

[54] **AIR-SUPPORTED THREAD OVERRUN ROLLER**  
 [75] Inventors: **Karl Bauer; Manfred Mayer; Peter Illg**, all of Remscheid; **Bernd Schimmel**, Remscheid-Luttringhausen, all of Germany

[73] Assignee: **Barmag Barmer Mashinenfabrik Aktiengesellschaft**, Wuppertal, Germany

[22] Filed: **July 6, 1972**

[21] Appl. No.: **269,457**

[30] **Foreign Application Priority Data**

Aug. 9, 1971 Germany.....P 21 34 247.2

[52] U.S. Cl..... **226/194, 308/DIG. 1**

[51] Int. Cl..... **B65h 17/20**

[58] Field of Search..... 226/97, 95, 194; 308/DIG. 1; 242/157 R

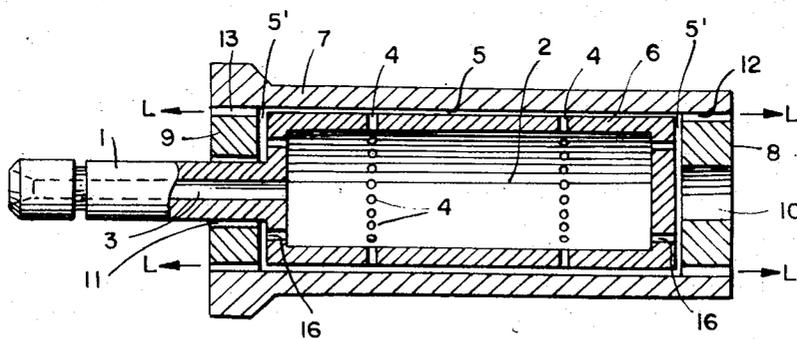
[56] **References Cited**  
 UNITED STATES PATENTS  
 3,063,041 11/1962 Quade et al. .... 308/DIG. 1

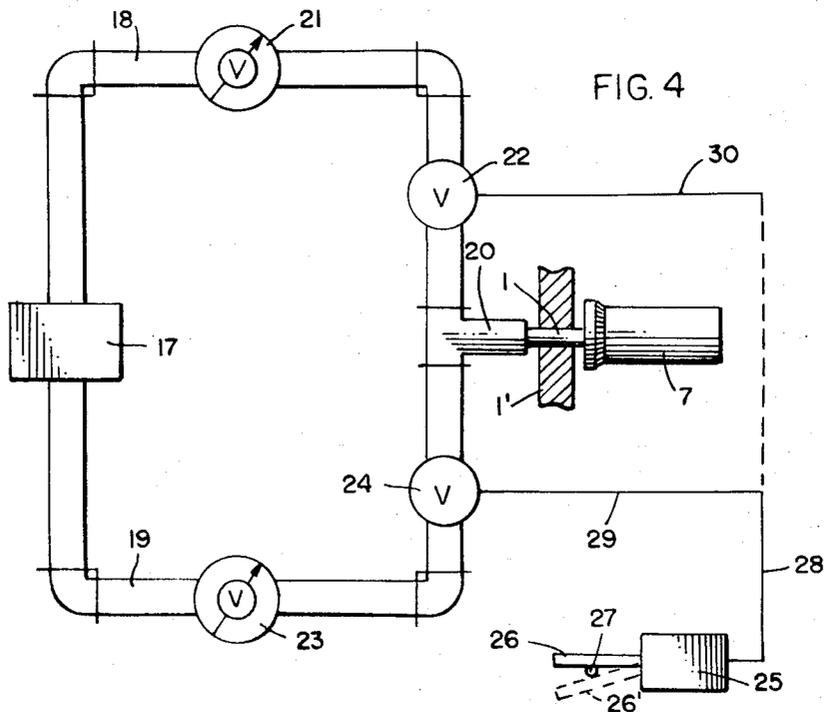
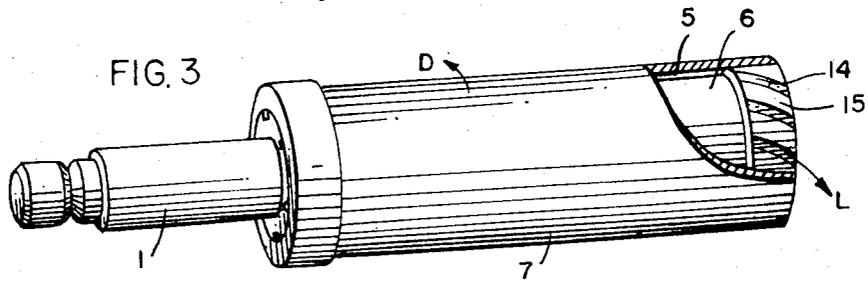
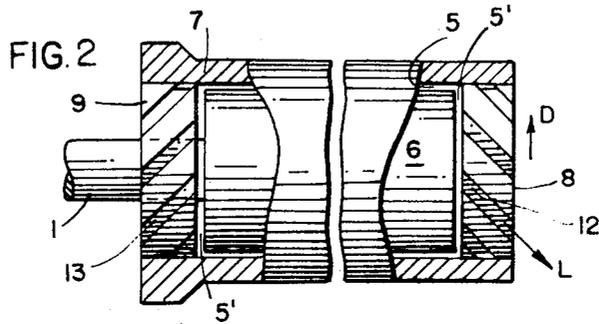
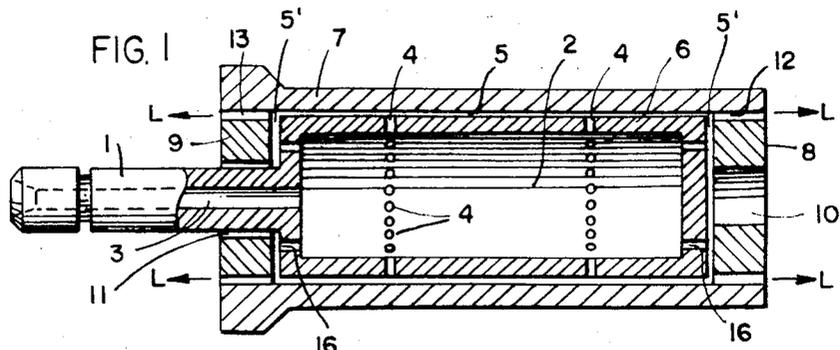
*Primary Examiner*—Allen N. Knowles  
*Attorney*—John H. Shurtleff

