

- [54] **DRILLING RIG WITH DRILL ROD
MAGAZINE**

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- [52] **U.S. Cl.**..... 175/52, 173/164, 175/85,
211/605

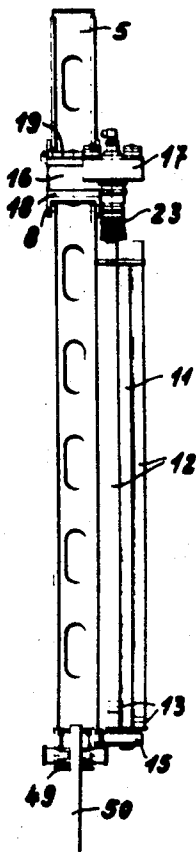
[51] **Int. Cl.**..... **E21b 19/14**

[58] **Field of Search** 175/52, 85; 173/164;
166/85, 77.5
- [56] **References Cited**
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- Primary Examiner*—Ernest R. Purser
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[57] ABSTRACT

A drilling rig comprising a mast on which a drilling carriage with a power rotating head is adapted to slide, a drilling rod magazine which is disposed on the mast or on the frame of the drilling rig and which has a holder for a storage device provided with receptacles for the rod parts and movable relative to the holder, the power rotating head being adapted to be moved out of a position above the center of a bore hole into a position above the storage device of the magazine and vice versa.
- 13 Claims, 14 Drawing Figures**



