

Feb. 4, 1936.

E. BURNS ET AL

2,029,609

WELL TOOL

Filed Aug. 7, 1933

2 Sheets-Sheet 1

Fig. 1.

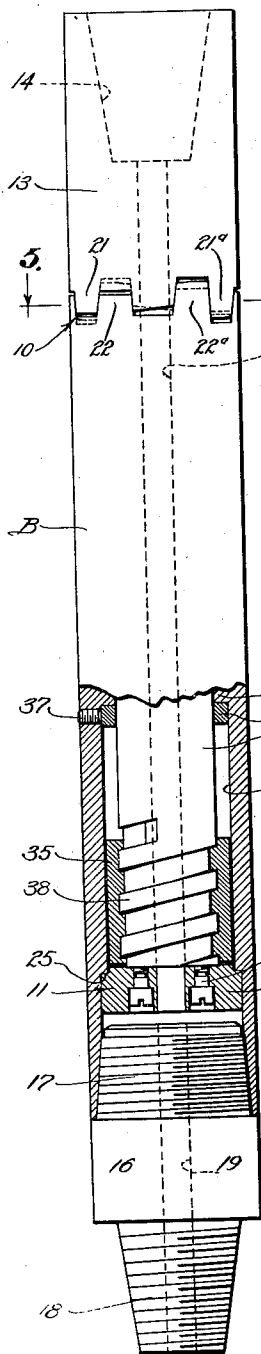


Fig. 2.

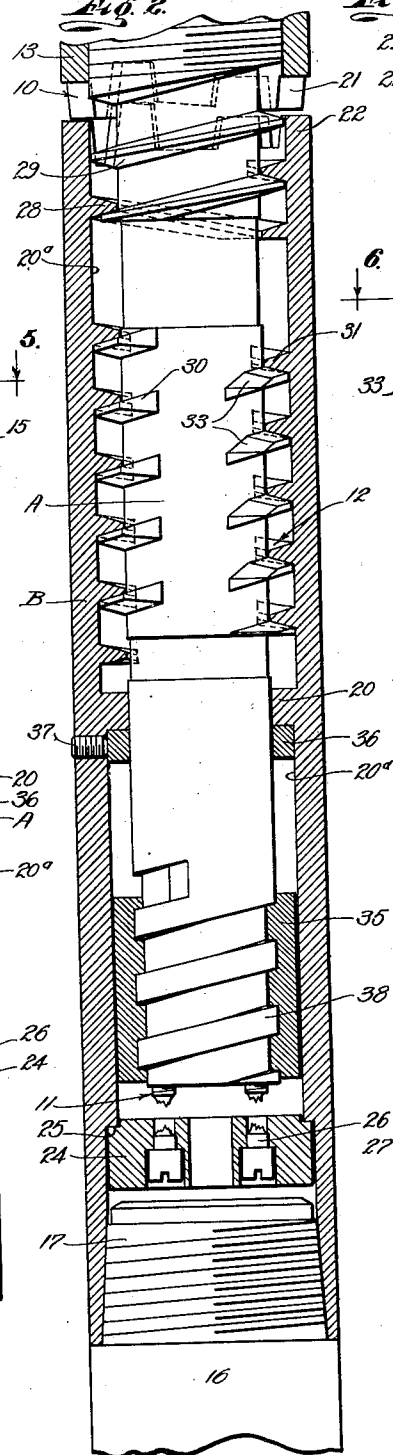
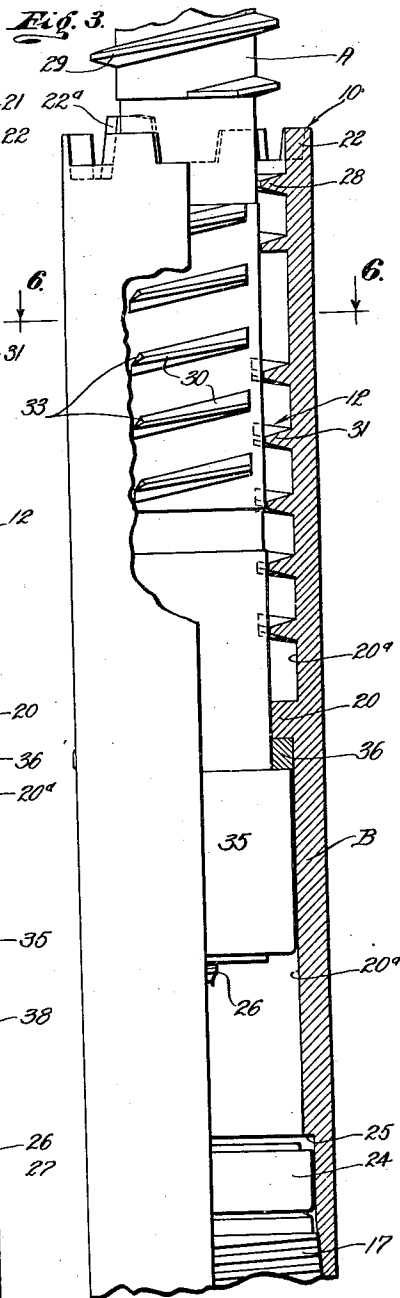


