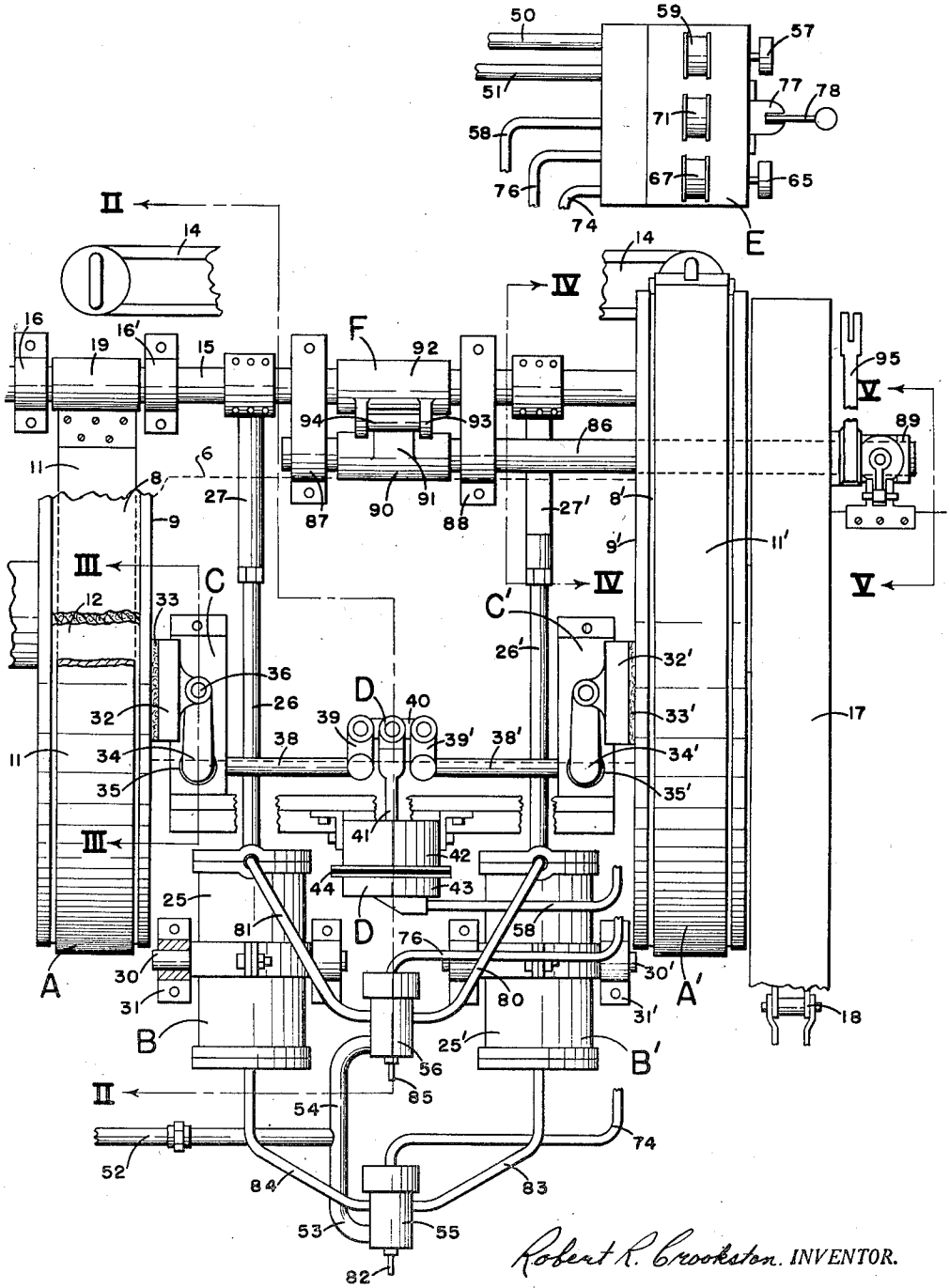
March 11, 1952 R. R. CROOKSTON 2,589,059

BRAKING DEVICE

Filed Aug. 19, 1946 3 Sheets-Sheet 1



Robert R. Crookston. INVENTOR.

FIG. 1.

