

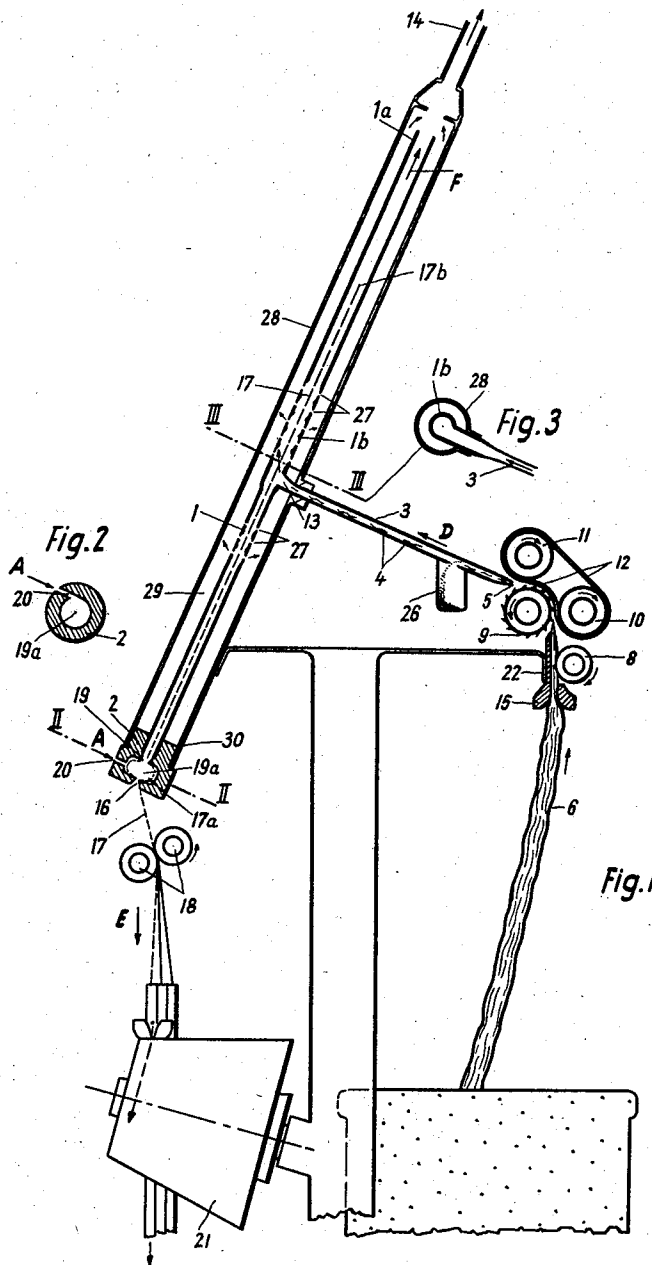
March 15, 1960

K. GÖTZFRIED
PNEUMATIC SPINNING DEVICE

2,928,228

Filed Sept. 5, 1957

3 Sheets-Sheet 1



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March 15, 1960

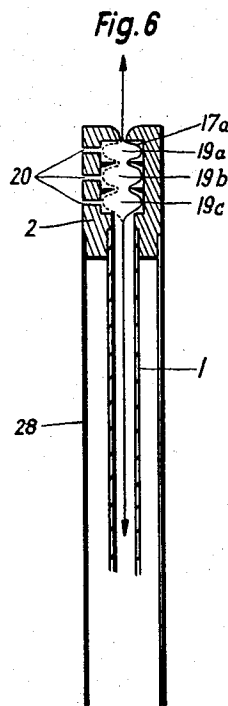
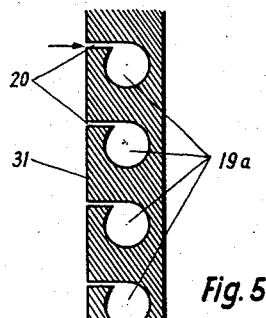
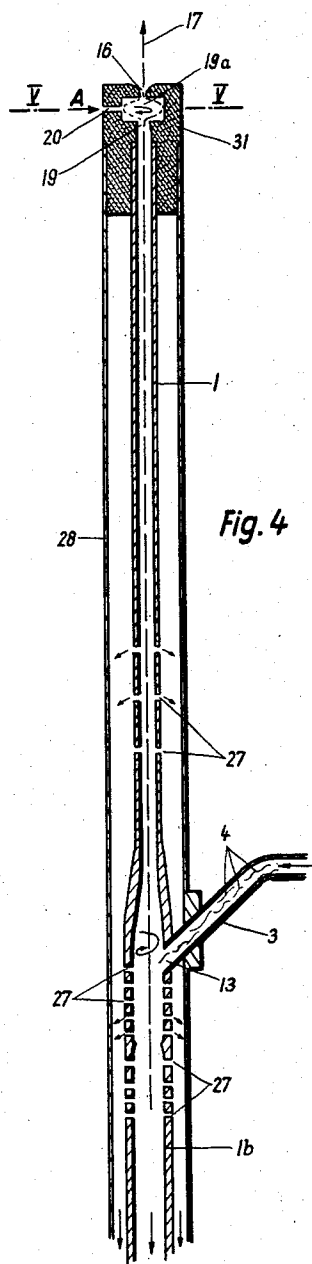
