3 Sheets
Sheet 1.

J. B. Tarr.

Manufacture of Spherical Shot & Shell.

No. 76271 Patented Mar. 31, 1868.

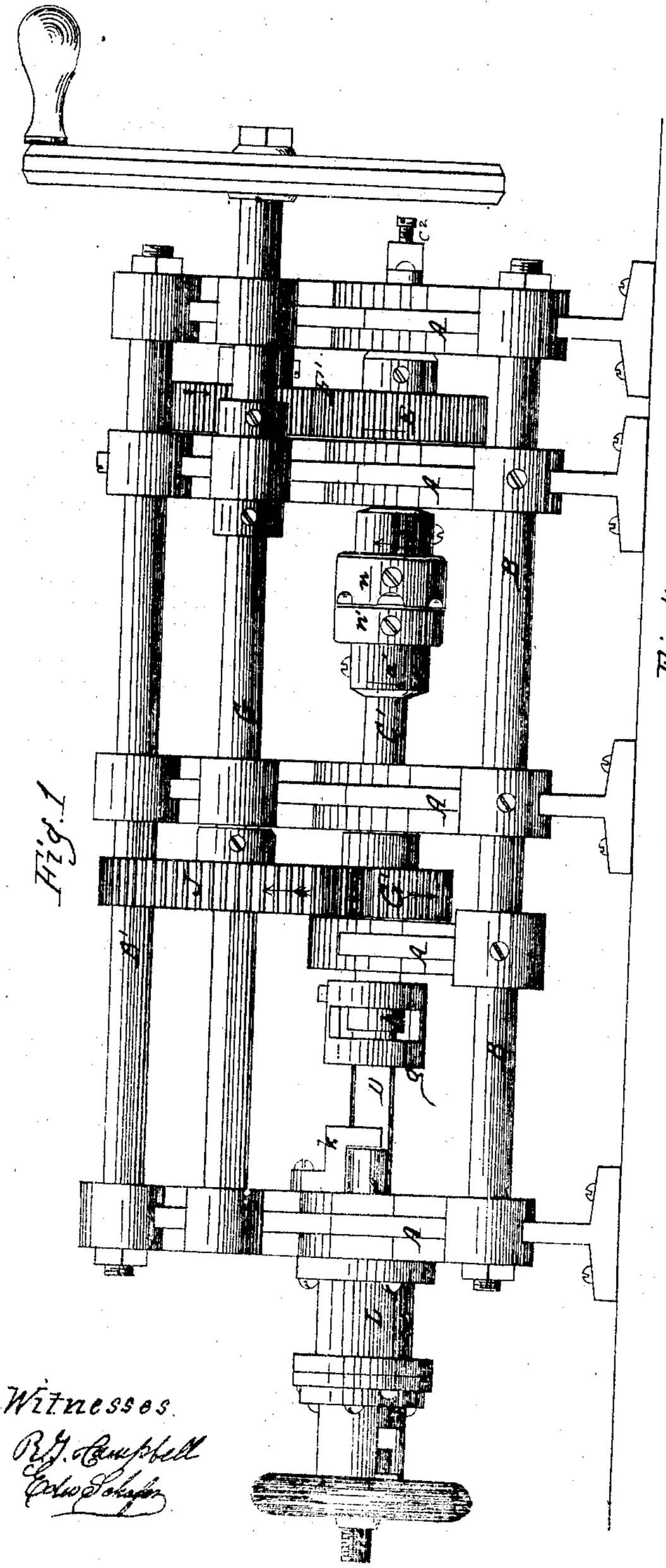

Fig. 1.

