

July 18, 1961

J. Y. DUNCAN ET AL

2,992,477

BIT PULLER

Filed Oct. 7, 1957

2 Sheets-Sheet 1

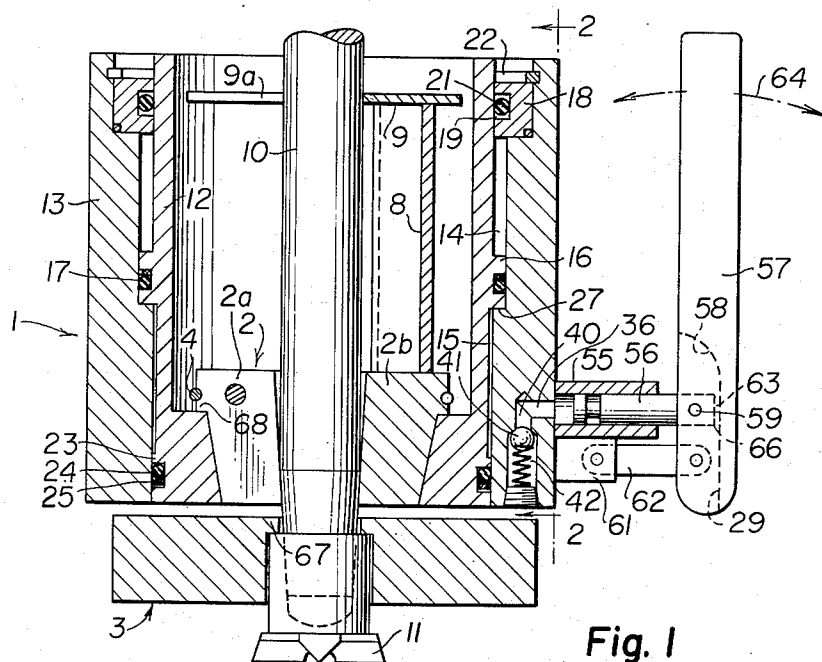


Fig. 1

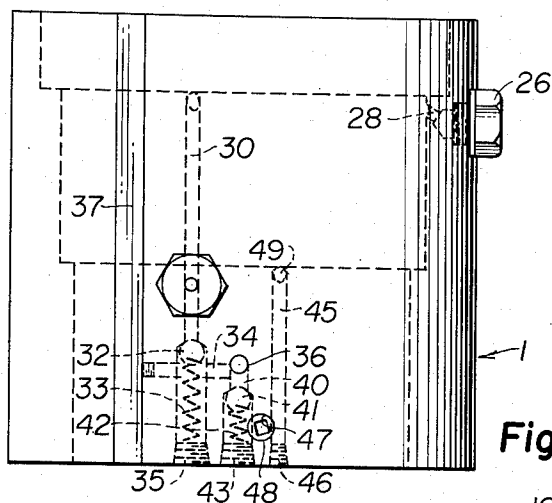


Fig. 2

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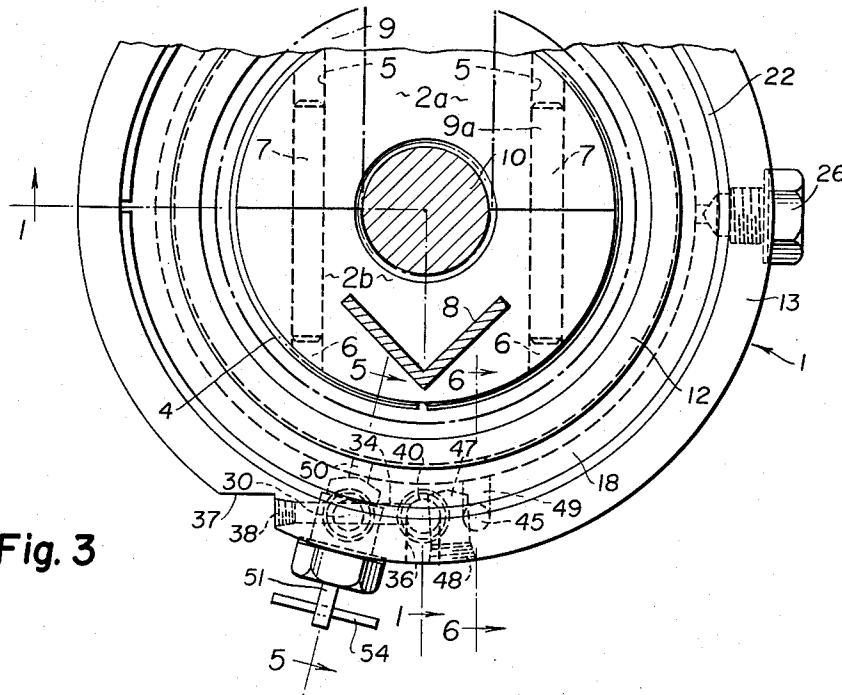


