Feb. 16, 1960 N. E. KLEIN ET AL 2,924,869

BRAKE AND BRAKING SYSTEM

Filed March 1, 1954 4 Sheets-Sheet 1

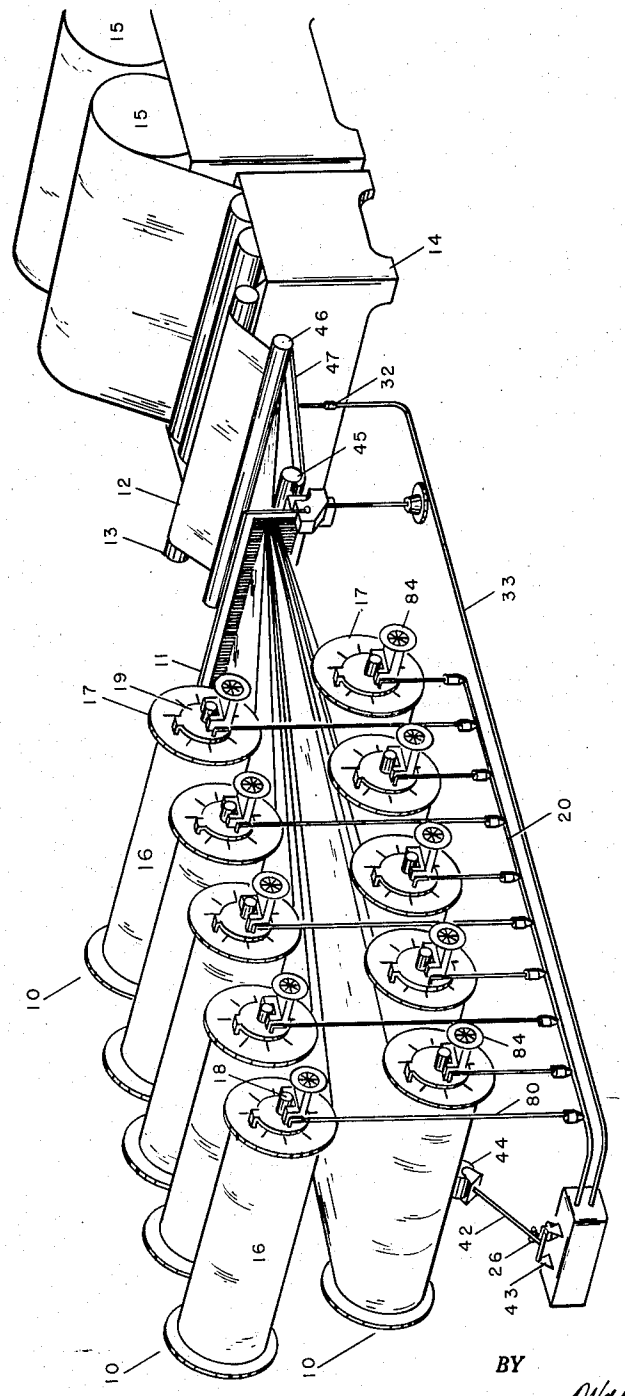


FIG. -1-

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BRAKE AND BRAKING SYSTEM

