Aug. 27, 1963 J. H. WILSON 3,101,828

SAFETY STOP FOR TRAVELING BLOCK OF DRILLING RIGS

Filed May 9, 1960 2 Sheets-Sheet 1

Fig. 1

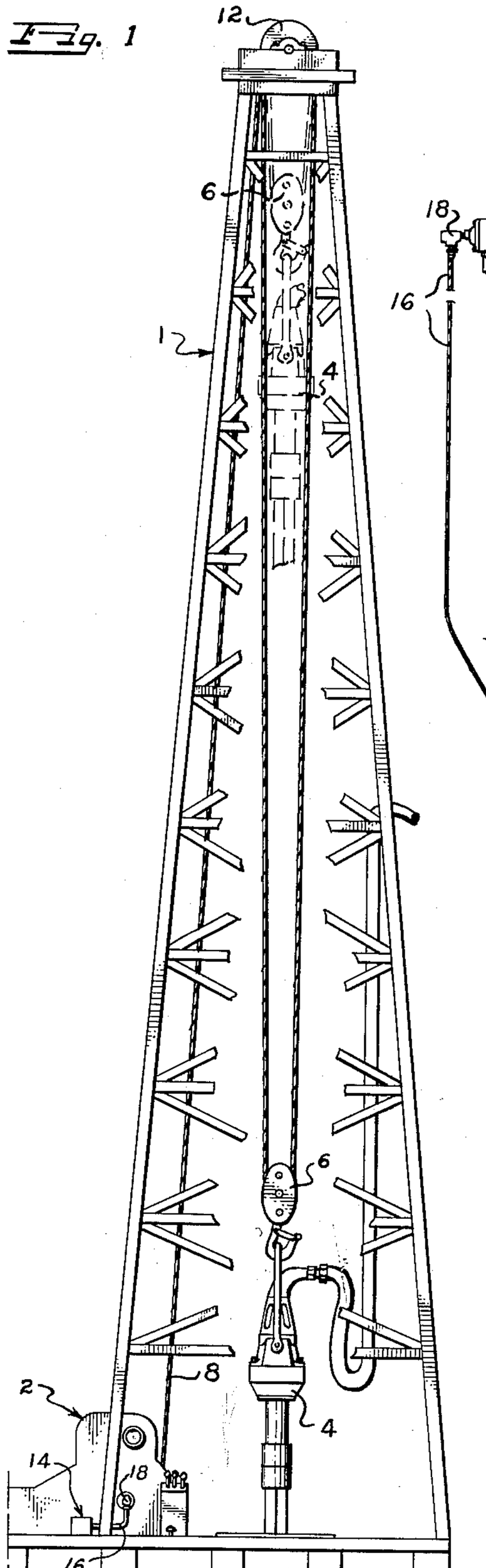

