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AIR BEARING BRAKE FOR ROTATING SPINNING RING

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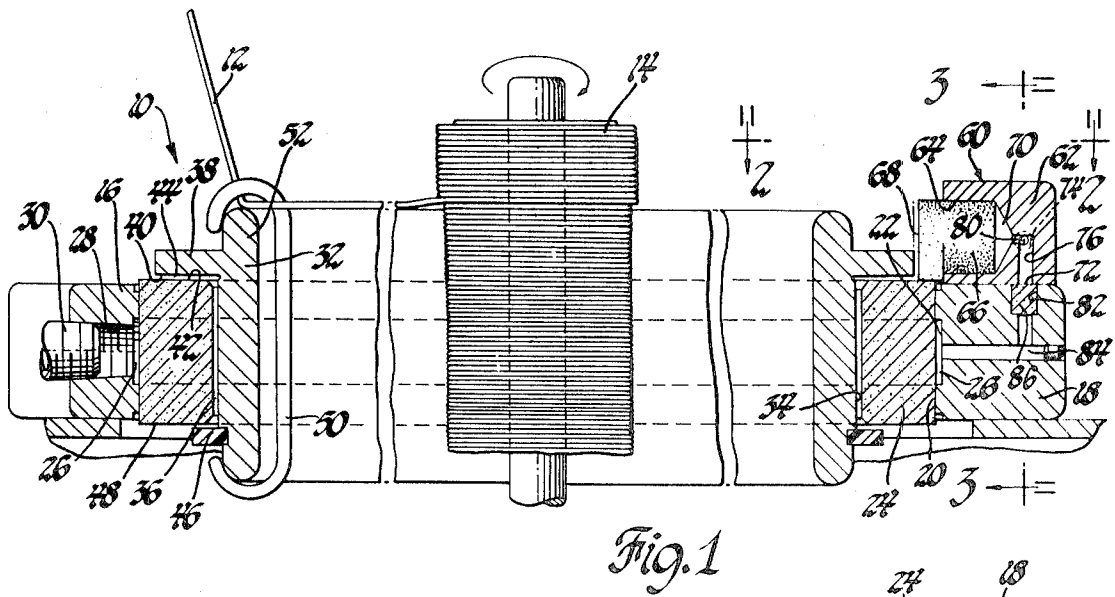


Fig. 1

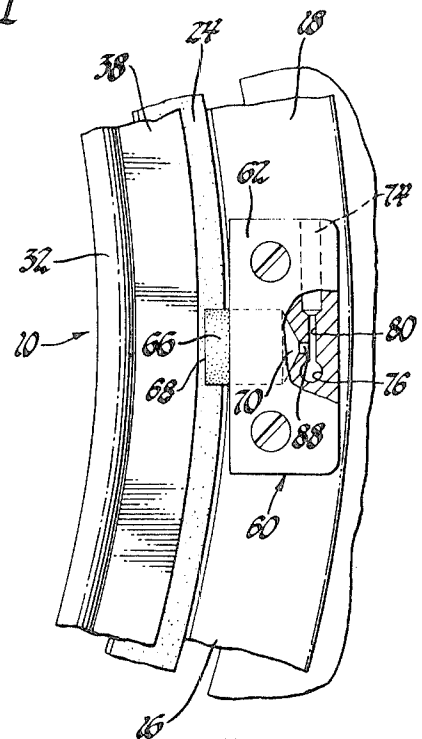


Fig. 2

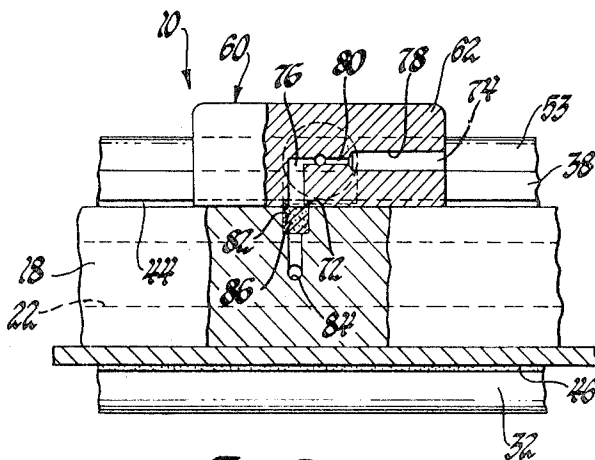


Fig. 3

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AIR BEARING BRAKE FOR ROTATING SPINNING RING

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4 Claims

ABSTRACT OF THE DISCLOSURE

A textile spinning ring having a gas bearing supported traveller ring is provided with a gas-operated brake. The brake is powered from the gas bearing supply plenum and is maintained in the disengaged position through a venturi effect.

