APPARATUS FOR THE DEFORMATION OF METAL SHEETS AND PRESHAPED BODIES UNDER SHOCK EFFECT IN WATER

Paul Nenitz, Kiel-Fries, Germany, assignor to MoK Maschinenbau Kiel G.m.b.H., Kiel-Friedrichsort, Germany, a firm

Filed July 23, 1963, Ser. No. 297,131
Claims priority, application Germany, Jan. 11, 1963, 55,390; May 11, 1963, 56,795
6 Claims. (Cl. 72—56)

The shaping or deformation metal sheets by shock effect produced by explosive by forcing a sheet metal disc into the vacuum space of a hollow mould by means of shock waves transmitted by water is known.

In the case of the shock deformation of heavy and large parts the mould with the sheet metal disc placed thereon is lowered with the explosive charge into a water vessel by means of a crane and after the deformation is lifted out of the water vessel by means of the crane for the purpose of removing the shaped part and inserting another disc and explosive charge.

These operations require heavy lateral swing-out crane planks, even in the case of medium sized moulds, knocking off of the ropes or chains out of the crane tackle is very dangerous in the event of a rope or chain accidentally whipping down on the charge. Moreover the ropes or chains can be damaged by the shock waves.

In the case of shock deformation under water in vessels sunk into the ground strong vibrations are produced in the ground by the shock waves and cause both the equipment for the shock deformation and also buildings in the vicinity of the site where the deformation is being carried out, to rock considerably.

It is the object of the present invention to avoid the disadvantages of the crane plant and to reduce the vibrations emanating from the deformation site to tolerable extent.

The invention provides an apparatus for the deformation of metal sheets and preshaped bodies under shock effect in water in which the deformation is effected by pressing the charge to be defomed into the vacuum space of a hollow mould by means of shock waves transmitted by water, which comprises a water vessel sunk in the ground, a lifting arrangement arranged underneath said water vessel, a working platform carried by said lifting arrangement, and a hollow mould as well as a holder frame for an explosive charge mounted on said platform, the hollow mould being lowered into its operating position in the water vessel and raised into its charging position above the water vessel by means of said lifting arrangement.

The working platform is preferably hydraulically movable.

The water vessel may have a wall composed of interengaging flanged U-girders (sheet piling) which are held together at the upper edge by a band and are cast with a concrete foundation at their lower end. The bottom of the water vessel may be provided with impact and shock absorbent materials above the concrete foundation.

A base, for example of ferro-concrete, may be placed on the foundation and supported by interposed regulatable resilient elements. These resilient elements cause the base to vibrate during the deformation process and thus reduce the shock wave energy emanating from the foundation.

The resilient elements may be constructed as air cushions which are connected with a source of compressed air. The pressure of the compressed air may be varied according to the load. The space between the base and the foundation may also be filled with compressed air the pressure of which is variable.

In order to reduce the effect of the shock waves on the side walls of the deformation vessel and the portion of the foundation which is not screened, the space between the base and the foundation may be provided with a jacket projecting into the foundation and acting as a bell which is fixed on the outer edge of the base.

Two preferred embodiments of the invention will now be described by way of example and with reference to the accompanying drawings, in which:

FIG. 1 is a vertical section through a deforming apparatus with raised working platform;

FIG. 2 is a top plan view of the working platform on a smaller scale;

FIG. 3 is a top plan view of a part of the sheet piling, and

FIG. 4 is a cross section through a working platform of modified construction lowered into the water vessel.

The deformation plant shown in FIG. 1 comprises a water vessel 1 sunk in the ground and having a wall composed of interengaging flanged U-girders 2 (FIG. 3). The U-girders 2 are welded together with a strong steel band 4 at the upper edge of the vessel and cast at its lower end with a concrete foundation 3. Between the concrete foundation 3 and a concrete base 5 with a steel plate 7 placed thereon, a shock absorbent material 6, such as wood or inflated pressure tubes are arranged. The concrete foundation 3 and the concrete base 5 are secured against lateral displacement by strong anchor bolts 24.

A protecting tube 8 is cast in the concrete foundation 3 and a hydraulic cylinder 9 is inserted therein and guided by means of a flange 11. The hydraulic cylinder 9 is fed by a conduit 21. A piston rod 10 is associated with the hydraulic cylinder 9 and carries on its upper end a working platform 12 composed of sheet metal carried by a FIG. 2) arranged on edge in star shape and firmly welded with a carrier plate 13. On the sheet metal carriers 12a wire mats 14 are provided for walking on the working platform 12.

