

Oct. 20, 1936.

I. J. McCULLOUGH

2,058,166

JARRING TOOL

Filed June 29, 1931

Fig. 1.

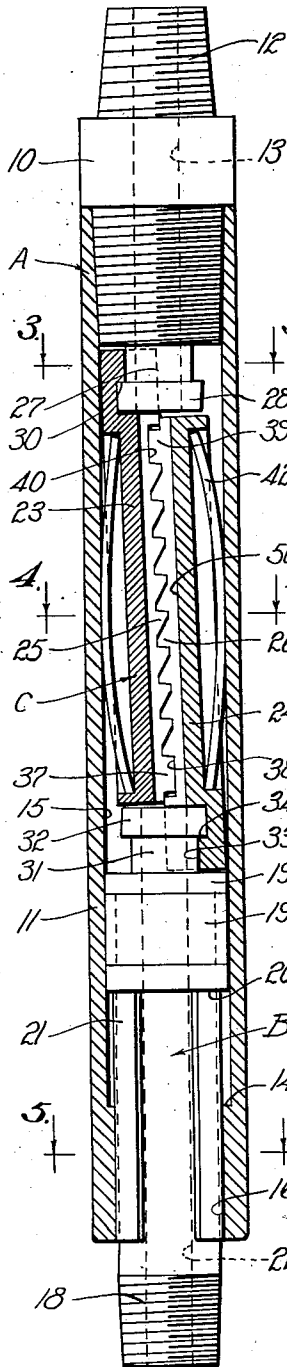


Fig. 2.

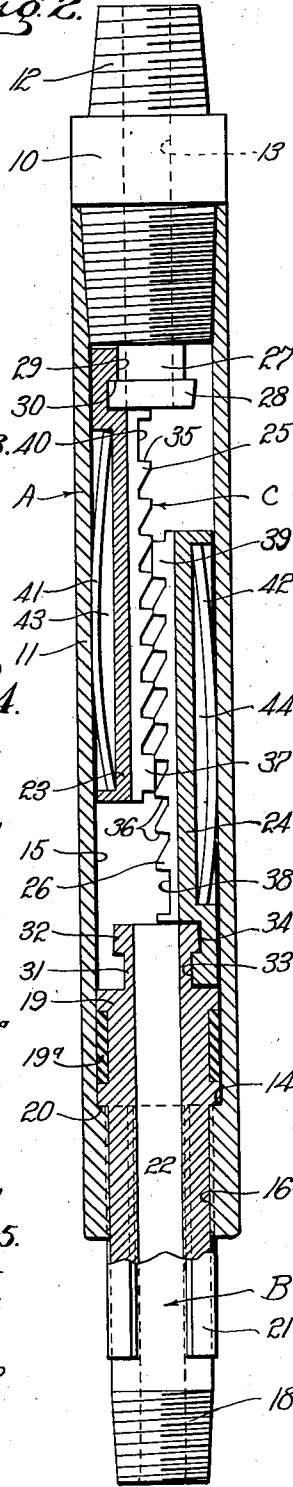


Fig. 3.

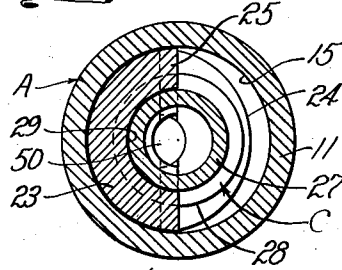


Fig. 4.

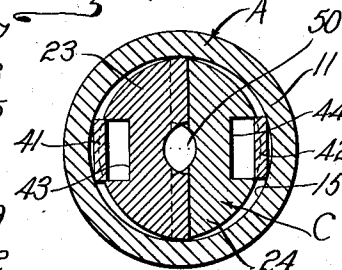


Fig. 5.

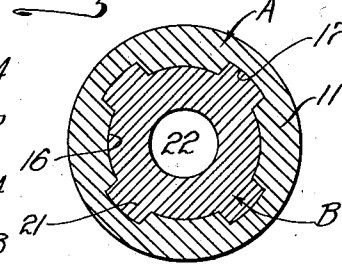
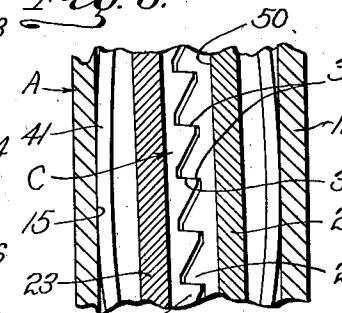


Fig. 6.



