June 7, 1966 M. A. BROWN 3,254,776

PIPE HANDLING AND STORAGE APPARATUS

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FIG. 1

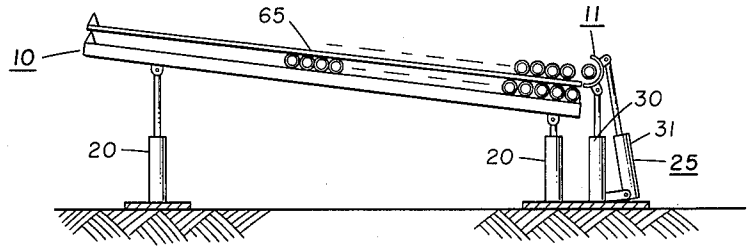


FIG. 2

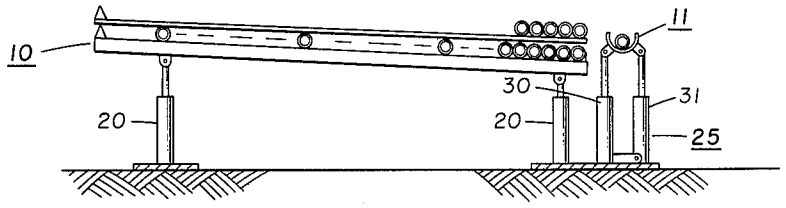
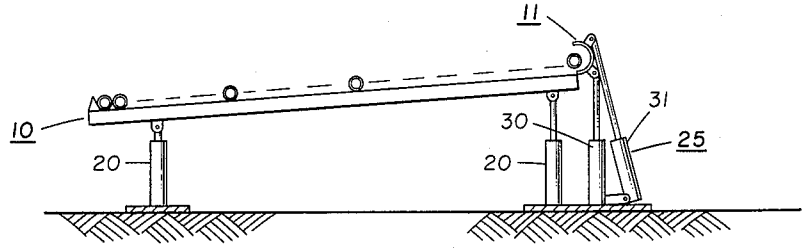


FIG. 3



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PIPE HANDLING AND STORAGE APPARATUS

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FIG. 4

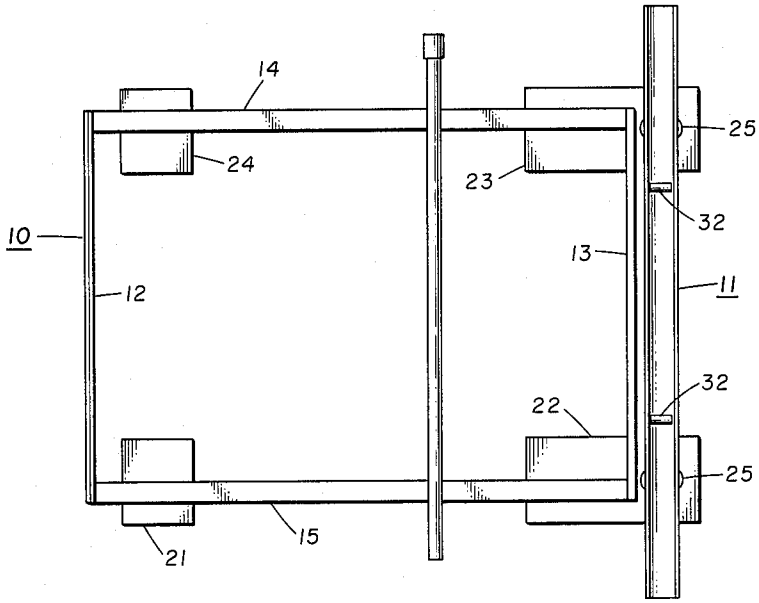
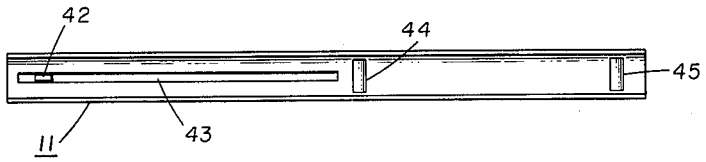


