

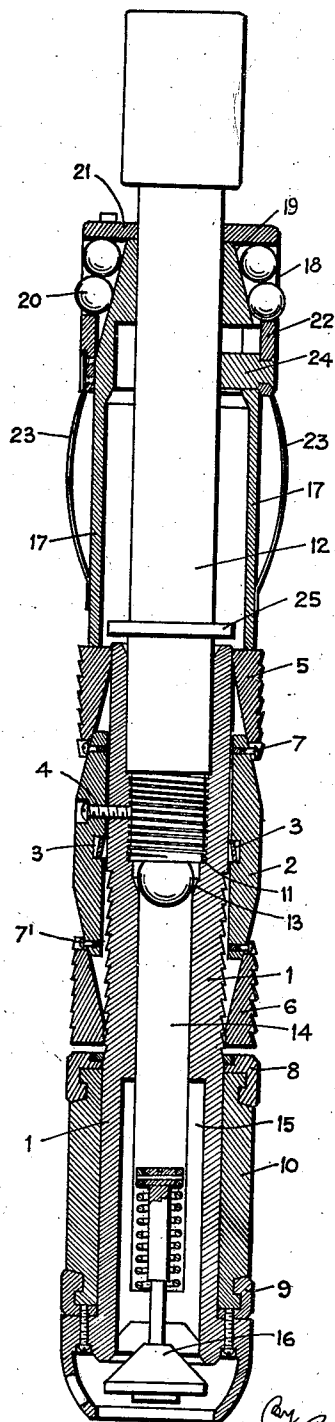
Nov. 7, 1939.

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2,178,999

MEANS FOR TRIPPING AND SETTING TOOLS

Filed March 12, 1938



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UNITED STATES PATENT OFFICE

2,178,999

MEANS FOR TRIPPING AND SETTING TOOLS

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Application March 12, 1938, Serial No. 195,508

4 Claims. (Cl. 166—12)

This invention is for improvements in and relating to the tripping or setting of tools, such as a cement trap or retainer, in a well bore casing or in any other locality where the problem arises of setting and securing a tool therein in a desired position.

Such practice is chiefly, although not exclusively, prevalent in well boring and drilling operations, such as for cementing or otherwise operating on the well bore casing, and in cementing operations for constructional purposes. The invention is not restricted, however, solely to cementing operations, but is applicable to the tripping or setting of any tool in the same or in any analogous location.

In cementing operations in well boring and drilling in particular, it is frequently desired either to cement the well bore casing in position or, after the said casing has been permanently set and cemented, to extend the well bore with a casing liner inserted through the main well bore casing and extending downwardly through the bottom of the latter, and to cement the said liner in position. Or again to cement a collar between the outer wall of the casing or liner and the wall of the bore hole at an intermediate point of the casing or liner where a hole or window has occurred through damage thereto. Such cementing of the main casing and/or of the liner or of the intermediate cement collar is effected by means of a cement trap or retainer (hereinafter termed cement retainer) having a non-return valve at the lower end thereof, which retainer is lowered into the casing or liner and to which cement is pumped through a pipe extending through the casing and/or liner.

In addition to the cement retainer a trip assembly is provided having for function, once the retainer has been lowered in the casing or liner in a desired position, to trip and set the same in the said position and, when the cementing operation has been finished, to be thereafter withdrawn leaving the cement retainer in the casing or liner. However, such trip assemblies, and method of operating the same and setting the cement retainer hitherto proposed have had various disadvantages, the chief of which resides in the complexity of the means provided for operating the trip assembly and thereby setting the cement retainer in a desired position. In one well known form of construction of trip assembly and method of operating the same, use is made of a built-up fluid pressure arising from fluid which is pumped through the trip assembly and cement retainer whilst secured at the end of the cement pipe line

and the through-flow of which is arrested at a desired moment in order to build up the said fluid pressure. Such arrangement, however, necessitates a special construction of the cement retainer for shutting off at will the through-flow of the fluid to build up the said fluid pressure whilst permitting thereafter through-flow of the cement. Furthermore, the means for setting the cement retainer in position in the casing or liner by the trip assembly before the cementing operation has been started, comprises top and bottom setting slips on the said retainer and the arrangement is such that the said slips are set successively by the trip assembly; the one by pulling on the same and the cement retainer and the other under the action of the built-up fluid pressure, the said slips making tight frictional contact with the internal wall of the casing or liner to hold the cement retainer in position when the trip assembly and pipe line have been disconnected therefrom and returned to the surface.