Inventor
Ira J. McCullough
By *W. H. McFarland*
His Attorney

UNITED STATES PATENT OFFICE

2,058,166

JARRING TOOL

Ira J. McCullough, Huntington Park, Calif., assignor to James A. Kammerdiner, Los Angeles, Calif.

Application June 29, 1931, Serial No. 547,478

8 Claims. (Cl. 255—27)

This invention relates to a tool for use in a well, and relates more particularly to a jarring tool for effecting a jarring or hammering action within a well. It is a general object of this invention to provide a simple, practical, and effective jarring tool useful in fishing operations, or the like, for imparting a jarring action to a fish or lost parts in a well.

It is an object of the invention to provide a jarring tool or jar that is operable to impart a very heavy jarring or hammering blow to the fish or object with which it is connected.

It is another object of the invention to provide a jarring tool that is operable by simple reciprocation of the operating string. The tool provided by this invention may be operated to effect the jarring blow upon a certain tensile strain being put upon it through the operating string, and may be re-set for further operation by lowering or settling the operating string.

It is another object of the invention to provide a jarring tool that does not at any time interfere with the free continuous circulation of fluid through the operating string.

It is another object of the invention to provide a jarring tool that includes two main parts or sections related for limited relative longitudinal movement and means for releasably holding the sections against relative movement in a contracted position that is operable to release the sections for relative movement upon a heavy tensile strain being put upon them to cause opposed shoulders on the sections to be brought into jarring engagement.

Another object of the invention is to provide a jarring tool of the character mentioned in which the releasable holding means may be regulated or controlled to release under different tensile strains by varying the pressure on the circulation fluid pumped or passed through the operating string.

It is another object of the invention to provide a jarring tool of the character mentioned in which the parts of the releasable holding means are simple and inexpensive of manufacture and are all easily and quickly replaceable.

A further object of the invention is to provide a jarring tool of the character mentioned that embodies a minimum number of simple, sturdy parts.

Other objects and features of my invention will be best and more fully understood from the following detailed description of a typical form and application of the invention, throughout which

description reference will be had to the accompanying drawing, in which:

Fig. 1 is a longitudinal detailed sectional view of the tool provided by the present invention, illustrating it in the normal or unactuated position. Fig. 2 is a view similar to Fig. 1, showing the tool in the actuated or jarring position. Figs. 3, 4, and 5 are enlarged transverse detailed sectional views taken as indicated by lines 3—3, 4—4, and 5—5, respectively, on Fig. 1. Fig. 6 is an enlarged fragmentary vertical sectional view of the releasable holding means, showing the parts in a partially released position.

The jarring tool provided by this invention includes, generally, two main or body sections A and B related for limited relative longitudinal movement, and means C for releasably holding the sections A and B against relative longitudinal movement in a contracted position and operable to release the sections for relative movement upon a heavy tensile strain being put on the tool.

The sections A and B form or constitute an assembly adapted to be connected between an operating string of drill pipe and the object to be jarred, or adapted to be interposed in an operating string connected with the object or fish to be jarred. The sections A and B are the main or body sections of the tool and are connected and related for limited relative longitudinal movement. In accordance with the invention, the sections A and B are telescoped or extend one into the other, the section A being tubular, and the section B being in the nature of a stem or mandrel extending into the section A. In the drawing, the section A is the upper section of the tool adapted to be attached to an operating string, while the section B is the lower section adapted to be connected with the object to be jarred. It is to be understood that the tool may be inverted, i. e., the relative positions of the sections A and B may be reversed, and that, where I use the terms "upper" and "lower", they are not to be taken as limiting or restricting the invention to the specific relative positions of the parts illustrated in the drawing.

The tubular body section A is intended to receive an end part of the section B and to house or encase the holding means C. In the embodiment of the invention illustrated in the drawing, the section A is sectional, consisting of two simple members or parts 10 and 11. The part 10 is provided at one end of the section A and is provided with means for connection with an operating string, while the part 11 is in the nature of a tubular housing for the means C and forms

a hammer member for co-operating with an anvil part on the section B. The part 10 is in the nature of a sub or connecting member and has a tapered screw-threaded pin 12 on its upper end to facilitate connection of the section A with the operating string. The lower end of the part 10 is externally screw-threaded to connect with the tubular part 11. A central longitudinal fluid passage 13 is provided in the part 10 for passing circulation fluid downwardly from the operating string of drill pipe.