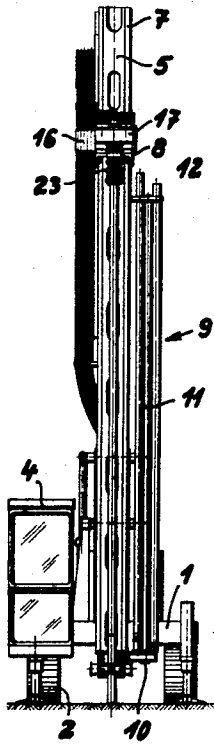


FIG. 2

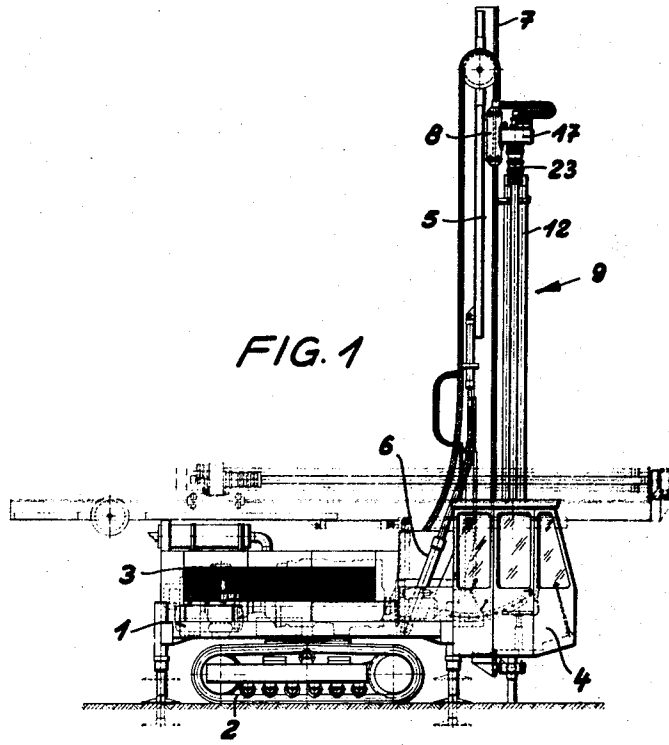


FIG. 1

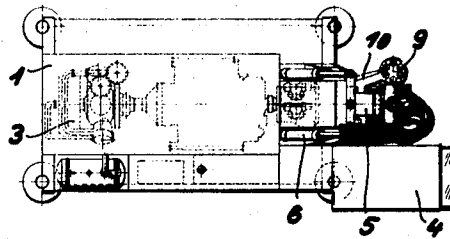
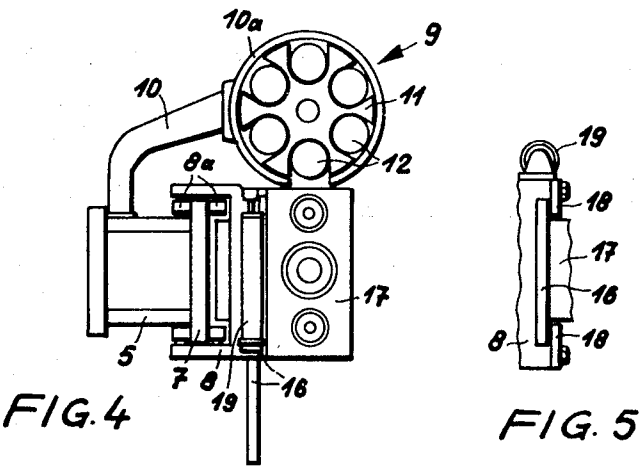
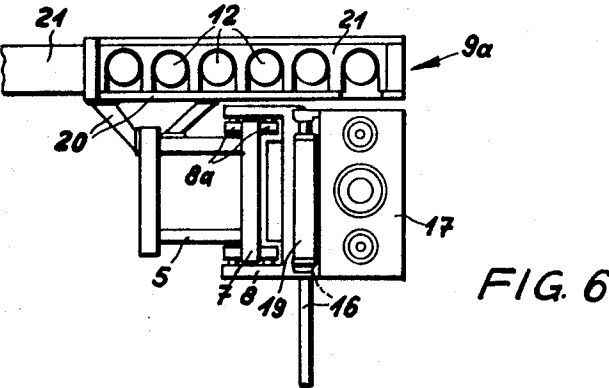
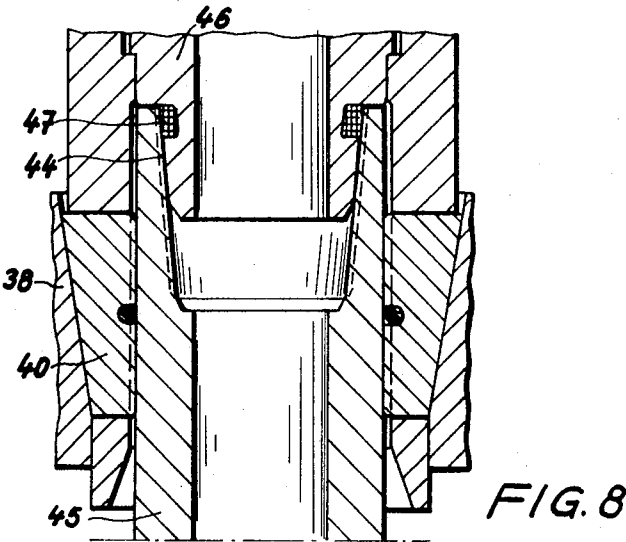
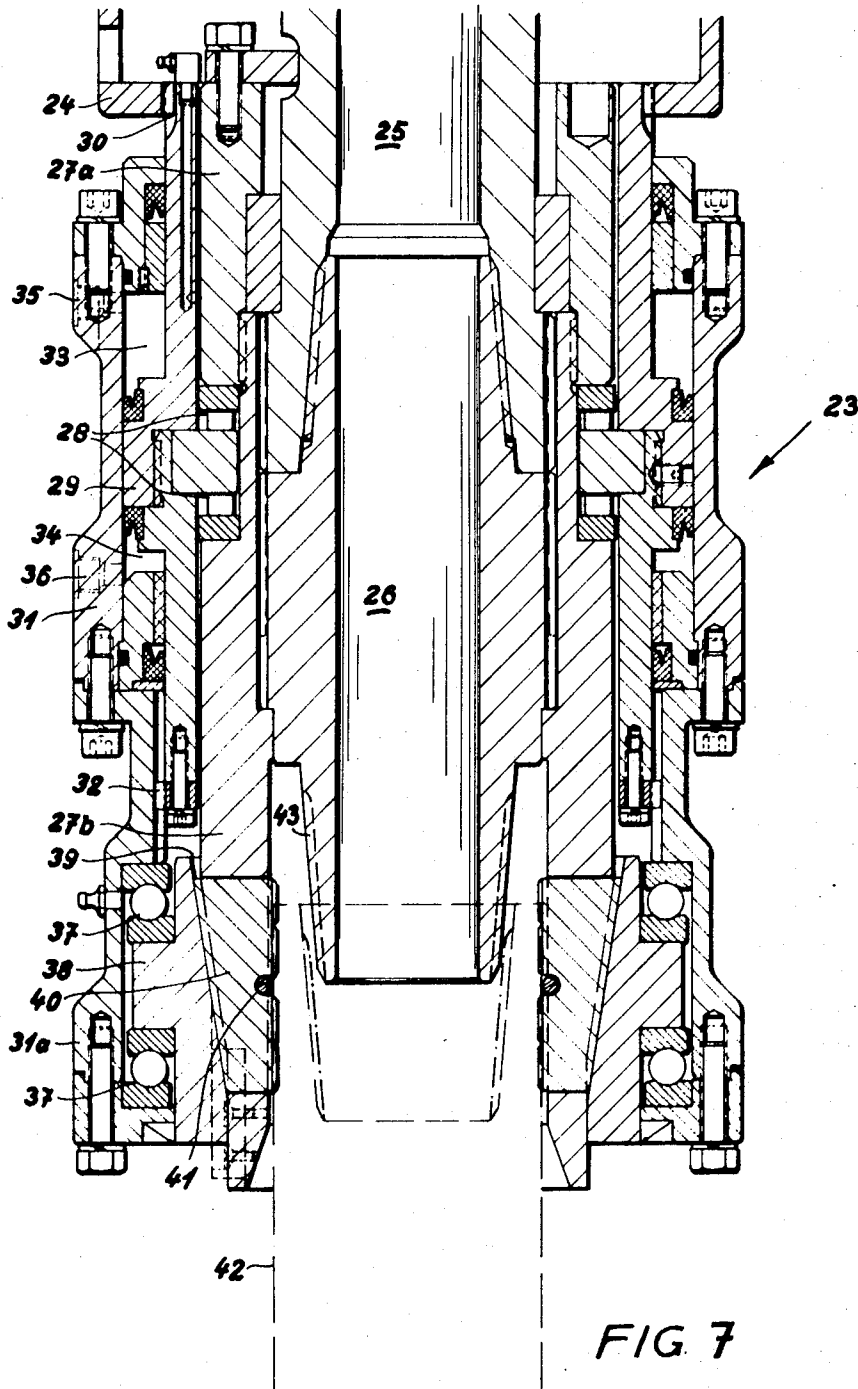


