

Oct. 22, 1957

J. W. KENNEDAY ET AL

2,810,440

TUBULAR EXTENSION MEMBER FOR WELLS

Filed July 25, 1955

2 Sheets--Sheet 1

FIG. 1.

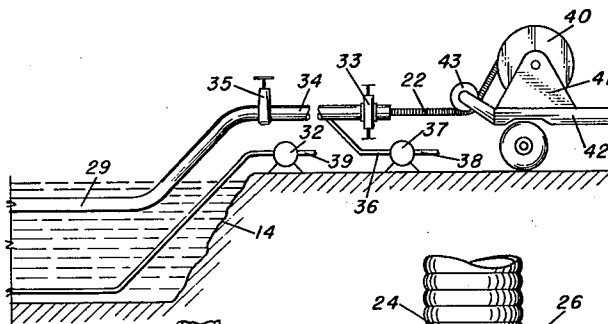
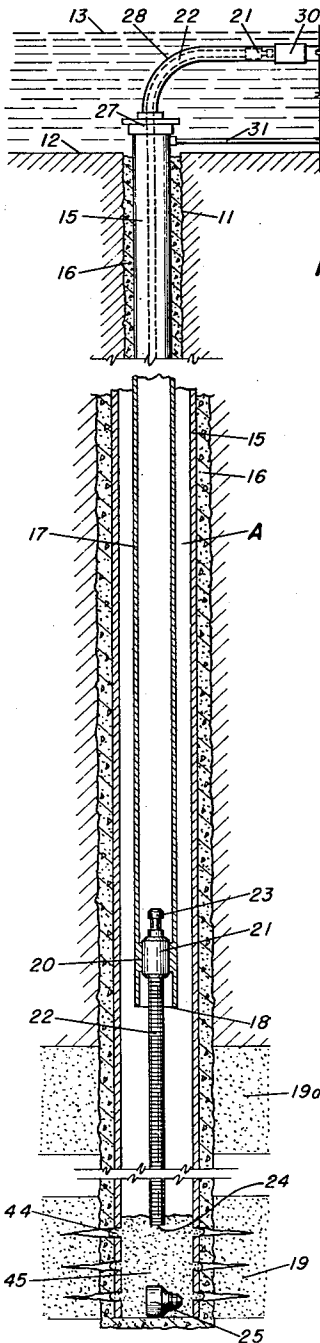


FIG. 2.

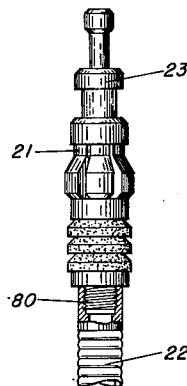
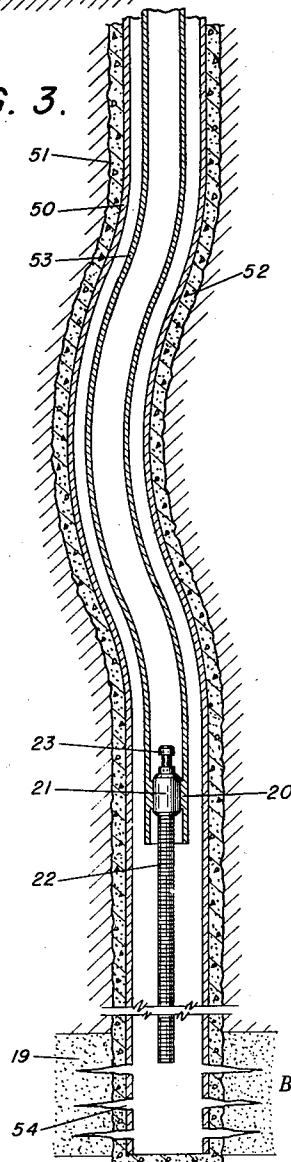
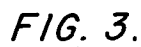


FIG. 6.



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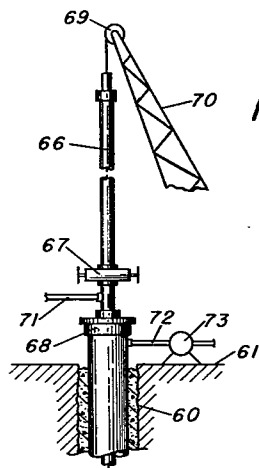


FIG. 4.