Filed March 1, 1954 4 Sheets-Sheet 2

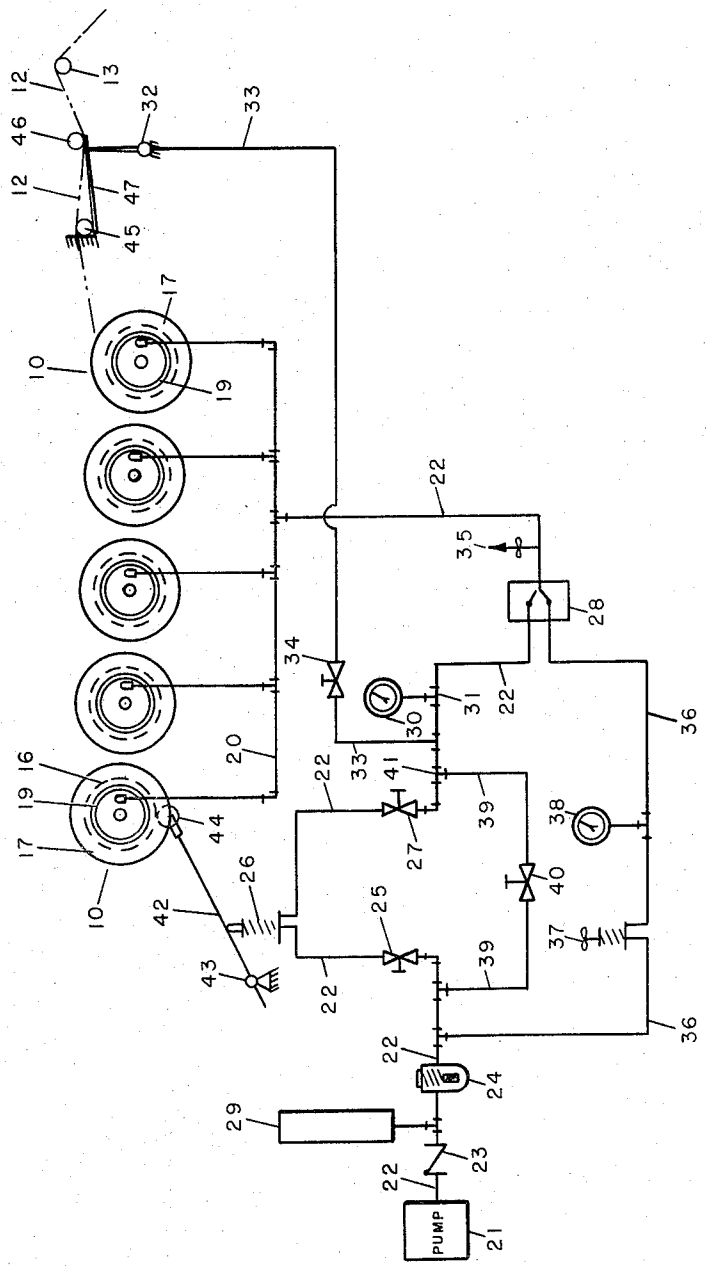


FIG.-2-

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BRAKE AND BRAKING SYSTEM

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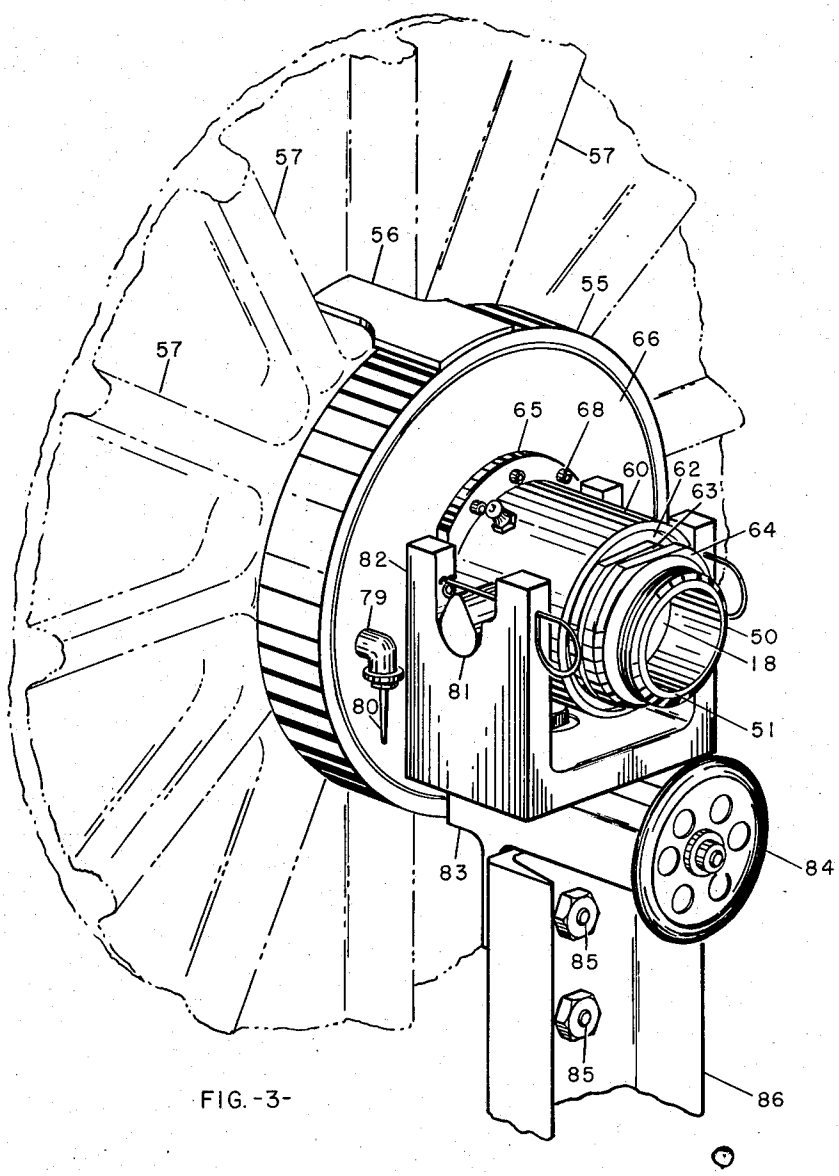


