United States Patent

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[54] **METHOD AND APPARATUS FOR VIBRATING AND CEMENTING A WELL CASING**
19 Claims, 13 Drawing Figs.

[52] **U.S. Cl.** **166/286,** 166/177, 166/278, 166/289
[51] **Int. Cl.** **E21b 33/14**
[50] **Field of Search** 166/286, 285, 249, 315, 177, 178, 241, 278; 175/55, 56

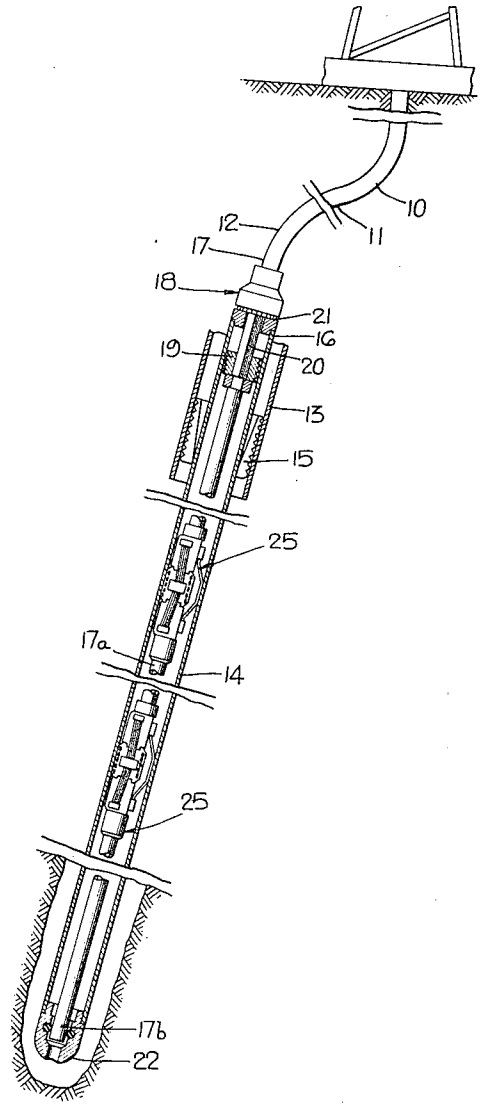
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ABSTRACT: A device adapted to be mounted on a drill pipe and inserted in a well casing with a radially movable impact member resiliently urged into engagement with the casing and repeatedly moved away from engagement and released for causing an impact upon rotation of the drill pipe while the device is resiliently held from rotating relative to the casing. The method of cementing or gravel packing the casing in the well by the use of such devices to vibrate the casing while the cement slurry or gravel is pumped through the drill pipe and into the annulus surrounding the casing and including the step of clearing the cement slurry from the drill pipe by a following plug pumped down the drill pipe.



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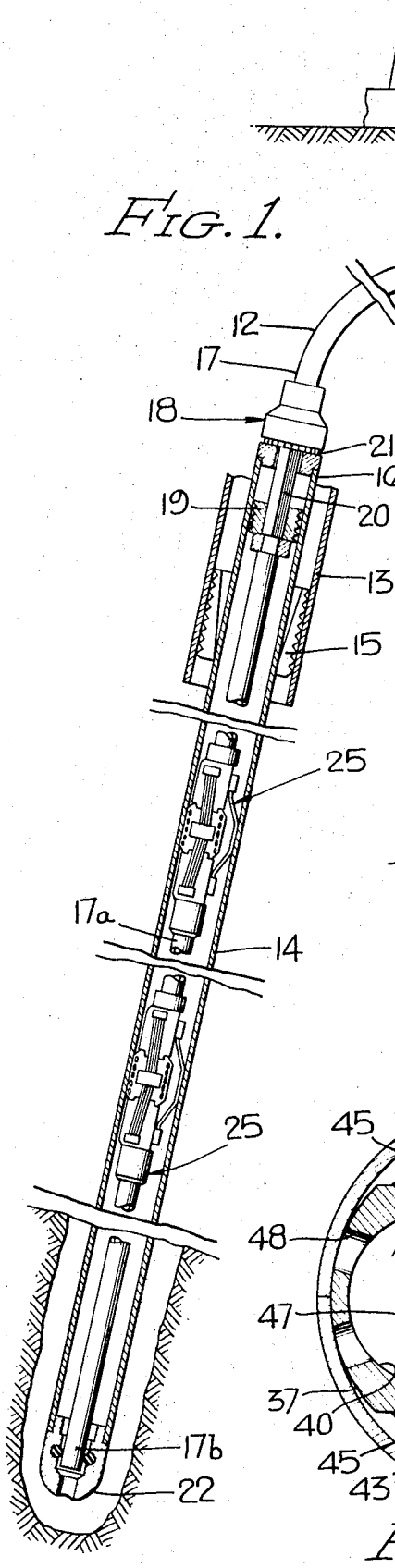


FIG. 1.

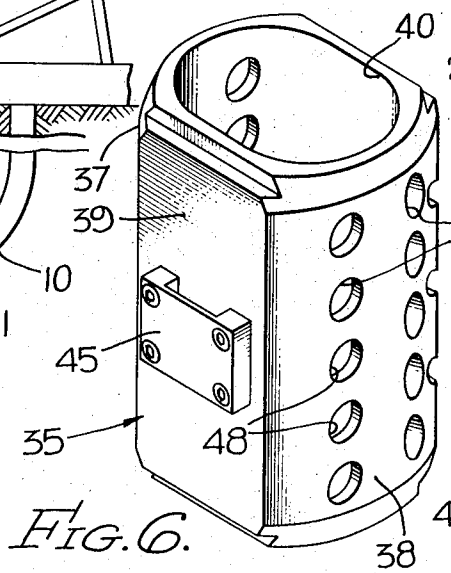


FIG. 6.