FIG. 3

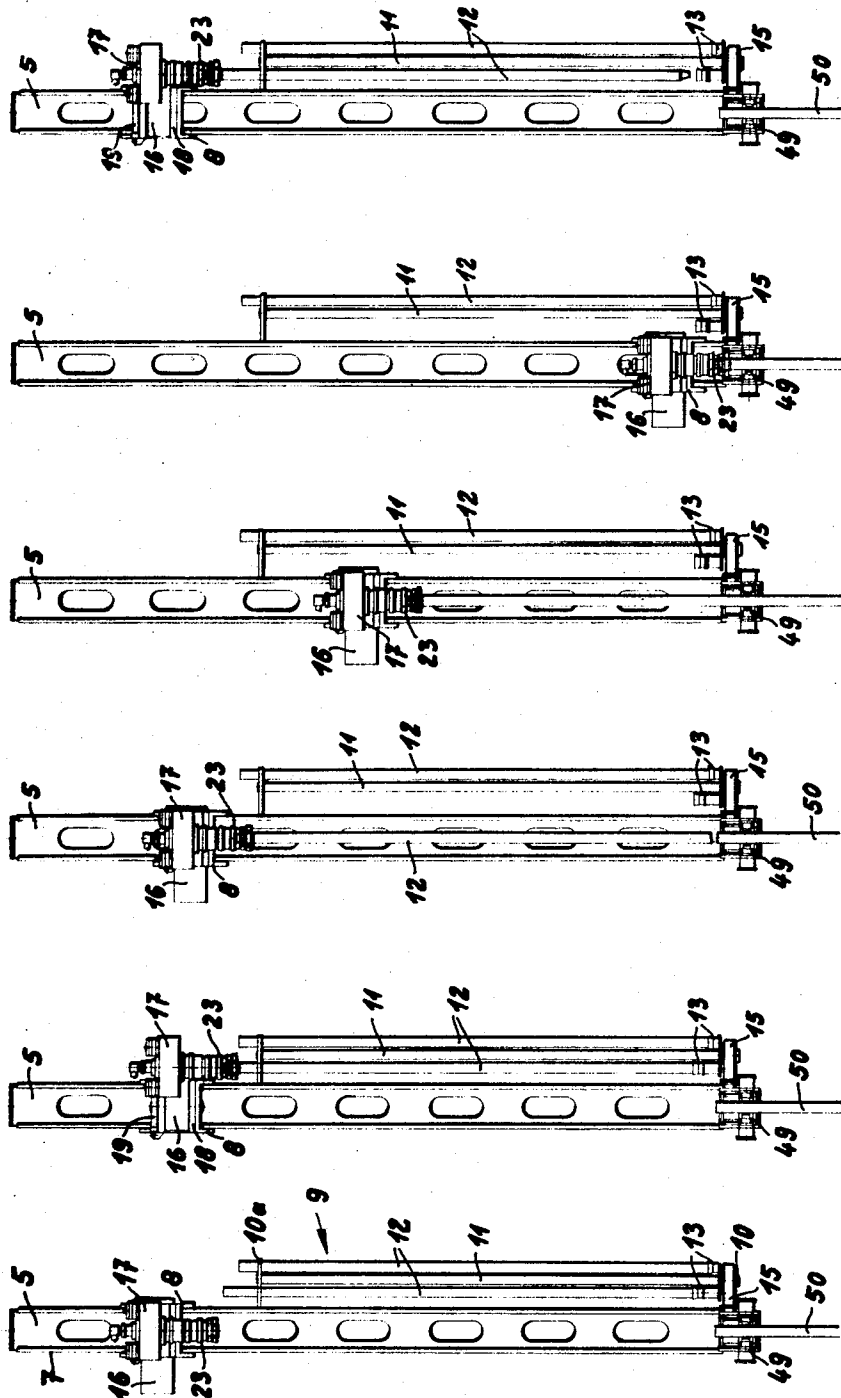
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DRILLING RIG WITH DRILL ROD MAGAZINE**BACKGROUND OF THE INVENTION**

