May 2, 1967 R. H. CULLEN ETAL 3,317,103

APPARATUS FOR HANDLING HOSE OR SIMILAR ELONGATE MEMBERS

Filed May 3, 1965 2 Sheets-Sheet 1

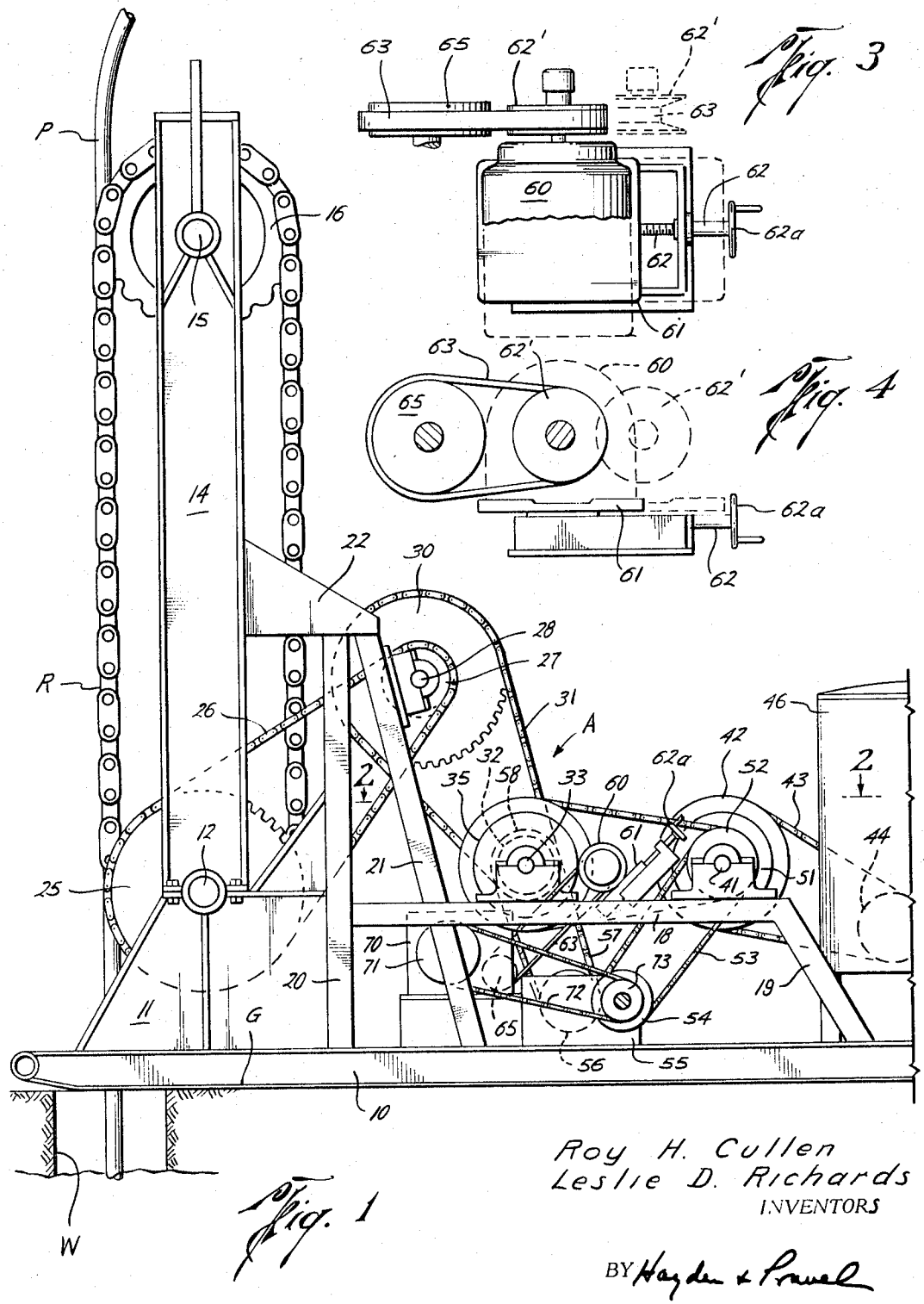


Fig. 1




Fig. 3




Fig. 4

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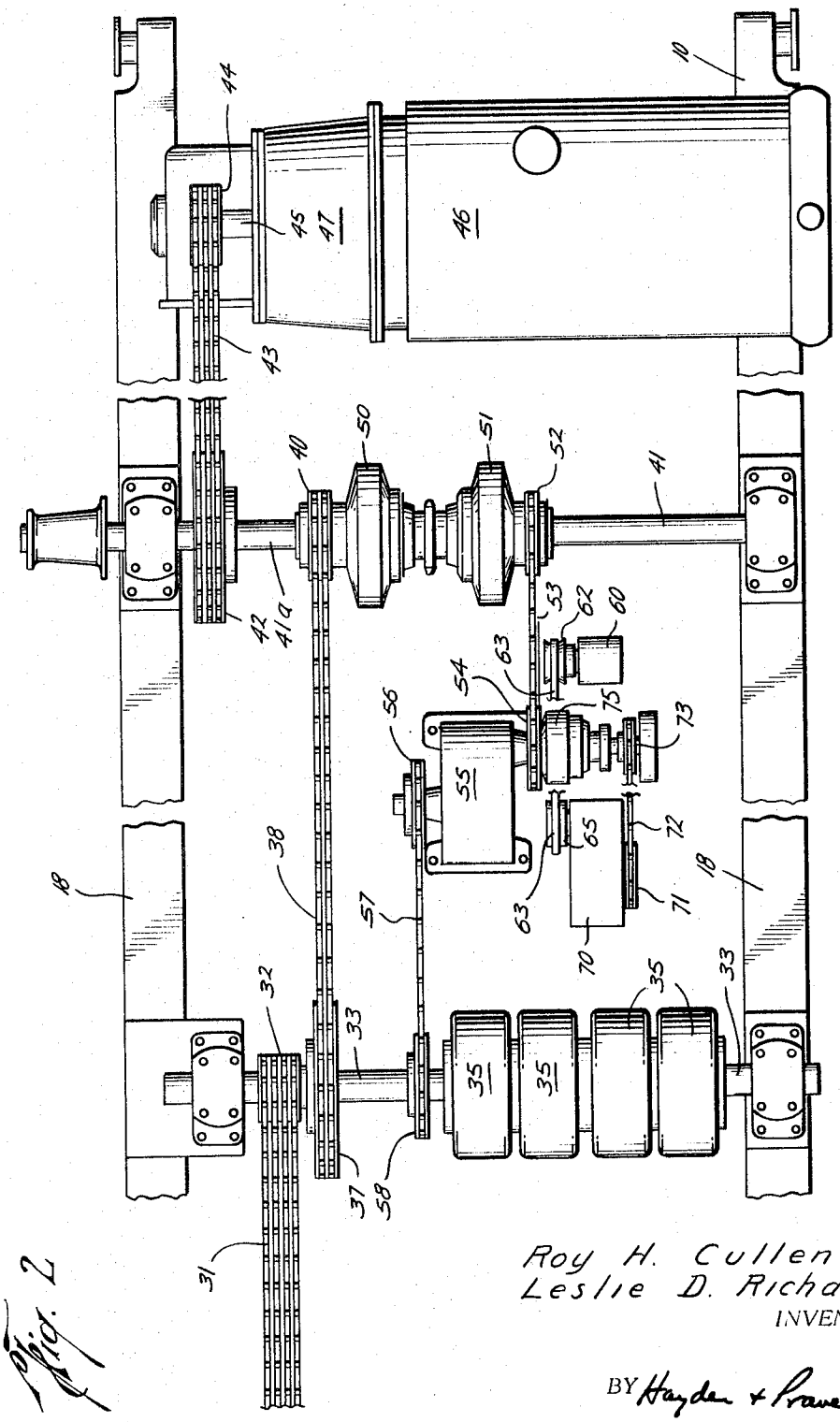


Fig. 2

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3,317,103

# APPARATUS FOR HANDLING HOSE OR SIMILAR ELONGATE MEMBERS

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3 Claims. (Cl. 226—173)

This invention relates to new and useful improvements in apparatus for handling hose or similar elongate members.

