fluid from the column, *e*, by the pipe, *z*, and actuates a shaft, 1, through suitable gearing, 9,
 10 disposed in a gear box, 2. On the end of the shaft, 1, a heart shaped cam, 3, is situated which imparts an oscillatory motion to the shaft, *x*, through a roller, 4. The roller, 4, is suspended from links, 5 and 6, the link, 6 being centered at 7, while the link, 5, is suspended from an arm, 8, rigidly attached to the shaft, *x*. The rotary motion of the shaft, 1, carrying the cam, 3, thus imparts an oscillatory motion to the shaft, *x*,
 20 which by means of the quadrants, *w*, and the chains, *v*, effects the requisite reciprocating motion of the bobbin rail. A shaft, 11, is also actuated from the turbine, *y*, through the gearing, 9, and transmits the motion to the feed rolls, *m*, through gearing, 12, and 13, and the inclined shaft, 14, suitable change wheel gear, 15, being provided between the gear wheels, 13, and the feed rolls. The feed
 30 rolls, *m*, are thus driven quite independently of the twisting elements the number of twists per inch in the material being determined by the velocity ratio of the feed rolls and twisting elements. This ratio may be altered within certain limits by controlling the supply of working fluid to the turbine a further alteration being effected by the change gear, 15, in order that the turbine need not require to work over too great a
 40 range of speed. The turbine, *y*, may preferably be controlled by means of any ordinary centrifugal governor, capable of being set to govern accurately at any predetermined speed over a sufficient range for purposes of changing the rate of feed as required in practice.

Instead of mounting all the feed rolls on a shaft extending the whole length of the machine I may divide the feed rolls in sections
 50 and provide means for driving each of the sections by an accurately governed turbine or other motor.

Instead of driving the feed rolls in the manner I have indicated I may in some cases
 55 drive the feed rolls throughout a mill from induction motors attached to each frame which are supplied with current at constant periodicity obtained from an accurately governed generator in the power house.

60 According to another method I may employ a continuous current motor to drive the rolls of each frame. The motor in this case being of the shunt wound type and having constant work to do will give an approximately constant speed with ordinary voltage
 65

regulation such as is suitable for lighting purposes. According to this method the amount of feed may be varied by varying the excitation of the motor.

According to another method I may effect
 70 the governing of the rotating part by means of a centrifugal governor attached thereto such as I have illustrated in Fig. 7. In this example springs, 16, are attached to a lagging tube having friction pads 17, on their
 75 outside sides. A sleeve, 18, is fixed to the bobbin rail, *q*, having contact surfaces disposed opposite to the friction pads, 17, but out of contact therewith. After a certain critical speed is reached the springs, 16, are
 80 caused to move outward owing to the action of centrifugal force and the friction pads, 17, coming in contact with the sleeve, 18, cause retardation of the rotating part until the speed falls to the normal again.
 85

It will be obvious that a device of this type could be applied with equal facility to a cup or cylinder spinner or doubler and I wish it to be understood that the example
 90 which I have shown illustrates a typical method of carrying this part of my invention into effect as it is obvious that various types of centrifugal governors with but slight modification may be adapted to govern the speed of rotation by introducing
 95 frictional resistance or by controlling the supply of working fluid to the twisting element without departing from my invention.

Instead of arranging the machine as shown in Figs. 1^a and 2, I may somewhat
 100 modify the construction of the fluid trunks to the form shown in Fig. 7. In this case supply and exhaust chambers are provided for the twisting element as before the working fluid being led to the chambers by the pipes,
 105 19^a. One method of governing has already been described with reference to this figure which may however be supplemented by an arrangement which automatically varies the pressure of the working fluid according to the drag on the yarn. One such arrangement is illustrated in Fig. 7. The yarn
 110 passes around the feed rolls *m*, and over the guide rod, 19, in the manner indicated by the dotted lines. The guide rod, 19, extends
 115 the whole length of the machine, being carried on one end of the levers, 20, disposed at suitable intervals thereon. The levers, 20, are rotatably mounted on standards, 21, fixed to the trough, *n*, and operate a throttle
 120 valve, 22, for regulating the air supply to the twisting elements. A spring, 23, is attached to the levers, 20, so as to balance the drag on the material by the tension therein.

When the drag of the material becomes
 125 greater owing to an increase of speed the guide rod end of the levers, 20, is depressed and the throttle valve, 22, diminishing the supply of working fluid to the twisting elements, when on the other hand the drag de-
 130

creases, the tension of the spring, 23, will cause the guide rod end of the lever, 20, to be raised and thereby increase the supply of working fluid to the twisting elements.