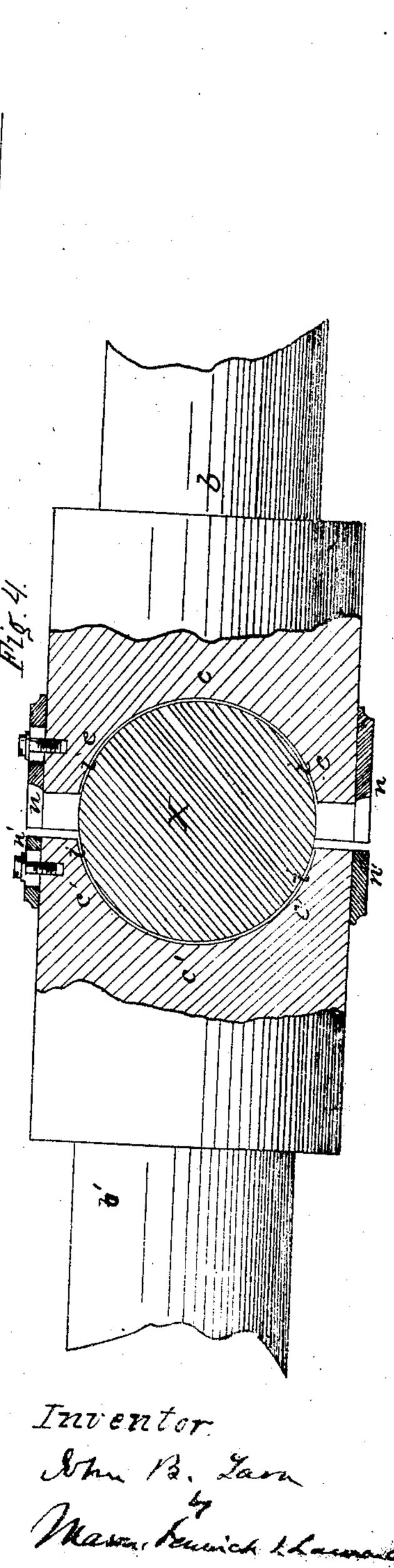

Fig. 4.

Witnesses.
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Sheet-2.

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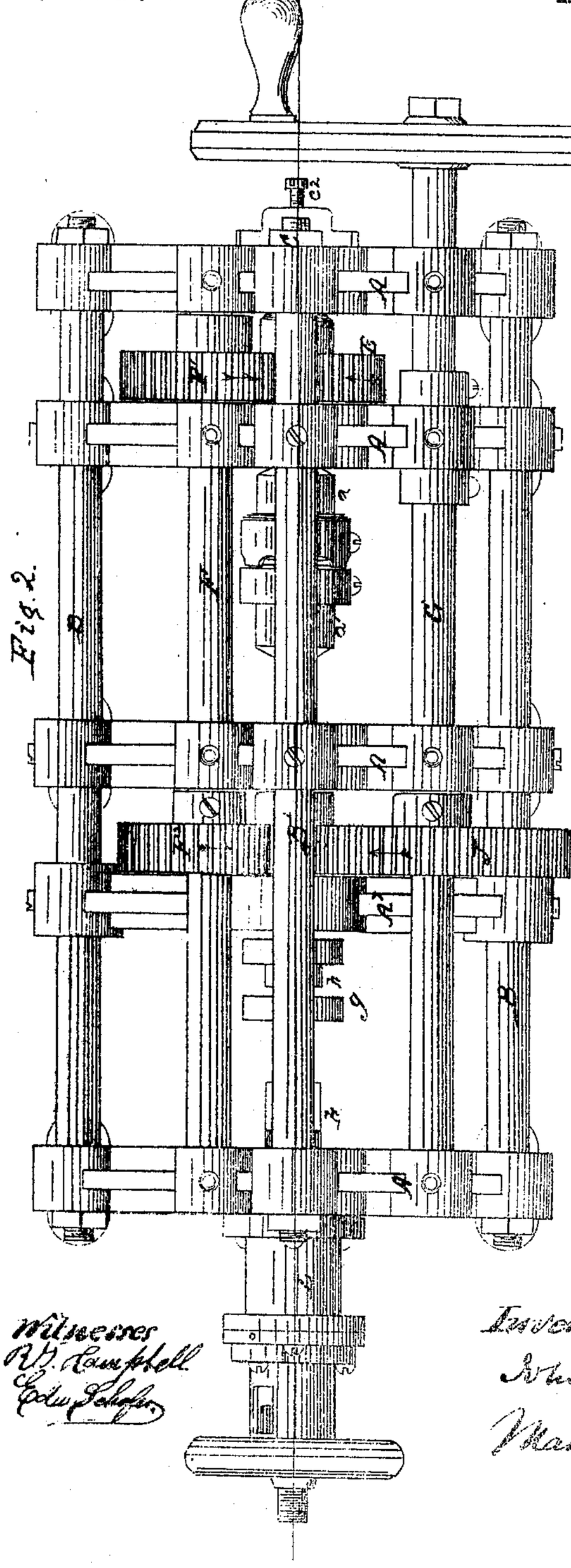

