UNITED STATES PATENT OFFICE.

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CARTRIDGE.

1,123,362. Specification of Letters Patent. Patented Jan. 5, 1915.

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To all whom it may concern:

Be it known that I, JOHN D. PEDERSEN, a citizen of the United States, residing in Jackson, in the county of Uinta and State of Wyoming, have invented certain new and useful Improvements in Cartridges, of which the following is a specification.

This invention relates to gun-operating cartridges of that class in which the metallic shell or tubular portion of the cartridge is preliminarily prepared by suitable structural formation thereof, for elongation by the force of the gases on the firing of the cartridge; and one object of the invention is to furnish such an extensible metallic shell in which the elongation may be safely continued to such an extent as to effectively operate the mechanism-actuator of the breech-mechanism of an automatic gun, or of an automatically reloading gun.

A further object is to accomplish this result by means of zones formed in the metal tube-wall of the shell and which are extensible by the gas-pressure in a manner to prevent the bursting or transverse severing of the shell, while securing the relatively large amount of extensibility thereof, which is desirable.

A further feature of my improvements relates to the means or features of construction whereby to obtain a progressive reformation of the metal of the extensible zones of the cartridge shell, by a re-forming action normally beginning at the forward end of these zones, and thence extending rearwardly in a progressive manner until the full elongation of the cartridge is obtained. During this operation the cartridge is, of course, to be used in a gun in which the breech mechanism has the breech-block, or some suitable portion thereof, arranged for being actuated rearwardly during the early stages of the increasing gas-pressure.

A gun mechanism of the character here referred to, and adapted for operation by means of cartridges such as herein described, will constitute the subject matter of a separate application to be concurrently pending herewith.

In the drawing accompanying and forming a part of this specification, Figure 1 is a side view of a cartridge shell made in accordance with my present improvements. Fig. 2 is a development of the cylindrical wall, or tube-wall, of the shell for illustrating the preferred arrangement of the elements or zones embodied therein and extensible by re-formation. Fig. 3 is a sectional view on the line *y—y*, Figs. 1 and 2, and is drawn in alinement with Figs. 1 and 2 for thus more clearly illustrating the invention. Fig. 4 is an end elevation of the shell as seen from the left-hand in Fig. 1. Fig. 5 illustrates the progressive sectional formation of one of the said extensible elements or members; these sections are taken at the points *a*, *b*, *c*, Fig. 2, but for convenience of illustration these sectional views are shown on an enlarged scale.

Similar characters designate like parts in all of the figures.

Referring to the drawing, the cartridge head is shown provided with some suitable extracter-rim or flange, as 4, and this is connected with the forward-tube B, by means of the elongatable tube-portion M located near to, or adjacent to the head and its extractor flange. In cartridges of some kinds, the shell may have the extension C, reduced in diameter or otherwise, for receiving the projectile. The lengths of the portions M, B and C, and also their relative lengths, may be varied to suit the requirements in any given instance.

For making the tube-length M elongatable, I form therein one or more extensible zones, or members, as N, N′, preferably not less than two in number, as herein illustrated, but in some instances three or more may be used. These shell-lengthening zones N, N′, are located adjoining the head and inclined to the plane of the cartridge head and extractor-rim, and are also extended around the shell for a considerable distance, preferably more than one entire circumference, and in some instances one and one-half, or even two or more times around may be used. This construction results in the spiral or approximately helical arrangement illustrated, so that each said zone, N, N′, is located after the manner of a screw, and when of considerable length, they over-lap, or extend side by side for a considerable distance; this is well shown by Figs. 1 and 2. The zones N and N′ are non-circular, since they are so located and transversely inclined that they do not connect to form a closed ring or circle, nor do they form a groove