Fig. 2

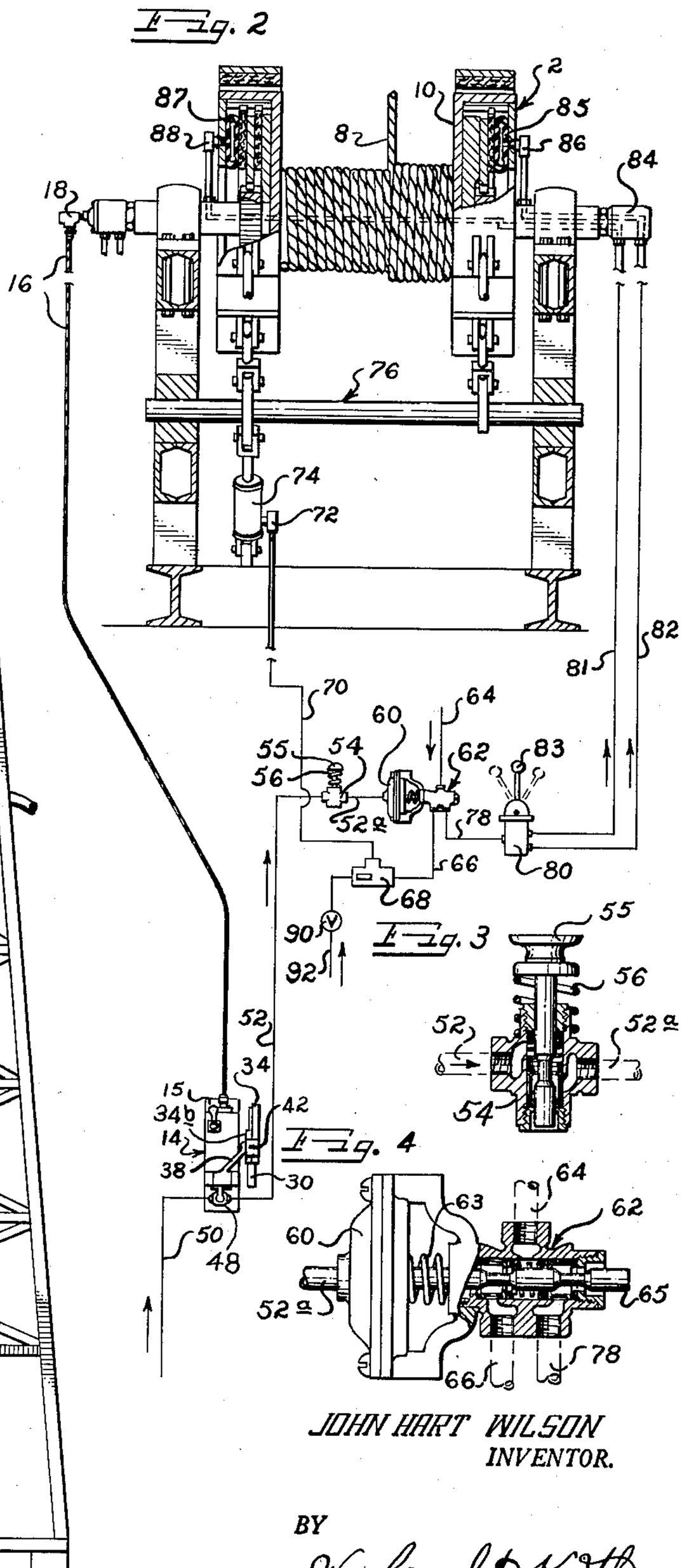

Fig. 3

Fig. 4

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Fig. 5

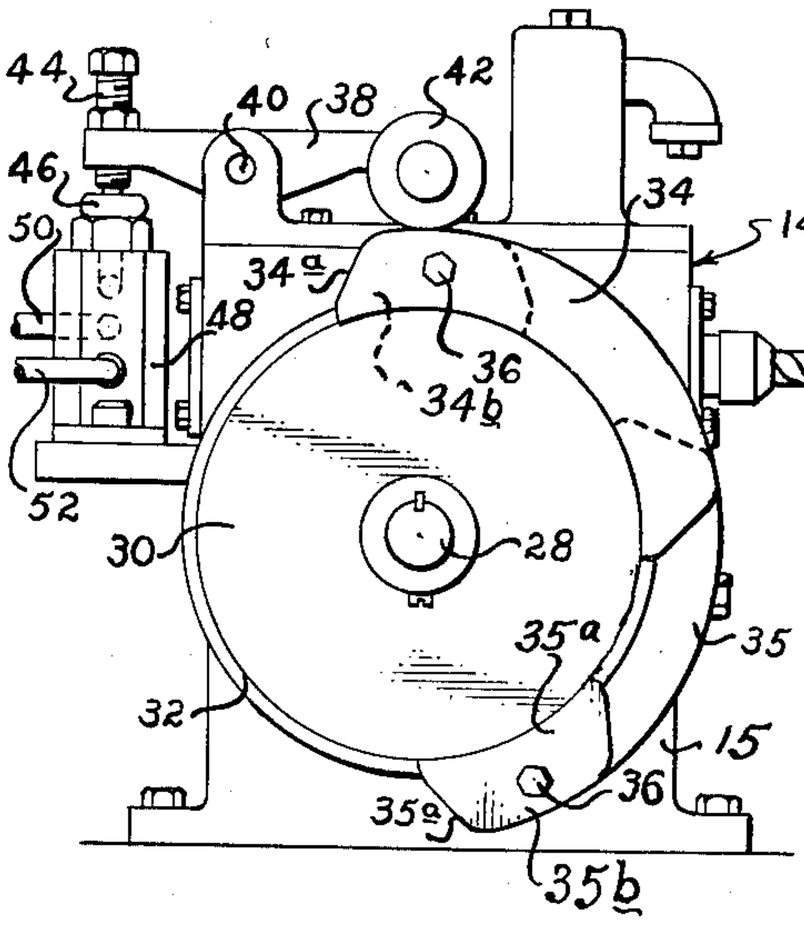


Fig. 6

