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[73] Assignee **The United States of America as represented by the Administrator of the National Aeronautics and Space Administration**

[54] **SHOCK WAVE CONVERGENCE APPARATUS**
5 Claims, 3 Drawing Figs.

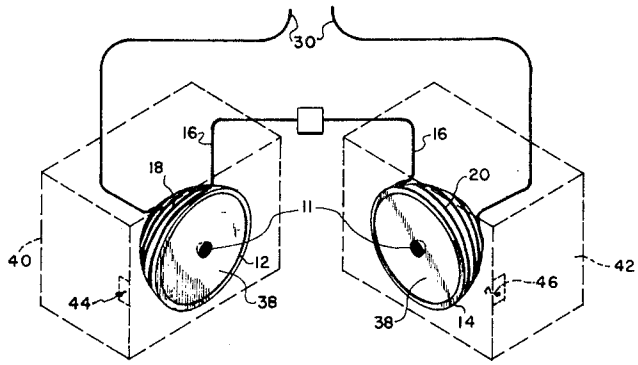
[52] **U.S. Cl.** **310/11,** 29/421, 264/22, 310/42
[51] **Int. Cl.** **H02k 41/00**
[50] **Field of Search** 310/10, 11, 42; 29/421; 264/22, 111

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ABSTRACT: An electrical device developing converging spherical shock waves which are used to treat materials placed inside two hollow dielectric hemispheres which are fastened together. The device can be used to create phase transformation in crystals, to cause chemical reactions between materials, or to create implosive forces which may be used to compact materials or for other purposes. Wire conductors are wound spirally on the outside of the hemispheres. The device uses a high-voltage, high-current power supply to create a sudden surge of current through the conductors. This sets up radially converging spherical shock waves in electrical conducting material filling the hemispheres. These shock waves converge on the material to be treated in the center of the cavity created by the two hollow hemispheres.