Fig. 3

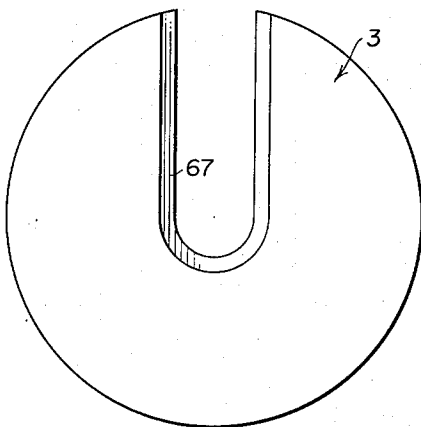


Fig. 4

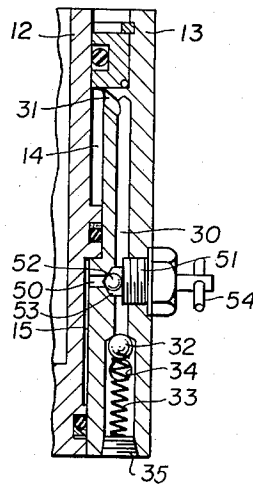


Fig. 5

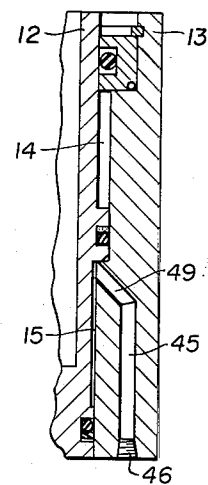


Fig. 6

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BIT PULLER

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8 Claims. (Cl. 29—243)

This invention relates to apparatus known as a "bit puller" for forcibly removing rock bits and the like from the "drill steel" on which such bits are mounted with a wedging fit in normal use. More particularly, the invention relates to hydraulically operated bit pullers of compact design which may be readily carried from point to point in the field for use where needed.

The principal objects of the invention are to provide a bit puller of the general character described which is sufficiently compact and light in weight to be easily transported manually; which is adapted for quick and convenient operation; which will not gouge the drill steel while gripping it for pulling off the bit; which is sufficiently rugged to withstand the high forces imposed upon it; and which is positive and reliable in its operation.

Various expedients have been used heretofore to remove rock bits from the drill steel on which they are mounted in normal use. In some instances, heavy pieces of steel adapted to slide over the drill steel have been employed much in the manner of a hammer to drive the bit off from the drill steel by impact. However, the use of tools of this character is dangerous and has not been satisfactory. Pneumatically operated machines have been employed to force the bit off from the drill steel, but most of these machines have been heavy and bulky so that it was necessary to bring the drill steel and bit to the location of the bit puller rather than transport the bit puller for use in any location where it is needed. In addition, pneumatically operated machines of this character have required connection to a compressed air line for receiving the power required to operate them. Various mechanically operated bit pullers have also been designed which rely upon other mechanical force supplying mechanisms to assert the required force on the bit while holding the drill steel. However, insofar as we are aware, none of such prior devices has satisfactorily met the need for a device having the above recited features and advantages provided by the present invention.

