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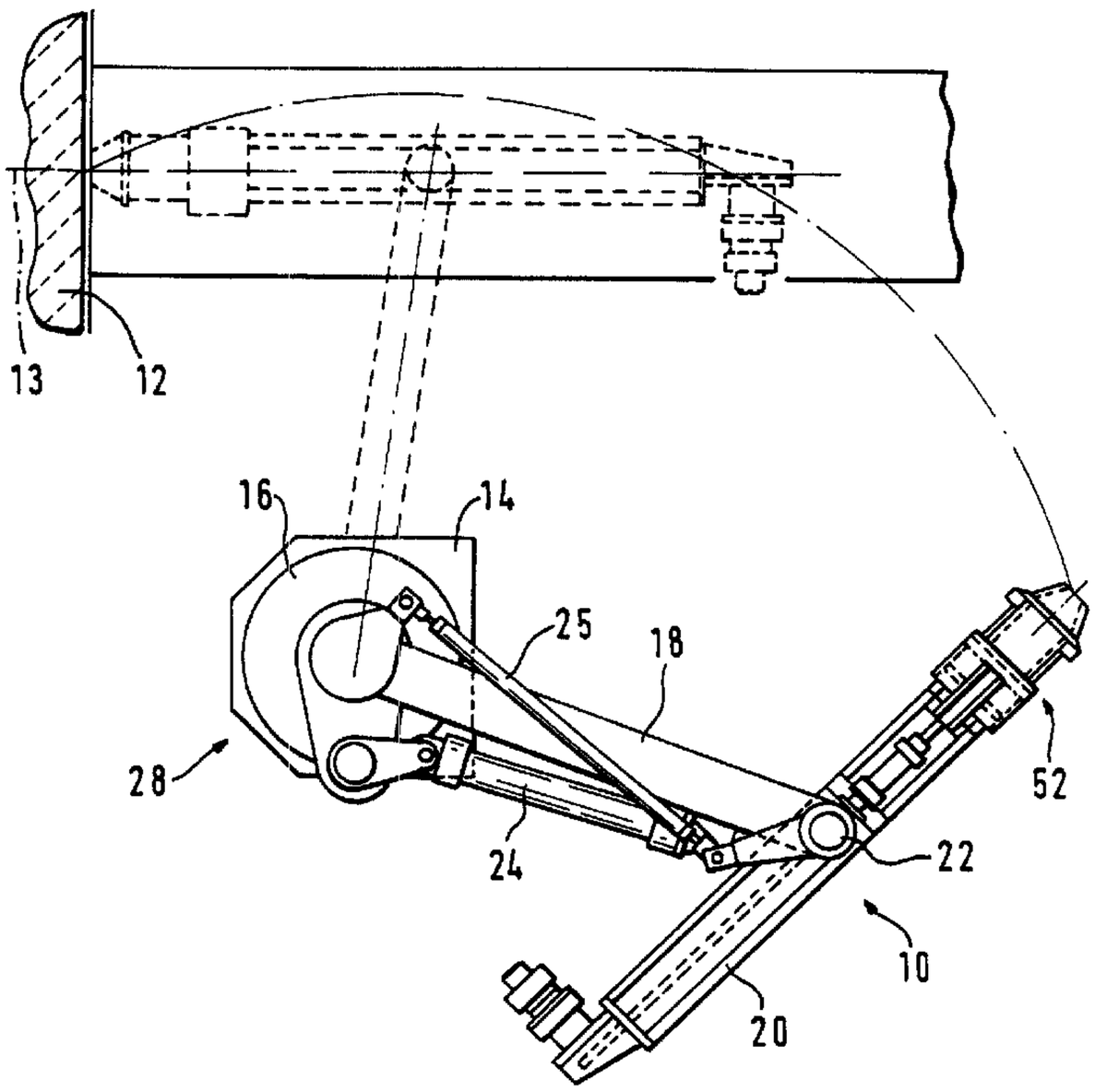

(57) Abrégé/Abstract:
A combined machine for opening a taphole (13) in a shaft furnace (12) and for plugging the taphole with a plugging mass is provided. The machine comprises a mount (20), a suspension structure for the mount (20), and drive means (30, 32) on the mount (20). For plugging the taphole, the machine comprises a plugging device (52) with plugging chamber (54), plugging snout (56) and a piston (57) for expelling the plugging mass. For the plugging operation, the plugging device (52) is supported on the mount (20) in the extension of the axis of the taphole and the expulsion piston (57) is coupled to the drive means (30, 32) present on the mount (20) for opening the taphole with a piercing rod or a drill bit.

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COMBINED MACHINE FOR OPENING AND PLUGGING A TAPHOLE IN A SHAFT FURNACE

ABSTRACT

A combined machine for opening a taphole (13) in a shaft furnace (12) and for plugging the taphole with a plugging mass is provided. The machine comprises a mount (20), a suspension structure for the mount (20), and drive means (30, 32) on the mount (20). For plugging the taphole, the machine comprises a plugging device (52) with plugging chamber (54), plugging snout (56) and a piston (57) for expelling the plugging mass. For the plugging operation, the plugging device (52) is supported on the mount (20) in the extension of the axis of the taphole and the expulsion piston (57) is coupled to the drive means (30, 32) present on the mount (20) for opening the taphole with a piercing rod or a drill bit.

Fig. 3.

COMBINED MACHINE FOR OPENING AND PLUGGING A TAPHOLE IN A SHAFT FURNACE

The present invention relates to a combined machine for opening a taphole in a shaft furnace and for plugging the taphole by injecting a plugging mass.