5 A form of brake mechanism which I prefer to use is illustrated in Fig. 8 in which the operation of admitting the working fluid to the twisting elements simultaneously releases the brake mechanism on all
10 the lagging tubes throughout the machine. In this case a cylinder, 24, is in communication with the source of supply of the working fluid and is so situated that the operation of turning on the supply of working
15 fluid to the twisting elements admits it at the same time to the cylinder, 24. A piston, 25, is disposed in the cylinder, 24, and carries a piston rod 26, to which a forked lever, 27, is connected, any motion of the piston
20 tending to compress a spring, 28, situated between the collar 29, and the stationary part. The lever, 27, is rigidly connected to a shaft 30, extending the whole length of the machine, light adjustable springs, 31, being
25 attached to the shaft in suitable positions for acting on the pads, 32, and make frictional contact with the lagging tube, 33. It will thus be seen that the operation of turning
30 on the supply of working fluid to the twisting elements causes the piston 25, to rise, and rotate the shaft, 30, a sufficient distance to withdraw the pad, 32, from frictional contact with the lagging tube, while
35 on cutting off the supply of working fluid the compression of the spring, 28, will cause the shaft, 30, to be rotated in the reverse direction and thereby cause the brakes on all
40 the lagging tubes to be simultaneously applied. The retardation of the ring flier is effected simultaneously with the retardation of the lagging tube by cutting off the supply of supporting fluid to the high speed rotating
45 parts, thereby allowing the supporting flanges of such parts to rest upon their seats the resulting friction between the flanges and their seats quickly bringing the ring flier to rest. The stiffness of the springs 28, should be chosen so as to bring the lagging
50 tubes to rest at practically the same instant as the ring fliers and thus prevent breakage of the material owing to over-running of the parts.

According to another method, see Figs. 9 and 10, I may still further govern the speed
55 by making the retardation of the driven part more positive by adding fans or vanes, 53, to the rotating part, 54. As the resistance given by these increases about as the square of the speed, the curves of driving and retardation in relation to the speed cross each
60 other very favorably and tend to great regularity of speed. I may more or less inclose the fans by altering the position of the casing, 55, so as to be able to vary the amount
65 of retardation caused by them, and so fix the

speed. In some cases I may even make the fans, 53, in the same form as would be used for an ordinary blower, and more or less close the exhaust or inlet, or both, so as to vary the amount of the retardation which
70 they effect, thereby securing all the control necessary for working under the various circumstances under which machines such as I have described have to operate.

According to one method I may effect the
75 stopping of the supply of yarn or roving by mounting rollers 56, see Fig. 11, loosely upon a common roller rod 57. The ordinary line of rollers is thus replaced by a line of shaft with the rollers loosely mounted upon them. 80
By means of clutches 58 fitted to each roller I can start or stop the rollers by giving each individual set a slight end movement, and thus causing any individual set to feed or stand according to the will of the operator. 85
This clutching of the rollers by either the claw or friction methods may be interconnected by means of a lever, 59 with the brake or supply of motive fluid to the individual motor, and worked by means of the stop motion, so that in case of the breakage of an
90 end the rollers and the twisting part are stopped rotating together.

According to another method, see Figs. 12 and 13, the rollers 56 may be mounted in a
95 frame 60 and carried above longitudinal shafts 61 running at the right surface speeds. When the frame 60 is slightly dropped, so that the dead weight of the rollers or friction wheels 62, at their ends is taken upon the running
100 shafts 61, the rollers 56 are then rotated at the correct speeds. When they are raised out of contact, they cease to rotate and feed.

The drive between the shaft and the rolls may be effected as a metal to metal drive, or
105 through leather or other suitable material. The rolls and shafts may come into actual contact, or friction wheels may be provided on one or both parts for the purpose of the transmission. Where doubling is being carried
110 out, there is only a single rotating shaft, or, if desired, two rotating shafts, between the depression of which the feeding rollers may lie and so be driven. When it is desired to vary the rate of feed, the speed of
115 the common driving shaft is varied as at present.

In spinning, where the yarn has to be attenuated by three rollers running at different
120 speeds as at present, I employ three longitudinal shafts running at the correct relative surface speeds, the speeds of which can be varied as at present, to suit the twist and amount of draw, and upon these mount
125 the three drawing rolls with pressure rolls above them, all of which are driven at suitable speed, or are stopped by hand, as may be desired, or by the stop motion throwing them out of contact with the driving shaft.
130 There are also several stop motions for doub-

ling, and also some for spinning, already existent, which may be usefully combined with stop motions for the twisting part, and applied to machines, according to my invention, to effect the desired result.

Where I use turbines using elastic fluid as the source of power for running the twisting portions of my machines I may construct them of any of the well known types.

In another concurrent application for Letters Patent, Serial No. 330,471, I have described a method of decreasing the losses due to skin friction and the fanning action of the blades by shielding the blades of the turbine and concentrating the nozzle discharges. This I effect by inclosing the turbine in a smooth and closely fitting casing.

In circumstances where I desire that the turbine should be self-regulating I can accomplish this by removing a certain portion of the inclosed casing thus allowing the turbine blades to fan the air which at once gives sufficient definite retardation to regulate the speed.

Throughout this specification I have used the word "air-borne" with respect to the bearings of high speed rotating parts in the sense that the bearing surfaces are air lubricated, full directions for the constructions of which bearings will be found in my patent specifications Serial Nos. 260,120 and 272,560. Also I have used the words pure "couple drive" to designate a drive of the type in which the unbalanced component in a radial direction with respect to the axes of rotation of the air borne rotating parts is small, *e. g.* a turbine or electro-motor drive. In the case of turbines working with air it is not essential that the nozzles should be symmetrically disposed about the axes of rotation as long as the unbalanced compound in the direction above described is insufficient to cause rupture of the air film between the bearing surfaces.