Fig. 2.

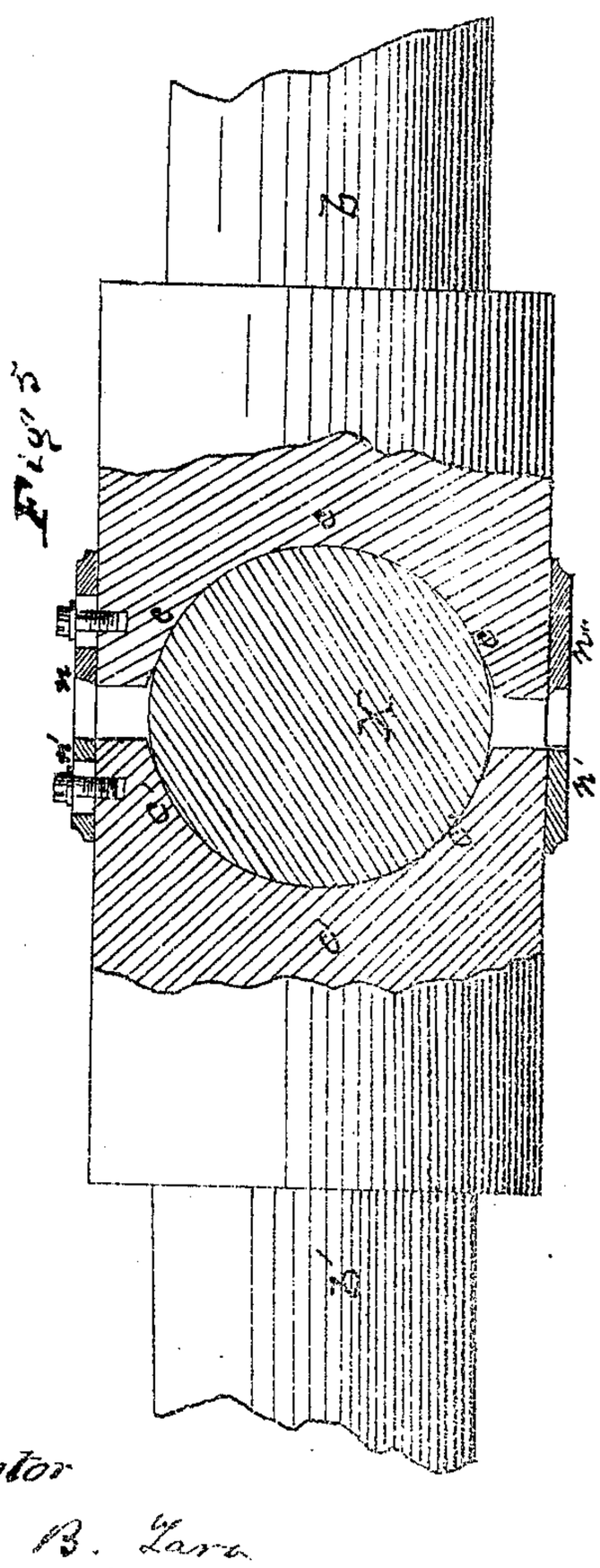

Fig. 5.