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BRAKING DEVICE

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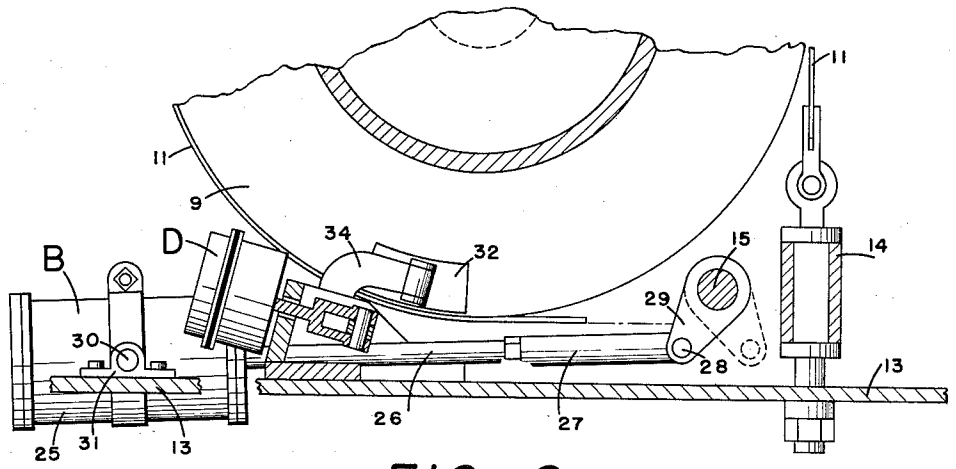


FIG. 2.

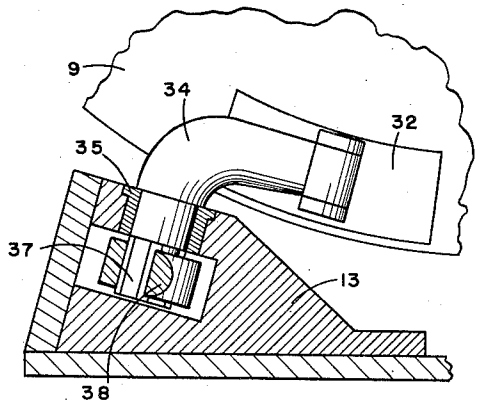


FIG. 3.

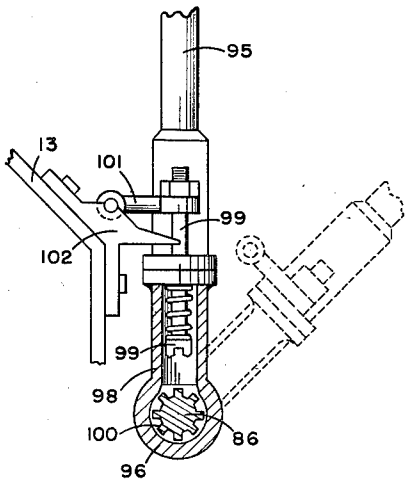


FIG. 5.

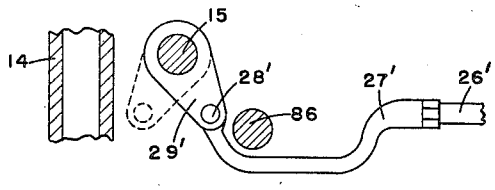


FIG. 4.

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BRAKING DEVICE

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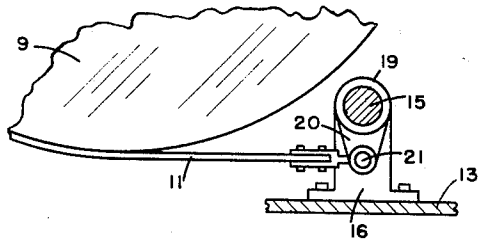


FIG. 7.

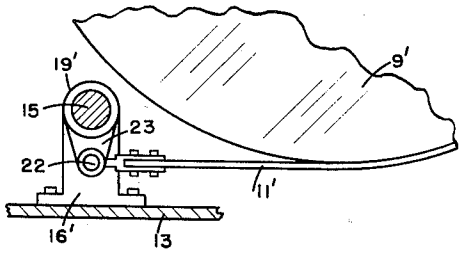


FIG. 8.

