United States Patent

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[32] Priority **Dec. 18, 1967**
[33] **Great Britain**
[31] **57368/67**

[54] **TEXTILE YARN HANDLING DEVICES**
7 Claims, 6 Drawing Figs.

[52] **U.S. Cl.** **226/97,** 28/1
[51] **Int. Cl.** **B65h 51/16**
[50] **Field of Search** ..... 226/97; 28/1.4; 302/(Inquired)

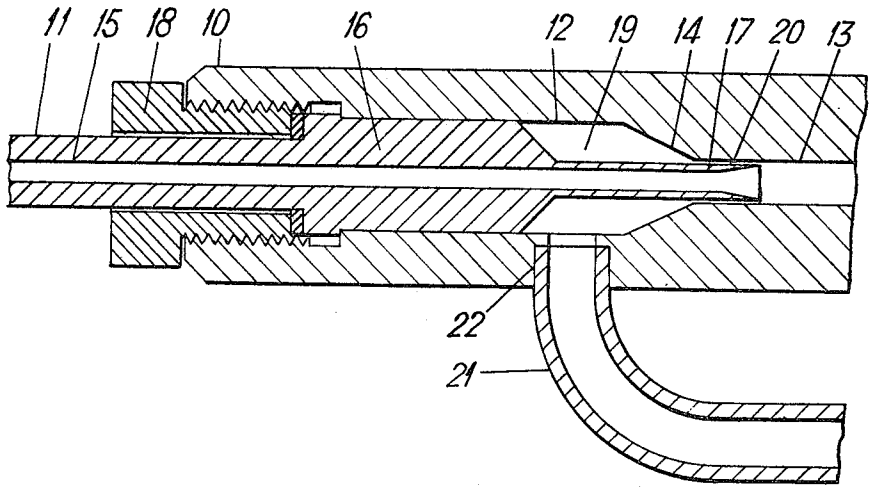
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ABSTRACT: A yarn handling device comprising in combination a driving air inlet tube having a first portion surrounding an entrained air and yarn inlet tube and an air and yarn outlet portion arranged to receive both driving and entrained air, said outlet portion having a cross-sectional area of similar dimensions to that of said driving air inlet tube where they abut, and said driving air inlet tube being so arranged that the driving air is accelerated along it, thereby entraining air along the said entrained air and yarn inlet tube, wherein said driving air enters said outlet portion in a direction substantially parallel to the general direction of flow of entrained air.