[57] **ABSTRACT**

In textile apparatus, an air-supported thread overrun roller of tubular shell construction rotatably carried on a hollow shaft segment of enlarged diameter having radial openings to direct compressed air into a small annular bearing gap, thereby providing an air-cushioned bearing for the shell, an annular face plate partly enclosing each end of the tubular shell and containing a plurality of air outlet channels extending approximately parallel to the shell and obliquely to the shell axis of rotation. The thread overrun roller is especially useful in the high speed transport of threads, yarns or the like in stretching, twisting and other textile processing operations.

**6 Claims, 4 Drawing Figures**





**AIR-SUPPORTED THREAD OVERRUN ROLLER**

The invention relates generally to an air-supported or air-cushioned thread overrun roller, in which a tubular roller shell is turnably carried on an axle which has an axial air feed channel and, in the bearing zone of the roller shell, also has radial openings through which the compressed air passes into the bearing gap between the axle and the inner wall of the roller shell.

By thread overrun rollers one generally means those rollers on a textile machine or apparatus which are driven by the running thread itself. There are known air-supported thread overrun rollers which are suited especially for use in thread treatment devices for synthetic threads, for example, for heated stretching or drawing, heat fixing and the like. In a known air-supported overrun roller, compressed air is supplied through a fixed pivot pin or axle and then passes through the porous structure of a sintered metal sleeve surrounding the axle into the bearing gap. However, where one uses very high turning rates of the driven roller (for example on the order of 30,000 rpm or more) as brought about by correspondingly high thread speeds, such revolving rollers are no longer capable of meeting the requirements of textile machines operating at such high thread running speeds. For example, thread breakage occurs frequently, especially in the initial application of the thread in starting the roller when the undriven thread overrun roller must be accelerated by the running thread. Furthermore, there exists the difficulty of achieving proper axial seating of the roller. Where this is not assured, there is the danger that the overrun roller may shift axially and thereby come into sliding contact with other bearing members to exert an undesirable braking effect. For this reason, typical air-suspension or air-cushioning bearings are unsuited for an overrun roller as is known, for example, according to German Pat. No. 842,877 for an air-supported belt pulley wherein compressed air is supplied to the bearing zone through an axial bore in a fixed shaft and the waste air is then drawn off through a second axial bore in the same shaft. In this bearing system, an axial stabilization of the air-suspended or air-cushioned roller is not assured.