FIG.-3-

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BRAKE AND BRAKING SYSTEM

Filed March 1, 1954 4 Sheets-Sheet 4

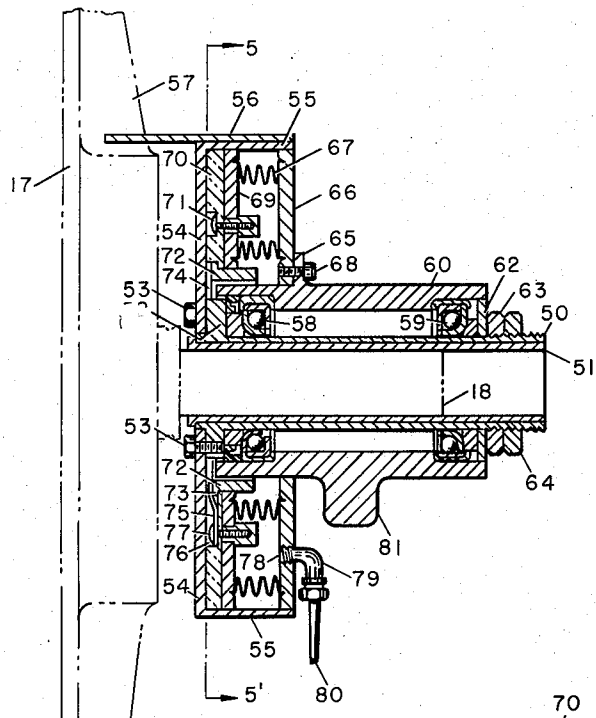


FIG.-4-

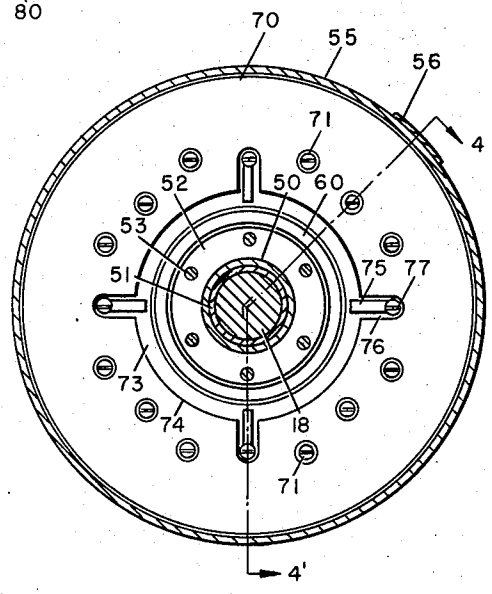


FIG.-5-

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United States Patent Office 2,924,869 Patented Feb. 16, 1960

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BRAKE AND BRAKING SYSTEM

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Application March 1, 1954, Serial No. 413,132

8 Claims. (Cl. 28—28)

This invention relates to brakes and braking systems and more particularly to fluid braking systems suitable for use with textile beaming or slashing apparatus and a new type of fluid activated brake suitable for use in such a braking system.

In beaming and slashing operations it is common practice to load a creel with a number of section beams each of which has been previously wound with a multitude of warp threads or ends. The ends from all of the section beams are combined to form a warp which is, at least in slashing operations, then treated with a liquid size, dried and wound on a warp beam. In all such beaming operations it is necessary that the section beams be braked in order to provide the proper tension in the warp and to prevent the warp from overrunning during such times as the apparatus is being brought to a stop. At present, braking action for the section beams is customarily provided by placing a weighted rope or band around one or both heads of each of the section beams in peripheral grooves provided for the purpose. In spite of numerous suggestions over a period of many years for replacing such brakes with a more precise system, rope brakes continue as the choice of most of the industry.