The present invention is characterized by a cylindrical relatively short housing and a cylindrical relatively short internal member which are axially movable relative to one another and define, between them, both an annular fluid reservoir and an annular pressure chamber of small dimensions. A manually operated pump is built into the housing member and communicates with the fluid reservoir and the pressure chamber for forcing fluid from the former into the latter; and the fluid reservoir and the pressure chamber are so arranged and dimensioned that each changes in volume by substantially the same amount as hydraulic fluid flows from one to the other in the force applying stroke of the device or in the opposite retracting operation thereof. The invention is further characterized by a manually operable pump handle construction which serves as a handle for transporting the bit puller as well as for activating the pump; and is further characterized by a separable drill steel clamp which is removable from the device for preliminary positioning on the drill steel before the drill steel is inserted in the device and engaged by a bit hook.

The foregoing objects, advantages and characteristic features of the invention, and others which will appear hereinafter will be more fully understood and appreciated from the following detailed description of an illustrative

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embodiment of the invention as shown in the accompanying drawings, in which:

FIGURE 1 is a longitudinal sectional view of a bit puller constructed in accordance with the invention with a drill steel and bit mounted in the device for separation thereby, the angularly disposed radial planes of the section being indicated by the lines 1—1 in FIG. 3.

FIG. 2 is a side view of the device in FIG. 1 with the pump and pump handle removed for clarity of illustration, the view being taken as indicated by the lines 2—2 in FIG. 1.

FIG. 3 is a fragmentary end or plan view, looking downwardly at the device of FIG. 1 as shown therein, the pump and pump handle again being removed for clarity and a drill steel support being shown in section and the upper portion in phantom outline.

FIG. 4 is a plan view, of a bit hook-plate constituting a part of the device of FIG. 1.

FIGS. 5 and 6 are additional longitudinal sectional views respectively taken along the lines 5—5 and 6—6 of FIG. 3.

Referring to the drawings, a device embodying the present invention may include three separable parts or assemblies, namely, a hydraulic force applying mechanism 1, a removable split collar type of clamp 2 for gripping a drill steel, and a U-shaped bit hook-plate 3 for transmitting force to a bit. A drill steel 10 with a bit 11 jammed thereon with a wedging fit is mounted in the device for removal of the bit from the drill steel by first withdrawing the clamp 2 from the force applying mechanism 1, then separating the two halves 2a and 2b of the clamp against the resilience of a surrounding spring 4, and sliding the drill steel through a central aperture defined by the two halves of the clamp until these parts are associated with each other as shown. This subassembly is then inserted axially into the hydraulic force applying mechanism 1 (downwardly as viewed in FIG. 1) to seat the clamp in the force applying mechanism while the clamp grips and restrains the drill steel against downward movement. Thereupon the bit hook-plate 3 is slid over the bit 11 about the drill steel 10 for engaging the bit and applying a downward force thereto, as the hydraulic force applying mechanism is operated, to separate the bit from the drill steel.

With the foregoing preliminary description, the various parts and mode of operation of the device shown in the drawings will now be described in more detail.

Referring to FIGS. 1 and 2, the hydraulic force applying mechanism 1 may comprise an inner, generally tubular sleeve 12 concentrically disposed within an outer casing or sleeve 13 for relative axial sliding movement of the inner sleeve within the outer sleeve. Such relative movement is effected hydraulically, the inner sleeve 12 serving a function analogous to that of a piston movable within the outer sleeve which serves a function analogous to that of a cylinder in a simple hydraulic piston and cylinder mechanism. The concentric, inner and outer sleeves 12 and 13 are shaped along their adjacent surfaces to provide a reservoir 14 and a pressure chamber 15 therebetween. The reservoir 14 and pressure chamber 15 are axially spaced and separated by an annular flange 16 encircling and integrally formed on the inner sleeve. The flange 16 is provided with a circumferential groove receiving a suitable resilient sealing ring 17, which may include a backup ring, as shown, for preventing leakage of high pressure hydraulic fluid thereby between the pressure chamber 15 and the reservoir 14.