which is annular, even when the zone is extended around the shell more than one entire circumference thereof. In cross-sectional form these spirally arranged zones are inwardly curved or arched, and in location they may be a helix, either exact or only approximate, and may have a relatively regular or irregular pitch or curvature, and hence, for convenience, I designate these substantially helical zones, in either form, as being helical, or helically located or arranged, or as being extended in a helical direction. When only two of the extensible zones are employed, I prefer to so arrange them that the rearward end of each one comes to the same distance or longitudinal position relatively to the extractor-rim 4, and to locate these two points respectively, on opposite sides of the shell. This arrangement is clearly indicated in Figs. 1 and 2. Here the zone N is shown beginning at about the point *a*, and extending in an inclined direction upward and toward the left hand to the edge of the developed shell, and thence extending from an opposite point (at the lower side of said Fig. 2) toward the upper side, as before, and at the same inclination to the plane of the head, which angle is preferably less than the inclination or angle relatively to the axis of the shell, in order to make the extensibility of the zones N, N′, mainly in the direction of the length of the shell. The said lesser angle is indicated at 1, Fig. 2, and the relatively greater angle or inclination between the zones N and D and the axis of the shell, is shown at *g*. Thus the two zones N, N′,—as will now be evident from the figures of the drawing, and when thus compared as an aggregate or total length,—considerably exceed one and one and one-half times the circumference of the shell. This circumference is, of course, equal to the width of the developed wall of the shell as illustrated in Fig. 2, which also shows how two such zones, from the rearward end of one zone to the forward end of another, may encircle the shell a plurality of times.

One of the inclined shell-lengthening zones, at one side of the shell, (as at N, sec. *a*, on line *y*—*y*, Fig. 1) extends circumferentially around the shell until it comes again to the same circumferential position, indicated at *b*, Fig. 1, but by reason of the said inclination comes to a different longitudinal position. Thus one such helically located extensible zone may supply a plurality of extensible zone-areas which are located, as regards one longitudinal line on the shell, as *y*—*y*, Fig. 2, at successive longitudinal positions. Thus when there is a plurality of the helically arranged zones and when one or more of these zones extends more than one entire circumference of the shell, then the total number of the extensible zone-areas along that one longitudinal line, is greater than the number of zones. Similarly, when these zones each extends for one and one-half or more times around the shell, the number of the said extensible areas along one longitudinal line, as the line *y*—*y*, Fig. 2, will be correspondingly increased. Another object which I accomplish by the described helical construction and organization is that the former or mandrel, which is convenient to use in the shell at a certain stage of the manufacture thereof for constituting the interior die or instrument by which the helically arranged extensible portions are to be shaped, may, on the completion of that operation, be screwed out of the shell, thereby avoiding the necessity of resorting to compound instrumentalities or tools for that purpose. By this means the extensible tube-portion M may be readily formed of the desired proportions and of high quality at a low cost.

In order to provide for the manufacture in a convenient manner of the shells having therein the helically arranged extensible zones, and also to provide in one manner, for the preferred mode of operation of the same when the cartridges are used in a gun, the shell of the cartridge is shown considerably thicker at its rearward end, (see Figs. 3 and 5), next to the extractor rim 4, (see Fig. 5, sec. *a*) and is made of a decreasing thickness forwardly therefrom until at the forward end of said extensible part M (see sec. *c*, Fig. 5) the thickness of the shell is shown materially decreased. As a result of this tapering down of the thickness of the metal in the tube-wall of the shell, (see Fig. 3,) the resistance or stability of the extensible zone, N, at section N^c, Fig. 5, can be made much less than the resistance or stability of the same member or zone at the rearward end, sec. N^a, thereof. This increasing resistance or stability of said zones will be evident from a comparison of section *c* with section *b* and section *a*, Fig. 5, and by comparing these several sections with the similar forms shown in Fig. 3 in connection with the development or plan view, Fig. 2 and the side view, Fig. 1. For more fully providing for a considerable amount of such extensibility, the section at *c* is shown of less depth than at *b*, and of a proportionately greater depth at section *a*. This progressive formation of these re-formable zones may in practice be produced by properly shaping the corresponding grooves in the former or mandrel which, as above explained, may be employed in the manufacture of the shells. In practice, that progressive formation may also be obtained by making the re-formable zones of the tube-wall of greater hardness near the head, and of a

decreasing hardness or increasing mobility from the head forwardly to the forward ends of these zones.