Fig. 3.



Inventors
Erwin Burns
and Harry P. Wickersham
By *W. H. Apple*
Their Attorney

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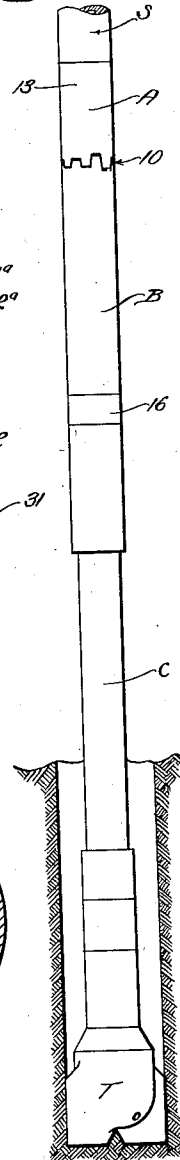
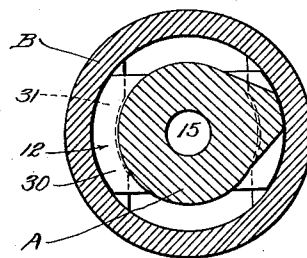
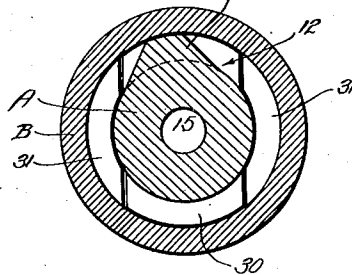
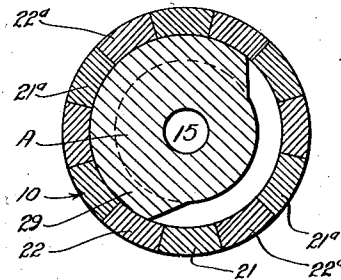
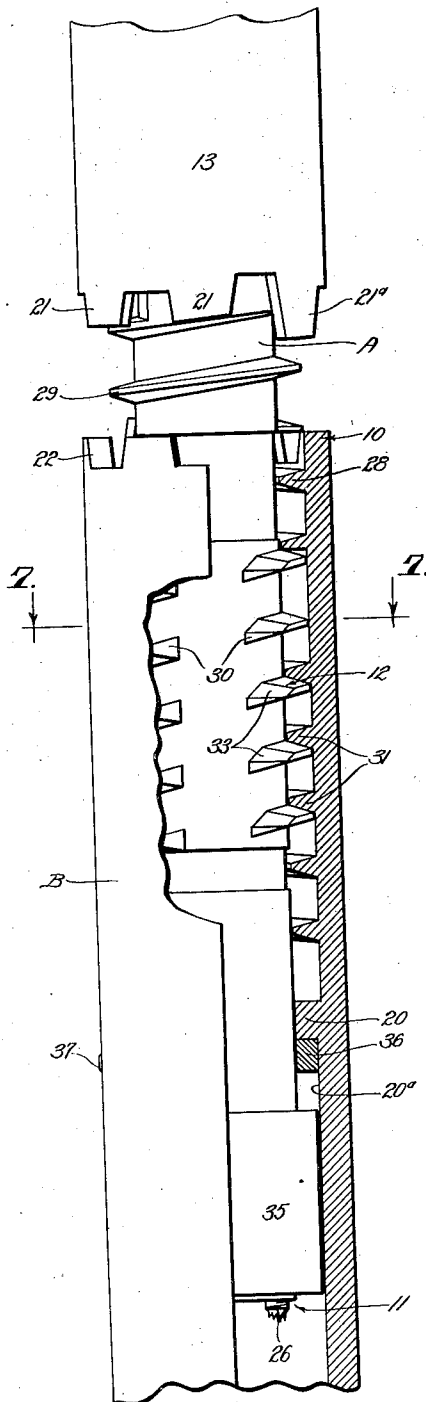
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2 Sheets-Sheet 2