At the opposite end of the reservoir 14 the outer sleeve 13 is provided with an annular closure ring 18 having an inner circumferential groove 19 therein for receiving a resilient O-ring 21. The O-ring 21 serves to seal this end of the reservoir 14 against leakage of hydraulic

fluid and is subjected to little or no fluid pressure. The groove 19 in which the O-ring 21 is seated is of substantially greater width than the diameter of the O-ring in order that the O-ring may move axially of the device with a rolling action as required to vary the effective volume of the reservoir 14 for the purpose hereinafter described. The closure ring 18 may be removably seated in an internally enlarged end portion of the outer sleeve 13 for convenient removal and replacement in the course of initially assembling the mechanism 1 or subsequently disassembling it for repair. The closure ring 18 may be removably retained in its seated position by a suitable snapping ring 22 engageable in an internal annular groove of the outer sleeve 13 as shown.

At the opposite end of the mechanism 1, the pressure chamber 15 is closed by a circumferential flange 23 on the inner sleeve 12 of relatively small radial depth. This flange 23 is provided with a circumferential groove receiving a suitable sealing ring structure for preventing leakage of hydraulic fluid from the pressure chamber. As shown in FIG. 1, this sealing ring structure may comprise an elastic O-ring 24 held under radial compression in the groove with the aid of a leather back-up ring 25.

The mechanism 1 is provided at any convenient location with an opening and a removable closure plug 26 for charging the mechanism with a suitable hydraulic fluid through a passageway 28 drilled in the outer sleeve 13 and into the reservoir 14 until the hydraulic system (described below) is full of fluid.

An arrangement of passageways and a cooperating manually operated pump (hereinafter described) are provided for pumping hydraulic fluid under pressure from the reservoir 14 into the pressure chamber 15. It is desired that both the reservoir 14 and pressure chamber 15 be at all times completely full of hydraulic fluid. Toward this end, an internal shoulder 27 is provided in the outer sleeve 13 with a radial dimension equal to the radial width of the reservoir 14 whereby, upon axial movement of the inner sleeve 12 away from the shoulder 27 of the outer sleeve 13, the volume of the pressure chamber 15 increases at exactly the same rate that the volume of the reservoir 14 decreases. In order that the reservoir 15 will have an appreciable minimum volume when the inner and outer sleeves are in the positions shown in FIG. 1 (hereinafter called the retracted condition of the mechanism 1), the inner sleeve 12 has a somewhat smaller external diameter in the region of the pressure chamber 15 than in the region of the reservoir 14.

When fluid is pumped from the reservoir into the pressure chamber under pressure, the pressure is applied against the surface of the annular flange 16 which defines one end of the pressure chamber so as to force the inner sleeve 12 upwardly relative to the outer sleeve 13, as viewed in FIG. 1 (to what is hereinafter called the extended condition of the mechanism 1). Since the volume of the reservoir 14 decreases in exactly the same amount as the volume of the pressure chamber 15 increases, while fluid is being pumped from the former into the latter, the fluid in the reservoir 14 exerts little or no back pressure on the annular flange 16 in opposition to such relative movement of the inner and outer sleeves 12 and 13.

Return of the mechanism to its retracted position is effected by manually telescoping the inner and outer sleeves 12 and 13 after opening a relief valve (hereinafter described) to permit return flow of fluid from the pressure chamber 15 into the reservoir 14.

In order to provide for the pumping of hydraulic fluid from the reservoir 14 under pressure into the pressure chamber 15 for extending the mechanism 1, and for return flow of fluid back into the reservoir 14 to permit retraction of the mechanism, an axially extending passageway 30 is formed in the outer sleeve 13 with a radially inwardly extending opening 31 communicating with the reservoir 14. Near its lower end, the passageway 30 is enlarged to provide a check valve chamber and seat for

the ball of a ball type check valve 32, the ball being yieldably held against a seat by a spring 33 and a cooperating plug 35 threaded into the lower end of the passageway 30 for also closing the same as shown in FIGS. 2 and 5.

Communicating with the passageway 30 below the check valve 32 is a transversely extending passageway 34 (FIGS. 2, 3, and 5) leading to a radially extending passageway 36 (FIGS. 1, 2, and 3). The transverse passageway 34 may be formed by milling or otherwise forming a notch 37 in the outer side of the outer sleeve 13, drilling the passageway 34 into one face of the notch 37, and closing the passageway 34 at the notch 37 by means of a threaded plug 38. The radial passageway 36 is in axial alignment and communicates with the barrel of a manually operated pump described hereinafter.

