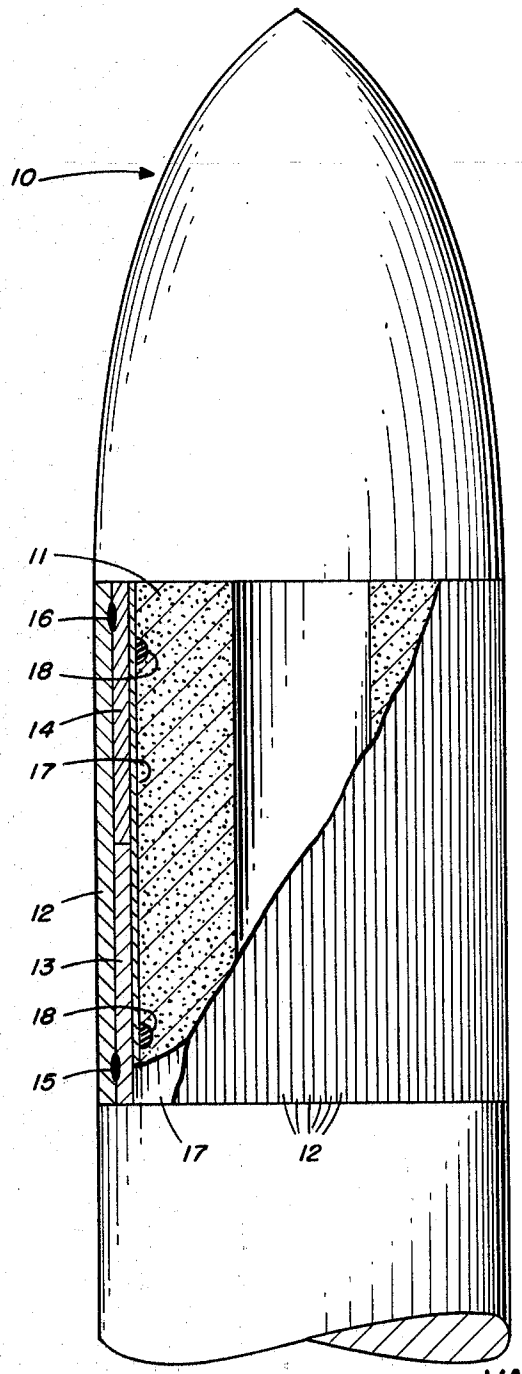
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CONTINUOUS ROD WARHEAD

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CONTINUOUS ROD WARHEAD

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

This invention relates generally to continuous rod warheads, and more particularly to means for preventing premature failure of the rods in the vicinity of the welded hinge joints between the rod pairs.

The construction and operation of continuous rod warheads are explained in detail in United States Patent No. 3,160,099 of the common assignee. The warhead is disposed around the entire exterior periphery of a high explosive charge, and consists of a plurality of rods of generally rectangular cross-section which are substantially aligned with the longitudinal axis of the warhead. Alternate opposite ends of the rods are rigidly connected by a welded joint or "hinge," so that the warhead will be propelled outwardly as a single expanding ring when the explosive charge is detonated.

Continuous rod warheads are subjected to very severe conditions during and immediately after the detonation of the explosive charge. Explosive pressures resulting from the detonation of the charge will reach several million p.s.i. These pressures may be applied to the rods of the projectile at loading rates of up to 25,000 feet per second. As a result of the explosion, the continuous rod warhead will be blasted outwardly as an expanding ring at a velocity of several thousand feet per second. Following detonation of the charge, the expanding rods unfold and the maximum bending and torsional stresses are encountered in the hinge joint zone. Furthermore, the shock wave resulting from the explosion tends to explosively harden the steel rods.

The effectiveness of these warheads is largely dependent upon the continuity of the ring. If the ring breaks prematurely, the possibility that the target will escape undamaged is greatly increased. Hence it is seen that it is essential that the structural integrity of the hinge joint between each pair of rods be maintained until the ring has fully expanded. The combination of the explosive hardening at the hinge joint and the concentration of high stress and strain which occur there results in a tendency for premature failure in the joint zone. The effectiveness of the warhead is therefore greatly reduced.

Accordingly, it is the principal object of this invention to increase the reliability and effectiveness of a continuous rod warhead.

It is a further object of this invention to reduce the likelihood of premature failure of the hinge joints of a continuous rod warhead, without the addition of any substantial weight or space penalty.

Other objects, advantages and novel features of the invention will become apparent from the following detailed description of the invention when considered in conjunction with the accompanying drawing wherein the figure is a partially broken away elevation of the continuous rod warhead projectile of this invention.

The continuous rod warhead **10** illustrated in the figure has a conventional rod configuration. The rods are arranged in inner and outer layers about the entire outer periphery of a high explosive charge **11**. The rods of the outer layer are disposed at a slight angle to those of the inner layer, so that the respective ends of each

rod will not overlap the same rod of the adjacent layer. Rod **12** represents a single rod of the outer rod layer, while rods **13** and **14** each lie in the inner layer of rods. Rod **12** is welded at **15** to rod **13** at one end, and is welded at **16** to rod **14** at its other end. Only a portion of the lengths of the inner rods **13** and **14** appears in the figure, due to the slight angle between these rods and the rods of the outer layer.

