

No. 632,462.

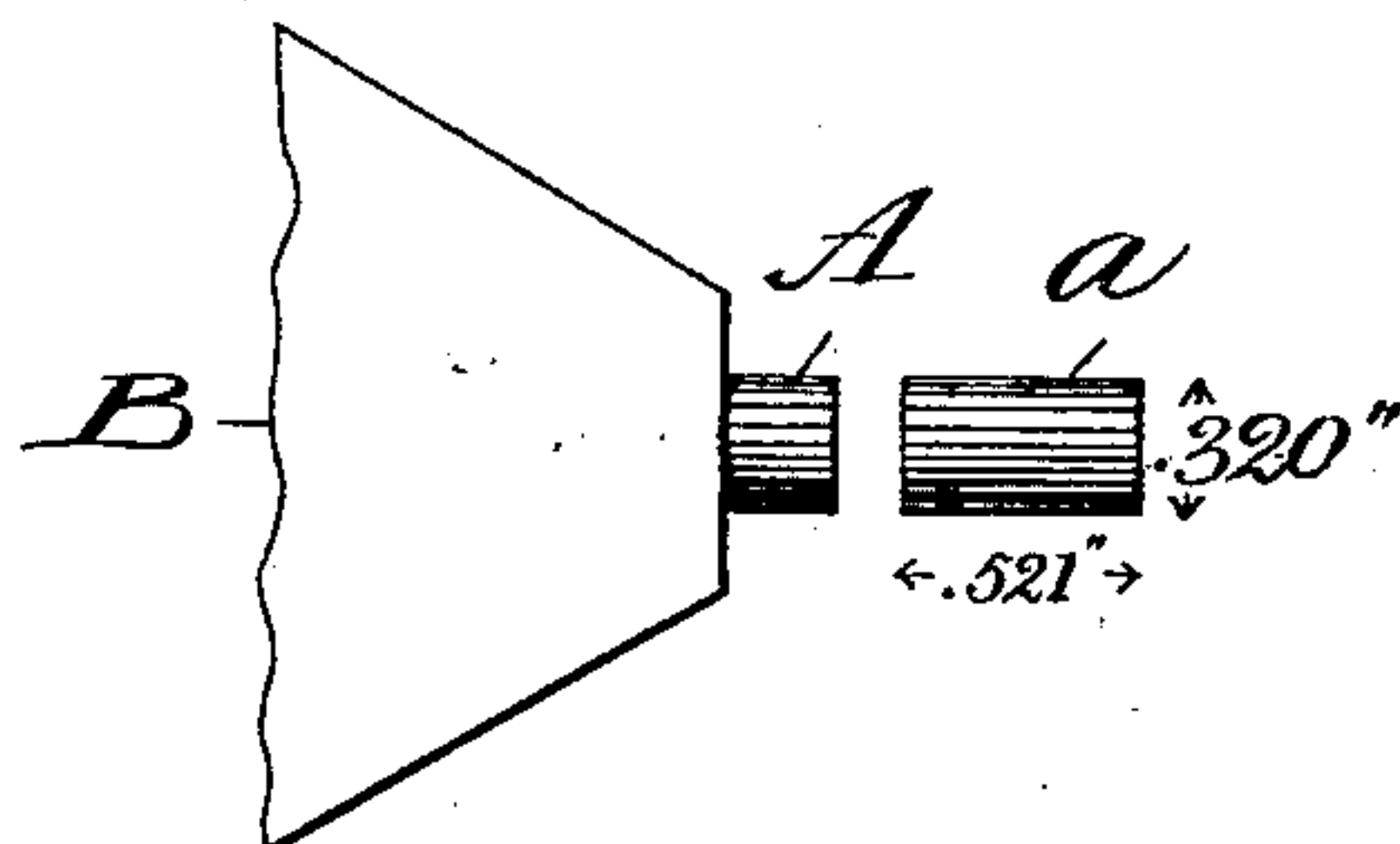
Patented Sept. 5, 1899.