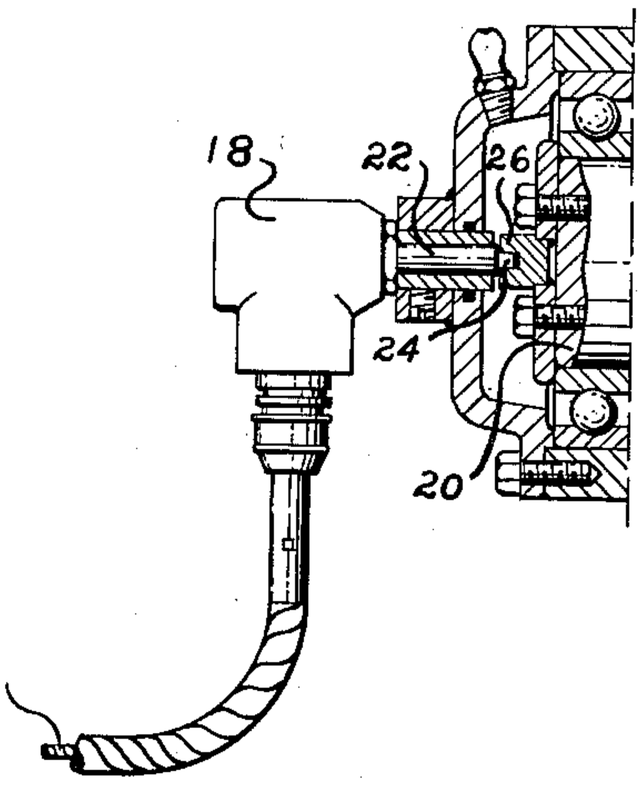


Fig. 7

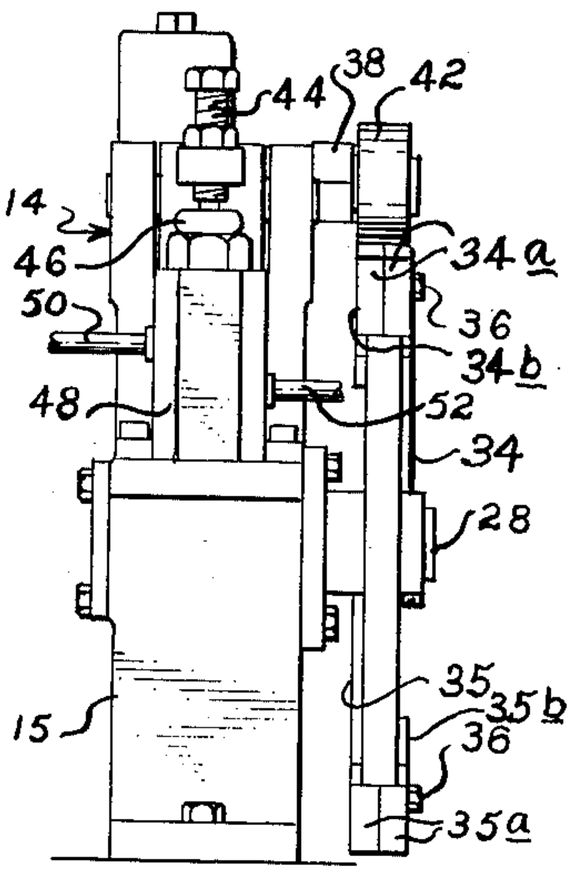
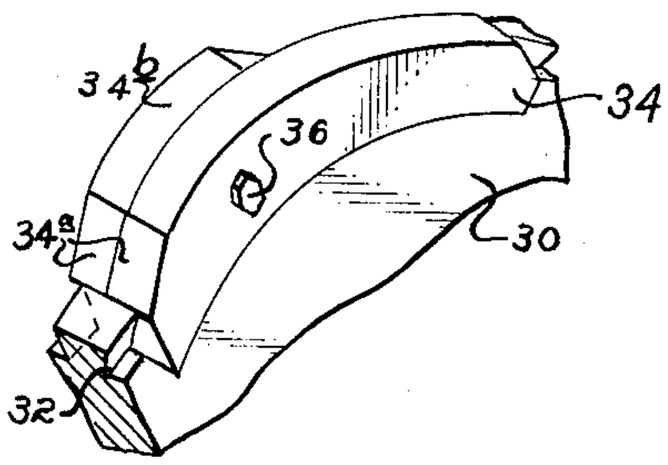
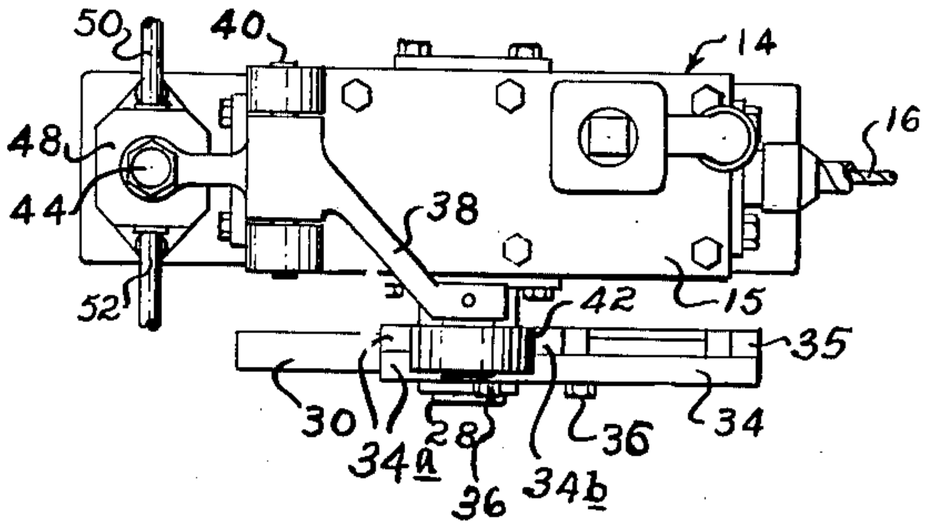


