May 25, 1965 C. T. KLEM 3,185,310

ROCK DRILL PIPE STORAGE AND HANDLING DEVICE

Filed March 11, 1963 3 Sheets-Sheet 1

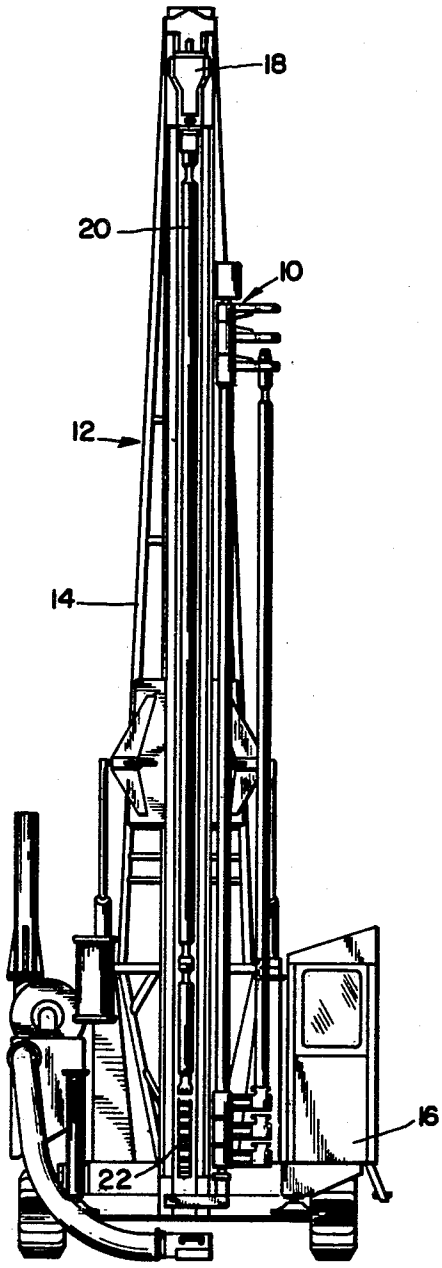

FIG. 1

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ROCK DRILL PIPE STORAGE AND HANDLING DEVICE

Filed March 11, 1963 3 Sheets-Sheet 2

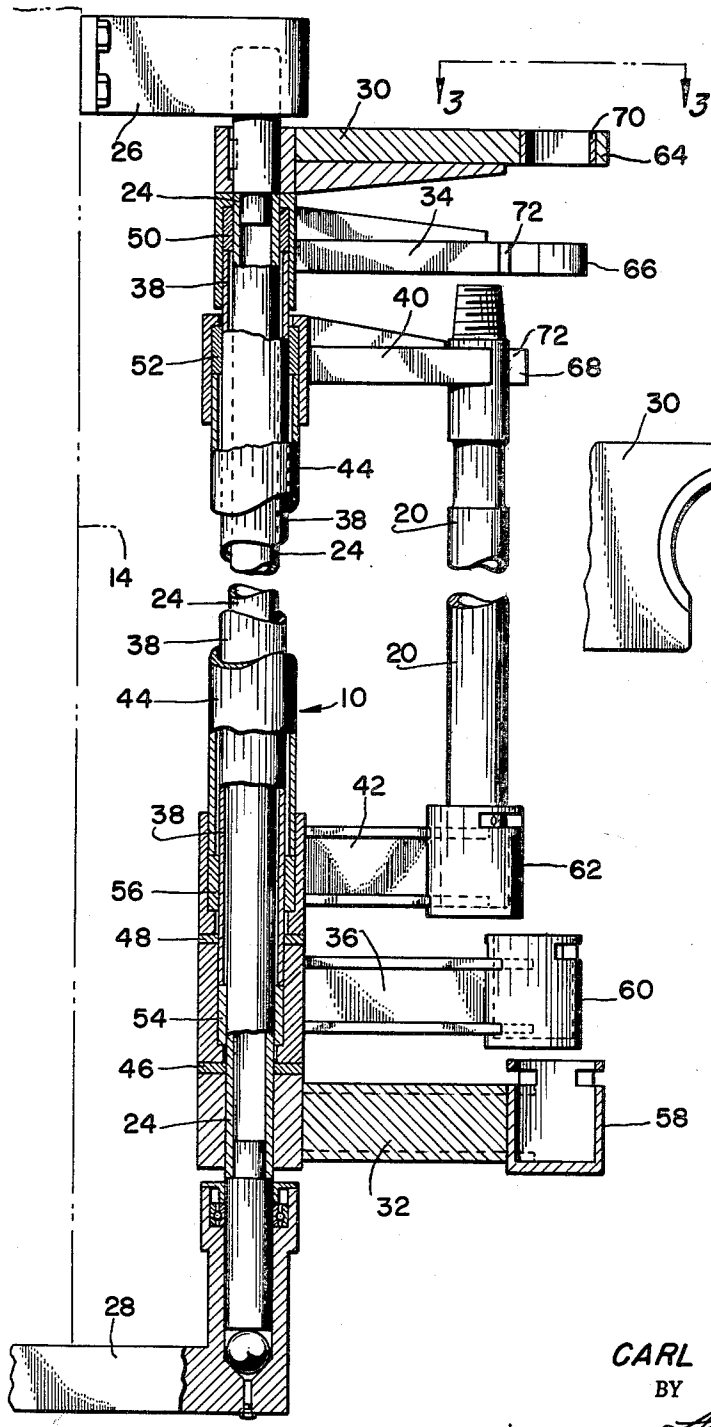

FIG. 2

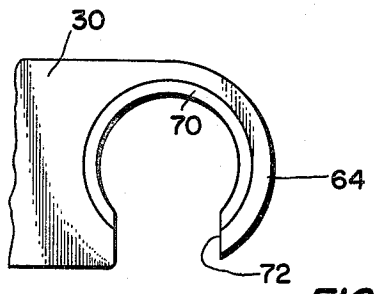

FIG. 3

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ROCK DRILL PIPE STORAGE AND HANDLING DEVICE