FIG. 7



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PIPE HANDLING AND STORAGE APPARATUS

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FIG. 5

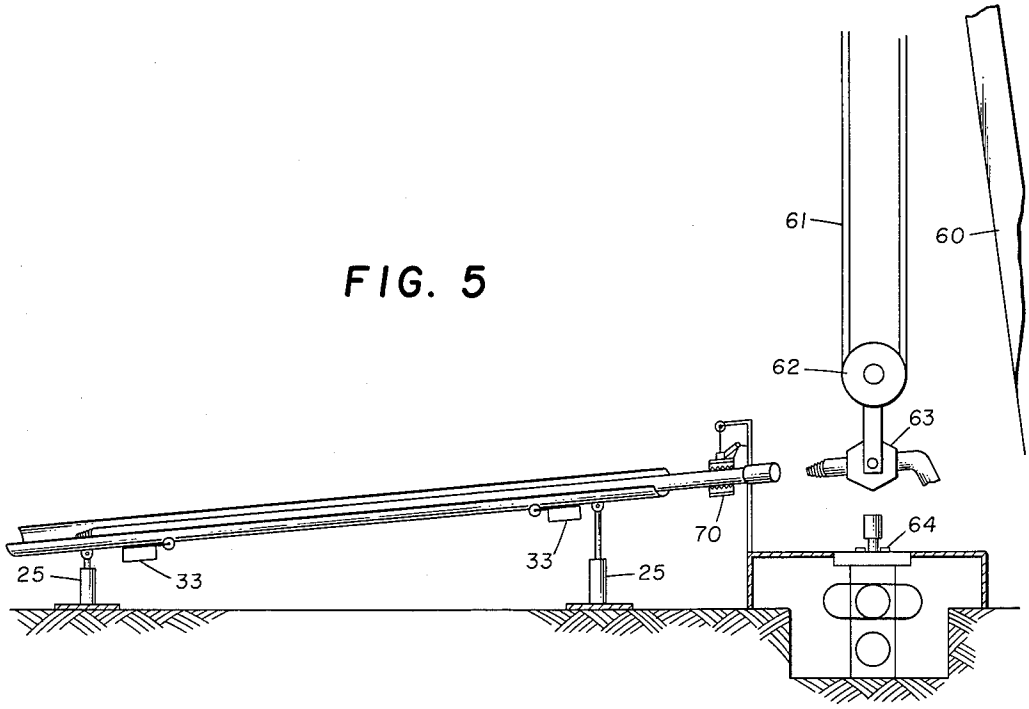


FIG. 6

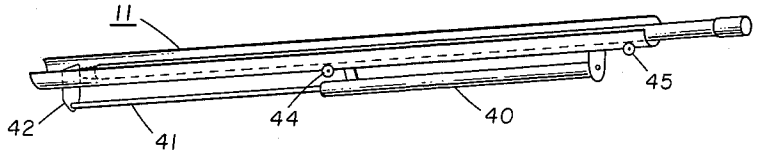
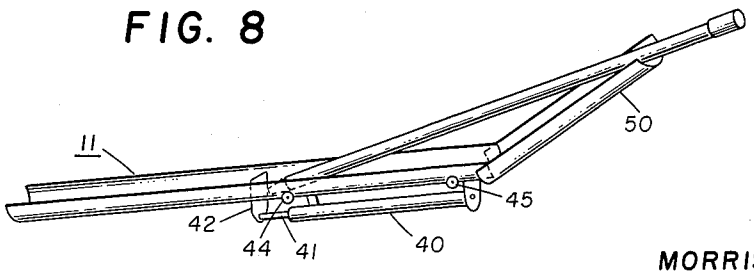


FIG. 8



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United States Patent Office 3,254,776 Patented June 7, 1966

3,254,776

PIPE HANDLING AND STORAGE APPARATUS

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Filed Apr. 10, 1964, Ser. No. 358,716
11 Claims. (Cl. 214—2.5)

This invention relates to apparatus used for handling and storing pipe in connection with the operation of a rig used in drilling wells. More specifically, this invention relates to a semiautomatic form of pipe racking apparatus.