Various machines have been provided for opening a taphole in a wall of a shaft furnace according to a process in which, after having plugged the taphole with a plugging mass, a metal rod is driven into the said mass before it has completely hardened and, at the desired moment, the said metal rod is removed with a view to opening the taphole. Such machines comprise a mount for supporting a piercing rod, a suspension structure for the mount designed in order to be able to displace the mount from a parked position away from the taphole into an operating position in which the mount is located in the extension of the axis of the taphole, drive means installed on the mount and developing a pulling force or pushing force, respectively, parallel to the longitudinal axis of the mount. In this case, a coupling device which can be displaced on the mount is connected to the said drive means in order to transmit the said pushing force to a piercing rod supported on the mount in order to drive it into the plugging mass previously injected into the taphole, or to transmit the said pulling force to a piercing rod sealed in the hardened plugging mass to remove this rod from the taphole, respectively. Various operating principles for such machines are, for example, described in Patent Specifications EP-0,379,018, LU-87,915, LU-88,029, LU-88,058, LU-88,059, LU-88,060 and LU-88,135. It shall be pointed out that, on all these machines, there also exists the possibility of drilling the taphole using a conventional drill bit driven by a rotary work device which can also be displaced on the mount by the said drive means.

Besides a boring machine, it is essential to have available a plugging machine in order to be able to inject

the plugging mass into the taphole. Such a plugging machine comprises, in a manner known per se, its own suspension structure for displacing a plugging device from a parked position away from the taphole into a plugging position in which it is aligned with the axis of the taphole and to apply it firmly against the wall of the furnace during the plugging operation. The plugging device of a plugging machine comprises, in a manner known per se, a plugging chamber receiving the plugging mass, a plugging snout, a piston for expelling the plugging mass, fitted in the plugging chamber and a powerful hydraulic jack arranged in the axis of the expulsion piston in order to displace the latter axially in the plugging chamber and in order thus to inject the plugging mass under pressure through the plugging snout into the taphole.

In point of fact, the presence of two machines, namely a boring machine and a plugging machine, constitutes, especially for small shaft furnaces, not only a problem of overall size but, also, a problem of investment costs.

The object of the present invention is to provide a combined machine which can be used both for opening the taphole in a shaft furnace and for plugging the taphole with a plugging mass.

This objective is achieved by a machine for opening a taphole in a shaft furnace and for plugging the taphole comprising:

a mount for supporting a piercing rod or a drill bit,

a suspension structure for the mount designed to displace the mount from a parked position away from the taphole into an operating position in which the mount is located in the extension of the axis of the taphole,

drive means installed on the mount and developing a pulling force or pushing force, respectively, parallel to the longitudinal axis of the mount, for axially displacing the piercing rod or the drill bit along the mount,

a plugging device comprising a plugging chamber (54) to receive the plugging mass, a plugging snout (56) mounted at the front of the plugging chamber, a piston for expelling the plugging mass, which is fitted and can be displaced in the plugging chamber,

a support integral with the mount to support the said plugging device in a plugging position on the mount , and

coupling means for coupling the said expulsion piston to the said drive means .

It will be appreciated that the combined machine that is provided by the present invention requires only one suspension structure for the mount. The plugging device is itself supported on the mount. Moreover, the plugging device does not include separate drive means. These two characteristics appreciably reduce the cost price of such a machine, compared with the cumulative cost prices of a separate plugging machine and boring machine.

From the point of view of floor space, the proposed combined machine is hardly bigger than a conventional boring machine. Consequently, from the point of view of floor space, the area formerly required for siting the plugging machine is saved.

It will be noted that, if the plugging device, supported in the said plugging position on the mount, does not impede the operation of introducing and removing the piercing rod or, respectively, drilling with a conventional drill bit, which is quite feasible, it can remain in position. If this is not the case, the plugging device must, for example, be temporarily removed from its support on the mount in order to permit the use of the machine as a boring machine.

In a preferred embodiment, the said support, integral with the mount, makes it possible to support the said plugging device, in the said plugging position, exactly in the fictitious extension of the taphole when the mount is in the said operating position. The said support then

advantageously comprises pivoting means designed to pivot the said plugging device away from the plugging position into a non-operating position, in which it is located away from the fictitious extension of the taphole when the mount is in the said operating position. This design of the machine has the advantage that the positioning and the orientation of the mount in front of the taphole are the same for the boring operation and for the plugging operation, which renders superfluous any readjustment of the suspension structure of the mount between the two operations.

It will usually be advantageous to pivot the said plugging device upwards through an angle of 90°. However, this does not rule out the fact that, for certain uses, a person skilled in the art will prefer to pivot the said plugging device into a lateral position with respect to the mount. The plugging device is pivoted preferably with the aid of a hydraulic jack which is connected between the plugging chamber and the mount.

For optimum transmission of the forces between the said drive means and the expulsion piston, it will be advantageous to provide a piston rod which is integral with the expulsion piston and extends outside the plugging chamber on the side opposite the plugging snout and which is, moreover, substantially parallel to the longitudinal axis of the mount.

The combined machine may include separate coupling means for coupling the said expulsion piston or the said piston rod, respectively, to the said drive means when the said plugging device is supported in the said plugging position. Usually, however, it is advantageous to use a coupling device already present on the mount and which is used to transmit the said pushing or pulling force, developed by the said drive means, to a piercing rod. Such coupling devices usually comprise a clamp, for clutching one end of the piercing rod so as to transmit a pulling

force to it, and a bearing surface for bearing on a front surface of the piercing rod so as to transmit an axial pushing to it. However, there are also systems for coupling by means of screw threads, keys, hooks, etc., which may all be used on the proposed machine.