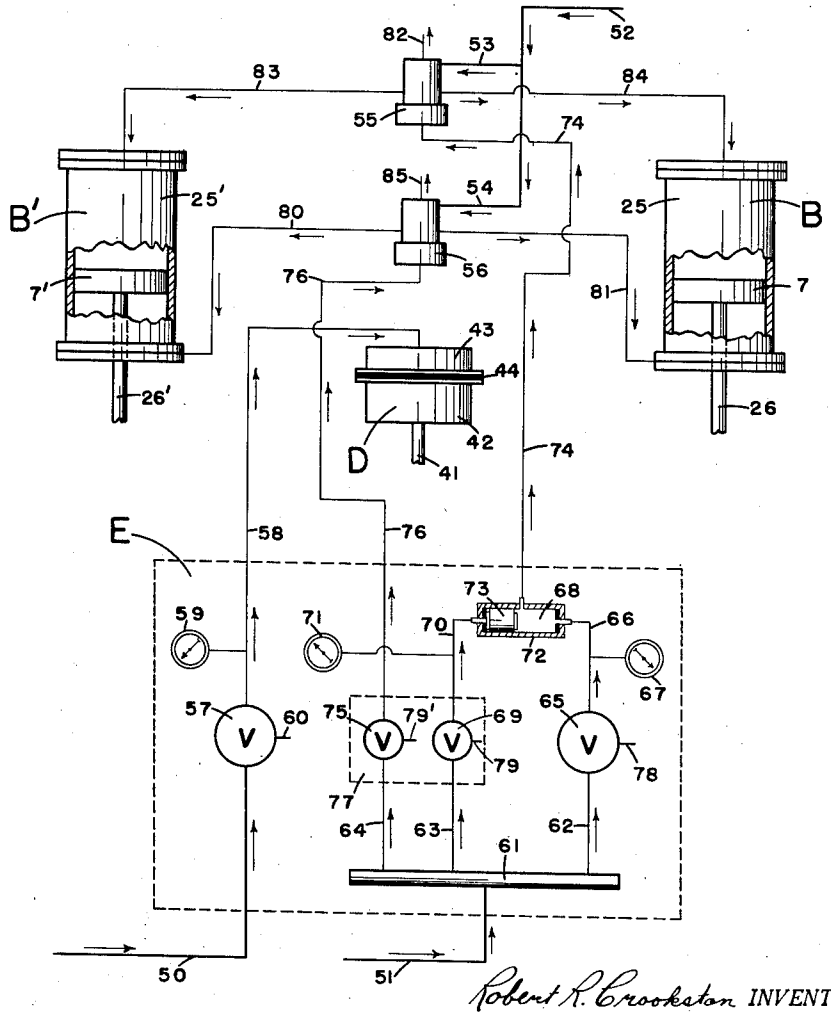


FIG. 6.

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Patented Mar. 11, 1952

2,589,059

UNITED STATES PATENT OFFICE

2,589,059

BRAKING DEVICE

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Application August 19, 1946, Serial No. 691,485

2 Claims. (Cl. 188—151)

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The present invention is directed to a device for applying a braking effect to a body mounted for rotation about a fixed axis.

In many operations it is desirable to apply a braking force to a body adapted for rotation about a fixed axis in such a way that the body will rotate under load at a relatively uniform rate and whereby the speed of rotation of said body may be accurately controlled. Examples of such operations are hoists employed for handling heavy loads.

For example, in the drilling of deep boreholes by the so-called rotary drilling method, a long string of drill pipe having a drilling bit attached to its lower end is rotated by a suitable mechanism at the surface of the earth. In this method of drilling, the weight of a long string pipe is so great that all of it cannot be allowed to rest on the drill bit and it is necessary to take a part of the weight through a drilling line reeved between the crown block and the travelling block with an end of the drilling line secured to a hoisting drum commonly known as a draw works. In the drilling operation, the drill must be lowered as it penetrates; this is accomplished by paying out the drilling line to lower the drill stem. It is desirable to pay out the drilling line smoothly and at such a rate that the weight carried by the drilling bit is substantially uniform as the drilling operation proceeds. Such conditions are desirable in order to insure a satisfactory rate of penetration of the drilling bit while maintaining a straight hole.

It is an object of the present invention to devise a means for controlling the rotation of a hoisting drum which will allow the speed of rotation of the hoisting drum to be controlled accurately while the drum is rotating under load.

Another object of the present invention is to devise a means for controlling the speed of rotation of a hoisting drum which requires only minor manual effort on the part of the operator.