The part 11 is an elongated tubular member of uniform external diameter. The upper end of the tubular part 11 is screw-threaded onto the lower end of the sub part 10. The lower end portion of the tubular part 10 is of restricted internal diameter to have an upwardly facing internal shoulder 14. The shoulder 14 is the hammering or jarring shoulder of the tool and is provided to co-operate with an opposed shoulder on the mandrel section B. The means C is carried in the opening 15 of the tubular part 10, and the opening 15 may be of uniform diameter from the shoulder 14 to the lower end of the sub part 10. The opening 16 in the restricted lower portion of the part 11 is adapted to slidably pass the section B, as will be hereinafter described, and is provided with spaced longitudinal keyways or spline grooves 17.

The body section B is the mandrel or stem section of the tool, and its lower end is adapted to be connected with the fish or part to be jarred. In the embodiment of the invention illustrated in the drawing, the lower end part 18 of the section B is screw-threaded to facilitate connection of the section B with a part of the operating string, a fishing tool, or the like. The section B extends upwardly through and is slidable in the opening 16 in the lower end of the section A. An enlargement or anvil portion 19 is provided on the upper end of the section B within the opening 15. The enlargement 19 may be round in cross section and slidably fits the opening 15. The lower end of the enlargement 19 forms a downwardly facing anvil-shoulder 20 that is adapted to be struck or jarred against by the hammer shoulder 14 when the means C is released. Packing 19^a may be provided on the enlargement 19 to seal with the walls of the opening 15. In the preferred construction, means is provided for holding the body sections A and B against relative rotation. Longitudinal keys or splines 21 are provided on the section B to slidably fit the keyways 17 and hold the sections A and B against relative rotational movement. A central longitudinal fluid passage 22 is provided in the section B to pass the circulation fluid.

The means C is provided to releasably hold the sections A and B in a contracted position where the shoulders 14 and 20 are spaced apart, and is operable to release the sections for relative longitudinal movement to permit the shoulders 14 and 20 to jar together upon a heavy tensile strain being put on the contracted sections. The means C includes one or more clutch parts 23 connected with the section A for co-operating with one or more clutch parts 24 connected with the section B. In the simple preferred construction illustrated in the drawing, a single clutch member 23 is carried by the section A for co-operating with a single clutch member 24 carried by the section B. The clutch members 23 and 24 are arranged in the opening 15 of the section A and are in the nature of couplers adapted to co-operate with one another to normally releasably hold the sections

A and B in the contracted positions illustrated in Fig. 1 of the drawing.

The clutch members 23 and 24 are swingably or tiltably connected to the sections A and B, respectively, the upper end of the member 23 being tiltably connected with the inner end of the sub part 10, and the lower end of the clutch member 24 being tiltably connected with the upper end of the section B. In accordance with the invention, the two clutch members 23 and 24 may be similar or identical in construction and are opposed and inverted with respect to one another. The members 23 and 24 are simple elongated structures, and are of semi-circular or arcuate cross sectional configuration. In accordance with the invention, the clutch members 23 and 24 are arranged longitudinally in the body opening 15, and their inner opposed sides are provided with spaced teeth 25 and 26, respectively, to co-operate or mesh to releasably hold the sections A and B in the contracted position.

The means for tiltably attaching the upper end of the clutch member 23 to the section A includes a central projection 27 on the lower end of the upper part 10. The projection 27 extends downwardly into the opening 15 and is provided at its lower end with an annular radial flange 28. The projection 27 and its enlargement 28 are preferably of round cross sectional configuration and are preferably integral with the part 10. A substantially semi-circular socket or recess 29 is provided in the inner side of the member 23 at its upper end to co-operate with or receive the projection 27. The lower end of the recess 29 is enlarged to receive the flange 28 and to present a downwardly facing shoulder 30 for co-operating with the upper end of the flange 28. The shoulder 30 seats on or co-operates with the upper end of the flange 28 to hingedly or tiltably support the clutch member 23 on the projection 27. The parts of the tiltable connection may be shaped and proportioned to allow for the desired tilting movement of the clutch member 23. The periphery of the flange 28 may be inclined downwardly and inwardly to permit the lower end of the clutch member 23 to swing inwardly to the position illustrated in Fig. 1 of the drawing.