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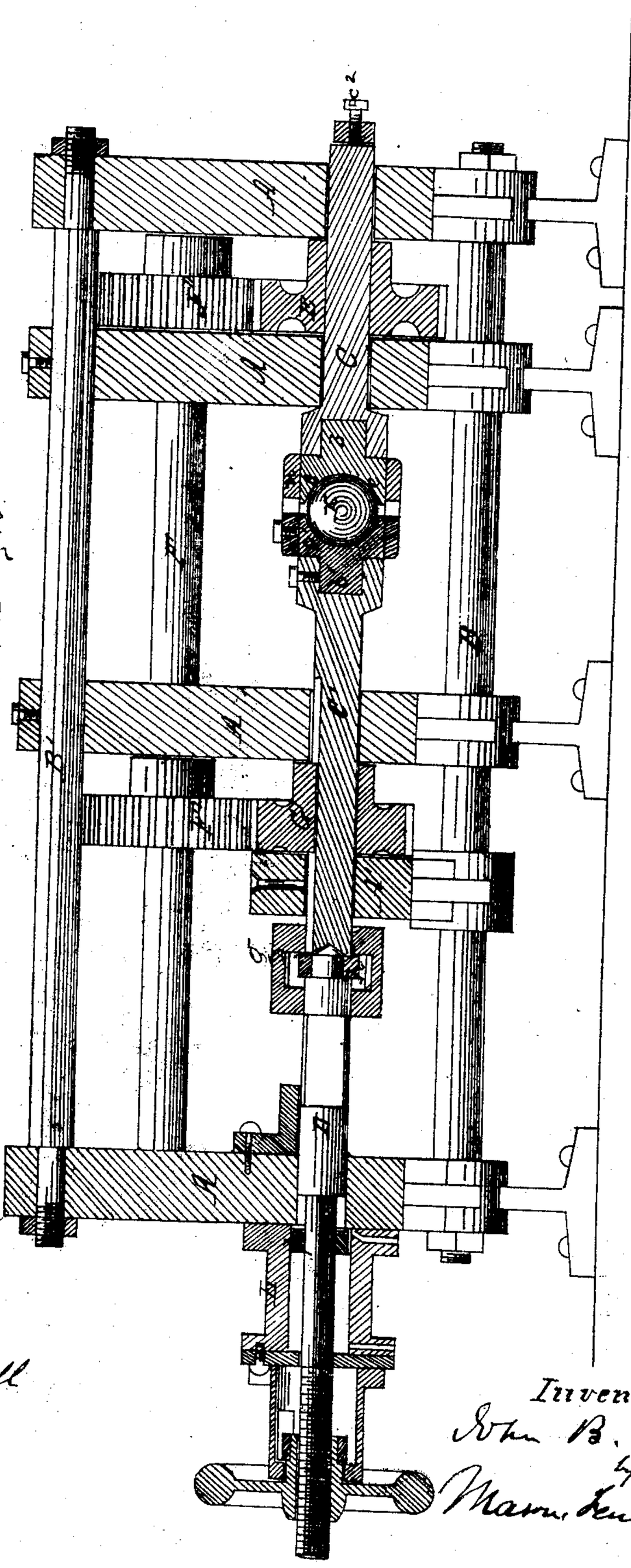
3 Sheets
Sheet 3

J. B. Tarr.

Manufacture of Spherical Shot & Shell

No. 76271 Patented Mar. 31, 1868.

Fig. 3.



Witnesses
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UNITED STATES PATENT OFFICE.

JOHN BLAKE TARR, OF FAIR HAVEN, MASSACHUSETTS.

IMPROVEMENT IN THE MANUFACTURE OF SPHERICAL SHOT AND SHELL.

Specification forming part of Letters Patent No. **76,271**, dated March 31, 1868.