A further object of the present invention is to device an apparatus of increased sensitivity for controlling the rotation of a hoisting drum.

The device of the present invention may be described briefly as including a means adapted to exert a major braking force on a hoisting drum and means arranged to exert a minor braking force on the hoisting drum, the aforesaid arrangement allowing the speed of rotation of the hoisting drum to be controlled more accurately than with the major braking force alone.

In its more specific aspects, the device of the present invention may be described as involving

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means for applying a major braking force through frictional contact between a braking surface of large area and the surface of a hoisting drum and a second means arranged for applying a minor braking force through frictional contact between a braking surface of small area and a surface arranged for rotation with the hoisting drum.

By analogy, the device of the present invention may be compared with a measuring instrument having a vernier scale and in this comparison the means applying the fractional braking force through the area of small surface and which is capable of closely regulating the rate of rotation of the hoisting drum is analogous to the accuracy of the instrument to be read.

The device of the present invention is particularly adapted to be applied to hoisting drums designed for handling heavy loads when such a load must be lowered at an accurately controlled rate such as in the lowering of the drill stem while drilling deep boreholes.

The device of the present application will now be described in detail in conjunction with the drawing in which

Fig. 1 is a top elevation illustrating a preferred embodiment of the present invention with parts conventional to the hoisting apparatus cut away in order to show the novel features of the present invention more clearly;

Fig. 2 is a view along line II—II of Fig. 1;

Fig. 3 is a view along line III—III of Fig. 1;

Fig. 4 is a view along line IV—IV of Fig. 1;

Fig. 5 is a view along line V—V of Fig. 1;

Fig. 6 is a schematic diagram illustrating the connections of the power cylinders shown in Figs. 1 and 2 with a source of compressible fluid maintained at superatmospheric pressure;

Fig. 7 is a fragmentary view showing in detail the method of attaching one of the brake band assemblies to a shaft for applying and releasing the brake band assembly; and

Fig. 8 is a similar view of the means for attaching the other brake band assembly.

Turning now specifically to the drawing and first to Fig. 1, the various assemblies which make up the complete combination are designated by letters. The means for applying the major braking force to the rotating drum are brake band assemblies designated as A and A'; the power assemblies arranged to operate brake band assemblies A and A' are designated as B and B', respectively. The means for applying the auxiliary braking force to the rotating drum are designated as C and C' and the power assembly

for operating assemblies C and C' is designated as D. The application of the braking force through power assemblies B, B' and D are controlled by an operator through control panel E. The device shown is further provided with an emergency brake mechanism F which is the hand brake mechanism conventionally employed in hand-operated brakes applied to draw works.

Turning now to Fig. 1, it will be seen that parts conventional to commercial hoisting apparatus have been omitted from the figure in order to show more clearly the novel features of the present invention. A showing of the shaft supporting the hoisting drum has been omitted between assemblies A and A', while the portion of the hoisting drum 6 between assemblies A and A' is outlined by dotted lines. An upper portion of brake band assembly A has been omitted in order to show more clearly the lower portion of this assembly. Other parts of the assembly which have been omitted for clarity include portions of the conduits connecting control panel E with assemblies B, B' and D.

Considering first the brake assemblies A and A', each assembly comprises a brake band 11 and 11' with its inside surface provided with a suitable lining 12 and having one end secured to frame 13 through equalizer member 14. Equalizer 14 is conventional and, accordingly, will not be described in greater detail.

Hoisting drum 6 defines cylindrical surfaces 8 and 8' for cooperating with the brake lining 12 and 12' of assemblies A and A', respectively, and radial surfaces 9 and 9' cooperate with the braking surfaces 33 and 33' of the auxiliary braking means.

The mechanism for tightening the brake band assembly A on the hoisting drum and for releasing it is shown in Fig. 1 taken in conjunction with Figs. 2, 4, 7, and 8. A shaft 15 is parallel with the axis of rotation of the hoisting drum and mounted for angular movement with one end supported in journals 16 and 16' and the other end is similarly supported in a journal not shown on the drawing because it is hidden by housing 17 covering a sprocket, not shown, and driving chain 18 used for supplying power to rotate the drum. A sleeve 19 between journals 16 and 16' is fitted to shaft 15 for rotation therewith and extending therefrom is downwardly extending crank arm 20 which is attached to the end of band 11 of assembly A through a transversely extending pin 21. The movable end of the brake band of assembly A' is similarly linked by a pin 22 to crank arm 23 which in turn embraces shaft 15 and moves therewith.