The invention relates to a drilling rig with a mast on which a drilling carriage provided with a power rotary head is adapted to slide or travel, and with a drill rod magazine which is disposed on the mast or the frame of the drill rig and which has a holder for a storage device provided with receptacles for the rod parts and movable relative to the holder.

PRIOR ART

In known constructions of drill rigs provided with rod magazines, the holder carrying the storage part of the magazine is mounted movably on the mast or frame of the drill rig in such a manner that the storage part of the magazine can thus be swivelled out of a side position into a position in front of the mast in order to bring a rod part above the center of a bore hole. Magazine constructions of this type are relatively unstable and in consequence of the weight of the rod parts contained in them tend to deform and to twist. This occurs to a particularly great extent when inclined bores have to be made, for which purpose the mast of the rig assumes a corresponding inclined position. The stresses acting on the magazines during the swivelling movement and even after the final position has been reached are, in this case, particularly heavy. Because of the necessary movability and also for reasons of cost, weight, and space required, the size and weight of the magazine holder cannot be increased indefinitely. Even when the mast is in the vertical position, there is consequently always a danger that the storage part of the magazine will not come into alignment with the center of the bore hole or the axis of the power rotating head of the rig. Consequently, in known arrangements, it is necessary in many cases to provide interceptor bowls or other additional aids to enable the magazine to fulfil its function.

The use of a rod magazine should serve to facilitate the drilling work and reduce the proportion of operations which have to be carried out by hand. In known drilling rigs equipped with a magazine, however, numerous individual operations and accessory devices are required during the removal of the rod parts from the magazine and screwing them to the existing drilling string, and also for the dismantling of the rods, that is to say the undoing of the screw connections, in the separation of the rod parts from one another, and in the detachment thereof from the power rotating head after replacement in the magazine, so that despite the use of a magazine the work to be carried out is still complicated and tedious.

OBJECTS AND SUMMARY OF THE INVENTION

The aim object of the invention is to overcome the previously existing disadvantages and difficulties and to provide a drilling rig with a rod magazine which is distinguished by a simple, convenient construction and also by a reliable method of operation which complies to a particularly great extent with practical requirements. In addition, the invention aims to provide a construction of the drilling rig such that the handling of the rods is substantially facilitated and the time required for the operation to be carried out is reduced. This applies particularly to the addition of rod parts and very particularly to the dismantling of the rods on comple-

tion of the drilling work. The invention provides for the holder for the storage part of the rod magazine to be fastened on the frame and/or on the mast of the drilling rig, and for a transverse slide carrying the power rotating head to be disposed on the drilling carriage, with the aid of which slide the power rotating head can be moved out of the position above the center of the bore hole into the position above the storage part of the magazine, and vice versa.

