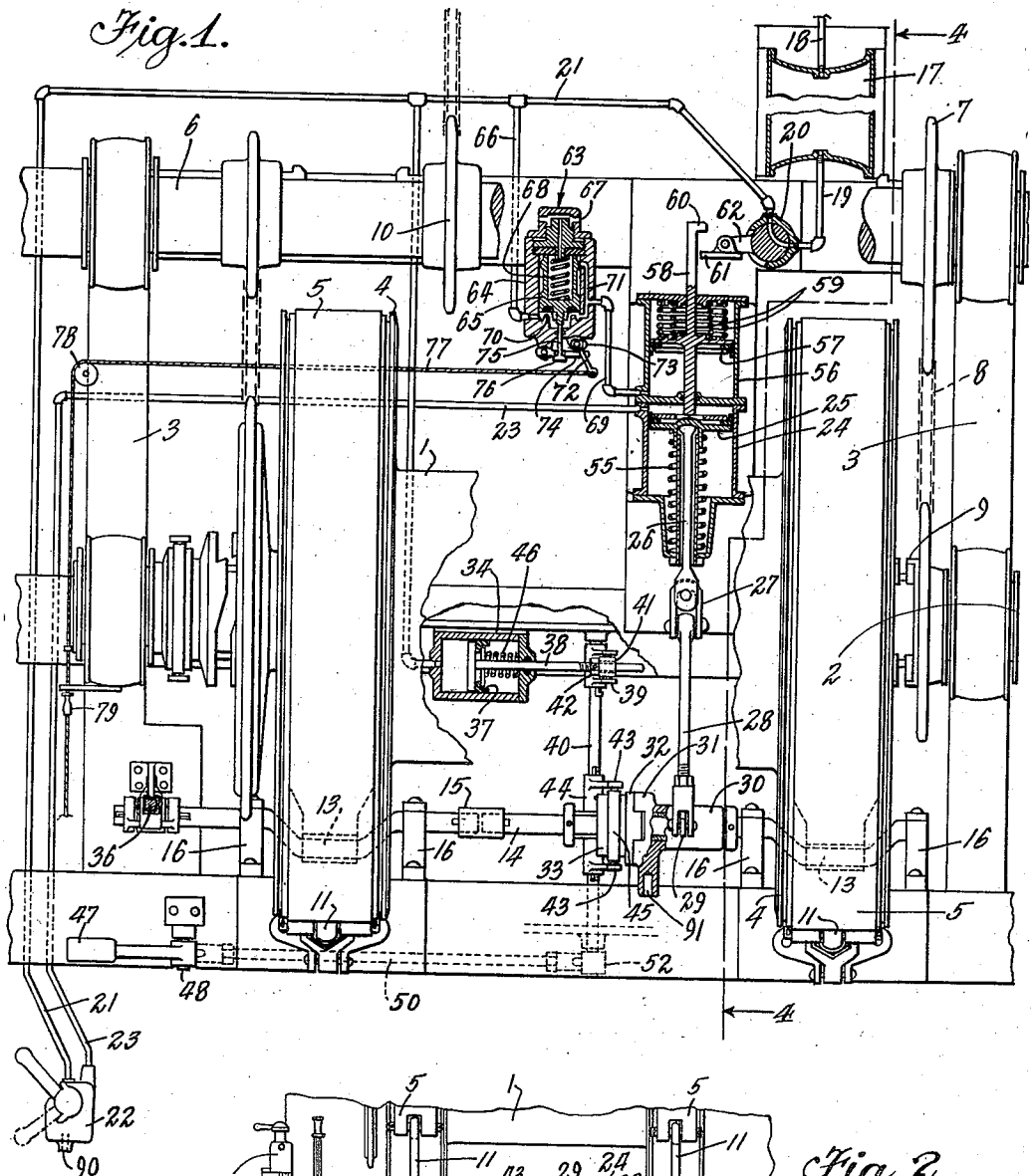
May 12, 1942. J. D. SPALDING 2,282,615

BRAKE FOR DRAWWORKS

Filed July 24, 1939 3 Sheets-Sheet 1

Fig. 1.



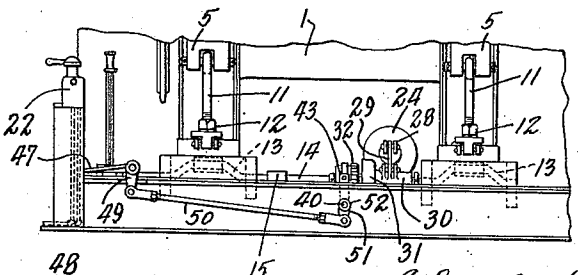
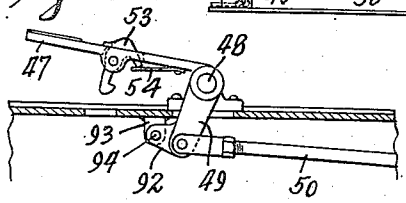


Fig. 2.

Fig. 3.



Inventor

John D. Spalding

By Lyon & Lyon

Attorneys

May 12, 1942. J. D. SPALDING 2,282,615

BRAKE FOR DRAWWORKS

Filed July 24, 1939 3 Sheets-Sheet 2

Fig. 4.