It will also be appreciated that the plugging device which can be folded back is advantageously equipped with a protective screen arranged below the plugging chamber and extending below the piston rod.

Advantageous drive means comprise a rotary hydraulic motor mounted at the rear of the mount and an endless chain mounted axially in the mount. Other drive systems using, for example, linear hydraulic motors, can also be envisaged or have already been proposed within the field of boring machines.

Further advantages and characteristics will emerge from the detailed description of an advantageous embodiment which is given below by way of illustration, with reference to the appended drawings, in which:

- Figure 1 is a plan view of the overall machine proposed; the solid lines represent the machine in the parked position; the broken lines represent the machine in the operating position in front of the taphole;
- Figure 2 is a front view of the overall machine proposed in the parked position;
- Figure 3 shows a front view of the mount of the proposed machine in the operating position in front of the taphole, prepared to introduce a piercing rod into the plugging mass previously injected into the taphole;
- Figure 4 shows a front view of the mount of the machine in the operating position in front of the taphole during plugging of the taphole;
- Figures 5.1 to 5.6 diagrammatically show the various stages of opening or plugging the taphole, respectively, using the proposed machine.

Figure 1 is an overall view of the combined plugging/boring machine 10 installed in front of a shaft furnace 12 which is shown diagrammatically by a section through its wall. A taphole is represented by its axis, referenced 13. The machine is mounted on a base 14 with the aid of a pedestal 16. A first end of a suspension arm 18 is articulated to this pedestal 16. The other end of this suspension arm 18 supports a mount 20 by means of an articulation 22. A jack 24 is connected between the pedestal and the mount 20 so as to be able to pivot the suspension arm 18 with respect to the pedestal 16. A guide bar 25 connects the mount to the pedestal 16 and, with the jack 24, forms a pseudoparallelogram. It follows that the jack 24 alone is sufficient to pivot the mount 20 away from a parked position, shown in solid lines, and to position it in front of the taphole in an operating position, shown in broken lines. An adjustment in the length of the guide bar 25 makes it possible to modify the final orientation of the mount in the plane of Figure 1. The inclination of the mount in a vertical plane about a horizontal articulation 26 in the suspension arm 18 may be determined with the aid of an adjusting bar 27 (cf. Figure 2).

The suspension structure, described above and referenced globally by 28 in Figure 1, has the advantage of having served satisfactorily in a number of uses on boring and plugging machines. However, it is not ruled out that, in certain cases, it may be more advantageous to choose another type of suspension for the mount 20.

The mount 20 is described with reference to Figure 3. It is principally a mount of a conventional taphole boring machine which has been modified for implementing the lost-rod process. The mount includes, at its rear end, a rotary hydraulic motor 30 driving one or more endless chains 32 which extend axially in the mount 20. This chain or these chains 32 drive a sliding carriage 34 along the mount 20. A coupling device 36 designed to transmit to a piercing

rod 100, either an axial pushing force in order to drive it into the plugging mass, or a pulling force in order to remove it from the taphole so as to be able to open the latter, is supported by the carriage 34.

In order to remove the rod from the taphole, this coupling device 36 comprises, for example, a clamp 38 with a pair of pneumatically actuated jaws arranged about an axial channel, so as to be able to exert a considerable pulling force on the free end of the piercing rod 100. This clamp 38 could, however, also be replaced by any other coupling enabling the carriage 34 to be coupled to the free end of the piercing rod 100 in order to transmit to it the pulling force necessary for its removal. The end of the piercing rod 100 could thus, for example, be coupled to the coupling device 34 with the aid of a transverse key. A percussion device 40 may, if appropriate, be used to release the piercing rod 100 before it is removed.

In order to be able to drive the piercing rod 100 into the plugging mass previously injected into the taphole, the clamp 38 includes, for example, in the said axial channel, a bearing surface which bears on one end of the piercing rod 100 introduced into this channel. As it advances towards the taphole, the carriage 34 thus exerts an axial pushing on this end of the piercing rod 100 and causes the other end to penetrate progressively into the plugging mass. In order to prevent buckling of the piercing rod 100, the latter may, for example, be guided laterally by one or more intermediate guides (not shown), or the percussion device 40 may, for example, be a percussion device which delivers a percussion force in the direction of the taphole. However, provision could also be made in the clamp 38 for a channel for the piercing rod 100 which axially traverses right through the body of the clamp 38. A second pair of jaws, disposed about the said channel and oriented in the opposite direction of the first pair of jaws, then makes it possible firmly to clutch the piercing

rod 100 so as to communicate to it an axial pushing in the direction of introduction into the taphole. This two-directional clamp can then be used to introduce the piercing rod 100 into the plugging mass in a reciprocal movement of the carriage 34 at the front of the mount. The stroke of this reciprocal movement is determined so as to be smaller than the critical buckling length of the piercing rod 100, which eliminates any risk of the rod buckling during its introduction.

At the front of the mount 20, the piercing rod 100 is supported in a manner known per se by a bearing piece, for example a sliding bearing piece 42. It remains to be pointed out that it is also possible to mount a rotary drive device (not shown) on the mount 20 in order to drill a taphole with a conventional drill bit.

At the front of the mount 20, a plugging device 52 is supported with the aid of a bent arm 50. This plugging device 52 includes a plugging chamber 54, to receive the plugging mass, and a plugging snout 56 via which the plugging mass can be ejected. A piston for expelling the plugging mass is fitted and can be displaced in the chamber 54. The piston rod 57 is extended axially outside the chamber 54.

