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METHOD AND APPARATUS FOR HYDRAULIC WORK HARDENING

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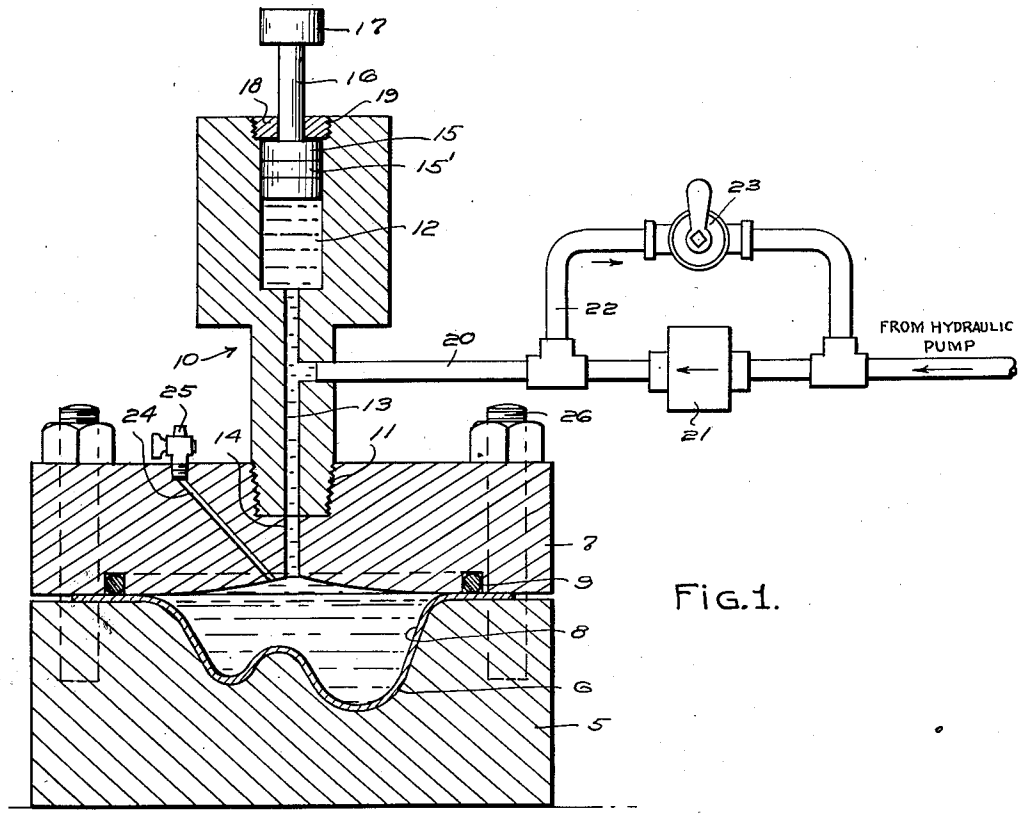

Fig. 1.