A mould 16 is placed on the carrier plate 13 in a guide 15. A sheet metal disc 19 is placed on a drawing die 17 in the mould 16 in a known manner and clamped with an annular holder 18. An explosive charge 23 is placed on a frame 20 and can be electrically ignited by an ignition wire 22. The air is exhausted from the mould 16 in a known manner through a vacuum conduit 25.

In FIG. 4 the water vessel 1 is again formed from U-girders 2 sunk in the ground. The bottom of the vessel is provided with an iron concrete foundation 3. A working platform 121 is arranged so that it can be lifted out of the vessel by means of hydraulic cylinders 26. The working platform 121 comprises a plate 13 carrying the hollow mould 16 on which the sheet metal disc 19 to be shaped is placed. The frame 20 carries the explosive charge 23 for the shock deformation.

Underneath the working platform 121 a concrete base 34 is arranged which is supported by air cushioning elements 33, which are placed on a foundation 32. The air cushioning elements 33 are supplied with the necessary compressed air from a conduit 28 through the intermediary of a reducing valve 37.

The space 30 between the base 34 and the foundation 32 is connected with the source of compressed air by a conduit 29 and can be regulatably supplied with compressed air. The air from the space 30 is forced with wind the outer edge of the base 34. For this purpose the base carries a jacket 35 projecting into the foundation and acting as a bell. An air screen ring 36 forms around the mould 16 in the water compartment of the deforming apparatus. The outflowing air screen effects a reduction of the shock wave effect on the side walls of the vessel 1. Furthermore a weakening of the shock wave effect on the unprotected parts of the foundation is also attained.
3

In order to amplify the screening effect an annular conduit 31 known per se can also be provided which is supplied with compressed air through a connecting conduit 40 and forms another annular air screen 27 in the water bath having the same effect as that above described.

The base 34 is secured against lateral displacement by guide bolts 38 sunk in the foundation.

I claim:

1. An apparatus for the deformation of metal sheets and preshaped bodies under shock effect in water in which the deformation is effected by pressing the part to be deformed into the vacuum space of a hollow mould by means of shock waves transmitted by water, comprising a water vessel sunk in the ground, a lifting arrangement arranged underneath said water vessel, a working platform carried by said lifting arrangement, and a hollow mould as well as a holder frame for an explosive charge mounted on said platform, the hollow mould being lowered into its operating position in the water vessel and raised into its charging position above the water vessel by means of said lifting arrangement, the working platform comprising a wall composed of interengaging flanged U-girders the upper ends of which are held together by means of band while their lower ends are cast in a concrete base and the bottom of the water vessel being covered with shock absorbent materials.

2. An apparatus for the deformation of metal sheets and preshaped bodies under shock effect in water in which the deformation is effected by pressing the part to be deformed into the vacuum space of a hollow mould by means of shock waves transmitted by water, comprising a water vessel sunk in the ground, a lifting arrangement arranged underneath said water vessel, a working platform carried by said lifting arrangement, and a hollow mould as well as a holder frame for an explosive charge mounted on said platform, the hollow mould being lowered into its operating position in the water vessel and raised into its charging position above the water vessel by means of said lifting arrangement, the working platform in its operating position resting on a base placed on the foundation and being supported thereon by interposed adjustable resilient elements.

3. An apparatus according to claim 2, wherein the resilient elements are constructed as air cushions and connected with a supply of compressed air the pressure of which is regulatable according to the load.

4. An apparatus according to claim 3, wherein the space between the base and the foundation is filled with compressed air the pressure of which is regulatable.

5. An apparatus according to claim 4, wherein a jacket is arranged in the space between the base and the foundation and projects into the foundation thereby forming a bell fixed on the edge of the base and producing an air screen.

6. An apparatus according to claim 5, wherein a compressed air annular conduit is arranged on the inner periphery of the water vessel outside the working space and has small apertures for the escapement of compressed air to form a second air screen around the hollow mould.

References Cited by the Examiner

UNITED STATES PATENTS

2,935,038 5/60 Chatten ------------- 113---44
3,136,049 6/64 Throner et al. -------------- 113--44

CHARLES W. LANHAM, Primary Examiner.