

(No Model.)

C. T. CAYLEY & R. S. COURTMAN.

METHOD OF MAKING TUBULAR ARTICLES.

No. 529,597.

Patented Nov. 20, 1894.

FIG. 4.



FIG. 9.

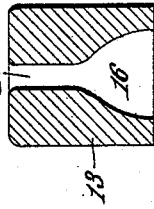


FIG. 10.

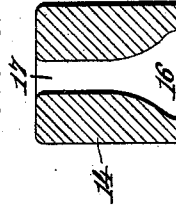


FIG. 3.

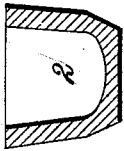


FIG. 8.

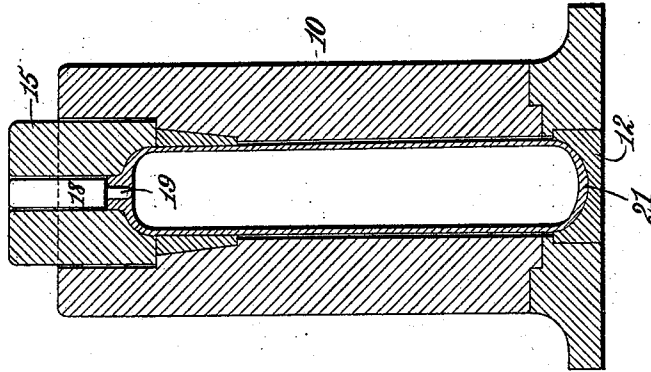


FIG. 2.



FIG. 7.

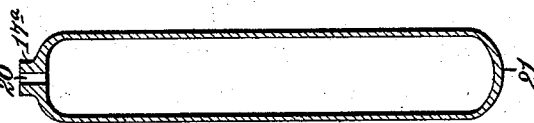
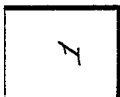


FIG. 6.



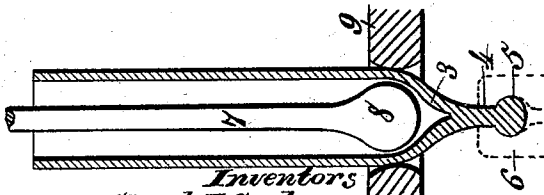
FIG. 1.



Witnesses,

E. W. Rea.
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FIG. 5.



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Att'y.

UNITED STATES PATENT OFFICE.

CLAUD T. CAYLEY AND REUBEN SAMUEL COURTMAN, OF LONDON, ENGLAND, ASSIGNORS TO THE UNITED STATES PROJECTILE COMPANY, OF BROOKLYN, NEW YORK.

METHOD OF MAKING TUBULAR ARTICLES.

SPECIFICATION forming part of Letters Patent No. 529,597, dated November 20, 1894.

Application filed August 25, 1892. Serial No. 444,140. (No specimens.) Patented in England November 23, 1891, No. 20,364; in France November 26, 1891, No. 217,684, and in Belgium November 30, 1891, No. 97,399.

To all whom it may concern:

Be it known that we, CLAUD THORNTON CAYLEY and REUBEN SAMUEL COURTMAN, engineers, subjects of the Queen of Great Britain, and residents of London, England, have invented certain new and useful Improvements in the Manufacture of Metal Tubes or Tubular Vessels, (for which we have obtained patents in Great Britain, No. 20,364, dated November 23, 1891; in France, No. 217,684, dated November 26, 1891, and in Belgium, No. 97,399, dated November 30, 1891,) of which the following is a specification.

Our invention relates to the manufacture of tubular vessels or bottles for containing hydrogen, oxygen, and other gases, under pressure, and for other uses; and said invention consists in the novel method of manufacturing such vessels or bottles from a solid block of metal, as hereinafter described and claimed.

In order that others skilled in the art may be able to understand and to practice our said invention, and to make the blank which constitutes part of the same, and produce the finished article therefrom we will now describe the said processes and the products thereof in detail, reference being had, for such purpose, to the accompanying drawings, in which—

Figure 1 is a view showing a solid block of metal, substantially such as that used by us in the production of a blank for a tubular vessel or bottle, suitable for holding oxygen, hydrogen, or other gases, under pressure, or for other uses, said blank being, also, adapted to the production of a tube. Fig. 2 is a view of said block after it has been pressed to the shape of the bottom of the mold. Fig. 3 is a sectional view of the block after it has been cupped, or hollowed, by the action of a punch. Fig. 4 is a sectional view showing the same at the succeeding stage in the process of manufacture, the cupped or hollow block seen in Fig. 3 having been drawn by one or more operations while heated nearly to the length, diameter and thickness of the finished article. Fig. 5 shows the article described in Fig. 4 swaged down and closed at one end to enable

it to be drawn through a die and over a mandrel as shown. Fig. 6 is a sectional view showing the completed blank, formed from the partly completed blank seen in Fig. 4, by subjecting the latter to a process of cold drawing. Fig. 7 is a sectional view of a bottle, or tubular vessel, completely formed from the finished blank shown in Fig. 6. Fig. 8 shows one step in the process of manufacture of the finished article shown in Fig. 7, whereby the end of the same is closed and formed. Figs. 9 and 10 show dies used successively in that portion of the process illustrated in Fig. 8.