My invention relates generally to braking and more specifically to the braking of apparatus in which the member to be braked is supported on a gas bearing popularly referred to as an air bearing.

The particular problem which precipitated my invention involved air bearing spinning rings. Spinning rings are devices well-known in the textile arts and are used in a winding environment. The spinning ring comprises a follower translatable on a follower ring which itself is rotatable and is used to guide a strand of yarn onto a rotating spool to form a wound package. In those designs where the follower ring is rotatably supported by an air bearing, the high inertia of the rotating ring and low torque of the air bearing combine for a long coast-down of the spinning ring after its motive power (the strand being wound on the package) has been removed. This long coast-down, unfortunately, unravels the terminal windage which must subsequently be discarded and constitutes waste.

At the outset, the object of my invention was broadly to eliminate the long coast-down associated with a textile spinning ring having an "air" bearing supported traveller ring and thereby minimize the terminal windage waste.

More specifically, the object of my invention was to provide a brake for the traveller ring to stop the spinning ring shortly after the package being wound was stopped.

It was an object of my invention to make the brakes simple both from the structural standpoint and the operational standpoint.

It was another object of my invention to tie in the operation of the brake with the operation of the spinning ring and/or the spinning apparatus.

Upon retrospect, it appears that my invention is broader than anticipated at the outset as it appears applicable to any apparatus having an "air" bearing supported member in which a long coast-down is considered a disadvantage and may in fact encompass a brake, inventive per se.

The exact nature of this invention as well as other objects and advantages thereof will be readily apparent from consideration of the following specification relating to the annexed drawing in which:

FIG. 1 is an elevation partially in cross section of an apparatus in accordance with my invention set in a textile winding environment.

FIG. 2 is a section taken along the line 2—2 of FIG. 1 and looking in the direction of the arrows.

FIG. 3 is a section taken along the line 3—3 of FIG. 1 and looking in the direction of the arrows.

Referring now to the drawings and more particularly to FIG. 1, the spinning ring indicated generally at 10 is utilized to guide a strand 12 of yarn or the like onto a rotating spool 14. The spinning ring 10 includes a stationary support member 16 which encircles the spool

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14 and is concentric with it. Member 16 comprises a housing 18, the inner circumferential wall 20 of which has a circumferential groove 22 which is closed by a permeable sleeve 24. Examples of suitable material for the sleeve 24 are porous bronze and porous ceramic. The groove 22 thus closed forms a plenum 26 which is fed pressurized gas from a pump (not shown) through conduit 28 and fitting 30. Disposed concentrically within the permeable sleeve 24 is a traveller ring 32.

The outer circumferential wall 34 on the traveller ring 32 lies closely adjacent the inner circumferential surface of the permeable sleeve 24 with a closely controlled small amount of space 36 therebetween, generally on the order of 0.001 inch per inch of ring diameter. A radial flange 38 on the upper part of the ring 32 provides a radial wall 40 which lies adjacent the upper radial surface 42 of the porous sleeve 24 and forms a space 44 which is ultimately determined by the weight of the ring 32 and the gas flow into it. A thrust washer 46 of nylon or other suitable material is provided on the lower end of the ring 32 adjacent the lower radial surface 48 on the porous sleeve 24. A C-shaped traveller 50 is loosely mounted on the cylindrical portion 52 of the traveller ring 32 for translation on it. The strand 12 after being threaded through an upper guide, not shown, passes between the traveller 50 and the ring 32 and onto the spool 14.

In the operation of the spinning ring, the pressurized gas, preferably air, is supplied to the plenum 26. From the plenum 26, the gas flows radially and circumferentially through the permeable sleeve 24 into the spaces 36 and 42 exhausting out the open end of these spaces. The gas flowing through the spaces 36 and 42 provides a pressure acting on the walls 34 and 40 and supports the ring 32 out of frictional engagement with the permeable sleeve 24. The ring 32 thus supported can in the well-known manner of an "air" bearing be rotated at very high speeds with comparatively little torque which is substantially constant and independent of load changes. With the "air" bearing operation, the spool 14 is rotated at high speed to wind the strand 12 on it. During the initial windage, the strand 12 causes the traveller 50 to translate around the traveller ring 32. As the traveller 50 translates, its frictional engagement with the ring 32 causes it to follow the traveller 50 and soon these components are rotating at the same speed. During start-up, there is a tendency for the ring 32 to lift. The washer 44 of nylon or similar antifriction material is mounted on the ring 32 limiting its lift until it settles to an equilibrium position. After the ring 32 is brought up to speed, it and the traveller 50 effectively are a single rotating part with static friction between the traveller 50 and the ring 32 fixing the traveller 50 with respect to the ring 32.