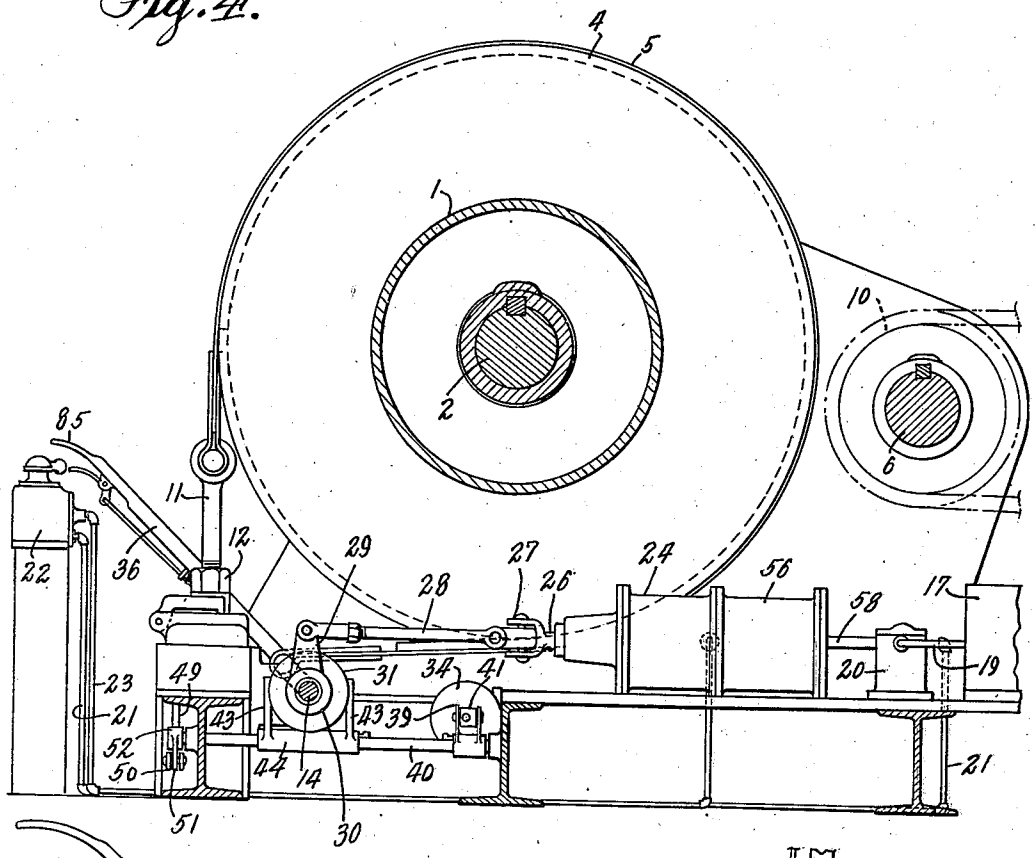


Fig. 5.

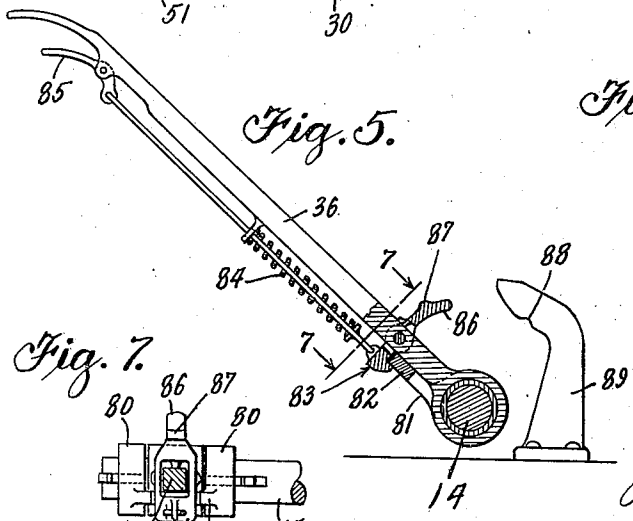


Fig. 6.

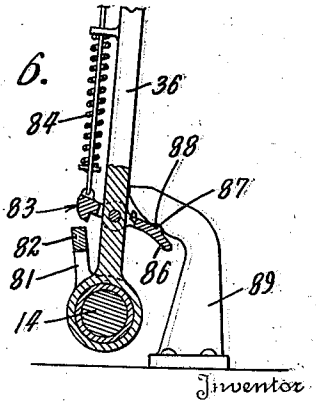


Fig. 7.

Inventor

John D. Spalding

By Lyon & Lyon

Attorneys

May 12, 1942. J. D. SPALDING 2,282,615

BRAKE FOR DRAWWORKS

Filed July 24, 1939 3 Sheets-Sheet 3

Fig. 8.

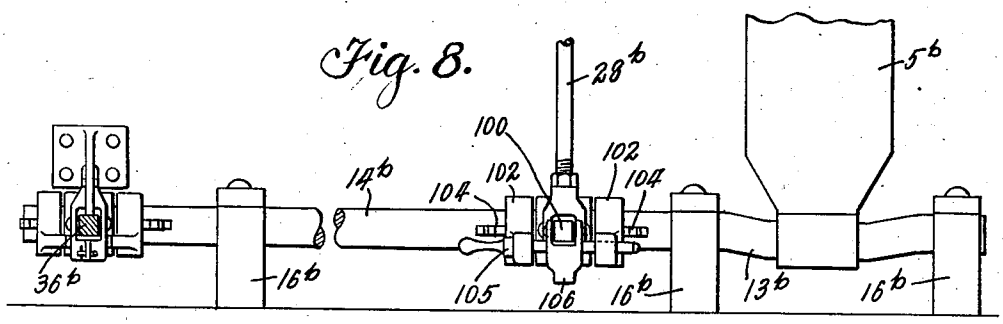
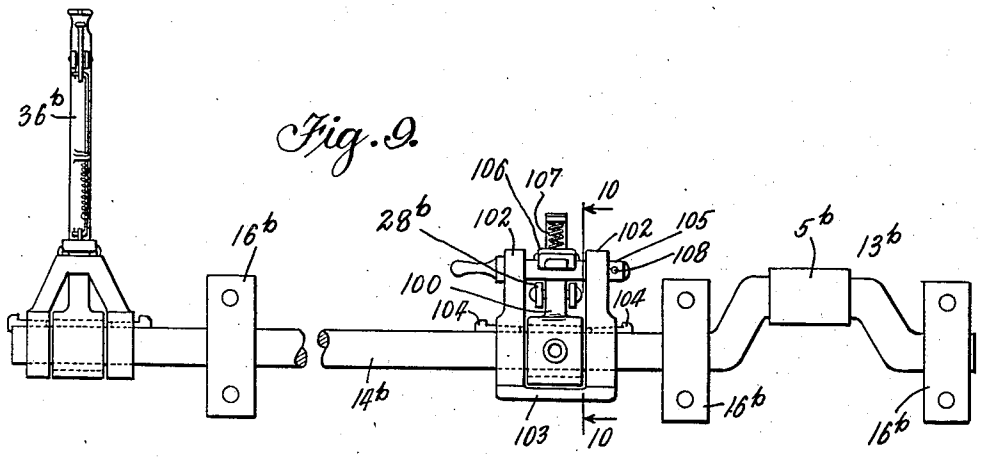


Fig. 9.