FIG. 4.

FIG. 7.

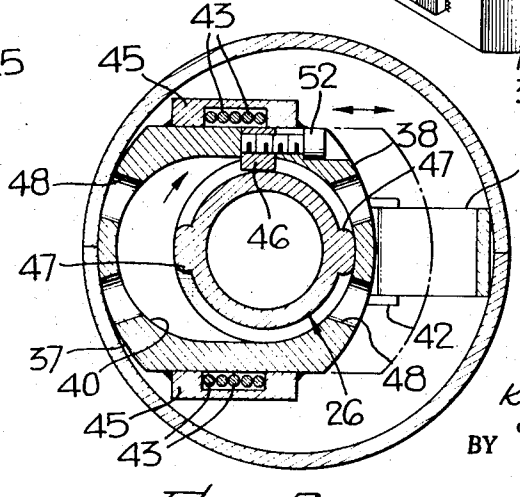


FIG. 5.

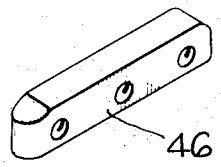


FIG. 8.

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FIG. 2.

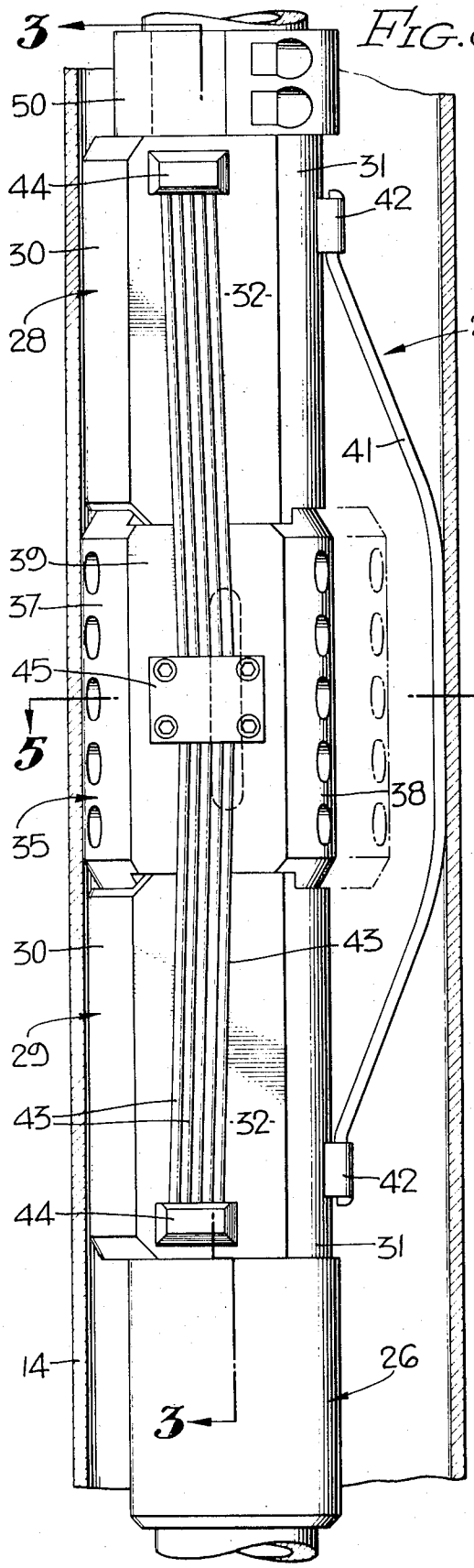
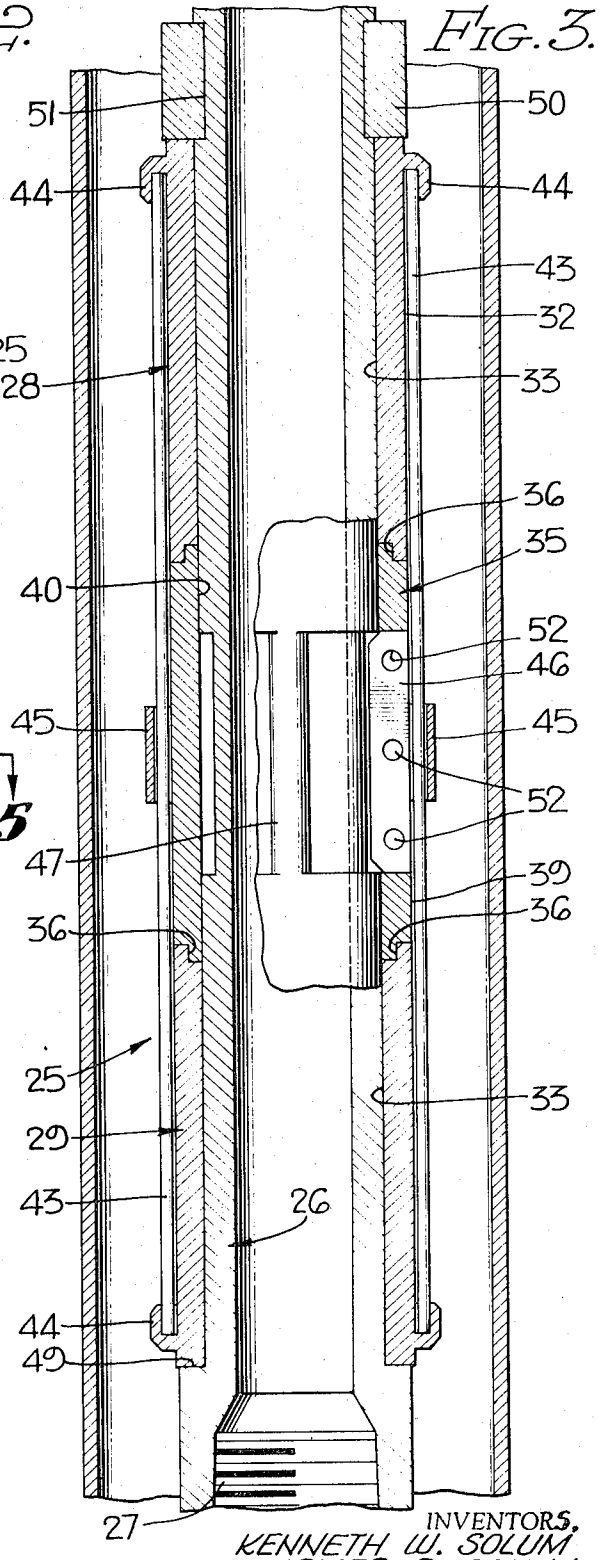