The disadvantages of weighted rope brakes are well recognized in the art. The brakes require constant attention since as the diameter of the yarn supply on each of the section beams decreases, it is necessary to decrease the braking action to maintan a constant tension in the warp and this means that an operator must be continually removing weights from the rope brakes on each of the section beams throughout the beaming operation. A second well recognized disadvantage of rope brakes is that the braking action is not decreased uniformly as the weights are removed, and one obtains a step wise reduction of braking action. A further serious disadvantage of the weighted rope brakes is that the ropes soon become frayed so that the braking action on various section beams is not uniform and, as a result, some section beams run out of yarn much sooner than others. As the yarn remaining after one beam is out cannot readily be employed in the preparation of a warp, this results in what is known to the trade as soft waste.

In spite of the fact that the disadvantages of rope brakes for beaming apparatus have been recognized for many years and many efforts have been made to replace the rope brakes, none of these efforts have met with any degree of commercial success. A primary reason that these efforts have not been successful is that conventional mechanical brakes in all instances possess measurable operating friction in the control system which results in objectional hysteresis characteristics. In other words, the amount of braking torque obtained with the application of a given force to the brake activating means varies with conventional mechanical brakes depending upon whether the selected value is approached from a smaller value or from a larger value. A further

reason why these efforts have been largely unsuccessful is that conventional brakes ordinarily do not have a linear response so that the amount of braking torque resulting from the application of the brake is not necessarily proportional to the amount of force applied to the brake activating means. A still further reason why these efforts have generally met with failure is that there has not been available a braking system capable of evenly compensating for the different braking torques required as the diameter of the section beams is decreased.

According to this invention there is provided a brake suitable for use on section beams wherein two disk shaped braking surfaces are engaged in frictional contact by the expansion of a bellows due to internal fluid pressure and there is also provided a fluid braking system suitable for use with the new brake in beaming operations. The new system evenly and adequately compensates for the change in diameter of the yarn supply on the section beams and results in the warp being maintained under a substantially constant tension at all times.

It is a feature of the new brakes of this invention that they display substantially no hysteresis effect and the amount of braking torque exerted by the brake with a given fluid pressure in the bellows is substantially the same irrespective of whether the selected pressure is approached from a lower value or from a higher value. This advantage is made possible only by a brake design which eliminates any part, necessary for the actual activation of the brake, moving frictionally against another except, of course, the braking surfaces. In fact, substantially the only operating friction in the new brakes of this invention is that resulting from the flow of the braking fluid and as this friction is completely dynamic in nature, the brakes are responsive to practically infinitesimal changes in the pressure of the activating fluid.

It is a further feature of the new brakes of this invention that they exhibit a near perfect linear response or in other words the braking torque is directly proportional to the pressure in the fluid system. In fact, not only does each individual brake display an almost perfect linear response, but each of a number of brakes of the same design generally gives substantially the same braking torque with a given fluid pressure even though the brakes have been subjected to different amounts of wear. As can be seen, this more readily permits the new brakes to be employed in a system using automatic control where it is desired that the same braking torque be applied to a plurality of rotating members.

Further features of the new brakes of this invention are that the brakes possess an absolute minimum of moving parts, are simple in design and have a large braking area compared to the size of the brake. These features result in long life with a minimum of maintenance.

It is a feature of the new braking system that it allows for the adjustment of minimum braking torque without allowing the warp to slacken on stopping of the beaming apparatus.

It is a further feature of the braking system that the braking torque on all of the section beams is substantially the same thereby insuring that the beams will run out at substantially the same time with the elimination of soft waste.

It is a further advantage of the new braking system when applied to beaming apparatus that the tension in the warp is maintained substantially constant at all times irrespective of the diameter of the yarn supply on the section beams thereby insuring that the warp will be wound on the warp beam at a constant tension.

Still another feature of the new braking system is that it provides means responsive to the diameter of the yarn supply and means responsive to the tension in the

warp which are adapted to be employed in combination or individually to control the braking torque applied to the section beams.

A preferred embodiment of the invention will now be described with reference to the accompanying drawings in which:

Figure 1 is a fragmentary perspective view, showing principal parts in location, of a sizing apparatus employing the new brakes and braking system.