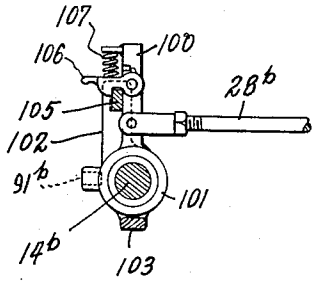


Fig. 10.

Inventor

John D. Spalding

By Lyon & Lyon

Attorneys

Patented May 12, 1942 2,282,615

UNITED STATES PATENT OFFICE

2,282,615

BRAKE FOR DRAW WORKS

John D. Spalding, Los Angeles, Calif., assignor to The National Supply Company, Pittsburgh, Pa., a corporation of Pennsylvania

Application July 24, 1939, Serial No. 286,098

17 Claims. (Cl. 188—151)

This invention relates to drilling apparatus of the type employed in drilling oil, gas, water, or other wells, and is more particularly directed to an improvement in the drawworks thereof and a means provided for operating brakes of such drawworks.

In the drilling of wells, the drawworks is usually constructed with a spooling drum for the line and one or more band-type friction brakes for restraining rotation of the drum. These brakes are ordinarily controlled by a brake lever manually actuated by the driller. In keeping pace with increasing requirements of such drilling apparatus, the drawworks have been steadily increased in size with the consequent increase in size of the brake bands and brake rims in order to enable the drawworks to handle the greatly increased weight and operating requirements as occasioned in deeper drilling and the constant demand for increase in speed of drilling operations.

The brakes of the drawworks have always offered a major problem in drilling apparatus as these brakes are required to sustain loads of great magnitude in controlling the spooling of the line on the drum. The manual operation of these brakes has always presented a major problem in the drilling of wells and the effective control of the entire drilling apparatus is to a considerable degree dependent upon the degree of control with which the driller is enabled to exert over the operation of the brakes.

As the brakes have increased in size, as necessitated by the deeper drilling, the control of the operation of the brakes has become a very difficult physical operation so that nicety of control is rendered almost impossible. It is therefore an object of this invention to provide a means whereby the brakes of a drawworks may be controlled accurately and positively and without the exertion of great physical effort upon the part of the driller or the consequent danger of physical fatigue to the driller.

Another object of this invention is to provide apparatus for operating the brakes of a drawworks by means of fluid under pressure wherein there is included means which will act to set the brakes in the event of failure of the fluid pressure or that the magnitude of the fluid pressure falls below a safe limit.

Another object of this invention is to provide a means for controlling the operation of the brakes of a drawworks wherein there is provided means for preventing the release of brakes in the event of failure of adequate fluid pressure and the subsequent restoration of the fluid pressure to above the minimum quantity required for the safe operation thereof.

Another object of this invention is to provide brake apparatus for a drawworks which is susceptible of either manual or fluid pressure operation and wherein the change from one type of operation to the other may be easily and quickly effected.

Other objects and advantages of this invention it is believed will be apparent from the following detailed description in its preferred forms as illustrated in the accompanying drawings.

In the drawings:

Figure 1 is a plan view partially in horizontal section and illustrating certain parts broken away for clarity.

Figure 2 is a fragmental front elevation thereof on a reduced scale.

Figure 3 is a fragmental sectional detail of a control pedal therefor.

Figure 4 is a sectional elevation taken substantially on the line 4—4 of Figure 1.

Figure 5 is a detail partly in vertical section of a manual control lever illustrating the same in operative position.

Figure 6 is a similar detail of the manual control lever illustrating the same in released position.

Figure 7 is a fragmental sectional view taken substantially on the line 7—7 of Figure 5.

Figure 8 is a partial plan view of a modified form of construction embodying my invention.

Figure 9 is a front elevation of the structure illustrated in Figure 8.

Figure 10 is a fragmental sectional view taken substantially on the line 10—10 of Figure 9.

In illustrating my invention I have chosen to illustrate the same as adapted to the conventional form of drawworks as the same is now utilized in the drilling of wells and have chosen this illustration merely for the purpose of enabling the same to be fully understood by those skilled in the art, but it is to be understood that my invention is in no way limited in its adaptability to any particular form or construction of drawworks as is obviously susceptible of use in connection with any hoisting apparatus as the same are, or may be, particularly adapted for the control of the pipe as it is run in or out of a well.

In the form of drawworks as illustrated, the spooling drum 1 is mounted upon a drum shaft 2 between supports 3. As illustrated, the spooling drum 1 carries at its opposed ends brake rims

4 on which brake bands 5 are mounted. The form of drawworks illustrated includes a drive shaft 6 which is adapted to drive through suitable chain and sprocket arrangements illustrated at 7 and 8 the drum 1 and shaft 2. As there is usually more than one such chain and sprocket drive, clutches 9 are ordinarily provided for releasably clutching in or out these transmission drives.