As is illustrated in detail in the United States Patent No. 3,160,099, the detonation of charge **11** initiates a radial expansion of the continuous rod assembly. As the rod assembly expands, each of the welded joints acts as a hinge, enabling each pair of welded rods to expand as an ever-widening V.

The effectiveness of a continuous rod warhead is largely dependent upon the continuity of the expanding ring. Obviously, if the ring should break at one or more points during the early stages of unfolding, gaps would result in the expanding ring. A target, though originally in the path of the warhead, might escape without being struck by the expanding ring. It is therefore highly desirable to maintain the continuity of the ring until each joint has completely unfolded, so that the ring diameter may be maximized and the chance that the target will escape be minimized.

The degree to which the continuity of the expanding ring is maintained is influenced by several interrelated factors, one of the most important of which is the design of the hinge joint zone between each pair of rods. The effectiveness of the joint is dependent upon at least three factors: the geometry of the joint, the relative motion of the rods as the joint opens during expansion, and the physical properties of the rod material itself.

It is desirable that the region of the rods adjacent the weld zone remain relatively ductile since excessive hardness would contribute to premature failure of the joint. As is well known, the very great pressure impulse which occurs upon detonation of the charge **11** induces a considerable hardening of the rod material resulting from refinement and twinning of the grain structure. The increase in hardness would be accompanied by an increase in the brittleness of the rod material. Filter **17**, which may be made of steel, completely encloses the annular explosive charge **11**. Filter **17** has several purposes. It functions to partially shield the rod layers from the hardening effect of the explosive detonation. Filter **17** also provides a cavity wall surface which is more uniform than that of the rods, and thereby permits more uniform explosive loading. It further functions to contain the explosive charge **11** during fabrication of the warhead so that no explosive grains can migrate into the spaces between the individual rods and rod layers.

Additional shielding of the hinge zones from the explosive wave is accomplished by rings **18**. These rings, shown in section in the figure, are located approximately abreast of the hinge zones **15** and **16** and pass completely around the inner periphery of filter **17**. As illustrated in the figure, rings **18** are placed slightly intermediate the welds **15** and **16**. However, it is to be understood that these rings may be placed anywhere in the region of the weld which would provide the maximum insulation from the explosive wave. The precise location would depend upon the geometry of the charge **11**, the rod cross-sections, and sequence of detonation initiation along the length of the charge.

In order to achieve maximum shielding of the weld zones, it is contemplated that rings **18** be fabricated of a material having a high sound absorption characteristic. Rubber, cork, or wood are examples of materials having this desired property. The cross-sectional size of rings **18** may be up to one-half inch thick and up to four inches

wide. The exact dimensions and geometry of the rings would also depend on the rod and explosive geometries.

Although the instant invention has been illustrated and described as embodied in a warhead having a double layer of rods, it is to be understood that it would perform in the same manner and with equal success in single or multiple rod layer installations.

The provision of the novel rings of this invention insures that the rods will possess more uniform hardness and strength along their length. By avoiding excessive hardness in the joint zone, the joint and rods may strain over a greater length and premature failure of the expanding ring is thereby avoided.

Obviously many modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described.

What is claimed is:

1. In a continuous rod warhead ordnance device comprising

an explosive charge, a plurality of rods substantially aligned with the longitudinal axis of the device, an annular filter disposed between the charge and the rods for partially shielding the rods from the hardening effect of the explosive detonation, the rods being disposed around the periphery of the warhead, the ends of each of the rods being rigidly connected, respectively, to the ends of an adjacent rod, the improvement which comprises

means concentrically disposed between said charge and said filter in the region of said rigid connections, said means comprising a pair of rings with one ring being in the region of each of said rigid connections, said means being so constructed as to provide a high degree of sound absorption;

whereby said means acts to additionally shield said rigid connections from the hardening effect of the explosive detonation by locally absorbing the shock wave generated by the detonation of said charge.

2. The device of claim 1 wherein the rigid connection between the rods comprises a welded joint.

3. In a continuous rod warhead ordnance device comprising

an explosive charge, a plurality of rods substantially aligned with the longitudinal axis of the device, an annular filter disposed between the charge and the rods for partially shielding the rods from the hardening effect of the explosive detonation, the rods being disposed around the periphery of the warhead in a plurality of layers, the respective ends of each of the rods of one layer being rigidly connected to the corresponding ends of respective ones of the rods of another layer, the improvement which comprises

means concentrically disposed between said charge and said filter in the region of said rigid connections, said means comprising a pair of rings with one ring being in the region of each of said rigid connections, said means being so constructed as to provide a high degree of sound absorption;

whereby said means acts to additionally shield said rigid connections from the hardening effect of the explosive detonation by locally absorbing the shock wave generated by the detonation of said charge.

4. The device as described in claim 3 wherein the rigid connection between the rods comprises a welded joint.

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