Inventors
Erwin Burns
and Harry P. Wickersham

By W. H. Randall
Their Attorney

UNITED STATES PATENT OFFICE

2,029,609

WELL TOOL

Erwin Burns, Los Angeles, and Harry P.
Wickersham, Huntington Park, Calif.

Application August 7, 1933, Serial No. 684,021

16 Claims. (Cl. 255—28)

This invention relates to a well tool and relates more particularly to a tool useful in well drilling operations. It is a general object of the present invention to provide a simple, practical and effective tool for use in a well drilling string that may serve as a safety joint and that may be operated to impart a jarring action to the drilling tool.

In the drilling of wells with the rotary method, the drilling tools sometimes become stuck or caught in the well bores while penetrating certain types of earth formations. A jarring tool is sometimes connected in a well drilling string so that the drilling tool may be loosened by a jarring or hammering action in the event that it becomes caught in the well bore. This practice is as costly, as the successful forms of jarring tools that have been introduced are very expensive.

An object of the present invention is to provide a simple inexpensive tool for use in a well drilling string that may be operated to impart a jarring or hammering action to the drilling tool in the event that the tool becomes caught in the well bore and that may be released or disconnected if desired or found necessary to permit the major portion of the drilling string to be recovered from the well if the drilling tool cannot be loosened and withdrawn from the well.

Another object of the invention is to provide a tool for use in a well drilling string that may be actuated to impart a hammering action to the drilling tool and that may serve as a releasable safety joint that normally forms a rigid unyielding joint or connection in the string capable of dependably transmitting heavy rotational and longitudinal strains.

It is another object of the invention to provide a tool of the character mentioned that may be easily rendered operative as a jarring tool by putting a tensile strain on the drilling string and then suitably turning the string.

It is another object of the invention to provide a combined jarring tool and safety joint of the character mentioned that may be operated to produce any desired or required number of jarring blows, the intensity of which may be controlled by governing the amount of tension maintained on the drilling string while actuating the tool.

It is another object of the invention to provide a combined jarring tool and safety joint of the character mentioned that may be easily and quickly disconnected after being actuated as a jar or without being employed as a jarring tool.

It is another object of the invention to provide

a well tool of the character mentioned that may be reset after it has been actuated to provide a jarring action so as to effectively and dependably transmit rotational and longitudinal strains. In accordance with the present invention, the tool may be operated to impart a jarring action to the drilling tool in the event that it is caught in the well bore and after the drilling tool has been freed, the device may be reset to a position where it constitutes a substantially rigid joint in the drilling string whereupon the drilling operation may be continued.

A further object of the invention is to provide a well tool of the character mentioned that is dependable in operation and that is simple and inexpensive of manufacture.

Other objects and features of the invention will be best and fully understood from the following detailed description of a typical form and application of the invention, throughout which description reference is made to the accompanying drawings, in which:

Fig. 1 is a side elevation of the tool provided by the invention with the parts in the unactuated or locked position illustrating the lower end portion of the tool in vertical cross section. Fig. 2 is an enlarged vertical detailed sectional view of the tool immediately after the frangible connecting parts have been broken. Fig. 3 is a one-quarter vertical detailed sectional view of the tool showing the parts in the jarring position. Fig. 4 is a view similar to Fig. 3 showing the parts in the position to be jarred. Fig. 5 is a transverse detailed sectional view taken as indicated by line 5—5 on Fig. 1. Fig. 6 is a transverse detailed sectional view taken as indicated by line 6—6 on Fig. 3. Fig. 7 is a transverse detailed sectional view taken as indicated by line 7—7 on Fig. 4, and Fig. 8 is a view illustrating the tool connected in a drilling string.