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PNEUMATIC SPINNING DEVICE

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3 Sheets-Sheet 2



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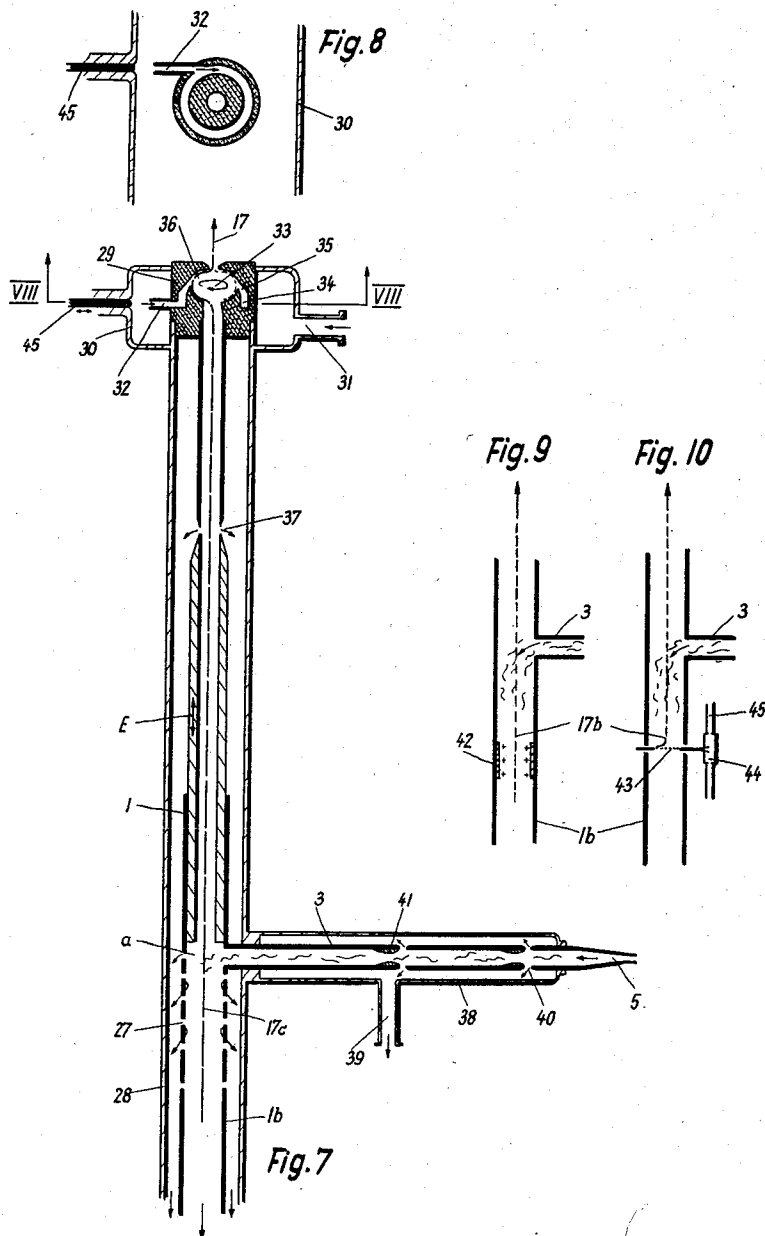
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PNEUMATIC SPINNING DEVICE

