June 22, 1948. J. C. CURTIS 2,443,814

FORGING APPARATUS

Filed June 8, 1942 5 Sheets-Sheet 1

Fig. 1.

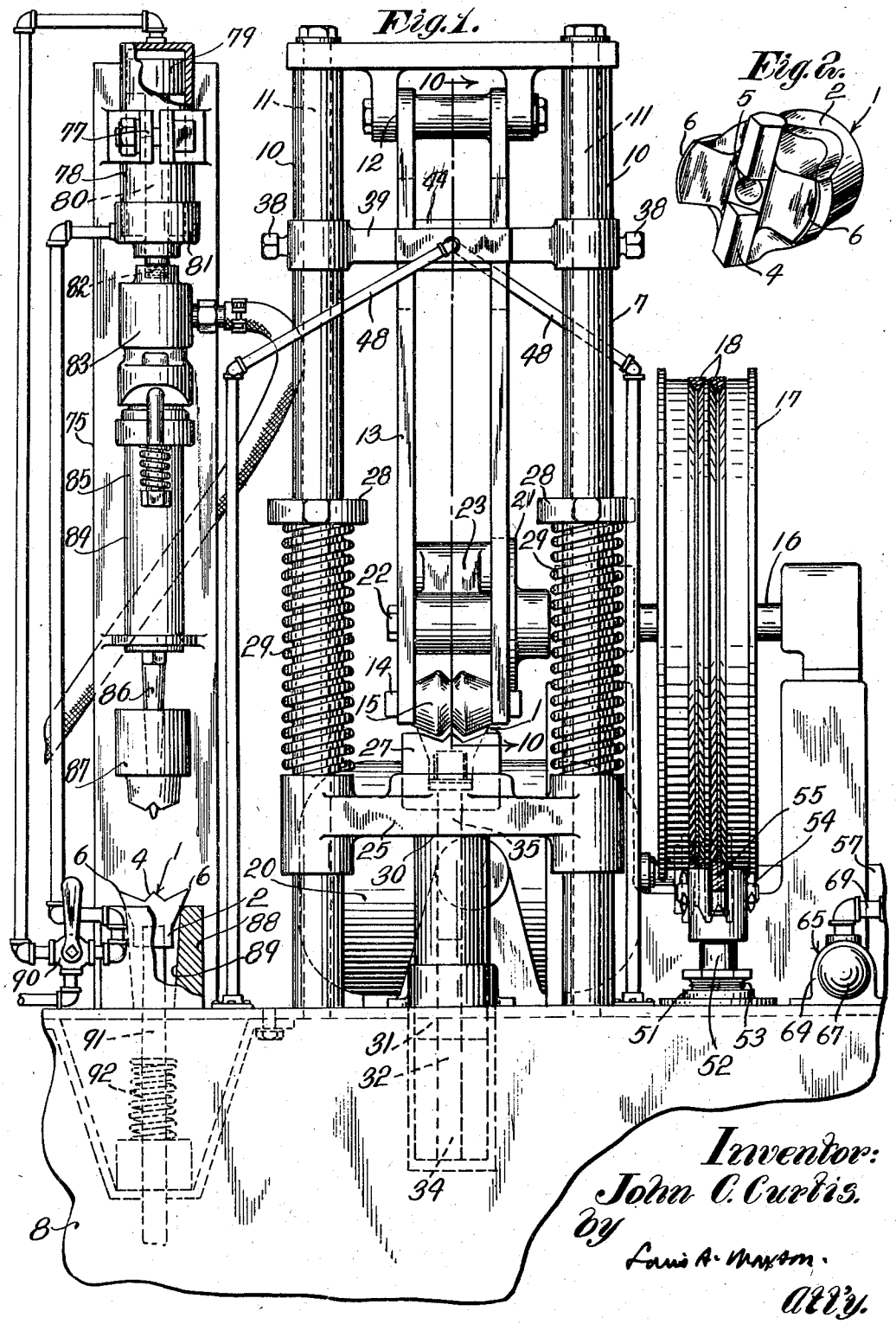


Fig. 2.

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Fig. 4.