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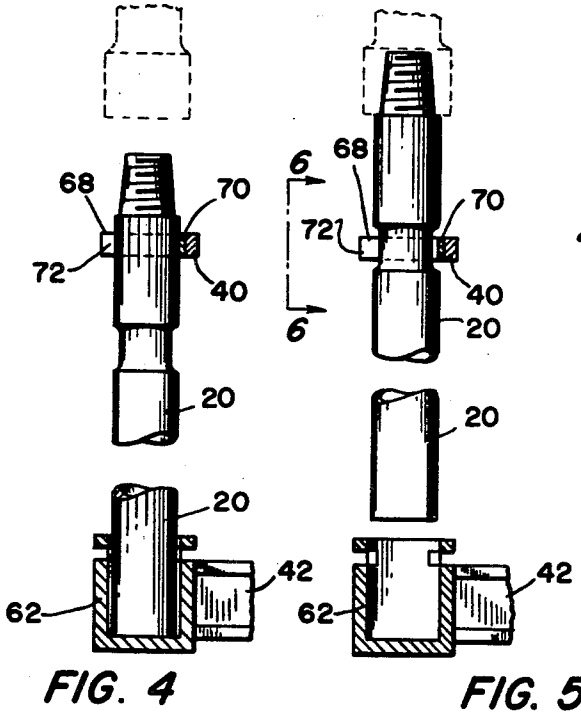

FIG. 4

FIG. 5

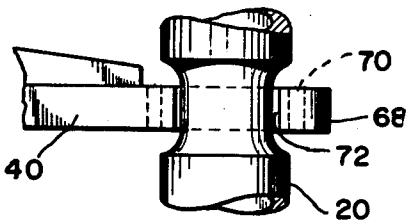

FIG. 6

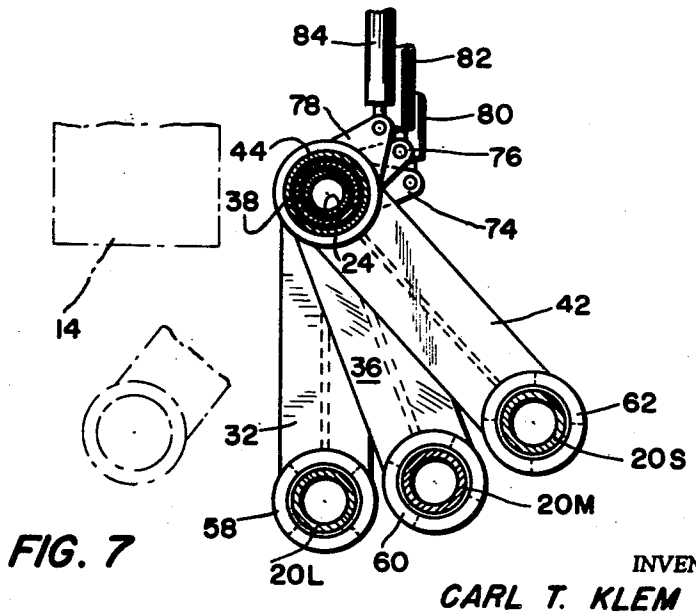

FIG. 7

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ROCK DRILL PIPE STORAGE AND HANDLING DEVICE

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5 Claims. (Cl. 211—60)

This invention relates to rock drilling apparatus in general and more in particular to rock drill pipe storage and handling equipment for a rock drilling apparatus.

