Nov. 25, 1941. G. H. JACOBS ET AL 2,264,266

AMMUNITION

Filed June 12, 1940

Fig. 1

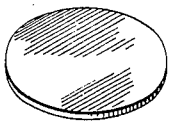


Fig. 2

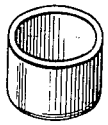


Fig. 3



Fig. 4

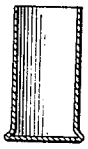


Fig. 5

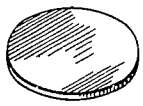


Fig. 6



Fig. 7

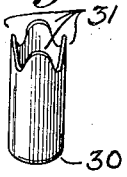


Fig. 8



Fig. 9

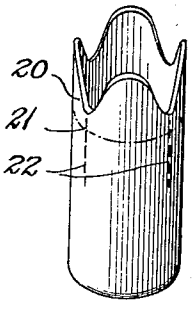


Fig. 10

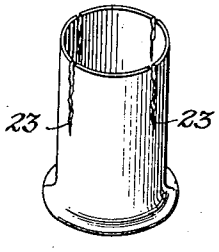


Fig. 11

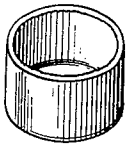


Fig. 12

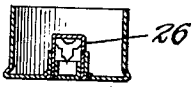


Fig. 13

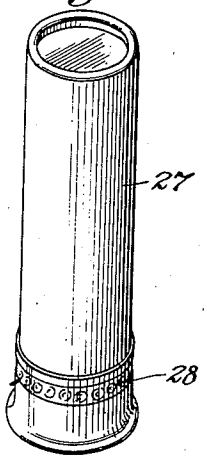


Fig. 14

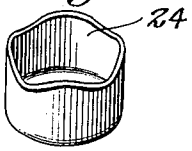


Fig. 15

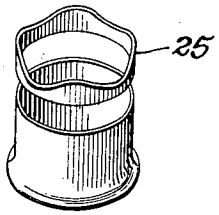


Fig. 18

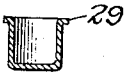


Fig. 16

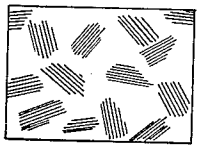
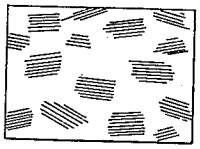


Fig. 17



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UNITED STATES PATENT OFFICE

2,264,266

AMMUNITION

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Application June 12, 1940, Serial No. 340,074

3 Claims. (Cl. 148—12)

This invention relates to the manufacture of ammunition components from steel. Brass and gilding metal have long been the commonly used components for ammunition, particularly the cases, because they satisfactorily meet the requirements of ammunition components in regard to shape, strength and corrosion resistance. These metals, however, have many disadvantages and among them may be enumerated cost and the tendency to react and cause the primers and/or powder contained therein to become unstable. Brass also has the tendency to season crack. In the use of metal for cartridge cases, it has been found that the metal must have certain properties so that it will not split in the chamber of the gun when it is fired and will extract with ease therefrom. Brass and gilding metal in general have these properties, but in order for a steel to be successful, it must have certain characteristics in order to give the desired results.

In the description following, the use of steel is shown as applied to a cartridge case and also for other of the ammunition components, such as, for example, shotshell heads and battery cups. It is to be understood, however, that it is applicable to ammunition components generally, including small arms center fire and rimfire cases, shotshell heads, and larger caliber ammunition cases. The other objects of the invention will appear from the following description and illustrations which are not intended to limit the invention to the forms shown and described.

In the drawing:

Fig. 1 is a perspective view of a disc of steel.

Fig. 2 is a perspective view of a cup, which may be formed from the disc of steel of Fig. 1 or directly from a strip of steel.

Fig. 3 is a perspective view of the cup of Fig. 2 after it has had a further drawing operation performed thereon.

Fig. 4 is a cross-sectional view of a rimfire cartridge which may be made from the steel of Fig. 3 by further processing.

Fig. 5 is a perspective view of a disc of steel which may be of the scalloping type.

Fig. 6 is a perspective view of a cup formed from the disc of Fig. 5, showing the beginning of the scalloping of the edge of the cup as it is formed into the cup.

Fig. 7 is a perspective view of the cup of Fig. 6 after it has had a further cold-shaping operation performed thereon, showing the increase of the scalloping.

Fig. 8 is a perspective view of the completed rimfire case, showing the scalloped portion separated therefrom during processing.

Fig. 9 is an enlarged view of the cup of Fig. 7, showing the scallops and the lines of weakness or potential failure.