The drive shaft 6 is normally driven by a suitable form of prime mover (not illustrated) and operatively connected with the transmission sprocket 10. The brake bands 5 are illustrated as of the form where the fixed, or dead end, of each band 5 is anchored to the frame of the drawworks through the medium of anchoring bars 11 which, as is customary in such constructions, are provided with adjusting means 12 whereby the bands 5 may be individually adjusted to the rims 4. The opposed, or live, ends of each brake band 5 are pivotally connected to a crank 13 of the brake operating shaft 14. The shaft 14 may be of any suitable or desirable construction and as herein illustrated is formed of two sections coupled together as indicated at 15 so that the two sections operate as an integral solid shaft. Spaced bearings 16 secured to the drawworks frame provide rotatable supports for the operating shaft 14.

In order to operate under fluid pressure and to likewise enable selectively the manual operation of the operating shaft 14, I have provided interlocking, manual and fluid pressure means for operating the shaft 14 which include as to the fluid pressure operating mechanism a pressure reservoir 17 which is operatively connected by means of a conduit 18 with any suitable or desirable source of fluid under pressure.

The fluid utilized may be any suitable or desirable fluid, but I prefer to utilize compressed air. The reservoir 17 is connected through a conduit 19 with a master control valve 20 which master control valve 20 connects with the control conduit 21 in which the operating valve 22 is mounted. Extending from the valve 22 is the fluid pressure conduit 23 which connects to the operating cylinder 24.

The valve 22 is preferably of the "self-lapping" type such as that shown in the E. K. Lynn et al., Patent No. 2,042,112, issued May 26, 1936.

The operating cylinder 24 contains a piston 25 carrying a piston rod 26. The piston rod 26 is in turn connected through a coupling 27 with the brake operating arm 28. The arm 28 is pivotally connected to the crank arm 29.

The crank arm 29 is formed on the sleeve 30 which is rotatably mounted upon the brake operating shaft 14. The sleeve 30 carries clutch jaws 31 complementary to clutch jaws 32 carried by a second clutch sleeve 33 splined upon the shaft 14 whereby the clutch sleeve may move longitudinally of the shaft 14 but is restrained from relative rotational movement. Thus, the piston 25 of the operating cylinder 24 is releasably clutched to the operating shaft 14. Upon release of this clutch, it will be obvious that the operating shaft 14 is released from operative connection with the fluid pressure operating means whereby manual operation of the brakes is permitted.

The fluid pressure operating means is provided with a safety means wherein automatic actuation of the brakes to a full braking position is provided in the event the pressure in the reservoir 17 falls below a previously determined safe minimum, and is likewise provided with a means wherein engagement of the clutch as thus described is at all times assured when pressure exceeding that minimum is maintained in the pressure reservoir 17 and wherein when the pressure in the reservoir falls below that safe minimum the master valve 20 is actuated to a closed position.

In order to provide for this safety operation, there is provided a clutch control cylinder 34 having therein a piston 37 connected to a piston rod 38 with a crank 39 carried on a clutch operating shaft 40. The piston rod 38 passes freely through a bore formed in the swivel sleeve 41 carried by the crank 39 and is provided with a nut 42 adjustably threaded on the rod 38 so that when the piston 37 is moved under the influence of fluid pressure, the adjustable stop nut 42 engages the end of the sleeve 41 to rotate the clutch operating shaft 40. The clutch operating shaft 40 is connected by means of crank arms 43 of a crank sleeve 44 with a clutch ring 45. The sleeve 44 is non-rotatably secured to the shaft 40. The clutch ring 45 is secured to the clutch sleeve 33. Mounted in the cylinder 34 is a spring 46 which normally acts to move the piston 37 to such position as to permit the opening of the clutch jaws. The spring is balanced against the fluid pressure so that when the fluid pressure exceeds the minimum, the piston 37 is moved in position to hold the clutch in engagement. The clutch may be released through the medium of a clutch operating pedal 47 suitably journaled on a supporting shaft 48 carried by the drawworks frame.

The pedal 47 is connected through arm 49 with a clutch operating rod 50, which rod 50 is in turn connected to arm 51 carried by a sleeve 52 secured to the clutch operating shaft 40.

When it is desired to manually operate the brake system, means are provided for maintaining the clutch disengaged, which means include a latch 53 carried by the clutch pedal 47. The latch 53 is adapted to engage the frame of the drawworks to hold the latch pedal 47 down, thus holding the clutch disengaged. A spring 54 serves to hold the latch 53 in engagement.

In order to automatically set the brake bands 5 against the brake rims 4 when the fluid pressure in the system falls below the allowable minimum, the following means are provided:

Mounted in the cylinder 24 is a spring 55 which acts to normally urge the piston 25 to the brake releasing position. Thus the spring 55 acts to retrieve the piston 25 when the air pressure in the pipe 23 is reduced or shut off entirely. Mounted adjacent the cylinder 24 is a brake setting cylinder 56 which carries a piston 57 having a piston rod 58.

The piston 57 is normally urged in a position to move the piston rod 58 against the piston 25 to overcome the effects of the spring 55 and to set the brake bands 5 against the brake rim 4. For this purpose a relatively strong spring, or series of springs, 59 is provided which is interposed between the piston 57 and the cylinder 56, and the springs 59 are powerful enough in operation to set the brake bands 5 when fluid pressure falls below the required minimum and the pressure of the fluid in the cylinder 56 is exhausted therefrom.

The piston rod 58 extends from both ends of the cylinder 56 through suitable stuffing boxes and at one end extends into the cylinder 24 to engage the piston 25 and at its opposite end it is provided with a latch element 60. The latch element

60 is adapted to engage a pivoted latch element 61 carried by the valve operating arm 62 of the master valve 20, so that when the piston rod 58 is moved under the influence of the spring 59 latch element 60 engages the latch element 61 to rotate the master valve 20 to a closed position. As the latch element 61 is pivotally carried by the valve arm 62, piston rod 58 is moved in a reverse direction without again opening the master valve, which may then be only opened manually, thus assuring that when pressure of the required magnitude is again established in the reservoir 17 the master valve 20 will not be opened to immediately release the brake bands 5.