The present invention aims at overcoming the disadvantages which have been found to be inherent in the method of and means hitherto proposed as above described for the tripping and setting of cement retainers and other tools in well bore casing or analogous localities and to provide an improved method of and means for such purposes.

One object of the present invention is to provide improved means for tripping and setting a tool, such as a cement retainer, in a well bore casing or analogous locality, whereby one or more setting members associated with the said tool are positively urged into the setting position without the use of any special controlling means, such as a fluid pressure control, for positively controlling the tripping assembly, yet ensuring easy and convenient operation and control of the latter.

A second object of the invention is to provide such improved means, wherein a plurality of setting members for securing the tool in position in the casing or analogous locality may be tripped and set simultaneously and not successively as has generally been the practice heretofore.

A third object of the invention is to provide an improved trip assembly for tripping and setting a tool, such as a cement retainer, in a well bore casing or analogous locality, the operation of which trip assembly is entirely mechanical, the construction of which is simple and convenient in operation and for the control of which no additional means whatsoever are required other

than the normal pipe line and cement retainer itself.

A further object of the invention is to provide an improved combined cement retainer and trip assembly therefor, for cementing operations, which is such that after being lowered into the required position the said retainer can be tripped and set by the trip assembly without necessitating any special means for the operation and control of the latter, and the said trip assembly may then be detached from the tripped and set cement retainer and withdrawn therefrom.

The above and other objects, features and advantages of the invention will be clearly understood from the following description with reference to the accompanying drawing of a trip assembly and cement retainer constructed in accordance with the invention. It will, however, be understood by those skilled in the art that the invention is not restricted to the specific details of the mechanism which is hereinafter described by way of example only as applied to the tripping and setting of a cement trap and that the invention is also applicable to the tripping and setting of other tools.

In the accompanying drawing which illustrates in elevation, and partly in section, the combination of a trip assembly and cement retainer in position for tripping and setting, the retainer consists of a trap body 1 having mounted on the outside thereof a sleeve 2 provided with a cone and rack lock 3 and secured by means of a shear screw 4 so as to be movable with the said trap body 1. The said sleeve 2 is conically shaped at each end thereof as shown and there is provided over each of the said conical ends of the sleeve 2 top and bottom setting slips 5, 6 for the trap, each of said slips being provided with serrated outer surfaces and being held in position thereon by shear screws 7, 7' of soft metal, e. g., copper screws, but being capable of being positively urged into the setting position thereof as hereinafter described. In their normal position as shown, which is that of the non-set position of the trap 1, the said slips 5 and 6 are located over the smallest ends of the conical portions of the sleeve 2 and the outer serrated faces thereof do not extend beyond the outer diameter of the middle part of the sleeve 2.

Below the bottom slips 6 the trap body 1 has rings 8 and 9 provided thereon between which extends, as shown, a rubber sleeve 10.

Towards the top, the interior of the trap body 1 is enlarged as shown and is provided with a screw thread 11 into which is adapted to be screwed the end of a member 12 of the trip assembly to be hereinafter described. The interior circulating passage for the cement through the trap body extends from the entry 13 thereof to which is connected the trip assembly 12 and comprises a passage 14 provided with an enlargement at 15 for by-passing the spindle and spring control means of a non-return valve 16 of known construction located in the bottom of the trap. The said trap is characterized in its construction by the feature that between the inlet 13 to the cement circulating passage 14 and the non-return valve 16 the said cement circulating passage 14 is so arranged that no closing of the said passage can be effected, the passage thus providing at all times an entirely free flow and circulation of the cement, and in consequence being of the utmost simplicity.

The trip assembly for use with the cement retainer above described comprises a hollow mem-

ber 12 adapted to be screw threaded to the cement retainer body, and a tripping body in the form of a sleeve 17, which is mounted on the said member 12 and is capable at all times insofar as its construction and manner of mounting on the member 12 as shown in the drawing are concerned of limited movement thereon in the axial direction. The lower end of the said sleeve 17 is adapted to engage, as shown, and when the end of the member 12 has been screwed into the top of the trap body 1, with the top of the top slip 5 of the trap 1. The top end of the said trip sleeve 17 is provided with a ball cage 18 having an inclined surface 19 on which rest the balls and which forms, as shown, a conical surface with the narrower end of the cage at the top. The ball cage 18 is so arranged that the balls 20 cannot come entirely out of the cage but are movable into upper and lower positions thereon. As shown, in their lower position corresponding to the larger end of the conical surface 19, the said balls project partly outside the said cage, whilst when in their upper position they are housed completely within the cage. A top cover-plate 21 is provided over the ball cage 18 and is secured in position by means of one or more screws.