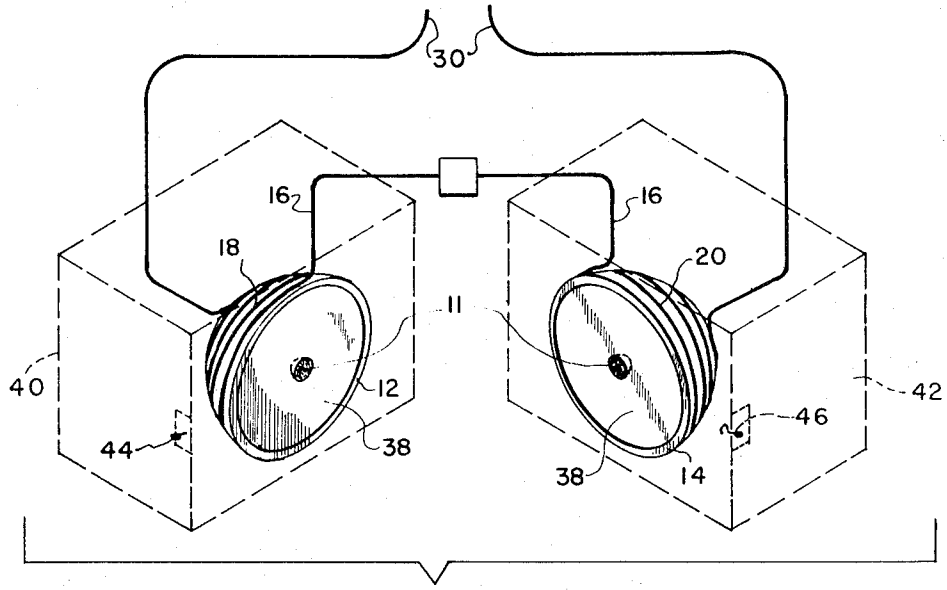


FIG. 2

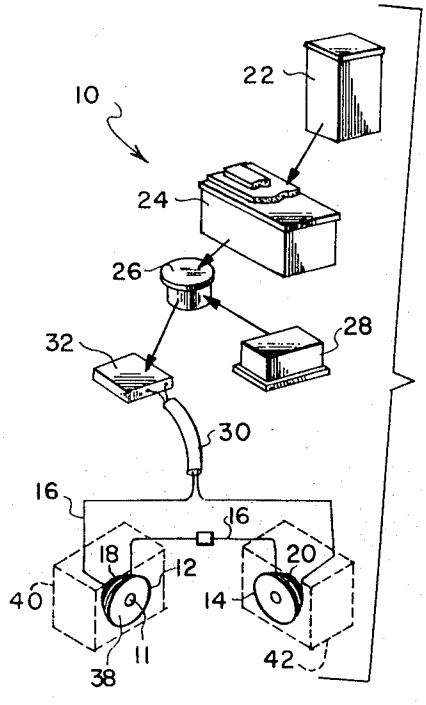


FIG. 1

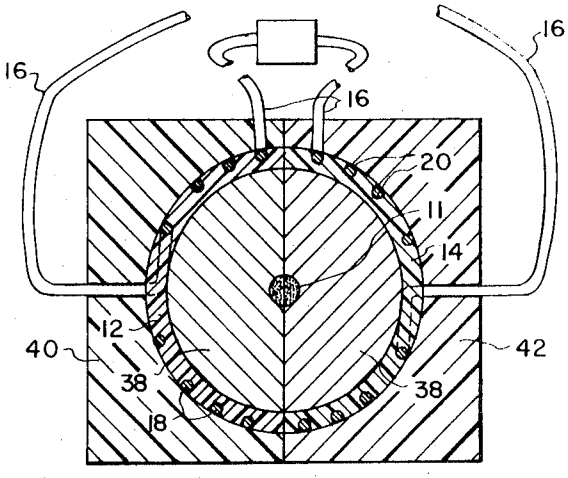


FIG. 3

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SHOCK WAVE CONVERGENCE APPARATUS

ORIGIN OF THE INVENTION

The invention described herein was made by an employee of the United States Government and may be manufactured and used by or for the Government for governmental purposes without the payment of any royalties thereon or therefor.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention relates to a device for processing materials and more particularly to a device for processing materials through the use of converging shock waves.

2. Description of the Prior Art

During the past few years, a number of electrical devices have been developed to perform work on a workpiece or other object. For example, magnetomotive or electromagnetic devices have been developed for the purpose of forming metals. In these devices, a large electrical coil receives a high-energy pulse which causes the powerful magnetic field to be set up around the coil. The strength of this powerful magnetic field strikes a hammerlike blow against the metal workpiece to deform it. Such magnetic hammers or forming coils are now well known in the metal treating art. Various other electromagnetic devices have also been developed to treat or transform a work object.

The above-mentioned devices suffer from limitations in how well they can utilize the forces they generate. The force developed by such coils is generally perpendicular to the coil conductor along the entire length of the coil. However, the inventor of the present invention visualized that, if such forces could be concentrated substantially on a point, rather than being effective along the entire longitudinal axis of a coil, such devices might be changed considerably and made much more efficient. Moreover, an even greater advantage in efficiency could be obtained by an implosion-type device which could concentrate radially converging forces from all directions on a point or small area. This greatly increased efficiency could then be channeled into new and varied modes of treating materials never before made possible or practicable.

SUMMARY OF THE INVENTION

Accordingly, it is an object of this invention to provide an improved device for processing materials.

Another object of this invention is to provide an improved device for treating materials with shock waves.

Still another object of this invention is to provide an improved device for treating materials with shock waves which converge from all directions on an area containing the materials to be treated.

These and other objects are accomplished in the present invention which provides a hollow sphere made up of two or more partial spheres arranged to be fastened together, helical coils connected in series and wound around the partial spheres, at least two blocks of dielectric material surrounding and supporting the partial spheres and the coils, a high-voltage, high-current power supply for pulsing the coils, and an electrical conductor material substantially filling the hollow cavity provided within the partial spheres when they are fastened together.

BRIEF DESCRIPTION OF THE DRAWING

The invention will be more fully understood by the following detailed description when taken together with the accompanying drawings in which:

FIG. 1 is a flow diagram showing the components of an illustrative embodiment of the invention.

FIG. 2 is a pictorial diagram of part of the invention shown in FIG. 1 disclosing details of the major parts of the device.

FIG. 3 is a sectional side view of the invention showing details of the helical coils.

DESCRIPTION OF THE PREFERRED EMBODIMENT

With continued reference to the accompanying FIGS. and with initial attention directed to FIG. 1, reference numeral 10 generally designates an illustrative embodiment of the invention used for treating materials 11 placed inside two hollow hemispheres 12 and 14. As may be seen best in FIG. 2, hemispheres 12 and 14 are wound with an electrical conductor 16 forming helical coil 18 on hemisphere 12 and helical coil 20 on hemisphere 14. A high-voltage, high-current power supply is provided for supplying and controlling pulses of electrical energy so as to produce a varying magnetic field of high intensity about helical coils 18 and 20. This power supply includes a high voltage source 22 for charging a bank of capacitors 24. Connected to the capacitor bank 24 is a switching means 26, such as an ignitron. The switching means 26 is operated by a trigger 28. The electrical energy system just described, which has a maximum energy capability of about 200 kilojoules, is connected to coils 18 and 20 by transmission lines 30, preferably coaxial cables, which enter the electrical energy system through a connector box 32.