In order to exhaust the air pressure from the cylinder 56 to permit the springs 59 to set the brake bands 5, an exhaust valve 63 is provided. The exhaust valve 63 includes a cylinder 64 within which a piston 65 is mounted. The cylinder 64 is connected with the pressure conduit 21 by means of a pressure conduit 66. The conduit 66 is connected to the cylinder 64 in such position as to bring the fluid under pressure below the piston 65 normally urging the same upward to a position to close the exhaust vent 67. The piston 65 is moved in the reverse direction by means of a balancing spring 68 set to operate when the pressure in the conduit 21 falls below the allowable minimum.

The cylinder 64 is connected by means of a conduit 69 with the cylinder 56 so that pressure is normally admitted below the piston 57 through the conduit 66 cylinder 64 and line 69. When the piston 65 is moved in the reverse direction under the influence of the spring 68, the same seats on closure seat 70 closing this communication and opening communication from the conduit 69 through the port 71 and exhaust passage 67, thereby exhausting the fluid under pressure within the cylinder 56 permitting the spring 59 to move the piston rod 58 downward against the piston 25 to move the brake arm 28 in a direction to set the brake bands 5.

Means are provided whereby exhaust valve 63 may be actuated to first set the brakes and close the master valve 20, which means include a lever 72 pivotally mounted on the cylinder 64 and carrying a cam 73. The cam 73 engages a second lever 74 pivotally mounted on the cylinder 64 through which lever 74 piston rod 75 extends. The piston rod 75 is provided with a rod head 76, so that when the lever 72 is pulled to rotate the cam 73 the lever 74 is forced downwardly, pulling the piston 65 downwardly against the seat 70, thereby closing off communication of pressure of the conduit 66 and opening the exhaust vent. This results, as heretofore set forth, in the setting of the brakes.

The lever 72 is connected by means of a cable 77 extending over direction pulley 78 to the driller's position where it is provided with an operating handle 79. Once actuated, the nose of the cam 73 acts to maintain the exhaust valve open, thereby rendering the pressure system inoperative as, of course, will be immediately done by the closing of the master valve 20.

The manually operated brake lever 36 is positioned intermediate the spaced hubs 80 of the yoke 81 which is in turn fixed to the shaft 14. Integrally connecting the spaced hubs 80 is an abutment bar 82 which the brake lever 36 is adapted to contact to turn the brake shaft 14.

A latch 83 is pivoted on the brake lever 36 and compression spring 84 is provided to hold the latch 83 in engagement with the abutment bar 82. A release handle 85 is provided near the outer end of the brake lever 36 to enable the driller to release the latch 83 from the bar 82 when desired.

An extension 86 on the rear of the latch 83 is provided with a lug 87 which is adapted to engage the complementary recess 88 formed on the under face of the bracket 89 secured to the drawworks frame.

The brake lever 36 is maintained in its released position by interengagement of the lug 87 with the recess 88 and the latch 83 is released at the same time.

The operating valve 22, as is customary in such structures, is provided with a vent 90 whereby the air under pressure may be exhausted into the atmosphere to permit the spring 55 to return the piston 25, thereby releasing brake bands 5 from the brake drums 4.

The operation of this modification of my invention is that with the master valve 20 open to admit air under pressure into the conduit 21, and assuming that the clutch jaws 31 and 32 are engaged, and that the manual control lever 36 is in the inoperative position illustrated in Figure 6, air under pressure may be supplied to the brake setting cylinder 56 through the exhaust valve 63, compressing the spring 59 to hold the piston rod 58 in its rear or "cocked" position. The driller may then actuate the valve 22 to control movement of the brake shaft 14 by admitting fluid under pressure into the cylinder 24. During such movement of the brakes by fluid pressure, the manual control lever 36 does not follow the movement of the brake shaft 14 because it is disconnected therefrom as illustrated in Figure 6. Thus danger of injury to the driller or other members of the drilling crew is avoided. The release of the brake bands 5 is accomplished by moving control valve 22 to the "off" position whereby the air line 23 is vented to the atmosphere through the exhaust port 90 and the spring 55 retrieves the piston rod 26.

If for any reason the pressure in the reservoir 17 should fall below the minimum value at which the operating cylinder 24 can safely hold the drum 4 under full load, the exhaust valve 63 immediately exhausts to the atmosphere the pressure in the brake setting cylinder 56. The spring at this time forces the piston rod 58 forward into contact with the piston 25 and moves the piston rod 26 and brake arm 28 forward against the effect of the relatively weak spring 55 to set the brakes. It will be noted that this action occurs automatically without assistance from the driller.

It will be observed that the failure of the air pressure does not release the clutch members 31 and 32 and therefore the sleeve 30 remains operatively connected to the brake shaft 14 so that the emergency spring 59 acts to set the brakes. The clutch members 31 and 32 do not disengage because the exhaust valve 63 causes the emergency spring 59 to set the brakes before the pressure in the auxiliary cylinder 34 is reduced sufficiently to permit the spring 46 to retrieve the clutch 33. Furthermore, the pressure on the clutch jaws 31 and 32 due to the force of the emergency spring 59 prevents disengagement of the clutch jaws while the brakes are in applied position. When the brake setting piston rod 58 moves forward, the latch element 60 engages the pivoted latch element 61 and closes the master valve. Should adequate air pressure subsequently be restored, the fact that

the master valve 20 is closed prevents air pressure from entering the brake pressure cylinder 56 through the exhaust valve 63 to release the brakes. Thus the master valve 20 must be reopened manually and then if adequate air pressure is available, the exhaust valve 63 admits air under pressure to the cylinder 56, retrieving the piston rod 58 and permitting control of the brakes again through the medium of the control valve 22.