Figure 2 is a schematic diagram illustrating the new braking system.

Figure 3 is a view in perspective of the new brake as applied to a section beam.

Figure 4 is a sectional view of the new brake taken substantially along the line 4, 4' in Figure 5.

Figure 5 is a sectional view of the new brake looking substantially along the line 5, 5' in Figure 4.

Referring to the drawings in greater detail, there is illustrated in Figure 1 a conventional rayon slashing apparatus modified to employ the new brakes and braking system of this invention. Certain elements of the rayon slashing apparatus such as the creel and warp beam are not illustrated as they are conventional in design and form no part of the present invention.

A plurality of section beams **10** each of which has been previously wound with a multitude of yarn ends, are arranged in two tiers and feed yarn ends to a comb **11**. After passing through the comb **11**, yarn ends from all of the section beams **10** are combined into a warp **12** which is drawn over a roller **13** and into a size box **14** where it is coated with a suitable sizing solution. The warp **12** is subsequently passed over drying rollers **15** and is eventually collected on a warp beam, not illustrated.

Each of the section beams **10** has a barrel section **16** on which the warp ends are wound and a head or flange **17** at each end of the barrel portion. Extending centrally from each of the heads **17** is a journal or gudgeon **18** on which the section beams are adapted to be journaled for rotation. Mounted around the gudgeon **18** on one end of each of the section beams **10** is a fluid activatable brake, generally indicated by the reference numeral **19**, to be more specifically described in subsequent paragraphs.

Each of the brakes **19** is operatively connected to a header **20** which, as best shown in Figure 2, is connected to a pump **21** through a conduit **22** containing a check valve **23**, a filter **24** to remove any suspended matter from the fluid, a valve **25**, a controllable pressure regulator **26**, a constriction such as needle valve **27**, and a two-way selector valve **28**. An air reservoir **29** is operatively connected to conduit **22** between the check valve **23** and the filter **24** and serves the purpose of smoothing out fluctuations in pressure introduced by the operation of the pump **21** and also serves, in combination with the check valve **23**, as a fail safe mechanism so that in the event of pump failure, the check valve **23** closes and the air reservoir **29** provides sufficient pressure to furnish braking action until the slashing apparatus can be brought to a stop.

A pressure indicator **30** is connected to conduit **22** by means of a connection **31** immediately preceding the two-way selector valve **28** and serves the purpose of measuring the pressure being supplied to brakes **19** during normal operation. An escape nozzle **32** which as will be subsequently explained acts as a secondary pressure regulating means, is connected to conduit **22** immediately preceding the connection **31** by means of a conduit **33** and a valve **34**. A safety valve **35** is connected into conduit **22** at a point intermediate the selector valve **28** and the header **20** as a precautionary measure to prevent the pressure being applied to the brakes from rising above a safe value.

A by-pass **36** containing a pressure regulator **37** is connected to conduit **22** at a point intermediate the filter **24** and valve **25** and to the two-way selector valve **28**. A pressure indicator **38** is provided for measuring the pressure of fluid in by-pass **36** between the pressure regulator **37** and the two-way selector valve **28**. A second by-pass **39** containing valve **40** is operatively connected at one end to conduit **22** at a point intermediate the filter **24** and valve **25** and at the other end to a connection **41** immediately following the valve **27**.

The pressure regulating means **26** is operated by a feeler arm **42** pivoted at one end from a suitable support **43** and having at the other end a contact for the yarn supply on beam **10** such as a small roller indicated by the reference numeral **44**. The roller **44** is preferably made of a light weight material such as cork and is adapted to be held against the surface of the yarn supply on a selected one of the beams **10** by the tension spring in the regulator **26**. As the diameter of the yarn supply on the section beam **10** decreases, a corresponding movement of the roller **44** and arm **42** allows pressure regulator **26** to close and decrease the pressure being supplied to brakes **19** by conduit **22**.

After the warp **12** passes through comb **11** it is passed over a stationary rod **45** and then under a rod **46** which is resiliently mounted by virtue of leaf springs **47** only one of which is shown. The warp is then passed upwardly over roller **13** so that the rod member **46** is displaced upwardly as a result of the tension in the warp and as will be apparent to those skilled in the art, the degree of displacement of the rod **46** will be dependent on the tension in the warp **12**. The nozzle **32** is positioned immediately below the spring member **47** so that the spring member acts as a variable closure for the nozzle.