To all whom it may concern:

Be it known that I, JOHN BLAKE TARR, of Fair Haven, in the county of Bristol and State of Massachusetts, have invented an Improvement in the Manufacture of Spherical Shot and Shells for Ordnance; and I do hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings, making part of this specification, in which--

Figure 1, Sheet 1, is an elevation of one side of a machine which is adapted for carrying out my invention. Fig. 2, Sheet 1, is a top view of the same machine. Fig. 3, Sheet 1, is a longitudinal section taken in a vertical plane through the center of the machine. Fig. 4, Sheet 2, is an enlarged view, in section, of the two cups, between which spherical shot and shell are rolled and compressed, showing a ball in the act of being compressed. Fig. 5, Sheet 2, is a similar view of the same parts, showing a ball after it has been fully compressed.

Similar letters of reference indicate corresponding parts in the several figures.

This invention relates to an improvement in the manufacture of steel spherical shot and shells for ordnance, whereby they are rendered more perfect in sphericity, and more effective in their destructiveness upon walls and other objects against which they are thrown than shot or shells hitherto made.

The invention relates more particularly to spherical steel shot, solid shot, and it is designed for rendering them so hard and dense throughout that they will be much less liable to break into fragments when suddenly arrested by a solid body than the spherical or round shot hitherto made.

It is well known that steel shot are more or less porous internally, which is caused by the metal cooling so much quicker at and near the circumference of the shot than it does nearer the center thereof. This difference in cooling and shrinking not only renders the metal weak and very liable to shatter into fragments when the shot are suddenly arrested in their flight, but the unequal cooling will in many instances cause an unequal shrinking and leave the shot irregular or spheroidal rather than perfectly spherical, as they should be.

To remedy the above-named objections in the manufacture of steel shot and shells, and to produce the same so that they shall be homogeneous in density and toughness throughout, the nature of my invention consists in an improved method of subjecting spherical shot, as well as spherical shells, to powerful mechanical compression while in a highly heated or plastic condition, and during the operation of condensing the ball, either simultaneously therewith or at intervals, giving them such motion about their axes as will leave them spherically true when finished, as will be hereinafter explained.

It also consists in a stop-gage applied to one of the ball-cups in such manner that when the proper degree of compression and condensation of the ball or shell, as the case may be, has been attained, said gage will prevent any further approximation of the cups, and also indicate that the work is complete, as will be hereinafter set forth.

To enable others skilled in the art to understand my invention, I will describe one practical mode of carrying it into effect.

The frame of the machine consists of several standards, A A A A, which are secured down firmly to a solid foundation in vertical planes and at proper distances apart, and are strongly braced and tied together by means of horizontal rods B B B′, as clearly shown in the drawings, Sheet 1. The several standards consist of arms radiating from central hubs, through which latter the three shafts C, C′, and D pass, as shown in Fig. 3. These three shafts are in a horizontal plane and their axes all coincide. The two shafts or spindles C C′ have enlargements *a a′*, formed on their inner ends, and in the ends of these enlargements sockets are formed for receiving the shanks *b b′* of cups or molds *c c′*, as shown in Fig. 3.

The shaft or spindle C has a spur-wheel, E, keyed upon it, which engages with a spur-wheel, F′, on a horizontal shaft, F, which latter receives motion from the arbor G, as will be hereinafter described. Shaft C is not allowed to have endwise motion, and its outer end bears against an adjustable screw-stop, c^2, which can be set up when necessary to compensate for longitudinal play of this shaft, caused by wear. In the operation of the machine there will be considerable pressure brought to act in a longitudinal direction upon the shaft C; and in order to enable it to resist such pressure without considerable fric-

tion I employ the step or abutment c^2, which may be made of hardened steel, fitted to impinge against a hardened-steel block or washer in the outer end of said shaft.