It is to be noted that the rotation of the spool 14 and the winding of the strand 12 thereon initiated translation of the traveller 50 on the ring 32 and maintains the rotation of the traveller 50 and ring 32. The rotating ring 32 being of a substantial mass builds up a substantial inertial force. This fact coupled with the low friction characteristics of the "air" bearing which supports the ring 32 introduces a problem when the spool 14 stops or is to be stopped. Namely, the continued rotation of the ring 32 and traveller 50 unwinds the strand 12 from the spool 14 thus wasting the terminal portion of the windage on spool 14. To avoid this waste, I have provided a brake indicated generally at 60 to stop the ring 32.

The brake 60 comprises a housing 62 secured to the stationary support member 16 of the spinning ring 10. The housing 62 includes a cylinder 64 in which is reciprocally mounted a piston 66. The forward portion of the piston 66 is enlarged so that the piston is guided by the surface 42 of the permeable sleeve 24. The piston

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face 68 is engageable with the face of the radial flange 38 on the ring 32 when extended. It is moved to its extended position in response to positive pressure in the cylinder chamber 70 behind the piston 66. The piston 66 is maintained in its retracted position shown in FIG. 1 in response to negative pressure in cylinder chamber 70.

The brake housing 62 includes an inlet 72 and an outlet or exhaust port 74 interfluidly connected by a vertical conduit 76, a horizontal conduit 78, and an intermediate horizontal conduit 80 of reduced cross section. Because of its reduced size, passage 80 acts as a nozzle or venturi increasing flow velocity and reducing pressure relative to the velocity and flow of fluid through the conduits 76 and 78.

The inlet 72 overlies the counterbored outlet 82 of passage 84 in the stationary support 16 leading from the plenum 26. In some instances, a restrictor 86 is disposed in the counterbore and may be necessary to control the flow from plenum 26 into the inlet 72. The restrictor may be a permeable member of material similar to that used for the permeable sleeve 24. As best shown in FIG. 2, a short conduit 88 leads from the cylinder chamber 70 and opens into the nozzle 80.

Returning to FIG. 1 and our operating spinning ring where spool 14 is being driven and ring 32 and traveller 50 are rotating in unison, it is to be noted that the pressurized gas in chamber 26 not only permeates the sleeve 24 to provide "air" bearing support for the rotating traveller ring 32 but also flows through the conduits 76 and 78 and interposed nozzle 80 in the housing 62. The gas flow through nozzle or venturi 80 behaves in a well-known manner, namely, flow velocity is increased and pressure is decreased. The decrease in pressure evacuates the cylinder chamber 70 until the pressure of the gas in the chamber 70 is substantially equal to that of the static pressure in the venturi throat. By proper sizing of the conduits in relation to the other significant parameters, such as the pressure of the gas in the plenum 26 and the mass of the piston 66, a sufficient negative pressure can be maintained in cylinder chamber 70 to retain the piston 66 in its retracted position out of engagement with the spinning ring 32. It is to be noted that so long as there is sufficient gas pressure in the plenum 26 to operate the "air" bearing, there is sufficient motive power to maintain the braking device in a nonengaged position where it does not interfere with the "air" bearing or continued operation of the spinning ring.

When it is desired or necessary, the spinning ring is easily stopped simply by blocking the outlet 74. The shutting off of the outlet 74 stops the flow through the venturi 80 and ceases its aspirator effect on the cylinder chamber 70. The flow stoppage creates a back pressure in the brake housing conduits. This back pressure which is substantially equal to the pressure in the plenum 26 or to the pressure downstream of the restrictor 86 when one is used is transmitted to the cylinder chamber 70. By the proper design of the components the pressure is sufficient to extend the piston 66 into engagement with the face of the flange 38 on the ring 32 and apply the braking force thereto necessary for braking the ring within a very short duration to minimize terminal windage loss.

By way of example, I have found that a 6 inch spinning ring supplied with air at 50 p.s.i.g. could be satisfactorily stopped with a normal braking force of approximately 5 lbs. I used a nylon piston approximately 0.1 square inch in cross section in combination with a nozzle section approximately .020 inch in diameter by $\frac{3}{16}$ inch in length. The mass flow into the braking conduits was approximately 1 cu. ft./hr. which flowed through the nozzle 80 at approximately 300 ft./sec. and produced a 1 p.s.i. pressure drop in the cylinder chamber 70. This negative pressure maintained the piston 66 retracted. When the exit 74 was blocked, the 50 p.s.i.g. plenum pressure was transmitted to the cylinder chamber 70 extending piston 66 into ring 32 with a force of 5 lbs.

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In braking the ring 32 to absorb the inertia of the ring 32, the traveller 50 is of such light weight relative to the ring 32 that it does not translate on the ring to any appreciable amount and is, therefore, stopped with it thus limiting the unraveling of yarn to the very short duration necessary for braking of the traveller ring 32.