Figure 2 shows that, for the operations of introduction and removal of a piercing rod 100, as well as for any boring operation using a drill bit, the said plugging device can be pivoted into a non-operating position about an articulation 58. In this position, the plugging device 52 is located entirely away from the extension of the axis of the taphole 13, when the mount is aligned with the latter for the introduction or the removal of a piercing rod, or for the drilling of a taphole with a conventional drill bit. In the figures, the axis of articulation 58 is horizontal and perpendicular to the axis of the mount. The plugging device 52 has, in the said non-operating position, the plugging snout 56 pointing

vertically upwards. It is, however, obvious that a lateral folding back of the plugging device 52 is also feasible. A jack 60, connected at one of its ends to the mount 20 and with the other end to the bent arm 50, makes it possible to control this folding-back hydraulically.

In Figure 4, the plugging device is shown in the plugging position, the mount still being aligned with the axis of the taphole. The jack 60 pushes the plugging chamber 54 with its rear surface 62 against a bearing surface 64 provided at the front of the mount 20 so that the plugging device is immobilized in the axis of the mount. In this plugging position of the plugging device 52, the jack 24 of the suspension structure 28 makes it possible to push the plugging snout 56 firmly against the wall of the furnace 12 in the extension of the axis of the taphole, when the mount 20 is located in the said operating position.

According to the present invention, the plugging device 52 does not itself have drive means for the said piston for expelling the plugging mass. This characteristic makes it possible to reduce the constructional length and the weight of the plugging device 52. Without this characteristic, it would, moreover, be virtually impossible to support the plugging device 52 on the mount 20. In fact, the overall length of the plugging device 52 with drive means would become too great, and the mount 20 and its suspension structure 28 would have to be reinforced in an exaggerated manner in order to support the additional load.

It will consequently be advantageous for the expulsion piston of the plugging device 52 to be, in the proposed machine, driven by the drive device of the carriage 34, namely, in the present case, by the rotary hydraulic motor 30 via the endless chain or chains 32.

The piston rod 57 is advantageously coupled to the chain 32 through the coupling device 36 already present on the mount and which, as has been seen above, is normally

used for the introduction of a piercing rod into the taphole and for its forcible removal. To this end, the rear end of the piston rod 57 must have substantially the same diameter as the piston rod and be aligned in the extension of the axis of the channel of the clamp 38. In this manner, the clamp 38 can bear on the rear end of the piston rod 57 in order to push the expulsion piston into the plugging chamber 54 in the direction of the plugging snout 56. In order to withdraw the piston rearwards again, so as to permit the filling of the plugging chamber 54, the clamp 38 clutches the rear end of the piston rod 57 and the carriage 34 is withdrawn rearwards. If, instead of the clamp 38, a system which uses a key to couple the coupling device 36 to the rear end of the piercing rod 100 is used for the removal of the piercing rod 100, it is naturally necessary for the rear end of the piston rod 57 to be designed in the same manner as the rear end of the piercing rod 100 in order to interact with the said key. If a two-directional clamp is employed, it suffices for the rear end of the piston rod 57 to be aligned in the extension of the axis of the channel of the clamp and to be capable of engaging in the latter over a sufficient length in order to enable it to be clutched by the two pairs of jaws oriented in the opposite direction.

The reference 66 refers to a protective screen arranged below the plugging chamber and extending below the piston rod 57. It will be noted that this protective screen efficiently protects the piston rod 57 and the front of the mount against any splashes projected when the taphole is opened.

It will further be noted that replacement of the rotary hydraulic motor 30 and the endless chain 32 by another drive system, for example one or more linear hydraulic motors, which may or may not be equipped with a stroke multiplier, is not excluded.

The various stages of opening and plugging the taphole with the proposed machine will be studied with the aid of Figures 5.1 to 5.6.

In Figure 5.1, the mount 20 is in the parked position, and the plugging chamber 52 is folded back upwards. The mount is brought by its suspension structure 28 into its operating position in the extension of the taphole (cf. Figure 5.2). The coupling device 34 is coupled to the free end of the piercing rod 100 which emerges from the taphole. The motor 30 withdraws the coupling device 34 towards the rear of the mount 20 and thus frees the taphole by removing the piercing rod 100.

The mount 20 is then brought back into the parked position (cf. Figure 5.3) and the piercing rod withdrawn from the taphole is removed from the mount 20. The plugging device 52 is then folded back into the horizontal position and the piston rod 57 is withdrawn rearwards by the coupling device 34 in order to permit the filling of the plugging chamber 54. In order to facilitate this filling of the plugging chamber 52 with the plugging mass, the plugging device is preferably folded back into the vertical position.

Next (see Figure 5.4), the plugging device 52 is again folded back into the horizontal position, the mount 20 is brought back into the operating position and the plugging snout 56 is pressed against the wall of the furnace 12. The coupling device 34 bears on the piston rod 57 and advances the expulsion piston towards the plugging snout, thus injecting the plugging mass into the taphole.

In the following stage (see Figure 5.5), the emptied plugging chamber 52 is again folded back upwards and a new piercing rod 100' is positioned on the mount 20.

Figure 5.6 diagrammatically shows a method of introducing this piercing rod 100' into the plugging mass during hardening. The coupling device 34 bears on the end of the piercing rod 100' and causes the said rod to

penetrate into the plugging mass. The percussion device 40 is actuated if there is a risk of the rod buckling.