The tool provided by the present invention includes generally, two sections A and B adapted to be connected in well drilling strings, means for holding the sections A and B against relative rotational movement releasable upon relative longitudinal movement of the sections, means for holding the sections A and B against relative longitudinal movement releasable by a tensile strain on the tool, and means operable to cause a jarring action between the sections A and B after the release of the means for holding the sections A and B against relative rotational movement.

The two body sections A and B of the tool form an elongate assembly adapted to be arranged or connected in a drilling string of drill pipe, or the like. In the particular application

of the invention illustrated in the drawings, the section A is a mandrel or stem member and the section B is a tubular structure normally receiving the stem section A. In the specific form of the invention illustrated in the drawings and being described, the stem section A is the upper section of the tool and is adapted to be connected to the drilling strings, and the section B is the lower section and is adapted to be connected to the drilling tool T or the drill collar C in connection with the drilling tool. A head 13 is provided on the upper end of the stem section A and has suitable means for facilitating connection of the section with the drilling strings. The head 13 is illustrated as having a tapered screw threaded socket 14 for receiving the threaded pin of a tool joint section or the like in the drilling string and as being screw threaded on to the body of the stem section A. In accordance with the invention, the stem section A is comparatively long and is provided with a central longitudinal fluid passage 15 extending from the lower end of the socket 14 to the lower end of the section.

The body section B is adapted to receive the body or major portion of the section A. Suitable means is provided on the lower end of the tubular body section B for connecting with the drilling tool T or the drill collar carrying the drilling tool. In the particular structure illustrated in the drawings, a connecting member 16 has a pin 17 screw-threaded into the lower end of the tubular body section B and is provided with a downwardly projecting pin 18 to facilitate connection with the drill collar. The member 16 has a central longitudinal fluid passage 19 in vertical longitudinal alignment with the fluid passage 15. An annular internal shoulder 20 is provided on the wall of the opening 20^a in the body section B at a point spaced between the opposite ends of the section. The shoulder 20 forms an anvil part or impact part as will be subsequently described.

The means 10 normally holds or locks the body sections A and B against relative rotation in both directions and is releasable, after the release of the means 11, by relative longitudinal movement of the sections. The means 10 may be released to condition the jarring means 12, that is, to render the jarring means 12 operative and after actuation of the means 12, may be reset to connect the sections A and B against relative rotational movement. The means 10 includes meshing or cooperating lugs on the lower end of the head 13 of the section A and the upper end of the section B. In accordance with the invention, two series of lugs 21 are provided on the lower end of the head 13 for cooperating with two complementary sets or series of lugs 22 on the upper end of the section B. Each set or series of lugs 21 includes a long lug 21^a and two or more circumferentially spaced shorter lugs 21. In a similar manner, each set of lugs 22 includes a long lug 22^a and two or more shorter lugs 22. The lugs 21^a of the head 13 are diametrically opposite one another and the long lugs 22^a on the section B are diametrically opposite one another. The shorter lugs 21 of each series of lugs are progressively shorter in a rear or left hand direction from the longer lug 21^a and the lower ends of all of the lugs on the head 13 are inclined upwardly and rearwardly. The shorter lugs 22 of each of the two series on the section B are progressively shorter in a forward or right hand direction from the long lug 22^a and the ends of the several lugs on the section B are of the same pitch or inclination as the ends of the lugs on

the head 13. The sides of the lugs on the head 13 and section B converge slightly toward the ends of the lugs so that the lugs of the two sections may be easily engaged and disengaged. The lugs of the two sections A and B are related and proportioned so that they are adapted to fit one between the other in the manner illustrated in Fig. 1 of the drawings, and when they are in mesh, operate to positively hold the sections A and B against relative rotation in both directions.