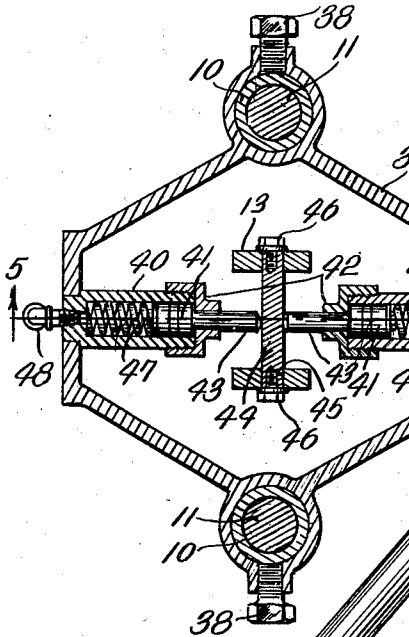
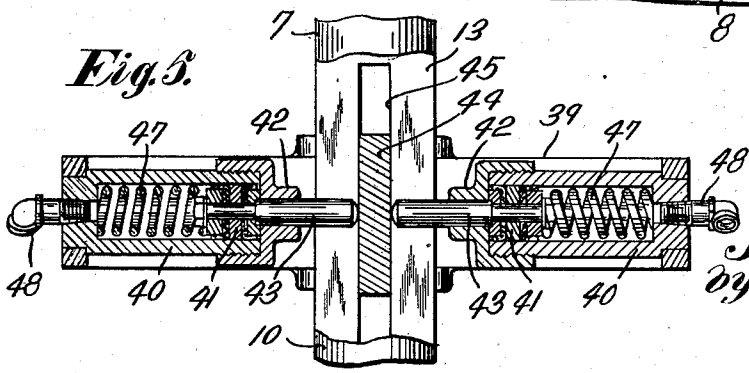


Fig. 3.

Fig. 5.



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FORGING APPARATUS

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Fig. 6.

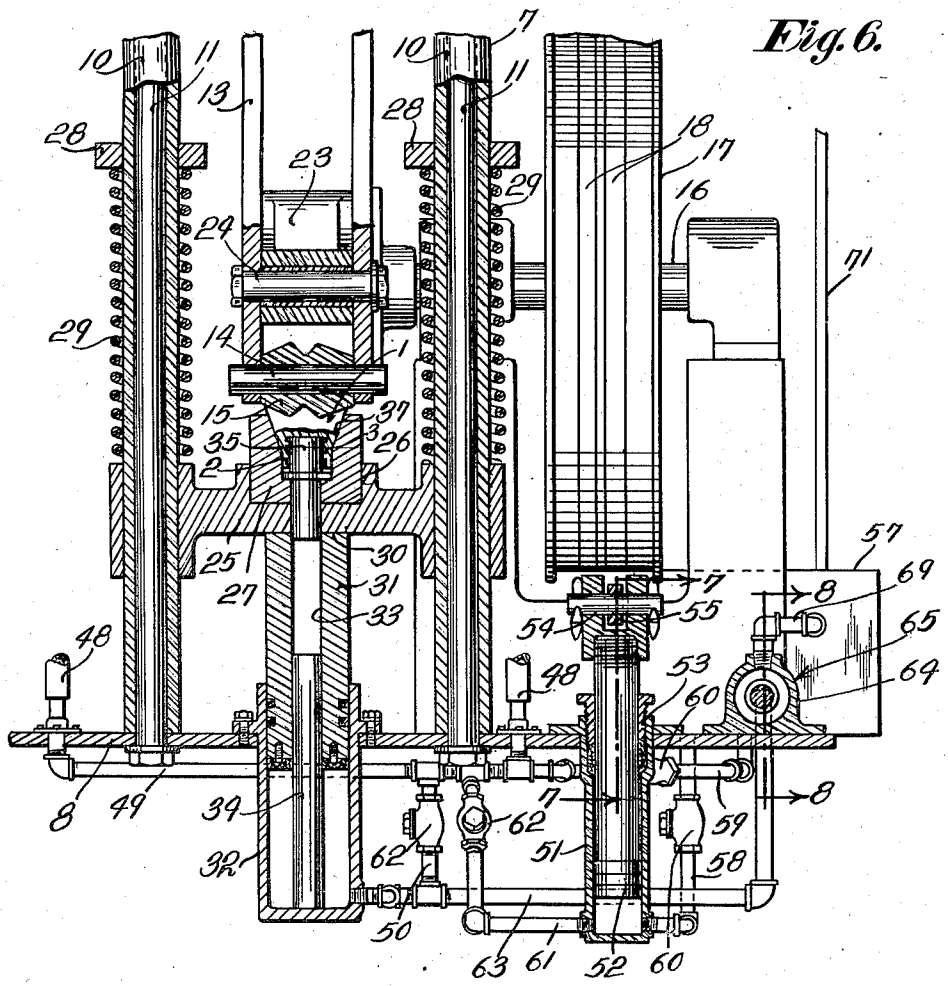


Fig. 7.

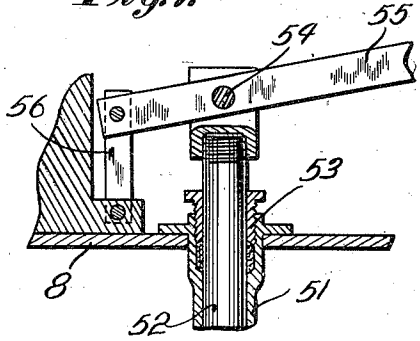
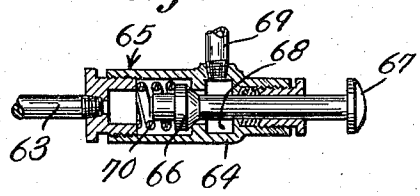


Fig. 8.