CLAIMS

1. Machine for opening a taphole in a shaft furnace (12) and for plugging said taphole by injecting a plugging mass, comprising

a mount (20) for supporting a piercing rod (100) or a drill bit,

a suspension structure for the mount designed to displace the mount (20) from a parked position away from the taphole into an operating position in which the mount (20) is located in the extension of the axis of the taphole,

drive means (30, 32) installed on the mount (20) and developing a pulling force or pushing force, respectively, parallel to the longitudinal axis of the mount, for axially displacing the piercing rod or the drill bit along the mount,

characterized

by a plugging device (52) comprising a plugging chamber (54) to receive the plugging mass, a plugging snout (56) mounted at the front of the plugging chamber, a piston for expelling the plugging mass, which is fitted and can be displaced in the plugging chamber,

by a support (50) integral with the mount (20) to support the said plugging device (52) in a plugging position on said mount (20), and

by coupling means for coupling the said expulsion piston to the said drive means (30, 32).

2. Machine according to Claim 1, characterized in that the said coupling means comprise a piston rod (57) integral with the expulsion piston and extends outside the plugging chamber (54) on the side opposite the plugging snout (56), and in that, in the said plugging position, the piston rod (57) is substantially parallel to the longitudinal axis of the mount (20).

3. Machine according to Claim 2, characterized in that the said support (50), integral with the mount (20), is

designed to support the said plugging device (52), in the said plugging position, exactly in the extension of the taphole when the mount (20) is in the said operating position, and in that the said support (50) comprises an articulation (58) and pivoting means for pivoting the said plugging device (52) away from the said plugging position into a non-operating position, in which the plugging device (52) is located away from the extension of the taphole when the mount (20) is in the said operating position.

4. Machine according to Claim 3, characterized in that the plugging device (52) can be folded back upwards from the said plugging position through an angle of about 90°.

5. Machine according to Claim 4, characterized in that the plugging device (52) is equipped with a protective screen (66) arranged below the plugging chamber and extending below the piston rod (57).

6. Machine according to Claim 3, 4 or 5, characterized in that the said pivoting means comprise a hydraulic jack (60).

7. Machine according to any one of Claims 2 to 6, characterized by a coupling device (36) which can be displaced on the mount (20) and connected to the said drive means (30, 32) in order to transmit the said pushing force to a piercing rod (100) supported on the mount in order to drive it into the plugging mass previously injected into the taphole, or to transmit the said pulling force to a piercing rod (100) sealed in the plugging mass to remove it from the taphole, respectively.

8. Machine according to Claim 7, characterized in that the said coupling means for coupling the said expulsion piston to the said drive means (30, 32) includes the said coupling device (36) provided for the introduction and removal of the piercing rod (100).

9. Machine according to any one of Claims 1 to 8, characterized in that the said drive means comprise a

rotary hydraulic motor (30) mounted at the rear of the mount (20) and at least one endless chain (32) mounted axially in the mount (20).

10. Machine according to any one of Claims 1 to 9, characterized by a work device with rotary drive which can receive a normal drill bit, and by means for coupling the said work device to the said drive means (30, 32).