The bottom of the said ball cage 18 is constituted by a finger-ring 22 movably mounted on the outside of the trip sleeve 17 and normally held in position at the bottom of the ball cage by means of four bow springs 23 secured thereto and to the trip sleeve 17 as shown. The said finger-ring 22 is provided with a plurality of lugs 24 (only one of which is shown) at the lower end thereof, and which are so disposed that should the member 12 of the trip assembly be pulled upwardly whilst the trip sleeve 17 is retained in its original position, a flange or ring 25 provided on the said member 12 will engage with the said lugs and thereby cause the said finger-ring 22 to be lifted upwardly and to urge the balls 20 into the upper position in the ball cage 18 where they are completely housed within the cage.

The combined cement trap and trip assembly above described is adapted in size and dimensions to the particular job in view and to be used and operated according to the invention in the following manner:

Let it be assumed that it is desired to cement a casing in a well bore hole. The trip assembly member 12, bearing the trip body 17 and associated mechanism above described, is screw-threaded at 11 to the trap body 1 and the combined assembly is secured through a suitable coupling to the end of a cement circulating pipe. The combined assembly at the end of the pipe is then lowered into the bottom of the casing and, if desired, a preliminary circulation of washing fluid is effected in a known manner.

In lowering the assembly into the desired position in the casing, the balls 20 in the ball cage 18 are pushed and maintained in their upper position in the enlarged part of the ball cage due to their own frictional contact with, and to flexing of the bow springs 23 by contact thereof with, the wall of the casing and consequent urging upwardly of the finger ring 22, and thus allow free passage of the assembly into the desired position in the casing.

The cementing is effected by connecting the cement pump to the top of the cement pipe and forcing the cement down the latter, through the hollow member 12 of the trip assembly, the ce-

ment circulating passage 14 of the cement retainer 1, and out through the non-return valve 16. Before the cementing, however, it is necessary to effect a good seal of the cement retainer 1 with the internal wall of the casing and to set the same in position therein so that it remains in the casing when the cement pipe and trip assembly have been withdrawn after the cementing. To such end, the trip assembly above described is adapted to trip and effect the engagement of the top and bottom slips 5 and 6 of the cement retainer 1 with the wall of the casing and simultaneously to cause the rubber sleeve 10 to effect a good seal with such wall. This tripping and setting of the cement retainer slips and of the rubber sleeve 10 is effected by pulling upward slightly on the drill pipe and therefore on the connected assembly of trip member 12 and cement retainer body 1. The whole device is therefore moved slightly upward but upon the initiation of such movement the balls 20 are urged into tight frictional contact with the casing walls which contact increases the more they tend to locate themselves in the extreme bottom part of the ball cage 18 and they are consequently urged to project out of the side of the cage. This causes the trip sleeve 17 to be held in substantially immovable contact with the wall of the well bore casing and as the cement trap body 1 continues to move upwardly slightly with the member 12 and cement pipe, the said top slip 5 is engaged by the end of the immovable trip sleeve 17 and is forced downwardly, breaking the shearing screws 7, and is thereby positively urged into tight frictional engagement with the wall of the casing. At the same time the shear-screw 4 of the sleeve 2 carried by the cement retainer body 1 is broken, thus permitting slight continued upward movement of the retainer body 1 whilst the said sleeve is held due to the setting of the top slip 5. The said upward movement of the retainer body 1 also causes the top ring 3 connected to the rubber sleeve 10 to engage with the bottom slip 6 and, due to the said upward movement continuing, to break the retaining screws 7' and to set also the bottom slip 6 by positively urging the same into tight frictional engagement with the wall of the casing. The slight further continued upward movement of the retainer body 1 causes the rubber sleeve 10 to be compressed and to expand outwardly between the ring 8 (the movement of which has been arrested by the setting of the slip 6) and the ring 9 the movement of which is continuing, and thus to effect a good seal between the end of the retainer body 1 and the internal wall of the casing. The cone and rack lock 3 ensures, however, that the retainer body 1 remains in supporting assemblage with the sleeve 2 when the trip assembly is withdrawn as herein-after described.

Approximately two points of pull may be required to ensure setting of the top slip 5 and three points of pull to ensure that the bottom slip 6 is also set, but since the same pulling action operates to set both slips there is believed to be justification for considering the slips as being set substantially simultaneously, as opposed to existing practice in which two entirely separate operations are required to set the two slips.