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FORGING APPARATUS

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Fig. 9.

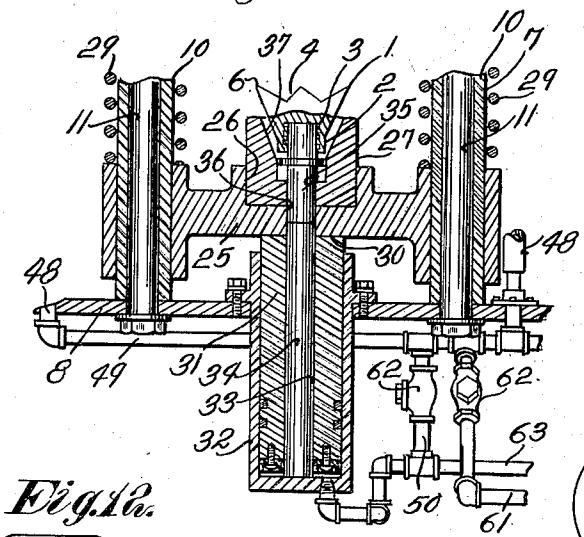


Fig. 10.

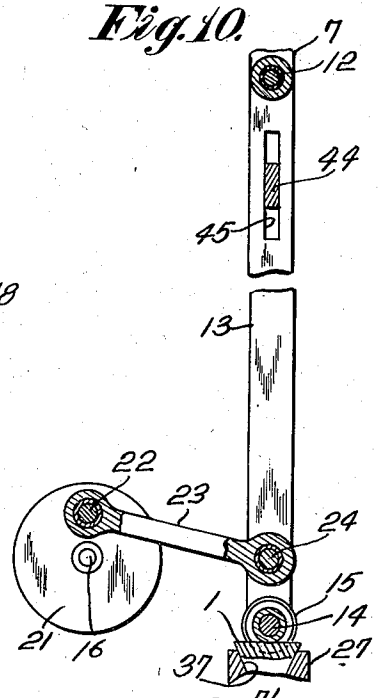


Fig. 12.

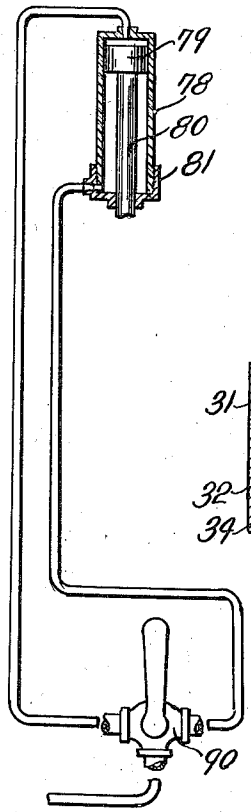
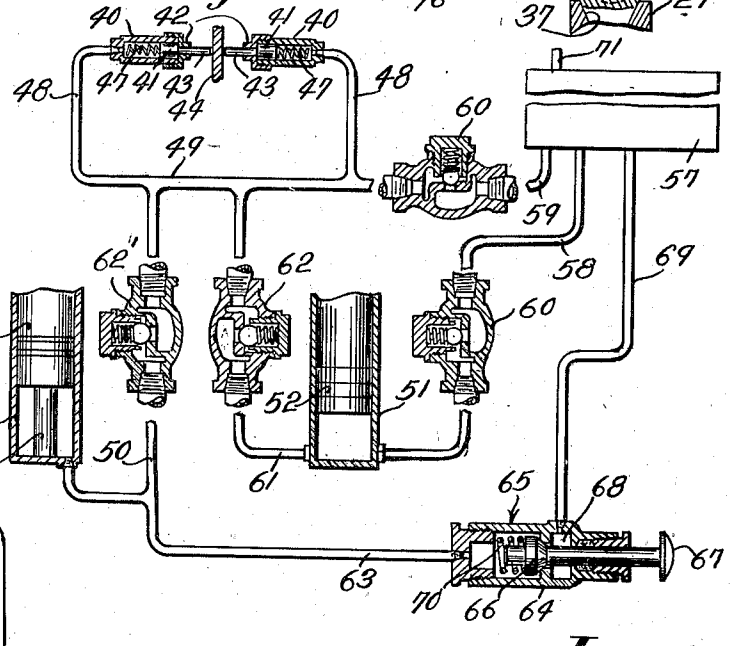


Fig. 11.



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Fig. 13.