The shaft C′ has its bearings in one of the intermediate standards A, and also in a bridge-block, A′, which is secured to and held by the two lowermost tie-braces B B of the frame, as shown in Sheet 1. This shaft C′ has a pinion spur-wheel, G′, keyed to it by a feather and groove, as shown, which will allow said shaft to receive an endwise movement while rotating or while at rest. The pinion spur-wheel G′ engages with the teeth of a spur-wheel, F^2, on the shaft F, and this wheel F^2 engages with the teeth of a spur-wheel, J, on the main driving shaft or arbor G, so that the two shafts C C′ are rotated in opposite directions and at different speeds. By changing the gearing the two shafts may be rotated in the same direction at different speeds; or they may be rotated in opposite directions, both having the same speed or velocity. I prefer to adopt the arrangement above described and shown in the drawings.

On the outer end of the shaft C′ a coupling-box, *g*, is rigidly secured, to which the inner end of the shaft D is applied. One end of this shaft D enters loosely through the head of the box *g*, and has an enlargement or shoulder, *h*, formed on it, which couples the two shafts C′ D together, so that a longitudinal movement can be given to the shaft C′ by moving shaft D longitudinally, whether the former be rotating or at rest. The shaft D is flattened on two sides a portion of its length, and received between the forks of a fixed bracket, *k*, which latter prevents shaft D from rotating. The inner extremity of shaft D is made conical, and fitted into a corresponding cavity in the outer end of the shaft C′, so that during the act of applying endwise pressure to the latter shaft there shall be as little friction as possible.

I have represented in the drawings, Sheet 1, two modes of moving the two shafts C′ and D longitudinally. I do not contemplate employing both of these modes at the same time. One mode, and that which I prefer to adopt, consists in bolting a very strong cylinder, L, of suitable length, to the frame of the machine, so that the shaft D shall pass into it, and in applying upon said shaft, within the cylinder, a piston, *p*. This cylinder I connect by means of suitable pipes with a forcing pump or engine similar to those used in the well-known hydrostatic presses. The other mode consists in forming a screw-thread upon the outer portion of the shaft D and applying a large fly or hand wheel upon it, as shown clearly in Fig. 3, so that by turning said wheel shaft D will be moved in a direction with its length.

I shall now refer particularly to Figs. 4 and 5 on Sheet 2 for the explanation of the cups or molds, within or between which the balls or shells are compressed and condensed. These cups or molds are both made exactly alike, and they are applied to their respective shafts C C′, so that they can be readily removed therefrom and others substituted in their stead, for operating upon different-sized balls or shells. The concavities or cups may be produced in the ends of solid heads by means of a drill, which in form is the segment of a circle corresponding in part to the diameter of the ball or shell which it is desired to make, so that when the ball is finished it will fit snugly into those portions of the cups or cavities made by such drill. It will also be seen that the outer terminations of the cups are made slightly flaring. This is done in order to allow of the reception of balls by the cups before the balls are compressed to the proper caliber or diameter, as shown in Fig. 4. In this figure it will be seen that the ball X only touches at two points, *i i*, whereas it will be seen by reference to Fig. 5 that the ball fits snugly into those portions of the cups or cavities which are concentric to its axis. This latter figure represents the condition of things when the ball is finished and ready to be removed from its cups. Surrounding the cupped head *c* is an adjustable collar, *n*, one end of which extends a proper distance beyond the end of its head, and is notched in order to allow of the free escape of scales which will fall from the ball during the operation of condensing it. On the opposite cupped head, *c′*, is a stop, *n′*, which may also be made adjustable, if desired, and which is intended to receive the projecting end of a collar against it when the shaft B′ has been moved up a proper distance. The collar *n*, with its ring-stop *n′*, forms a stop-gage for stopping further compression of the ball when it has been properly centered and condensed in its cups, as shown in Fig. 5. In making the cavities or cups in the heads, and in applying these heads to their respective shafts, care should be had to have the cavities exactly coincide with the axes of said shafts. The rotundity of the ball while it is in a highly-heated state and confined between the cups is effected by the action of the rotation of the ball between the cups, in conjunction with the compression of said cups upon the ball—that is to say, after the ball has been rotated by the cups, more or less, to impart rotundity to it, the cups may then be made to approach each other, so as to compress the ball more or less. The cups then being slackened up, or drawn slightly apart, motion will be so imparted to the ball as to change its plane of rotation within the cups, thus preventing other parts of the surface of the ball to the rotating and compressing effects of the cups. This being done, the cups are again tightened or made to approach each other, thus again compressing the ball, as before stated; and this operation is repeated as often as may be required to make the ball not only perfectly spherical, but also cause its density to be the same throughout. During the rotary motion of the shaft C′ it, with its cup *c′*, may be very slowly moved toward the cup *c*, and thus the shaping and condensing of the ball be performed simultaneously. This