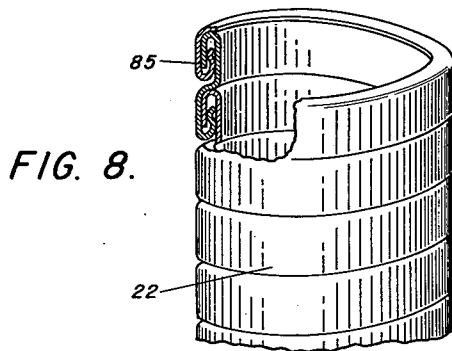


FIG. 8.

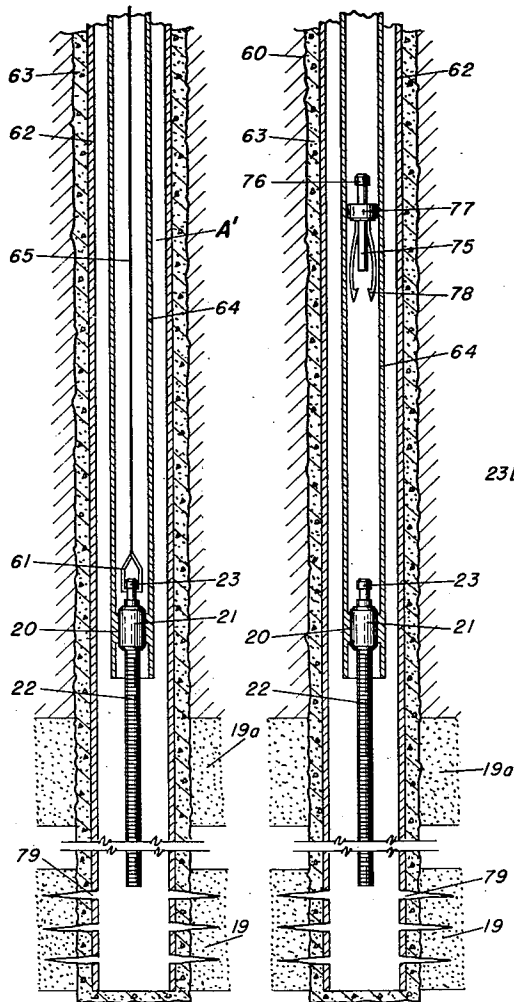


FIG. 5.

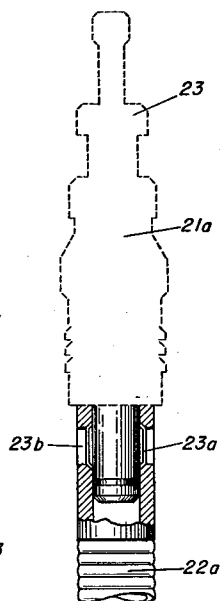


FIG. 7.

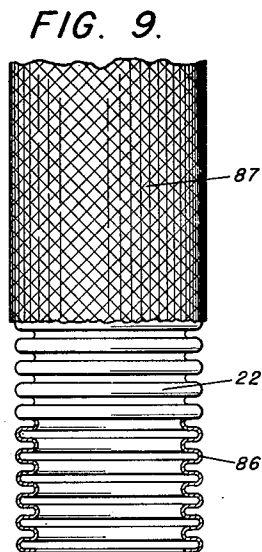


FIG. 9.

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TUBULAR EXTENSION MEMBER FOR WELLS

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Application July 25, 1955, Serial No. 523,963

8 Claims. (Cl. 166—77)

The present invention is directed to a tubular extension member for use in wells. More particularly, the invention is directed to apparatus for extending the effective length of tubing in wells deviated from the vertical. In its more particular aspects, the invention is directed to apparatus and method for completing and servicing wells located offshore at a marine or water location.

The present invention may be briefly described as an apparatus for use in a well bore comprising a flexible tubular member having means on its upper end for suspending the tubular member in the well. The flexible metallic member is particularly adapted for use in a tubing arranged in a well casing in a well and is provided with suspending means which is removably connected to the upper end of the tubular extension member for suspending the tubular extension member in the tubing and/or well. The suspending means may suitably be removably connected to the flexible metallic tubular extension member by screw threads, latching devices, latching dogs, pipe engaging means, and the like.