Fig. 8





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SAFETY STOP FOR THE TRAVELING BLOCK OF DRILLING RIGS

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5 Claims. (Cl. 192—139)

This invention relates to an automatic stop for a hoist, and more particularly to a traveling block safety stop for drilling rigs, which safety stop will limit the upward movement and the downward movement of the traveling block of a drilling rig.

Traveling block stops have been proposed heretofore, for limiting the upward movement of traveling blocks, such as disclosed in my Patent No. 2,564,457, issued Aug. 14, 1951, Safety Device for Drilling Rigs, however traveling block stops of this character necessitated the use of an element in the derrick for actual physical engagement with the traveling block to actuate a member which would stop the traveling block on the upward movement only thereof. This traveling block stop would not stop the downward movement of the traveling block, therefore the driller had always to be on the alert to see that the downward movement of the traveling block did not endanger workmen by the descent thereof below a predetermined elevation.

The present traveling block stop is so constructed that both the maximum upward and the downward movement of the traveling block can be accurately controlled, and the stops of the device may be individually and readily adjusted either at the uppermost point of travel or the lowermost point of travel, without affecting the stopping of the traveling block at any intermediate point, either on the upward or downward movement thereof.

An object of this invention is to provide a stop mechanism for the hoisting drum of a drilling rig which will stop the hoisting drum either during the winding of the cable or the paying out of the cable, at a predetermined point, thereby enabling the movement of the traveling block, with which the cable is strung, to be accurately controlled within predetermined limits.

Another object of this invention is to provide a stop for the traveling block of a drilling rig, which is connected in direct, geared relation to the hoist drum of the drilling rig, and which may be readily adjusted without having to adjust stops within the length of the derrick.

Still another object of the invention is to provide a stop for a traveling block of a drilling rig, which is simple in construction, which is compact, and which may be readily installed on any drilling rig.

A further object of the invention is to provide a traveling block safety stop which may be selectively by-passed by the driller to enable the traveling block to move to a higher or a lower elevation, without moving the preset automatic stops.

With these objects in mind and others which will become manifest as the description proceeds, reference is to be had to the accompanying drawings in which like reference characters designate like parts in the several views thereof, in which:

FIG. 1 is an elevational view of a rotary drilling rig, including the derrick thereof showing the traveling block therein, with parts of the derrick being broken away, and with the traveling block being shown in full outline, in one extreme position, the opposite extreme position thereof being shown in dashed outline, the traveling block safety stop mechanism being shown attached to the drawworks of the drilling rig;

FIG. 2 is an elevational view of the drawworks of a conventional rotary drilling rig, which utilizes air actu-

ated clutches and an air actuated braking system on which is shown diagrammatically the traveling block control system, which is connected thereto;

FIG. 3 is an enlarged cross-sectional, elevational view showing one of the control valves within the control system;

FIG. 4 is an enlarged elevational view of a four-way control valve which enables the actuation of the air clutches and the air brake system, with portions of the valve being broken away and portions being shown in section to bring out the details of construction;

FIG. 5 is an enlarged elevational view of the traveling block safety stop mechanism, with parts broken away and with parts shortened, and showing the manner of connecting the mechanism to the rotating shaft, such as a drum shaft;

FIG. 6 is a top plan view of the operating mechanism of the stop mechanism, with a portion of the cable being broken away;

FIG. 7 is an elevational view of the stop mechanism as shown in FIGS. 5 and 6; and

FIG. 8 is a fragmentary elevational view of one of the cams of the stop mechanism and showing a portion of the cam disc to which the cams are secured.