Having thus described my invention what I claim as new and desire to secure by Letters Patent is:—

1. In a spinning, twisting or doubling machine the combination of means for imparting twist to the material, said means including a plurality of air-borne twisting elements, and including also motor means for each of said elements, together with rolls serving said elements, said rolls acting independently of said twisting means.

2. In a spinning, twisting or doubling machine the combination of means for imparting twist to the material, said means including a plurality of air-borne twisting elements, and including also a pure couple drive on said twisting elements together with means for feeding material to said twisting elements, said feeding means acting independently of said twisting means.

3. In a spinning, twisting or doubling machine the combination of means for imparting twist to the material, said means including one or more air-borne twisting elements, and including also turbines on said twisting elements; means for feeding material to said twisting elements, and a turbine for actuating said feeding means and acting independently of said twisting means.

4. In a spinning, twisting or doubling machine, the combination of one or more air-borne twisting units, a "pure couple" drive motor on said twisting units, means for feeding material to said twisting units, said feeding means acting independently of said twisting units, together with means for governing the speed of said twisting units, as set forth.

5. In a spinning, twisting or doubling machine, the combination of one or more air-borne twisting units, a "pure couple" drive motor on said twisting units, means for feeding material to said twisting units, said feeding means acting independently of said twisting units, together with means co-acting with the drag of the yarn for governing the speed of the twisting units, as set forth.

6. In a spinning, twisting or doubling machine, the combination of one or more air-borne twisting units, a "pure couple" drive motor on said twisting units, means for feeding material to said twisting units, said feeding means acting independently of said twisting units together with means for stopping the feed of the material to said units, as set forth.

7. In a spinning, twisting or doubling machine, the combination of one or more air-borne twisting units, a "pure couple" drive motor on said twisting units, means for feeding material to said twisting units, said feeding means acting independently of said twisting units, together with means for automatically stopping the feed of material to said twisting units and controlling the supply of working fluid thereto on the breakage of a thread, as set forth.

8. In a spinning, twisting or doubling machine, the combination of one or more air-borne twisting units, a "pure couple" drive motor on said twisting units, means for feeding material to said twisting units, said feeding means acting independently of said twisting units, together with means co-acting with the pressure of the working fluid for retarding said twisting units, as set forth.

9. In a spinning, twisting or doubling machine, the combination of a plurality of twisting units; motors for each of said units; rolls for said units, said rolls acting independently of said motors for said unit, means for actuating said rolls together with means operatively connected with said roll actu-

ating means for laying the twisted material.

10. In a spinning, twisting or doubling machine, the combination of a plurality of turbine driven twisting units, means for feeding material to said twisting units, a turbine for operating said feeding means working independently of said twisting units, a plurality of bobbins adapted to receive spun material from said twisting units, means for reciprocating said bobbins, said reciprocating means cooperating with the turbine operating said feeding means, as set forth.

11. In a spinning, twisting or doubling machine, the combination of a plurality of turbine driven twisting units, means for feeding material to said twisting units, a turbine for operating said feeding means, working independently of said twisting units, a plurality of bobbins adapted to receive spun material from said twisting units, means for reciprocating said bobbins, said reciprocating means cooperating with the turbine operating said feeding means, together with means for varying the number of twists in the material, as set forth.

12. In a spinning, twisting or doubling machine, the combination of a plurality of turbine driven twisting units, means for feeding material to said twisting units, a turbine for operating said feeding means working independently of said twisting units, a plurality of bobbins adapted to receive spun material from said twisting units, means for reciprocating said bobbins, said reciprocating means cooperating with the turbine operating said feeding means, means for varying the number of twists per inch in the material together with means for automatically stopping the feed of the material

to said twisting units and controlling the supply of fluid thereto on the breakage of a thread, as set forth.

13. In a spinning, twisting or doubling machine the combination of means for imparting twist to the material, said means including the combination of a plurality of air-borne twisting elements, and including also motor means driving each of said elements, interconnected rolls serving said elements, together with motor means independent of said twisting means for driving said interconnected rolls.

14. In a spinning, twisting or doubling machine the combination of means for imparting twist to the material, said means including a plurality of air-borne twisting elements, and including also motor means driving each of said elements; rolls serving said elements; traverse means for evenly laying the twisted material, together with motor means independent of said twisting means for driving said rolls and said traverse means.

15. In a spinning, twisting or doubling machine, the combination of a plurality of twisting units; turbines for each of said units; rolls for said units; a turbine independent of said first mentioned turbines for driving rolls corresponding to a certain plurality of said units; means for receiving spun material from said twisting units together with means co-acting with said roll-driving turbine for laying material on said receiving means.

In testimony whereof, I affix my signature in presence of two witnesses.

SEBASTIAN ZIANI DE FERRANTI.

Witnesses:

CHAS. N. DANIELS,
LUTHER J. PARR.