

Sept. 8, 1925.

F. C. LANGENBERG

1,552,848

METHOD OF INCREASING THE STRENGTH OF HOLLOW METAL ARTICLES

Filed March 28, 1925

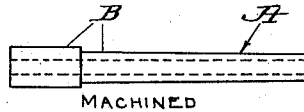
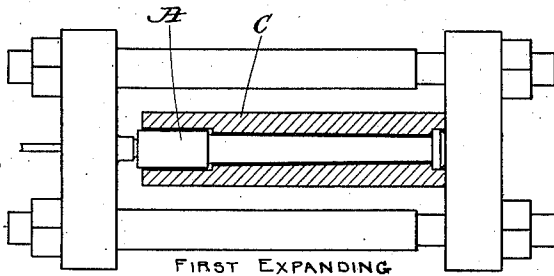
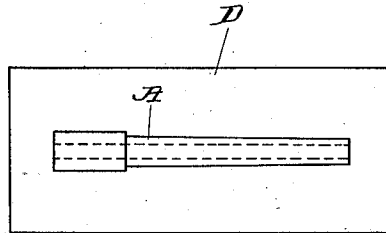


Fig. 1.



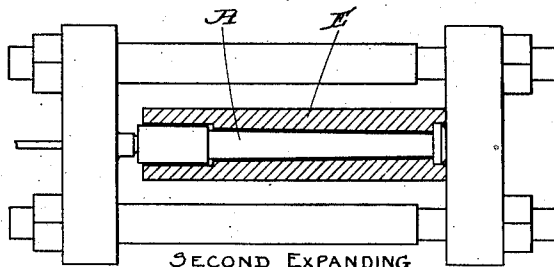
FIRST EXPANDING

Fig. 2.



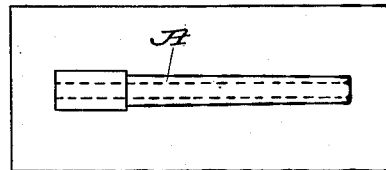
FIRST ANNEALING

Fig. 3.



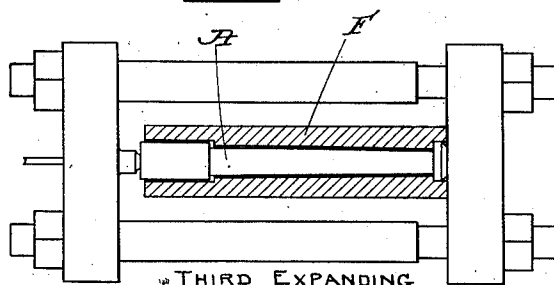
SECOND EXPANDING

Fig. 4.



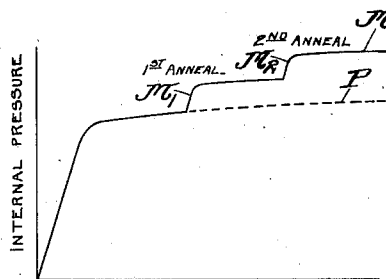
SECOND ANNEALING

Fig. 5.



THIRD EXPANDING

Fig. 6.



% BORE ENLARGEMENT

Fig. 7.

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UNITED STATES PATENT OFFICE.

FREDERICK C. LANGENBERG, OF CAMBRIDGE, MASSACHUSETTS, ASSIGNOR OF ONE-HALF TO TRACY C. DICKSON, OF WATERTOWN, MASSACHUSETTS.

METHOD OF INCREASING THE STRENGTH OF HOLLOW METAL ARTICLES.

Application filed March 28, 1925. Serial No. 19,173.

To all whom it may concern:

Be it known that I, FREDERICK C. LANGENBERG, a citizen of the United States, residing at Cambridge, county of Middlesex, State of Massachusetts, have invented a certain new and useful Improvement in Methods of Increasing the Strength of Hollow Metal Articles, of which the following is a specification, reference being had therein to the accompanying drawings.

The present invention relates to the manufacture of hollow steel articles. Heretofore it has been known that if a hollow steel article is expanded or stretched beyond its elastic limit the elastic limit will be permanently raised. Attempts have been made to apply this principle to the manufacture of guns but no considerable commercial success has been attained because it has been impossible to control the increase in elastic limit in an article of varying thickness. In an application filed March 28, 1925, Serial No. 19001 I have disclosed a method and apparatus by which it is possible to raise the elastic limit of an article of non-uniform section a predetermined amount and to whatever extent is required. In practicing this method in connection with the manufacture of guns and shells, I have made certain discoveries which greatly increase the possibilities of usefulness of the method of increasing the elastic limit of hollow metal articles which consists in subjecting them to an internal expanding pressure.

I have discovered that for a given percentage of enlargement over the original size of the article, a greater increase in elastic limit takes place if the enlarging is done in successive steps and the article is annealed and cooled between the successive stretching steps. Accordingly in the manufacture of certain articles it is desirable to subject the article to successive expansion treatments alternating with annealings. My novel method herein described therefore makes it possible to increase the strength of a given material or to use an inferior material for an article requiring a given strength. My improved method is also effectively practiced in conjunction with another novel method described in a companion application filed March 28, 1925, Serial No. 19172 in which the manufacture of guns and shells direct from the casting and without forging is described.

The invention will be fully understood from the following description when taken in connection with the accompanying drawings and the novel features thereof will be pointed out and clearly defined in the claim at the close of this specification.

In the drawings:

Fig. 1 shows the article after it has been machined.

Fig. 2 illustrates the first expanding step.

Fig. 3 shows the first annealing step.

Fig. 4 illustrates the second expanding step.

Fig. 5 shows the second annealing step.

Fig. 6 illustrates the third expanding step.

Fig. 7 is a diagram showing the effect on the elastic limit of the article.

In practicing my improved invention I proceed as follows: The hollow article A is preferably machined on the surfaces required as indicated at B. It is then placed (see Fig. 2) in a container C and expanded a predetermined amount which amount is determined by the shape of the interior of the container, then it is removed from the container and annealed as indicated in Fig. 3 in the furnace D. After being allowed to cool, it is placed in a second container E (see Fig. 4) and again expanded. After being expanded it may be again annealed, as shown in Fig. 5 and then again expanded in the container F, Fig. 6.

The effect on the elastic limit or strength of the article is indicated in the diagram shown in Fig. 7. In this diagram per cent of enlargement is plotted against the interior pressure producing the enlargement. The resulting curves show the changes in the elastic limit. The curve P shows the changes in elastic limit or a piece which is not annealed. The curve M shows the change for a piece which is annealed twice at M_1 and M_2 .

What I claim is:

The method of increasing the strength of metals which consists in subjecting the article to an internal expanding pressure restrained to prevent its passing beyond a predetermined point, annealing the article and again subjecting it to a restrained expansion.

In testimony whereof I affix my signature.

FREDERICK C. LANGENBERG,