Sept. 2, 1969 W. KLEIN 3,464,249

METHOD OF AND APPARATUS FOR EXPLOSIVE TREATMENT OF METALS

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FIG. 1

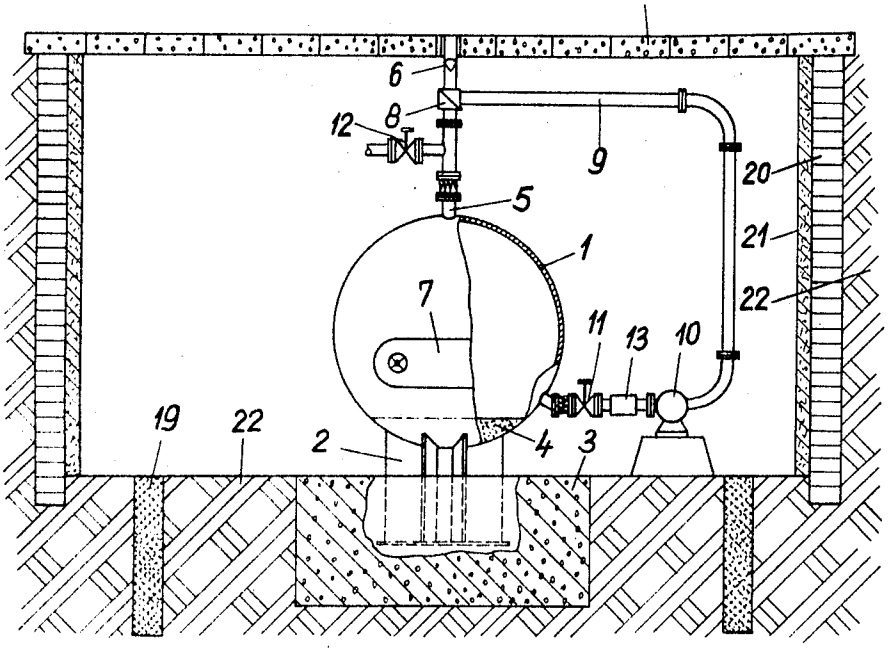

FIG. 2

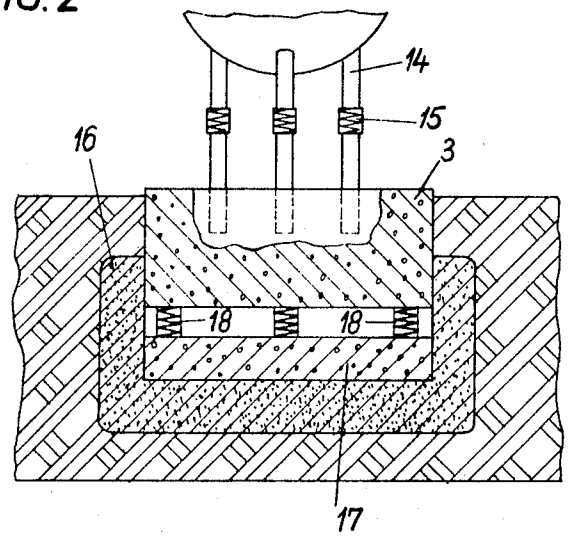

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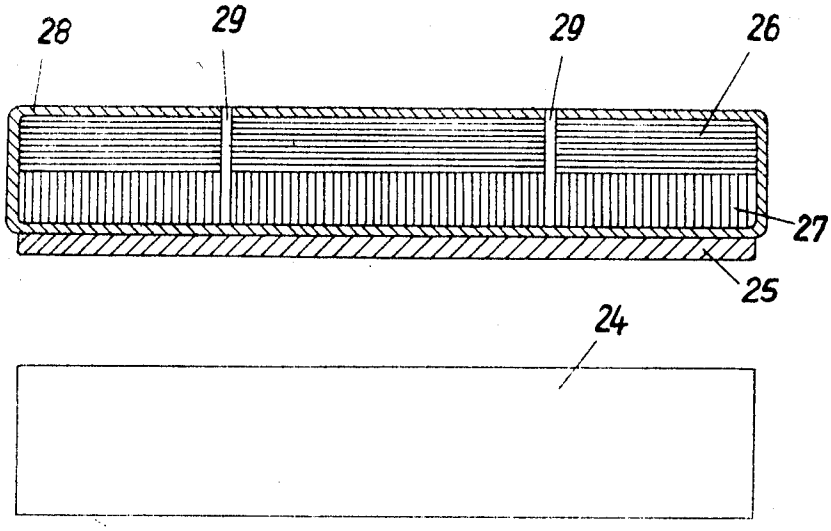
FIG.3



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METHOD OF AND APPARATUS FOR EXPLOSIVE TREATMENT OF METALS

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U.S. Cl. 72—56 18 Claims

ABSTRACT OF THE DISCLOSURE

A method and apparatus of explosive-plating or -hardening of metals in a safety explosive chamber dampened to noise transmission comprising equipping a workpiece to be explosively treated with an explosive charge, coating the workpiece and the explosive charge together completely with an air-tight envelope, inserting the coated workpiece and explosive charge into a safety explosive chamber spaced from the walls thereof, subsequently subjecting the chamber with the coated workpiece and the explosive charge to vacuum, and igniting the explosive charge.