Since the magazine no longer has to perform a movement for this purpose but is stationary relative to the mast, it can be constructed with the simplest means in such a manner that its accurate position is ensured under all operating conditions and whatever the inclination of the mast. The guiding of the cross-slide carrying the power rotating head on the drilling carriage also presents no difficulties. A simplification of the construction of the drilling rig is thus achieved, together with great accuracy of the parts which have to be brought into alignment with one another, so that a completely smooth transfer of a rod part from the magazine for use on the drilling string and also the return of a rod part to the magazine are ensured.

For the movement of the cross-slide carrying the power rotating head on the drilling carriage a pressure medium cylinder is advantageously provided. More particularly, in this arrangement the end positions of the cross-slide may coincide with the end positions of a piston sliding in a pressure medium cylinder. The path of the cross-slide together with the power rotating head is therefore accurately fixed in a very simple manner.

The storage device of part of the magazine may be rotatable relative to its holder, as is also the case in known rigs. Another construction permitted by the invention consists in arranging the storage part of the magazine to be rectilinearly adjustable relative to its holder. A construction of this kind may be more advantageous in certain cases than a rotatable construction.

In order further to facilitate the work to be carried out for the connection of individual rod parts to one another or for the separation of said parts from one another, and in particular with the object of also simplifying the removal of rod parts from the magazine or the return of the same to the magazine, according to another feature, the invention provides for a clamping device to be provided on the power rotating head for the purpose of gripping and holding fast a rod part, the clamping elements of said device, which act on the rod part, being adapted to be operated independently of the rotation of a power rotating head spindle. Complicated manipulations in the screwing together or unscrewing of rod parts, such as for example two operations of applying wrenches or the like, are unnecessary and for the removal of rod parts from the magazine and the return of the same to the magazine no screwing operation at all is now required. This results in a substantial facilitation and acceleration of the work, while, in addition, no particular requirements are now imposed on the skill and ability of the operating team. On the contrary, it is possible for all the work to be carried out by a single operator.

The clamping device may form a fixed component of the power rotating head or else may be so constructed that it can be detachably connected to the power rotating head.

In an advantageous construction, the clamping device has clamp jaws which, in a manner known in itself, can be applied in the radial direction by means of a clamp ring, which is axially slidable through the action of a pressure medium, and with the aid of wedge surfaces. The clamp ring is, in this case, advantageously mounted rotatably, so that it can rotate together with the rod held by it, if this is desired in order to carry out a determined operation.

In a convenient embodiment, the clamping device contains an annular piston which is axially stationary and held so as to be non-rotatable, as well as an axially slidable cylinder part surrounding the annular piston and, together with the latter illustrated in the drawing should, as far forming two cylinder chambers. Said axially slidable cylinder part may also be provided at the same time with the mounting for the clamp ring.

A rod connector or adaptor, which is usually provided on the spindle of the power rotating head, is advantageously disposed in the interior of the clamping device, above the clamping elements, when a clamping device of the type described above is provided.

The connector may have an external screw-thread which corresponds to the internal screw-thread on the rod parts used.

According to the invention, a bearing surface for a rod part to be received may be provided inside the clamping device. When a rod connector is contained in the interior of the clamping device, the bearing surface in question is advantageously disposed on the connector. In all cases the bearing surface may have at least one seal or else may be formed by a seal itself.

With a construction of this kind it is then possible to dispense completely with the screwing of the top end of the uppermost rod part to the drilling string by the rotating part of the power rotating head. On the contrary, it is sufficient simply to clamp the rod part with the aid of the clamp device, the torque being applied through the clamp elements.

Further details and features of the invention will be seen from the following description in conjunction with the drawings, in which:

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side view of a drilling rig constructed in accordance with the invention,

FIG. 2 is a front view of the drilling rig according to FIG. 1,

FIG. 3 a plan view of the drilling rig according to FIG. 1.