With more detailed reference to the drawing, the numeral **1** designates generally a drilling rig derrick with the drilling rig hoist mechanism or drawworks designated generally at **2**, which drawworks is positioned on the derrick floor. A swivel **4** is suspended by a traveling block **6**, which traveling block is suspended by cable **8**, which cable passes off drum **10** and over crown block sheaves **12** to support the traveling block **6** for upward or downward movement within derrick **1**, as is well understood in the art of well drilling.

The traveling block safety stop, which is designated generally at **14**, is attached, through flexible shaft **16** and angle drive unit **18**, to a drum shaft **20**, which drum shaft is rotatable with the drum **10**. A shaft **22** extends outward from angle drive unit **18** and is connected with drum shaft **20** by means of a tongue member **24** which interconnects with a complementary slotted member **26** of the drum shaft **20**. It is preferable that the gearing on the right angle drive unit **18** be of a character to obtain a reduction of speed of the flexible shaft **16**. The flexible shaft **16** drives into a speed reducer gearing within housing **15** so as to revolve shaft **28** at a low speed ratio with respect to the speed of the drum shaft **20**.

A cam disc **30** is fixedly secured to shaft **28** of speed reducer gearing so as to rotate in geared relation with respect to drum shaft **20**. The peripheral edge of the cam disc **30** is dove-tailed, as indicated at **32**, and as best seen in FIGS. 5 and 8, to receive complementary, dove-tailed, arcuate cams **34**, **34***b*, **35** and **35***b* thereon. The arcuate cams **34** and **35** are relatively long and are disposed on opposite sides of dove-tail periphery **32** in cam disc **30**. The cams **34** and **35** are so positioned that the adjacent end portions will be in side-by-side, overlapping relation so as to present a uniform diameter cam follower roller engaging surface throughout the combined arcuate length of cams **34** and **35**. Shorter cams **34***b* and **35***b* are disposed on opposite sides of dove-tailed portion **32** of cam disc **30**, with the outer end of cam **34***b* being in transversely aligned relation with the outer end of cam **34** and the outer end of cam **35***b* being in transversely aligned relation to the outer end of cam **35**, so that the cam follower roller will simultaneously engage said adjacent transversely aligned ends of the respective cams.

The arrangement of the cams in this manner allows a wide range of adjustments of the cams to be had on cam disc **30**, while a uniform peripheral arcuate cam follower roller surface for cam follower roller **42** to roll upon is maintained, to prevent the cam follower roller **42** from

overrunning the cam to cause the air valve **48** to be opened.

The cams **34**, **34***b*, **35** and **35***b* are held on the disc **30** by means of bolts **36** which bindingly engage the edges of the cam with the periphery of the cam disc **30**.

An arm **38**, which forms a first valve actuator, is pivotally mounted on a pin **40**, which pin is positioned on the upper side of housing **15**. One end of the arm **38** has a cam follower roller **42** journaled thereon, which roller is in aligned relation with cams **34** and **35**. The cams **34**, **34***b*, **35**, and **35***b* each have the roller engaging ends thereof beveled at approximately forty-five degrees, as indicated at **34***a* and **35***a* respectively, to enable the roller **42** to roll up on the respective cams, as will be brought out more in detail hereinafter.

The opposite end of the arm **38** has a set screw **44** threadably engaged therein, which set screw is adapted to engage a slidable plunger **46** in a three-way air valve **48**, which valve **48** is mounted on an outstanding bracket on gear housing **15**, so as to direct air from a supply pipe **50** into a pipe **52** which leads to and through a three-way control valve **54** to a diaphragm chamber **60**, which diaphragm chamber forms a second valve actuator to actuate a four-way air valve **62**. The air valve generally designated at **62** is of the slidable plunger type, as will best be seen in FIG. 4, which valves are sold under various trade names, one of which is Valvair. The valve **62**, when in one position as shown in FIG. 4, will direct air from an air supply line **64** through the valve **62** and out through conduit **66** and through two-way check valve **68** to direct the air into a conduit **70** leading to and through a quick release valve **72** to a pneumatic cylinder **74** to actuate a brake mechanism designated generally at **76**, such as shown in my Patent No. 2,928,505, Brake System for Hoisting Drums, issued March 15, 1960.

Upon movement of valve plunger **65** into position as shown in FIG. 4, the air pressure that was in the particular clutch tube being used, will be vented to atmosphere by opening an axial port in the end of valve **62** opposite the diaphragm chamber **60**, to release the pressure in the particular expansible tube of the clutch mechanism which has been last used, whereby a portion of the air will be passed out through pipe **78** and axial opening in valve **62** to drop the pressure in pipe **78**, which will enable air to be bled out through quick release valve **86**, which will result in the disengagement of the drum clutch, which may at that time be engaged, simultaneously the valve **62** will direct air from supply pipe **64** through conduit **66**, double check valve **68**, and conduit **70** through quick release valve **72** to the brake air cylinder **74**, whereupon the plungers will actuate the brake mechanism **76**, which will engage the brakes thereof with drum **10**.