The suspending means which is removably attached to the flexible metallic extension member may suitably be a hanger, such as described in the Composite Catalog of Oil Field and Pipe Line Equipment, 1954 edition, pages 3977 and 4000, and may comprise pipe engaging means such as pipe slips, latching dogs, anchoring means, and the like. The tubular extension member and the hanger are suitably provided with packing, such as chevron packing, for engaging with the walls of a landing seat, and supporting means or landing nipple, such as has been described in the Composite Catalog of Oil Field and Pipeline Equipment, 1954 edition, page 3977.

The present invention also comprises apparatus in combination with a well drilled in the earth's surface having a casing extending substantially the depth of the well and having a tubing arranged in the casing with its lower end at a level above at least one productive interval, the well casing and tubing being closed at the upper end by a well head. A pipe is connected to the well head and tubing having a permanent, substantially short radial bend and a laterally extending conduit means is connected to the pipe for introducing into the tubing through the pipe a flexible metal tubular extension member which is adapted to be and is supported and/or suspended at its upper end in sealing engagement with the tubing in the lower end of the tubing such that it projects therefrom.

It is contemplated that the laterally extending conduit means may extend from a well head connected to a well drilled at a marine location with the well head being arranged below the level of the water and with the conduit extending laterally to the shore of the water location.

It is further contemplated that the well, whether it be at a marine location or drilled on dry land, may be deviated substantially from the vertical such that it is necessary, when the effective length of the tubing is extended, to move the flexible metallic tubular extension member through the well bore deviated substantially from the vertical. The flexible tubular extension member is ad-

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mirably suited for moving through a deviated well or moving through a passage which is deviated from the vertical and which traverses a path from the horizontal to the vertical or at an angle from the vertical.

In the practice of the present invention, it is contemplated that the flexible metallic tubular extension member may be moved through the passageway or through the tubing by attaching same to a wire line and lowering the tubular extension member or the tubular extension member may be moved by pumping fluid or flowing fluid into contact with the tubular extension member. For example, at least one end of the tubular member may be closed and fluid pumped thereagainst to cause same to move through the tubing and the lateral conduit. When running the tubular extension member into the well, the lower end of the tubular member may be closed by an expendable plug and when retrieving the tubular extension member from the well, the upper end thereof may be closed and/or sealed to allow fluid to be pumped against the tubular extension member to retrieve same from the well.

The present invention will be further illustrated by reference to the drawing in which:

Fig. 1 is a schematic showing of a well drilled at a water location illustrating the flexible tubular extension member in place and at various stages of running in;

Fig. 2 is a partial sectional view of the lower end of the tubular member in a closed position;

Fig. 3 shows a tubular member run through a deviated well bore;

Fig. 4 illustrates the lowering of the flexible tubular member on a wire line;

Fig. 5 illustrates means for retrieving the tubular member from the well;

Fig. 6 is a partial sectional view of a suspending means removably attached to the flexible tubular extension member;

Fig. 7 is an illustration of a latching means for releasably connecting the hanger to the tubular extension member;

Fig. 8 is a partial cutaway view of the flexible construction of the tubular member;

Fig. 9 is a partial sectional view of a bellows-type flexible extension member and shows the metallic covering of the bellows-type extension member.

Referring now to the drawing in which identical numerals will be employed to designate identical parts and particularly to Figs. 1 and 2, numeral 11 designates a well drilled from the water bottom 12 of a water location 13 at a substantial distance from a shore line 14. Arranged in the well bore 11 is a casing 15 which is cemented in place with primary cement 16, the casing 15 extending substantially the depth of the well. Arranged in the casing 15 is a tubing 17 having its lower open end 18 arranged at a level above a hydrocarbon productive interval 19. The tubing 17 has arranged adjacent the lower open end 18 a landing nipple 20 in which is suspended a hanger assembly 21. Releasably or permanently connected to the hanger assembly 21 is a flexible tubing extension member 22. The hanger assembly 21 and extension member 22 are provided on the upper end of the hanger assembly 21 with a fishing neck 23. The extension member 22 is run into the tubing 17 with its lower end 24 closed by an expendable plug 25 which is also attached thereto by shear pins or other releasable attaching means 26. Plug 25 is also provided with a cup-type packer 25a for the purpose of pumping extension member 22 into the tubing.