Looking again at FIG. 2, the detailed arrangement of the invention shown in FIG. 1 may be seen, without the power supply. Hollow hemispheres 12 and 14 are made of a dielectric material having considerable strength, such as, for example, an epoxy type plastic. Hemispheres 12 and 14 are designed to be fastened together in a manner to be described below, as to form a completely enclosed spherical container, which may contain the materials to be treated 11. Hemispheres 12 and 14 are substantially filled with a material 38 which is a solid or liquid electrical conductor. A suitable liquid material might be mercury; a suitable solid material might be Wood's metal or Rose metal, both of which are well known to those skilled in the metallurgical arts. The material to be treated 11 is located at the center of the hollow spaced between the hemispheres and is completely surrounded by the electrically conducting material 38. It should be understood that if conducting material 38 is a solid material, a small hollowed out area may be left at the center of the hemispheres 12 and 14 to hold the material to be treated 11. On the other hand, if material 38 is a liquid, then suitable supports (not shown) must be provided to hold material to be treated 11 in its proper position at the center of the hemispheres 12 and 14.

Each of the hemispheres 12 and 14 and its corresponding helical coil (18 or 20, respectively) is surrounded and supported by a solid block of dielectric material, such as an epoxy type plastic. Dielectric block 40 supports hemispheres 12 and coil 18 while dielectric block 42 supports hemisphere 14 and coil 20. Because of the great forces imposed upon the device 10 by the magnetic field generated when coils 18 and 20 are pulsed, it is necessary to firmly fasten together dielectric blocks 40 and 42 during use of the device. To this end, dielectric blocks 40 and 42 are located together with a plurality of pairs of cooperating latching elements 44 (on dielectric block 40) and 46 (on dielectric block 42).

Looking now at FIG. 3, the hemispheres 12 and 14 are shown completely closed as they would be if dielectric blocks 40 and 42 are securely latched together. The material to be treated 11 is completely enclosed in electrically conducting material 38 which in turn is completely enclosed by hemispheres 12 and 14. Dielectric blocks 40 and 42 completely enclose and support helical coils 18 and 20 and hemispheres 12 and 14. In FIG. 3, coils 18 and 20 are shown wound in deep grooves in the outer surface of hemispheres 12 and 14 so that the conductors are substantially flush with the outside surface of hemispheres 12 and 14. Although this is the preferred arrangement, it should be understood that conductors 16 may lie in shallower grooves or may even be wound on the outer surface of hemispheres 12 and 14.

In the operation of the device, a piece of material to be treated 11 is placed at the center of the hollow hemispheres 12 and 14, so that it is surrounded by electrical conductor material 38. The hemispheres are then held securely together because dielectric blocks 40 and 42 are latched together using

a plurality of latching elements 44 and 46. A fast-rising current pulse is then delivered to helical coils 18 and 20 by the power supply shown in FIG. 1. This causes a powerful magnetic field to build up suddenly around the hemispheres 12 and 14. This in turn generates powerful shock waves which converge radially upon the material to be treated 11, at the center of the hemispheres 12 and 14. The spherical geometry of the device makes possible an implosion effect which amplifies and concentrates the shock waves so that substantially all of the released energy is brought to bear simultaneously on material 11. Thus, materials to be treated 11 undergo treatment or transformation as previously described.

From the foregoing it may be seen that applicant has invented a novel device for generating radially converging shock waves for treating materials under conditions of extreme heat and pressure. It is understood that the device may have a wide variety of uses including the preparation of crystals, making of superconductor materials, implosion devices, and the propulsion of hypervelocity particles. It should also be understood that hemispheres 12 and 14 and dielectric blocks 40 and 42 may be made of several known dielectric materials having the proper characteristics of strength and flexibility. Electrical conductor material 38 may also consist of several known materials in addition to those mentioned above.

What is claimed is:

1. An electrical shock wave convergence apparatus comprising:

a plurality of hollow partial spherical sections composed of dielectric material;

a plurality of helical coils, said coils being connected in series, each said coil being wound around one of said spherical sections;

a plurality of blocks of dielectric material, said blocks being arranged to be fastened together to completely enclose said spherical sections and said helical coils and to hold said spherical sections firmly together, so as to form a hollow sphere;

a high-voltage, high-current power supply connected to said coils, for delivering high energy pulses to said coils;

electrical conductor material for substantially filling the hollow center of said sphere, said electrical conductor material being arranged so as to leave a small open space at the center of said conductor material to receive a material to be treated.

2. The electrical shock wave convergence apparatus of claim 1 wherein said apparatus comprises two hemispheres, each aid hemisphere having one said helical coil wound around it.

3. The electrical shock wave apparatus of claim 2 wherein said device comprises two blocks made of dielectric material, each said block enclosing and supporting one of said hemispheres and one of said coils.

4. The electrical shock wave convergence apparatus of claim 3 wherein said electrical conductor material is a solid.

5. The electrical shock wave convergence apparatus of claim 3 wherein said electrical conductor material is a liquid.

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