FIG. 4 a plan view on a larger scale of a magazine arrangement,

FIG. 5 is a side view of the cross-slide guide,

FIG. 6 a plan view of a modified magazine arrangement,

FIG. 7 a section of a construction of the clamping device,

FIG. 8 shows a modified construction of the clamping device in a cross-section corresponding to part of FIG. 7 and,

FIGS. 9 to 14 each show a drilling rig mast with a rod magazine according to the invention with the power rotating head and clamping device in various positions.

DETAILED DESCRIPTION OF THE INVENTION

The drilling rig illustrated in FIGS. 1 to 3 is a rock drilling rig and serves, for example, for making blast

holes in quarries. It has a frame 1 which is carried by a caterpillar truck 2 and which can rest on a slewing ring and carries equipment, designated generally by the reference 3, required for operating the rig. On one side of its front end there is provided on the frame 1 a driver's cab 4, which also contains the operating station with the operating and control means for the operations to be carried out for drilling purposes. At the side of the driver's cab 4 there is disposed, in the middle of the front end of the frame, a mast 5 of a rig, which, in known manner, can be swivelled about a horizontal axis with the aid of hydraulic cylinders 6. The horizontal position of the mast is indicated in dot-and-dash lines in FIG. 1. Between this position, and the vertical position the mast may assume any desired intermediate position which may be necessary for the particular work to be done.

A drilling carriage 8 with rollers 8a is adapted to travel along the mast 5 on guide rails 7, said carriage being driven in known manner with the aid of ropes or chains operated by a hydraulic drive.

At the side of the mast 5 there is disposed a rod magazine, which is designated generally 9 and which in the embodiment illustrated in FIGS. 1 to 5 and FIGS. 9 to 14 has a storage device or part 11 for individual drilling rod parts 12 and which device is mounted rotatably on a holder 10. The holder 10 is made fast to the mast 5 or frame 1 of the rig, so that the distance between the axis of rotation of the storage part 11 and the center of the bore hole is invariable. In the embodiment illustrated, the storage part 11 may contain six rod parts 12, which at their bottom ends are received by pots or receptacles 13, (see FIGS. 9 to 14) and near their upper ends are held in recesses 14 in a star-shaped plate belonging to the storage part. As FIG. 4, shows, over the greater part of its periphery this plate is surrounded by a ring 10a fastened on a part of the holder 10, said ring being interrupted only at one point. This interruption is sufficiently large to enable a rod part to be moved transversely through the opening thus formed.

The storage part 11 of the magazine can be driven rotationally by a drive 15 disposed at the bottom end (FIGS. 9 to 14), for example a hydraulic motor with a worm drive, while fixed angular steps may, if desired, also be predetermined.

As can be seen particularly from FIGS. 4 and 9 to 14, the drilling carriage 8 is equipped with a horizontally adjustable cross-slide 16, which carries a power rotating head 17. The construction may be selected in accordance with the example illustrated in such a manner that the cross-slide is provided with a plate on which the power rotating head 17 is fastened and over which guide bars 18 on the drilling carriage 8 engage at its top and bottom edge (FIG. 5). For the movement of the cross-slide 16, use is made of hydraulic cylinder 19 (FIGS. 4 and 10). The stroke of the piston sliding in said cylinder is so selected that in the retracted end position of the piston, the axis of the power rotating head 17 is situated exactly over the center of the bore hole (for example position shown in FIGS. 4 and 9), while in the extended end position of the piston, the cross-slide 16 has also reached its laterally extended end position (FIGS. 10 and 14), in which the axis of the power rotating head 17 is in line with the axis of a rod part 12 situated in the magazine 9 or with the axis of a receptacle 13 for a rod part.

FIG. 6 illustrates another construction of the magazine, which is designated generally by the reference 9a. In a holder, which once again is fastened to the mast pipe or to the frame of the drilling rig, there is here provided a rectilinear support and guide 20 for a straight storage part 21 receiving drilling rod parts 12. The movement of the storage part 21 can be effected by means of a hydraulic cylinder, by means of a rack drive, or by means of any suitable device. Here again, the arrangement is selected so that the axis of the power rotating head 17 is situated exactly above a rod part situated in the storage part 21, or above a receptacle receiving such a part, when the cross-slide 16 is in the extended position.