The tubing 17 and the casing 15 are closed in by a well head 27 which has attached thereto and to the tubing 17 a short radius bend pipe 28 which may be of any desired degree. The pipe 28 is connected to a

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laterally extending conduit 29 by a pipe connecting means 30, the laterally extending pipe or conduit 29 extending to the shore 14.

Connected to the casing 15 and providing communication with the annulus A between the casing and tubing is a conduit 31 which also extends to the shore 14 and has a pump 32 arranged therein.

The conduit 29 is provided with a blowout preventer 33 which serves as a supporting means for the tubular extension member 22 as will be described. Connected to the blowout preventer or supporting means 33 is a lubricator 34 provided with a valve 35. Connected to the lubricator 34 by a laterally extending conduit 36 is a pump 37 which connects to a source of fluid, not shown, by a conduit 38. The pump 32 also connects to a source of fluid by a conduit 39. The fluid source may be drilling mud, oil, fresh or salt water as may be desired or may be a suitable treating agent, such as acid, acid gel, cement slurry, and many other fluid materials used in oil well servicing and completion operations.

Shown in the running in position is a tubular extension member 22 being run in through the blowout preventer 33 into the conduit 34, the flexible extension member being wound or spooled on a reel or drum 40 mounted by a mounting means 41 on a service truck 42, the flexible tubular extension member being run off the reel 40 over a sheave 43 carried by the truck 42.

The flexible, metallic extension member may conveniently be formed in sections of a predetermined length coupled together by a removable connection means. Such sections may be of 50, 100, 200, 300, 500 feet in length as may be desired.

It is to be noted in Fig. 1 that the hydrocarbon productive interval 19 has been perforated to form a flow path from the interval 19 into the casing. This has been accomplished by previously inserting through the tubing 17 a tubing gun perforator and firing same to form the perforations 44 through the casing 15 and cement 16. Thereafter, as shown in Fig. 1, a body of cement 45 has been deposited to seal the perforations 44.

Referring now to Fig. 3, it will be seen that a well casing 50 has been arranged in a well bore 51 which is deviated from the vertical and cemented in place with primary cement 52. A tubing string 53 follows the deviated casing 50 and well bore 51 and has arranged in the lower end thereof a landing nipple 20 suspended from a hanger assembly 21, a flexible metallic tubular extension member 22 provided with a fishing head 23. Like the illustration of Fig. 1, a production interval 19 has been penetrated by perforating the casing 50 to form perforations 54 through the casing 50 and the cement 52.

Referring now to Fig. 4, a well 60 drilled from the earth's surface 61 has penetrated the hydrocarbon productive interval 19. The well has a casing 62 arranged therein and cemented in place with primary cement 63. In the casing 62 is a tubing 64 having its lower open end arranged above the hydrocarbon productive interval 19. Shown lowered on a wire line 65 and attached thereto by a fishing means 66 attached to fishing neck 23 is a flexible metallic tubular member 22 which has been landed in the landing nipple 20.

The wire line 65 extends through a lubricator 66 attached to a blowout preventer 67 which, in turn, is attached to the well head 68. The wire line runs over a sheave 69 on a truck crane 70 and runs to a reel thereon, not shown. The sheave 69 may be mounted on the lubricator 66 if desired.

Connected to the tubing 64 below the blowout preventer 67 and above well head 68 is a flow line 71 and connected to the casing 62 is a pipe or conduit 72 provided with a pump 73 therein which connects to a source of fluid, not shown. Flow line 71 also connects to a pump and source of fluid, not shown.

In Fig. 5 means are provided in the apparatus of

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Fig. 4 for retrieving the extension member 22. Shown being pumped down is a retrieving assembly 75 provided with a fishing neck 76, a sealing member 77, and grab hooks 78 for engaging with the fishing neck 23.