If for any reason it is desired to operate the brakes manually as, for example, if adequate air pressure is not available or it is desired to rotate the drum 1 to raise the load after the air pressure has failed, the manually operable means for the brakes are connected and the fluid pressure operating means are rendered inoperative. This is accomplished by swinging manual control lever 36 down and latching the same in operative position with respect to the brake shaft 14, as illustrated in Figure 5. The brakes are then held in set position by means of the lever 36 and at the same time another individual of the drilling crew inserts a bar (not illustrated) in the socket 91 of the sleeve 30 to relieve the pressure between the clutch jaws 31 and 32. The clutch pedal 47 is then actuated to disengage the clutch jaws. If it is desired to continue the manual operation, the clutch pedal is locked down to the frame by means of the latch 53.

On release of the sleeve 30 from the shaft 14, the spring 59 merely moves the piston 57 forwardly to the end of the cylinder 56. If it is desired to lock the clutch pedal 47 in raised position to prevent the accidental disengagement of the clutch 32 when the fluid pressure actuating system of the brakes is being utilized, there is provided on the arm 49 a latch arm 92 which is moved to a position in alignment with a bracket 93 carried by the frame.

Complementary holes are formed through the elements 92 and 93 to receive a lock, pin, bolt, padlock, or the like, 94, thus holding the clutch jaws 31 and 32 in engagement against accidental release.

If this precaution has been taken, it would, of course, be necessary to remove the latch element 94 before attempting the manual operation. When it is desired to return to fluid pressure operation from manual operation, the operator, through the medium of the manual lever 36, holds the brakes in applied position while the master valve 20 is manually opened. Assuming there is then sufficient pressure in the reservoir 17, the exhaust valve 63 is moved immediately to close the exhaust vent and admit pressure under the piston 57 to re-compress the spring 59. The clutch control cylinder 34 then moves the piston 37 in the direction to re-engage the clutch jaws 31 and 32, this movement being permitted by release of the latch member 53. Re-engagement of the clutch jaws 31 and 32 is accomplished by actuation of the control valve 22 to bring the said jaws into correct relative position, at which time full engagement will occur under the impulse imparted to the jaw 32 from the clutch cylinder 34. The driller may then hold the brake bands 5 in applied position by means of the service valve 22 while he actuates the release 85 and swings the control lever 36 back to the inoperative position of Figure 6.

The exhaust valve 63 not only provides an automatic means for setting the brakes in event of failure of the air pressure, but also provides an emergency means through which the brakes may be set at any time by any member of the crew in case of any emergency arising. This emergency setting of the brakes may be accomplished by any member of the crew at any time of any emergency by merely pulling upon the cable 79, which action, as heretofore set forth, immediately exhausts the air pressure from cylinder 56, permitting an immediate setting of the brakes under the influence of spring 59. This is an extremely valuable feature of this invention as it allows for an immediate setting of the brakes at any time as is often required in drilling operations to prevent dropping of the load as carried by the line spooled on the drum 1 in case of failure of any other part of the system.

In the modified form of my invention as illustrated in Figures 8, 9 and 10, similar parts have been indicated with a similar numeral, with the addition of an exponent "b" thereto.

The principal difference between this modified form of my invention and that as illustrated and described with respect to Figures 1 to 7, inclusive, is that in this modification I have dispensed with the clutch including the clutch jaws 31 and 32 for the fluid pressure control system, together with the clutch actuating cylinder 34 and the clutch shifter pedal 47 and their attendant mechanisms. All other parts of the system remain substantially as explained in connection with the modification of Figures 1 to 7, inclusive.

In this modification the brake arm 28^b is actuated by the fluid pressure cylinder the same as in the first described modification. The brake arm 28^b is pivotally connected to a crank 100 formed on the sleeve 101. This sleeve 101 is rotatably mounted upon the brake shaft 14^b intermediate the side bars 102 of the yoke 103. The yoke 103 is secured to the brake shaft 14^b as illustrated at 104. The side bars 102 are provided with aligned rectangular openings through which a bumper bar 105 is inserted. A latch member 106 is pivotally mounted upon the crank 100 and is adapted to engage the bumper bar 105. A spring 107 is provided to maintain the latch member 106 in engaged position. If desired, an opening 108 may be provided in the bumper bar 105 through which a pin, latch, or other means may be inserted to prevent untimely withdrawal of the bumper bar.

The operation of this form of my invention is similar to that heretofore described. In so far as the manual control is concerned, it differs only in the manner of the operative connections provided between the brake arm 28^b and the brake shaft 14^b. When the manual control lever 36^b is in its inoperative position and the brakes are being operated by air pressure, the link 28^b controls the movement of the brake shaft 14^b through the crank 100, bumper bar 105 and latch 106. In the event that the brake-setting cylinder 56 should come into play and set the brakes either because of failure of air pressure or as a result of actuation of the emergency cable 79, manual control may be resorted to. Manual control is established by swinging the manual control levers 36^b downward into operative position to hold the brake bands 5^b in applied position and the connection between the brake actuating arm 28^b and brake shaft 14^b is disrupted by relieving the pressure between the crank arm 100 and the bumper bar 105 by inserting a bar (not shown) in the recess 91^b of the sleeve 101. The pressure thus relieved, the bumper bar 105 is withdrawn

laterally from the openings in the side bars 102, thus disconnecting the fluid pressure system from the brake shaft 14b.

Having fully described my invention, it is to be understood that I do not wish to be limited to the details herein set forth, but my invention is of the full scope of the appended claims.

I claim:

1. In a device for operating a friction brake, the combination of a brake shaft, connecting means whereby the brake shaft may actuate said friction brake, a supply conduit adapted to deliver fluid under pressure, a master valve in said conduit, a service control cylinder responsive to fluid pressure and adapted to actuate said brake shaft, a service valve operatively interposed between said master valve and said service control cylinder and adapted to regulate fluid pressure in the latter when the former is in open position, emergency control means adapted to actuate said brake shaft including resilient means acting in a direction to set the brake and pressure responsive means acting to oppose such action by the resilient means, a protective valve operatively interposed between the master valve and the pressure responsive means for the emergency control means, said protective valve acting to de-energize the pressure responsive means for the emergency control means upon the fluid pressure in the protective valve falling below a predetermined value, and thereby permit the resilient means to actuate the brake shaft to apply the brake, and means associated with said emergency control means adapted to close the master valve upon movement of the emergency control means to apply the brake.