One object of the present invention is to provide an air-supported overrun roller for use in textile apparatus in such a way that the thread or yarn is relieved of undesirable tension, especially during the initial application of the thread, by providing means for accelerating the overrun roller in the starting phase. Moreover, it is also an object of the invention to achieve a stabilization of the axial position of the rotating roller member driven by the running thread. Yet another object of the invention is to provide means to control and/or vary the air pressure supplied to the overrun roller in order to obtain a more efficient and effective operation. Other objects and advantages of the invention will become more apparent upon consideration of the following detailed specification.

It has now been found, in accordance with the invention, that such objects can be achieved in textile apparatus by means of an air-supported thread overrun roller which comprises a hollow tubular roller shell adapted to be rotatably driven by a transported thread, axle means to carry said roller shell including a shaft segment having an inlet conduit for compressed air extending axially into said roller shell and a hollow cylindrical

segment of enlarged diameter connected to said shaft segment so as to extend axially between the two ends of said roller shell and to provide a compressed air chamber fitting concentrically within said roller shell with a small annular bearing gap therebetween, the cylindrical wall of said enlarged segment having radial openings to release compressed air into said bearing gap, and an annular face plate on said roller shell at either end thereof with the inner diameter of the face plate being smaller than the outer diameter of said enlarged axle segment, each face plate having a plurality of air outlet channels approximately parallel to the roller shell and extending obliquely to the axis of rotation of the shell, said channels being arranged at regular intervals on a circle concentric to the axis of rotation of the shell.

This particular structure of the thread overrun roller and its air-cushioned bearing means has the consequence that the air emerging laterally from the circumferential or narrow annular bearing gap thereupon flows obliquely to the axis of rotation through the air-outlet channels or openings of the face plates. In this escape of the compressed air, it undergoes such a deflection that an active force component arises preferably in tangential direction at the roller circumference, thereby yielding a positive drive moment for the roller completely apart from the drive imparted by the running thread. The compressed air advantageously exerts two functions simultaneously. In addition to its basic function of assuring a very nearly frictionless suspension or air-cushioning of the roller shell, especially in the initial starting of the machine, the compressed air also has the function of providing a major or even substantial portion of the total drive force for rotating the roller shell. Accordingly, the constituent of the total acceleration moment to be contributed by the running thread is now only very slight so that the danger of thread breakage is virtually completely eliminated, even for threads having a fine denier or yarn size. The time required for initially applying or starting the overrun of the thread, moreover, is thereby considerably shortened.

A preferred feature of the invention resides in providing a structure wherein the diameter of the circle on which the oblique air-outlet channels lie or upon which these channels are centered cross-sectionally is equal to or very nearly equal to the mean diameter of the bearing gap between the axle and the inner wall of the roller shell. Furthermore, it is advantageous for the axle enlargement in the bearing zone of the roller shell to exhibit axially directed openings through its end walls, the compressed air passing through these openings into a gap space between the inner side of the face plates of the roller shell and the outwardly facing surfaces of the end walls of the enlarged segment of the axle.

Because the path of the compressed air to the oblique outlet channels is the shortest possible in emerging from the bearing gap, a relatively large proportion of the energy resulting from the released air is utilized for the drive of the roller. Furthermore, this preferred construction prevents any suction formation between the face plates of the roller shell and the enlarged axle, and an air stream is generated radially in the small circular end gap spaces so as to ensure a full stabilization of the axial position of the roller shell.

To increase the efficiency of the device, an especially advantageous and preferred embodiment is one in

which the air outlet channels in each annular face plate follow a curved path, such that these channels and their intervening bridges, lands or fillets are curved in scoop form in the manner of the blades of an axial turbine.

In the drawings the invention is partly schematically represented by two different embodiments of the roller device constructed according to the invention.

FIG. 1 is a longitudinal section through the axis of rotation of the thread overrun roller;

FIG. 2 is a partial plan view taken from FIG. 1 to show partially sectioned end zones of the thread overrun roller;

FIG. 3 is a perspective view of another embodiment of a thread overrun roller with part of one end broken open; and

FIG. 4 is a schematic representation of means for supplying and controlling the pressure of the air introduced into the pressure chamber of the thread overrun roller.