The tiltable connection between the member B and the clutch part 24 may be similar to the connection just described. A central projection 31 is provided on the upper end of the enlargement 19 and has an annular radial flange 32 on its upper end. A semi-circular recess 33 is provided in the inner side of the clutch member 24 at its lower end. The upper portion of the recess 23 is enlarged to receive the flange 32 and to provide an upwardly facing shoulder 34 to co-operate with the under side of the flange. The shoulder 34 co-operates with the lower side of the flange 32 to tiltably or pivotally connect the clutch member 24 with the projection 31. The periphery of the flange 32 may be inclined upwardly and inwardly to allow for the necessary inward tilting of the clutch member 24.

The meshing parts or teeth 25 and 26 of the clutch members are identical and are opposed and inverted with respect to one another so as to effectively co-operate to releasably hold the sections A and B against relative longitudinal movement. The clutch teeth 25 and 26 project horizontally from the inner sides of the clutch members and extend transversely across the inner sides or faces of the members. The teeth 25 have upwardly facing upper ends 35 for co-operating with the lower ends 36 of the teeth 26.

The ends 35 and 36 of the teeth are flat and slightly inclined relative to the longitudinal axes of the members 23 and 24 so as to tend to slide apart or disengage when the members are under tension. The lower ends of the teeth 25 are inclined downwardly and outwardly to co-operate with the upper ends of the teeth 26 which are inclined upwardly and outwardly. The extreme outer ends of the teeth 25 and 26 are preferably comparatively short and are flat. A rectangular projection 37 is provided adjacent the lower end of the clutch member 23 to fit into or co-operate with a correspondingly shaped socket 38 in the lower end of the member 24 when the members are in their holding positions. A similar rectangular projection 39 is provided adjacent the upper end of the clutch member 24 to fit into a correspondingly formed socket 40 adjacent the upper end of the clutch member 23. The projections 37 and 39 are longer than the notches or spaces between the clutch teeth so as to ride over the outer ends of the teeth when the sections A and B are moved longitudinally relative to one another to prevent the teeth 25 and 26 from slipping back into mesh during the relative movement of the sections. It will be apparent how the teeth 25 and 26 of the two clutch members are adapted to co-operate to hold the sections A and B against relative longitudinal movement when under a tensile strain. The clutch members 23 and 24 are tiltably mounted in the manner described above and are proportioned so as to be movable outwardly away from one another to permit disengagement of their teeth 25 and 26.

The invention provides means for yieldingly holding the clutch members 23 and 24 in co-operative engagement and to resist their disengagement. The means for resisting outward tilting of the clutch members 23 and 24 is in the nature of a spring means and includes a leaf spring 41 for urging the clutch member 23 inwardly, and a leaf spring 42 for urging the clutch member 24 inwardly. The spring 41 is arranged in a longitudinal groove 43 in the outer side of the clutch member 23 and has its opposite ends bearing against the opposite ends of the groove. The spring 41 is longitudinally bent or bowed outwardly to pressurally engage the interior of the part 11. The opposite ends of the leaf spring 41 bear inwardly and longitudinally in opposite directions against the clutch member 23, while the middle portion of the spring bears outwardly against the walls of the part 11. As the spring 41 is confined within the groove 43 in this manner, it at all times urges the member 23 inwardly.

The spring 42 is mounted in a manner similar to the spring 41, i. e., it is arranged within a longitudinal groove 44 in the outer side of the clutch member 24. The spring 42 is longitudinally bowed to press outwardly against the tubular part 11, and its opposite ends engage the opposite ends of the groove. When the sections A and B are in their normal or contracted positions, the springs 41 and 42 yieldingly hold the clutch members 23 and 24 in their "in" or tilted positions illustrated in Fig. 1 of the drawing.

The clutch members 23 and 24 are connected to the sections A and B and are related so that, when they are in the meshing or holding position, the member 23 is tilted or inclined downwardly and inwardly from its upper end, while the member 24 is tilted or inclined upwardly and inwardly from its lower end. When the tool is subjected to a tensile strain, the locked or

meshing clutch members 23 and 24 tend to move to positions in parallelism with the longitudinal axis of the tool, i. e., the lower end of the member 23 tends to swing outwardly, while the upper end of the member 24 tends to tilt outwardly. It will be apparent how the springs 41 and 42 yieldingly resist such movement or tendency of movement of the members. Upon the tensile strain on the tool reaching a given value, the springs 41 and 42 yield so that the members 23 and 24 assume positions parallel with the longitudinal axis of the tool and their teeth 25 and 26 are thus disengaged.

