April 28, 1942. H. V. THADEN 2,281,213

BOMB AND METHOD OF MAKING SAME

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FIG. 1.

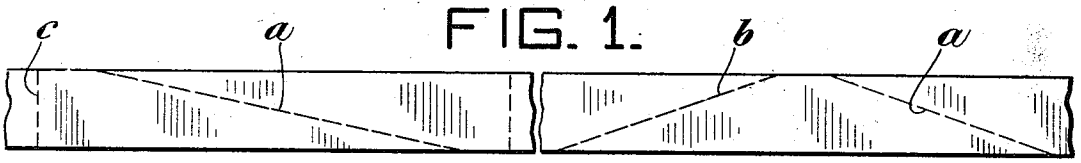


FIG. 6.



FIG. 2.

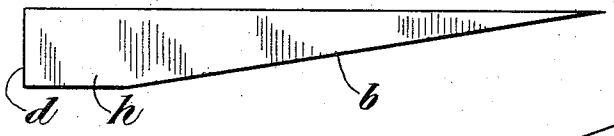


FIG. 3.

FIG. 4.

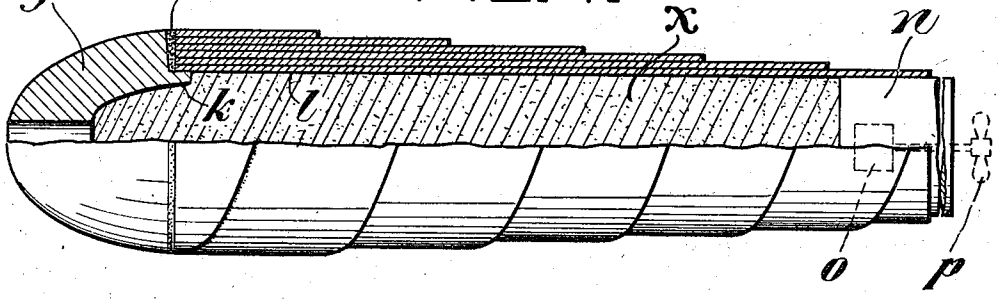
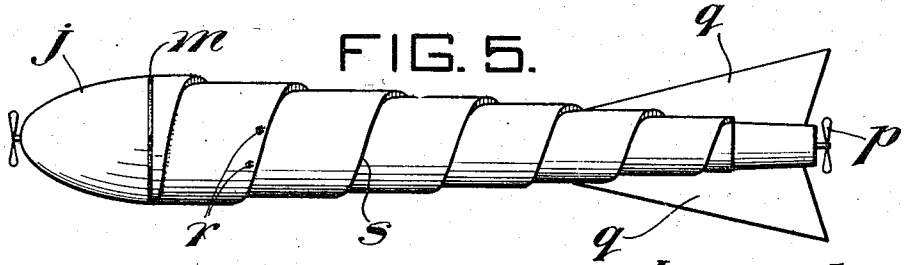


FIG. 5.



Inventor:
HERBERT V. THADEN,
by: John E. Jackson
his Attorney.

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FIG. 7.

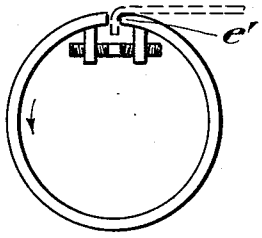


FIG. 8.

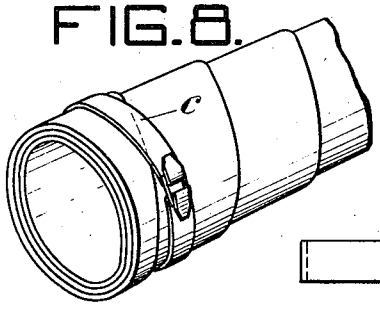


FIG. 9.

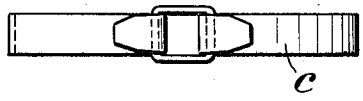


FIG. 10.

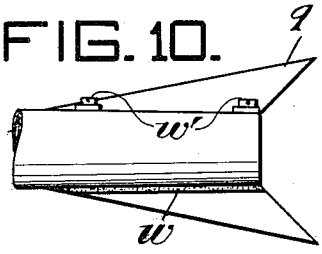


FIG. 11.

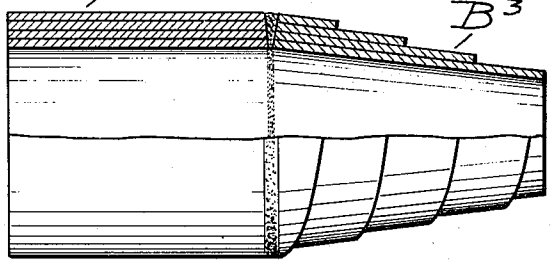


FIG. 12.