In United States Patent No. 2,892,535, an apparatus is disclosed for handling an elongate member, such as a flexible pipe or hose, in well operations. The present invention is an improvement on such apparatus in that it provides a new and improved control assembly for such apparatus which controls the feeding-off or lowering of the flexible pipe or hose with the apparatus. Although such control assembly is particularly suitable for use with the apparatus of said Patent No. 2,892,535, it may be used with other apparatus for feeding-off or lowering an elongate member.

It is therefore an object of this invention to provide a new and improved control assembly which is suitable for use with apparatus such as that disclosed in United States Patent No. 2,892,535, or similar apparatus, for controlling the feed-off or lowering of an elongate member with such apparatus.

Another object of this invention is to provide a new and improved apparatus wherein an elongate member such as a flexible drill pipe or hose having a drill bit at the lower end thereof is fed or lowered at a controlled rate which is related to the rate of drilling progress so that the proper weight can be maintained on the drill bit during drilling.

A further object of this invention is to provide a new and improved apparatus for raising and lowering an elongate member, wherein a main drive is provided for stopping or retarding the lowering of the elongate member, and an auxiliary drive means is provided for overriding the braking action to control the feed-off or lowering of the elongate member.

The preferred embodiment of this invention will be described hereinafter, together with other features thereof, and additional objects will become evident from such description.

The invention will be more readily understood from a reading of the following specification and by reference to the accompanying drawings forming a part thereof, wherein an example of the invention is shown, and wherein:

FIG. 1 is an elevation, partly in section, illustrating the preferred form of the apparatus of this invention;

FIG. 2 is a plan view taken on line 2—2 of FIG. 1, but illustrating the apparatus in a horizontally extended position to more clearly illustrate the relationship of the parts thereof;

FIG. 3 is a plan view illustrating one type of variable speed motor used in the apparatus of FIG. 1; and

FIG. 4 is an elevation, partly in dotted lines, illustrating the variable speed motor of FIG. 3.

In the drawings, the letter A designates generally the apparatus of this invention which includes an endless assembly or retractor R, preferably of the type illustrated in United States Patent No. 2,892,535, or other suitable apparatus for handling an elongate member P such as a flexible pipe or hose. Briefly, the apparatus A is adapted to be operated so that the flexible pipe P is raised and lowered with respect to a well W, generally for the purpose of drilling such well W. A drill bit (not shown) of conventional construction is normally disposed at the lower end of the flexible pipe P, and by reason of the improvements present in the present apparatus A, the rate of feed-off or lowering of the flexible pipe P and the drill bit therewith is controlled so as to be properly related to the rate of drilling progress with the bit in the particular formations encountered during the drilling of the well W.



Considering the invention more in detail, the apparatus A preferably includes a skid or base **10** upon which the entire apparatus A is mounted to facilitate the moving of the apparatus A to different drilling locations. The skid or base **10** rests upon the ground G or substructure at the location for the drilling of the well W. The skid **10** has suitable framework welded or otherwise mounted thereon, including spaced support plates **11** for supporting a pair of laterally spaced stub shafts **12**. A pair of spaced upright frame members **14** are bolted or otherwise secured to lower frame members **11** for the purpose of supporting upper stub shafts **15** which are laterally spaced with respect to each other. The framework also includes laterally spaced horizontal frame bars **18** which are welded or otherwise suitably joined to angled or vertical frame members **19** and **20**. A brace **21** connected to a triangular shaped frame element **22** is provided for each of the upright frame members **14** to strengthen same if desired.