On account of the difficulty of fully representing, in the views given in Figs. 1 and 2, the curved surfaces indicated at *s*, *s'*, in section *a*, Fig. 5, these smaller curves or surfaces of the ogee formation are indicated by lines and with little or no shading in Figs. 1 and 2. These lines, or surfaces, therefore, do not indicate that the formation or shape is of an angular character, but they show the location substantially or approximately of the borders or boundaries of the successive zones when these are arranged in the preferred manner. By comparison of Figs. 1 and 2 with the sectional view shown in Fig. 3, these features will be evident.

A further feature which aids the complete and effective re-formation of the zones N, N', is the construction,—in their preferable form indicated in Fig. 5,—whereby the principal cross-sectional curvature *n*, is connected at each side with the intermediate and preferably narrower zones D, D', by the two reversely-disposed curves *s*, *s'*, respectively. The cross-sectional form of the zone N is shown and may be designated as a double-ogee, and I find this construction to be favorable for the purposes herein set forth. Thus the intermediate zone, as D, however narrow relatively to the re-formable zone, serves to laterally connect successive re-formable zone-areas in the direction of the length of the shell, whether or not these zone-areas (on any one side of the shell) are formed of successive turns of one extended re-formable zone, or of successive re-formable zones following side by side around the shell. In Fig. 5, by way of connecting the several section-locations, *a*, *b*, and *c*, with a single zone, these locations are here indicated by the combination characters, N^a, N^b, N^c, respectively.

As between the head and its rim 4, and the forward-tube B, the continuity of the cylinder of the shell is not wholly interrupted, since between the inclined or helical re-formable zones N, N', there are located the draft-zones, D, D', which are both circumferentially and longitudinally intermediate of the said re-formable zones, and extend in an unbroken and substantially cylindrical surface externally about uniform or in alinement with the outer surface of said forward-tube, B, from the head to the forward-tube. Thus the said forward-tube, B, Fig. 1, connects directly with the head of the shell through a portion of the extensible portion M of the shell: and thus during the extraction of the shell by means of said head or flange 4, a direct connection between the head and the forward-tube B is at all times maintained, partially through the said winding or helical un-re-formable zones, D, D'. In practice, it will sometimes be desirable, as I apprehend, to make these intermediate zones D, D' somewhat wider and in other instances to make these zones D, D' narrower than the re-formable zones. And in some cases, and especially when the diameter of the shell is sufficient therefor, a plurality of three helical re-formable zones may be preferable to a smaller number thereof. When, as illustrated in the drawings, the plurality of re-formable or cartridge-extending zones, as N and N', are about equally spaced circumferentially of the shell, and each extends forwardly from a point near the head, and also extends circumferentially substantially one and one-half times around the shell, the result is that the plurality of re-formable zones taken together will encircle the shell two or more times: that is, from the beginning of one said zone forwardly to the end of another said zone. By reason of the helical arrangement side by side of a re-formable zone and a contiguous non-re-formable zone which connects the head and its extraction flange with the forward portion of the tube by an unbroken and relatively cylindrical surface,—these zones encircling the shell circumferentially thereof through a distance of more than one circle,—this portion of the shell becomes extensible by the re-formation of said re-formable zones without wholly interrupting the connection (through the cylindrically disposed metal of the shell) between the head and the forward portion B of the shell. This organization of those members of the shell thus provides for the proper and considerable amount of elongation without wholly intersecting the tube surface circumferentially at any one point of its length. During the lengthening of the shell and while the said non-circular or helically-arranged zones, as N and N', are being broadened transversely of said zones and longitudinally of the shell by their re-formation, the pitch or spirality of these zones, and also of the intermediate zones or connection members, as D and D', is, of course, increased in a proportionate manner: and this action, as will now be evident tends to laterally deflect or flex those intermediate non-reformable members in a direction relatively edgewise thereof, but without materially deforming or dislocating them out of their original position in alinement with the tube wall in its so-called cylindrical portions. This latter term refers, of course, to the usual slightly conical form of the shell-tube, made so chiefly for securing an easier extraction of the same from the barrel of a gun: and hence I herein include that small and usual degree of taper or conical formation of the shell, under the

terms cylindrical and cylindrically-disposed, as employed in this description and in the accompanying claims.