Upon rotation of cam disc **30** in one direction, the cams **34** and **34***b* will engage roller **42** journaled on arm **38** to depress plunger **46** of valve **48** to open an air passage through valve **48**, or the same action will take place if cams **35** and **35***b* engage the follower roller **42**. However, upon reversal of cam disc **30**, roller **42** will roll off of the respective cams on which they are engaged, to pivot arm **38** about pivot pin **40** to release plunger **46**, which will cause valve **48** to close, which will close the inlet port which leads to air inlet line **50** and open air relief port which will release the pressure from conduit **52** which will cause the spring **63** on valve **62** to then move the valve plunger **65** to open an axial port of the valve **62**, which port is adjacent the diaphragm **60** and which port connects conduit **66** therewith, and also lowers the pressure in conduit **70** connected with conduit **66**. This will permit the quick release valve **72** to exhaust air from pneumatic cylinder **74**, which will release brake mechanism **76**.

The same movement of the valve plunger **65** by the spring **63**, adjacent to the diaphragm chamber which releases the brake mechanism as set out above, also connects the air supply **64** to the conduit **78** which leads to

control valve **83** which supplies air to either the high or low speed drum clutches or releases same, and places the rig in normal operating position.

The turning of the drum shaft **20** of the drawworks **2** turns the shaft **22** of the angle drive unit **18** to which flexible shaft **16** is connected. The opposite end of the flexible shaft **16** is connected to a shaft in gear housing **15**, which gear housing **15** is so geared as to turn shaft **28**, to which cam disc **30** is attached, at a relatively slow speed and in proportion to the revolutions of the drum **10**.

A bolt **36** passes through holes in cams **34** and **34***b* to hold the beveled ends **34***a* thereof in transversely aligned relation, and a bolt **36** passes through cams **35** and **35***b* so as to hold the beveled ends **35***a* thereof in transversely aligned relation.

The cams **34** and **35** overlap transversely so as to present a uniform peripheral diameter so that cam follower roller **42** may either run up on bevel face **34***a* and be maintained on the face of the cam to close valve **48** until the inertia of the moving drum is arrested, or the cam follower roller **42** may roll up on bevel face **35***a* onto the face of the cam, when cam disc **30** is rotating in the opposite direction and which roller **42** remains on the face of the cam **34** or **35** to maintain the valve **48** closed until the drum **10** is arrested. By having the cams **34** and **35** overlapping transversely, such arrangement gives an extended arcuate length of travel of the cams relative to the cam follower roller **42**, thereby obviating the possibility of the cam follower roller rolling off at the opposite end of the cam and opening valve **48** which would allow continued movement of the traveling block **6**.

As the cam follower roller **42** rolls up onto either cam **34** and **34***b* or **35** and **35***b*, the pivoted arm **38** will pivot about pin **40** to actuate valve **48** by depressing plunger **46**, which will admit air through air supply conduit **50** and through three-way valve **48** and direct air out through conduit **52** through valve **54** to act upon diaphragm in diaphragm chamber **60** to move the plunger **65** to the position as shown in FIG. 4. When the cam roller **42** moves off cam **34** and **34***b* or cam **35** and **35***b*, the plunger **46** of valve **48** will move upward, therefore the air will exhaust through conduit **52** and upward through a passage around plunger **46**, in a manner well understood in the art of plunger actuated valves.

Upon release of pressure from conduit **52**, spring **63** in valve **62** will move plunger **65** into position to close the port at the end of the valve opposite diaphragm chamber **60** and open a port around the plunger **65** adjacent the diaphragm chamber **60**.

The conduit **78** which leads from one of the ports of valve **62** connects to a three-way control valve **80**, which has branch conduits **81** and **82** leading therefrom. The conduits **81** and **82** lead through a dual rotary air seal **84** into and through conduits in the shaft of drum **10**, in a manner as shown in my Patent No. 2,774,453, Pneumatic Clutches. The valve **80** has a lever **83** thereon which actuates the valve members therein to selectively direct air either into conduit **81** or into conduit **82** to direct air to the axially expansible air clutch tubes **85** or **87**, respectively. Quick release valves **86** and **88** are mounted within the respective conduits **81** and **82** adjacent the respective air clutch tubes **85** and **87**, so upon release of air from conduits **81** and **82**, respectively, the quick release valves **86** and **88** will quickly bleed the air from the respective air tubes.