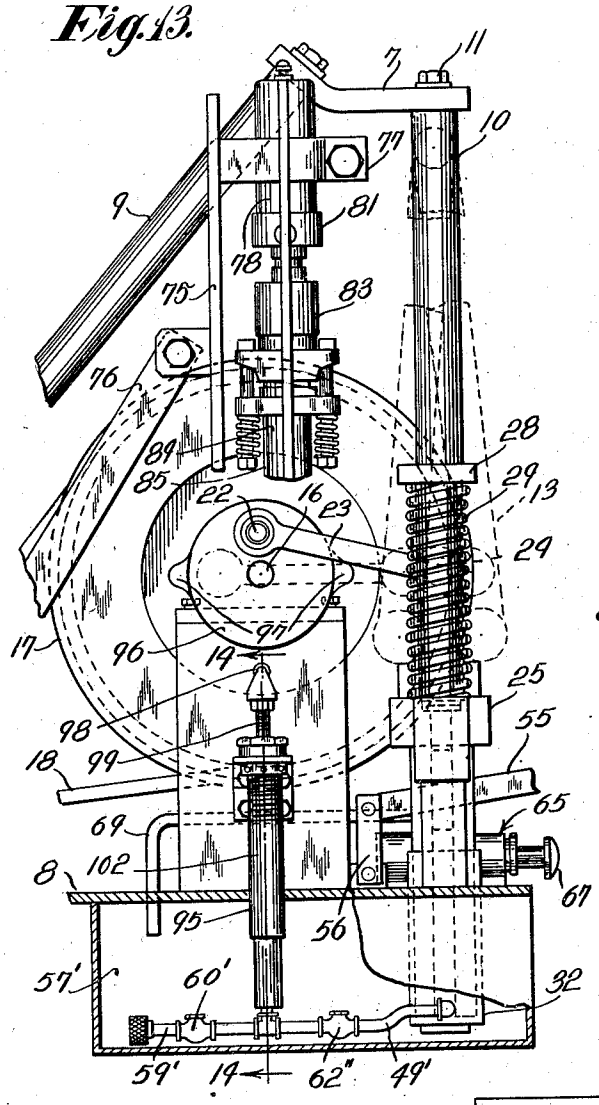


Fig. 14.

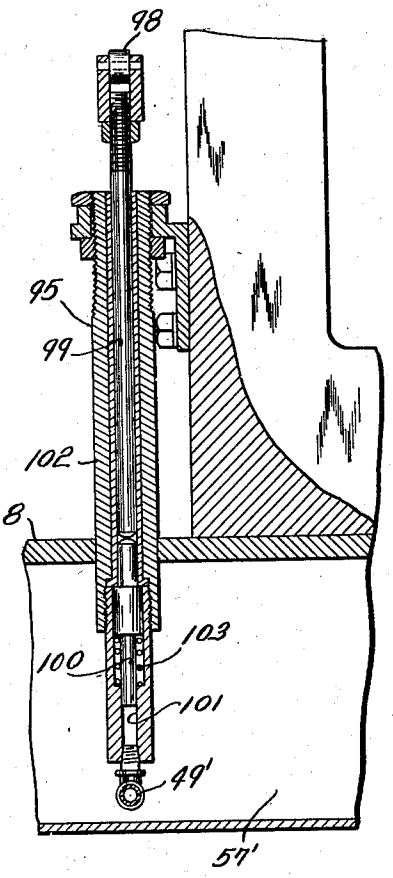
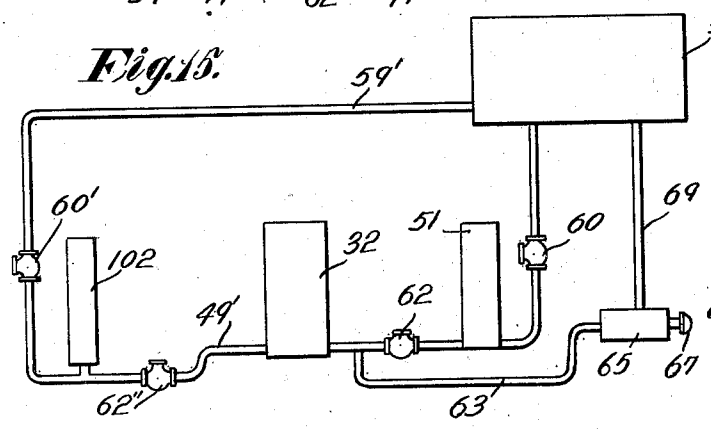


Fig. 15.



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Patented June 22, 1948 2,443,814

UNITED STATES PATENT OFFICE

2,443,814

FORGING APPARATUS

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Application June 8, 1942, Serial No. 446,202

8 Claims. (Cl. 76—5)

1

This invention relates to an article forming apparatus and more particularly to an improved hot rolling apparatus especially designed for use in the formation of the cutting portions of rock drill bits.

It is now common practice in the drilling of rock by means of percussive tools, to employ rock drill bits of the detachable type which are attached to drill rods, usually by coupling threads. Such detachable rock drill bits are necessarily of an inexpensive design since after a few sharpenings of the worn cutting surfaces, they are discarded. Also the sharpening process must be rapid and accurate so that the cutting portions of the drill bits may be readily and quickly formed to the exact shape desired thereby to reduce the cost and provide bits which are uniform so that efficiency in operation may be attained. Heretofore, it has been a common practice to grind down the worn cutting edges on a grinding wheel, although, in certain instances, sharpening has been effected by a hot milling process. Since such grinding and milling methods remove a substantial portion of the metal during the sharpening operation they result in a product which is more expensive due to more frequent bit replacement.