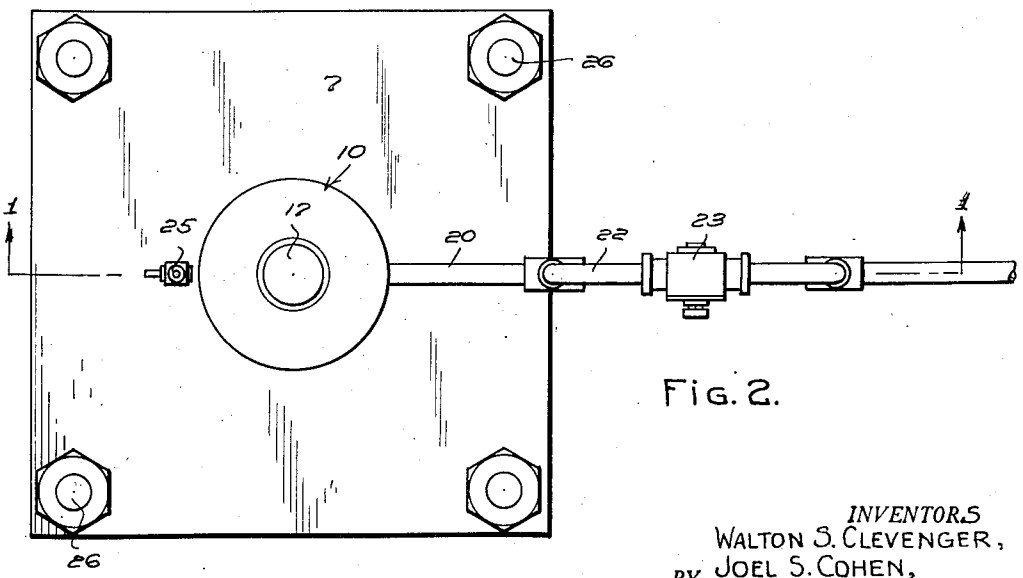

Fig. 2.

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METHOD AND APPARATUS FOR HYDRAULIC WORK HARDENING

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2 Claims. (Cl. 113—44)

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This invention relates to the art of die forming by hydraulic pressure wherein a female die member and a pressure plate serve to clamp a sheet of stock to be formed therebetween and, by hydraulic pressure, the stock is forced into the die impression and the invention has for its prime purpose a means to impact harden the material after it has been formed in the die impression.

The invention contemplates a die forming arrangement as above indicated wherein a liquid supply is conducted to the pressure plate to force the material into the die impression and an impact cylinder having a liquid column directly communicating with the liquid within the pressure plate and a piston having a projecting head for receiving blows from a suitable tool for imparting the force of the blows directly through the liquid column to impinge upon the formed material in the die to harden the same.

Details for carrying out the invention will be more clearly described during the following description, reference being had to the accompanying drawing, wherein has been shown an example of the device and wherein like characters of reference are employed to denote like parts throughout.

In the drawing:

Figure 1 is a central vertical section through a forming die, showing the invention applied thereto, taken on line 1—1 of Figure 2 and,

Figure 2 is a top plan view of the device.

Referring specifically to the drawing, the numeral 5 designates a female die member, having a suitable die impression 6, formed therein. A pressure plate 7 serves to securely clamp a sheet of material upon the upper open face of the die 5 to overlie the impression 6. The pressure plate 7, upon its clamping face, is provided with a suitable sealing medium 9 to prevent the lateral escape of fluid pressure.

An impact cylinder 10, has threaded engagement within an opening 11 formed in the upper face of the pressure plate 7. The upper portion of the cylinder is enlarged and is provided with an enlarged bore 12, open at its upper end. The bore 12 is concentric with a reduced bore 13 that communicates with a bore 14 formed in the pressure plate 7 and communicating with the inner side of the plate 7. The bores 12, 13 and 14 are concentric and in alignment. Operable within the bore 12, is a piston ram 15, having a sealing ring 15', formed upon a piston rod 16. The rod 16 projects above the cylinder 10 and carries an impact head 17. A stop collar 18, threaded within an opening 19, limits the upward movement of the ram 15. A fluid pressure conduit 20, leading from a source of hydraulic pressure, connects with the reduced bore 13 and serves to conduct hydraulic pressure to the cylinder and to the die, for pressure forming the material 8. A check valve 21 is interposed in the conduit 20 and a by-pass conduit 22 communicates with the conduit 20 upon opposite sides of the check valve 21. A suitable cut-off valve 23 is interposed in the by-pass conduit. An air bleed port 24 communicates with the interior of the die through the pressure plate and is controlled by a valve 25.

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In the use of the device, the sheet of material to be formed is placed over the die impression and the pressure plate 7 brought into contact therewith and rigidly clamped in place by any suitable means, such as bolts 26. Fluid, such as oil, is then introduced to the pressure plate through the conduit 20, forcing the ram 15 to its uppermost limit and filling the cavity of the pressure plate. Any air that might have been trapped in the device is released through the valve 25. Continued hydraulic pressure from a pump or other source forces the material 8 downwardly into conforming contact with the walls of the die impression. Lateral escape of the oil under pressure between the work and the pressure plate is prevented by the seal 9.