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3 Sheets-Sheet 3



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2,928,228

PNEUMATIC SPINNING DEVICE

Konrad Götzfried, Augsburg-Goggingen, Germany

Application September 5, 1957, Serial No. 682,145

Claims priority, application Germany January 29, 1957

13 Claims. (Cl. 57—58.89)

My prior application, identified below, relates to a pneumatic spinning process, and also to a device for carrying this process into effect, comprising a nozzle closing the suction tube and having a narrow axial discharge opening for the spun thread, and at least one passage for the admission of air and opening tangentially into the axial bore of the nozzle. At the nozzle end, the spinning tube is additionally connected to a tubular shell which surrounds the latter and which is connected to a source of vacuum. Opening into the spinning tube is a supply tube through which the fibres are drawn in by suction and fed to the spinning tube.

The present invention is concerned with an improvement and further development of the spinning device disclosed in United States patent application, Serial No. 628,116 filed by me on December 13, 1956 and is more particularly concerned with the economic production of an even better thread of high tensile strength, i.e. a more strongly twisted uniform thread.

According to the invention, that section of the axial bore of the suction nozzle into which the tangential passage opens is enlarged to form a twist chamber, the diameter of which is substantially larger than the axial bore of the nozzle. Due to the arrangement of this twist chamber, a thread balloon of the pneumatically spun thread is produced and thus at the same time a propeller-like rotation of the yarn with an extraordinarily strong rotational effect. The result hereby obtained is that the thread is withdrawn with comparatively weak thread tension, but on the other hand, owing to the twist chamber, a very tightly and uniformly twisted thread is produced with a correspondingly high tensile strength.

The faster the suction air flows tangentially into the twist chamber, the stronger will be the rotational force therein. In order to produce a high inflow velocity, the cross-section of the suction duct is chosen to be comparatively small. The rotational effect can advantageously be further substantially improved by compressed air being supplied through the tangential duct of the twist chamber.

Details of the invention are illustrated by way of example in the drawing and are hereinafter more fully explained.

In the drawing:

Fig. 1 shows a pneumatic spinning device in vertical section,

Figs. 2 and 3 are cross-sections on the lines II—II and III—III of Fig. 1,

Fig. 4 is a vertical section through a pneumatic spinning tube according to the invention, but to a larger scale,

Fig. 5 is a cross-section on the line V—V of Fig. 4,

Fig. 6 is a longitudinal section through a spinning tube with a suction nozzle of a different design,

Fig. 7 is a longitudinal section through another design of a spinning tube,

Fig. 8 is a cross-section on the line VIII—VIII of Fig. 7,

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Figs. 9 and 10 are fragmentary longitudinal sections through particular constructions of spinning tubes.

In the drawing, a spinning tube is indicated at 1, a suction nozzle at 2 and a suction tube at 3, the said suction tube opening into the spinning tube 1 at a distance from the nozzle 2 and serving for the supply of the fibres indicated 4 and floating in a stream of air. The spinning tube is enclosed in spaced relation by a tubular shell 28, one end of which is connected in air-tight manner at 30 to the nozzle 2 and the other end of which is connected to a suction pipe 14 which leads to a source of vacuum (suction pump or fan). The suction nozzle 2 is formed with an axial bore 19, a narrow axial discharge opening 16 for the spun thread 17 and at least one passage 20 opening tangentially into the enlarged axial bore 19a. The thread 17 spun in the spinning tube 1 is withdrawn by means of the conveyor rollers 18 in the direction E, i.e. opposite to the direction F of the axial suction eddy current, and wound on to a bobbin 21.