It is a primary object of the present invention to provide an implement-forming apparatus which is rapid and efficient in operation. Another object is to provide an improved apparatus for forming or sharpening the cutting portions of detachable rock drill bits. A further object is to provide an improved apparatus for forming metallic articles whereby the forming process is effected with a rolling action. Yet another object is to provide a novel hot rolling apparatus for forming the cutting portions of rock drill bits. A still further object is to provide an improved hot rolling apparatus having novel means for mounting and operating the rolling die element thereof. Yet another object is to provide novel means for controlling the position of the work with respect to the forming element. A still further object is to provide a novel metal rolling apparatus especially designed for use in the hot rolling of the cutting portions of rock drill bits. Another object is to provide a novel hydraulically operated positioning means for locating a work piece relative to the forming die of the rolling apparatus. A further object is to provide novel bit gauging means.

The invention comprises the novel parts, and the novel combination and arrangement thereof, as shown in the accompanying drawings, as described in this specification, and as will be more particularly defined by the claims appended hereto.

In the drawings:

Fig. 1 is a front elevational view of the improved hot rolling apparatus.

Fig. 2 is a perspective view of a rock drill bit.

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Fig. 3 is a side elevational view of the apparatus shown in Fig. 1.

Fig. 4 is an enlarged horizontal sectional view taken substantially on line 4—4 of Fig. 3, illustrating the automatic pumping means.

Fig. 5 is an enlarged vertical sectional view taken substantially on line 5—5 of Fig. 4.

Fig. 6 is an enlarged vertical sectional view taken substantially on line 6—6 of Fig. 3.

Fig. 7 is a detailed vertical sectional view taken substantially on line 7—7 of Fig. 6, illustrating the hand pump.

Fig. 8 is a detailed vertical sectional view taken on line 8—8 of Fig. 6, illustrating the ram release valve.

Fig. 9 is a fragmentary sectional view taken on the plane of Fig. 6, showing parts in a different position.

Fig. 10 is a fragmentary vertical sectional view taken substantially on line 10—10 of Fig. 1, illustrating the roller die and its associated mounting and operating means.

Fig. 11 is a diagrammatic view illustrating the hydraulic system associated with the bit positioning means.

Fig. 12 is a diagrammatic view illustrating the fluid system associated with the bit gauging and hole opening means.

Fig. 13 is a fragmentary view, similar to Fig. 3, showing a modified form of pumping means.

Fig. 14 is an enlarged vertical sectional view taken substantially on line 14—14 of Fig. 13.

Fig. 15 is a diagrammatic view of the hydraulic system associated with the modified pumping means, shown in Figs. 13 and 14.

In this illustrative embodiment of the invention, there is shown a hot rolling apparatus especially designed for use in the formation of the cutting surfaces of a detachable rock drill bit. It will be evident, however, that various features of the invention may be embodied in other types of metal-forming apparatus and that the apparatus may be employed in the formation of other types of metallic articles.

The detachable rock drill bit disclosed herein is of a well known design and may be generally similar to that disclosed in the patent to P. H. Nast, No. 2,168,102 granted November 30, 1938, and is known as the "Sullivan" detachable rock drill bit. The drill bit is generally designated 1 and comprises a body 2 having a threaded socket 3 adapted for connection to a conventional drill steel, and the cutting face of the bit body has, as shown in Fig. 2, alined radial cutting edges 4, 4 spaced for a central opening 5, and arcuate peripheral chopping edges 6, 6 arranged at the opposite sides of the diametric cutting edges. The drill bit is of the so-called double-taper type and has relatively inclined, double-taper outer surfaces as is fully described in the patent above referred to.