FIG. 3.



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FIG. 10.

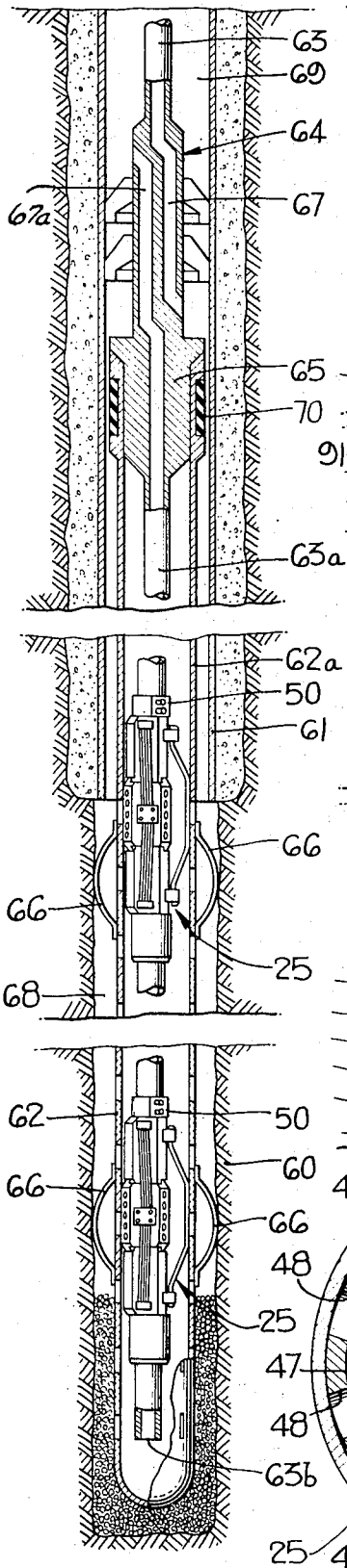


FIG. 11.

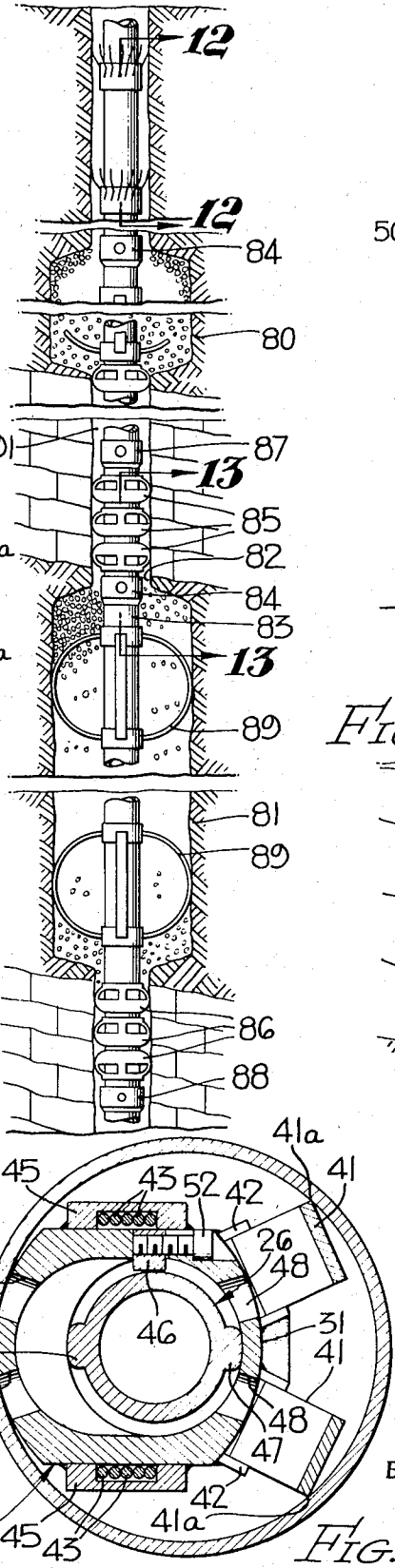


FIG. 9.

FIG. 12.