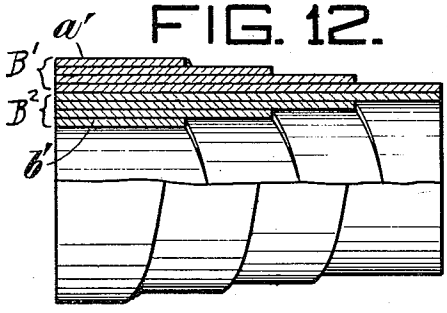


FIG. 13.

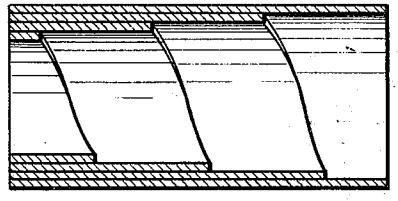


FIG. 14.

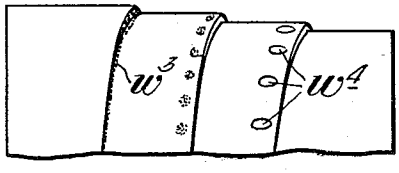


FIG. 15.

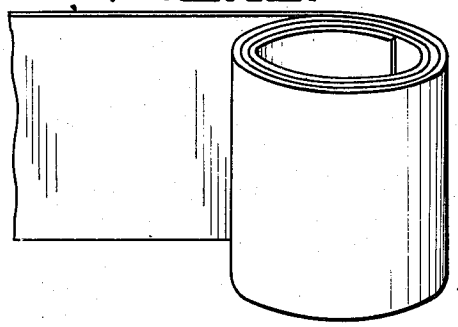
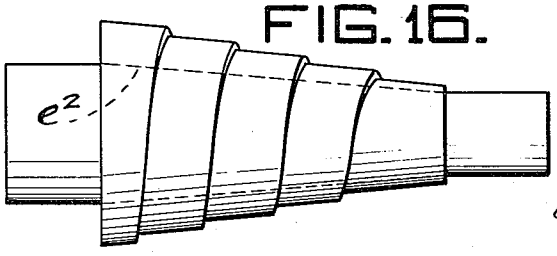


FIG. 16.



Inventor:
HERBERT V. THADEN,
by: John E. Jackson
his Attorney.

Patented Apr. 28, 1942

2,281,213

UNITED STATES PATENT OFFICE

2,281,213

BOMB AND METHOD OF MAKING SAME

Herbert V. Thaden, Mount Lebanon, Pa.

Application December 23, 1938, Serial No. 247,523

16 Claims. (Cl. 29—1.21)

This invention relates to improvements in a method of manufacturing shells, aerial bombs or the like and to the improved product resulting from the practice of the method.

One object of the invention is to provide an improved bomb and method of making the same whereby the bomb will have a laminated body of sufficient strength to withstand the forces of impact with a hard surface target through which the bomb is required to penetrate before the usual delayed action fuse becomes operative.

Another object is to provide an improved method for making a bomb capable of penetrating an extremely hard surface without breaking up when dropped from an altitude sufficiently high to allow penetration of the maximum diameter of the bomb through a mass of concrete of substantial thickness lying on a bed of crushed rock or the like.

Other objects are to provide a method of low cost of bomb manufacture and to improve ballistics and aerodynamics.

In some bombs heretofore made, the sudden deceleration involved in the bomb striking and penetrating a mass of concrete or similar hard substance causes the powder in the bomb to set up forces which act analogous to a liquid of very high density and to consequently exert an enormous pressure which acts radially on the shell. Such pressure varies approximately uniformly from zero at the tail of the bomb to a maximum at the head thereof.

In bombs of conventional types, failures frequently develop hoop-like tension cracks in the shell, tearing of the longitudinal butt welds of the shell or plastic deformation of the shell producing an outward bump near the head of the bomb in the unpenetrated portion thereof which is exterior to the plane of the hard surface of the target.

The present invention aims to produce a method and a resulting bomb which will overcome the suggested shortcomings of the prior conventional practice. For a full disclosure of the invention, reference should be made to the following detail description, the accompanying drawings and the appended claims.