In operation, the slashing apparatus is provided with full section beams, pump **21** is started to build up suitable operating pressure, and the selector valve **28** is positioned to open by-pass **36**. Pressure regulator **37** is opened sufficiently to give approximately the correct braking pressure and the slasher is placed in operation. Pressure regulator **37** is then adjusted to give exactly the desired braking action as determined visually. The reading of pressure indicator **38** is noted and with the selector valve **28** still in the position to open by-pass **36**, and with needle valve **27** wide open and valve **34** closed, pressure regulator **26** is adjusted to give a reading on pressure indicator **30** slightly in excess of that on pressure indicator **38**. Valve **34** is then opened and nozzle **32** positioned with respect to the spring member **47** so that the escape of fluid from nozzle **32** is appreciable but not excessive. As pressure regulator **26** will be trying diligently to compensate for the loss of fluid through nozzle **32**, it will be found that the reading of pressure indicator **30** has fallen but slightly so that needle valve **27** is then closed sufficiently to give a reading on pressure indicator **30** identical to that on pressure indicator **38**. The escape of fluid from nozzle **32** is then again checked to make certain it is satisfactory in volume and if necessary readjustment of nozzle **32** and needle valve **27** is made. When the escape of fluid from nozzle **32** is satisfactory and the reading of pressure indicator **30** is identical to that of pressure indicator **38**, selector valve **28** is operated to close by-pass **36** and open conduit **22**.

As has been previously explained, it is necessary that the braking action be decreased as the diameter of the yarn supply on the section beams decreases in order that the tension in the warp be maintained constant. It will be apparent from the above description that this is accomplished by pressure regulator **26** providing a decreased pressure on the fluid being supplied to brakes **19** by reason of the movement of arm **42** with decreasing yarn supply diameter. Pressure regulator **26** is, therefore, the primary pressure regulating means and the purpose of the escape nozzle **32** in ordinary operation is that of a secondary pressure regulating means responsive to warp

tension. The escape of fluid from nozzle 32 not only smooths out small fluctuations in warp tension in normal operation but also reduces braking torque during starting and increases torque during stopping thereby preventing unnecessary stretching and overrunning of the warp. In other words, should the tension in warp 12 decrease slightly, the rod 46 is lowered as a result of the tension in spring members 47 thereby decreasing the volume of fluid escaping through the nozzle 32 so that the fluid pressure being supplied to brakes 19 is equal to the pressure in conduit 22 between pressure regulator 26 and needle valve 27. On the other hand should the tension in warp 12 increase above the desired value, rod 46 and spring members 47 are raised vertically thereby allowing an increased escape of fluid from nozzle 32. Due to the constriction in conduit 22 furnished by valve 27, this results in a reduced fluid pressure being applied to the fluid activatable brakes 19, so that the tension in the warp is decreased.

It is a feature of the present braking system that it can be operated with either nozzle 32 or pressure regulator 26 serving as the sole pressure regulating means and this is advantageous in numerous instances. If for example pump 21 becomes defective so that it is incapable of furnishing sufficient fluid to operate the system when escape nozzle 32 is in operation, it may be desirable to operate the braking system solely by means of pressure regulator 26. On the other hand if the pressure regulator 26 should become defective in action, one might desire to operate the system with escape nozzle 32 as the sole pressure regulating means.

To operate the braking system with regulator 26 as the sole regulating means, a correct operating pressure is determined as explained above by by-pass 36 and pressure indicator 38. With valve 34 closed and valve 27 open, pressure regulator 26 is then adjusted so that pressure indicator 30 gives a reading identical to that of indicator 38. The selector valve 28 is then operated to close by-pass 36 and open conduit 22.

To operate the braking system with escape nozzle 32 as the sole pressure regulating means, a correct operating pressure is determined by means of by-pass 36 as above and with valve 25 closed and valves 34 and 40 open, nozzle 32 is positioned to give a pressure reading on indicator 30 equal to that on indicator 38. If the escape of fluid from nozzle 32 is excessive, valve 40 should be partially closed and nozzle 32 again adjusted to give a correct pressure reading on indicator 30. When the escape of fluid from nozzle 32 is satisfactory and the reading of pressure indicator 30 is identical to that of pressure indicator 38, selector valve 28 is operated to close by-pass 36 so that fluid pressure is then supplied to the brakes through by-pass 39, conduit 22 and header 20.