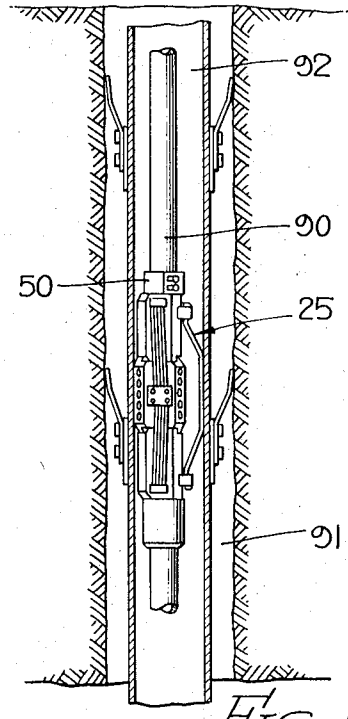
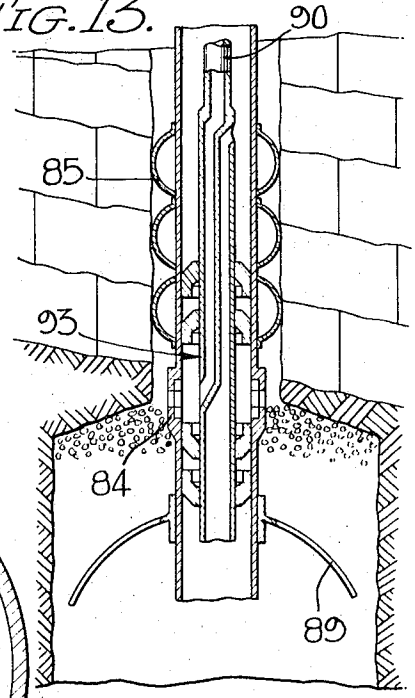


FIG. 13.



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METHOD AND APPARATUS FOR VIBRATING AND CEMENTING A WELL CASING

This invention relates to an apparatus for vibrating a well casing through the manipulation of the drill pipe during any procedure wherein such vibration is desirable and further is particularly directed to novel methods of cementing and gravel packing well casings by the use of such apparatus.

There are numerous operations and processes performed in the drilling and completion of oil, gas and water wells which involve the placing of a fluid or granular material in the annular space surrounding the well casing. In most such operations and processes it is highly desirable to achieve the maximum possible compaction, displacement or fill of such fluid or materials in the annulus. One common procedure is gravel packing wherein the gravel is flowed into the annular space surrounding a slotted liner at the production zone. It is highly desirable that a complete compaction and fill of the gravel be obtained whereby the production fluid must pass through the gravel at all points. Heretofore, there has been no manner in which a complete gravel fill could be assured but rather the operator was forced to rely solely upon a careful dispersion of the gravel in the carrying fluid and hope for a uniform placement of the gravel.

Another common procedure involving the filling of the annulus externally of a casing is in cementing the casing in the well bore. The usual procedure in casing cementation to insure a complete displacement of the drilling mud by the cement slurry in the annulus is to provide scratchers or turbulence generating devices on the casing and to rotate or reciprocate the casing during placement of the cement. However, in many situations it is impossible or impractical to move the casing due to the particular well condition such as in highly deviated well bores where substantial difficulty is encountered in merely running the casing into the full desired depth and the operator cannot risk damaging or sticking the casing by attempting rotation or reciprocation. Under such conditions it is well recognized that the cement slurry fill in the annulus is usually less than complete although it may be adequate. However substantial remedial procedures must be taken if, through testing, the cement fill is found to be inadequate.

Accordingly, it is a principal object of this invention to provide novel methods for the improved gravel packing and cementation of a casing in a well bore by vibrating the casing during gravel or cement placement without rotating or reciprocating the casing and a novel apparatus for positioning within the casing and causing such vibration by rotation of a drill pipe to which the apparatus is connected.

An object of this invention is to provide a novel method for compactly placing a pumpable material in the annular space externally of a well casing in a well bore without reciprocating or rotating the well casing by vibrating the casing at the location of material placement through the use of device or series of devices positioned within the casing at that location and operated by a drill pipe string.

Another object of this invention is to provide a novel method for cementing casing in a well bore employing the drill pipe for conducting the cement slurry to the lower end of the casing and rotating the drill pipe with devices thereon for vibrating the casing during the cement placement.

A further object of this invention is to provide a novel form of device for vibrating a remote section of the casing fixedly positioned in a well bore wherein the device is connected to a drill pipe extending into the casing and frictionally engages the interior of the casing whereby rotation of the drill pipe causes repeated actuation of a radially biased impact member to radially jar the casing. A still further object of this invention is to provide such a device wherein the impact member is spring biased toward engagement with the casing and a cam member on the rotating drill pipe moves the impact member away from the casing and releases the impact member upon such revolution of the drill pipe.

A more detailed object of this invention is to provide a method for gravel packing multiple zones of a well bore and cementing the intervening zones for completing the well.

Still another object of this invention is to provide a novel form of device for internally jarring a casing through rotation of the drill pipe on which the device is mounted and with only frictional engagement between the device and the smooth interior of the casing.

Other and more detailed objects and advantages of this invention will appear from the following description and the accompanying drawings wherein:

FIG. 1 is a diagrammatic illustration of a typical slant drilled well in which one form of the method and apparatus of this invention may be used for cementing a casing in the well bore.

FIG. 2 is an elevation view of the device of this invention positioned within a casing shown in section and illustrating in phantom lines the biased or cocked position of the impact member.

FIG. 3 is a sectional elevation of the device of this invention taken substantially on the line 3–3 as shown in FIG. 2.

FIG. 4 is a perspective view of the tubular mandrel of the device of this invention.