When the slips have been set in the manner above described and the cementing finished, it is then desired to remove the trip assembly and cement circulating pipe and to such end the said pipe with the member 12 of the trip assembly connected thereto is backed off from the screw-

threaded connection 11 of the retainer body 1, and is raised upwards. The trip body or sleeve 17 being held in tight frictional engagement with the wall of the casing by the balls 20 remains thus during such initial upward movement of the member 12, but at a determined moment during said upward movement the ring 25 on the member 12 contacts with the lugs 24 on the finger-ring 22 and urges the latter upwards, thereby urging the balls 20 into their upper position in the cage 18 and out of frictional engagement with the wall of the casing. The trip sleeve 17 on the member 12 is thus allowed to be withdrawn with the latter member leaving the cement retainer tripped and set in the casing.

It will be seen that by the construction of the trip assembly and method of operating the same above described, the entire construction and operation may be effected easily and conveniently, without the necessity of special control means, such as by building up a fluid-pressure to operate the trip assembly. Furthermore, the whole construction and operation is entirely mechanical and of a simple nature and in the case wherein a plurality of setting members are provided for the tool, i. e. the cement trap above described, the said setting members are adapted to be set by one and the same controlling action.

It will also be understood that the above description with reference to the accompanying drawing has been given by way of example only and that many modifications and developments of the said construction and method of operation may be devised within the scope of the appended claims.

I claim:

1. A trip assembly for tripping and setting a tool, such as a cement retainer, in a well bore casing or analogous locality, comprising a member adapted to be detachably secured to the tool, a tripping body comprising a sleeve movable in an axial direction on the said member, and a ball cage on the said trip sleeve the balls of which are movable on an inclined surface on the said sleeve which is such that in one position in the said cage the said balls project partly outside the cage and in another position are completely housed within the same.

2. A trip assembly for tripping and setting a tool, such as a cement retainer, in a well bore casing or analogous locality, comprising a member adapted to be detachably secured to the tool, a tripping body comprising a sleeve movable in an axial direction on the said member, a ball cage on the said trip sleeve the balls of which are movable on an inclined surface on the said sleeve which is such that in the lower position in the said cage the balls project partly outside the cage and in the upper position they are completely housed within the same, a movable ring on the said trip sleeve adapted to form the bottom of the said ball cage, and spring means adapted to be flexed by contact of the well bore or analogous casing to urge the said movable ring in a direction to push the balls into the said upper position in the cage.

3. A trip assembly for tripping and setting a tool, such as a cement retainer, in a well bore casing or analogous locality, comprising a member adapted to be detachably secured to the tool, a tripping body comprising a sleeve movable in an axial direction on the said member, a ball cage on the said trip sleeve the balls of which are movable on an inclined surface on the said sleeve which is such that in the lower position in the said

cage the said balls project partly outside the cage and in the upper position they are completely housed within the same, a movable ring on the said trip sleeve adapted to form the bottom of the ball cage, and means mounted on the said member and capable of contacting with the said movable ring to displace the same in a direction towards the top of the said ball cage when the said member has been displaced to a sufficient extent and in a predetermined direction relatively to the said trip sleeve.

4. A combined cement trap and trip assembly for tripping and setting the said trap in a well bore casing or analogous locality, comprising a cement retainer body having top and bottom setting slips therefor capable of being urged positively into the setting position thereof, a trip assembly comprising a member adapted to be detachably connected to the cement retainer body, a tripping body comprising a sleeve movable in an axial direction on the said member and the bottom of which is adapted to engage with the top setting slip on the cement retainer, an in-

clined surface on the said trip sleeve towards the top end thereof, a ball cage surrounding the said inclined surface the balls of which are movable on the said inclined surface in such a manner that in the lower position in the said cage the balls project partly outside the cage and in the upper position they are completely housed within the same, and means on the said cement retainer body adapted to be brought into engagement with and to set the said bottom setting slip thereon, the arrangement being such that upon an upward movement being given to the connected assembly of trip mechanism and cement retainer when in the well bore casing or analogous locality, the said balls carried by the trip sleeve cage are caused to engage with the wall of the casing and to lock the trip sleeve thereto, and the continued upward movement of the connected assembly then causes the said trip sleeve to trip and set the top setting slip of the cement retainer and the member carried by the said retainer to trip and set the said bottom slip.

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