Reference will now be made to Figures 3, 4 and 5 of the drawings wherein the new fluid activatable brake is illustrated in greater detail. The reference numeral 50 designates a tubular sleeve adapted to be placed over a gudgeon 18 extending centrally from the head 17 of a section beam. As gudgeons of various section beams vary slightly in diameter, an adapter sleeve 51 is provided to eliminate needless play. Sleeve 50 is provided with an annular flange 52 near one end and attached to the flange 52 by any suitable means such as by bolts 53 is a centrally apertured, disk shaped member 54 having a wide peripheral annular flange 55. Secured to the flange member 55 for instance by welding is a lug member 56 adapted to engage any one of a number of ribs 57, with which the heads of section beams are conventionally provided, and thereby secure the disk member 54 and sleeve 50 for rotation with section beam 10.

Journaled about sleeve 50 and free to rotate with respect thereto by virtue of low friction bearings 58 and 59 is a cylindrical housing 60. The housing 60 is secured against lateral movement by a grease retainer ring 62

and lock nuts 63 and 64 threaded onto sleeve 50. The housing 60 is provided with a pair of opposed arcuate flanges 65 to which an end member 66 of a toroid shaped bellows 67 is attached by any suitable means such as by bolts 68. The opposite end member 69 of the toroid shaped bellows 67 serves as a brake shoe to which there is attached a section of brake lining material 70 by any suitable means such as by screws 71 having their heads recessed within the brake lining material. The braking surface of brake shoe member 69 is adapted to frictionally engage the inner surface of the disk member 54 which, of course, is machined to a high degree of smoothness to present a suitable braking surface and to eliminate unnecessary abrasion of the brake lining 70. The braking surfaces as well as the flexible part of bellows 67 are protected from external dirt and lint by means of flange 55 which serves as a protective cover.

Mounted through the brake shoe 69 in spaced relationship to the housing 60 is an inertia ring member 72 having an annular flange 73. The inner peripheral edge of brake lining 70 is provided with an annular recess 74 to receive the flange 73 which is maintained in sliding frictional contact with the brake lining 70 by means of a number of clip springs 75. The springs 75 are mounted in suitable recesses 76 in the brake lining material and are secured to the brake drum member 69 by screws 77.

The end member 66 of the bellows 67 is provided with an orifice 78 into which a suitable fitting 79 is threaded. The fitting 79 is connected by a suitable conduit 80 to header 20 (Figure 1) for the supply of a fluid under pressure.

The housing 60 is provided with a pair of trunnions 81 suitable for supporting the same in a trunnion box 82 quite similar to that with which creels are conventionally equipped. The trunion box 82 is pivotally secured to a slide, not illustrated, but conventional in construction, which in turn is mounted in a housing 83 and is movable laterally in a conventional manner by rotation of the wheel 84. The housing 83 is in turn rigidly attached by any suitable means such as a bolt 85 to a conventional creel standard 86.

In operation, the bellows 67 is expanded lengthwise by internal pressure above atmospheric by means of a fluid being admitted through conduit 80 and fitting 79. On expansion of the bellows 67, the brake lining material 70 frictionally engages the smooth surface of rotating disk member 54. Since the brake lining 70 is not free to rotate because of its attachment to bellows 67 and housing 60, a braking torque is exerted on disk member 54 and since disk member 54 is secured for rotation with the section beam 10 by means of lug 56 bearing against rib 57 of the section beam head 17, the section beam is effectively braked. As will be apparent, the magnitude of the braking torque is dependent on the internal pressure in bellows 67 which can be effectively varied by changing the pressure on the fluid being supplied through conduit 80.

The brake lining 70 is secured against rotation only by virtue of its attachment to the free end of bellows 67 and since bellows 67 is not completely torsionally rigid, this introduces the likelihood of high frequency vibration of the brake shoe member 69. The inertia ring member 72 provides means for effectively damping the high frequency vibration which may possibly result because of this arrangement. While the inertia ring 72 does not prevent rotation of the brake shoe member 69, it momentarily discourages transient actions because of the inertia of the ring and the sliding frictional contact of the flange 73 with the brake lining 70 so that the brake shoe member 69 is effectively prevented from oscillating in a rotary manner.