This pump draws fluid from the reservoir 14 through the opening 31 and passageway 30, past the check valve 32, and through the transverse and radial passageways 34 and 36. The fluid thus trapped by the valve 32 against reverse flow into the reservoir 14 is then forced by the pump through an axially extending passageway 40 (FIGS. 1, 2, and 3) in which the ball of a second ball type check valve 41 is yieldably held against a seat by a spring 42 for preventing reverse flow of the fluid into the barrel of the pump while it is drawing more fluid from the reservoir 14. The axial passageway 40 may be formed by drilling from the lower end of the outer sleeve 13 and closing the lower end of the passageway by means of a threaded plug 43. The plug 43 also serves to compress the spring 42 for holding the ball of the valve 41 against its seat in the passageway 40.

Communication between the axial passageway 40 and the pressure chamber 15 may be completed by drilling another axial passageway 45 (FIGS. 2, 3, and 6), closing its open end with a threaded plug 46, and drilling a cavity 47 (FIGS. 2 and 3) radially inwardly so as to cut into the side walls of the axial passageways 40 and 45 and provide communication therebetween. The cavity 47 is closed by another threaded plug 48.

Fluid flowing under pressure from the pump through the radial passageway 36, through the axial passageway 40 past the check valve 41 therein, and through the cavity 47 and the axial passageway 45, then flows into the pressure chamber 15 through a radially extending passageway 49 (FIGS. 2, 3, and 6). The fluid under pressure is thus introduced into the pressure chamber 15, forcing the inner sleeve upwardly relative to the outer sleeve as viewed in FIG. 1.

Return flow of fluid from the pressure chamber 15 to the reservoir 14 is effected by means of a radial passageway 50 (FIGS. 3 and 5) leading into the axial fluid supply passageway 30 (FIGS. 2, 3, and 5) at a point adjacent the upper end of the pressure chamber. The radial passageway 50 is normally closed by a manually rotatable, threaded, valve stem 51 holding a valve ball 52 so as to block the radial passageway 50. As shown in FIG. 5, the valve ball 52 is disposed in an enlarged valve chamber 53 interposed in the path of the passageway 30 so that fluid may normally flow around the seated valve ball 52 while it is being drawn from the reservoir 14 through the supply passageway 30 by the pump or while initially filling the hydraulic system with fluid. The valve stem 51 may be manually retracted by turning a valve handle 54 so as to release the valve ball 52 from its seat when return flow of fluid from the pressure chamber 15 is initiated by manually telescoping the inner and outer sleeves 12 and 13 and when fluid is being initially charged into the system.

The pump by which fluid flow is effected from the reservoir 14 into the pressure chamber 15, as described above, may comprise a barrel or cylinder 55 communicating and axially aligned with the radial passageway 36. A pump plunger 56 is mounted for reciprocation in the barrel 55 by means of a handle 57. For this purpose, the plunger 56 is provided with an outer end portion hav-

ing opposed flat sides that are freely fitted between the side walls of a slot 58 milled into the adjacent end portion of the handle 57. A pivotal connection between this end of the plunger 56 and the handle 57 is made by a pin 59. The handle 57 is pivotally mounted on the outer sleeve 13 by means of an integrally formed yoke 61 on the side wall of the sleeve and a link 62 pivotally connected at its opposite ends between spaced arms of the yoke 61 and between the side walls of the slot 58 in the handle 57.

Limited pivotal movement of the handle 57 is thus permitted for reciprocating the plunger 56 in the barrel 53 of the pump, and thereby drawing fluid from the reservoir 14 and forcing it into the pressure chamber 15. The handle 57 also serves as a carrying handle for manually transporting the mechanism 1 from place to place where it is to be used. In order to prevent withdrawal of the plunger 56 from the barrel 55 while actuating the pump or while carrying the mechanism by the handle 57, a space 63 between the bottom of the milled slot 58 and the adjacent end of the plunger is provided which is only sufficiently great to permit the required amplitude of reciprocation of the plunger. Further outward movement of the plunger beyond the desired limit by swinging the handle 47 in the direction of the arrow 64 in FIG. 1, is positively stopped by engagement of an edge 66 of the outer end of the plunger with the bottom of the milled slot 58 in the handle.