The improved hot rolling apparatus as shown in Figs. 1 to 12 inclusive comprises an upstanding frame structure 7 mounted on a suitable base 8, and rigidly braced with respect to the base by suitable brace rods 9. The frame structure includes a pair of tubular guides 10, 10 and frame tie-rods 11 pass centrally through these tubular guides in the manner shown. Pivotally suspended at 12 from the upper part of the frame structure is an arm or link 13 herein preferably arranged between the guides and swingable in vertical planes. Journaled on a cross shaft 14 carried at the lower free end of the swingable arm is a roller die 15 provided with appropriately shaped forming surfaces. Suitably journaled on the frame structure is a horizontal drive shaft 16 having fixed thereto a pulley 17 connected by a drive belt 18 to a motor pulley 19, the latter being fixed to the shaft of a motor 20. This motor is preferably of the electric type and is mounted on the base 8. Fixed to the drive shaft 16 is a crank disc 21 having its crank pin 22 pivotally connected to a connecting rod 23, in turn pivotally attached at 24 to the roller supporting arm 13. It is accordingly evident that when the crank disc is driven by the motor through the belt and pulley connections, the roller arm is oscillated about its pivot to move the roller die back and forth for a purpose to be later explained. Reciprocably guided on and extending between the parallel guides 10, 10 is a sliding frame or crosshead 25 having a centrally located socket 26 for receiving a support 27 for the drill bit 1. Encircling the guides 10 and extending between collar-like abutments 28 fixed as by set screws to the guides, are coiled springs 29 which act on the crosshead 25 constantly to urge the latter in a downward direction. The abutments 28 may be adjusted relative to the guides 10 to vary the tension of the springs 29 in an obvious manner. Abutting at 30 the bottom of the crosshead is a ram or piston 31 reciprocably mounted in a vertical cylinder 32 rigidly secured to the base. This ram has a central bore 33 for receiving a rod 34 which engages the cylinder bottom. When the crosshead 25 is in its lowered position on the guides 10 as shown in Fig. 9, the rod 34 is engaged by a cylindric plunger 35 guided in a central bore 36 in the bit support 27. The bit support has a tapered socket 37 for receiving the bit body and the upper portion of the plunger is received in the threaded socket 3 of the bit. The rod 34, when the crosshead is lowered, lifts the plunger 35 with respect to the bit support to raise the bit from its socket in the bit support thereby to facilitate removal of the bit after the completion of the rolling process.

Attached as by screws 38 to the guides 10 near the upper ends of the latter is a horizonal frame 39 (see Figs. 4 and 5) carrying a pair of alined pump cylinders 40, 40 containing reciprocable pistons 41, 41. Projecting outwardly through the inner heads 42 of the pump cylinders are piston rods 43 for abutting the opposite sides of an abutment plate 44 carried by the swingable roller arm 13. The pump frame 39 is adjustable in a vertical direction relative to the guides 10 and the roller arm 13 is vertically slotted at 45 adjustably to receive the abutment plate 44. Screws 46 carried at the opposite ends of the abutment plate are engageable with the sides of the arm 13 to clamp the abutment plate in an adjusted position. By adjusting the pump cylinder frame 39 relative to the guides the stroke of the pump pistons 41 may be varied, as desired. Arranged

in the pump cylinders and acting on the pistons are coiled springs 47 which constantly urge the piston rods into engagement with the abutment plate. The remote ends of the pump cylinders are connected by branch pipes 48, 48 to a pipe 49 and the latter is connected by a pipe 50 leading to the bottom of the ram cylinder 32. Thus as the roller arm 13 is oscillated through the crank and connecting rod connections the pump pistons are reciprocated to force liquid under pressure to the ram cylinder beneath the ram 31 to effect lifting of the ram as hereinafter described. The valve arrangements associated with the pump cylinders will be later described.

Mounted on the base at one side of the frame structure 7 is a conventional hand pump including a vertical cylinder 51 containing a pump plunger 52 (see Figs. 6 and 7). This pump plunger extends upwardly through a stuffing box 53 at the upper end of the pump cylinder, and is pivotally connected at 54 to an operating lever 55. This lever is pivotally mounted through a pivoted link 56 on the base. Thus when the operator actuates the pump lever to reciprocate the pump piston, liquid under pressure may be forced into the bottom of the ram cylinder 32 to raise the ram. A tank 57 is mounted on the base and, as shown diagrammatically in Fig. 11, this tank is connected by a pipe 58 to the lower end of the pump cylinder 51 and by a pipe 59 to the pipe 49. Check valves 60 in the pipes 58 and 59 respectively prevent reverse flow from the pump cylinders 40 and 51 toward the tank. The lower end of the pump cylinder 51 is connected by a pipe 61 to the pipe 49 and the pipe 61 has a check valve 62 which prevents reverse flow to the lower end of the cylinder 51 from the pipe 49. The pipe 50 leads to the lower end of the cylinder 32 and a check valve 62' prevents reverse flow between the cylinders 40 and the lower end of the ram cylinder 32. The pipe 50 leading to the lower end of the ram cylinder is connected through a pipe 63 to a casing 64 of a release valve generally designated 65. This release valve includes a valve element 66 operated by a conveniently located push button 67. The valve casing at the outer side of the valve element 66 has a chamber 68 connected by a pipe 69 to the supply tank 57. A coiled spring 70 acting on the valve element 66 constantly urges the latter toward its seated position. When the operator presses inwardly on the push button 67 the valve is unseated so that the liquid in the lower end of the ram cylinder 32 beneath the ram is exhausted back to the tank. It will be understood that a rotary valve might be substituted for the valve 66, if desired. A stand pipe 71 may be desirably provided to maintain the oil level at or above the cylinders 40, 40.