H. C. L. HOLDEN.  
PROCESS OF MAKING CRUSHER GAGES.

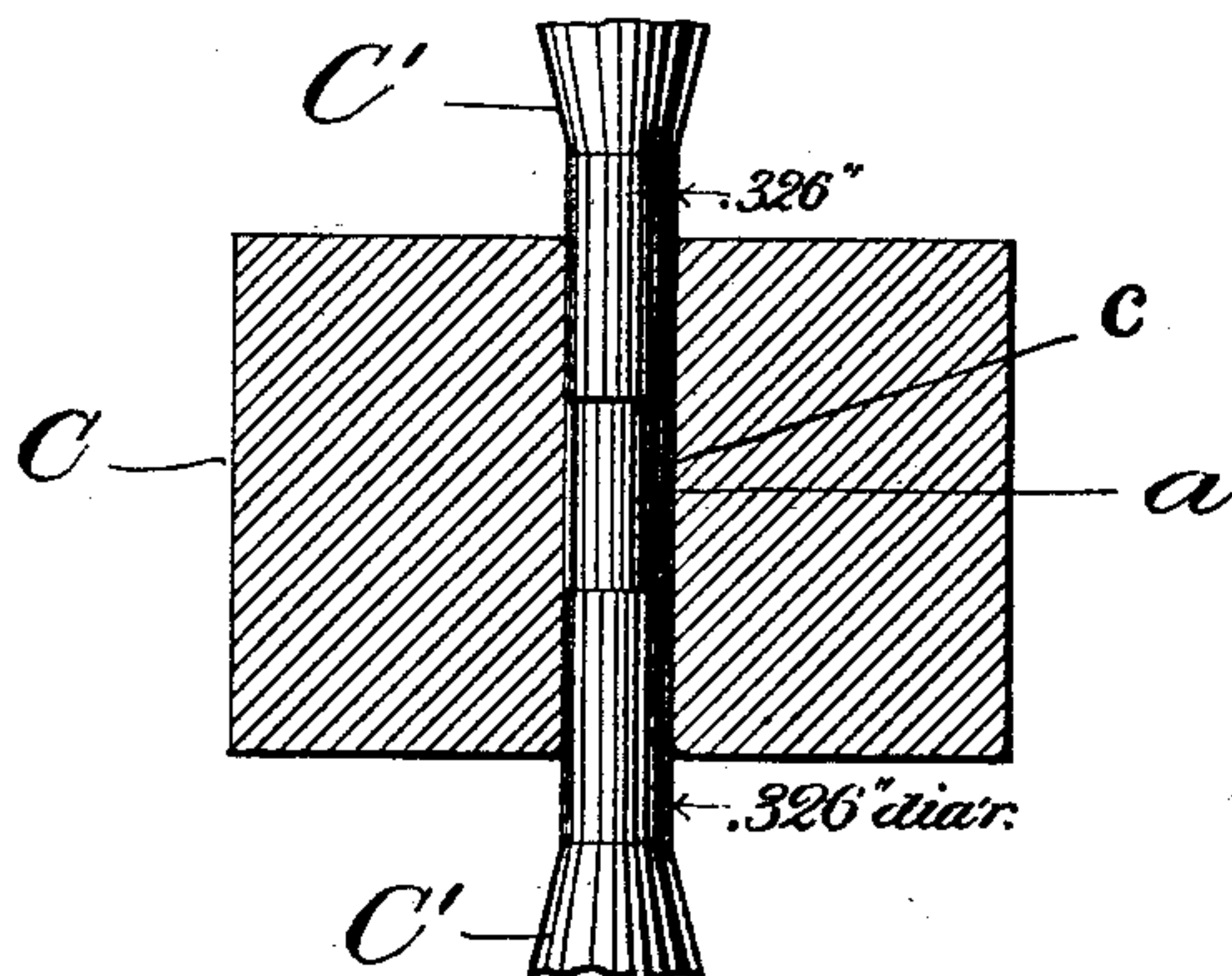
(Application filed Feb. 28, 1899.)

(No Model.)

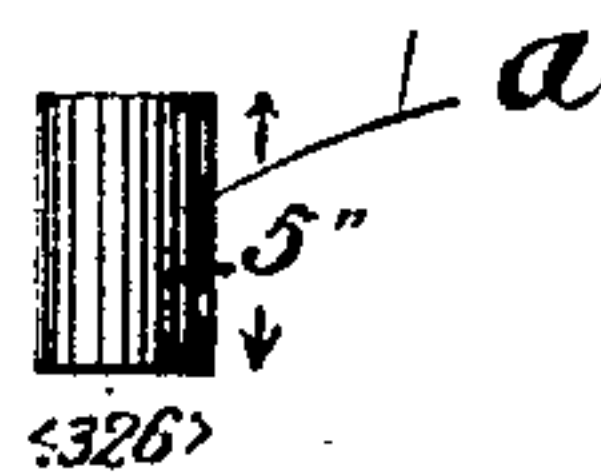
*Fig. 1.*



*Fig. 2.*



*Fig. 3.*



Witnesses  
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# UNITED STATES PATENT OFFICE.