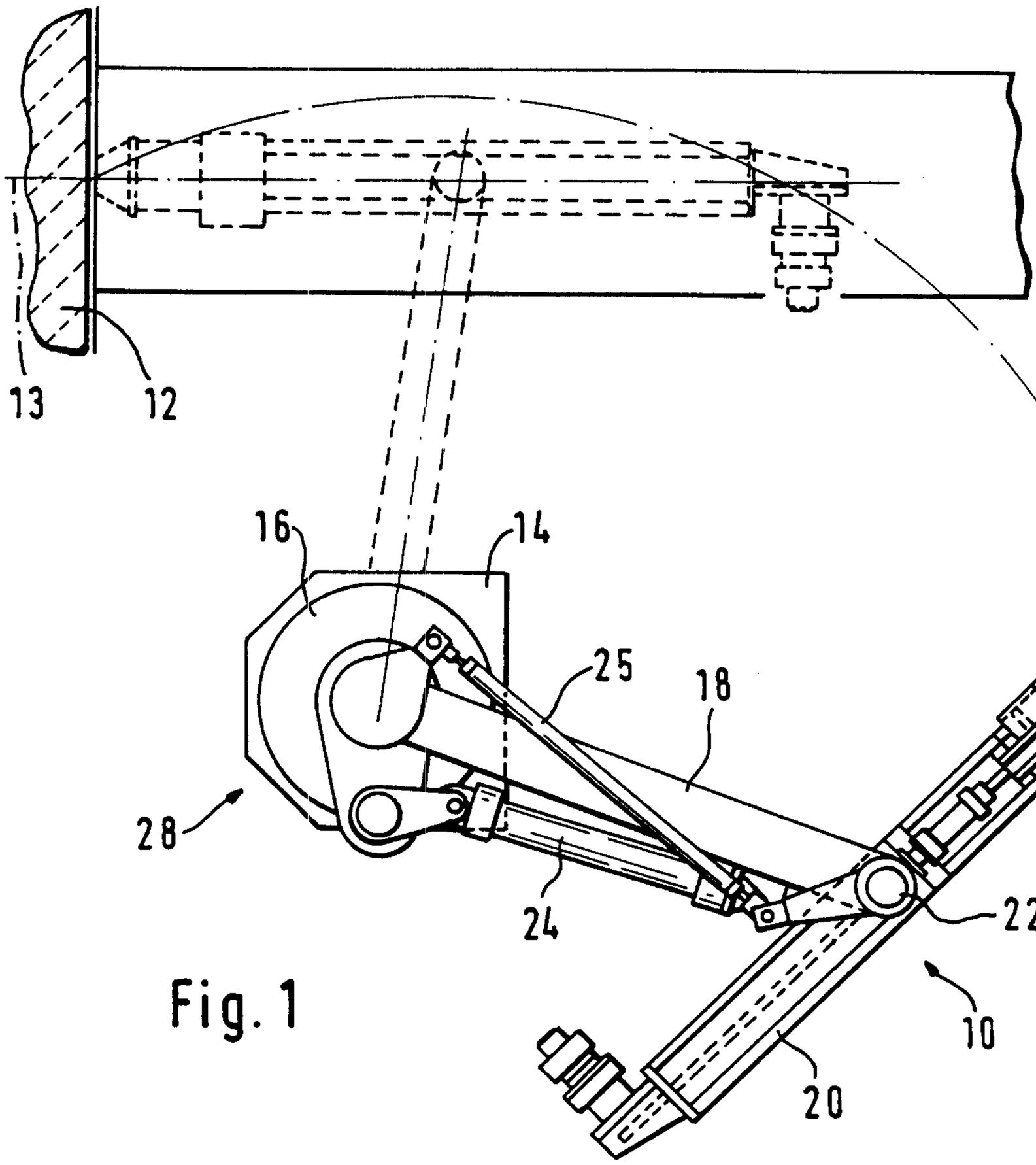

Fig. 1

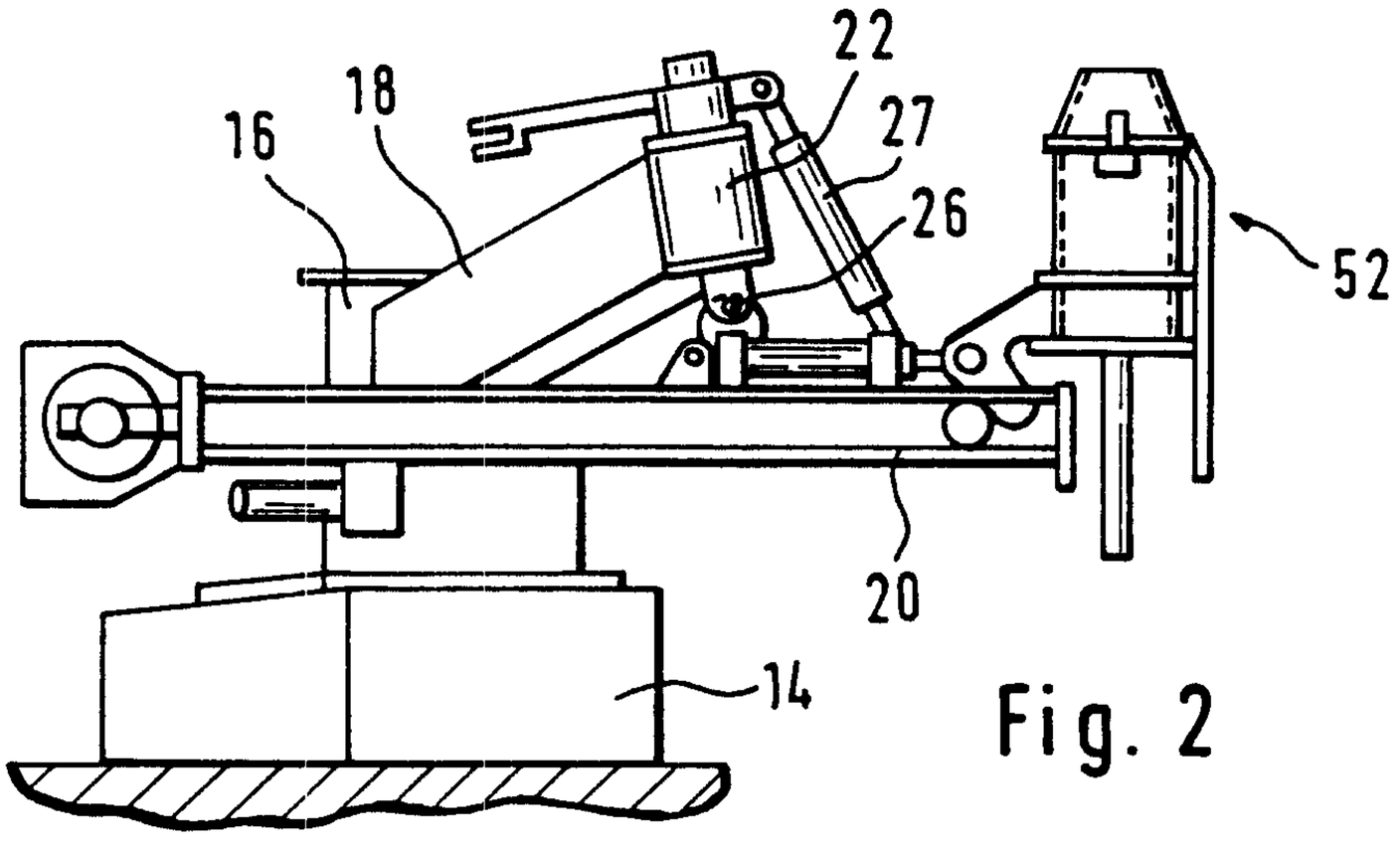

Fig. 2