It is preferable to have the gear ratio of cam disc **30** to drum shaft **20** about two hundred to one, so upon the normal turning of the drum, which is from fifty to one hundred twenty-five turns, the traveling block **6** will be moved the desired distance in the derrick **1**, depending on the height of the derrick. The cams **34** and **34***b* and **35** and **35***b* may be readily adjusted to actuate mechanisms to stop the traveling block at any desired point in the travel thereof, which engagement of the cams with

the cam follower roller **42** will initiate an action which will disengage either of the clutches and simultaneously apply the brakes of brake mechanism **76**. The cams **34** and **34***b* and **35** and **35***b* are beveled on the respective ends thereof, as indicated at **34***a* and **35***a*, so that the came follower roller **42** will roll up on the face of the respective cams with a gradual rise, so as to prevent an abrupt stopping of the drum **10** of the drawworks **2**. However, the cams **34** and **35** are made with sufficient arcuate length as to overlap transversely so that the roller **42** will move along the face of the cams, in event the momentum of the drum is sufficient to cause an extended rotation of cam disc **30** if the drum **10** is not stopped upon the initial engagement of the respective cam faces **34***a* or **35***a* thereon on roller **42**, thereby preventing damage to either the traveling block safety stop mechanism or to the drawworks traveling block of the drilling rig.

A further control valve **54** is provided with a pedal **55**, which pedal is held upward, as is the plunger connected thereto, by a spring **56**, which valve **54** is connected within conduits **52** and **52***a*, and which conduit **52***a* connects with diaphragm chamber **60**. However, upon depressing pedal **55**, conduit **52** is closed, and conduit **52***a* is opened, so as to bleed the air from the diaphragm chamber **60**, which will permit the spring **63** in valve **62** to shift plunger **65** toward the diaphragm chamber **60**. With the valve **54** depressed, air will bleed out through the axial port on the lower end of valve **54**, whereupon, a manually operated valve **90**, in air supply line **92**, may be opened, which will cause double check valve **68** to shift to direct air into conduit **70**, through quick release valve **72** into air cylinder **74** to actuate the brake mechanism **76** to apply braking action to drum **10**.

If it is desired to have the traveling block **6** travel beyond the position where the traveling block would normally stop at that setting of the cam, the pedal **55** on valve **54** can be depressed by the operator, and this will prevent air from valve **48** reaching the diaphragm valve **62**, and therefore the automatic stop will be inoperative. This will permit the driller to raise the block higher than the position for which it is normally set, and will also permit him to lower the block below the position for which it is normally set, simply by depressing pedal **55** on valve **54**, and by operating lever **83** of clutch control valve **80**.

Having thus fully illustrated and described the invention, what is claimed as new and desired to be secured by Letters Patent is:

1. A safety stop mechanism for selectively stopping the rotation of a power driven winding drum which is mounted on a shaft, a frame mounting the shaft of said winding drum for rotation in either direction, a fluid actuated clutch mounted on the shaft of said winding drum, a fluid actuated brake mounted on said frame and being connected in braking relation with said winding drum, said safety stop mechanism comprising a gear reduction unit mounted on said frame, means operatively connecting said gear reduction unit in driven relation to the shaft of said winding drum, a shaft extending outwardly from a side of said gear reduction unit, a cam disc mounted on said shaft extending outwardly from said gear reduction unit, a cam of effective, adjustable length of at least 30 degrees of arcuate length operably mounted on said cam disc and being rotatable therewith about the axis of said shaft and in unison therewith, a first valve actuator pivotally mounted on said gear reduction unit, a cam follower mounted on said first valve actuator and being actuated by said cam on said cam disc when said shaft is rotated, a first fluid supply conduit to supply fluid under pressure, a first valve mounted on said gear reduction unit and connected in fluid communication with said first fluid supply conduit, said first valve being operable by said first valve actuator upon movement of said cam, a second valve actuator, said second valve actuator being operable by fluid pressure from said fluid supply conduit, a fluid conduit connecting

the outlet of said first valve and said second valve actuator in fluid communication, a second valve, said second valve being connected in actuating relation with said second valve actuator, a second fluid supply conduit connected to said second valve, branch conduits leading from said second valve, one of said branch conduits being connected with the fluid actuated clutch, the other of said branch conduits being connected with the fluid actuated brake, so the fluid actuated clutch and the fluid actuated brake respectively will be actuated simultaneously, but inversely, upon movement of said second valve by said second valve actuator in synchronous relation to the cam actuated first valve to direct fluid from said fluid actuated clutch and to direct fluid under pressure to said fluid actuated brake respectively to stop the rotation of said winding drum.