FIG. 5 is a sectional plan view taken substantially on the line 5–5 in FIG. 2.

FIGS. 6 and 7 are perspective views of the impact member and one of the stationary members, respectively, of the device of this invention.

FIG. 8 is a perspective view of the removable cam or key member of the device.

FIG. 9 is a sectional plan view of a modified form of the device of this invention.

FIG. 10 is a diagrammatic illustration of an open hole well completion with gravel packing and using the method and apparatus of this invention.

FIG. 11 is a diagrammatic illustration of a multiple zone well completion with gravel packing and cementation using the method and apparatus of this invention.

FIGS. 12 and 13 are enlarged sectional elevations taken substantially on the lines 12–12 and 13–13, respectively, in FIG. 11 and illustrating the internally positioned tools.

Referring now to FIG. 1 of the drawings, a typical oil well configuration is illustrated of the type in which the method and apparatus of this invention are particularly useful due to the adverse conditions presented. It has become relatively common to slant drill wells as shown in FIG. 1 wherein the well bore starts vertically and is deviated at 10 to a laterally extending portion 11 which may be up to 70° from vertical. Then by a second deviation at 12 the well bore may be returned to the vertical or slightly inclined as shown. While the drill pipe used in the rotary drilling of the well is sufficiently strong to assume the S-curve of such a well, it is relatively difficult to run the conventional casing into the well and then either rotate or reciprocate that casing due to these severe deviations in the well bore. Thus, the usual procedure of rotating or reciprocating the casing with scratchers or the like externally mounted on the casing to insure a complete cement fill in the surrounding annulus cannot be followed safely and as a result the percentage and quality of the cement fill in the annulus without such agitation is somewhat questionable. It is for these reasons and other factors that the method and apparatus of this invention are extremely useful.

In a typical well as shown in FIG. 1, one or more larger sizes of casing 13 may be cemented in the well bore and extend to the shallow or intermediate depths either above the deviation points 10 and 12 or below, as shown in the drawing. Conventionally a casing 14 of the size desired at the producing zone extends for a substantial portion of the depth of the well beyond the first or intermediate stage casing 13. The casing 14 may extend to the surface of the well or, as diagrammatically shown in the drawing for convenience, may be anchored in the lower portion of casing 13 by a hanger 15. After completion of the cementation of the casing 14 a conventional packer may be installed on the upper end 16 of the casing 14 to establish a seal between the casings 13 and 14.

In the method of this invention, the upper end 16 of the casing 14 may be releasably connected to a drill pipe 17 by a releasing tool, generally designated 18, of the general type

well known to those skilled in the art. For example, the releasing tool 18 may have a left-hand threaded bushing 19 slidably mounted on a noncircular mandrel 20 and threadedly engaging the casing 14 whereby right-hand rotation of the drill pipe 17 will cause unthreading of the bushing 19 to release the casing. The releasing tool 18 may also have a thrust bearing 21 for rotatably supporting at least a portion of the weight of the drill pipe 17 on the upper end 16 of the casing 14. The drill pipe 17 has a portion 17*a* extending within the length of the casing 14 and terminating in a portion 17*b* which sealably engages the casing shoe 22. A plurality of casing impacting and vibrating devices, generally designated 25, are mounted in spaced relation along the length of the casing 17*a* within the casing 14 and, as will appear more fully hereinafter, rotation of the drill pipe 17 and portion 17*a* causes actuation of the devices 25 to impact and vibrate the casing 14. The spacing and positioning of the devices 25 will depend on the length of casing 14 to be cemented and the particular conditions of the well bore.

In using the arrangements shown in FIG. 1 in the method of this invention, the casing 14 is lowered into the well bore with the portion 17*a* of the drill pipe and the devices 25 positioned within the casing, all of which is supported from the drill pipe 17. When the hanger 15 has been set to properly locate the casing 14 and fluid circulation has been established, the cement slurry is pumped down the drill pipe 17. A conventional frangible cementing plug may precede the cement slurry although it is not essential to this invention. Before the cement slurry reaches the casing shoe 22, rotation of the drill pipe 17 is initiated to actuate the devices 25 for vibrating the casing 14. After the appropriate predetermined amount of the cement slurry is introduced into the drill pipe 17 for filling the desired portion of the annulus surrounding the casing 14, a conventional top cementing plug is introduced into the drill pipe 17 on top of the cement slurry and fluid pumping is continued until the top plug reaches the casing shoe 22 where it becomes lodged in the conventional manner to close the end of the casing. This effectively cleans the cement slurry from the entire drill pipe 17 and 17*a* thereby avoiding the problems in backscuttling the cement slurry from the drill pipe and casting. Rotation of the drill pipe 17 is continued throughout the placement of the cement slurry in the annulus to produce continuous operation of the devices 25 thereby agitating the fluid in the annulus and maximizing the percentage of cement slurry fill. Once the top plug has reached the casing shoe 22 the drill pipe 17 may be lifted and circulation continued, if desired, to assure that the drill pipe and casing are free of cement slurry. The drill pipe 17 and 17*a* together with the devices 25 are then removed from the well and normal completion procedures are followed.