It is to be noted that like the other figures, the casing 62 and cement 63 in Figs. 4 and 5 have been perforated in the interval 19 to form the perforations 79.

Referring now to Fig. 6, the hanger assembly 21 is releasably connected to the extension member 22 by screw threads 80 on the lower end of the hanger 21 which matingly engage with internal screw threads on the extension means 22.

Referring now to Fig. 7, the hanger assembly 21a is latchably attached to the extension member 23a by spring latches 22a which are forced outwardly into engagement with a recess 23b in the inner walls of extension member 23a when the embodiment of Fig. 7 is inserted therein, as shown.

Referring to Fig. 8, it will be seen that the flexible metallic extension member 22 is provided with interlocking segments 85 which provide flexibility for the extension member.

Referring to Figs. 9 and 10, the extension member 22 is made up of a bellows construction 86, which is covered by a woven metal covering 87.

In employing the device of the present invention with particular reference to Figs. 1 and 2, the tubular extension member 22 is spooled off the reel 40 and inserted into the lubricator 34 as shown. After the desired length has been inserted, a hanger, such as 21, shown in Figs. 6 and 7, is releasably attached thereto and the complete assembly manually inserted in the lubricator 34. Thereafter, the valve 35 is opened and the pump 37 started to force the extension member 22 through the lubricator 34, conduit 29 and through the curved pipe 28 into the tubing 17. The dotted lines show the extension member 22 traversing the pipe of short radius and entering into the tubing 17, while the full lines show the tubular extension member 22 seating in the landing nipple 20. After the tubular extension member is seated in the landing nipple 20, pressure is applied thereto to shear the shear pins 26 and cause the plug 25 to drop to the bottom of the well. Thereafter, the pipe 38 connected to pump 37 is connected to a source of fluid for treating the well; for example, a cement slurry, such as described in the Salathiel Patent 2,582,459, to seal the perforations 44 which have been made previously by lowering a tubing gun perforator through the tubing 17.

Thereafter, the assembly 22 may be retrieved either by engaging with a wire line, such as 65, carrying a grab hook 61 or preferably an assembly, such as shown in Fig. 5, is pumped down to allow the grab hooks 78 to engage the fishing neck 23 and form a seal with the inner walls of the tubing with the sealing member 77. Thereafter, fluid is pumped down the annulus A from a source not shown by conduit means 39 and pipe 31 by means of pump 32 to force the extension member 22 back up the tubing and through the curved pipe 28 and conduit 29 into the supporting means or blowout preventer 33 which serves to hold the conduit in that position and allow it to be retrieved through the lubricator 34 for spooling again on the reel 40 after detaching the removable hanger 21 by unscrewing the screw threads 80 or depressing the latches 22a.

The extension member 22 may be run in or removed from a deviated well, such as shown in Fig. 3, in the same manner as has been described with respect to Fig. 1. Likewise, with respect to Fig. 4, buoyancy may be provided to the tubular extension member 22 during its lowering and raising operation by circulating fluid down the annulus A' by way of pump 73 connected to the casing 62 by conduit 72. In the running in position, the extension member 22 may be provided with a plug, such as shown in Figs. 1 and 2, and buoyancy provided by trapping air within the extension member 22, whereas on

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removing same reverse circulation will provide buoyancy as the device is being raised on the wire line 65.

In the embodiment of Fig. 5, the tubular extension member may be run in, either on the wire line or pumped in as shown in Fig. 1 and then retrieved by pumping down the retrieving assembly shown in Fig. 5 to engage with the fishing neck 23. Thereafter by reverse circulation, the assembly may be retrieved by virtue of the seal formed by sealing member 77 with the tubing 62.

After retrieving the assembly 22, as has been described, the well 11 may be reperfdrated in the same interval or vertically displaced therefrom such as in interval 19 or productive interval 19a.

The device of the present invention is quite advantageous and allows the effective length of a tubing to be lengthened or increased in wells for flow passage and/or tubing and casing which deviate from the vertical. Thus, for example, deviated wells are no longer a problem in well servicing and completion where flexible tubular extension members, as set out herein, are employed. By virtue of the flexible nature of the flexible tubing extension the extension may be carried on a reel or service truck and run in or retrieved in a fraction of the time required for rigid extension members. Deviated or deflected bore holes do not limit the scope of utility of the flexible extension member of the present invention since it may be used offshore with all the well connections on shore and all service and completion operations for the marine location conducted from the shore location.