Arranged in a vertical position at one side of the frame structure 7 is a support 75, braced with respect to the base 8 by a suitable brace rod 76. Supported preferably by a split clamp 77 on this support is a pneumatic feed cylinder 78 containing a reciprocable feed piston 79, the latter having its piston rod 80 extending downwardly through the lower cylinder head 81. The piston rod is threadedly attached at 82 to the rear head 83 of a pneumatic impact tool 84 of a conventional design. This tool includes a vertical cylinder 85 containing a reciprocable hammer piston (not shown) for delivering impact blows to the shank of a pin 86. The rear portion of the motor cylinder is slidingly received within the rear head 83, and there is a throttle valve (not shown) arranged to be opened and closed upon movement of

the cylinder relative to the head in one direction or the other. The pin 86 is suitably supported within a chuck arranged within the front end of the motor cylinder and fixed to this pin is an upsetting tool 87 having its bottom face shaped to conform to the cutting face of the rolled bit. Supported on the base beneath the impact tool is a gauge block 88 having a tapered bore 89 for receiving the rolled bit. Subsequent to the rolling operation, the bit is placed in the bore of the gauge block and upon admission of pressure fluid to the upper end of the feed cylinder under the control of a valve 90, the impact tool is fed downwardly to bring the upsetting tool 87 into engagement with the bit face. When movement of the upsetting tool is resisted by the work, relative movement between the motor cylinder 85 and the rear motor head 83 occurs thereby automatically starting the hammer tool so that the upsetting tool is hammered downwardly to drive the bit into the gauge block bore. Driving of the bit into the bore of the gauge effects proper gauging of the bit and concurrently with the gauging operation the projecting end of the pin 86 serves to open the axial bore of the bit in a well known manner. A release rod 91 operated in any suitable manner and constantly urged upwardly by a coiled spring 92 is movable upwardly within the gauge block bore to facilitate release of the completed bit from the gauge block.

The modified form of the invention shown in Figs. 13, 14 and 15, is generally the same as that above described, with the exception that a different form of pumping means is substituted for the pumping means 40, 41 above described. In this construction the pumping means associated with the roller arm 13 is completely eliminated, and a pumping means 95 is provided which is operated directly from the drive shaft 16. As shown in Fig. 13 the shaft 16 has fixed thereto for rotation therewith a cam plate 96 having spaced cams 97 which are engageable with a roller 98 mounted at the upper end of an actuating stem 99 for a pump piston 100. This pump piston is reciprocable in the bore 101 of a vertical cylinder 102 attached to the frame structure 7 and extending down within the liquid tank 57'. A spring 103 urges the pump piston in an upward direction as shown in Fig. 14. The hydraulic system, shown in Fig. 15 is similar to that shown in Fig. 11, and likewise the tank 57' which is arranged in the base of the apparatus, is connected by the pipe 69 to a pressure release valve 65, and the latter is connected by the pipe 63 to the ram cylinder 32. The lower end of the pump cylinder 102, which actually extends into the tank 57' as shown in Fig. 13, is connected with a pipe 59' having a check valve 60' therein, so that it can draw fluid from the tank. A pipe 49' leads from the pump discharge to the lower end of the ram cylinder 32 and a check valve 62'' prevents reverse flow back to the pump. Essentially the same pipe connections between the ram cylinder and the cylinder 51 are provided as in the other embodiment above described. Thus as the shaft 16 is driven the cams 97 effect reciprocation of the pump piston 100 to force liquid under pressure to the ram cylinder beneath the ram 31 to effect lifting of the ram to raise the work toward the roller die 15, in a manner similar to that above described.

The general mode of operation of the improved hot rolling apparatus is as follows: A properly heated bit 1 to be sharpened may be placed on the bit support 27 as shown in Fig. 6, with the upper portion of the plunger 35 received in the

bit socket 3. The motor 20 may then be started to effect oscillation of the roller die 15 and thereafter the hand pump may be operated to effect upward movement of the ram 31, thereby to raise the bit support 27 to move the bit toward the roller die thereby properly to position the bit. This will charge the hydraulic system, as will be evident; and the latter may be equipped with suitable float controlled air-bleed valves if desired. As the roller arm 13 swings or oscillates rapidly back and forth, the roller die passes over the bit to effect forming of the cutting and chopping edges 4 and 6 of the bit 1, and as the roller arm swings, it effects reciprocation of the pump pistons 41 to force liquid under pressure beneath the ram 31 to raise the latter, thereby automatically to feed the bit support upwardly to move the bit toward the roller die. Accordingly after each pass of the roller die with respect to the bit, the latter is automatically fed upwardy a slight distance toward the roller die. Upon completion of the rolling process the operator may press the push button 67 of the ram release valve 66 inwardly to connect the lower end of the ram cylinder 32 to the tank 57 and as a result, the bit support is lowered by the coiled springs 29 into the position shown in Fig. 9. As the bit support approaches the lowermost position the rod 34 engages the plunger 35 to cause the latter to lift the bit from the bit support bore. When the rolled bit is so raised, it may be easily removed from the plunger 35 and placed in the tapered bore 89 of the gauge block 88, and the impact tool 84 may then be operated to deliver impact blows to the upsetting tool thereby to effect gauging of the sides of the bit and concurrent opening of the axial bit bore. On completion of the gauging and bore opening operations the impact tool may be retracted by its feed piston, and the plunger rod 91 may be operated to lift the completed bit from the gauge block bore in the manner shown in Fig. 1. The method of forming the drill bit includes the initial rolling of the working face of the bit by transverse movement of a roller die with respect thereto and thereafter effecting gauging of the bit by imparting thereto an endwise hammering action. Thus the transverse rolling process effects the formation of the cutting and chopping edges of the bit while the endwise hammering action effects proper gauging of the sides of the bit.