With the drill steel 10 and associated bit 11 held by the split collar 2 in the hydraulic mechanism 1, as described above, and with the hook-plate 3 slid into place so as to straddle the drill steel, with a flange 67 of the hook-plate disposed between the bit and the adjacent end of the hydraulic mechanism 1, the pump is actuated to force fluid from the reservoir 14 into the pressure chamber 15. This drives the inner sleeve 12 upwardly relative to the outer sleeve 13, as viewed in FIG. 1, and effects corresponding movement of the drill steel, the bit, and the hook-plate until the hook-plate engages the lower end of the outer sleeve 13. Further upward movement of the bit is thus prevented by the hook-plate 3 as the inner sleeve 12, split collar 2, and drill steel 10 gripped by the collar are further raised relative to the outer sleeve 13. This forcibly withdraws the bit from the end of the drill steel.

As explained above, it is desired that both the reservoir 14 and pressure chamber 15 be full of hydraulic fluid at all times, and that the total volume of these two fluid containing chambers remain constant. However, by reason of the displacement of the pump plunger 56, the volume of the various interconnecting fluid passageways and chambers, which should also be full of fluid at all times, varies over a range equal to this displacement. This change in volume is compensated by the ability of the O-ring 21 to move axially with a rolling action in the groove 19 so as to vary the effective volume of the reservoir 14 oppositely, but in an amount corresponding to the variation in the total volume of the various fluid passageways and chambers connecting the reservoir 14 and pressure chamber 15. This will be understood from the fact that the effective volume of the reservoir 14 includes the variable volume of fluid present between the actual upper end of the reservoir and the axially movable O-ring seal 21 defining the effective upper end of the reservoir.

The principal advantage of this automatic compensation for the displacement of the pump plunger is that the device, in use, may be disposed at practically any angle without an air bubble being introduced into the high pressure side of the hydraulic system and disrupting the positive application of force that is obtainable in such a system, as distinguished from a pneumatic system. Also, to whatever small degree hydraulic fluid may escape from the system past the high pressure seal 24, 25 while the device is in use, compensation for this loss of total fluid volume is automatically made by similar axial adjustment of the position of the low pressure O-ring seal

21 along the groove 19. Any slight leakage of fluid from the pressure chamber 15 past the O-ring seal 17 into the reservoir 14 cannot normally approach the pumping rate of the pump and, therefore, does not present a problem, the fluid lost from the pressure chamber in this way being returned to the reservoir 14.

As shown in FIG. 1, the split collar 2 is provided with a frusto-conical lower end portion that is removably seated in a frusto-conical opening in the lower end of the inner sleeve 12 having the same angle of divergence. The split collar clamp is also provided with an upper peripheral flange 68 which serves as a stop to prevent wedging of the clamp in the frusto-conical opening of the inner sleeve 12. The clamp is also provided with a frusto-conical internal bore having an apex angle preferably the same as the apex angle of the tapered end of the drill steel 10. By appropriately selecting the minimum diameter of the bore of the clamp 2 so that it is substantially smaller than the maximum diameter of the drill steel 10, the clamp is capable of applying the desired clamping force on the drill steel at the base of its tapered end without gouging the surface of the tapered end of the drill steel. Although the drill steel is generally wedged in the clamp 2 as the bit is forced off from its tapered end, the flange 68 of the clamp prevents wedging of the clamp in the frusto-conical opening of the inner sleeve 12. Thus, when the bit has been removed from the drill steel, the drill steel and clamp may be freely withdrawn axially, in an upward direction, as viewed in FIG. 1, and the clamp then removed from the drill steel.

From the above description of the manner in which the clamp 2 is preassembled on the drill steel 10, it will be recognized that the two halves 2a and 2b of the clamp should be accurately aligned with each other. In order to maintain this alignment while permitting separation of the two halves of the clamp for inserting and subsequently removing the drill steel, the two halves of the clamp may be drilled to provide a pair of holes 5 in the clamp portion 2a and a pair of aligned holes 6 of slightly larger diameter in the clamp portion 2b. A pair of dowels 7 may be press-fitted in the smaller diameter holes 5 and project with a close, but free sliding fit in the larger diameter holes 6.