mode, however, may not be as desirable as the mode just described. Thus produced, the balls will require no further finish except that of polishing or smoothing, which may be done in the usual well-known manner by rolling and attrition with emery-powder or other suitable polishing substance. In practice the balls may be reheated preparatory to their being placed between the cups or molds; but the work would be greatly facilitated by removing the balls directly from the molds in which they were cast to the condensing-cups before the balls become too cool. This will save the expense and labor of reheating them after they have become cool. After each ball is finished and brought to the proper size or caliber, as above described, the shaft C′, with its cup *c*′, is moved back far enough to allow the ball to drop out, when it may be caught by a spiral trough, and thus conducted into a "pickle" and cooled.

Instead of having but two cups or molds, as above described, three or more cups of proper shape and size might be employed for giving motion to the ball in different directions about its axis during compression and condensation. Such cups would have to be applied to radial shafts arranged at regular distances apart around a common center; and, if desirable, the cups may be arranged in gangs consisting of many pairs of cups applied to shafts mounted in a single frame, thereby admitting of the compression of a number of balls of the same or of different sizes, at one and the same time.

Having now described and shown one practical mode of carrying out my invention, I do not wish to be understood as limiting myself to the precise instrumentalities herein set forth, as others operating upon the same general principle may be adopted without departing from my invention.

I am aware that in the patent of Perry G. Gardner, dated December 23, 1851, a contrivance is described for forming a wrought-iron car-wheel which is somewhat similar to that hereinbefore set forth; but that invention did not contemplate, and could not effect, the main object I have in view in my own, which is to compress and shape a completely-spherical shot or shell by causing it to revolve between cup-shaped dies under circumstances that produce a constant change in its axis of revolution, so as to bring different portions of the surface continually under the action of those dies, whereas in Gardner's machine the axis of revolution is not only unchanging, but wholly unchangeable. I am also aware that John L. Knowlton, in his patent of August 1, 1865, represents a machine approximating in appearance still more nearly to my own, but the cups used by him are not dies, but chucks to hold the shot fast and cause it to revolve while it is being polished by another instrument. The operation is not to swage or shape the shot, but merely to smooth its surface. No differential motion of the two chucks is provided for or contemplated, nor is the axis of rotation subjected to the gradual and constant change which is so essential to the successful operation of my machine. Knowlton's purpose is to operate upon the shot after it is cold and rigid, while mine is to work it into shape, while in a plastic state, through the instrumentalities I have described. I do not, therefore, claim either of the contrivances above referred to; nor do I claim as new any of the parts hereinbefore described separately and distinct from other parts; but

What I do claim as new, and desire to secure by Letters Patent, is—

1. A combination of mechanical devices, substantially such and operating essentially so as that hereinbefore described, for compressing and forming spherical shot while in a plastic state from heat.

2. In a machine such as is hereinbefore described, giving the outer edges of the retaining and forming dies an additional flare, in the manner and for the purpose above set forth.

3. In combination with a pair of concave dies arranged to compress or form spherical bodies of heated metal, as above described, mechanism for imparting to each of said dies a different motion from that given to the other, substantially as and for the purpose above described.

4. In a machine for forming spherical bodies from heated metal in the manner above shown, the construction and use of a stop-gage constructed substantially as described, in combination with compressing and forming dies.

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Witnesses:

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EDW. SCHAFER.