Referring to the drawings:

Figure 1 is a plan view of a strip of metal stock which is provided as one of the initial steps in my improved method of producing a bomb;

Figure 2 is a view of a blank or a portion severed from the strip of Figure 1;

Figure 3 is a view of a rotary mandrel in the act of winding a blank such as shown in Figure 2, and illustrates a further step in the method;

Figure 4 is a side elevation of the completed bomb made in accordance with the present invention, with parts shown in section in the interest of clearness; and

Figure 5 is an elevation of the improved bomb of my invention made in accordance with the novel method; and

Figure 6 illustrates a variation in the shape of the blank which will be used to produce a bomb wherein the tapered edge may be arcuate instead of straight.

Figure 7 is a detail cross sectional view of a mandrel showing a clamp to grasp the end of a strip to be wound;

Figure 8 is a perspective view of a strip wound on the mandrel and illustrating a temporary clamp for holding the strip so as to prevent the same from uncoiling prior to its convolutions being welded or otherwise secured;

Figure 9 is a detail view of the temporary clamp shown in Figure 8;

Figure 10 is a fragmentary detail view illustrating means of uniting the fins to the body of the bomb;

Figure 11 is a view partly in section and partly in elevation of a modified type of bomb;

Figure 12 is a view partly in section and partly in elevation showing a bomb constructed of two axially aligned coiled body portions;

Figure 13 is a view in longitudinal section illustrating an alternative embodiment of the invention;

Figure 14 is an elevation of a portion of a bomb illustrating the manner of welding or otherwise securing adjacent convolutions thereof to one another;

Figure 15 is a perspective view of a portion of a bomb during the coiling thereof; and

Figure 16 is a detail view showing a tapered mandrel and a portion of a bomb in the act of being coiled thereon.

Referring in detail first to the method of manufacture, an elongated strip of either ferrous or non-ferrous metal is provided. This is severed along the oppositely inclined diagonal lines *a* and *b* and also along the line *c* which is perpendicular to the parallel side edges of the strip. The results of the cutting operations performed on the strip along the lines such as *a* and *c* will produce a metal blank such as shown in Figure 2. In the manufacture of a large order of bombs of the same size, all of the blanks will be duplicates and it will be apparent from the manner of cut-

ting described that there will be no waste of material. This blank when convoluted will provide a body portion shown in Figures 4 and 13. If the strip is cut on the lines *a* and *b*, this resultant blank when convoluted produces a body portion shown in Figure 12.

The next step in the method of manufacture is to tightly wrap the blank, such as shown in Figure 2, in a spiral-like manner. This is conveniently accomplished by engaging the wide end *d* of the blank as shown in Figure 2 with a suitable clamp *e'* on a mandrel *e* of a winding machine such as shown at *e'* in Figure 7, whereupon the blank is coiled in a manner suggested in Figure 3. During the winding or coiling of the strip, back tension is applied to the trailing end thereof by any suitable means. In the embodiment illustrated, a spring tensioning means at *f* acts in the direction of the arrows, which is contrary to the tension imposed on the blank by the winding operation. Usually the mandrel *e* will be of a collapsible type and the mandrel gear *g* will be powered by any known type of driving mechanism.

Upon completion of the winding or coiling operation, a clamp such as shown at *c* in Figures 8 and 9 will generally be applied to the last convolution to prevent the inherent tendency of the convolution to separate or, alternatively, during the process of coiling the successive convolutions may be spot-welded at convenient intervals, as indicated by the spot-welds indicated at *r* in Figure 5.

During the winding or coiling operation of the blank, care will be taken that the square edge portion *h* of successive convolutions is maintained in alignment so that the end surface of the structure resulting from the winding will be substantially perpendicular to the longitudinal axis of the mandrel and, therefore, perpendicular to the longitudinal axis of the laminated structure formed by the coiling operation.

Upon completion of the coiling operation the mandrel may be collapsed and the laminated coiled body produced will be removed therefrom. The next step is to assemble on the perpendicular end of the fabricated body a piercing head *j* which has previously been formed of cast or wrought metal. This piercing head will have a contour to give it good penetrating and piercing characteristics. The piercing head will usually have an inwardly extending portion *k* which will make a snug fit with the substantially cylindrical inner surface *l* of the laminated body. The piercing head *j*, after assembly with the laminated coiled body, will preferably be homogeneously united with the same by means of a body of weld metal *m*. This welded joint may be made by electric welding, arc welding or any other conventional method of joining metals.

Any conventional explosive such as shown by hatching *x* in Figure 4 may be loaded within the interior of the shell body. I have illustrated somewhat conventionally a tail body closure *n* enclosing a suitable fuse *o* which is adapted to be fired by a conventional form of air operated spinner *p* which is effective by a screw action after the bomb has traversed a predetermined distance to actuate the fuse. As shown in Figures 5 and 10, a plurality of fins *q* will be welded as at *w* in Figure 10 or bolted as at *w'* to the laminated coiled body of the bomb, these fins being of conventional form and serving the usual function.