In carrying our said invention into practice, we take a solid block 1 of iron, steel, or other suitable metal, of such dimensions as will give the required weight to the finished blank, and heat the said block to such a degree as to render it moderately plastic. It is then placed in a mold and pressed, hammered, or otherwise worked into the shape seen in Fig. 2. The block is then removed from the mold described and, while still retaining the heat imparted to it, or after reheating, should this seem necessary, it is placed in a second mold and, by means of a proper punch, or die, or a series of the same, it is worked into the form of a hollow cup, or vessel 2, shown in Fig. 3, a series of molds being employed, if necessary, for this purpose. The initial tubulation of the metal being thus effected, the cup 2 is placed upon a mandrel of suitable dimensions and length and submitted to a process of hot drawing through dies of successively diminishing size, to which the blank is subjected in proper order, being reheated as often as may be necessary during this stage of the process of manufacture, in order that the metal may be retained in a suitable plastic condition. When this hot-drawing process is concluded, having been accomplished either by the mechanism described, or by any other suitable means, the blank will have been brought substantially to the shape seen in Fig. 4. The solid block of metal has now been converted into cylindrical form having nearly the same diameter, length and thickness as the finished article, but it has not been brought to the form of the completed blank. If it is to be

used in manufacturing a tube, about four feet, or less, in length, the blank may be finished by merely subjecting it to a process of cold drawing by which it is reduced to the proper length and thickness, and brought to the exact diameter required, thereby constituting a complete, finished, metallic blank, ready for use in the process of manufacture of the complete, finished tubes, bottles, or tubular vessels about to be described. If, however, the tube, bottle or tubular vessel is to be of greater length than four feet, or thereabout, we can by known methods subject the blank described above to the action of rolls, after having punched, cut, or otherwise removed its closed end and inserted a mandrel, said rolls having a series of grooves of diminishing size. After reducing it very nearly to the length, diameter and thickness it will have when finished, it is preferably pickled, to remove the oxide, or scale, from its surface, is then subjected to an annealing process and finally finished by cold-drawing. By the latter process we are enabled to reduce the metal to any required thickness, however slight, and we impart to it great strength, stiffness, and toughness. We may use for this cold drawing process any known method, but we prefer that illustrated in Fig. 5 of the drawings. This method consists, substantially, in closing and swaging, or shaping the end 3 of the tube in such manner as to form thereon a strong, prolonged neck, or shank 4, provided, at its extremity, with a knob, ball, enlargement, or other suitable holding device 5. This device is placed within the grasp of jaws 6, reciprocated by any suitable means. Within the tube we insert a mandrel, or bar 7, having upon its end a ball, or enlargement 8, of such size as to impart the proper interior diameter to the tube. The exterior diameter is imparted by means of a circular die 9, having its edge convex, or rounded, and lying in suitable position with relation to the interior device 8. The cold drawing may be completed at a single operation, or it may be effected by repeatedly drawing the tube, the diameter of the die 9 and bulb or mandrel being slightly diminished at each operation. By this process we produce not only tubular blanks suitable for the manufacture of bottles, or tubular vessels, capable of holding gases under pressure, but we can also form tubing-sections of any suitable, or ordinary length, diameter and thickness, having great strength, stiffness and toughness, and of substantial uniformity throughout.

In the manufacture of blanks for the production of bottles, and tubular vessels, for the uses mentioned, we operate upon a solid block of steel, or iron, by substantially the same method as that described until it is reduced to the form shown in Fig. 6, the blank being of a length somewhat in excess of that

of the bottle, or tubular vessel, when the latter is finished. We then cut off the surplus length from the upper, or open end of the tube, and turn, or otherwise shape, the bottom or closed end, to bring it to the required shape and thickness. The open end of the blank is then heated and placed in a mold 10 (Fig. 8), in which the open end of the blank is to be closed and its neck formed. At the lower end of said mold is a block 12, to support the blank against the action of the die, or dies, 13, 14 and 15, of which I may use one, two, three, or more. These dies, when more than one is used, operate successively, preferably by hydraulic pressure. The matrix-recess 16 in each die is successively approximated to the complete or finished shape, until the last is reached, which imparts the necessary form. The matrix-recess in each die opens into a concentric bore 17 having a form adapted to receive and aid in forming the neck 17^a of the bottle or vessel, this operation being completed by the use of a mandrel 18, having a reduced end 19, which is passed down through the bore 17 in the die to form the opening 20, in the neck, which is to receive the valve.

It should be clearly understood that we base our invention upon the production of the tubular blank, the tube, or the bottle, or tubular vessel from a solid metal bar, in contradistinction to the use of a plate, or disk of metal, for a similar purpose. It is upon this difference that we predicate the characteristics and qualities which distinguish our invention in the market from similar articles produced by processes differing from our own.

What we claim as our invention is—

The process herein set forth for the manufacture of tubular vessels, consisting in hollowing out or initiating a tubular formation in a block of metal, hot drawing the said block of metal through dies of successively diminishing size while in a suitably plastic condition, pickling and then cold drawing the same, closing one end of the blank, and shaping and partially closing the other end of the blank to form a neck having a valve opening, substantially as described.

In testimony whereof we have hereunto signed our names in the presence of two subscribing witnesses.

CLAUD T. CAYLEY.

REUBEN SAMUEL COURTMAN.

Witnesses to the signature of the said Reuben Samuel Courtman:

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45 Southampton Buildings, London.

W. M. HARRIS,

17 Gracechurch Street, London, E. C.

Witnesses to the signature of Claud Thornton Cayley:

WILLIAM A. PORTER,

L. H. GOULD.