It will also be recognized that accurate axial alignment of the drill steel 10 with the clamp 2 is important for insuring that the pull on the bit is truly along the axis of the drill steel. In order to maintain this alignment while positioning the drill steel in the clamp, the clamp portion 2b may have one end of an axially directed arm 8 of angle iron stock or the like welded or otherwise rigidly secured thereto. A plate 9 having a U-shaped slot 9a therein is similarly rigidly secured to the opposite end of the arm 8 so that, when the drill steel is seated in the slot 9a, against the bottom thereof as shown in FIG. 1 and in phantom outline in FIG. 3, the desired axial alignment will be maintained.

During preassembly of the drill steel and the clamp as previously described, the dowels 7 serve to maintain the two halves of the clamp in alignment with each other during contraction of the clamp about the drill steel. The plate 9 serves as a guide against which the drill steel is manually held both while positioning the clamp on the drill steel and while seating the clamp and drill steel in the inner sleeve 12.

From the foregoing detailed description of the illustrated example of a bit puller constructed in accordance with the present invention, it will be apparent that a simple, rugged, easily portable and operable device has been provided having all of the advantages sought in accordance with the objects of the invention described above. While the invention has been described herein with detailed reference to a specific illustrative embodiment thereof, it will be understood that the invention is

not limited to such details except as required by the terms of the appended claims.

Having described our invention, we claim:

1. A force applying mechanism comprising an outer sleeve having a generally cylindrical bore and having a force applying end adapted to bear against a tool gripping member, a concentric inner sleeve slidable axially in said bore, said inner sleeve having an internal annular flange at one end thereof defining a frusto-conical opening concentric with said bore and tapering toward an apex located outwardly beyond said flange adjacent the force applying end of said outer sleeve, a split collar for gripping a shaft against which an axial force is to be applied while the outer sleeve bears against said gripping member, said collar comprising at least two separable segments normally engaged one with another, said segments, when so engaged, defining a frusto-conical outer surface seated in surface-to-surface contact with the frusto-conical surface of the opening in said inner sleeve and also defining a frusto-conical bore concentric with said first frusto-conical opening and converging in the same direction, whereby a tapered end of a shaft may be extended in the same direction into said frusto-conical bore and wedged therein against further movement in said direction relative thereto, and said collar may in turn be held in the frusto-conical opening in said inner sleeve against movement in said direction relative to said inner sleeve, and means mounted on one of said sleeves and actuatable to exert a force between the two sleeves for effecting axial movement of said inner sleeve in the reverse direction relative to said outer sleeve to forcibly effect corresponding movement of said shaft relative to said outer sleeve.

2. A force applying mechanism according to claim 1, including external circumferential flanges on the segments of said split collar, said flanges being located to move axially into engagement with the internal flange on said inner sleeve when said collar moves axially to seat the outwardly frusto-conical surface thereof in said frusto-conical opening.

3. A force applying mechanism according to claim 1, including external circumferential flanges on the segments of said split collar, said flanges being located to move axially into engagement with the internal flange on said inner sleeve when said collar moves axially to seat the outwardly frusto-conical surface thereof in said frusto-conical opening, and means associated with said split collar for resiliently resisting radial separation of said segments thereof.

4. In a force applying device including an outer sleeve and a coaxial inner sleeve slidable therein along the common axis of the sleeves, spaced opposed surface portions of said inner and outer sleeves defining therebetween an annular fluid reservoir and an annular fluid pressure chamber axially spaced from said reservoir, means operable to force hydraulic fluid from said reservoir into said pressure chamber under pressure for causing relative axial movement of said sleeves in one direction, and means independently operable to permit return flow of hydraulic fluid from said pressure chamber into said reservoir to permit reverse relative movement of said sleeves; the improvement comprising radial offsets in opposed cylindrical surfaces of said sleeves defining the opposite end wall areas of both said reservoir and said pressure chamber, said radial offsets including opposed end wall offsets respectively disposed on said inner and outer sleeves in association with said reservoir for movement toward each other to reduce the volume of the reservoir when the sleeves are moved in said one direction, and opposed end wall offsets respectively disposed on said inner and outer sleeves in association with said pressure chamber for movement away from each other to increase the volume of said pressure chamber when the sleeves are moved in said one direction, the areas of said offsets being proportioned so that,

upon relative axial movement of said sleeves, the reservoir and pressure chamber undergo equal and opposite changes in volume.