In presently used rock drill pipe storage and handling equipment for a rock drilling apparatus, the operation of the various components of the rock drill pipe handling device requires automatic and remotely controlled control mechanisms to provide for proper functioning of the various components of the device. The structure of this type of rock drill pipe storage and handling device is extremely complicated requiring high costs of manufacture and maintenance. Since this type of rock drill pipe handling device is frequently exposed to rough handling because of the nature of operations associated with rock drilling, maintenance costs are accordingly high.

An object of this invention is to provide a simple type of rock drill pipe handling device.

Another object of this invention is to provide a rock drill pipe handling device which is economical to manufacture.

Yet another object of this invention is to provide a rock drill pipe handling device which is durable and efficient.

The nature of the invention will be readily understood from the following description when read in connection with the accompanying drawings in which:

FIGURE 1 is a front view of a rock drilling apparatus equipped with a rock drill pipe storage and handling device according to this invention,

FIG. 2 is a longitudinal sectional view of the rock drill pipe storage and handling device,

FIG. 3 is an enlarged view of one of the drill pipe retainers of the drill pipe storage and handling device looking in the direction of the arrows 3—3 of FIG. 2,

FIGS. 4 and 5 show the positions of a drill pipe, respectively, when supported by the associated pair of arms, and when raised to be removed from the associated pair of arms,

FIG. 6 is an enlarged view of a retainer and a portion of a drill pipe received in the retainer looking in the direction of the arrows 6—6 of FIG. 5, and

FIG. 7 shows the position of the lower arms of the device when in a retracted position relative to the drill hole and to the tower structure of the rock drilling apparatus.

Referring to the drawings, the novel drill pipe storage and handling device is designated 10 and is shown in FIG. 1 in association with a commonly known type rotary drilling apparatus designated 12. The drilling apparatus comprises a vertical derrick or tower structure 14 mounted on a mobile base 16 (partly shown). A rotary head or drill rotating mechanism 18 is movably mounted on the tower structure 14 to be longitudinally guided along the tower structure to rotate the drill pipes 20 forming the drill string. Rotary head 18 is connected to a motor actuated feed chain 22 which serves to move the rotary head longitudinally along the tower structure to lower the drill string into the hole being drilled, or to raise the drill string from the hole being drilled. The drill string is made up of drill pipes 20 screwed in end to end relation to each other. The drill pipes to be added to the drill string are transferred from the drill pipe storage and handling device to the rotary head 18 while the drill pipes

detached from the drill string are transferred from the rotary head to the drill pipe storage and handling device in a commonly known manner.

Referring to FIG. 2, the novel drill pipe storage and handling device 10 preferably comprises means to store and handle three drill pipes 20. The device includes a central shaft 24 journaled for rotation about its axis and supported by suitable bearings in upper and lower brackets 26, 28, respectively, mounted on the side of the tower structure 14. A pair of longitudinally spaced arms 30, 32 is rigidly connected to central shaft 24 to rotate with central shaft 24 about the axis of central shaft 24, arm 30 being connected to the upper end portion of central shaft 24, and arm 32 being connected to the lower end portion of central shaft 24. A second pair of longitudinally spaced arms 34, 36 is rigidly mounted on a hollow shaft 38 for rotation therewith about central shaft 24, and a third pair of longitudinally spaced arms 40, 42, is rigidly mounted on a hollow shaft 44 for rotation therewith about shaft 38. Arm 34 is mounted forwardly of and adjacent arm 30 while arm 40 is mounted forwardly of and adjacent arm 34. Arm 36 is mounted rearwardly of and adjacent arm 32 while arm 42 is mounted rearwardly of and adjacent arm 36.

Shaft 38 for carrying arms 34 and 36 is supported by a thrust bearing 46 which in turn is supported by the portion of arm 32 connected to shaft 24 while shaft 44 for carrying arms 40 and 42 is supported by a thrust bearing 48 which in turn is supported by the portion of arm 36 connected to shaft 38. The upper and lower end portions of shafts 38 and 44 are mounted in suitable bearings for rotation about the associated shafts, the upper end portions of shafts 38 and 44 being received in bearings 50, 52, respectively, and the lower end portions of shafts 38 and 44 being received in bearings 54, 56, respectively. With this arrangement each pair of arms 30 and 32, 34 and 36, and 40 and 42, is independently rotatable relative to each other about a common axis, the axis of central shaft 24.