The fixed axle or shaft mounted in the frame 1' of a textile machine or thread treating apparatus according to FIGS. 1 and 4, is enlarged in diameter along one segment located in the bearing zone inside the roller as compared with respect to its adjoining segment or segments protruding axially from the roller, so that a pressure chamber 2 is provided into which there issues the compressed air feed conduit 3. From the pressure chamber 2, the radial bores 4 lead into a small annular bearing gap 5 formed between the enlarged segment 6 of the fixed axle 1 and the inner wall of the rotatably positioned tubular roller shell 7. In addition to the radial bores 4 there is also provided a number of axial bores 16 which also lead compressed air out of the pressure chamber 2 at either enclosed end.

Face plates 8 and 9 are permanently joined at each end to the roller shell 7 and have axial central bores 10 and 11 to accommodate the protruding segment of a fixed axle 1 at one or both ends. The air outlet channels 12 and 13 in these face plates run parallel to the outer circumferential surface of the roller shell 7 and according to FIG. 1 are schematically shown as being parallel to the axis of rotation but in fact, according to the plan view of FIG. 2, these outlet channels extend obliquely to the axis of rotation.

According to the embodiment of FIG. 3, the lands, bridges or fillets 15 left between the air outlet channels 14 are constructed along curved lines in scoop or vane-like form in the fashion of the blades of an axial turbine. Through this construction, the force component of the compressed air acting in axial direction to the circumference of the roller is increased.

The manner in which rollers can be carried by means of a radial air suspension is generally known. In the air-supported thread overrun roller according to the invention, the compressed air is conducted through the feed conduit 3 of fixed axle 1 into the pressure chamber 2. Another non-illustrated embodiment of the invention can include fixed axles that protrude from each end of the roller and are secured on both sides to the machine frame. The compressed air supplied to the pressure chamber 2 can emerge both through the radially directed bores 4 and also through the axially directed bores 16. The air emerging through the bores 4 forms an air layer between the axle segment 6 and the roller shell 7, this air layer flowing in both circumferential and axial direction. This layer thereby acts as a cushion exerting a radial outward force evenly around the en-

tire circumference to maintain the shell 7 in a balanced concentric position on the enlarged axle 6. The air emerging from this layer in the bearing gap 5 then flows obliquely out of the roller through the air outlet openings or channels 12, 13 or 14. The component of recoil force generated by the obliquely emerging air, i.e. a recoil force active in tangential direction to the circumference of the roller shell, drives the roller in the direction of arrow D. The direction of the emerging air is indicated by arrows L.

The air emerging through the axial bores 16 in the end walls of chamber 2 stabilizes the roller in its axial position by another air layer which prevents a contact or rubbing of the face plates 8 and 9 along their inner surfaces on the corresponding oppositely facing surfaces at the ends of the axle segment 6. This second air layer formed in the gap space 5' at each end of the axle segment 6 is in a plane perpendicular to the axis of rotation and is preferably somewhat narrower than the bearing gap 5 and/or provided with fewer openings 16 compared to radial openings 4 so that most of the compressed air flows axially out through the channels 12. In general, both concentric centering and axial positioning tend to be self-balancing in this roller device.

In textile machines with a large number of such air-supported thread overrun rollers, the amount of air to be furnished by a compressed air source can be quite considerable. In the case of the high turning rates present during the normal thread driven operation of the machine, it was found however that such a large dynamically generated driving force is created by the contacting thread for the rollers, that it is actually possible to dispense with the statically generated driving force of compressed air. Thereby, a supply of compressed air during the normal operation became fundamentally unnecessary. On the other hand, in order to guarantee a stabilization of the axial position of the thread overrun roller even in this normal operating phase, it proved expedient to continue a supply of compressed air even after the starting phase or initial acceleration when first applying the running thread. This subsequent supply of air during normal operation is considerably reduced, however, as compared to the pressure which the compressed air must have during the starting phase.