With the valve 23 closed, the oil pressure has completely filled the mold, formed the material, forced the ram 15 to its uppermost position in the cylinder and now maintains a static column of oil under pressure against the ram and the formed work. The hardening method consists of a series of rapid blows upon the head 17, either manually or mechanically and these blows are transmitted through the static column of oil to the formed material in the die, since the material is held in conforming contact with the walls of the die impression. These rapid blows are continued for a predetermined length of time, dependent upon the type of material to be hardened. The shock of the blows are prevented from travelling toward the source of the fluid pressure, by the check valve 21. Upon a completion of the work hardening, the valve 23 is opened to permit a by-pass of the oil to its original source, suitable mechanism, not shown, being employed to reverse the flow of the oil, after which, the pressure plate 7 may be removed and the formed object taken from the die.

It will be apparent, that a very simple and novel means has been provided to work harden an object that has been die formed under hydraulic pressure. The mechanism is extremely

cheap to manufacture and results in a considerable saving of time and labor costs over the old methods of work hardening by mechanical impact. In the hydraulic die, the forming medium, in this particular case, being oil, is employed as the medium to transmit the mechanical blows to the hydraulically formed work prior to its removal from the die, thus performing the complete operation of forming and hardening in a single operation. The method readily lends itself to many forms of hydraulic dies where work hardening is essential or required.

It is to be understood, that the invention is not limited to the precise structure shown, but that various changes in the shape, size and arrangement of parts may be resorted to as readily fall within the spirit of the invention or the scope of the subjoined claims.

Having described our invention, what we claim as new and desire to secure by Letters Patent is:

1. A work hardening means for use with a hydraulic die forming device embodying a female die and a pressure plate for clamping a work sheet over an impression formed in the die, an impact device connected with the pressure plate centrally thereof, the impact device and the pressure plate provided with axially aligned ports, the upper end of the impact device being provided with a cylindrical chamber that slidably receives a ram plunger, the chamber communicating with the ports and axially arranged therewith, a rod carried by the plunger and extending above the impact device, a head carried by the rod, a fluid pressure conduit connected with the impact device and communicating with the port for conducting fluid under pressure to the impact device and the die for forcing the work sheet into conforming engagement with the walls of the die impression, the fluid pressure forming the work sheet causing the ram to shift to its maximum outward travel, a check valve in the fluid pressure conduit that maintains a static body of fluid in the die and the impact device after work forming, a by-pass conduit around the check valve, a valve for controlling the by-pass, the ram head after the work has been formed, adapted to receive a plurality of blows to be conducted to the static column of fluid by the ram, the shock of the blows impinging upon the surface of the formed work in the die, and an air relief port for the pressure plate.

2. A work hardening impact device for use with the pressure plate of a female die device, comprising a body portion connected with the upper face of the pressure plate centrally thereof, the body portion terminating in an enlarged chambered head, an axial port formed in the body portion that communicates with the chamber and a through port formed in the pressure plate, a ram device operable in the chamber, a rod carried by the ram and projecting above the head, a hydraulic pressure conduit connected with the body portion and communicating with the axial port for conducting hydraulic pressure to the ram and to the interior of the die for hydraulically forming a sheet of material clamped between the die and the pressure plate, a check valve in the hydraulic pressure conduit for preventing a reverse flow of hydraulic pressure from the die and the ram after work forming, the check valve maintaining a static column of hydraulic fluid under pressure against the ram and the formed work in the die, an air relief port formed in the pressure plate, the formed work in the die adapted to receive a series of work hardening shocks imparted to the ram rod, a by-pass conduit connected to the hydraulic pressure conduit upon opposite sides of the check valve and a control valve for the by-pass.

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