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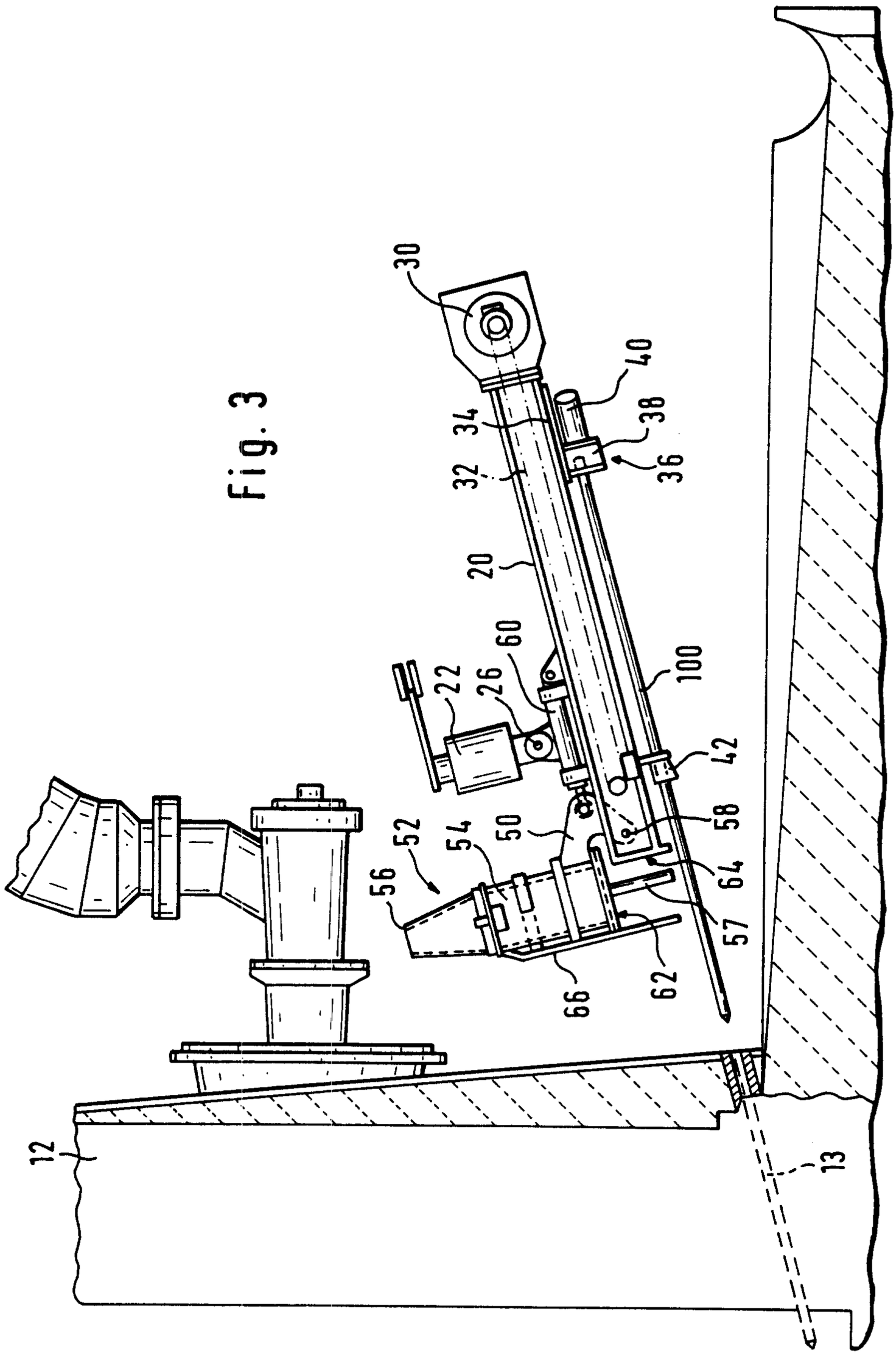