Each of the lower arms 32, 36, 42 is provided with a cup-shaped receiver 58, 60, 62, respectively, mounted in axial alignment with each other on the free end of the associated arm to receive and carry the forward or lower end of a drill pipe. The upper arms 30, 34, 40 are each provided with a retainer 64, 66, 68, respectively, mounted in axial alignment with each other and in axial alignment with receivers 58, 60, 62 on the free end of the associated arm to receive and retain the rearward or upper end of a drill pipe. The arms of each pair of arms are so spaced to provide for a short, medium, and a long drill pipe to be stored and handled by the drill pipe handling device, i.e., a short drill pipe 20S is carried by arms 40, 42, a medium pipe 20M is carried by arms 34, 36, and a long drill pipe 20L is carried by arms 30, 32.

The retainers 64, 66, 68 are each in the form of a lined bushing 70 having an inner diameter slightly larger than the outer diameter of the drill pipes to receive the upper end portion of a drill pipe, see FIG. 3. A portion of the bushing is cut out to form a radial passage 72 through the wall of the bushing, the width of passage 72 being smaller than the outer diameter of the drill pipes and smaller than the inner diameter of the bushing. This arrangement has been made to provide for a simple and economical manner of retaining the drill pipe in storage position in the drill pipe handling device. Each drill pipe is provided at its upper end portion or second end portion with a reduced portion, the diameter of which being slightly smaller than the width of passage 72. When the drill pipe is in storage position with the lower end or first end portion supported by the bottom of, for example, the receiver 62 of arm 42, the upper end of the drill pipe extends upwardly of retainer 68 of arm 40. In

this position the reduced portion of the drill pipe is positioned forwardly of arm 40 as shown in FIG. 4, and since the width of passage 72 is smaller than the outer diameter of the drill pipe, the upper end portion of the drill pipe is prevented from passing through passage 72.

When the drill pipe 20 is to be removed from arms 40, 42 of the drill pipe handling device 10, drill pipe 20 is raised from a storage position as shown in FIG. 4 to a position as shown in FIG. 5. In the latter position, the first end portion or lower end of the drill pipe 20 is slightly higher than the upper end of receiver 62 of arm 42 while the reduced portion at the upper end portion or second end portion of the drill pipe is positioned in the bushing and at the same height of passage 72 of retainer 68 to permit passage of the reduced portion of the drill rod through passage 72 of retainer 68.

The drill pipe handling device is mounted on the side of the tower structure and serves to store drill pipes as well as to provide for each pair of arms and associated retainers and receivers with or without a drill pipe to be actuated from a storage or retracted position into a position in axial alignment with the rotary head 18 of the drilling apparatus and with the hole being drilled. Actuation of each pair of arms 30, 32; 34, 36; and 40, 42, is achieved by providing each lower arm 32, 36 and 42 with an ear 74, 76, 78, respectively, see FIG. 7, and connecting each ear to a suitable and commonly known hydraulic cylinder and piston type motor (partly shown) 80, 82, 84, respectively. Each hydraulic motor (partly shown) has one end connected to the tower structure 14 and the other end to the associated ear to provide for each pair of arms of the drill pipe handling device to be independently actuated from a predetermined storage position, see FIG. 7, to a position in axial alignment with the rotary head 18 of the drill hole.

Operation

During drilling operations when drill pipes are to be added to the drill string as the hole being drilled deepens, the drill pipes 20 in the drill pipe handling device 10 are held in a pattern as shown in FIG. 7, the long drill pipe 20L supported by arms 30, 32, the medium drill pipe 20M supported by arms 34, 36, and the short drill pipe 20S supported by arms 40, 42. The order of positioning the drill pipes in axial alignment with the rotary head 18 of the drilling apparatus is the long drill pipe 20L first, then the medium drill pipe 20M, and thereafter the short drill pipe 20S. To position drill pipe 20L in axial alignment with the rotary head 18, the associated hydraulic motor is operated to cause arms 30, 32 to swing drill pipe 20L from a storage position to the proper position in axial alignment with the rotary head 18. Rotary head 18 being in its uppermost position is first lowered to be connected to drill pipe 20L and thereafter raised to permit arms 30, 32 as explained hereinbefore with respect to the reduced portion of each drill pipe to be retracted by the associated hydraulic motor to their original storage position. For the addition of the next drill pipe to the drill string, arms 34, 36 supporting drill pipe 20M are swung out by the associated hydraulic motor to position drill pipe 20M in axial alignment with the rotary head 18. As arms 30, 32 are wider spaced from each other than arms 34, 36, arms 34, 36 are permitted to pass between arms 30, 32 when moved from the storage position rearward of arms 30, 32, to a position in axial alignment with the rotary head 18, and from the latter position to their original storage position. Likewise, arms 34, 36 being wider spaced from each other than arms 40, 42, arms 40, 42 are permitted to pass between arms 34, 36 when moved from the storage position rearward of arms 34, 36 to a position in axial alignment with the rotary head 18, and from the latter position to their original storage position.