In the drilling of wells into the earth, strings of pipe are utilized to support the drill bit and other tools which must be used in drilling and various procedures carried out in connection with wells. The pipe strings generally are made up of a number of pipe joints which must be assembled and secured together as the drill string is lowered into a well. In order to remove the drill string from the well, it is necessary that the various joints of pipe be disconnected as the drill string is lifted from the well. It facilitates both assembly and disassembly of the drill string to have means at hand which will permit the joints of pipe to be quickly and efficiently brought to the proper location for assembly and removed and stored after disassembly.

With the present trend in apparatus for drilling wells leaning toward the portable-type rig which is readily transportable between sites and quickly set up and taken down at the sites, it becomes more desirable to have equally portable and transportable apparatus for the handling of the pipe necessary in drilling.

It is one object of the present invention to provide pipe handling and racking apparatus for use with a well drilling rig. It is another object of the present invention to provide semiautomatic pipe handling and racking apparatus which may be compact in size and quickly and easily assembled and disassembled at a rig site. These and other objects of the invention will be evident from the following description taken in conjunction with the accompanying drawings.

In the drawings:

FIGURE 1 is an end view in elevation of one embodiment of apparatus constructed in accordance with the invention. FIGURE 1 illustrates the step in the operation of the apparatus of the invention in which a joint of pipe is received from the tilted pipe rack by the pipe trough.

FIGURE 2 is a view similar to FIGURE 1 showing the joint of pipe in the trough ready to be conveyed to the drilling rig.

FIGURE 3 is another view similar to FIGURE 1 illustrating the discharging of a joint of pipe from the trough to the rack.

FIGURE 4 is a top view in elevation of the invention showing both the rack and the trough.

FIGURE 5 is a side view in elevation showing the pipe trough and a portion of a drilling rig with which the invention is employed.

FIGURE 6 is a view in perspective of an alternative form of feed mechanism which may be utilized with the pipe trough of the invention.

FIGURE 7 is a top view in elevation of the pipe trough illustrated in FIGURE 6.

FIGURE 8 is a view in perspective of a further modification of the pipe trough illustrated in FIGURES 6 and 7.

Referring to the drawings, particularly FIGURE 4, the invention generally comprises a pipe rack **10** adapted to receive and store one or more layers of pipe and a pipe trough **11** which functions to convey pipe between a drilling rig and the pipe rack. The pipe trough discharges

pipe joints to the pipe rack and receives pipe joints from the pipe rack. Both the pipe rack and the pipe trough may be independently raised and lowered. The pipe rack also may be tilted from a horizontal position by raising and/or lowering either side independently to facilitate manipulation of the pipe on the rack. The pipe trough, as is particularly evident in FIGURES 1, 2, and 3, is rotatable about its longitudinal axis in order to permit it to discharge pipe to the rack and receive pipe from the rack.

As shown in FIGURE 4, pipe rack **10** is formed of side members **12** and **13** and end members **14** and **15**. These members are generally assembled in a rectangular configuration, though the exact shape of the pipe rack is not material so long at it is adequate to provide a base on which one or more layers of pipe may be stored in an orderly fashion. The side and end members forming the pipe rack are connected together in any satisfactory manner which will permit ready assembly and disassembly of the rack. In order to store the pipe in a manner which will not impose undue bending stresses on it, it may be necessary to provide more than the two end members such as **14** and **15** or to provide some form of decking over the surface of the pipe rack, depending upon the length, wall thickness, and material of the pipe.

Referring to FIGURES 1–3, pipe rack **10** is supported on a plurality of jacks **20** which may be either mechanical or hydraulic. In the particular embodiment of the apparatus disclosed, one jack is located near each of the four corners of the pipe rack. Jacks **20** are supported on mats or plates **21**, **22**, **23**, and **24** (FIGURE 4). The mats provide a substantial bearing surface for supporting the pipe rack and trough so that the apparatus may be placed on bare ground near a drilling rig. The mats may be made of material such as sheet steel. As is evident from FIGURES 1–3, jacks **20** are utilized to adjust both the elevation of rack **10** and the tilt angle of the rack. If the particular demands to be placed on the apparatus do not require that the elevation of rack **10** be adjustable, then the jacks **20** nearest side **12** may be replaced with fixed length supports, leaving the tilting of the rack to be effected by manipulation of the jacks **20** nearest side **13**.