Due to the tangential intake of air through the passage 20, a strong suction eddy current is produced in the suction nozzle and thereafter in the spinning tube 1, the velocity of said current being substantially higher at the beginning than at the end 1a of the spinning tube. As will be seen from the drawing, only that portion of the axial bore 19 into which the tangential passage 20 opens is enlarged to form a twist chamber 19a, the diameter of which is substantially larger than the axial bore 19 of the nozzle. In the example illustrated, the diameter of the twist chamber 19a is at least twice as large as the diameter of the axial bore 19, while the height of the twist chamber is smaller than its diameter. Furthermore, a comparatively fine suction duct 20 is provided which has a cross-section substantially smaller than that of the axial bore 19. As will be seen from the drawing, the spinning tube 1 connected to the nozzle 2 has a comparatively small diameter over a relatively large length and is only increased to a larger diameter at the point 13 where it enters the spinning tube section 1b.

As indicated at 17a, the provision of the twist chamber 19a produces a strongly emphasised thread balloon in the chamber and thus exerts an extraordinarily strong twisting action on the thread. Under the influence of the eddy current, the thread forms a helical thread balloon, so that by applying the fibres to the rotating thread, the actual thread formation takes place in the spinning tube 1b, while the formation of the strong twist in order to produce a thread of high tensile strength takes place in the spinning tube 1.

As indicated in Fig. 6, two or more superimposed twist chambers 19a, 19b and 19c can be provided in the suction nozzle 2. In this constructional form, the tangential suction duct 20 opens into the twist chambers 19a, 19b and 19c. In order to reduce the flow inside the spinning tube 1, radial discharge openings 27 are provided according to Fig. 1, so that some of the eddy current air, as indicated by arrows in the drawing, is extracted radially from the stream of air. In this manner, a suction eddy current is produced in the spinning tube 1 and 1b, the velocity of such current (rotational velocity and also axial velocity) being initially substantially larger, i.e. several times larger, than at the end 1a of the spinning tube. The rotating thread 17 formed in this spinning tube from the fibres therefore has applied to it a twist which constantly increases from the start of the thread at 17b as far as the withdrawal point 16, so that an evenly twisted thread is produced. The fibres entering the range of the rotating thread wrap around the thread, so that there is simultaneously produced a stretching of the fibres longitudinally of the thread and a substantial parallel relationship of the fibres. For initiating the spinning, it is merely necessary for one end of the thread

to be brought into the preferably funnel-shaped opening 16. The new thread is then continuously formed on this end of the thread, which is immediately drawn in, and the new thread can then be withdrawn with the pair of rollers 18.

As will be seen from Fig. 4, the fibre supply tube 3 enters the spinning tube 1b at 13 at an acute angle to the axis of the spinning tube. If desired, as indicated in Fig. 3, this supply tube 3 can also open tangentially into the spinning tube.

According to Fig. 5, a common suction nozzle 31 can be provided for a plurality of spinning tubes. The fibres 4 supplied to the spinning tube through the suction pipe 3 are drawn in through a suction nozzle 5 disposed at the end of the supply tube 3. Referring to the constructional example shown in Fig. 1, a sliver 6 (for example a carded or drawing frame sliver) is provided as initial material, which is drawn through a condenser 15 and is supplied by a delivery roller 8 co-operating with a polished plate 22 to a driven picking roller 9, which co-operates with an endless rubber or like elastic band 12 guided over rollers 10 and 11. By means of this roller 9, the fibres or small fibre tufts are picked or plucked from the sliver 6 and are drawn in through the suction nozzle 5.

Even if in principle a suctional force is used in accordance with the constructional examples previously described for operating the automatic spinning device, it is nevertheless advantageous to support the suctional force by compressed air being fed to the spinning chamber 19a through the tangential passage 20. The rotational force acting on the spun thread is thus substantially increased, since this rotational force is stronger in proportion as the air flows more quickly and tangentially into the twist chamber. The additional supply of compressed air at this point has the further advantage that the pneumatic spinning device can be operated with a comparatively low vacuum and it is possible for this purpose to use blowers which are employed for suction plants used in connection with breakages of the thread and which produce a vacuum of about 100 mm. water column.

The diameter of the tangential air inlet passage 20 depends on the superatmospheric pressure of the compressed air, so that with a relatively high pressure, this diameter is only about 1.5 mm., while with a lower superatmospheric pressure of for example 400 mm. water column, this diameter is about 3 mm.