When the shell has a plurality of two or more of the re-formable non-circular or helical zones, with a plurality of the intermediate non-circular or helical non-re-formable zones extending forwardly from the head and together with the re-formable zones extending around the shell one or more times, the extensibility of each of the re-formable zones transversely of itself and longitudinally of the shell, secures an extended lengthening of the shell,—or a relatively large longitudinal extensibility of the shell,—while continuously maintaining a plurality of cylindrically-disposed surface connections (which are relatively non-re-formable) between the forward portion of the tube and the head of the shell. And when such plurality of the re-formable non-circular zones are in successive locations about equally spaced,—as illustrated in the drawings,—circumferentially of the shell and are each extended forwardly from a point near the head for substantially or more than one and one-half times around the shell, these zones then have, when taken together, an aggregate extension around the shell of two or more times the circumference thereof, thereby securing the relatively large longitudinal extensibility which is desirable, and without interrupting the cylindrically-disposed connection between the forward-tube B, and the extractor-flange, 4, of the head. By means of this organization of the structural elements of my improved metallic, extensible cartridge shell, the effective extraction of the shell is secured, notwithstanding some weakening or incipient cracking of the re-formable zones should occur during their transverse extension by the progressive re-formation thereof under the gas-pressure. A further result which I accomplish by means of the described arrangement of the re-formable and non-re-formable zones, is that in the circumference of the shell in any transverse plane in the said re-formable portion of the length of the shell, the metal has a peculiar yieldable or mobile formation, which, in connection with the relatively large extensibility longitudinally of the axis, gives to the shell, after the firing of the cartridge, a modified tension or stress favorable for the free retraction of the shell out of the barrel of the firearm.

My improved longitudinally-extensible cartridge-shells, when first used in a cartridge-operated gun, are not thereby destroyed but are converted, or re-formed, into plain-tube shells which may afterward be reloaded for use in guns having a corresponding bore and a hand-operated or machine-operated breech-loading mechanism. When the shell, as originally formed, is thus subjected to concurrent re-formation and elongation to the extent of completing the normal limit of elongation, the shell tube becomes of a plain tubular formation and of a permanently increased length. Thus the shell, when initially constructed and used as herein set forth for one kind of service, is thereby re-formed (formed anew) into a different kind of shell suitable for another kind of service. And in addition to those two capacities and successive formations, the shell during the period of such re-formation has a third and important characteristic, which is the combination of a non-sliding tubular member with a piston-like rearwardly-moving gun-mechanism-operating member (*i. e.* the head portion of the shell) with the intermediate and extensible tube-portion serving at that time as an actuator for progressively driving backwardly the said piston-like member by (from) the increasing gas pressure.

Having thus described my invention, I claim—

1. In an elongatable metallic shell for gun-operating cartridges, the combination with a head having an extractor-rim, of a tubular portion having a decreasing thickness of tube-wall from the head forwardly thereof, and having adjacent to the head a zone extensible transversely of itself and longitudinally of the shell by re-formation and located in a helical direction around the shell, so as to project out the extractor-rim of the shell upon firing of the cartridge.

2. The improved elongatable metallic shell for gun-operating cartridges herein described, it comprising a head and a tubular portion having a decreasing thickness of tube-wall from the head forwardly therefrom, and having formed therein adjacent to the head a plurality of helically located zones extensible by re-formation and having an aggregate extension around the shell for one circumference thereof, so as to project out the head of the shell upon firing of the cartridge.

3. In an elongatable metallic shell for gun-operating cartridges, the combination of a plurality of helically-located re-formable shell-lengthening zones located adjacent to the head in successive circumferential positions, respectively, and a plurality of intervening and laterally-connecting non-re-formable zones relatively narrow so as to permit their endwise flexing upon firing of the cartridge.