Fig. 10 is a perspective view of a fired rimfire shell made from the cup of Fig. 9, showing the splits that occur on these lines of weakness, or lines of potential failure.

Fig. 11 is a cup which may be formed similar to Fig. 2.

Fig. 12 is a cross sectional view of a completed shotshell head formed from the cup of Fig. 11.

Fig. 13 is a perspective view of a complete shot shell.

Fig. 14 is a perspective view of a cup made from the steel of Fig. 5, showing the scalloping.

Fig. 15 is the completed shotshell head with the scalloping portion cut therefrom during manufacture.

Fig. 16 is a schematic or diagrammatic view of the crystalographic fiber orientation of a non-scalloping steel.

Fig. 17 is a diagrammatic view of the crystalographic fiber orientation of a steel such as shown in Fig. 16 after it has been cold worked.

Fig. 18 is a cross-sectional view of a completed battery cup.

The conventional gun is provided with a chamber into which the cartridge case fits. The cartridge case is properly sized in the course of manufacture to fit the chamber, but this fit will vary due to manufacturing tolerances of the cases, tolerances in the machining of the chamber of the gun, and the wear of the chamber. As the cartridge is fired, the pressure of the powder gas forces the projectile through the barrel of the gun, and, at the same time, the case is forced radially outwardly to fill the clearance substantially completely, thereby sealing the powder gases and preventing the escape thereof backward through the working mechanism of the gun instead of being effective to act upon the projectile in its passage through the barrel. It is evident from this that the metal of the case must be in such a condition as to withstand the outward force exerted thereupon, and that any weaknesses produced in the forming of the case will immediately become apparent and will cause the shell to split. It is necessary, therefore, that a steel be used which will have no inherent weaknesses residual in the component after the cold shaping and heat treating operation.

A steel which may be shaped to a cup or cup-like form in which the edges are substantially

smooth after the cold shaping operation is known as "non-scalloping" steel. In comparison to this, a "scalloping" steel is one wherein the edges of the cup as it is formed from the flat strip or disc will develop characteristic four ears or scallops located at substantially 90° to each other. The edge of the non-scalloping steel cup will be slightly irregular, but will not have the four ears located at 90° to each other. In order for a steel to be non-scalloping, its grains, fibers, or slip planes of the grains or fibers, must be so arranged that upon cupping by cold shaping, the edge will not develop the ears or scallops. The arrangement of the slip planes or fibers in non-scalloping steel is schematically or diagrammatically shown in Fig. 16, in which there is a random orientation of the slip planes or fibers, as may be demonstrated, for example, by X-ray diffraction methods. If a steel having its fibers oriented in a random manner be cold rolled sufficiently, the fibers will tend to take up a preferred orientation, as shown diagrammatically and schematically in Fig. 17. It may be theorized that in such a structure, it is easier for slippage to take place in the direction of the orientation.

Merely as an example, after the grains or fibers have attained a preferred orientation, they may be changed to a random orientation by heating above the A_3 line, and then cooling, whereupon the fibers, for example of a steel having preferred orientation such as in Fig. 17, will be substantially placed in random orientation such as in Fig. 16.

As another example thereof, a cold rolled steel can be made non-scalloping or be given a substantially random orientation of the fibers by making the last intermediate anneal at a high temperature or above the A_3 line, making the last cold reduction small, and the last anneal at a low temperature, but sufficient to give recrystallization. In this type of treatment, the fibers, by a combination of a heat treatment and cold working are placed in a random orientation. In general, it can be said that by normalizing the steel and following this by a small reduction only and then a comparatively low temperature anneal, that the steel will have its fibers so oriented as to not give the characteristic four ear 90° scallops after the cupping operation from the flat stock.

By any of these means, and other means, a steel that may be cupped without scalloping can be produced, the slip planes within the grains or fibers being located in a random direction in respect to each other. Such a steel with a random orientation of fibers may be cold shaped to a cup, such as seen in Figs. 2 and 3, having an edge which is substantially smooth, and not having the characteristic four ears or scallops located at 90° to each other, such as shown in Figs. 6, 7 and 8.

In the cold shaping of a steel having a preferred orientation of fibers, scalloping may occur, such as shown in Fig. 9. Further drawing of the cup, such as in Fig. 9, will cause the scalloping to move down the lines of weakness, which have occurred because of the cupping operation. It is to be noted that these lines of weakness are retained in the cup throughout the further drawing thereof. The upper portion of the scallop **20** is cut off in the vicinity of the dotted lines **21** during some subsequent operation of the forming of the case. However, the lines of weakness or potential failure have developed along the direction of the scallop and extend down into the body portion of the case, such as indicated at **22**, and are not removed in the cutting off operation. It has been found that such a shell, upon firing, will split, such as at **23** (Fig. 10) along these lines of weakness, if a steel be used which has scalloping characteristics or preferred orientation of fibers.