With tangential introduction of compressed air into the twist chamber of the nozzle, a very high rotational velocity for producing the twisting action can be produced with a comparatively small quantity of air, but the axial flow is comparatively low. As hereinafter more fully explained, this axial flow can also be reduced with various measures shown by reference to Fig. 7.

In this constructional example, the nozzle 29 connected to the tubular shell 28 is situated in a chamber 30, to which compressed air is supplied at 31. This compressed air then flows through a tangentially arranged passage 32 into the twist chamber 33. In order to be able to draw the initial spinning thread into the twist chamber and the spinning tube, a displaceable valve rod 45 is provided by which the inlet opening of the passage 32 can be temporarily throttled. In the constructional example illustrated, this twist chamber 33 is surrounded by an annular chamber 34 into which the passage 32 opens tangentially. An annular space 35 connecting this annular chamber 34 to the twist chamber 33 is provided above the said passage 32. Moreover the twist chamber is advantageously made substantially spherical, so that the annular space 35 according to Fig. 7 opens into the twist chamber 33 while being directed tangentially upwards. This construction according to Fig. 7 has the following advantages:

If in accordance with Fig. 1 or Fig. 4, a stream of

compressed air of small cross-section and high velocity is caused to enter directly into the twisting chamber, it has been shown that a single helical jet of air is also formed in the spinning tube. In order to prevent this and to produce a constant rotating air envelope in the twist chamber and also in the spinning tube, the compressed air flowing through the passage 32 is distributed in accordance with Fig. 7 in the annular chamber 34 and then enters the twist chamber 33 through the annular space 35 uniformly and tangentially over the entire circumference. Due to the tangential inlet 35 and the shaping of the twist chamber, the thread balloon is forced at 36 against the wall of the twist chamber, so that thereby the desired rotational effect on the threads withdrawn at 17 is still further improved. This envelope of air circulating helically in the spinning tube 1, 1b also promotes the constant wrapping of the fibres at a around the rotating length of fibres 17c.

For the formation of a uniform thread, it is important that the fibres drawn in at 5 through the tube 3 should enter the spinning tube 1b at the lowest possible speed, and also that only a comparatively low axial flow obtains in this tube. This only slight flow is also desired in order to restrict the thread formation to a comparatively short range at the end of the thread, as illustrated in Fig. 7. For this purpose, the spinning tube 1b comprises a relatively large number of air suction openings 27 directly at and behind the fibre inlet. Moreover, an annular gap can be provided at 37 between the nozzle 29 and the spinning tube 1, so that air can also be drawn as indicated from the spinning tube into the tubular shell 28.

If necessary, the width of this annular gap or slot can be varied by displacement of the spinning tube 1 in the direction of the arrow E.

In order to reduce the speed in the fibre supply tube 3, this is surrounded by a jacket 38 from which the air is drawn through the tube 39. The tube 3 is formed with holes 40 at several points over a relatively large range of its length, through which holes the air can be withdrawn by suction. If necessary, this suction effect can also be supported by suction nozzles, as indicated in the drawing.

Due to the aforementioned steps by means of which the axial velocity in the spinning tube 1b is substantially reduced, there is consequently also obtained a smaller loss of fibre. In order effectively to reduce this still further, it is also possible for an intercepting device to be provided in the range of the thread end 17b in the spinning tube 1b, as indicated in Figs. 9 and 10, the said device holding back the fibres extracted by suction during the spinning operation. As indicated in Fig. 9, the fibres can be retained by means of an electrostatic device indicated at 42, or even also by means of a screen 43, which is rotatably mounted at 44 about a shaft 45 and can be automatically swung out of the spinning tube 1 in order to avoid clogging of fibres during the idle travel (i.e. when no thread is spun).

As shown in Figs. 9 and 10, the thread end 17b oscillates in the range of the intercepting devices 42 and 43, so that the fibres retained here are taken up by the thread end and wrap around the latter.