After assembly of the laminated coiled body, in some cases a plurality of spot welds will be made, as indicated at *r*. Alternatively, seam welds or riveted joints may be made along the approximately helical line where the rear edge *s* of an upper convolution intersects the surface of the next adjacent lower convolution; that is, along the line *s* of Figure 5. Such seam welds are shown at w^3 in Figure 14, and a riveted joint is shown at w^4 in the same figure.

The bomb resulting from the practice of the novel method, it is clear, will have a laminated body composed of a plurality of overlapping convolutions, and because of the tapering form of the blank shown in Figure 2, from which the body is built up, the same will have an approximately streamline form as viewed in side elevation. As otherwise expressed, the thickest portion of the body will be in the zone of the piercing head and the thinnest portion will be in the zone of the tail. Figure 4 illustrates such a structure. The structure will have the maximum cross section of metal adjacent the piercing head where the greatest strength is required and the section will vary toward the tail, where a lesser wall thickness is satisfactory. This construction, such as shown in Figure 4, has the advantage over prior constructions in that it results in a more forward position of the center of gravity of the shell weight and a minimum shell weight for a given size and type of shell. The wall thickness may thus be made to exactly suit strength requirements. Moreover, the laminated body is advantageous from a standpoint of economy as it enables the production of a shell from readily produceable sheet or strip material. Also the use of longitudinal seams, which are objectionable, is avoided. Only one continuous encircling helical seam is present and that is true because of the peculiar method of constructing the shell body. The seam follows a line which progresses at a constant rate from head to tail of the bomb. Therefore, any forces tending to rupture the seam are distributed over a great length of seam; hence no one seam portion becomes overstressed. While I have specifically described the method of producing a tapered or streamline type of bomb by the utilization of a blank having converging edges such as shown in Figure 2, it is to be understood that in some cases a shell with a laminated cylindrical wall may be made merely by coiling a long flat strip with parallel sides, such as shown in Figure 15.

In the bomb body illustrated in Figure 4, the interior and exterior surfaces of the various convolutions conform substantially to surfaces of cylinders having been wound on a substantially cylindrical mandrel.

In some cases, as illustrated in Figure 16, I contemplate winding the strip on a tapered mandrel *e'* so that the surfaces of the convolutions will correspond to surfaces of a long tapering cone. When making such a tapered or cone-like laminated body, I will use a slightly modified form of blank such as illustrated in Figure 6. The end of the blank will be cut off at a suitable angle, as indicated at d^1 and the blank will be plotted by the use of certain elemental lines d^2 and the edges d^3 and d^4 will follow properly plotted curves to suit the tapered body to be made.

Instead of coiling the shell body from the blank of the shape of Figure 2, I may start with either a triangulated blank or, for example, with a trapezoidal blank. Such a trapezoidal blank would be formed by severing the strip of Figure 1 along the oppositely inclined lines *a* and *b* at

the right of the figure. The laminated body so produced would in longitudinal section taper both interiorly and exteriorly, as shown in Figure 12.

In some cases the bomb body as a whole may be built up of a plurality of convoluted laminated units B^1 and B^2 aligned axially and welded or otherwise secured to one another in axial alignment, as illustrated in Fig. 12 alternatively, two laminated bodies of the kind shown in Figure 4 might be joined together end to end in much the same manner as the piercing head is joined to the laminated body or, alternatively, a convoluted laminated tapering body B^3 such as shown in Figure 11 might be aligned end to end with and secured intimately to a convoluted laminated body B^4 having a substantially cylindrical exterior. Such a unit with a substantially cylindrical exterior is securable by winding a blank such as illustrated in Figure 2 by starting the winding operation from the pointed end; that is, from the reverse end to that illustrated in Figure 3. In this connection it is noted that when the winding operation is performed, as suggested in Figure 3, the interior chamber of the bomb body corresponds to a substantially true cylindrical surface, while the exterior is of a tapered or streamline form, as is clearly shown by the sectioned upper portion of the laminated body in Figure 4. When starting the winding operation from the pointed end of the blank of Figure 2, the resulting convoluted laminated body will have a substantially cylindrical exterior and a tapering interior. Thus it will be appreciated that by joining the differently wound convoluted bodies B^1 and B^2 nested axially, as shown in Figure 12, suitable variations as to overall interior or exterior longitudinal sectional contour of the bomb as a whole is attainable.