The releasable means 11 for holding the sections A and B against relative longitudinal movement normally or initially holds the body sections together in positions where the lugs 21^a and 22^a and the lugs 21 and 22 are in full engagement or mesh. The means 11 may be released by a comparatively heavy tensile strain on the drilling string to permit upward movement of the section A relative to the section B to allow for the disconnection or release of the means 10. The means 11 includes a plug or ring 24 within the section B seating upwardly against a downwardly facing shoulder 25 on the wall of the opening 20^a. Screws 26 pass through spaced openings in the ring 24 and thread into openings in the lower end of the stem section A to hold the sections A and B against separation or longitudinal movement. The heads of the screws 26 may be counter-sunk in sockets 27 in the ring 24. The screws 26 are in the nature of frangible connections of known tensile strength and are intended to fail upon being subjected to a predetermined tensile strain. As the tool is initially assembled, and during the normal drilling operations, screws 26 operate to connect the sections A and B to hold them in positions where their respective lugs 21^a and 22^a and 21 and 22 are in mesh. It will be apparent how the inter-engaging or meshing lugs hold the body sections A and B against relative rotation and limit the movement of the section A into the tubular section B.

A releasably threaded connection is provided between the body sections A and B to govern the disengagement of the lugs of the means 10 after breaking of the screws 26 and to control the operation of the jarring means 12. The threaded connection includes a comparatively short thread 28 on the wall of the opening 20^a in the upper portion of the section B for cooperating with a thread 29 on the upper portion of the stem section A. The thread 28 may extend downwardly from the upper end of the section B while the thread 29 extends downwardly from the end of the head 13. The threads 28 and 29 are pitched in the same direction as the ends of the lugs 21^a and 22^a and have substantially the same pitch as the helical plane generated by the ends of the progressively smaller lugs 21 and 22 described above. In accordance with the invention, substantial clearance is provided between the threads 28 and 29 as illustrated throughout the drawings.

After the screws 26 have been broken by a tensile strain on the drilling string, a suitable tensile strain may be maintained on the tool and the clearance between the threads 28 and 29 allows the section A to move upwardly relative to the section B a distance sufficient to permit the lower ends of the long lugs 21^a to clear the upper ends of the smallest of the lugs 22. The drilling strings with which the section A is connected is turned in a left hand or counter clock-wise direction while maintaining the tensile strain on the string and the cooperating threads 28 and 29 feed the section A upwardly relative to the sec-

tion B so that the longer lugs 21^a continue to clear the lugs on the section B. In practice, three-quarters of a turn of the section A in a left hand direction relative to the section B completely disengages the lugs of the means 10, while the threads 28 and 29 may be formed so that rotation of the section A for about a turn and one quarter relative to the section B disengages the thread 29 from the thread 28. If it is desired to completely disconnect the section A from the section B, the section A is further rotated in a left hand direction to completely disengage the threads 28 and 29 and to disengage the parts of the jarring means 12 as will be hereinafter described. It will be apparent how the threads 28 and 29 operate to control the disengagement of the lugs of the means 10 by feeding the section A upwardly relative to the section B during the rotation of the section A in a left hand direction.

The hammering or jarring means 12 is operable, after breaking of the screws 26 and disengagement of the lugs of the means 10, to impart an upward jarring action to the section B and the parts connected therewith. The means 12 includes longitudinally extending sets or series of pitched segmental shoulders 30 on the section A for cooperating with complementary series of inclined segmental shoulders 31 on the wall of the opening 20^a in the section B. In the preferred construction illustrated in the drawings, there are two series of shoulders 30 and two series of cooperating shoulders 31. The upper ends of the series of shoulders 31 are spaced some distance below the lower end of the thread 28. In accordance with the invention, the sets or series of pitched segmental shoulders 30 and 31 are proportioned and related so that the sets of shoulders 30 may freely move vertically between the sets of shoulders 31 when the sections A and B are in the relative positions illustrated in Fig. 3 of the drawings. The shoulders 30 and 31 are pitched in the same direction as the threads 28 and 29 and have the same inclination or helical pitch as the threads. Substantial clearance is provided between the respective shoulders 30 and 31 when the shoulders are in mesh or cooperation as illustrated in Fig. 2 of the drawings. In practice the clearance of the cooperating shoulders 30 and 31 is approximately equal to the clearance in the threads 28 and 29. The shoulders 30 of the two series on the section A lie in a common helix curve and in a similar manner the several shoulders 31 of the two series of shoulders in the section B have a common helix curve. The leading or forward ends 33 of the shoulders 30 are bevelled or inclined to permit the easy meshing or engagement of the shoulders 30 and 31. The engaging or cooperating surfaces of the shoulders 30 and 31 are preferably flat and are inclined downwardly and outwardly.