By this means, any loss of fibres is practically avoided. By way of amplification, it is to be pointed out that especially with the pneumatic spinning device shown in Fig. 7, the thread is spun in the spinning tube 1b with a gentle initial twist at a low axial air velocity, and that thereafter the thread is given a very strong twist in the tube 1 and the twist chamber 33 and the final twisting therefore takes place in the latter chamber.

I claim:

1. A pneumatic spinning device comprising, in combination, an elongated spinning tube formed with a bore of a given diameter; nozzle means connected to one end of said spinning tube, said nozzle means being formed

in the interior thereof with a chamber communicating with said bore and having a diameter substantially greater than said given diameter of said bore, said nozzle being further formed with an outlet opening of a diameter considerably smaller than said given diameter, said outlet opening communicating with said chamber and being coaxial with said bore, and an air inlet passage leading in tangential direction into said chamber; air suction means communicating with the other end of said spinning tube; fibre feeding means communicating with said spinning tube intermediate the ends thereof for feeding loose fibres into said tube; and yarn withdrawal means located adjacent said outlet opening for withdrawing a yarn therefrom, whereby when loose fibres are fed through said fibre feeding means into said spinning tube a strand of fibres is formed by the action of said air suction means in the interior of the tube, which strand is twisted within the tube to a yarn by the eddy current produced by the tangential entrance of air through the air inlet passage in the nozzle.

2. Spinning device according to claim 1, in which at least two superimposed twist chambers are provided.

3. Spinning device according to claim 1, in which said fibre feeding means includes a supply tube for the fibres which opens tangentially into the spinning tube.

4. Spinning device according to claim 1, in which said fibre feeding means includes a supply tube for the fibres which opens into the spinning tube at an acute angle in relation to the axis of the latter.

5. A pneumatic spinning device comprising, in combination, an elongated spinning tube formed with a bore of a given diameter; nozzle means connected to one end of said spinning tube, said nozzle means being formed in the interior thereof with a chamber communicating with said bore, said chamber being co-axial with said bore and having a diameter substantially greater than said given diameter of said bore, said nozzle being further formed with an outlet opening of a diameter considerably smaller than said given diameter; said outlet opening communicating with said chamber and being co-axial with said bore, and an air inlet passage leading in tangential direction into said chamber; air suction means communicating with the other end of said spinning tube; fibre feeding means communicating with said spinning tube intermediate the ends thereof for feeding loose fibres into said tube; and yarn withdrawal means located adjacent said outlet opening for withdrawing a yarn therefrom, whereby when loose fibres are fed through said fibre feeding means into said spinning tube a strand of fibres is formed by the action of said air suction means in the interior of the tube, which strand is twisted within the tube to a yarn by the eddy currents produced by the tangential entrance of air through the air inlet passage in the nozzle.

6. A pneumatic spinning device comprising, in combination, an elongated spinning tube formed with a bore of a given diameter; nozzle means connected to one end of said spinning tube, said nozzle means being formed in the interior thereof with a chamber communicating with said bore, said chamber being co-axial with said bore and having a diameter at least twice as large as said given diameter of said bore and having a height smaller than its diameter, said nozzle being further formed with an outlet opening of a diameter considerably smaller than said given diameter, said outlet opening communicating with said chamber and being co-axial with said bore, and an air inlet passage leading in tangential direction into said chamber; air suction means communicating with the other end of said spinning tube; fibre feeding means communicating with said spinning tube intermediate the ends thereof for feeding loose fibres into said tube; and yarn withdrawal means located adjacent said outlet opening for withdrawing a yarn therefrom, whereby when loose fibres are fed through said fibre feeding means into said spinning tube a strand of fibres

is formed by the action of said air suction means in the interior of the tube, which strand is twisted within the tube to a yarn by the eddy currents produced by the tangential entrance of air through the air inlet passage in the nozzle.