While I have described quite specifically the method followed in producing the type of bomb or shell illustrated, it is not to be construed that I am limited thereto and the description matter and drawings are to be interpreted in an illustrative rather than a limiting sense.

I claim:

1. In the manufacture of bombs, the method which comprises coiling an elongated metal strip so as to form a laminated hollow body, fastening certain convolutions to one another as the coiling proceeds so as to negative their tendency to uncoil, and securing a piercing head to one end of said body.

2. In the manufacture of bombs, the method which comprises providing an elongated strip of sheet metal, tapering in width from one end toward the other, coiling said strip into the form of a laminated hollow body, securing to one another certain of the laminations thus produced as the coiling proceeds, and applying a piercing head to one end of said body.

3. In the manufacture of bombs, the method which comprises coiling an elongated metal strip while applying a back tension thereto so as to insure tight engagement between adjacent convolutions of the laminated body thus produced, and securing a piercing head to one end of the laminated hollow body thus formed.

4. In the manufacture of bombs, the method which comprises coiling an elongated metal strip while applying a back tension thereto so as to insure tight engagement between adjacent convolutions of the laminated body thus produced, spot welding certain of the convolutions to one another so as to prevent the uncoiling thereof, and securing a piercing head to one end of the laminated hollow body thus formed.

5. In the manufacture of bombs, the method which comprises providing an elongated strip of sheet metal having parallel edges throughout the major portion of its length and tapered in width for the remaining portion of its length, coiling said strip into the form of a laminated hollow body, maintaining the laminations in coiled juxtaposition, permanently fastening adjacent laminations to one another, and assembling a piercing head therewith.

6. In the manufacture of bombs, the method which comprises providing an elongated strip of sheet metal tapered in width from one end toward the other, coiling said strip into the form of a laminated hollow body, sequentially welding the laminations in coiled juxtaposition, assembling a piercing head therewith, and homogeneously uniting the metal of the piercing head with that of one end of said body.

7. In the manufacture of bombs, the method which comprises providing an elongated metal strip whose forward end is relatively wide and which tapers toward its rear end, coiling said strip about a collapsible mandrel, restraining the laminated body thus formed so as to prevent its inherent tendency to expand, collapsing the mandrel and removing the laminated body therefrom, and securing a piercing head to one end thereof.

8. A bomb of the character described having a piercing head united to a hollow laminated metal body comprising a plurality of convolutions attached to one another along the helical zone where they overlap.

9. A bomb of the character described including a hollow body portion comprising a continuous metal strip convoluted into a succession of overlapping laminations, a helical seam of weld metal for preventing separation of such laminations, a piercing head secured to one end of said body, and a fuse containing structure secured to the opposite end thereof.

10. In the manufacture of bombs, the method which comprises coiling an elongated metal strip so as to form a laminated, hollow body, sequentially securing certain convolutions to one another so as to negative their tendency to uncoil, securing a piercing head to one end of said body and securing a tail body to the other end.

11. In the manufacture of bombs, the method which comprises coiling an elongated metal strip so as to form a laminated hollow body, sequentially securing certain convolutions to one another so as to negative their tendency to uncoil, welding a piercing head to one end of said body and securing fins to the other end.

12. In the manufacture of bombs, the method which comprises providing an elongated strip of sheet metal of substantially triangular form, coiling said strip so as to form a laminated hollow body, attaching certain convolutions thereof to one another by means of a helical seam weld so as to negative their tendency to uncoil, and securing a piercing head to said body.

13. A body portion of a bomb of the character described formed of a plurality of units aligned axially and secured to one another, each body unit comprising a continuous metal strip convoluted into a succession of overlapping laminations, and a helical seam of weld metal preventing separation of such laminations.

14. A bomb of the character described having a piercing head united to a laminated hollow

body, said body comprising a continuous convoluted metal strip with overlapping portions, the union of said head to said body providing the means for holding said laminations in close overlapped relation.

15. In the manufacture of bombs, the method which comprises providing an elongated strip of sheet metal having parallel edges throughout the major portion of its length and tapered in width for the remaining portion of its length, having one end edge substantially perpendicular to a side edge, coiling said strip into the form of a laminated hollow body, maintaining the laminations in coiled juxtaposition by a helically progressing seam of weld metal, and joining a metallic piercing head thereto by a body of weld metal which unites with the metal of said side edge of the strip.

16. A bomb of the character described including a hollow body portion consisting of a continuous metal strip convoluted and having portions so disposed that they provide varying degrees of overlap, and a metal piercing head secured to said body.

HERBERT V. THADEN.