4. In an elongatable metallic shell for gun-operating cartridges, the combination, with the head and its extractor-rim, of a plurality of helical re-formable zones, as N, N′, located adjacent to the head in suc-

cessive circumferential positions and having an aggregate extension around the shell for more than one circumference thereof, and a plurality of intervening non-re-formable zones which, respectively, extend between and laterally connect the re-formable zones, and also directly connect the head and its extractor-rim with the forward portion of the shell, said non-re-formable zones being relatively narrow so as to permit endwise flexing upon firing of the cartridge.

5. The improved elongatable metallic shell for gun-operating cartridges herein described, it comprising a tubular portion having a decreasing thickness of tube-wall from the rearward end forwardly therefrom, and having formed therein two helically arranged extensible zones located adjacent to the head and each extending around the shell for more than one entire circumference of the shell, and each having an increasing depth of formation from the forward end thereof rearwardly toward the head of the shell, so that the head of the shell upon firing will project out by a progressive backward extension of said tubular portion.

6. The improved elongatable metallic shell herein described for gun-operating cartridges, it comprising a head and a tubular portion adjoining the head of the shell, and having formed therein a plurality of non-circular zones extensible by re-formation and each extending around the shell more than one circumference thereof, these zones having an aggregate extension around the shell of substantially twice the circumference thereof, and each said extensible zone having a progressively increasing cross-sectional area of metal therein, from the forward part thereof rearwardly toward the head of the shell, so that the head of the shell upon firing of the cartridge will be projected outward by a progressive backward extension of said tubular portion.

7. The improved elongatable metallic shell herein described for gun-operating cartridges, it comprising a head and a tubular portion adjoining the head and having a decreasing thickness of tube-wall from the head forwardly therefrom, and having formed therein a plurality of non-contiguous and non-circular extensible zones with an aggregate extension around the shell of more than one entire circumference thereof, said extensible zones from the forward part thereof rearwardly toward the head of the shell, having a progressively increasing resistance to re-formation by gas-pressure, so that the head of the shell upon firing of the cartridge will be projected outward by a progessive backward extension of said tubular portion.

8. The improved elongatable metallic integral shell herein described for gun-operating cartridges, it comprising a head and a tubular portion adjoining the head and having a decreasing thickness of tube-wall from the head forwardly therefrom, and having a plurality of non-circular inwardly arched zones extensible by re-formation and each extending around the shell more than one circumference thereof, these zones having an aggregate extension around the shell of substantially twice the circumference thereof, and each said extensible zone having a progressively increasing cross-sectional area of metal therein, from the forward part thereof rearwardly toward the head of the shell, so that the head of the shell upon firing of the cartridge will be projected outward by a progressive backward extension of said tubular portion.

9. In an elongatable metallic integral shell for gun-operating cartridges, the combination with the forward-tube of the shell, and with the head and its extractor-flange, of a substantially helical and relatively wide and inwardly arched zone extensible transversely of itself and longitudinally of the shell by re-formation, and a cylindrically-disposed contiguous helical and relatively narrow non-re-formable zone joining and extending forwardly from the head and together with the re-formable zone encircling the shell more than one circumference thereof, whereby to secure the longitudinal extensibility of the shell while continuously maintaining a cylindrically-disposed un-reformed surface-connection between the forward portion of the shell and the head thereof, so as to prevent snapping off of the rear end of the tube when extending backward upon firing of the cartridge.

10. The improved elongatable metallic shell herein described for gun-operating cartridges, it comprising a tubular portion adjoining the head of the shell and having a decreasing thickness of tube-wall from the rearward end forwardly therefrom, and having formed therein a plurality of non-contiguous helically-located zones extensible as described by re-formation and with an aggregate extension around the shell of more than one entire circumference thereof, and having said extensible zones of an increasing depth and also of an increasing width of formation, and also of an increasing resistance to re-formation by gas-pressure from the forward part of these zones rearwardly toward the head of the shell; and an intermediate non-extensible zone connecting a plurality of the extensible zones, forming a non-extensible strip forward from the head and throughout the tubular body, and adapted by its relatively narrow width for being flexed in an edgewise direction on the elongation of the shell, substantially as described.