The means 12 includes a hammer part or nut 35 on the lower end portion of the stem section A. The nut 35 is adapted to jar against or strike an impact ring 36 seated against the lower end of the shoulder 20. The ring 36 may be locked in position by a set screw 37. Threads 38 releasably connect the nut 35 with the stem section A. The threads 38 are of the same pitch as the threads 28 and 29 and shoulders 30 and 31. The nut 35 is normally free in the opening 20^a so that it turns or rotates with the stem A until it is forcibly held against the impact ring 36. During the rotation of the section A in a reverse or left hand direction to release the lugs of the means 10, the threads 28 and 29 feed or urge the

section A upwardly to bring the nut 35 to approximately the position illustrated in Fig. 4 of the drawings. After the release or disengagement of the lugs of the means 10, the section A may be further turned in a left hand direction while maintaining a slight tensile strain on the drilling string to completely disengage the thread 29 from the thread 28 which brings the series of shoulders 31 to position between the series of shoulders 30 so that the section A may be suddenly moved upwardly to bring the jarring nut 35 into hammering engagement with the impact washer or ring 36. The means 12 may be successively operated after this first actuation by rotating the section A in a right hand direction relative to the section B. When the nut 35 is against the ring 36 the shoulders 30 are in position to enter under the shoulders 31 and continuous turning of the section A in a right hand direction relative to the section B causes the cooperating inclined shoulders to feed the section A downwardly to separate the nut 35 from the ring 36 and as the series of shoulders 30 come to the positions between the sets of shoulders 31 the section A is free to move upwardly causing the nut 35 to jar against the ring 36. In this manner the means 12 is operable to impart one upward jarring blow to the section B during each revolution of the section A relative to the section B in a right hand direction.

It is believed that the operation of the tool provided by the present invention will be readily understood from the foregoing detailed description. The parts are normally and initially in the positions illustrated in Fig. 1 of the drawings, and during the normal drilling operations, the lugs of the means 10 positively prevent relative turning between the body sections and limit downward movement of the section A relative to the section B while the frangible screws 26 prevent upward movement of the section A relative to the section B so that the device normally constitutes a rigid unyielding joint adapted to dependably transmit both rotational and longitudinal strain in both directions. In the event that the drilling tool T on the lower end of the drill collar C becomes caught or immovable in the well bore, it may be desirable or necessary to subject the drilling tool to a jarring action to free it from the formation.

When the tool is to be actuated to impart a jarring action to the drilling tool T, a comparatively heavy upward strain is put on the string S which breaks the frangible pins 26 and moves the section A upwardly relative to the section B to partially disengage the lugs of the means 10. In order to disengage the long lugs 21^a and 22^a, the strings with which the section A is connected, is turned in a counter-clockwise direction, causing the threads 28 and 29 to cooperate and feed the section A upwardly whereby the lower ends of the lugs 21^a clear the upper ends of the lugs on the section B. After the disengagement of the means 10, the counter-clockwise rotation of the section A may be continued to completely disengage the threads 28 and 29 and allow the section A to suddenly move upwardly when the series of shoulders 30 reach positions between the series of shoulders 31. This upward movement of the section A brings the nut 35 into hammering engagement with the impact ring 36. The tool may be operated to impart successive jarring blows to the section B and the tool connected therewith by rotating the section A in a right hand direction relative to the section B. As de-

scribed above, the means 12 is operable to produce one upward jarring action or blow to the section B during each revolution of the section A in a clock-wise direction while maintaining a tensile strain on the drilling string.

The drilling tool T may be loosened from the formation by these jarring blows and it may be desired to continue the drilling operation, in which event, the drilling strings are permitted to settle and are turned in a right hand direction. Settling of the drilling strings allows the section A to move downwardly relative to the section B so that the threads 28 and 29 are again brought into cooperation. The clearance between the inclined segmental shoulders 30 and 31 allows for this downward movement of the section A relative to the section B. After engagement of the threads 28 and 29, turning of the section A in a right hand direction relative to the section B feeds the section A downwardly until the long lugs 21^a strike the long lugs 22^a. The drilling string is then raised to move the section A upwardly relative to the section B an amount equal to the clearance in the continuous threads 28 and 29 and the pitched segmental shoulders 30 and 31 so that the section A may again be turned in a right hand direction, during which turning the long lugs 21^a clear the upper ends of the long lugs 22^a. When the long lugs 21^a and 22^a again come into engagement, the drilling string may be permitted to settle, thus bringing all of the lugs of the means 10 into mesh. The drilling operation may then be resumed as the lugs of the means 10 are operable to transmit rotational strains in both directions and to transmit downward forces from the section A to the section B. The threads 28 and 29 as well as the pitched shoulders 30 and 31 effectively hold the sections A and B against any appreciable longitudinal separation so that the tool may be withdrawn from the well together with the drilling string.