7. A pneumatic spinning device comprising, in combination, an elongated spinning tube formed with a bore of a given diameter; nozzle means connected to one end of said spinning tube, said nozzle means being formed in the interior thereof with a chamber communicating with said bore, said chamber being co-axial with said bore and having a diameter substantially greater than said given diameter of said bore, said nozzle being further formed with an outlet opening of a diameter considerably smaller than said given diameter, said outlet opening communicating with said chamber and being co-axial with said bore, and an air inlet passage leading in tangential direction into said chamber, said inlet passage having a cross-section substantially smaller than the cross-section of said bore; air suction means communicating with the other end of said spinning tube; fibre feeding means communicating with said spinning tube intermediate the ends thereof for feeding loose fibres into said tube; and yarn withdrawal means located adjacent said outlet opening for withdrawing a yarn therefrom, whereby when loose fibres are fed through said fibre feeding means into said spinning tube a strand of fibres is formed by the action of said air suction means in the interior of the tube, which strand is twisted within the tube to a yarn by the eddy currents produced by the tangential entrance of air through the air inlet passage in the nozzle.

8. A pneumatic spinning device comprising, in combination, an elongated spinning tube formed with a bore of a given diameter; nozzle means connected to one end of said spinning tube, said nozzle means being formed in the interior thereof with a chamber communicating with said bore, said chamber being co-axial with said bore and having a diameter substantially greater than said given diameter of said bore, said nozzle being further formed with an outlet opening of a diameter considerably smaller than said given diameter, said outlet opening communicating with said chamber and being co-axial with said bore, and an air inlet passage leading in tangential direction into said chamber; air suction means communicating with the other end of said spinning tube; fibre feeding means communicating with said spinning tube intermediate the ends thereof for feeding loose fibres into said tube, said bore of said tube being enlarged to a larger diameter between the point of communication of said fibre feeding means with said tube and the other end of said tube; and yarn withdrawal means located adjacent said outlet opening for withdrawing a yarn therefrom, whereby when loose fibres are fed through said fibre feeding means into said spinning tube a strand of fibres is formed by the action of said air suction means in the interior of the tube, which strand is twisted within the tube to a yarn by the eddy currents produced by the tangential entrance of air through the air inlet passage in the nozzle.

9. A pneumatic spinning device comprising, in combination, an elongated spinning tube formed with a bore of a given diameter; nozzle means connected to one end of said spinning tube, said nozzle means being formed in the interior thereof with a chamber communicating with said bore and having a diameter substantially greater than said given diameter of said bore, said nozzle being further formed with an outlet opening of a diameter considerably smaller than said given diameter, said outlet opening communicating with said chamber and being co-axial with said bore, and an air inlet passage leading in tangential direction into said chamber; compressed air feeding means communicating with said air inlet passage for feeding compressed air through said air inlet passage into said chamber; air suction means communicating with the other end of said spinning tube; fibre feeding means

communicating with said spinning tube intermediate the ends thereof for feeding loose fibres into said tube; and yarn withdrawal means located adjacent said outlet opening for withdrawing a yarn therefrom, whereby when loose fibres are fed through said fibre feeding means into said spinning tube a strand of fibres is formed by the action of said air suction means in the interior of the tube, which strand is twisted within the tube to a yarn by the eddy currents produced by the tangential entrance of air through the air inlet passage in the nozzle.

10. A pneumatic spinning device comprising, in combination, an elongated spinning tube formed with a bore of a given diameter; nozzle means connected to one end of said spinning tube, said nozzle means being formed in the interior thereof with a chamber communicating with said bore and having a diameter substantially greater than said given diameter of said bore, said nozzle being further formed with an outlet opening of a diameter considerably smaller than said given diameter, said outlet opening communicating with said chamber and being co-axial with said bore, and an air inlet passage leading in tangential direction into said chamber; air suction means communicating with the other end of said spinning tube; fibre feeding means including a fibre feed tube communicating with said spinning tube intermediate the ends thereof for feeding loose fibres into said tube, said fibre feed tube being formed with at least one aperture there-through so that some of the air drawn by the air suction means through said spinning tube will be drawn in through said aperture in said fibre feed tube; and yarn withdrawal means located adjacent said outlet opening for withdrawing a yarn therefrom, whereby when loose fibres are fed through said fibre feeding means into said spinning tube a strand of fibres is formed by the action of said air suction means in the interior of the tube, which strand is twisted within the tube to a yarn by the eddy currents produced by the tangential entrance of air through the air inlet passage in the nozzle.