Pipe trough **11** is supported by at least two jack units **25**, one of which is secured to mat **22** and the other of which is secured to mat **23**. Acting in a cooperative relationship, units **25** serve a triple function with respect to support and manipulation of the pipe trough. By operation of the units, simultaneously and/or independently, the elevation of the pipe trough may be adjusted, the pipe trough may be rotated about its longitudinal axis as shown in FIGURES 1–3, and the pipe trough may be tilted from end to end as illustrated in FIGURE 5. In the particular embodiment illustrated, each of units **25** comprises jacks **30** and **31** which may be either mechanical or hydraulic. The positioning and securing of jacks **30** and **31** are such that they may be actuated relative to each other in a manner which will effect rotation of pipe trough **11** about its longitudinal axis or about an axis parallel to its longitudinal axis. As illustrated, the lower end of jack **30** is secured to mat **22**, while a pivot connection is provided between the upper end of the jack and the pipe trough. With respect to jack **31**, a pivot connection is provided between the lower end of the jack and either the mat or the base of jack **30**, while the upper end of the jack is also secured by means of a pivot connection to the bottom of pipe trough **11**. Actuation of jack **31**, while maintaining jack **30** in a fixed position, will cause the pipe trough to rotate about the pivot connection between the upper end of jack **30** and the pipe trough. The particular positionings of the pivot connections on the bottom of the pipe trough between the pipe trough and

the jacks **30** and **31** are such and the cross section of the pipe trough, particularly that edge of the pipe trough adjacent to side **13** of the pipe rack, is so designed that one joint of pipe at a time may readily be received from the pipe rack when the rack is moved through the position illustrated in FIGURES 1 and 2.

After the pipe trough has received one joint of pipe, as shown in FIGURE 1, it is rotated into the position illustrated in FIGURE 2; and the design of the elements discussed immediately above should be such that, as the trough is moved into the position shown in FIGURE 2, the edge of the trough adjacent side **13** of the pipe rack will move up to prevent the next joint of pipe rolling into the trough. Of course, the jacks **30** and **31** also must be designed such that the elevation of the ends of the pipe trough may be independently varied to give the pipe trough a tilt from end to end as illustrated in FIGURE 5 to facilitate moving each joint of pipe into the vicinity of the portion of a drilling rig where the drill strings are made up and broken down during drilling.

One necessary function of the pipe trough is movement of each joint of pipe handled by it along its length to and from the vicinity of the drilling rig as shown in FIGURE 5. The form of pipe trough illustrated in FIGURES 4 and 5 is provided with powered rollers **32** which are driven by motors **33** interconnected with the rollers by some form of gearing. Each roller and its respective motor is mounted on the bottom of the trough with the roller being positioned in a slot opening through the trough. A joint of pipe lying in the trough contacts the rollers exposed through the bottom of the trough so that rotation of the rollers will cause the pipe joint to be propelled along the length of the trough. The rollers are operable in either direction so that the pipe joint may be moved along the trough toward the drilling rig or moved along away from the drilling rig into position for discharging the pipe joints to the pipe rack.

A modified form of pipe trough **11** is illustrated in FIGURES 6 and 7. Secured to the bottom of the trough is a hydraulic cylinder **40** which actuates rod **41** connected to a dog **42** extending through the bottom of a slot **43** (FIGURE 7) formed through the bottom of the trough. Free-turning rollers **44** and **45** are secured through slots in the bottom of the trough to facilitate the sliding of a joint of pipe along the length of the trough. Dog **42**, extending through the bottom of the trough, contacts an end of a joint of pipe and, when actuated by the hydraulic cylinder, moves the joint of pipe along the trough. In lieu of hydraulic cylinder **40**, motor means may be used to actuate rod **41** through any one of several forms of gear connections such, for example, as a rack and pinion gear arrangement.