Referring now to FIGS. 2 through 8, the impact and vibrating device 25 is shown in greater detail. A tubular mandrel 26 extends interiorly the length of the device and preferably has an internal diameter equal to that of the drill pipe 17 for allowing the cementing plugs to pass therethrough. Both ends of the mandrel 26 are provided with threads 27 for threadably connecting to the drill pipe 17*a* with or without the use of additional couplings or nipples. Upper and lower body members 28 and 29, respectively, of similar configuration are rotatably mounted on the mandrel 26 and together form a support body for the other elements of the device. Each of the support members 28 and 29 have one curved outer surface 30 of a radius approximately equal to the internal radius of the casing 14 and a rear surface 31 that may be of the same or a different radius of curvature. The sides 32 of each of the body members 28 and 29 are preferably flat and parallel. The internal bore 33 of each support member 28 and 29 is adapted to rotatably fit the mandrel 26 and is offset closer to surface 31, than surface 30, as best shown in FIG. 7. The confronting ends of support members 28 and 29, that is the lower end of 28 and the upper end of 29, are provided with slideways 34 for slidably receiving the impact member 35. The slideways 34 may be of any conventional configuration such as a dovetail or, as shown in the drawings, a flat surface bordered by straight shoulders 36. Thus the impact member 35 is captured between the support members 28 and 29 and supported for sliding radial movement.

The impact member 35 also has a curved front surface 37 of a radius approximately equal to the internal radius of the casing 14 for smoothly fitting the casing. The back surface 38 of the impact member 35 like surface 31 may or may not be of the same radius as the casing. The side surfaces 39 of impact member 35 are parallel and flat as well as being spaced the same distance as the flat surfaces 32 of support members 28 and 29 whereby the surfaces 32 and 39 on both sides of the device are coplanar as best shown in FIG. 3. The internal bore 40 of impact member 35 is oval with a width equal to the diameter of bore 33 but of a greater length to allow the radial movement of the impact member 35 on the mandrel 26 relative to the support members 38 and 29.

Means are provided for inhibiting the rotation of the support members 28 and 29 relative to the casing 14 as well as urging the front surfaces 30 of the members into engagement with the casing 14 and, as shown in FIGS. 1—8 of the drawings, the means may comprise a leaf spring 41 extending longitudinally between the members 28 and 29. The ends of the bowed or leaf spring 41 are supported in keepers 42 mounted on the surfaces 31 of the members 28 and 29 and the intermediate portion of the leaf spring 41 bows outwardly to resiliently engage the interior of the casing 14. At least one end of the leaf spring 41 must be only loosely confined by the keeper 42 for allowing movement upon resilient collapsing of the spring 41.

In the modified form of device 25 shown in FIG. 9, a pair of longitudinally extending spring bows 41 are mounted on surfaces 31 and it may be seen that by reason of their nonradical relationship to the casing 14 the edges 41*a* of the spring bows engage the casing and enhance the resistance to rotation. Moreover the two bows 41 tend to center the device 25 to insure a more solid impact by member 35.

Means are provided for resiliently urging the impact member 35 into engagement with the casing 14 at its front face 37 and, as shown in the drawings, these means may include a plurality of spring rods 43 extending longitudinally between the support members 28 and 29 and engaging the impact member 35. A like plurality of spring rods 43 are positioned on each side of the device 25 along the surfaces 32 and 39 to balance the resilient forces imposed upon the impact member 35. For convenience five spring rods 43 have been shown on each side of the device and the ends of the spring rods are captured by keepers 44 mounted on the surfaces 32 of the support members 28 and 29. A channel-shaped keeper 45 is removably mounted on each side of impact member 35 with the spring rods 43 passing therethrough. Other configurations of resilient means will readily appear to those skilled in the art as substitutes for spring rods 43 but it is to be noted that by using a plurality of spring rods 43 positioned flat on each side of the device there is a minimum increase in the lateral width of the device which might otherwise form an obstruction and yet the rods are of a form which may be repeatedly flexed in the lateral direction with assurance of dependability and lack of fatigue.

Means are provided for producing an interengagement between the mandrel 26 and the impact member 35 to translate the rotary movement of the mandrel into a lateral sliding movement of the impact member and, as shown in the drawings, these means may include a longitudinally extending key 46 mounted on one side of the impact member 35 and protruding inwardly to engage longitudinally extending ribs 47 on the mandrel 26. Between the ribs 47 there is a reduced diameter portion on the mandrel 26 into which the key 46 protrudes between successive engagements by the ribs 47. As best shown in FIG. 5, as the mandrel 26 is rotated in a clockwise direction a rib 47 engages the key 46 and urges the impact member 35 toward the right, as shown by the phantom lines, and out of engagement with the casing 14. This lateral

movement is resiliently opposed by the spring rods **43** and therefor, upon the rib **47** rotating passed the key **46** to release the impact member **35**, the spring rods **43** rapidly urge the impact member **35** into engagement with the casing **14** to produce the desired impact and vibration. It is to be noted that lateral movement of the entire device is opposed by the leaf spring **41** thereby assuring a delivery of the maximum possible impact force to the casing. A plurality of ports **48** are provided in the faces **37** and **38** of the impact member **35** to minimize the fluid resistance to the rapid movement of the member. Thus it may be seen that, in effect, the interengaging key **46** and ribs **47** produce a translation of rotary motion of the drill pipe **17** and mandrel **26** into a lateral movement and the attendant energy produced by such lateral movement is stored in the spring rods **43** for producing the desired impact upon release between the interengaging means.

The device **25** may be conveniently assembled by successively installing the support member **29**, impact member **35** and support member **28** on the mandrel **26** with the lower end of support member **29** being supported on a shoulder **49** on the mandrel **26**. With the springs **41** and **43** captured in the keepers **42** and **44**, respectively, a split ring collar **50** may be installed at the upper end in mating engagement with a groove **51** in the mandrel **26** to provide the proper spacing and clearance between the members **38**, **29** and **35**. The key **46** may then be inserted laterally through a longitudinal slot in the side of impact member **35** and held in place by bolts **52**. The keepers **45** may then be installed.