Assemblies B and B' are arranged for transmitting power to shaft 15 for angularly moving the shaft to tighten the brake band assemblies A and A' on the hoisting drum and for releasing the assemblies. Power is supplied to assemblies B and B' through the medium of a gas under superatmospheric pressure which hereafter for convenience will be termed compressed air although it will be understood that other inert gases may be used for this purpose. Hand brake assembly F is arranged for operating brake band assemblies A and A' in case of emergency when compressed air is not available to supply power to assemblies B and B'.

Assembly B includes a cylinder 25 in which is slidably mounted a piston 7. The piston is connected to piston rod 26 slidably extending through the head end of the cylinder. The piston rod is linked through member 27 and pin 28 to a

crank arm 29 secured to rod 15 for movement therewith. The outer surface of cylinder 25 is provided with trunnions 30 mounted in journals 31 which may be secured, by means not shown, to the frame 13 of the draw works; this arrangement for mounting the piston assembly minimizes friction between the piston rod 26 and the cylinder head during the operation thereof.

Assembly B' is similar to assembly B with members 25', 26', 28' and 29' exactly the same as the parts designated as 25, 26, 28 and 29, respectively, in assembly B. Part 27' which connects piston rod 26' to pin 28' is bent, as shown in Fig. 4, so that piston rod 26' may move back and forth when engaging and releasing the brakes without interfering with the hand brake assembly F.

Assembly C includes a member 32 defining a plane surface upon which is mounted a flat brake lining member 33. A bent crank arm 34 is mounted on journal 35 which in turn is supported by frame 13. The upper end of arm 34 defines an opening for receiving a pin 36 which links member 32 therewith. The lower end of arm 34 defines a splined surface 37 which engages with a splined opening defined by an end of lever 38. Assembly C' has parts corresponding to that of assembly C; a sectional view of assembly C' is not given but on Fig. 1 corresponding to parts 32, 33, 34, 35 and 38 parts are designated with numerals 32', 33', 34', 35' and 38', respectively. The adjacent ends of levers 38 and 38' are connected through links 39 and 39', respectively, to link 40 which in turn is secured to piston rod 41.

Assembly D includes a housing 42, a head 43 and a flexible diaphragm 44 secured between housing 42 and head 43. Such an assembly is generally known to the art, being used for example in automobile trucks provided with air-powered brakes. The center portion of diaphragm 44 is arranged to move longitudinally with respect to housing 42 and has secured thereto by suitable means, not shown, piston rod 41 which slidably extends through the piston rod end of housing 42.

It will be seen that assemblies D, C and C' cooperate whereby movement of piston rod 41 outwardly moves the adjacent ends of levers 38 and 38' away from the piston rod end of housing 42 and such movement in turn rotates lever arms 34 and 34' around their axes to force braking surfaces 33 and 33' against surfaces 9 and 9', respectively. Movement of piston rod 41 inwardly with respect to housing 42 forces the adjacent ends of arms 38 and 38' toward housing 42 and this movement in turn rotates arms 34 and 34' and surfaces 33 and 33' away from surfaces 9 and 9'.

The assemblies B, B' and D are powered by compressed air which is applied thereto in the following manner. Referring particularly to Fig. 6, compressed air is supplied to panel E through inlet lines 50 and 51. Compressed air is also supplied to the system through line 52 which is connected through branch lines 53 and 54 to relay valves 55 and 56, respectively. For convenience the pressure in inlet lines 50, 51 and 52 will be designated as main line pressure.

The flow of the compressed air through the various lines in the system will now be traced. Compressed air at main line pressure passes through inlet 50 to valve 57 mounted on panel member E. If valve 57 is open the air passes into line 58 which is provided with a pressure

gauge 59 for indicating to the operator the pressure in line 58, the air passing through line 58 into the space defined by head 43 and diaphragm 44 of assembly D. Valve 57 is provided with an outlet 60 for releasing air pressure in line 58 when the valve is closed; this construction is conventional and for that reason details of the construction of valve 57 are not shown in the drawing. It will be observed that this arrangement allows compressed air within assembly D to be bled off upon the closing of valve 57; it will be obvious that if the piston rod 41 has been moved laterally away from head member 43 the closing of valve 47 will release the pressure and allow the diaphragm to return rod member 41 to its initial position.