In the preferred form of the invention, the upper stub shafts **15** each preferably has an upper sprocket **16** rotatably mounted thereon for engagement with the links of the endless assembly R. Similarly, each of the lower stub shafts **12** has a lower sprocket (not shown) thereon which engage with the links of the endless assembly R. At least one of such lower sprockets is usually driven by driving a sprocket **25** mounted on the shaft **12**, and outwardly connected to a driving source, as will be more fully explained.

Chains or drive belts **26** are disposed around the sprocket **25** and are operably connected with a small diameter sprocket **27** mounted on a sprocket shaft **28**. Preferably, such sprocket shaft **28** is suitably mounted on the pair of laterally spaced angled braces **21** (FIG. 1). A large diameter sprocket **30** is also mounted on the sprocket shaft **28** and it has chains or drive belts **31** operably connected thereto and also to a smaller diameter sprocket **32** disposed on a brake shaft **33** (FIGS. 1 and 2).

The brake shaft **33** preferably has a plurality of brakes **35** of the electric actuation type mounted on the brake shaft **33** for stopping the rotation of the shaft **33** and the parts operably connected thereto so as to provide a holding means for the endless assembly R. Another sprocket **37** is mounted on the shaft **33** to which chains or drive belts **38** are operably connected. The other end of the endless chain **38** is disposed on a smaller diameter sprocket **40** which is mounted on a clutch shaft **41**. The clutch shaft **41** has a large diameter sprocket **42** mounted thereon with chains or drive belts **43** extending therefrom to a sprocket **44** on the drive shaft **45** of the main drive means or engine **46**. Such main drive engine **46** is of conventional construction and is either a diesel, gasoline, or other type of engine which has therewith a torque converter or fluid drive **47** for driving the shaft **45**.

The clutch shaft **41** has clutches **50** and **51** mounted thereon so that either of such clutches may be connected for operation, as will be explained, or they may be both disconnected, as will also be explained. Thus, when the clutch **51** is disengaged and the clutch **50** is engaged, the rotation of the shaft portion **41***a* leading from the sprocket **42** imparts a rotation to the sprocket **40** and thus drives the chain **38** for operating the sequence of chains up to the sprocket **25**, whereby the sprocket **25** is turned in a clockwise direction as viewed in FIG. 1 to effect a raising of the flexible pipe P with the endless assembly R as the gripping elements of the assembly R pull the pipe P upwardly during the rotation of the endless assembly R.

However, when the clutch **50** is disengaged the drive

from the shaft 41*a* is not transmitted to the sprocket 40, but instead the drive is transmitted to a sprocket 52 which has a chain or drive belt 53 connected thereto and also to a sprocket or pulley 54 on a gear reducer 55. The gear reducer 55 has a sprocket 56 on the output side thereof to which is connected a chain or belt 57 and which is also connected to a sprocket or pulley 58 on the brake shaft 33. The direction of rotation of the shaft 33 is reversed when driving through the clutch 51 as compared to when driving through the clutch 50 by reason of the gear drive 55 so that the sprocket 25 is rotated counterclockwise when the clutch 51 is engaged to lower the flexible pipe P with the endless assembly R.