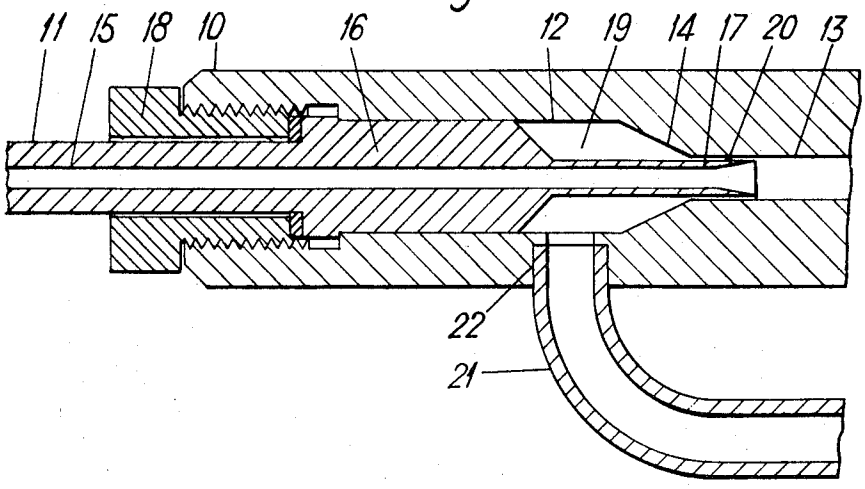


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SHEET 1 OF 2

Fig.1



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Fig. 2

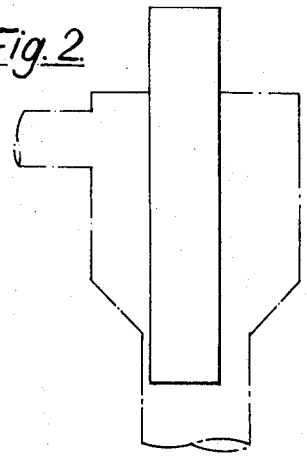


Fig. 3

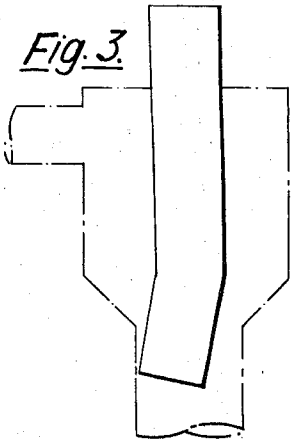


Fig. 4

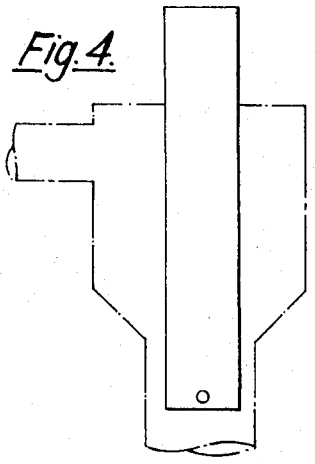


Fig. 5

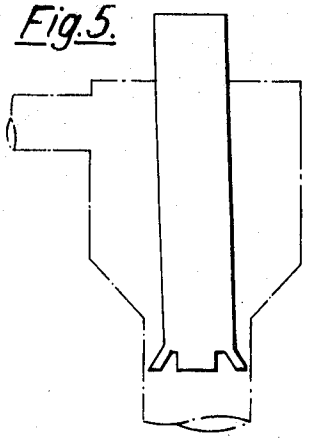
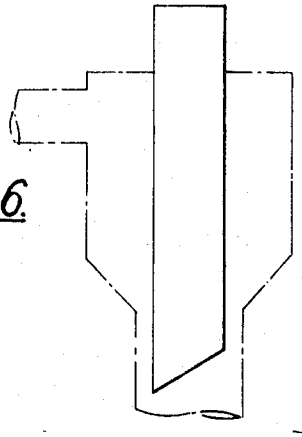


Fig. 6



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TEXTILE YARN HANDLING DEVICES

This invention relates to improvements in pneumatic devices for handling textile yarn and in particular to devices for picking up a running length of yarn, maintaining it under tension and forwarding it to a collector.

By yarns in this specification we mean strands of natural or synthetic filamentary material, which strands may consists of single continuous filaments or assemblies of continuous filaments or staple fibers.

Yarn handling devices are known in which an air jet is employed to induce a flow of fluid through a tube, the entrained fluid carrying the yarn through the tube with it and to a collector. U.S. Pat. No. 2,667,964 to Miller describes such a conventional yarn-handling device and in general such devices consists of a driving air inlet tube surrounding an entrained air and yarn inlet tube an air and yarn outlet tube contiguous with the driving air inlet tube receiving both the driving and the entrained air. The driving air is accelerated to a very high velocity in the driving air inlet tube creating a low-pressure zone at the inner end of the entrained air and yarn inlet tube which low-pressure area causes air and yarn to be entrained through the entrained air and yarn inlet tube. Once the yarn has been entrained it is necessary to maintain it under tension and keep it moving through the outlet tube and to a collector and the outlet tube generally contains a divergent section for this purpose.

The known yarn-handling devices have all used a converging nozzle type of arrangement to accelerate the driving air, the arrangement being such that the driving and entrained air flows meet an an angle. With this type of device the position of the entrained air and yarn inlet tube in relation to the driving air inlet and the outlet tubes affects the performance of the device and it has been found that the position to obtain adequate tension at high yarn speeds does not give good entrainment and vice versa. Thus two settings of the tubes have been employed in this type of device, one setting to obtain adequate entrainment of the yarn and the second setting to maintain adequate tension on the yarn once it has been entrained.

The known yarn-handling devices also suffer from the disadvantage that, in order to obtain adequate tension at high yarn speeds, the driving air consumption must be high, making such yarn-handling devices inefficient to run.

We have now discovered a yarn-handling device which will exhibit both satisfactory entrainment and tension characteristics particularly at high yarn speeds without having to alter the position of the component tubes and which has a greater efficiency than prior art devices and accordingly the invention comprises in one of its aspects a yarn-handling device comprising a driving air inlet tube surrounding an entrained air and yarn inlet tube and, contiguous with said driving air inlet tube, an air and yarn outlet tube arranged to receive both the driving and the entrained air, said outlet tube having cross-sectional area of similar dimensions to that of the driving air inlet tube where they abut and said driving air inlet tube being arranged so that the driving air is accelerated along it, entrains air along the entrained air and yarn inlet tube and enters the outlet tube in a direction substantially parallel to the general direction of flow of the entrained air.

By arranging that the driving air enters the outlet tube in a direction substantially parallel to the general direction of flow of the entrained air both good tension and entrainment are achieved at one tube setting.