Referring to FIG. **10**, the method and apparatus for gravel compaction completion of a well are illustrated. The producing zone **60** of the well is shown as an open hole without casing which is immediately below a casing **61** cemented in the well in the conventional manner. The well completion string is comprised of a slotted liner **62** for lowering the liner into the well. A fluid crossover tool **64** with a releasing portion **65** releasably connecting the drill pipe **63** to the liner **62**. A portion **63***a* of the drill pipe extends downwardly throughout most of the length of liner **62** and has a plurality of the impacting and vibrating devices **25** mounted thereon. This assembly is lowered into the well to the desired location by the drill pipe **63** with the liner **62** positioned in the producing zone **60** and preferably centered therein by the centralizers **66**. The gravel is pumped with a fluid down the drill pipe **63**, through the port **67** in crossover tool **64**, into the annulus **68** and downward to fill the annulus, with the fluid passing in through the slots in the liner to the end **63***b* of the drill pipe and back to the crossover tool **64** where it passes out through port **67***a* into space **69** for returning to the surface. During this gravel placement the drill pipe **63** is rotated to actuate the devices **25** for vibrating the liner throughout its length to compact the gravel in the annulus **68**. A substantial section of blank or unperforated liner **62***a* may be provided above the producing zone whereby the compacted gravel in this area will serve to retain the gravel in zone **60** with the need for the usual packer on top. However, if it is desired a packer **70** may be provided on the top of the liner and be actuated after completion of gravel packing. The drill pipe **63**, crossover tool **64**, and devices **25** are then removed.

Referring to FIGS. **11**, **12** and **13**, a multiple zone completion using the method and apparatus of this invention is shown. While only two producing zones **80** and **81** are shown it will readily appear to those skilled in the art that additional zones may be completed in the same manner. The well bore **82** through the production zones **80** and **81** is left open between the zones and above the upper zone, and the well bore is underreamed at the producing zones, as shown. The well completion string comprises a liner **83** extending through all of the producing zones with slots or perforations opposite such zones and no slots in the portions of the liner between and above the producing zones. A port collar **84** is provided in the liner and located at the top of each producing zone. A series of cement baskets **85** are positioned immediately above each port collar **84** for engaging and sealing with the well bore in the nonproducing zone. A second series of cement baskets **86** are positioned immediately below each producing zone. Due to the characteristic of a cement basket only stopping fluid flow in one direction, it is preferred that each series of cement baskets comprise at least two upwardly facing baskets for stopping downward flow and at least one downwardly facing basket therebelow for stopping upward flow. Thus during completion of the well the cement baskets effectively eliminated all fluid flow between the producing zones and the adjacent nonproducing zones. An upper port collar **87** and a lower port collar **88** are provided in each nonproducing zone between the two series of cement baskets. Finally, it is preferred to provide centralizers **89** in the producing zones. The aforedescribed string may be prelocated in the well bore or lower in together with the drill pipe **90** positioned therein.

In either event the completion steps begin with the drill pipe **90** having a plurality of vibrating devices **25** thereon and appropriate port collar manipulating tools therein being positioned in the lowermost nonproducing zone and open the port collars **87** and **88** in that zone. The devices **25** are positioned throughout the zone. The cement slurry is pumped down the drill pipe **90**, out through lower port collar **88**, and upwardly in the annulus **91** with the returning fluid flowing in through the port collar **87** and to the surface in the space **92**. Throughout this pumping the drill pipe **90** is rotated to actuate the devices **25** for assuring a complete fill of the annulus **91** without rotating or reciprocating the liner **83**. After filling one zone between the cement baskets the drill pipe **90** may be lifted to the next nonproducing zone and the same procedure followed for cementing that zone until all the desired cementing has been completed. The drill pipe is then removed and rerun with a crossover tool **93** adapted to mate with the port collar **84** and with devices **25** mounted therebelow throughout the height of the producing zone. As described with respect to FIG. **10**, the gravel may be flowed into the annulus and compacted by rotating the drill pipe to actuate the devices **25**. After filling and compacting each producing zone with gravel the drill pipe **90** and devices **25** are removed.

It may be seen that by this invention there is provided a method for gravel packing or cementing a liner through the use of an internal impacting device whereby the fill is physically improved without moving the liner and further, there is provided an impacting and vibrating device actuated simply by drill pipe rotation. The interconnection of the impacting and vibrating device between the drill pipe and the casing is solely resilient whereby there will be no damage to the casing and the device will not become stuck in the casing. Moreover the assembly of drill pipe and impacting and vibrating devices may be successively moved from zone to zone for accomplishing the same operation in multiple zones without making a round trip with the drill pipe. Although we have described the method and apparatus of our invention in connection with particular well conditions and methods as shown in FIGS. **1**, **10** and **11**, and a specific form of device as shown in some of the remaining FIGS., it is to be understood that our invention is not limited to the specific details herein set forth but rather is of the full scope of the appended claims.

We claim:

1. In a method for cementing a casing in a well bore using a drill pipe with rotation actuated casing vibrating devices thereon, comprising steps of: positioning the casing in the well bore with the drill pipe extending to and engaging the lower end of the casing and with the casing vibrating devices positioned within the casing; pumping cement slurry down the drill pipe to and through the lower end of the casing into the surrounding annulus; rotating the drill pipe during said pumping for actuating the casing vibrating devices to vibrate the casing and enhance the complete filling of the annulus; discontinuing pumping and rotation following placement of the desired amount of cement slurry in the annulus; and removing the drill pipe and vibrating devices from the well.