Main air pressure is fed through inlet line 51 to the manifold 61 carried by panel member E and passes from the manifold into branch lines 62, 63 and 64. Air passes through branch line 62 through valve 65 into conduit 66 provided with a pressure gauge 67 and into a device designated as a double check valve assembly 68. Air passes through branch line 63 through valve member 69 into conduit 70 which is provided with a pressure gauge 71, and into double check valve member 68. Air passes through branch line 64 through valve member 75, and through conduit 76 to relay valve 56.

It is to be understood that valves 57, 65, 69, and 75 are of a conventional type and arranged so that when the valves are closed the pressure within lines 58, 66, 70 and 76, respectively, is bled off to the atmosphere through outlets 60, 78, 79, and 79', respectively.

In construction double check valve member 68 may be defined as including a housing 72 having a piston 73 slidably mounted therein, an inlet at one end of housing 72 connected with line 66 and an inlet at the other end of the housing connected with line 70. An outlet line 74 connects the center portion of housing 72 with relay valve 55. The arrangement of double check valve 68 allows either the branch line 66 or 70, that is the branch line in which the pressure is higher, to control the movement of double check valve 68. That is to say, if the pressure in line 66 is greater than that in line 70 the slidable member 73 moves to the position shown in the drawing and air passes through line 66, housing 72 into line 74 and thence to relay valve 55. If the pressure in line 70 is greater than that in line 66 the slidable member 73 is moved away from the position shown in the drawing to the other end of housing 72 and allows air to flow through line 70, housing 72 and thence through line 74 to relay valve 55.

It is to be noted that valves 69 and 75 are shown within a dashed rectangle 77 in Fig. 6 which corresponds to housing 77 in Fig. 1. In the actual construction of the device it is convenient for valves 69 and 75 to be operated by a common lever arm 78, as indicated in Fig. 1, whereby movement of the lever arm from a neutral position in one direction operates valve 69 and movement of the lever arm from a neutral position in the opposite position operates valve 75.

Relay valves 55 and 56 are of a type conventional to the art. The purpose of a relay valve is well known to the art. This purpose may be described briefly as to relay or repeat the operation of a controlling valve or device. An increase of the control pressure actuates the relay valve

to produce the same or a proportional pressure in an air cylinder. Likewise, a reduction of the control pressure results in a similar or proportional reduction of the cylinder pressure. With a relay valve in the pipe between the controlling valve and an air cylinder and connected to a large source of air supply, the controlling valve then serves to pilot the large capacity flow to and from the air cylinder. The use of a relay device thus provides that a small capacity controlling valve may be used to control the operation of a large capacity air cylinder.

It will be seen in the drawing that the operation of relay valve 56 is controlled by air pressures in line 76. When the air pressure in line 76 is greater than a predetermined value, relay valve 56 opens to allow air from inlet line 52 to pass through branch line 54 into lines 80 and 81 which in turn discharge into the piston rod end of cylinders 25 and 25'. When the pressure in line 76 is less than a predetermined value, the relay valve 56 closes thereby preventing communication between line 54 and lines 80 and 81 but allowing communication between lines 80 and 81 and outlet 85 whereby the air in cylinders 25 and 25' is bled off to the atmosphere through outlet 85. Relay valve 55 operates similarly. When the pressure in line 74 is greater than a predetermined value, relay valve 55 opens and air passes through the main line 52 through branch line 53, relay valve 55 and conduits 83 and 84 to the head end of pistons 25 and 25'. When the pressure in line 74 is less than a predetermined value, relay valve 55 closes thereby preventing communication between line 53 and lines 83 and 84 but allowing communication between lines 83 and 84 and outlet 82 whereby pressure in the head ends of cylinders 25 and 25' is bled off to the atmosphere.

The auxiliary brake mechanism F includes a shaft 86 mounted for angular movement about journals 87, 88, and 89. Shaft 86 has mounted thereon for rotation therewith a sleeve 90 from which projects a lever arm 91. A shaft 15 is provided with a sleeve 92 defining a lever arm 93. Lever arm 93 and lever arm 91 are connected together through pin 94. A hand lever 95 is mounted at the end of shaft 86 with its lower end in the shape of an annulus 96 embracing the end of shaft 86. A housing 98 is carried by the lower end of hand brake lever 95 with a ratchet member 99 mounted therein. Ratchet member 99 is arranged to engage with notches 100 in shaft 86. The upper end of ratchet member 99 projects above the housing and has secured thereto a laterally extending member 101 arranged to serve as a catch to engage projection 102 of frame 13.