In FIGS. 1, 2, and 9 to 14 reference 23 designates a clamping device which may be combined with the power rotating head 17 or be detachably connected to the latter. An example of construction of this clamping device is shown in detail in FIG. 7. Here reference 24 designates a housing part, which is joined, for example by threaded bolts, to the housing of the power rotating head 17, which is not shown in FIG. 7. A spindle 25 of the power rotating head projects into the clamping device 23 and is provided with a screwed-in rod connector 26. The spindle 25 or the connector 26 are surrounded by parts 27a and 27b which rotate with the spindle and on which, by means of two roller bearings 28, an annular piston 29 composed of two parts is mounted so as to be incapable of axial sliding. An extension of this annular piston 29 is provided at its upper end with teeth 30 engaging in coacting teeth on the housing 24, whereby the annular piston 29 is also secured against rotation.

The annular piston 29 is surrounded by a cylinder which is designated generally 31 and which, in the axial direction, is slidable relative to the annular piston 29, but which is secured against rotation relative thereto by tooth engagement 32. Together with the annular piston 29, the cylinder 31 forms two cylinder chambers 33 and 34, through which pressure medium can be fed selectively through connection 35 and 36 from a source (not shown) by way of hoses.

In the bottom part of the clamping device 23, a clamp ring 38 is mounted rotatably in an extension 31a of the cylinder 31, with the aid of rolling contact bearings 37, said clamp ring forming on its inner side clamp jaws 40 provided with recesses with inclined surfaces 39 as bearing surface for corresponding wedge surfaces on their rear side. Said clamp jaws engage through apertures in the part 27b and are pressed outwards by a clip 41, an annular spring, or the like, and thus held in contact with the inclined surface 39. When pressure medium is fed to the upper cylinder space 33 through the connection 35, the cylinder 31 moves upwards in relation to the stationary annular piston 29, so that the clamp jaws 40 are displaced inwards in the radial direction by means of the clamp ring 38. In this way they can be brought to bear against a drilling rod part 42 and clamp the latter fast between them. Detachment is effected correspondingly by supplying pressure medium through the connection 36 to the bottom cylinder space 34, while the upper cylinder space 33 is connected by way of the connection 35 and with the aid of a valve to a tank.

In the embodiment illustrated in FIG. 7, the connector 26 is provided at its bottom end with a screw-thread 43, so that it can be screwed to the top end of a rod part

or drilling string to be driven by the power rotating head. In the embodiment illustrated in FIG. 8, the connector 46 does not have a screw-thread, but forms a bearing surface 44 for the end of a rod part 45 while one or more seals 47 may be provided if, for example, the sealing of the interior of a hollow rod in relation to the outside is necessary, for example when drilling with flushing. In the construction according to FIG. 8, the rod is rotated by means of the power rotating head with the aid of the clamp jaws 40 of the clamping device (FIG. 7), so that no screwing is here necessary for connecting the rod to the power rotating head.

The mode of operation of the apparatus according to the invention is explained below with reference to FIG. 9 to 14. FIG. 9 illustrates the moment at which the power rotating head 17 is detached from a rod string 50 situated in the bore hole and has been raised to its upper position on the mast 5, for the purpose of taking a new rod part 12 out of the magazine 9 and attaching it to the drilling string 50. The drilling string 50 is held by an interceptor device 49 at the bottom end of the mast 5. For this purpose, the cross-slide 16 carrying the power rotating head 17 is run out to the side by means of the hydraulic cylinder 19 so that the axis of the power rotating head 17 is in line with the axis of a rod part 12 situated in the magazine 9, and the drilling carriage 8 is then moved downwards slightly so that the clamp device 23 situated under the power rotating head 17 engages over the top end of the respective rod part 12 (FIG. 10).

Through the feeding of pressure medium to the upper cylinder space 33 of the clamping device 23 (FIG. 7) the clamping device is now operated, so that the clamp jaws grip the rod part 12 between them. Immediately thereafter the cross-slide 16 together with the power rotating head 17 and the rod part 12 held by the clamping device 23 can then be moved back into the starting position above the center of the bore hole (FIG. 11). After the rod part 12 has been screwed to the drilling string 50 through simply switching on the power rotating head, the drilling operation can be continued (FIG. 12), after the interceptor device 49 has freed the drilling string.