In FIG. 4 there is schematically represented one example of means for the supply of compressed air under controlled conditions. The box or vessel 17 can be any source of compressed air, for example, a compressed air main such as is commonly installed in most plants. The hollow feed line of axle 1 fixed to frame 1' is connected over the branched lines 18 and 19 and the line T-section 20 with the compressed air source 17. In the compressed air line 18 there are installed a pressure adjusting valve 21 and also a cut-off valve 22. Likewise, the compressed air line 19 also has a pressure adjusting valve 23 and a cut-off valve 24. By way of example, the pressure adjusting valve 21 can be set at that pressure required during the initial starting or accelerating phase, for example at a pressure of 6 atmospheres gauge. On the other hand, the pressure adjusting valve 23 can be set at the pressure required for normal running operation, for example at one atmosphere gauge. During the initial starting phase, the blocking valve 22 is open and the cut-off valve 24 is closed. After the starting phase is completed, the cut-off valve 22 is closed while the cut-off valve 24 is opened. The operation of the cut-off valves can be carried out by hand or

also electrically or pneumatically in conventional manner. Instead of the two cut-off valves 22 and 24, one can also use a single multi-path valve, e.g. alternating between two supply lines.

FIG. 4 further indicates a thread monitor device 25 with a thread sensor 26 by which the operation of the cut-off valves 22 and 24 can be automatically brought about over electric or pneumatic lines 28, 29 and 30 in response to the presence or absence of the thread 27 in contact with the sensor arm or feeler 26. The operation of such valves can also depend upon thread tension changing the exact position of the sensor 26 as suggested by the broken line position 26'. More sophisticated pressure control means for adjusting the pressure in response to thread tension can also be easily adapted to the illustrated thread overrun roller. The use of such control arrangements brings about a considerable saving in compressed air and a corresponding saving in electric power.

When operating at high rotational speeds, e.g. 30,000 rpm or more, very little air pressure is required to maintain the carefully balanced and air-cushioned roller shell turning at about the same speed as the thread or yarn running in contact therewith. With the added stabilization of the roller shell in its axial position, an exceptionally smooth running of the thread is achieved, for example, where the thread is being drawn, stretched, twisted, fixed or otherwise processed as it is rapidly transported by conventional nip rolls, winding means or the like in textile apparatus. The thread overrun roller of the invention is thus useful as a driven roller of various known types, e.g. as a separator roller, a thread deflection or guide roller and alone or in combination with other rollers or guide means.

The air outlet channels located in the end face plates of the tubular roller shell, preferably axially adjacent to the inner circumference of the shell, are of particular value in quickly accelerating the rotational speed of the shell when the thread or yarn is first applied thereto so as to practically eliminate thread breakage.

The new air-supported thread overrun rollers of the invention are easily constructed and readily installed by means of their fixed axle or carrying shaft on the frames or by supplemental supports on existing textile machinery. Many variations are possible within the intended scope of this invention.

The invention is hereby claimed as follows:

1. An air-supported thread overrun roller in textile apparatus comprising:

a hollow tubular roller shell adapted to be rotatably driven by a transported thread;

an axle means to carry said roller shell including a shaft segment having an inlet conduit for compressed air extending axially into said roller shell and a hollow cylindrical segment of enlarged diameter connected to said shaft segment so as to extend axially between the two ends of said roller shell and to provide a compressed air chamber fitting concentrically within said roller shell with a small annular bearing gap therebetween, the cylindrical wall of said enlarged segment having radial openings to release compressed air into said bearing gap; and

an annular face plate on said roller shell at either end thereof with the inner diameter of the face plate being smaller than the outer diameter of said enlarged axle segment, each face plate having a plurality of air outlet channels approximately parallel to the roller shell and extending obliquely to the axis of rotation of the shell, said channels being arranged at regular intervals on a circle concentric to the axis of rotation of the shell.

2. A roller as claimed in claim 1 wherein the diameter of said circle on which the air outlet channels are arranged is approximately equal to the mean diameter of the annular bearing gap located between the enlarged axle segment and the roller shell.

3. A roller as claimed in claim 1 including a plurality of axial openings in the end walls of the hollow cylindrical segment of said axle to release compressed air into a gap space between each end wall and the adjacent annular face plate of the roller shell.

4. A roller as claimed in claim 1 wherein said air outlet channels in each annular face plate follow a curved path scooped in the fashion of the blades of an axial turbine.

5. A roller as claimed in claim 1 including means to control the air pressure in said pressure chamber formed by said enlarged axle segment.

6. A roller as claimed in claim 5 including at least two pressure lines connected to said pressure chamber to supply air at different pressures and means to selectively switch said pressure chamber to each of said pressure lines.

\* \* \* \* \*

50

55

60

65