2. A safety stop mechanism for selectively stopping the rotation of a power driven winding drum which is mounted on a shaft, a frame mounting the shaft of said winding drum for rotation in either direction, which winding drum has a fluid actuated clutch mounted on the shaft thereof, a fluid actuated brake mounted on the frame and being connected in braking relation with said winding drum, said safety stop mechanism comprising a gear reduction unit mounted on said frame and being operatively connected in driven relation to the shaft of said winding drum, a shaft extending outwardly from a side of said gear reduction unit, cam mounting means fixedly secured to said shaft which extends outwardly from said gear reduction unit, cam means of an effective, adjustable arcuate length operably mounted on said cam mounting means and being rotatable therewith about the axis of said outwardly extending shaft, a fluid supply conduit to supply fluid under pressure, a first valve mounted on said gear reduction unit and being connected in fluid communication to said fluid supply conduit, a valve actuator arm to form a first valve actuator pivotally mounted on said gear reduction unit, a cam follower roller journaled on said valve actuator arm and being adapted to engage said cam, the opposite end of said valve actuator arm being engageable with said first valve to actuate said first valve, a second valve actuator, which valve actuator is operable by pressure, a fluid conduit connecting the outlet of said first valve and said second valve actuator in fluid communication, a second valve connected in mechanical relation to said second valve actuator, so upon movement of said first valve actuator, fluid under pressure will be directed through the fluid conduit connecting said first valve and said second valve actuator to actuate said valve, a second fluid supply conduit connected to said second valve, two branch conduits connected to said second valve, one of said branch conduits being connected to the fluid actuated brake, said second valve having the other branch conduit connected to the fluid actuated clutch, said second valve being adapted to direct fluid under pressure selectively to either the fluid actuated brake or the fluid actuated clutch and to simultaneously release pressure from the other of said mechanisms to actuate the fluid actuated clutch and the fluid actuated brake to selectively control the rotation of the winding drum.

3. A safety stop mechanism as defined in claim 2, wherein said cam mounting means comprises a disc-like element, and wherein said cam means comprises at least two cams which are attachably and adjustably secured, at spaced circumferential intervals, on opposite flat faces of said disc-like element, which cam follower roller element engages with said cams, and wherein the transverse periphery of said cams presents an uninterrupted arcuate track for said cam follower roller throughout the length of said cams when said cams are in a selected adjusted position.

4. A safety stop mechanism as defined in claim 2, wherein said cam mounting means comprises a disc-like element, and wherein said cam means comprises at least

two cams which are attachably and adjustably secured, at spaced circumferential intervals, on opposite flat faces of said disc-like element, and wherein the transverse periphery of said cams presents an uninterrupted track, throughout the length of said cams, for said cam follower roller when said cams are in a selected adjusted position, and wherein the composite length of said arcuate cams is adjustable, but said arcuate track contacting said roller will be maintained a uniform height throughout the travel of said cam follower roller.

5. A safety stop mechanism for a winding drum mounted on a frame, which winding drum has a rotating shaft, said safety stop mechanism comprising a gear reduction mechanism connected in geared relation to said rotating winding drum shaft, said gear reduction mechanism having an outwardly extending shaft, a member mounted on said outwardly extending shaft and being rotatable therewith, a plurality of independently movable, circumferentially adjustable projections mounted on said rotatable member, a first valve mounted on said gear reduction mechanism, a first fluid supply conduit connected to said first valve, a first valve actuator pivotally mounted on said gear reduction mechanism and having an end thereof positioned to engage said first valve when said first valve actuator is in one position, the other end of said first valve actuator having means thereon engageable with said projections on said rotatable member to selectively open said first valve when said rotatable member rotates in either direction to selectively direct fluid through said first valve and through said first fluid supply conduit, said gear reduction mechanism being adapted to rotate said rotatable member in timed relation with the shaft of said winding drum, a second fluid supply conduit, a second valve, a fluid actuated clutch mounted on the shaft of said winding drum, a fluid actuated brake mounted on the frame in braking relation with said winding drum, a second valve actuator, said first fluid supply conduit being connected to said second valve actuator, said second valve having said second fluid supply conduit connected to the inlet thereof, branch conduits leading from said second valve, one of said branch conduits being connected in fluid communication with said fluid actuated clutch, the other of said branch conduits being connected with said fluid actuated brake so upon fluid being directed through said first valve to said second valve actuator, fluid will be directed from said fluid actuated clutch to disengage said drum from said drum shaft, which fluid will exhaust through said second valve, and fluid will be directed from said second valve to said branch conduit which leads to said fluid actuated brake to engage said fluid actuated brake in braking relation with said winding drum.

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