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## PROCESS OF MAKING CRUSHER-GAGES.

SPECIFICATION forming part of Letters Patent No. 632,462, dated September 5, 1899.

Application filed February 28, 1899. Serial No. 707,220. (No model.)

*To all whom it may concern:*

Be it known that I, HENRY CAPEL LOFFT HOLDEN, a subject of the Queen of Great Britain, residing at Woolwich, London, England, have invented a new and useful improved process for the manufacture of copper cylinders such as are employed in crusher-gages for registering the pressure developed in ordnance and firearms generally, (for which I have applied for a patent in Great Britain, No. 17,993, dated August 22, 1898; in Germany, dated December 9, 1898, and in France, dated February 20, 1899;) and I do hereby declare that the following is a full, clear, and exact description of the invention, which will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to the manufacture of copper cylinders such as are employed in what are known as crusher-gages used for the determination of pressures developed in ordnance and firearms generally, and the efficiency of which depends mainly upon the accuracy of the said copper cylinders.

In the accompanying drawings, which illustrate my invention, Figure 1 represents a portion of a lathe, showing a section of copper rod and one cylinder-blank cut from the same. Fig. 2 represents a perforated die and two punches in the act of compressing a cylinder-blank longitudinally and expanding it laterally to give it the correct shape when finished. Fig. 3 represents the finished cylinder.

On the drawings I have indicated the dimensions of the finished cylinder as it is used in England, and the approximate dimensions of the blank for making this cylinder.

Hitherto the production of such cylinders has been confined to hand processes carried out by skilled mechanics, the said cylinders having been turned from a copper rod to correct diameters in a lathe and afterward finished by hand to the correct length, both of which operations are slow and expensive, and even with the greatest care it has been very difficult to obtain the required degree of accuracy.

The object of my invention is to insure the greatest accuracy in dimensions and at the same time effect great economy and rapidity of production, and this I accomplish by the

process hereinafter described, which can be carried out by unskilled labor.

In carrying out my process a round copper rod, of a diameter slightly smaller than that which the finished copper cylinders are to have, is cut into lengths in an automatic cutting-off lathe or machine of any usual or preferred construction, the length of each piece when cut off being such that its weight is very slightly greater than the weight which the completed copper cylinder is to possess, and then the weight of each piece is adjusted more or less exactly to the standard weight corresponding with that of the finished cylinder by filing it or by grinding it against an emery or other wheel, this operation requiring no care except so far as the weight is concerned. The pieces of copper, thus accurately adjusted as to weight, are now individually compressed between dies (the female of which is cylindrical and has exactly the diameter of the finished cylinder) and subjected to such pressure that the copper flows and fills the female die, with the result that the diameter and length are corrected, the latter being dependent upon the correct diameter and weight.

In Fig. 1, A represents the copper rod from which the cylinder-blanks, one of which is shown at *a*, are cut, a portion of the lathe being indicated at B.

In Fig. 2 I have illustrated one form of apparatus for compressing the cylinder-blank *a* longitudinally and expanding it laterally. In this figure, C represents a female die having an aperture *c* therethrough of exactly the diameter of the finished cylinder, and C' C' represent punches working in said aperture and adapted to compress the cylinder-blank between them.

The next and final step in the process is to soften the copper cylinders, and this is effected by heating them in a furnace (and preferably a muffle, so as to prevent as far as possible the contact of oxygen with the metal) to a temperature of, say, 1,000° Fahrenheit and then suddenly cooling them in water at a temperature of, say, 65° Fahrenheit or whatever temperature may be required to produce the desired annealing effect. A finished cylinder is shown at *a* in Fig. 3.



In practice it is found that the copper cylinders made by this process vary only very slightly from one another in their physical properties and are superior in this respect to  
5 those hitherto made by hand processes.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is—

10 The herein-described process of manufacturing copper cylinders for use in crusher-gages for registering pressures developed in ordnance and firearms, which consists in taking a copper rod of a diameter slightly less  
15 than the required diameter of the finished

cylinders, severing therefrom pieces of such length that their weight is slightly greater than that required in the finished cylinders, removing portions of said pieces to reduce their weight exactly to that required in the  
20 finished cylinder, then compressing the pieces longitudinally and expanding them laterally to the required diameter, then softening the cylinders by heating them and cooling them in water, substantially as described.

HENRY CAPEL LOFFT HOLDEN.

Witnesses:

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