The tubes may be of any designed cross-sectional shape but are generally circular or rectangular and the air and yarn outlet tube may be of constant cross-sectional area or may contain a diverging section. The diverging section, if present, should commence where the entrained air and yarn emerge from the inlet tube and the section should preferably have an included angle not greater than 10°.

The inner end of the entrained air and yarn inlet tube may be arranged symmetrically with respect to the driving air inlet tube and the yarn and air outlet tube but we have found that the performance of the devices may be improved by offsetting the air and yarn inlet tube with respect to the other tubes or by bending its inner end. This inner end may be plain but we have found that the performance of the devices can also be improved by providing holes passing through the walls of the tube near its inner end or by providing a castellated or a chamfered end.

Although the above design characteristic is the major feature necessary to obtain good tension and entrainment characteristics with the devices of this invention, attention should be paid to other details in the design in order to obtain devices having high efficiencies. Thus the driving air inlet tube should be so shaped as to give smooth acceleration of the driving air and the length of the yarn and air outlet tube should be chosen to give a large area of contact between air and yarn but not so long that the pressure drop along it adversely affects the tension. The cross-sectional areas of the bores of the entrained air and yarn inlet tube and the driving air inlet and outlet tube should be carefully chosen with regard to the air pressure to be applied to the device and the characteristics of the yarns to be entrained.

The invention will now be described in more detail with reference to the accompanying drawings and following examples which are not intended to limit the scope of the invention in any way and of which drawings,

FIG. 1 shows a sectional view of a pneumatic yarn-handling device according to the present invention,

FIG. 2 shows a representation of a pneumatic yarn-handling device according to the present invention having an offset entrained air and yarn inlet tube,

FIG. 3 shows a representation of a pneumatic yarn-handling device according to the present invention having a bent entrained air and yarn inlet tube,

FIG. 4 shows a representation of a pneumatic yarn-handling device according to the present invention having an entrained air and yarn inlet tube with holes drilled in its walls near its inner end,

FIG. 5 shows a representation of a pneumatic yarn-handling device according to the present invention having an entrained air and yarn inlet tube with a castellated inner end, and

FIG. 6 shows a representation of a pneumatic yarn-handling device according to the present invention having an entrained air and yarn inlet tube having a chamfered inner end.

FIG. 1 shows a device consisting essentially of a combined driving air inlet and air and yarn outlet tube **10** and an entrained air and yarn inlet tube **11**. The bore of tube **10** has a section **12** of relatively large diameter and a section **13** of smaller diameter connected by a converging section **14** and the tube **11** has a constant diameter bore **15**, a section of relatively large external diameter **16** and a section of smaller external diameter **17**. Tube **11** is held inside tube **10** by screw seal **18** so as to provide an air chamber **19** between part of section **17** of tube **11** and part of section **12** and section **14** of the tube **10** and an annular passageway **20** between the remainder of section **17** of tube **11** and part of section **13** of tube **10**. Driving air supply tube **21** fits into a bore **22** in the wall of section **12** of tube **10** and supplies chamber **19** with air under pressure.

In practice, pressurized air enters the device through air supply tube **21** and passes into air chamber **19**. This driving air is accelerated in the converging section **14** of tube **10**, and in the annular passageway **20** and into section **13** of tube **10**. The high-speed driving air emerging from the annular passageway **20** causes air to be entrained through the entrained air and yarn inlet tube **11** and with it any yarn which is in the vicinity of the outer end of tube **11**. The entrained air and yarn passes into section **13** of tube **10** and is transported through a waste pipe to a yarn reservoir (not shown).

FIGS. 2 to 6 show variations in the construction or position of the entrained air and yarn inlet tube which provide the devices of the present invention with even better tension and/or entrainment characteristics and such variations are also useful in improving the performance of other pneumatic yarn handling devices.

The following Examples illustrate the scope of the invention but are not to be taken as limitative thereof.

EXAMPLE 1

The performance of the yarn-handling device as shown in FIG. 1 was first compared with a device of the converging nozzle adjustable type having similar driving air consumption rates. The tensions exerted on 60/20 poly (hexamethylene adipamide) yarn having a finish and running at 10,000 ft./min. by the device shown in FIG. 1 were measured at a series of driving air static pressures and the entrained and driving air consumption rates were also measured. The tube position of the prior art device was adjusted at each air pressure to give a comparable entrained air consumption and the tensions exerted on 60/20 yarn running at 10,000 ft./min. and driving air consumption were measured. The results are given in table I.