I have referred to the exit 74 being blocked to operate the brake, however, it is to be understood that such reference includes the concept of a valve located at the exit 74. This operation of this valve or its equivalent can be automated and controlled from the spinning machine as desired. For instance, an electromagnetic valve could be deenergized concurrently with an electric motor driving the spool 14 thereby blocking the exit 74 and braking the spinning ring concurrently with the removal of power from the spool 14. The valve alternatively might be responsive to strand breakage or plenum pressure.

While I have shown only one brake, in some instances, it may be desirable to have a plurality of brakes. In such a case, the brakes are preferably located for a balanced application, for instance, two brakes at diametrically opposed locations, three brakes at 120° intervals, etc.

I wish it to be understood that I do not desire to be limited to the exact details of construction shown and described, for obvious modifications will occur to a person skilled in the art.

I claim:

1. In a spinning ring for guiding a filament onto a rotating spool having a traveller carried by a rotatable ring supported by a cushion of gas flowing between a bearing surface on said ring and a bearing surface on a stationary member, said gas being supplied from a plenum in the stationary member, the improvement comprising, a gas operated brake for stopping said rotatable ring, said brake comprising a housing on said stationary member, a cylinder in said housing, a piston reciprocally mounted in said cylinder and frictionally engageable with said rotatable ring in its extended position, a fluid conduit in said housing, said fluid conduit having an inlet, an outlet, and a nozzle therebetween, passage means in said stationary member connecting said supply plenum to said conduit inlet, restrictor means in said fluid conduit means or in said passage means, and a second fluid conduit in said housing connected to said cylinder and opening into said nozzle whereby said piston is held in a retracted position out of engagement with said rotatable ring in response to a negative pressure in said cylinder produced by the high velocity flow of gases through said nozzle exhausting through said outlet when said plenum is connected to a source of pressurized gas and said piston is extended into frictional engagement with said rotatable member to impart a braking force thereto when said plenum is connected to a source of pressurized gas and said outlet is blocked.

2. In a gas bearing apparatus having a stationary member with a first bearing surface, a rotatable member with a second bearing surface spaced sufficiently closely adjacent to said first bearing surface so that said rotatable member is supported by a gas film interposed between said bearing surfaces, and means including a supply plenum to provide a fluid passage from a source of pressurized gas to the gas film through said first bearing surface, the improvement comprising a brake for stopping said rotatable member, said brake comprising a cylinder, a piston reciprocally mounted in said cylinder, said piston frictionally engaging said rotatable member in an extended position and being spaced from said rotatable member in a retracted position, fluid motor means including said cylinder, said fluid motor means moving said piston to said extended position in response to a positive gas pressure in said cylinder and to said retracted position in response to a negative gas pressure in said cylinder, conduit means fluidly to connect said cylinder to said supply plenum whereby said cylinder is adapted to be supplied gas at a positive pressure, and aspirator means fluid-

ly connected to said cylinder, said pressurized gas supply plenum, and an exhaust port whereby said cylinder is adapted to be exhausted to gas at a negative pressure.

3. In a gas bearing apparatus having a stationary member with a first bearing surface, a rotatable member with a second bearing surface spaced sufficiently closely adjacent to said first bearing surface so that said rotatable member is supported by a gas film interposed between said bearing surfaces, and means including a supply plenum to provide a fluid passage from a source of pressurized gas to the gas film through said first bearing surface, the improvement comprising, a gas operated brake for stopping said rotatable member, said brake comprising, a cylinder in said stationary member, a piston reciprocally mounted in said cylinder and frictionally engageable with said rotatable member in its extended position, a fluid conduit in said stationary member, said fluid conduit having a nozzle and an outlet connected in a series flow relationship with said supply plenum, a second fluid conduit fluidly connected to said cylinder and opening into said nozzle, said piston being held in a retracted position by vacuum pressure in said cylinder produced by the high velocity flow of gases through said nozzle exhausting through said outlet when said plenum is connected to a source of pressurized gas and said piston being extended into frictional engagement with said rotatable member to impart a braking force thereto when said plenum is connected to a source of pressurized gas and said outlet is closed.

4. In a spinning ring for guiding a filament onto a rotating spool having a traveller carried by a rotatable ring supported by a cushion of gas flowing from a pres-

surized gas supply plenum in a stationary member, the improvement comprising, a brake for stopping said rotatable ring, said brake comprising a cylinder, a piston reciprocally mounted in said cylinder, said piston frictionally engaging said rotatable ring in an extended position and being spaced from said rotatable ring in a retracted position, fluid motor means which moves said piston to said extended position in response to a positive gas pressure and to said retracted position in response to a negative gas pressure, conduit means fluidly connecting said fluid motor means to said pressurized gas supply plenum and, aspirator means fluidly connected to said fluid motor means and said pressurized gas supply plenum.

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