The present invention relates to a method of and apparatus for explosive treatment of metals in general, and to a method of explosive treatment of metals in a noise-dampened safety explosive chamber, as well as an explosive chamber for performing the method, in particular, whereby the explosive chamber comprises a substantially ball-shaped container, which is equipped with a transportation door capable of being closed, as well as with a gas escape tube equipped with a noise silencer.

For the metal working by means of an explosive, and particularly for the connection, plating and hardening of metal, in case of workpieces of a large size appreciable explosive quantities are required, and for this reason, an extended operational area is necessary which is sufficiently remote from rural areas.

It is one object of the present invention to provide a method of and apparatus for the explosive treatment of metals, by which it is possible to avoid to a large extent the consequences and the effects of a detonation, as shock- and sound-waves in the atmosphere, and the seismic waves in the ground, in order to perform the metal working by means of an explosive also in the neighborhood of urban areas and industrial establishments.

It is another object of the present invention to provide a method of and apparatus for the explosive treatment of metals, wherein an explosive chamber is evacuated after insertion of the workpiece to be treated, since concentration waves cannot occur in vacuum.

In order to obtain a complete detonation of the explosive, in suitable manner the workpiece to be treated and the explosive is equipped together with an air-tight envelope prior to the insertion thereof into the explosive chamber.

It is another object of the present invention to provide a method of explosive treatment of metals wherein the envelope surrounding the workpiece to which the explosive has been applied and the explosive is made of synthetic material. It is to be understood that the workpiece

can be equipped, however, with an envelope of any suitable material, since the workpiece and the explosive is surrounded air-tight.

The material for the envelope should furthermore suitably be such, that no splinter effect occurs during the performance of the explosive treatment in the explosive chamber.

It is yet another object of the present invention to provide a method of explosive treatment of metals, wherein the container and the explosive chamber, respectively, is equipped with a pump pipe terminating into the gas escape tube, in which pump pipe are disposed in series a valve, a filter and a vacuum pump.

With these and other objects in view, which will become apparent in the following detailed description, the present invention will be clearly understood in connection with the accompanying drawings, in which:

FIGURE 1 is a vertical section of the apparatus for explosive treatment of metals;

FIG. 2 is a vertical section of another embodiment of the apparatus for performing the method of the present invention; and

FIG. 3 is a workpiece shown, by example, with an envelope surrounding the workpiece indicated in section.

Referring now to the drawing, and in particular to FIG. 1, the apparatus designed in accordance with the present invention comprises an explosive chamber which consists of a substantially ball-shaped container **1**, which is made of steel suitably nonsensitive against brittleness, or of a corresponding material, as for instance pretensioned steel concrete. The container **1** rests on a portable frame **2** and is anchored with the latter in a strongly reinforced concrete base **3**. By means of a loose granular material, which is disposed inside of the container **1** in form of a heap **4** of a predetermined height, maximum explosive loads can be brought to detonation. The container **1** is furthermore equipped with a flanged escape tube **5** through which the partly poisonous gases created during the detonation and consisting of CO, CO_2 and NO_2 can escape. The sound waves created during the detonation are still further dampened by means of a silencer **6** disposed in the escape tube **5**.

In order to reduce still further the sensitivity to brittleness of the working material of which the container **1** consists, at low surface temperatures, it is of advantage to provide a device (not shown) for outer heating of the container **1**.

The workpiece to be treated is at first inserted with the explosive applied thereto through the transportion door **7** into the container **1**, and is supported by the sand accumulations **4**. After the closing of the transportation door **7**, the container **1** is pumped to a heavy vacuum in advantageous manner by means of a vacuum pump **10**, for instance, a rotary pump, a piston pump, or a steam jet pump while the explosion flap **8** is closed, which is disposed at the entrance of the pump pipe **9** into the gas escape tube **5**. Upon reaching the desired pressure in container **1**, a valve **11** is closed and the explosive is brought to detonation. Upon opening the explosion flap **8** the detonation gases expand and escape partly through the escape tube **5** and the noise silencer **6**. The opening explosion flap **8** closes thereby the pump tube pipe **9**.

After the detonation gases have escaped, the explosion flap **8** falls back into its original position and the valve

11 and the fresh air valve 12 are opened in the escape pipe 5. The remaining poisonous detonation gases are then sucked off through the air filter 13 by means of the vacuum pump 10. Upon termination of this working step, the transportation door 7 is opened again and the explosive treated workpiece is removed from the container 1. Then, the next working cycle starts.

In order to reduce the transmission of the shock waves, the container 1 is, as can be determined from FIG. 2, advantageously disposed on columnar portable frame 14, which is equipped with hydraulic or mechanical resilient and damping operating elements 15.