When the hand lever 95 is vertical as indicated in Figs. 1 and 5 the catch 101 engaged with member 102 raises the lower end of ratchet member 99 so that it is clear of shaft 86. It it is desired to use the hand brake the hand lever 95 may be pulled in a clockwise direction to the position indicated by dotted lines in Fig. 5; as soon as member 101 is disengaged from catch 102 ratchet member 99 is pulled downwardly by spring 103 so that it engages with shaft 86. When the ratchet member is engaged with the shaft the brake handle may be rotated in counterclockwise direction as viewed in Fig. 5 and this rotation causes movement of shaft 86 and lever arm 91 which in turn moves lever arm 93 and shaft 15 to tighten the brake bands of assemblies A and A'. The hand brake allows the device to be op-

erated in an emergency when no supply of compressed air is available for operating the power brakes.

The operation of the assembly when using compressed air as the source of power for applying and releasing the brakes will now be described.

If it be assumed that the hoisting drum is to be allowed to rotate slowly under a load, as when lowering drill stem during a drilling operation, the brake assemblies A and A' are controlled by valve **65** and the brake assembly D is controlled by valve **57**. As heretofore stated, such normal drilling operations involve relative movement between cylindrical surfaces **8** and **8'** and radial surfaces **9** and **9'** defined by the hoisting drum and the friction surfaces **12**, **12'**, **33** and **33'**, respectively. If it is desired to stop rotation of the hoist drum entirely this may be done by manipulation of valve **65** or valve **69**. If it is desired to release the brakes by air pressure this may be done by valve **75**.

Assuming that the hoisting drum is to support a load by a tight line and to rotate slowly under the tension of the line to lower the load, customarily the operator will open valve **65** to allow full line pressure to enter line **66**; this will insure that the parts of the double check valve **68** are in the position shown in the drawing and substantially full line pressure is transmitted to line **74** to operate relay valve **55** whereby compressed air from inlet **52** and branch line **53** pushes pistons **7** and **7'** toward the piston rod ends of the cylinders **25** and **25'**. In other words, the full line pressure applies brake assemblies A and A' to the hoisting drum. Valve **65** may then be adjusted until the friction exerted by the assemblies A and A' is just enough to allow the hoist to rotate under load; the assembly D is then brought into operation by opening valve **57** slightly to allow air pressure from inlet line **50** to pass to assembly D. The valves **65** and **57** are then preferably adjusted by the operator so that approximately 95% of the braking force is exerted through pistons **25** and **25'** and the remainder through assembly D. If the hoisting drum **7** is rotating with the valves adjusted as indicated, rotation thereof may be stopped at any time without altering the adjustment of valves **65** and **57** by opening valve **69** to allow full line pressure to pass into line **70**. If full line pressure is given access to line **70** with less than full line pressure in line **66**, slidable member **73** in double check valve **68** is moved to the right in the view shown in Fig. 6 and allows line pressure to pass from line **70** through double check valve **68** to line **74** which in turn operates relay valve **55** and allows full line pressure to pass from inlet **52** to the head end of cylinders **25** and **25'**. If it is desired to release the brakes and allow the drum to rotate at the speed previously employed, valve **69** may be closed; the closing of valve **69** allows the air in line **70** to bleed off through outlet **79** and allows the pressure in line **66** to move member **73** of double check valve **68** to the position shown in Fig. 6 of the drawing and the force exerted by the main brake bands and auxiliary brake bands is the same as that exerted before the brakes were fully applied.

If it is desired to release the brakes under power, as when using the hoisting drum to return the drill stem into the borehole, valve **57** may be closed to release unit D and valve **75** opened to operate relay valve **56**; this in turn allows full line pressure to enter piston rod end of cylinders **25** and **25'** and insures full release of the brakes.