In accordance with the invention, the pressure on the circulating fluid passing downwardly through the operating string may be employed to control the means C. It is an important feature of the invention that the means C may be regulated from the surface to release under various tensile strains by putting different pressures on the circulation fluid. Longitudinal grooves are provided on the inner sides of the clutch members 23 and 24 to form a fluid passage 50 between the members when they are in the contracted or meshing position. The passage 13 in the part 10 extends downwardly through the projection 27 so as to discharge downwardly into the upper end of the passage 50. The fluid passage 22 of the section B extends upwardly through the projection 31 so as to receive fluid passing downwardly through the fluid passage 50. In practice, the opposite ends of the passage 50 are in substantially direct alignment with the fluid passages 13 and 22. It is preferred to form the grooves in the members 23 and 24 of less than 180° in cross section so that the fluid passage 50 is elliptical in cross sectional configuration and is of less diameter than the fluid passages 13 and 22. Further, it is preferred to relate the parts of the tool so that the opposite end portions of the members 23 and 24 are immediately adjacent the ends of the projections 27 and 31, so that the circulation fluid is effectively directed through the passage 50 and into the fluid passage 22. By putting a heavy pressure on the fluid passing through the tool, the members 23 and 24 may be urged or shifted outwardly from one another. It will be apparent how the fluid under pressure passing through the reduced or restricted and slightly inclined passage 50 operates to urge the clutch members 23 and 24 apart against the action of the springs 41 and 42. Increased or a high pressure may be put on the fluid when the tool is being set for operation and before it is put under tension to cause the clutch members 23 and 24 to be urged apart to positions where their teeth are in partial mesh so the means C may be released under a lesser tensile strain. The heavy pressure may be maintained on the fluid during the application of the tension on the tool, so that the fluid pressure may aid the tensile strain in disengaging the clutch members 23 and 24. Fig. 6 of the drawing illustrates the clutch members 23 and 24 in partially operated or out positions where the teeth 25 and 26 are in partial meshing engagement. If a desired and definite pressure is maintained on the circulation fluid during the re-setting of the tool, it resists the action of the springs 41 and 42 so that the clutch members may be re-set in positions where their teeth are in partial mesh. In this manner, the tool may be repeatedly re-set for actuation so as to release under a given tensile strain and provide jarring blows of the desired strength. It will be obvious how the releasable holding

means C may be re-set to trip or release under different tensile strains by putting different pressures on the circulation fluid when the tool is re-set for actuation.

It is believed that the operation of the jarring tool provided by the present invention will be readily apparent from the foregoing detailed description. When it is desired to trip or operate the tool, a given or desired pressure is put on the circulation fluid to cause the clutch members 23 and 24 to be moved away from one another a certain extent so that their teeth 25 and 26 are in partial mesh. A heavy tensile strain or upward pull may be put on the operating string to cause the teeth 25 and 26 to be disengaged and thus release the holding means C. The circulation of fluid through the operating string may be maintained as desired. A high pressure may be maintained on the fluid passage through the drilling string to act outwardly on the clutch members 23 and 24 and aid the tensile strain in releasing the means C. Upon the tensile strain or the combination of the tensile strain and action of the high fluid pressure reaching a certain value, the lower end of the clutch member 23 tilts outwardly and the upper end of the clutch member 24 swings outwardly so that the teeth 25 and 26 are released. Upon disengagement of the teeth shoulders 35 from the shoulders 36, the section A is free to move upwardly relative to the section B so that the hammering shoulder 14 is brought into jarring engagement with the shoulder 20. It is to be noted that the operation of the tool, that is, the tensile strain under which it is tripped and the resultant jarring action, may be governed or controlled from the surface by pumping the circulation fluid through the operating string at a desired pressure to initially set the clutch members as desired.