If it becomes necessary to completely disconnect the section A from the section B the means 10 and 11 are released in the manners described above and the section A is turned in a counter-clockwise direction while maintaining a tensile strain on the string to completely unthread the pitched shoulders 30 and 31 and threads 28 and 29. During this unthreading of the sections A and B the nut 35 is forcibly held up against the ring 36 and is thereby held against rotation so that the stem section A is threaded out of the nut. In this manner the section A may be entirely disconnected from the section B.

Having described only a typical preferred form and application of our invention, we do not wish to be limited or restricted to the specific form or application herein set forth, but wish to reserve to ourselves any variations or modifications that may appear to those skilled in the art or fall within the scope of the following claims:

Having described our invention, we claim:

1. A well tool including, two sections adapted to be connected in an operating string, means holding the sections against relative rotation and longitudinal movement in both directions releasable by a tensile strain on the sections, and means operative after release of the first mentioned means to hold the sections against relative longitudinal movement and releasable by a strain on the sections for effecting a jarring action between the sections, the last mentioned means including parts on the sections adapted to cooperate one with the other and related to be moved one past the other out of engaging relation upon separat-

ing movement between the sections whereby the sections are detachable one from the other after the release of the first mentioned means.

2. A well tool including, two sections adapted to be connected in an operating string, releasable means holding the sections against relative rotation, frangible means holding the sections against relative longitudinal movement in both directions, and means operative subsequent to the release of said means to hold the sections against relative longitudinal movement and releasable by a strain on the sections for effecting a jarring action between the sections.

3. A well tool including, two sections adapted to be connected in an operating string, cooperating parts on the sections holding the sections against relative rotation, means holding the sections against relative longitudinal movement releasable by a tensile strain on the sections to permit disengagement of said parts, and means operable by relative rotation between the sections after disengagement of said parts for effecting a jarring action between the sections including series of longitudinally spaced inclined meshing shoulders on the sections.

4. A well tool including, two sections adapted to be connected in an operating string, cooperating parts on the sections holding the sections against relative rotation, frangible means holding the sections against relative longitudinal movement releasable by a tensile strain on the sections to permit disengagement of said parts, and means operable by relative rotation between the sections after disengagement of said parts for effecting a jarring action between the sections.

5. A well tool including, two sections adapted to be connected in an operating string, cooperating parts on the sections holding the sections against relative rotation disengagable upon longitudinal movement of one section relative to the other, frangible means holding the sections against such longitudinal movement and subject to failure by a tensile strain on the sections, and means operative after disengagement of said parts for effecting a jarring action between the sections, said parts being re-engagable after actuation of the last mentioned means.

6. A tool for use in a drilling string including, two sections related for relative movement, means operable by rotation of one section relative to the other to effect a jarring action between the sections, means holding the sections against relative movement releasable by a tensile strain on the sections, and means whereby the sections may be disconnected after the release of the last mentioned means including an impact part detachably threaded on one section and adapted to be unthreaded therefrom by relative rotation between the sections.

7. A tool for use in a drilling string including, two sections related for relative movement, means for holding the sections against relative movement releasable by a strain on the sections, impact parts on the sections to effect a jarring action between the sections upon the release of the first mentioned means, frangible means releasable by a tensile strain for holding the sections against relative longitudinal movement, and means holding the sections against relative rotation releasable upon the release of the last mentioned means to condition the first mentioned means for operation.

8. A tool for use in a drilling string including, two sections related for relative movement, means

for holding the sections against relative longitudinal movement and releasable by a strain on the sections to effect a jarring action between the sections including series of spaced pitched meshing shoulders on the sections, means releasable by a tensile strain for holding the sections against relative longitudinal movement in both directions, and means holding the sections against relative rotation releasable upon the release of the last mentioned means to condition the first mentioned means for operation, said sections being disengageable from one another after the release of the two last mentioned means.