2. In a device for operating a friction brake, the combination of a brake shaft, connecting means whereby the brake shaft may actuate said friction brake, a supply conduit adapted to deliver fluid under pressure, service control means for said brake shaft including pressure responsive means adapted to actuate said brake shaft, a passage connecting the supply conduit and the service control means, a service valve operatively interposed in said passage and adapted to regulate the degree of fluid pressure acting on said pressure responsive means, an emergency control means for said brake shaft including resilient means acting in a direction to set the brake and pressure responsive means normally acting to oppose such action by the resilient means, a protective valve operatively interposed between the supply conduit and the pressure responsive means for the emergency control means, said protective valve acting to de-energize the pressure responsive means for the emergency control means upon the fluid pressure in the protective valve falling below a predetermined value, whereby the resilient means may actuate the brake shaft to set the brake.

3. In a device for operating a friction brake, the combination of a brake shaft, connecting means whereby the brake shaft may actuate said friction brake, a supply conduit adapted to deliver fluid under pressure, a crank operatively connected to said brake shaft, a service control cylinder responsive to fluid pressure and adapted to actuate said crank, a service valve operatively interposed between said supply conduit and said service control cylinder and adapted to regulate fluid pressure in the latter, an emergency control cylinder positioned in tandem relation with respect to said service control cylinder and adapted to actuate said crank, means associated with said emergency control cylinder including a spring acting in a direction to apply the brake and pressure responsive means adapted to oppose such action of the spring, means interposed between the fluid pressure supply conduit and the emergency control cylinder adapted to de-energize the pressure responsive means upon the pressure in the supply conduit falling below a predetermined magnitude, whereby the spring may actuate the crank to apply the brake.

4. In a device for operating a friction brake, the combination of a brake shaft, connecting means whereby the brake shaft may actuate said friction brake, a supply conduit adapted to deliver fluid under pressure, a crank rotatably mounted on said brake shaft, releasable means selectively operable to connect the crank with said brake shaft, a service control cylinder responsive to fluid pressure and adapted to actuate said crank, a service valve operatively interposed between said supply conduit and said service control cylinder and adapted to regulate fluid pressure in the latter, an emergency control cylinder positioned in tandem relation with respect to said service control cylinder and adapted to actuate said crank, means associated with said emergency control cylinder including a spring acting in a direction to apply the brake and pressure responsive means adapted to oppose such action of the spring, means interposed between the fluid pressure supply conduit and the emergency control cylinder adapted to de-energize the pressure responsive means upon the pressure in the supply conduit falling below a predetermined magnitude, whereby the spring may actuate the crank to apply the brake.

5. In a device for operating a friction brake, the combination of a brake shaft, connecting means whereby the brake shaft may actuate said friction brake, a fluid pressure supply conduit, a master valve in said conduit, a service cylinder having a service piston and rod therein, operative connections whereby the service piston rod may actuate the brake shaft, a service valve operatively interposed between the master valve and the service cylinder and adapted to regulate the degree of fluid pressure acting against the service piston and rod when the master valve is in open position, an emergency cylinder having an emergency piston and rod therein and positioned adjacent the service cylinder whereby the emergency piston rod may contact the service piston, a spring associated with said emergency cylinder adapted to move said emergency piston rod toward said service piston, fluid pressure supply means connecting said emergency cylinder to said conduit, the pressure in said emergency cylinder normally acting to oppose the force of the spring to maintain the emergency piston and rod in inoperative position, a protective valve associated with said fluid pressure supply means and adapted to exhaust the pressure in the emergency cylinder upon the fluid pressure in the said conduit falling below a predetermined value, the spring automatically forcing the emergency piston rod to move the service piston and rod to apply the brake upon exhaust of the emergency cylinder, and means adapted to close the master valve upon movement of the emergency piston rod to apply the brake.

6. In a fluid pressure device for operating the brakes of a drawworks, the combination of a brake shaft, a member rotatably mounted relative to the brake shaft, pressure responsive means operatively connected to actuate said member, a

fluid pressure supply conduit communicating with said pressure responsive means, a valve associated with said conduit adapted to control the operation of said pressure responsive means, releasable means to connect said member with the brake shaft in non-rotatable relation, and auxiliary pressure responsive means connected to said conduit and acting to maintain said releasable means in engaged position.

7. In a device for operating a friction brake, the combination of a brake shaft, connecting means whereby the brake shaft may actuate said friction brake, a supply conduit adapted to deliver fluid under pressure, a master valve in said conduit, a member rotatably mounted on said brake shaft, releasable clutch means selectively operable to engage said member with said brake shaft, an auxiliary cylinder responsive to fluid pressure and operatively interposed between said master valve and said clutch means, said auxiliary cylinder acting to maintain said clutch means in engaged position while said master valve is in open position, a service control cylinder responsive to fluid pressure and operatively connected to actuate said member, a service valve operatively interposed between said master valve and said service control cylinder and adapted to control the operation of the latter, and means acting automatically to close said master valve upon the pressure in the supply conduit falling below a predetermined magnitude.

8. In a fluid pressure device for operating the brakes of a drawworks, the combination of a fluid pressure supply conduit, a brake shaft, a lever on said shaft whereby the brakes may be manually operated, a member rotatably mounted on said brake shaft, releasable clutch means adapted to operatively connect the member to the brake shaft, pressure responsive means adapted to actuate said member to control the operation of the brakes, valve means operatively interposed between said supply conduit and said pressure responsive means and adapted to control the operation of the latter, auxiliary fluid pressure means connected to said supply conduit normally acting to maintain said clutch means in engagement, and shifter means manually operable to release said clutch means.