Fig. 3

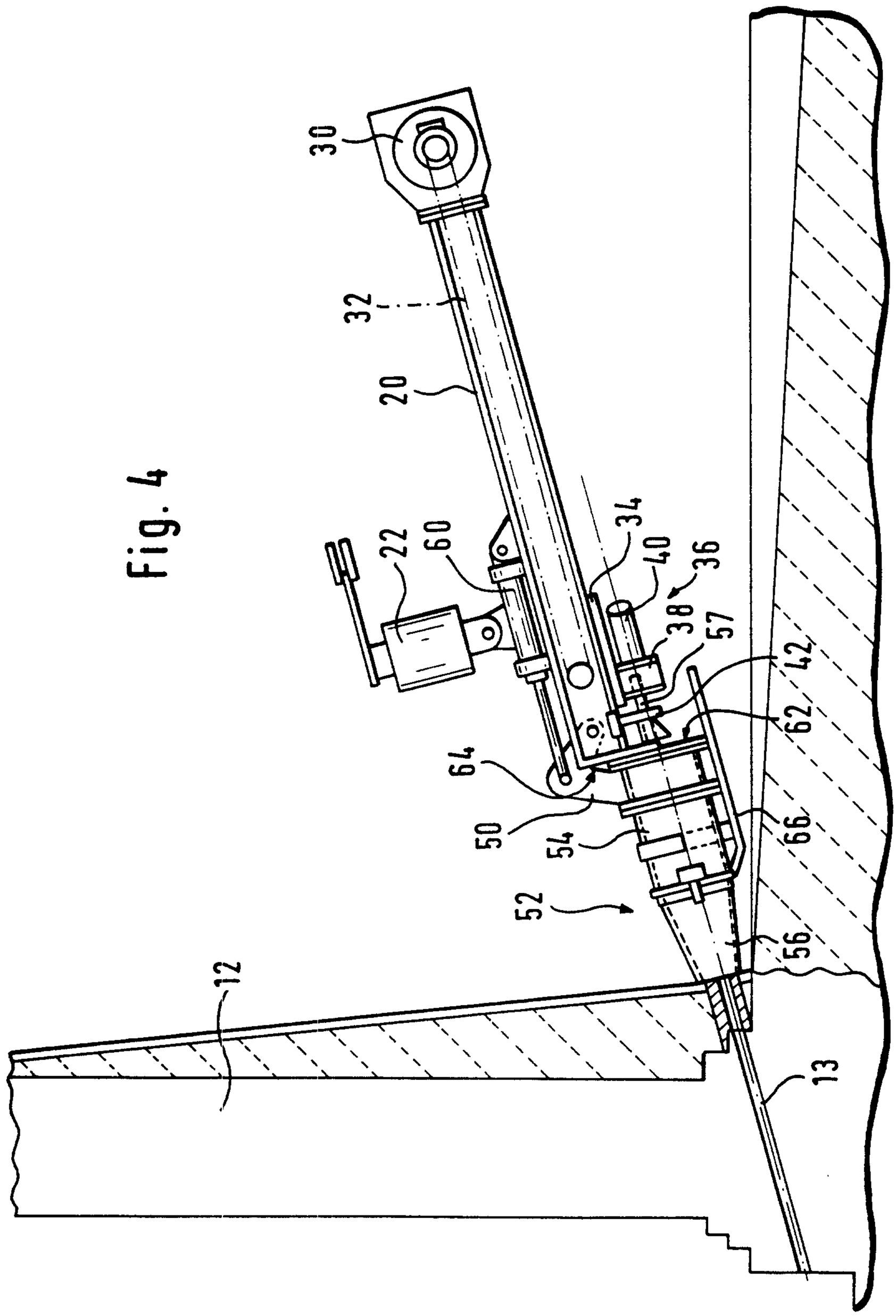
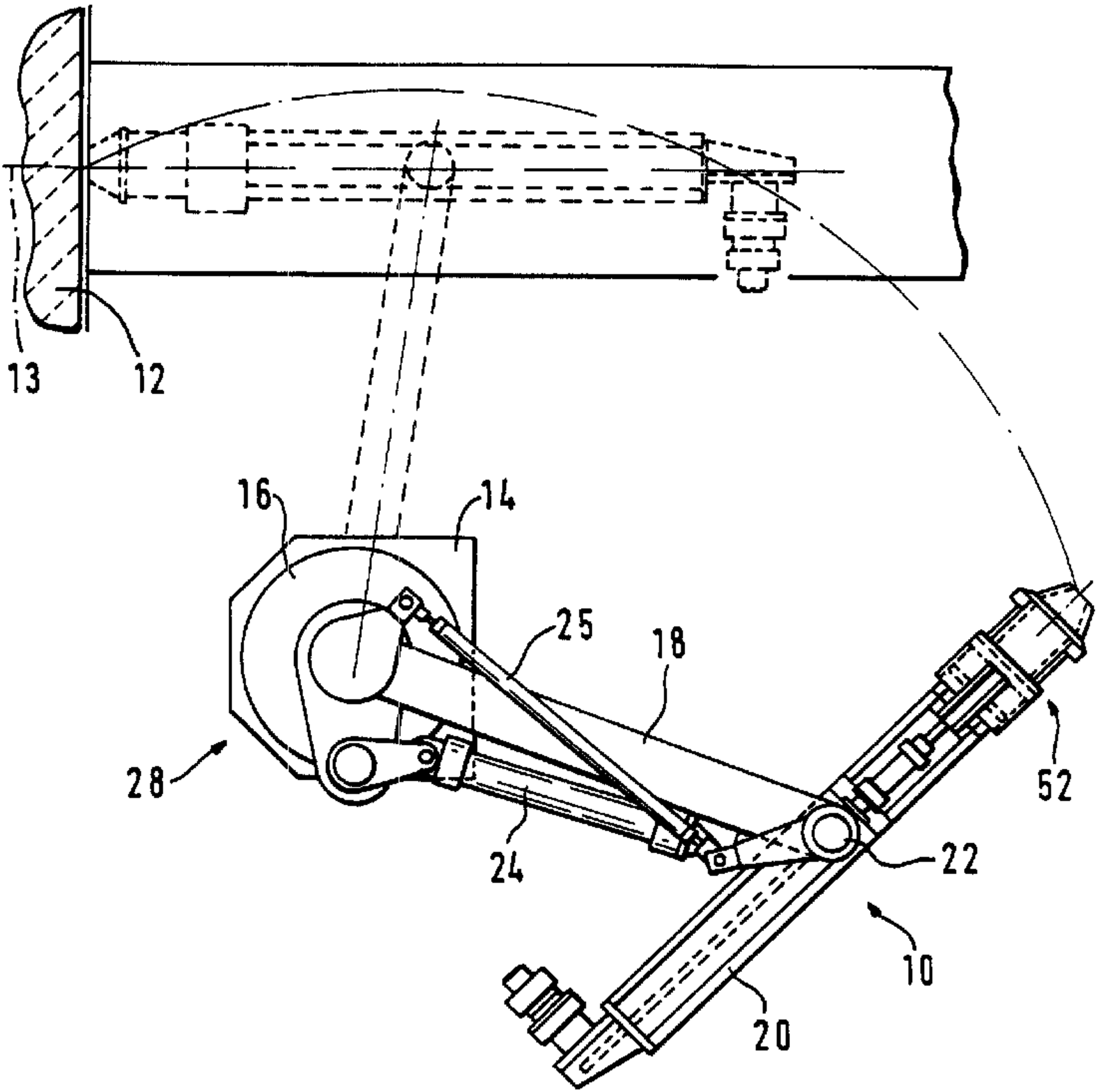


Fig. 4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