9. A tool for use in a drilling string including, two sections related for relative movement, means operable upon movement of one section relative to the other to effect a jarring action between the sections, a slack threaded connection between the sections operable upon relative rotation of the sections after actuation of said means to recondition said means for further operation, and cooperating parts on the sections for preventing relative rotation of the sections disengageable by relative longitudinal movement of the sections under control of the threaded connection.

10. A tool for use in a string of well equipment, including two sections related for relative movement, meshing parts on the sections holding them against relative rotation, frangible means holding the sections against relative longitudinal movement releasable by a strain on the string to partially disengage said parts, a slack threaded connection between the sections for controlling the disengagement of said parts, and means operable after disengagement of said parts to effect a jarring action between the sections, the last mentioned means being such that the sections may be disconnected.

11. A tool for use in a string of well drilling equipment including, two sections related for relative movement and connecting adjacent members of the string, means connecting the sections whereby they are operable to transmit rotational and longitudinal strains, said means being subject to failure by manipulation of the string to release the sections for relative rotation and longitudinal movement, and means operable by relative rotation between the sections after release of said means for effecting a series of jarring blows between the sections, the last mentioned means including spaced pitched shoulders on the sections which automatically engage and disengage during such relative rotation, the sections being disconnectible after the release of said means.

12. A tool for use in a string of well drilling equipment including, two sections related for relative movement and connecting adjacent members of the string, means normally connecting the sections against relative movement to transmit rotational and longitudinal strains and releasable by manipulation of the string to permit relative rotation and longitudinal movement of the sections, and means operable after release of said means for effecting a jarring action between the sections, the last mentioned means including impact parts on the sections, and spaced pitched shoulders on the sections adapted to be disengaged by relative turning of the sections to permit relative longitudinal movement of the sections to bring the impact parts into hammering cooperation.

13. A tool for use in a string of well drilling

equipment including, two sections related for relative movement and connecting adjacent members of the string, means connecting the sections against relative movement to transmit rotational and longitudinal strains and releasable by manipulation of the string to permit relative rotation and longitudinal movement of the sections, and means operable after release of said means for effecting a jarring action between the sections, a slack threaded connection between the sections, the last mentioned means including impact parts on the sections, and spaced pitched cooperating shoulders on the sections disengageable by relative rotation between the sections to allow upward movement of one section relative to the other to bring the impact parts into hammering cooperation, the pitched shoulder of said section being adapted to be threaded past the thread of the other section to permit disconnection of the sections.

14. A tool for use in a string of well drilling equipment including, two sections related for relative movement and connecting adjacent members of the string, means connecting the sections against relative movement to transmit rotational and longitudinal strains and releasable by manipulation of the string to permit relative rotation and longitudinal movement of the sections, and means operable after release of said means for effecting a jarring action between the sections, a slack threaded connection between the sections, the last mentioned means including impact parts on the sections, and spaced pitched cooperating shoulders on the sections disengageable by relative rotation between the sections to allow upward movement of one section relative to the other to bring the impact parts into hammering cooperation, the pitched shoulder of said section being adapted to be threaded past the thread of the other section to permit disconnection of the sections, the impact part on said section being adapted to be unthreaded during threading said shoulder past the thread.

15. A tool for use in a drilling string including, two sections related for relative movement, means operable upon movement of one section relative to the other to effect a jarring action between the sections, means releasable by a tensile strain for holding the sections against relative longitudinal movement, said means including a screw connecting the sections and adapted to fail under a predetermined tensile strain, releasable holding means holding the sections against relative rotation partly releasable following the breaking of the screw, and threads on the sections operable by relative rotation between the sections following the breaking of the screw to feed the sections one relative to the other to complete the release of the releasable holding means and thus condition the first mentioned means for operation.

16. In combination, a string for operation in a well bore, a tool on the lower end of the string, and a device interposed between two sections of the string including a frangible connection normally connecting the sections against relative movement and subject to failure by strain on the string, and means operable by rotation of the string after failure of said connection to effect jarring of the tool, the device being disconnectible after failure of said connection.

ERWIN BURNS.

HARRY P. WICKERSHAM.