Having thus described out invention, what we desire to claim and protect by Letters Patent is:

We claim:

1. A fluid activated brake for applying braking torque

to a rotatable member said brake comprising in combination a smooth surfaced disk member rotatable about the axis of rotation of said rotatable member in fixed relationship therewith, a torsionally rigid bellows expandable lengthwise by internal fluid pressure, said bellows having the shape of a toroid circumscribing the axis of rotation of said rotatable member, means securing one end of said bellows to prevent rotation with said rotatable member, a disk shaped brake shoe attached to the free end of said bellows for frictionally engaging said smooth surfaced disk member upon expansion of said bellows, said brake shoe being restrained against rotation only by attachment to said bellows and the torsional rigidity of said bellows, and damping means comprising an inertia ring mounted in sliding frictional contact with said brake shoe.

2. In a beaming apparatus, a brake comprising a sleeve adapted to encircle the gudgeon of a beam, a disk shaped brake member carried by said sleeve, means adapted to secure said disk member for rotation with the beam, a cylindrical housing journaled about said sleeve, a toroid shaped bellows circumscribing said housing, said bellows being secured at one end to said housing, a disk shaped brake shoe carried by the free end of said bellows for engaging said disk member on expansion of said bellows, said disc-shaped brake shoe being restrained from rotation only by attachment to said bellows and the torsional rigidity of said bellows, an inertia ring carried by the free end of said bellows to damp high frequency vibration of said brake shoe, and means on said cylindrical housing for supporting the housing in a creel and securing the same against rotation.

3. In a beaming apparatus, a braking system comprising a sleeve adapted to incase the gudgeon of a beam, a disk shaped brake member carried by said sleeve, a lug member on said brake member adapted to engage a rib on a beam head whereby said brake member is secured for rotation with the beam, a cylindrical housing journaled about said sleeve, a toroid shaped bellows positioned about said housing and secured at one end to said housing, a centrally apertured, disk shaped brake shoe positioned in spaced relationship about said housing and carried by the free end of said bellows, said brake shoe having a lined surface for frictionally engaging said disk shaped brake member on expansion of said bellows, a flanged annular inertia member positioned through said centrally apertured brake shoe in spaced relationship to said housing, a recess in the brake lining to receive the flange of said annular inertia member, a plurality of resilient retaining members secured to said brake shoe to retain the flange of said inertia member in sliding frictional contact with said brake lining, a pair of trunnions on said cylindrical housing for supporting said housing in a creel and to secure the same against rotation, and a fluid supply system to supply a fluid under pressure internally to said bellows.

4. A braking system as in claim 3 wherein said fluid supply system is provided with means for automatically decreasing the pressure of the fluid supplied to said bellows as the diameter of the yarn supply on said beam decreases.

5. A fluid activated brake for applying braking torque to a rotatable member, said brake comprising in combination a substantially flat-faced braking surface adapted for rotation about the axis of rotation of said rotatable member in fixed relationship therewith, a torsionally rigid bellows expandable lengthwise by internal pressure, said bellows being secured at one end to prevent rotation with said rotatable member, a second substantially flat-faced braking surface operatively connected to and supported by said bellows and designed to frictionally engage said first surface upon expansion of said bellows and to be freely disengageable from said first surface upon contraction of said bellows, said second braking surface being restrained from rotation only by the torsional rigidity of said bellows, and an inertial damping element operatively connected in energy absorbing relation to and movable relative to said second braking surface to inertially absorb energy from and thereby damp vibration of said second braking surface.

6. A brake arrangement according to claim 5 wherein said bellows is in the shape of a toroid circumscribing the axis of rotation of said rotatable member.

7. A fluid activated brake for applying braking torque to a rotatable member, said brake comprising a first disk shaped braking surface rotatable about the axis of rotation of said rotatable member in fixed relationship therewith, a torsionally rigid bellows expandable lengthwise by internal fluid pressure, said bellows being secured at one end to prevent rotation with said rotatable member, a second disk shaped braking surface attached to the free end of said bellows for frictionally engaging said first braking surface upon expansion of said bellows, said second braking surface being restrained from rotation only by attachment to said bellows, and the torsional rigidity of said bellows, and an inertial damping element operatively connected in energy absorbing relation to and movable relative to said second disk shaped braking surface to inertially absorb energy from and thereby damp high frequency vibration of said second disk shaped braking surface.

8. A brake arrangement according to claim 7 wherein said bellows is in the shape of a toroid circumscribing the axis of rotation of said rotatable member.

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