11. The improved elongatable metallic shell herein described for gun-operating cartridges, it comprising a tubular portion adjoining the head of the shell and having a decreasing thickness of tube-wall from the rearward end forwardly therefrom, and having formed therein a plurality of helically located zones extensible by re-formation as set forth and with an aggregate extension around the shell of more than one entire circumference thereof, and having said extensible zones of an increasing depth of formation from the forward part of these zones rearwardly toward the head of the shell, so that the head of the shell upon firing of the cartridge will be projected outward by a progressive backward extension of said tubular portion.

12. The improved elongatable metallic shell herein described for gun-operating cartridges, it comprising a tubular portion adjoining the head of the shell and having a decreasing thickness of tube-wall from the rearward end forwardly therefrom, and having formed therein a plurality of helically located zones extensible as set forth by re-formation and with an aggregate extension around the shell of more than one entire circumference thereof, and having said extensible zones of an increasing depth and also of an increasing width of formation, and also of an increasing resistance to re-formation by gas-pressure, from the forward part of these zones rearwardly toward the head of the shell, so that the head of the shell upon firing of the cartridge will be projected outward by a progressive backward extension of said tubular portion.

13. In an elongatable metallic shell for gun-operating cartridges, the combination with the forward-tube of the shell, and with the head, of a plurality of substantially helical zones each extensible as set forth transversely of itself and longitudinally of the shell by re-formation, and intermediate helical non-re-formable zones joining and extending forwardly from the head and together with the re-formable zones extending around the shell more than one entire circumference thereof, and the shell having a relatively large longitudinal extensibility of the shell while continuously maintaining a plurality of cylindrically-disposed surface-connections between the forward portion of the shell and the head thereof, so as to prevent snapping off of the rear end of the tubular portion when extending backward upon firing of the cartridge.

14. In a metallic longitudinally-extensible shell for gun-operating cartridges, the combination with the head, and with the ungrooved forward-tube, of a tubular portion adjoining the head, and having a helically located zone extensible by re-formation and extending around the shell for more than one entire circumference of the shell, and having said extensible zone of an increasing depth of formation from its forward end rearwardly toward the head of the shell, and located at a lesser angle from the plane of the head than from the axis of the shell, and having the cross-sectional form of the double-ogee, so that the head of the shell upon firing of the cartridge will project out by a progressive backward extension of said tubular portion.

15. In a metallic longitudinally-extensible shell for gun-operating cartridges, the combination with the head and with the relatively non-extensible integral forward-tube, of a tubular portion adjoining the head and having a plurality of helically arranged zones following side by side around the shell and extensible as set forth by re-formation, and extending around the shell for more than one entire circumference thereof, and having said extensible zones of an increasing depth of formation from their forward ends rearwardly toward the head of the shell, and located at a lesser angle from the plane of the head than from the axis of the shell, and having the cross-sectional form of the double-ogee; and intermediate helically located zones connecting re-formable zone-areas of a plurality of said re-formable zones, in the direction of the length of the shell, so as to prevent snapping off of the rear end of the tube when progressively extending backward upon firing of the cartridge.

16. In a metallic longitudinally-extensible shell for gun-operating cartridges, the combination with the head and with the relatively non-extensible integral forward-tube, of a tubular portion adjoining the head and having a decreasing thickness from the rearward end forwardly therefrom, and having a zone extensible as set forth by re-formation and located in a helical direction and extending around the shell for more than one entire circumference thereof, and located at a lesser angle from the plane of the head than from the axis of the shell, and having the cross-sectional form of the double-ogee; and an intermediate helically located zone connecting successive re-formable zone-areas in the direction of the length of the shell, so as to prevent snapping off of the rear end of the tube by the progressive backward extension of the tubular portion upon firing of the cartridge.