When the elongate member P has been lowered to the point at which drilling is to proceed with the drill bit (not shown) on the bottom of the well W, the rate of feed-off or lowering of the flexible pipe P is controlled by disengaging the clutches 50 and 51 so that the motor or engine 46 is completely inoperative insofar as driving the endless assembly R is concerned. Such feed-off or lowering during drilling is controlled by an auxiliary drive means which in the preferred form of the invention includes a hydraulic or fluid-driven motor 60, preferably of the variable speed type which is controlled by the operator who may vary the hydraulic fluid volume supplied to the motor 60. The motor 60 may be operated by electricity or by any other suitable means, but in the present form it is operated by hydraulic fluid. Such motor 60 is made so that it can be moved on a fixed base 61 or other suitable support for changing the diameter of a pulley 62 which is driven by the motor 60. For the purpose of changing the position of the motor 60 on the base 61, a threaded crank shaft 62 having a handle 62*a* is preferably provided so that when the pulley 62 is in the solid line position of FIG. 3, the diameter of the pulley 62 is at the maximum for providing a maximum speed for the drive belt 63 connected thereto. When the pulley 62 has been spread apart in the conventional manner by adjusting to the dotted line position of FIG. 3, the pulley 62 is in its minimum diameter position and the belt 63 connected thereto is likewise being operated at the minimum speed. Such expansible type of pulley 62 is of conventional construction for providing variable speeds with the motor 60. The belt 63 is connected to a driven pulley 65 which is mounted on a shaft of a gear reducer 70. The gear reducer 70 has a pulley or sprocket 71 mounted on the output side thereof to which is connected a chain or pulley 72 which has connection with a belt or sprocket 73 mounted on the same shaft as the sprocket or pulley 54. A clutch 75 is disposed on the shaft carrying such sprocket or pulley 73 so that when the clutch 75 is engaged, the auxiliary drive motor 60 is imparting rotation through the gear drive 55 to the brake shaft 33. It will be understood that when the clutch 75 is engaged, the clutches 50 and 51 are disengaged, and suitable safety apparatus is provided for preventing a connection of the clutch 75 when either of the clutches 50 or 51 are engaged.

In the operation or use of the apparatus A of this invention, the flexible pipe or hose P is initially lowered into the well W to the bottom thereof, so that drilling can proceed to a greater depth. During such running in or lowering of the flexible pipe or hose P, the weight of the flexible pipe P and other weights suspended therefrom such as drill collars and drill bit (not shown) may be sufficient to cause the drill pipe P to move downwardly by the force of gravity, but normally the friction involved in the endless assembly R is such that it is necessary to rotate the endless assembly R in a counterclockwise direction for running the pipe P into the hole of the well W. For such purpose, the engine 46 is utilized with the clutch 50 disengaged and with the clutch 51 engaged. The clutch 75 is also disengaged. Therefore, the drive from the engine 46 is through the chain 43, the chain 53, the chain 57, the chain 31 and the chain 26 to the drive sprocket 25 on the shaft 12. The sprocket 25 and the drive sprocket for the endless assembly R are thus rotated



in a counterclockwise direction to overcome the friction and to cause the endless assembly R to rotate counterclockwise for the downward feeding or lowering of the pipe P until the bit on the lower end thereof reaches the bottom of the hole in the well bore W.

It has been found that when the length of the drill pipe or hose P which is suspended by the endless assembly R is approximately 600 feet, the weight of the suspended pipe and the parts connected thereto is sufficient to overcome the friction of the endless assembly R and cause a feeding downwardly of the pipe P by gravity. The length of 600 feet is merely by way of example since the point of which the weight becomes sufficient to overcome friction and thereby become self-feeding varies depending upon the weight of the drill collars and other suspended weight on the drill pipe P. In any event, when the length of the pipe P and the weights suspended therewith are sufficient to feed same by gravity rather than by the forced feeding through the drive at the engine 46, a braking action is utilized to prevent the apparatus from running away or lowering too fast. For this purpose, the brakes 35 may be applied to some extent; but normally the braking action occurs through a retarding affect in the conventional torque converter 47 attached to the engine 46. Thus, the engine 46 is operated at an idling speed with the clutch 50 engaged and the force exerted on the torque converter 47 causes the converter 47 to be driven and thereby resists the downward pull thereon from the moving flexible pipe P as it is lowered in the well W. Electrical brakes 35 may be applied to some extent to assist the action of the torque converter 47, again depending upon the extent of the weight and the speed of lowering desired.