11. A pneumatic spinning device comprising, in combination, an elongated spinning tube formed with a bore of a given diameter; nozzle means connected to one end of said spinning tube, said nozzle means being formed in the interior thereof with a chamber communicating with said bore and having a diameter substantially greater than said given diameter of said bore, said nozzle being further formed with an outlet opening of a diameter considerably smaller than said given diameter, said outlet opening communicating with said chamber and being co-axial with said bore, and an air inlet passage leading in tangential direction into said chamber; compressed air feeding means communicating with said air inlet passage for feeding compressed air through said air inlet passage into said chamber; air suction means communicating with the other end of said spinning tube; fibre feeding means communicating with said spinning tube intermediate the ends thereof for feeding loose fibres into said tube; a tubular shell surrounding said elongated spinning tube and being arranged co-axially therewith and spaced therefrom, said tubular shell being closed at one end thereof adjacent said one end of said spinning tube and communicating at the other end thereof with said air suction means, and said spinning tube being formed adjacent the entrance of said fibre feeding means into said spinning tube and in the region between said entrance and said other end of said spinning tube with a plurality of openings providing communication between the interior of said spinning tube and the space between said spinning tube and said tubular shell; and yarn withdrawal means located adjacent said outlet opening for withdrawing a yarn therefrom, whereby when loose fibres are fed through said fibre feeding means into said spinning tube a strand of fibres is formed by the action of said air suction means in the interior of the tube, which

strand is twisted within the tube to a yarn by the eddy currents produced by the tangential entrance of air through the air inlet passage in the nozzle.

12. A pneumatic spinning device comprising, in combination, an elongated spinning tube formed with a bore of a given diameter; nozzle means connected to one end of said spinning tube, said nozzle means being formed in the interior thereof with a chamber communicating with said bore and having a diameter substantially greater than said given diameter of said bore, said nozzle being further formed with an outlet opening of a diameter considerably smaller than said given diameter, said outlet opening communicating with said chamber and being co-axial with said bore, and an air inlet passage leading in tangential direction into said chamber; compressed air feeding means communicating with said air inlet passage for feeding compressed air through said air inlet passage into said chamber; air suction means communicating with the other end of said spinning tube; fibre feeding means communicating with said spinning tube intermediate the ends thereof for feeding loose fibres into said tube; a tubular shell surrounding said elongated spinning tube and being arranged co-axially therewith and spaced therefrom, said tubular shell being closed at one end thereof adjacent said one end of said spinning tube and communicating at the other end thereof with said air suction means, said spinning tube being formed between said entrance of said fibre feeding means into said spinning tube and said nozzle with an annular gap providing communication between the interior of said spinning tube and the space between said spinning tube and said tubular shell; and yarn withdrawal means located adjacent said outlet opening for withdrawing a yarn therefrom, whereby when loose fibres are fed through said fibre feeding means into said spinning tube a strand of fibres is formed by the action of said air suction means in the interior of the tube, which strand is twisted within the tube to a yarn by the eddy currents produced by the tangential entrance of air through the air inlet passage in the nozzle.

13. A pneumatic spinning device comprising, in combination, an elongated spinning tube formed with a bore of a given diameter; nozzle means connected to one end of said spinning tube, said nozzle means being formed in the interior thereof with a chamber communicating with said bore and having a diameter substantially greater than said given diameter of said bore, said nozzle being further formed with an outlet opening of a diameter considerably smaller than said given diameter, said outlet opening communicating with said chamber and being co-axial with said bore, and an air inlet passage leading in tangential direction into said chamber; air suction means communicating with the other end of said spinning tube; fibre feeding means communicating with said spinning tube intermediate the ends thereof for feeding loose fibres into said tube; intercepting means located in said elongated spinning tube between said other end thereof and said fibre feeding means for preventing passage of fibres beyond said intercepting means into said air suction means; and yarn withdrawal means located adjacent said outlet opening for withdrawing a yarn therefrom, whereby when loose fibres are fed through said fibre feeding means into said spinning tube a strand of fibres is formed by the action of said air suction means in the interior of the tube, which strand is twisted within the tube to a yarn by the eddy currents produced by the tangential entrance of air through the air inlet passage in the nozzle.

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