In practice, the tensile strain required to operate or release the means C is sufficient to stretch the operating string to a considerable extent so that the resiliency of the operating string is utilized to provide for a heavy upward blow when the shoulders 14 and 20 come into engagement. During upward movement of the section A relative to the section B, the projection 37 slides over the outer ends of the teeth 26, while the outer ends of the teeth 25 engage the projection 39 so that the teeth cannot grab or go back into mesh. To re-set the tool after operation, the section A is lowered relative to the section B so that the teeth 25 and 26 may again mesh or cooperate with one another. The desired pressure is maintained on the circulation fluid during re-setting of the tool so that the clutch members lock or mesh in positions where the teeth mesh the desired depth. The projections 37 and 39 prevent premature meshing of the clutch teeth during re-setting of the tool. It is to be noted that the springs 41 and 42 effectively resist tilting of the clutch members when the tool is under tension, so that a heavy tensile strain is necessary to operate the tool, it being understood that the tensile strain required to release the clutch members 23 and 24 is dependent upon the initial setting of the members by the fluid pressure. The springs also operate to resist outward tilting of the clutch members due to the fluid pressure in the passage 50.

The present invention provides a jarring tool involving a mechanical means for releasably holding the body sections against relative movement that is controllable by varying the pressure on the circulation fluid passing through the tool.

It will be apparent how the proper relation or balance between the tensile strain and fluid pressure may be determined to provide for the desired operation of the tool. The springs 41 and 42 may be constructed so that the tool will release under any given strain and/or fluid pressure.

Having described only a typical preferred form of my invention, I do not wish to limit myself to the specific details set forth, but wish to reserve to myself any changes or variations that may appear to those skilled in the art or fall within the scope of the following claims.

Having described my invention, I claim:

1. A well tool of the character described including, two sections related for limited relative longitudinal movement, and means for releasably holding the sections against relative longitudinal movement including duplicate clutch members tiltably connected with the sections to be in diametrical opposition.

2. A well tool of the character described including, two sections related for limited relative longitudinal movement, and means for releasably holding the sections against relative longitudinal movement including duplicate rigid clutch members tiltably connected with the sections, and means for yieldingly holding the clutch members in co-operation.

3. A well tool of the character described including, two sections related for limited relative longitudinal movement, and means for releasably holding the sections against relative longitudinal movement including a clutch member having an end tiltably connected with one section, and a clutch member tiltably connected with the other section, the clutch members being duplicates and having teeth to releasably cooperate with one another.

4. A well tool of the character described including, two sections related for limited relative longitudinal movement, and means for releasably holding the sections against relative longitudinal movement including a clutch member having an end tiltably connected with one section, and a clutch member having an end tiltably connected with the other section, the clutch members being duplicates and in opposed inverted relation to cooperate to hold the sections against relative movement when in tilted positions, and means yieldingly resisting movement of the members from the tilted positions.

5. A well tool of the character described including, two sections related for limited relative longitudinal movement, and means for releasably holding the sections against relative longitudinal movement including duplicate co-operating toothed members connected with the sections, the members being mounted so as to be inclined relative to the longitudinal axes of the sections when in engagement and so as to tilt to positions parallel with the longitudinal axes of the sections where their teeth are disengaged when the sections are subjected to a tensile strain, and means yieldingly resisting such tilting of the members.

6. A well tool of the character described including, two sections related for limited relative longitudinal movement, and means for releasably holding the sections against relative longitudinal movement including, a toothed member tiltably connected with one section, a toothed member tiltably connected with the other section, there being a passage between opposing parts of the members for conducting fluid, the toothed members being related to tilt away from one another and disengage upon a tensile strain being put

on the sections, and spring means yieldingly resisting such tilting of the members.

7. A well tool of the character described including, two sections related for limited relative longitudinal movement, and means for releasably holding the sections against relative longitudinal movement including, a clutch member tiltably connected with one section, a clutch member tiltably connected with the other section, the clutch members being of like configuration and related so as to be inclined relative to the longitudinal axes of the sections when in co-operation and so as to tilt away from one another and disengage upon a tensile strain being put on the sections, and spring means yieldingly resisting such tilting of the sections, said means including a spring

carried by each member and bearing outwardly against a section.

8. A jarring tool for use on a string of drill pipe including, two sections connected for limited relative longitudinal movement, the sections having fluid passages, and means for releasably holding the sections against relative longitudinal movement including two toothed members normally co-operating to hold the sections against relative longitudinal movement and releasable by a tensile strain on the sections, the members having grooves registering to form a fluid passage when in co-operation to pass fluid between the passages of the sections.

IRA J. McCULLOUGH.

15