2. In a method for cementing a casing in a well bore using a drill pipe with rotation-actuated basing vibrating devices

thereon, comprising steps of: positioning the casing in the well bore with the drill pipe extending to and engaging the lower end of the casing and with the casing vibrating devices positioned within the casing; pumping cement slurry down the drill pipe to and through the lower end of the casing into the surrounding annulus; rotating the drill pipe during said pumping for actuating the casing vibrating devices to vibrate the casing and enhance the complete filling of the annulus; inserting a plug in the drill pipe immediately following the desired amount of cement slurry and pumping said plug to the lower end of the casing for clearing the cement slurry from the drill pipe; and discontinuing pumping and rotation and removing the drill pipe and vibrating devices from the well.

3. In a well tool for radially jarring a casing located at a remote depth in a well through the use of a drill pipe, comprising: a mandrel adapted to be connected to the drill pipe; means rotatably supported on said mandrel including an impact member mounted for movement toward the casing relative to said mandrel; said means having means for resisting rotation relative to the casing; and interengaging means on said mandrel and impact member operable upon rotation of the drill pipe and mandrel for repeatedly and consequently causing movement of said impact member into impacting engagement with the casing.

4. The well tool of claim 3 wherein biasing means urge said impact member toward said impacting engagement with the casing and said interengaging means causing a biasing movement and then release of said impact member.

5. The well tool of claim 3 wherein said means for resisting rotation relative to the casing comprises an axially extending leaf spring bowed outwardly to engage the casing.

6. The well tool of claim 5 wherein said impact member is movable toward casing and impacting engagement diametrically opposed to the engagement of said leaf spring with the casing.

7. In a well tool for radially jarring a casing located at a remote depth in a well through the use of a drill pipe, comprising: a mandrel adapted to be connected to the drill pipe; a support body rotatably mounted on said mandrel and having means for engaging the casing for resisting rotation of the support body relative to the casing; and impact member mounted on said support body for movement toward the casing relative to said support body; and interengaging means on said mandrel and impact member operable upon rotation of the drill pipe and mandrel for repeatedly and sequently causing movement of said impact member into impacting engagement with the casing.

8. The well tool of claim 7 wherein biasing means urge said impact member toward said impacting engagement with the casing and said interengaging means causing a biasing movement and then release of said impact member.

9. In a well tool for radially jarring a casing located at a remote depth in a well through the use of a drill pipe, comprising: a tubular mandrel adapted to be connected to the drill pipe and positioned within the casing; a support body rotatably mounted on said mandrel and having means for engaging the casing for resisting rotation of the support body relative to the casing; an impact member mounted on said support body for movement of said impact member toward the casing relative to said support body; means resiliently urging said impact member toward the casing relative to the support body; and interengaging means on said mandrel and impact member operable upon rotation of the drill pipe and mandrel for repeatedly and sequently first moving said impact member away from the casing in opposition to the urging of said resilient means and then releasing said impact member for rapid movement into impacting engagement with the casing.

10. The well tool of claim 9 wherein said means for engaging the casing and resisting rotation comprises and outwardly bowed leaf spring mounted on said support body to extend axially of the casing.

11. The well tool of claim 10 wherein said leaf spring is positioned on said support body for engaging the casing directly opposite the location of impacting casing engagement by said impact member.

12. The well tool of claim 9 wherein said support body comprises two axially spaced members rotatably mounted on said mandrel with said impact member positioned therebetween, and parallel mating slideways are provided on said impact member and two members for allowing said movement of the impact member and preventing relative rotation among the three members.

13. The well tool of claim 12 wherein said slideways are perpendicular to the axis of rotation of the mandrel for causing radial impacting movement of said impact member.

14. The well tool of claim 12 wherein said resilient means for urging the impact member comprise a plurality of spring rods positioned on both sides of said three members relative to the movement of said impact member and extending longitudinally between and mounted on said two support body members, and means connecting said spring rods to said impact member whereby movement of said impact member away from the casing biases said spring rods.

15. The well tool of claim 9 wherein said means for engaging the casing for resisting rotation comprises means resiliently urging the support body into engagement with the casing on the same side as the impacting engagement.

16. The well tool of claim 9 wherein said impact member has a large curved face for engaging the casing for impacting and said face has ports therein for allowing fluid movement therethrough to avoid resistance to the impact.

17. The well tool of claim 9 wherein said interengaging means comprise a longitudinally extending rib on said mandrel and cam on said impact member with said cam positioned to be engaged by said rib to move the impact member away from the casing and to release the impact member as the rib rotates passed the cam.

18. In a method for compactly placing a material externally of a liner in a well bore through a port collar in the liner using a drill pipe with vibrating devices thereon, comprising steps of: positioning the casing in the well bore with the drill pipe extending into the liner with the casing vibrating devices positioned within the liner; manipulating the drill pipe to open the port collar to connect the drill pipe in fluid communication with the exterior of the liner; pumping the material down the drill pipe to and out through the port collar into the surrounding annulus; rotating the drill pipe during said pumping for actuating the vibrating devices to vibrate the liner and enhance the complete filling of the annulus; manipulating the drill pipe to close the port collar; and removing the drill pipe and vibrating devices from the well.

19. The method of claim 18 wherein multiple space zones in the well bore are to be filled with such material and a port collar is provided adjacent each zone, including the steps of successively moving the drill pipe from a position opposite one zone to other zones after placing the material and closing the port collar at said one zone and then opening the port collar opposite said other zone and successively repeating the method at each zone.