Illustrated in FIGURE 8 is an alternative embodiment of the pipe trough illustrated in FIGURES 6 and 7. This particular form of pipe trough is especially adapted for use under conditions where a drilling rig floor is at an elevation in excess of that attainable by the pipe trough simply through the action of raising it by units **25**. The pipe trough illustrated in FIGURE 8 is identical to that of FIGURES 6 and 7 with the exception that the trough portion itself is somewhat longer and is articulated in the sense that the portion **50** is connected at the end nearest the drilling rig in such a manner that the elevation of its outward end may be varied depending upon the height necessary to get the pipe joint ends into the required location for connection into the swivel. Portion **50** of the trough may be a separate section, if desired, which is secured in the proper position to slide the pipe joints to and from the major portion of the trough when the apparatus is set up at a drilling rig site. Portion **50** may be referred to as an auxiliary trough slide.

FIGURE 5 illustrates the relationship of the apparatus of the invention to a drilling rig with which it is employed. Only that portion of the drilling rig which is necessary to the function of the apparatus of the invention is illustrated for the purposes of understanding the operation of the invention. Derrick **60** may be any form of derrick normally employed in the drilling of wells. More probably, derrick **60** will be of the smaller, portable type. Suspended from the upper end of the derrick are cables **61** which movably support a traveling block **62**. Secured to and supported by the traveling block is a power swivel **63** which is a form of hydraulic motor used with some of the present-day, portable-type drilling rigs. The swivel is mounted on horizontal pivots and balanced so that it may be easily pivoted by hand to manipulate it into position for engagement with the end of a pipe joint. Positioned in the rig floor are power slips **64** which assist in breaking and making up joints in the drill string.

The apparatus of the invention is employed during the carrying out of two major functions of a drilling rig, namely, that of introducing a drill string into a well and the removal of a drill string from a well. In carrying out these functions, pipe joints are removed from storage, made up into a drill string, and the drill string is lowered into the well as it is made up. In removing a drill string from a well, the pipe joints are disassembled and stored. In describing the procedure of making up a drill string and lowering it into a well, reference will be made to FIGURES 1, 2, and 5. Referring to FIGURE 1, two partial layers of stacked pipe are illustrated separated by dividers **65** which are laid on each layer of pipe in order to provide a base or support for the next succeeding layer of pipe. The layers of pipe will have been stored on the pipe rack either as the equipment is installed for the starting of the drilling of a well, or, where the well has been partly drilled, the pipe will have been stored on the rack each time that the drill string is removed from the well and broken down. To start the make-up of a drill string, pipe trough **11** is adjusted by means of units **25** and pipe rack **10** is adjusted by jacks **20** until the trough is at the height of the uppermost layer of pipe on the pipe rack so that the trough will be in a position to receive the pipe joint by joint from the rack. As shown in FIGURE 1, the pipe trough is rotated through an angle of approximately ninety degrees to a position where a joint of pipe may be rolled into the trough from the uppermost layer of pipe on the pipe rack. The pipe rack is tilted by jacks **20** toward the edge adjacent to the pipe trough. A joint of pipe will then roll into the pipe trough as shown in FIGURE 1. The pipe trough is rotated back by means of its supporting cylinders to a substantially horizontal position as illustrated in FIGURE 2. As previously explained, the axis about which the trough is rotated and the position of the edge of the trough are such that the edge nearest the pipe rack will, upon return of the trough to a horizontal position, fit in between pipe joints such that the trough picks out one joint from the uppermost layer of pipe on the pipe rack. With one joint of pipe in the pipe trough, the end of the pipe trough nearest the drilling rig, as shown in FIGURE 5, is raised by means of unit **25** until the elevation of that end of the trough is such that the pipe joint within the trough may be conveyed to a point where it may be connected to power swivel **63**. With this end of the pipe trough in the proper elevation, motors **33** are actuated to rotate the rollers **32** for propelling the pipe joint along the pipe trough toward the drilling rig. Of course, if the embodiment of the pipe trough illustrated in FIGURES 6 and 7 is being utilized, the pipe joint will be conveyed along the pipe trough by the dog **42** actuated by cylinder **40**. Also, if the elevation of the drilling rig floor is such that additional height is necessary, the embodiment illustrated in FIGURE 8 may be used so that auxiliary trough slide **50** will guide the pipe up to the vicinity of the power swivel. With the pipe joint moved along the trough to the point where it may be connected to the power swivel, the joint is engaged by the tongs **70** which are used to hold the pipe and prevent its being rotated while the power swivel is actuated to engage