5. In a force applying device according to claim 4, a hydraulic fluid seal disposed axially beyond the end of said reservoir remote from said pressure chamber, said seal comprising an annular groove in one of said sleeves opening toward the other sleeve, and an elastic O-ring disposed in said groove and surrounding the inner sleeve, said O-ring being under radial compression between the bottom of said groove and said other sleeve, and said groove being of substantially greater axial width than the axial dimension of said O-ring in the assembly, whereby said O-ring may move axially along the bottom of said groove to vary the effective volume of the reservoir between it and the O-ring.

6. In a force applying device according to claim 4, a hydraulic fluid seal disposed axially beyond the end of said reservoir remote from said pressure chamber, said seal comprising an annular groove in one of said sleeves opening toward the other sleeve, and an elastic O-ring disposed in said groove and surrounding the inner sleeve, said O-ring being under radial compression between the bottom of said groove and said other sleeve, and said groove being of substantially greater axial width than the axial dimension of said O-ring in the assembly, whereby said O-ring may move axially along the bottom of said groove to vary the effective volume of the reservoir between it and the O-ring, said means operable to force hydraulic fluid from said reservoir into said pressure chamber comprising a displacement pump and associated passageways, and the displacement of said pump being less than the change in the effective volume of said reservoir resulting from movement of said O-ring between the extremes determined by the axial width of said groove.

7. A bit puller comprising an outer sleeve and a coaxial inner sleeve slidable therein along their common axis between a telescoped retracted relationship in which they are approximately coterminal at one end and an extended relationship in which said one end of said outer sleeve projects beyond said one end of said inner sleeve, means on said inner and outer sleeves defining therebetween an annular fluid pressure chamber for causing relative axial movement of said sleeves from their retracted to their extended relationship in response to fluid pressure in said pressure chamber, means mounted on said outer sleeve and connected to said pressure chamber to selectively force a hydraulic fluid into said pressure chamber under pressure and to permit exhaustion of fluid therefrom, a drill steel clamp for gripping the tapered end portion of a drill steel with the bit carrying tip thereof spaced beyond an outer end of the clamp, means adjacent said one end of said inner sleeve for receiving said clamp when moved into and through the inner sleeve toward said one end thereof and for limiting further movement of the clamp in the same direction when said outer end thereof is approximately aligned with said one end of said outer sleeve, and a U-shaped hook-plate insertable in straddling relationship to the projecting tapered end portion of a drill steel so gripped by the clamp between said leading end of the clamp and a bit on the tip of the drill steel, said hook-plate extending transversely into the path of the outer sleeve at diametrically opposite points thereon for forcible engagement thereby when said sleeves are moved toward their extended relationship.

8. A bit puller comprising an outer sleeve and a coaxial inner sleeve slidable therein along their common axis between a telescoped retracted relationship in which they are approximately coterminal at one end and an extended relationship in which said one end of said outer sleeve projects beyond said one end of said inner sleeve, means mounted on one of said sleeves for causing relative axial movement thereof from their retracted to their

extended relationship, a drill steel clamp for gripping the tapered end portion of a drill steel with the bit carrying tip thereof spaced therebeyond, means on said inner sleeve adjacent said one end thereof for receiving said clamp when moved into and through the inner sleeve toward said end thereof and for limiting further movement of the clamp in the same direction when an outer end thereof is approximately aligned with said one end of said outer sleeve, and a U-shaped hook-plate insertable in straddling relationship to the projecting tapered end portion of a drill steel so gripped by the clamp between said leading end of the clamp and a bit on the tip of the drill steel, said hook-plate extending transversely into the path of the outer sleeve at diametrically opposite points thereon for forcible engagement thereby when said sleeves are moved toward their extended relationship.

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