The present invention may be used in all well servicing operations such as cleaning mud from a well bore to the total well depth where the tubing is arranged at a level above a plurality of hydrocarbon productive intervals, sand removal may be afforded in deviated wells, cementing operations where a slurry of cement is deposited in regions adjacent perforations and excess fluid cement then removed therefrom and other treatments of wells or servicing operations where fluid is deposited in a well below the lower open end of the tubing which is arranged at a high level in the well.

The present invention has great utility and is particularly useful at water locations and/or deviated and/or deflected wells where the well tubing, well casing, or other flow passages deviate substantially from the vertical or where connections having short radial bends are connected to the well tubing or to the casing.

The nature and objects of the present invention having been completely described and illustrated, what we wish to claim as new and useful and to secure by Letters Patent is:

1. In a well drilled in the earth to penetrate a plurality of productive subsurface intervals having a casing extending substantially the depth of the well and having a tubing arranged in said casing with its open lower end at a level above said plurality of productive subsurface intervals, said tubing being provided with a supporting means adjacent its lower end, said well casing and tubing being closed at their upper ends by a well head, the combination of a pipe connected to said well head and tubing having a substantially short radius bend, a flexible tubular extension member provided with means removably connected to the upper end of said tubular extension member sealingly engaging said tubular extension member with said supporting means in the lower end of said tubing, laterally extending conduit means connected to said pipe through which said tubular extension member is introduced into said tubing through said pipe, means connected to said conduit means for introducing said flexible tubular member into said conduit means, and fluid pressure means connected to said conduit means for moving said tubular extension member freely through said conduit means and pipe and into said tubing for passage through said tubing.

2. In a well drilled in the earth at a water location to

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penetrate a plurality of productive subsurface intervals having a casing extending substantially the depth of the well and having a tubing arranged in said casing with its open lower end at a level above said plurality of productive subsurface intervals, said tubing being provided with a supporting means adjacent its lower end, said well casing and tubing being closed at their upper ends by a well head below the water level at said water location, the combination of a pipe connected to said well head and tubing having a substantially short radius bend, a flexible, metallic tubular extension member provided with means removably connected to the upper end of said tubular extension member sealingly engaging said tubular extension member with said supporting means in the lower end of said tubing, laterally extending conduit means extending to the shore of said water location and connected to said pipe through which said tubular extension member is introduced into said tubing through said pipe, means connected to said conduit means for introducing said flexible tubular member into said conduit means, and fluid pressure means connected to said conduit means for moving said tubular extension member freely through said conduit means and pipe and into said tubing for passage through said tubing.

3. In a well drilled in the earth to penetrate a productive subsurface interval having a casing extended substantially the depth of the well and having a tubing arranged in said casing with its open lower end at a level above said productive interval, said tubing being provided with a supporting means adjacent its lower end, said well casing and tubing being closed at their upper ends by a well head, the combination of a pipe connected to said well head and tubing having a substantially short radius bend, a flexible tubular extension member adapted to be engaged by its upper end with said supporting means, laterally extending conduit means connected to said pipe through which said flexible tubular extension member is introduced into said tubing through said pipe, means connected to said conduit means for introducing said flexible tubular extension member into said conduit means, and fluid pressure means connected to said conduit means for moving said tubular extension member freely through said conduit means and pipe and into said tubing for passage into said tubing.

4. The combination of claim 3, in which the fluid pressure means is a pump connected to a source of fluid.

5. Apparatus in accordance with claim 3 in which the means connected to the conduit means for introducing the flexible tubular member into the said conduit means is a lubricator.

6. Apparatus in accordance with claim 3 in which the flexible tubular extension member is provided with a sealing means on its lower end.

7. Apparatus in accordance with claim 3 in which the flexible tubular member is provided with a plug closing its lower end and said plug having a sealing means thereon.

8. Apparatus in accordance with claim 3 in which the flexible tubular extension member is provided with a hanger assembly on its upper end for engaging with said supporting means.

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