When finally, after this additional rod length has completed the drilling, the power rotating head 17 reaches the bottom end of the mast 5 (FIG. 13), the clamping device 23 is released and the power rotating head 17, which is thus separated from the drilling string 50 is moved upwards by means of the drilling carriage 8 in order to take another rod part out of the magazine. The same operation is then repeated as was described above, starting from FIG. 9, except that the storage part 11 of the rod magazine has in the meantime been turned through a corresponding angle by means of the drive 15. As can be seen particularly from FIGS. 2 and 9, the individual rod parts 12 in the storage part 11 of the magazine 9 are disposed alternately higher and lower through a corresponding construction of the receptacles 13. The rod parts situated at a higher level are in each case taken from the first, third, and fifth storage positions and then the rod parts situated at a lower level are taken from the second, fourth, and sixth rod positions, in the case of a magazine holding six rod parts.

For the dismantling of the drilling string, the top part of the latter is held fast by the interceptor device 49 and the power rotating head 17 unscrewed from the

rods, except when the connection was made only by means of the clamping device. The rod is then gripped by the clamp device 23, the interceptor device 49 is released, and the power rotating head 17 together with the drilling string is moved upwards at the high return 5 until the power rotating head 17 has reached its top position. After further securing of the rods by the interceptor device, while the uppermost rod part is still clamped by means of the clamping device 23, all that is then required is for the screw connection between this rod part and the drilling string to be unscrewed, 10 whereupon by operation of the cross-slide 16 the released rod part can be returned to the magazine. After release of the clamping device 23, the cross-slide 16 can be run back and at the same time the drilling carriage 8 can be returned, at high forward speed, to its lowest position, where, without further screwing and solely with the aid of the clamping device 23, the next 15 rod part is size, detached similarly from the drilling string, and returned to the magazine. In this, a great simplification and an exceptional saving of time in the assembly, and particularly also in the dismantling, of the drilling string is achieved.

All the features mentioned in the description above or as is permitted by the prior art, be regarded as coming within the scope of the invention either alone or in combinations, even if they are not expressly mentioned in the claims.

I claim:

1. A drilling rig comprising a mast, a drilling carriage 30 mounted for travel on the mast in the longitudinal direction thereof, the drilling carriage being provided with a power rotating head, a drilling rod magazine including a holder for a storage device provided with receptacles for drilling rods, means fixably connecting the holder to the mast laterally thereof, the storage device being movable relative to the holder such that each of the receptacles is adjustable by such movement in a predetermined rod transfer position provided in a fixed lateral distance from the mast, a cross-slide positioned on the drilling carriage and carrying the power 40 rotating head, driving means for moving the cross-slide relative to the drilling carriage in a linear path between only two end positions of the cross-slide, whereby in one end position of the cross-slide, the axis of the power rotating head is in alignment with the center of a bore hole, and in the other end position of the cross-head, the axis of the power rotating head is in alignment with the rod transfer position of one of the recep-

tacles of the storage device.

2. The drilling rig according to claim 1, characterized in that the storage device of the magazine is rotatable relative to its holder.

3. The drilling rig according to claim 1, characterized in that the storage device of the magazine is adjustable rectilinearly relative to its holder.

4. The drilling rig according to claim 1 characterized in that the power rotating head is provided with a clamping device having gripping elements intended for gripping and holding fast a rod part and in which the clamping elements, which can be caused to act on the rod part, are operable independently of the rotation of a power rotating head spindle.

5. The drilling rig according to claim 4, characterized in that the clamping device is detachably connected to the power rotating head.

6. The drilling rig according to claim 4, characterized in that the clamping device has clamp jaws which can be adjusted in a radial direction by means of a clamp ring, which is axially slidable by the action of a pressure medium, with the aid of wedge surfaces.

7. The drilling rig according to claim 6, characterized in that the clamp ring is mounted rotatably.

8. The drilling rig according to claim 6, characterized in that the clamping device contains an annular piston which is axially stationary and secured against rotation and also an axially slidable cylinder part surrounding the annular piston and, together with the piston, define two cylinder spaces.

9. The drilling rig according to claim 8, characterized in that the cylinder part is provided with the mounting for the clamp ring.

10. The drilling rig according to claim 4, including a rod connector fastened or detachably connected to a spindle of the power rotating head, the rod connector being disposed in the interior of the clamping device above the clamp elements.

11. The drilling rig according to claim 10, characterized in that a bearing surface for a rod part to be received is provided inside the clamping device.

12. The drilling rig according to claim 11, characterized in that the bearing surface is provided on the rod connector.

13. The drilling rig according to claim 11, characterized in that the bearing surface has at least one seal or is formed by a seal.

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