The expansion and transmission of the shock waves during the detonation of the explosive in the container 1, as well as its effects are, furthermore, very strongly reduced in an advantageous manner such that the concrete foundation 3 mounted in a material 16, preferably sand absorbing the created ground waves and has a weight up to 100 times the weight of the container 1. For damping the ground waves created by the detonation, the concrete foundation is further mounted advantageously on a further concrete plate 17, whereby hydraulic or mechanical spring elements 18 are provided between the concrete foundation 3 and the concrete plate 17. Also the slot grooves provided in the range adjacent the concrete foundation 3, which slot grooves 19 are additionally filled advantageously with material absorbing the ground waves, serve the same purpose.

In order not to transmit the detonation shock outwardly by means of the tube conduits, cable lines and other auxiliray lines, the feed lines and escape lines are connected elastically with the container 1.

In order to obtain an additional noise damping and to warrant a sufficient splinter protection, finally the container 1 with the concrete foundation 3 is surrounded by a wall 20, consisting of bricks, concrete or tiles, which wall is covered at its inside with a layer 21 of sound-damping material and at its outside an embanking 22 of dirt is provided whereby the space defined by the wall 20 is equipped with a transportable roofing 23.

If now, in the container 1, a bracket sheet 25 is applied by means of explosive on a base work material sheet 24, the required explosive 26, as well as suitably used intermediate layer 27, is arranged in an air-tight envelope 28, as clearly shown in FIG. 3, which FIG. 3 shows an elevation in the direction of detonation. The envelope 28 is advantageously fortified by additional webs 29.

In accordance with the method of the present invention the workpiece to be explosively treated for explosive-plating or -hardening is equipped with an explosive charge. The workpiece and the explosive charge together are then completely coated with an air-tight envelope and in this manner inserted into the explosive chamber spaced from the walls of the chamber. The chamber is then evacuated and the charge then detonated.

By the new method, as well as apparatus for performing the method in accordance with the present invention, the shock wave pressure to the container wall created during the detonation of the explosive in the container 1 is appreciably reduced, whereby the durability of the container is tremendously increased. Simultaneously, the sound level caused by the acoustic shock of the detonation is simultaneously appreciably reduced. Furthermore, it is obtained, that vacuum produced in the explosive chamber has no influence on the explosive and its detonation, respectively.

While I have disclosed several embodiments of the present invention, it is to be understood that these embodiments are given by example only and not in a limiting sense, the scope of the present invention being determined by the objects and the claims.

I claim:

1. A method of explosive-plating or -hardening of metals in a safety explosive chamber dampened to noise transmission comprising the steps of

equipping a workpiece to be explosively treated with an explosive charge,

coating the workpiece and the explosive charge together completely with an air-tight envelope,

inserting the coated workpiece and explosive charge into a safety explosive chamber spaced from the walls thereof,

subsequently subjecting said chamber with said coated workpiece and said explosive charge to vacuum, and

igniting said explosive charge.

2. An apparatus for explosive treatment of metals, comprising

a substantially ball-shaped container having a closable door,

a gas escape tube extending from said container and including a noise silencer therein,

an armored concrete foundation supporting said container,

a pipe terminating into said gas escape tube and having in series a valve, a filter and a vacuum pump.

3. The apparatus, as set forth in claim 2, wherein

said container comprises steel nonsensitive against brittleness, and

means for outer heating of said container applied to the latter.

4. The apparatus, as set forth in claim 2, wherein

said container comprises steel enforced concrete, and

means for outer heating of said container applied to the latter.

5. The apparatus, as set forth in claim 2, which includes

an explosive flap disposed at the joining of said pipe with said gas escape tube.

6. The apparatus, as set forth in claim 2, which includes

a column-shaped portable frame supporting said container, and

said portable frame including hydraulic and damping elements.

7. The apparatus, as set forth in claim 2, which includes

a column-shaped portable frame supporting said container, and

said portable frame including mechanical, resilient and damping elements.

8. The apparatus, as set forth in claim 2, wherein

said armored concrete foundation is mounted in a material absorbing bottom waves caused by the detonation, and

said material having a weight up to about 100 times of that of said container.

9. The apparatus, as set forth in claim 8, wherein

said material comprises sand.

10. The apparatus, as set forth in claim 2, which includes

a further concrete plate supporting said concrete foundation, and

hydraulic, resilient elements disposed between said concrete foundation and said concrete plate.

11. The apparatus, as set forth in claim 2, which includes

a further concrete plate supporting said concrete foundation, and

mechanical, resilient elements disposed between said concrete foundation and said concrete plate.

12. The apparatus, as set forth in claim 2, which includes

a slot-runner disposed in the range adjacent to said concrete foundation.

13. The apparatus, as set forth in claim 12, wherein

said slot runner is fitted with a material absorbing the ground waves.

14. The apparatus, as set forth in claim 2, wherein

said gas escape tube extending from and a feeding tube leading to said container, and

said tubes are elastically connected with said container.

15. The apparatus, as set forth in claim 2, which includes

a wall surrounding said container to define a space and having at its inside a layer of sound-damping material and at its outside a layer of dirt, and

said space being equipped with a transportable roof.

16. The apparatus, as set forth in claim 15, wherein said wall comprises bricks.

17. The apparatus, as set forth in claim 15, wherein said wall comprises concrete.

18. The apparatus, as set forth in claim 15, wherein said wall comprises piles.

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U.S. Cl. X.R.

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