17. In a metallic longitudinally-extensible shell for gun-operating cartridges, the combination with the head and with the relatively non-extensible integral forward-tube, of a tubular portion adjoining the head and having a decreasing thickness from the rearward end forwardly there-

from, and having a plurality of helically arranged zones following side by side around the shell and extensible as set forth by reformation and extending around the shell for more than one entire circumference thereof, and located at a lesser angle from the plane of the head than from the axis of the shell, and having the cross-sectional form of the double-ogee; and intermediate helically located zones connecting re-formable zone-areas of a plurality of said reformable zones, in the direction of the length of the shell, said intermediate zones being relatively narrow to permit edgewise flexing upon firing of the cartridge.

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CARTRIDGE.

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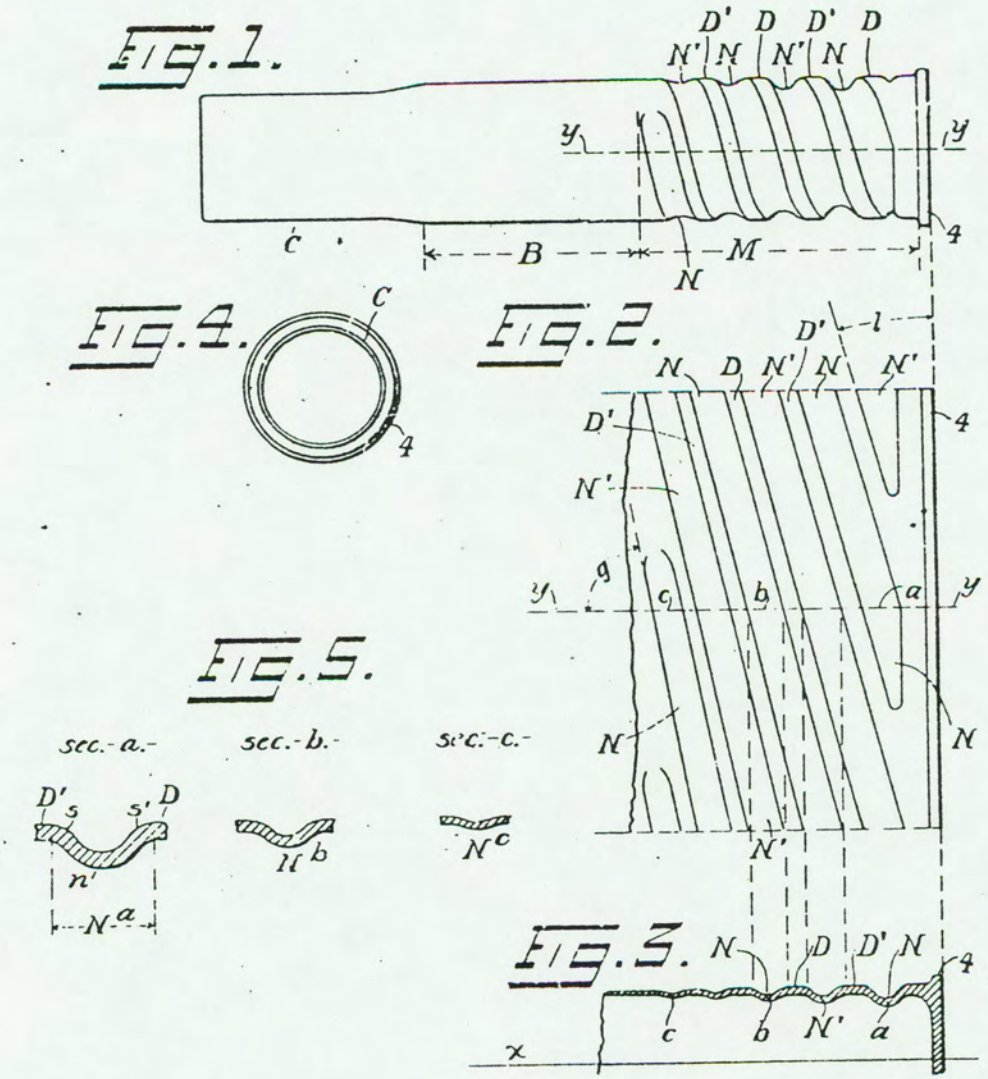

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