TABLE I

Device shown in Fig. 1		Driving air static pressure, p.s.i.	Entrained air consumption, s.c.f.m.	Prior art device	
Tension, grams	Driving air consumption, s.c.f.m.			Tension, grams	Driving air consumption, s.c.f.m.
12.25	15.4	90	1.2	7.5	6.8
10.5	15.0	80	1.3	6.25	5.8
9.5	13.8	70	1.4	5.5	5.5
8.0	12.4	60	1.6	Unobtainable entrained air rate	

The tube position of the prior art device was then adjusted at each static air pressure so that it exerted, on 60/20 yarn running at 10,000 ft./min., comparable tensions to those exerted by the device shown in FIG. 1 and the entrained air consumption and driving air consumption were measured. The results are give in table II.

TABLE II

Device shown in Fig. 1				Prior art device	
Entrained air consumption, s.c.f.m.	Driving air consumption, s.c.f.m.	Driving air static pressure, p.s.i.	Tension, grams	Entrained air consumption, s.c.f.m.	Driving air consumption, s.c.f.m.
1.2	15.4	90	12.25	Unobtainable tension	
1.3	15.0	80	10.5	Unobtainable tension	
1.4	13.8	70	9.5	0.32	9.2
1.6	12.4	60	8.0	0.38	8.5

The entrained air consumption can be taken as an indication of entrainment efficiency and the results of example 1 show the superiority of the devices according to the present invention shown in FIG. 1 over the prior art device in terms of both tension developed at comparable entrainment rates and entrainment when comparable tensions are exerted and also serve to illustrate the "all round" utility of the devices according to the present invention when used in one fixed position.

The devices according to the present invention may also be favorably compared with prior art devices with regards to the driving air consumption. Thus the device described in U.S. Pat. No. 3,094,262 exerts, on 70/34 yarn, with finish, running at 9,000 ft./min., tensions of 16.5 g. 27 g. and 32.5 g. at air consumptions of 30, 40 and 45 s.c.f.m. Extrapolating these results it could be deduced that the tension exerted with an air consumption of say 13.5 s.c.f.m. would be very low indeed and at best could not be more than about 7.5 g. At low air consumptions therefore it appears that the devices according to the present invention apart from having no necessity for adjustment of position to get good entrainment will exhibit better tension characteristics than this prior art device.

EXAMPLE 2

The performances of yarn handling devices similar to that shown in FIG. 1 but having entrained air and yarn inlet tubes as shown in FIGS. 4 and 6 were evaluated by measuring the tensions exerted by the devices operating at 90 p.s.i. static pressure on 60/20 poly (hexamethylene adipamide) yarn having a finish and running at 10,000 ft./min. and measuring also the entrained air and driving air consumption rates, the device shown in FIG. 4 having 3 holes symmetrically spaced around the inner end. The results are given in table 3 together with the results obtained for the device shown in FIG. 1 and clearly show the improved performance obtained with the devices shown in FIGS. 4 and 6, the device of FIG. 4 giving greatly improved entrainment with slightly reduced tension and the device of FIG. 6 giving improved tension and entrainment, as compared with the device of FIG. 1.

TABLE III

Device shown in Figure—	Tension, grams	Entrained air consumption, s.c.f.m.	Driving air consumption, s.c.f.m.
1	12.25	1.2	15.4
4	9.0	9.5	19.25
6	14.5	4.2	26.0

We claim:

1. A yarn-handling device comprising a yarn inlet tube having an outlet end portion of constant external cross section for conveying yarn and entrained air; wall means defining a driving air chamber surrounding said yarn inlet tube, said chamber having a first portion of relatively large cross-sectional area and a second coaxial portion of decreasing cross-sectional area; means defining an outlet passageway of constant cross section extending coaxially from said second chamber portion, said yarn inlet tube projecting into said passageway a short distance and terminating therein so as to define a generally annular constant cross section passageway through which driving air from said chamber flows into said outlet passageway in a direction substantially parallel to the general direction of flow of entrained air.

2. A yarn-handling device as claimed in claim 1 wherein said yarn inlet tube is assymetrically arranged within said outlet passageway.

3. A yarn handling device as claimed in claim 1 wherein the said yarn inlet tube is bent at its terminal end.

4. A yarn-handling device as claimed in claim 1 wherein the said yarn inlet tube is provided with holes in its walls at its terminal end.

5. A yarn-handling device as claimed in claim 4 in which three holes are provided in the wools of said yarn inlet tube at its terminal end.

6. A yarn-handling device as claimed in claim 1 in which said entrained air and yarn inlet tube is provided with a castellated inner end.

7. A yarn-handling device as claimed in claim 1 in which said entrained yarn and yarn inlet tube is provided with a chamfered inner end.