When the drill bit (not shown) has reached the bottom of the well W, it is difficult, and often impossible, to control the feed-off of the pipe P so as to correlate it with the speed of drilling with the bit by using the engine 46, the torque converter 47, and the brake 35. Therefore, the present invention includes the control apparatus which has the auxiliary motor 60 connected as previously described to the brake shaft 33 through the clutch 75. Thus, with the drill bit on the bottom of the hole, the clutches 50 and 51 are disengaged and the clutch 75 is engaged. The brakes 35 are partially set, and the motor 60 is operated so as to override or overcome the braking action of the brakes 35. With such operation, the feeding-off of the flexible pipe P is controlled in accordance with the speed of the motor drive provided by the variable speeds set-up illustrated in particular in FIG. 3 and FIG. 4, wherein the speed from the variable speed motor 60 is varied by changing the hydraulic fluid volume to the motor; and if it is desired to change the speed range, this may be accomplished through the adjustment of the variable diameter pulley 62. Of course, other types of variable speed drives may be employed; but in any event, the drive with the motor 60 is such that it overcomes or overrides the braking action 35 enough to feed the pipe P downwardly as the drilling progresses. The operator of the apparatus at the surface of the well may observe the weight indicator so that he will know when the drill bit is on bottom and drilling properly, and he can adjust the speed of the motor 60 so that the speed is coordinated with the rate of drilling progress in each formation encountered. Thus, when a relatively porous or sandy formation is encountered through which the drill bit may move rapidly, the feed-off with the motor 60 is increased, whereas when hard rock or other difficult formations are encountered so that the rate of drilling with the bit is slow, the speed of feed-off with the motor 60 is accordingly reduced. The braking action with the brakes 35 is set so that it is just capable of holding the weight of the drill pipe P and the weights suspended therefrom when the motor 60 is disengaged with the clutch 75. In other words, when the clutch 75 is disengaged, the brakes 35 are set

so that they prevent any downward movement of the drill pipe P until such brakes **35** are released. It is to be noted that the motor **60** can be operated in reverse for limited raising of the pipe P to reduce the load on the drill bit during drilling.

When it is desired to pull the flexible pipe P out of the well W, the clutch **75** is disengaged, the clutch **50** is engaged, then the brakes **35** are released so that the chain **38** is operable to drive the brake shaft **33** for rotating the sprocket **25** clockwise to thereby rotate the endless assembly R and the gripping elements therewith clockwise as viewed in FIG. 1.

The foregoing disclosure and description of the invention is illustrative and explanatory thereof; and various changes in the size, shape, and materials, as well as in the details of the illustrated construction, may be made within the scope of the appended claims without departing from the spirit of the invention.

What is claimed is:

**1.** In an apparatus for handling flexible pipe having a drill bit and motor suspended therefrom wherein such apparatus includes an endless means for raising and lowering such flexible pipe in a well, the improvement residing in a control assembly for controlling said lowering, which control assembly includes:

(a) a drive shaft operably connected to drive said endless means,

(b) a main drive means operably connected to said drive shaft for the operation of the endless means,

(c) first clutch means for connecting and disconnecting said main drive means from said drive shaft,

(d) an auxiliary drive means adapted to be operably connected to said drive shaft for obtaining a controlled rate of lowering of the flexible pipe when said main drive means has been operably disconnected from said drive shaft, and

(e) second clutch means for connecting and disconnecting said auxiliary drive means with said endless means.



**2.** The structure set forth in claim **1**, including:

(a) brake means connected to said endless means and adapted to exert a braking action on the endless means, and

(b) said auxiliary drive means being operable to override the braking action of the braking means sufficiently to obtain the controlled rate of lowering of the flexible pipe.

**3.** The structure set forth in claim **1**, including:

(a) brake means connected to said endless means and adapted to exert a braking action on the endless means, and

(b) said auxiliary drive means including:

(1) a variable speed fluid actuated motor, and

(2) means for varying the speed of the motor so as to vary the amount of drive by the auxiliary drive means in overriding the brake means.

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