The characteristic scalloping usually has rather sharp edges, particularly in the indentations or "valleys" of the scallops. The edge of the non-scalloping steel may have a slight unevenness as shown in Fig. 11 and the edge is usually slightly rounded, but there will be no evidence of a pronounced "earing" at the four points located 90° apart, as in the scalloping steel.

As an example of the carrying out of the invention, a disc may be provided, such as shown in Fig. 1, of a steel which is a non-scalloping steel, and a cup-like form, such as shown in Fig. 2, formed therefrom by a suitable punch and cupping die. It is also evident that the cup (Fig. 2) may be cut and formed from a flat strip, as well as from a disc, the punch and die serving to cut the disc and cup it during the same operation. There will be a slight unevenness at the edge of a non-scalloping steel, but not one of any substantial proportions or having the characteristic four ears or scallops of a scalloping steel located substantially 90° apart, such as seen at **31** in Fig. 7. The cup of Fig. 2 may then be drawn through any number of suitable dies and finally headed to form the rimfire shell of Fig. 4. If desired, the shell may be annealed between the various draws, so as to make the metal more workable. After it has been placed in the form of Fig. 4, the cold shaping has set up certain strains within the shell and, in order for the shell to function properly, it is generally necessary that it be subjected to a stress relieving heat treatment. As an example of the stress relieving anneal that will relieve the internal strains set up by the cold shaping, the component may be subjected to a temperature of between 300° and 500° C. for a period of time between four hours and ten minutes. It is to be understood that, if desired, the shell of Fig. 4, after its last drawing, may have the edge suitably finished. A shotshell head may be made similar to that shown in Fig. 13, by suitable drawing operations from a cup of the form shown in Fig. 12, there being no substantial scalloping of the edge when a non-scalloping steel is used. If a scalloping steel be used, a substantial scalloping, such as at the edge of Fig. 15, will begin to occur with the resultant lines of weakness at the bottom of the scallops.

After the cutting-off operation, the removing of portion **25** (Fig. 15), will still allow the lines of weakness to remain in the walls of the case. A steel battery cup, such as **26** of Fig. 13, may be made in a manner similar to that of Fig. 2 and heat treated similarly. The shot shell head of Fig. 13 may be assembled to a paper tube, such as **27** of Fig. 14, after the shell has been suitably marked, as at **28**, by a stamping or other process. The shotshell head of Fig. 13 is stress relieved in a manner similar to the shell of Fig. 4.

The battery cup shown in Fig. 18 has had the upper edge **29** turned over, which is done only with great difficulty when a scalloping steel has been used, even though the scallops might have been cut off. The lines of inherent weakness will cause splitting as the edge is turned over. This does not occur when a non-scalloping steel is used, and in such case it is merely necessary to

properly design the punch and dies so that the edge will turn over without cracking.

Besides the disadvantages produced by the weakness of a scalloping steel, other disadvantages of a scalloping steel occur in the processing and handling of the cups in the various automatic delivery means employed in the production and manufacture of ammunition components. For example, when a column of cups, such as in Fig. 7, are fed to a machine through a delivery tube, the rounded lower portion 30 of the cup will tend to imbed itself between the scallops of the cup immediately preceding it, causing difficulties in separations thereof at the delivery points from the tube.

It is apparent from the foregoing description that by this invention a steel which is non-scalloping may be used to satsifactorily produce ammunition components. The steel shells will not be subject to season cracking, and certain powders and priming materials may be used therein without difficulty. It is to be understood that this invention is not to be limited to the details of composition and treatment as shown herein. It is to be broadly construed as covering all equivalent devices and process falling within the scope of the appended claims.

What is claimed is:

1. In the manufacture of ammunition components, the method comprising the steps of providing a steel having a substantially random orientation of fibers, such that the steel has substantially smooth edged cupping properties upon cold shaping; and cold shaping the cup from the steel; and thereafter subjecting the component to a stress relieving heat treatment.

2. In the manufacture of steel rimfire cases having a primer recess in the base, the method comprising the steps of treating a steel to produce a substantially random orientation of the fibers therein so that the steel will cup with a smooth edge upon cold shaping, cold shaping a cup from the steel, and then further shaping the cup to form the completed rimfire case.

3. In the manufacture of steel center fire cartridge cases, the method comprising the steps of treating a steel to produce a substantially random orientation of the fibres therein so that the steel will cup with a smooth edge upon cold shaping, cold shaping a cup from the steel, and then further shaping the cup to form the completed center fire cartridge case.

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