The mode of operation of the modified apparatus shown in Figs. 13, 14 and 15 is essentially similar to that above described. In this instance, however, the cams 97 effect reciprocation of the pump piston 100 to force liquid under pressure beneath the ram 31 to raise the latter, thereby automatically to feed the bit support upwardly to move the bit toward the roller die. It is thus evident that the pump is operated wholly independently of the roller swinging arm 13 directly from the drive shaft of the apparatus. Otherwise, this form of the invention operates in the same general manner as in the other embodiment.

As a result of this invention a novel hot rolling apparatus is provided whereby the cutting face of a rock drill bit may be quickly and efficiently formed. By the provision of the manual and automatic hydraulic means for raising the bit support the bit may first be properly positioned with respect to the roller die and, during the rolling process, may be automatically fed step by step toward the roller die. Further by the provision of pneumatically operated gauging means the rolled bit may be expeditiously brought to

the proper gauge while the axial bore of the bit is concurrently opened. Also by the provision of the novel roller mounting arrangement improved shaping of the cutting and chopping edges of the bit is effected while the cost of sharpening is decreased and the bit efficiency is increased. Further by application to the work of a transverse rolling operation and an endwise hammering operation a novel forming method is attained. Other uses and advantages of the invention will be clearly apparent to those skilled in the art.

While there are in this application specifically described one embodiment and a modification thereof which the invention may assume in practice, it will be understood that this embodiment and modification of the same are shown for purposes of illustration and that the invention may be further modified and embodied in various other forms without departing from its spirit or the scope of the appended claims.

What I claim as new and desire to secure by Letters Patent is:

1. In a forming apparatus, a frame structure, parallel vertical guides, a roller die movably mounted on said frame structure between said guides, a cross head slidable along said guides, a work support carried by said cross head, and means for sliding said cross head along said guides to move said work support toward said roller die.

2. In a forming apparatus, a frame structure, parallel vertical guides, a roller die movably mounted on said frame structure between said guides, a cross head slidable along said guides, a work support carried by said cross head, means for sliding said cross head along said guides to move said work support toward said roller die, and means for constantly urging said cross head along said guides in a direction away from said die.

3. In a forming apparatus, a frame, an arm pivotally mounted on said frame to swing relative thereto, a forming die carried by said arm, means operatively connected to said arm for oscillating the same to effect movement of said die with respect to the work, fluid operated means for feeding the work with respect to said die, and fluid pumping means operative as a result of oscillatory movement of said arm for supplying fluid at a controlled rate to said feeding means.

4. In an apparatus for forming metallic articles, a frame providing a stationary guideway, a forming die movable relative to said frame while said guideway remains stationary, a work support mounted on said guideway for rectilinear movement in a fixed path therealong towards and from said die, resilient means for opposing movement of said work support towards said die, said resilient means acting constantly to urge said work support away from said die, and means for feeding said work support along said guideway towards said die against the action of said resilient means, and said resilient means serving to move said work support along said guideway away from said die when said feeding means is rendered ineffective.

5. In an apparatus of the character described, a frame providing a guideway, a work support movable along said guideway, a forming die mounted on said frame for movement with respect to said work support, a fluid operated cylinder and piston device extending lengthwise of said guideway for feeding said work support towards said die, and means coordinated with the movement of said die for automatically regulating the flow of operating fluid with respect to said cylinder and piston device.

6. In a forming apparatus, a movable die, a work support, means for effecting relative movement of said movable die and work support during the forming process, power operated means for feeding the work towards said die, manually operable means for feeding the work towards said die, and means associated with both of said feeding means and operable at will for reversing said feeding means for quickly effecting retraction of the work with respect to said die.

7. In a forming apparatus, a movable die, a work support, means for effecting relative movement of said movable die and said work support during the forming process, a feeding device for moving the work towards said die, power operated means for supplying operating medium to said feeding device, manually operated means for supplying operating medium to said feeding device, and means associated with said feeding device and operable at will for rendering both of said supply means ineffective to effect reversal of said feeding device quickly to retract the work from said die.

8. In an apparatus for forming metallic articles, means providing a guideway, a forming die movable back and forth with respect to said guideway, a work support mounted on said guideway for movement in a fixed path therealong towards and from said die, constantly operative means for yieldingly opposing movement of said work support along said guideway towards said die, and power operated means for feeding said work support along said guideway towards said die against the action of said yielding opposing means, and said yielding opposing means serving automatically to move said work support along said guideway away from said die whenever said feeding means is rendered ineffective.

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