It will be seen that the device disclosed herein is arranged to allow rotation of the hoisting drum under the tension of a tight line at a predetermined rate with the speed of rotation readily adjustable within close limits by the operator of the drum. The arrangement of a mechanism for applying frictional force through a friction lining of large area and a mechanism for applying a force through the friction lining of small area enables the total frictional force applied to be regulated within close limits.

It will also be seen that the device disclosed allows the application of brakes under power obtained from a supply of compressible fluid at superatmospheric pressure. The means for applying the power is such that the force may be adjusted accurately to allow rotation at a selected speed of the hoisting drum or may be readily and easily altered by the operator to increase the braking force and stop completely the rotation of the hoisting drum or to release completely the braking force and to allow unhampered rotation of the braking drum.

It will be obvious to a worker skilled in the art that various changes in the shapes, sizes and proportions of the parts of the mechanism may be made without departing from the scope of the present invention and it is my intention to embrace such changes by the hereto appended claims.

Having fully described and illustrated a preferred embodiment of the present invention, what I desire to secure by Letters Patent is:

1. A means for applying a braking force to a hoisting drum mounted on a frame for rotation about a fixed axis comprising, in combination, a brake band provided with a first frictional lining adapted to engage with a surface defined by the hoisting drum, a first power unit comprising a cylinder, a member within the cylinder cooperating with the cylinder to define a first and a second chamber and arranged for movement with respect thereto, a first piston rod carried by said member and mechanically linked to the brake band for applying the brake band to the drum when in a first position and for releasing the brake band from the drum when in a second position, a second power unit comprising a housing, a second member mounted therein for movement relative thereto, a second piston rod attached to the second member for movement therewith, a second friction lining of small area, a means mechanically linked to the second piston rod arranged for moving said second friction lining to a first position to engage said lining with the drum and to a second position for disengaging the friction lining from the drum, a fluid system comprising an inlet line fluidly connected with a compressible fluid under superatmospheric pressure, a conduit including a valve fluidly connecting said inlet line with the housing of the second power unit, a conduit including a valve fluidly connecting the inlet line with the first chamber of the first power unit, a double check valve defining two inlet ports and one outlet port having a valve member arranged to assume a first position allowing communication between one of the inlet ports and the outlet port and a second position allowing communication between the other inlet port and the outlet port, a conduit including a valve fluidly connecting the inlet line with one inlet port of the check valve

unit, a second conduit including a valve fluidly connecting the inlet line with the other inlet port of the check valve unit and a conduit fluidly connecting the outlet port of the check valve unit with the second chamber of the first power unit.

2. A braking device adapted for controlling the rate of rotation of a hoisting drum mounted for rotation about a fixed axis on a frame, said drum defining two symmetrical cylindrical surfaces and two symmetrical radial surfaces comprising, in combination, two brake bands the surfaces of said brake bands adapted for engagement with the cylindrical surfaces of said hoisting drum, means for engaging the inner surfaces of said brake bands with said cylindrical surfaces comprising, in combination, a shaft having its axis parallel with the axis of rotation of said hoisting drum and adapted for angular movement, a pair of lever arms secured to said shaft for movement therewith, means securing the end of one of said brake bands to one of said levers, means securing said brake bands to the other of said levers, a second pair of lever arms secured to the shaft for rotation therewith, a pair of cylinders mounted on said frame, a piston slidably mounted in each of said cylinders, a rod connecting one of said cylinders with one of said second pair of lever arms, a second rod connecting the other of said pistons with the other of said lever arms whereby movement of the pistons in one direction causes angular movement of said shaft and tightening of said brake bands and movement of said pistons in the reverse direction rotates a shaft in the other direction and releases said brake bands, a pair of brake shoes, each brake shoe defining a plane area much less than the area defined by each of said cylindrical surfaces, a pair of bent lever arms mounted on said frame for movement about parallel axes, said parallel axes being at right angles to the axis of rotation of the hoisting drum, means mounting one brake shoe to one end of one of said bent lever arms whereby movement of the other end of the lever arm causes engagement and disengagement of the brake shoe with one of said radial surfaces, means mounting the other brake shoe to the end of the other brake lever arm whereby movement of the opposite end of the other lever arm causes engagement and disengagement of the brake shoe with the other radial surface, a small cylinder having arranged therein a member carrying a piston rod and moving parallel with the axis of the cylinder, means linking said piston rod to said pair of bent lever arms whereby movement of the piston causes engagement and disengagement of the brake shoes with said radial surface.

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