the threads of the pipe joint. With the power swivel connected to the end of the pipe joint, the pipe joint is lifted by raising the power swivel with the block **62** until the lower end of the pipe joint may be engaged with that portion of the drill string which is already in the well and is being held by power slips **64**. The power slips are then disengaged and the power swivel is lowered until the pipe joint which has just been connected is down to the point where the power slips are again engaged to hold the drill string until the next joint of pipe can be secured in place. The pipe trough is then lowered until it is in position alongside the pipe rack **10** to receive another joint of pipe. This procedure is repeated with each joint of pipe being removed from the pipe rack and engaged with the drill string until the desired number of joints of pipe have been placed within the string.

When it is necessary to remove the drill string from the well and stack the pipe, the power swivel is raised by means of the block until a joint of pipe is supported by the swivel above the power slips, at which time the power slips are engaged with the joint of pipe immediately below the joint to be removed. The tongs are then used to break the connection between the joint being held by the power slips and the joint of pipe which is to be removed and stacked. With the connection broken by the tongs, the completion of the backing out of the joint is done by the power swivel. The lower end of the disconnected joint is then maneuvered to the end of the pipe trough nearest the drilling rig, such pipe trough end having been raised by means of a unit **25** until the pipe trough is in position to receive the joint of pipe. The joint of pipe is allowed to slide into the trough with its movement along the trough being assisted by power rollers **32**. When the joint of pipe is fully within the pipe trough and alongside the pipe rack, the trough is rotated approximately ninety degrees until it is in the position shown in FIGURE 3, at which point the joint of pipe is discharged or dumped from the trough onto the pipe rack. The pipe rack may be inclined to substantially match the inclination of the troughs. Also, the pipe rack is tilted so that each joint of pipe will roll along the rack away from the trough. It is not necessary that there be an ejection mechanism for discharging the pipe joint, as the position of the trough will cause the joint to roll from the trough onto the rack. Since the pipe rack is tilted away from the trough, the joint of pipe will roll down the pipe rack until it engages the stop at the farthest edge of the pipe rack or bumps into the last joint of pipe which was removed. The joints of pipe are successively removed by this procedure until all of the desired joints have been taken from the well and stored on the pipe rack. If sufficient joints are removed to make up several layers of pipe on the rack, as each layer is filled, dividers **65** are laid on the layer to provide a base for receiving the next succeeding layer of pipe joints.

Having described the apparatus and function of the invention, it is to be understood that various modifications will occur to those skilled in the art and the invention is intended to be limited only within the scope of the following claims.

What is claimed is:

1. Pipe handling and storage apparatus which comprises in combination:

(a) pipe rack means adapted to support at least one layer of pipe;

(b) means for supporting said pipe rack means whereby said rack means may be tilted to permit joints of pipe to be rolled toward either side of said rack means;

(c) a pipe trough positioned along one side of said rack means for conveying pipe joints between said rack means and the vicinity of a rotary table on a drilling rig with which said pipe handling and storage apparatus is employed;

(d) means for supporting said trough whereby the elevation of the ends of said trough may be adjusted both simultaneously and independently of each other and said trough may be tilted about its longitudinal axis for receiving pipe joints from and discharging pipe joints to said pipe rack; and

(e) means connected to said trough for moving a pipe joint along the length of said trough toward one end thereof for receiving and discharging a pipe joint at said end.

2. Apparatus in accordance with claim **1** wherein said means for moving a pipe joint along said trough comprises at least one powered roller positioned through the bottom of said trough to contact a pipe joint within said trough to convey said pipe joint toward an end of said trough.