9. In a rotary drawworks having a spooling drum and a friction brake for said spooling drum, the combination of a brake shaft, connecting means whereby the brake shaft may actuate said friction brake, a supply conduit adapted to deliver fluid under pressure, service control means for said brake shaft including pressure responsive means adapted to actuate said brake shaft, a service valve operatively interposed between said supply conduit and said service control means and adapted to regulate operation of the latter, an emergency control means for said brake shaft including resilient means acting in a direction to set the brake and pressure responsive means normally acting to oppose such action by the resilient means, a protective valve operatively interposed between the supply conduit and the pressure responsive means for the emergency control means, said protective valve being operable independently of the emergency control means and adapted to automatically de-energize the pressure responsive means for the emergency control means upon the fluid pressure in said conduit falling below a predetermined magnitude, and manually operable means including an emergency cable connected to said protective valve whereby the pressure responsive means for the emergency control may be manually de-energized in case of emergency, said resilient means acting to apply the brake upon such de-energization being effected.

10. In a drilling rig including a drawworks having a spooling drum and a friction brake for said spooling drum, the combination of a brake shaft, connecting means whereby the brake shaft may actuate said friction brake, a supply conduit adapted to deliver fluid under pressure, service control means for said brake shaft including pressure responsive means adapted to actuate said brake shaft, a service valve operatively interposed between said supply conduit and said service control means and adapted to regulate operation of the latter, a manually operated control lever for said service valve, an emergency control means for said brake shaft including a cylinder having a piston therein and a rod for said piston, spring means acting to move said rod in a direction to apply the brake, means to admit fluid pressure from said conduit into said cylinder whereby the piston normally acts to oppose such movement of the rod, and manually operable means adapted to exhaust the pressure in said cylinder to permit the spring to apply the brake, said manually operable means including an emergency cable which may be actuated in emergency from any one of a plurality of locations remote from said service valve control lever.

11. In a drawworks having a spooling drum and a friction brake for said spooling drum, the combination of a brake shaft, connecting means whereby the brake shaft may actuate the friction brake, a pair of crank members secured on said brake shaft in fixed angular relation, a lever associated with each of said crank members and pivotally mounted upon said brake shaft, an abutment element operatively interposed between each crank member and its respective lever whereby movement of either lever in one direction acts to turn the brake shaft in that direction, a releasable latch operatively interposed between one of said crank members and its respective lever whereby movement of said lever in the other direction acts to turn the brake shaft in the other direction, the abutment element for the other of said crank members being removable to permit operation of the brake shaft independently of the lever associated therewith, the lever having the latch being adapted for manual operation, and fluid pressure means operatively connected to operate the other lever.

12. In a device for operating a friction brake, the combination of an actuating element, means whereby the actuating element may operate the friction brake, resilient means acting on said actuating element to apply the friction brake, pressure responsive means associated with said actuating element and adapted to oppose such action of the resilient means, means adapted to supply fluid under pressure to said pressure responsive means, and means operable independently of the pressure responsive means and adapted to vent the fluid pressure in the pressure responsive means upon said pressure falling below a predetermined value, whereby the resilient means may move the actuating element to apply the friction brake.

13. In a device for operating a friction brake, the combination of an actuating element, connecting means whereby the actuating element may operate the friction brake, resilient means acting on said actuating element to apply the

friction brake, pressure responsive means associated with said actuating element and adapted to oppose such action of the resilient means, a conduit adapted to supply fluid under pressure to said pressure responsive means, a valve in said conduit means adapted to vent the fluid pressure in the pressure responsive means upon said pressure falling below a predetermined value, whereby the resilient means may move the actuating element to apply the friction brake, and means associated with said actuating element adapted to close the valve upon movement of the actuating element to apply the friction brake.

14. In a device for operating a friction brake, the combination of a cylinder having a piston slidably mounted therein, a piston rod secured to said piston, connecting means whereby the piston rod may actuate the friction brake, resilient means acting to urge said piston rod in a direction to apply the friction brake, means including a conduit to supply fluid under pressure to said piston and cylinder whereby such action of the resilient means may be pneumatically opposed, and a protective valve operable independently of said piston and adapted to vent the cylinder to atmosphere in the event the fluid pressure therein falls below a predetermined value, whereby the resilient means may move the piston rod to apply the friction brake.

15. In a device for operating a friction brake, the combination of a service control cylinder responsive to air pressure and operatively connected to actuate the friction brake, means adapted to deliver air under pressure to said service control cylinder, a self lapping valve operatively associated with said means and adapted to regulate the degree of pressure in said service control cylinder, an emergency control cylinder having an element adapted to actuate the friction brake, resilient means acting to urge said element in a direction to apply the brake, means adapted to supply air under pressure to said emergency control cylinder whereby such action of the resilient means may be pneumatically opposed, and a protective valve automatically and independently operable in the event that the air pressure available for actuating the service control cylinder falls below a predetermined value and adapted to vent the emergency control cylinder to atmosphere, whereby the resilient means may move said element to apply the friction brake.

16. In a device for actuating a friction brake, the combination of spring means resiliently acting to apply the brake, pressure responsive means normally acting to oppose the spring means, a fluid pressure supply line for said pressure responsive means, and means automatically operable independently of the pressure responsive means adapted upon decrease in available supply line pressure to reduce the pressure in the pressure responsive means to a value below that in the supply line.

17. In a device for actuating a friction brake, the combination of pressure responsive means adapted for service operation of the brake, a pressure supply line for said means, emergency means for applying the brake upon failure or reduction of supply line pressure including a spring acting in a direction to apply the brake and a second pressure responsive means for opposing the spring, and means automatically operable independently of the pressure responsive means adapted to vent said second pressure responsive means upon reduction of supply line pressure whereby the spring may apply the brake.

JOHN D. SPALDING.