From the foregoing description it is readily apparent that when drill pipes are to be detached from the drill string, the order of detaching the drill pipes for storage in the drill pipe handling device is: a short drill pipe 20S first, then a medium drill pipe 20M, and thereafter, a long drill pipe 20L, a reverse operation relative to the operation of adding drill pipes to the drill string, as hereinbefore described.

While there is shown and described a specific form of the invention, it is to be understood that various changes and modifications may be made without departing from the spirit of the invention as set forth in the appended claims.

I claim:

1. In combination:
(*a*) a drill pipe,
(*b*) a base,
(*c*) a shaft supported by said base,
(*d*) a pair of longitudinally spaced arms mounted on said shaft for supporting said drill pipe,
(*e*) the free end of one of said arms having a receiver for the first end portion of said drill pipe to carry said drill pipe,
(*f*) the free end of the other arm having a bushing to receive the second end portion of said drill pipe, the second end portion of said pipe being provided with a reduced portion,
(*g*) said bushing and said drill pipe having means to cooperate with each other to permit removal of said second end portion of said drill pipe radially from said bushing when said reduced portion of said second end portion of said drill pipe is positioned in said bushing and to prevent removal of said second end portion of said drill pipe radially from said bushing when said reduced portion of said second end portion of said drill pipe is positioned longitudinally beyond said bushing.

2. The combination claimed in claim 1 in which said cooperating means include:
(*a*) said reduced portion of said drill pipe having a reduced width relative to the width of said second end portion of said drill pipe, and
(*b*) a radial passage formed through the wall of said bushing having a width to permit passage of said reduced portion of said drill pipe radially through said passage and to prevent passage of the unreduced portion of said second end portion of said drill pipe radially through said passage.

3. In combination:
(*a*) a drill pipe with a first end portion and a second end portion formed with a portion of reduced width relative to the width of the first end portion,
(*b*) a base,
(*c*) a shaft vertically supported by said base,
(*d*) a pair of longitudinally spaced arms mounted on said shaft for supporting said drill pipe,
(*e*) the free end of one of said arms having a receiver for said first end portion of said drill pipe to carry said drill pipe,
(*f*) the free end of the other arm having a bushing to receive said second end portion of said drill pipe,
(*g*) a radial passage formed through the wall of said bushing having a width to permit passage of said reduced width portion of said drill pipe radially through said passage of said bushing but to prevent passage of said second end portion of said drill pipe radially through said passage of said bushing,
(*h*) the distance between said receiver and said bushing of said arms being such that when said drill pipe is carried by said receiver said reduced width portion of said drill pipe is positioned longitudinally beyond said bushing.

4. A device for handling at least two drill pipes of different lengths comprising:
(*a*) a base,
(*b*) a shaft supported by said base,

(*c*) at least two pairs of longitudinally spaced arms mounted on said shaft for swinging about the axis of said shaft,

(*d*) first means on each pair of arms for supporting one of said drill pipes,

(*e*) said first means associated with the arms of one of said pairs of arms for supporting said longer drill pipe being longitudinally spaced further from each other than the first means associated with the arms of the other of said pairs of arms for supporting said shorter drill pipe to prevent said shorter drill pipe from engaging said first means associated with the arms for supporting said longer drill pipe, and

(*f*) second means for swinging each of said pairs of arms independently of each other.

5. A device for handling at least two drill pipes of different lengths comprising:

(*a*) a base,

(*b*) a shaft vertically supported by said base,

(*c*) at least two pairs of longitudinally spaced arms mounted on said shaft for swinging about the axis of said shaft in a substantially horizontal plane,

(*d*) the longitudinally spaced arms of one pair of arms being spaced further from each other than the longitudinally spaced arms of the other pair of arms and positioned horizontally outwardly of said arms of said other pair of arms,

(*e*) the arms of each pair of arms forming a unit with each other and having means for vertically carrying a drill pipe positioned to prevent the short drill pipe to engage the means for carrying the long drill pipe, and

(*f*) means to swing said pairs of arms independently of each other.

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