3. Apparatus in accordance with claim **1** wherein said means for moving a pipe joint along said trough comprises a power-actuated dog adapted to extend through and move along the length of said trough to engage an end of a pipe joint within said trough to move said pipe joint toward an end of said trough.

4. Apparatus in accordance with claim **3** wherein said trough is provided with at least one free-rolling roller to assist in conveying a pipe joint along the length of said trough, said roller being positioned through the bottom of said trough between said dog and the end of said trough toward which said dog conveys said pipe joint.

5. Apparatus in accordance with claim **3** wherein said trough is an articualted unit having at least one end portion which at one end thereof may be raised to an elevation above the elevation of the remaining portion of said trough to form an auxiliary trough slide for compensating for differences in elevation attainable by said trough and the elevation of the floor of the drilling rig with which said apparatus is employed.

6. Apparatus in accordance with claim **5** wherein said trough is provided with at least one free-rolling roller to assist in conveying a pipe joint along the length of said trough.

7. Apparatus in accordance with claim **1** wherein said means for supporting said pipe rack means is adapted to both tilt said rack means and adjust the over-all elevation of said rack means.

8. Pipe handling and storage apparatus which comprises in combination:

(a) a pipe rack adapted to support at least one layer of pipe joints;

(b) a plurality of jacks secured to and supporting said pipe rack whereby the elevation of said rack may be adjusted and said rack may be tilted toward either side thereof;

(c) a pipe trough positioned along one side of said pipe rack, said pipe trough being semicircular in cross section and open at opposite ends;

(d) at least two pipe trough support elements for adjusting the elevation of said trough, raising and lowering each end of said trough independent of the other end of said trough, and tilting said trough about its longitudinal axis toward said pipe rack for receiving pipe joints from and discharging pipe joints to said rack, said trough supports each comprising a first jack rigidly mounted on its base end and pivotally connected at its other end to the bottom side of said trough and a second jack pivotally interconnected at its base end to said first jack and pivotally connected at its other end to the bottom side of said trough, said first and second jacks cooperating to raise and lower said trough and rotate said trough about the connection point between the bottom side of said trough and said first jack; and

(e) apparatus associated with said trough for contacting a pipe joint supported in said trough to move said pipe joint toward an end of said trough.

9. Pipe handling and storage apparatus in accordance with claim **8** wherein said apparatus for moving a pipe joint along said trough comprises:

(a) at least one roller positioned through the bottom

of said trough for contacting a pipe joint supported within said trough; and

(b) a motor supported from said trough and interconnected with said roller for powering said roller.

10. Pipe handling and storage apparatus in accordance with claim **8** wherein said apparatus for moving a pipe joint along said trough comprises:

(a) a dog extending through a slot provided along the length of said trough;

(b) a rod secured to said dog to move said dog along the length of said slot;

(c) a hydraulic cylinder connected to said rod for moving said rod along the length of said trough; and

(d) at least one free roller secured through the bottom of said trough for contacting and supporting a joint of pipe being conveyed along said trough by said dog.

11. Pipe handling and storage apparatus in accordance with claim **10** wherein said trough is an articulated unit having at least one member forming a movable end portion at the end of said trough toward which said dog moves pipe joints, said end portion being elevatable at its outer end above the height of the major portion of said trough to provide an auxiliary trough slide for aiding in conveying a pipe joint to and from a drilling rig floor positioned above the elevation of the major portion of said trough.

References Cited by the Examiner

UNITED STATES PATENTS

2,352,726	7/1944	Maulding.	
2,535,546	12/1950	Pitts	214—2.5
2,743,823	5/1956	Breedlove	214—2.5
2,999,605	9/1961	De Jarnett	214—2.5
3,053,401	9/1962	Jenkins	214—2.5

References Cited by the Applicant

UNITED STATES PATENTS

Re. 24,907	12/1960	Maydew.
2,589,181	3/1952	Yount.
2,674,379	4/1954	Gregory.
2,880,881	4/1959	Robishaw.
2,958,430	11/1960	Robishaw.

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