2 Sheets—Sheet 1.

D. TREADWELL.

Ordnance.

No. 42,701. Patented May 10, 1864.

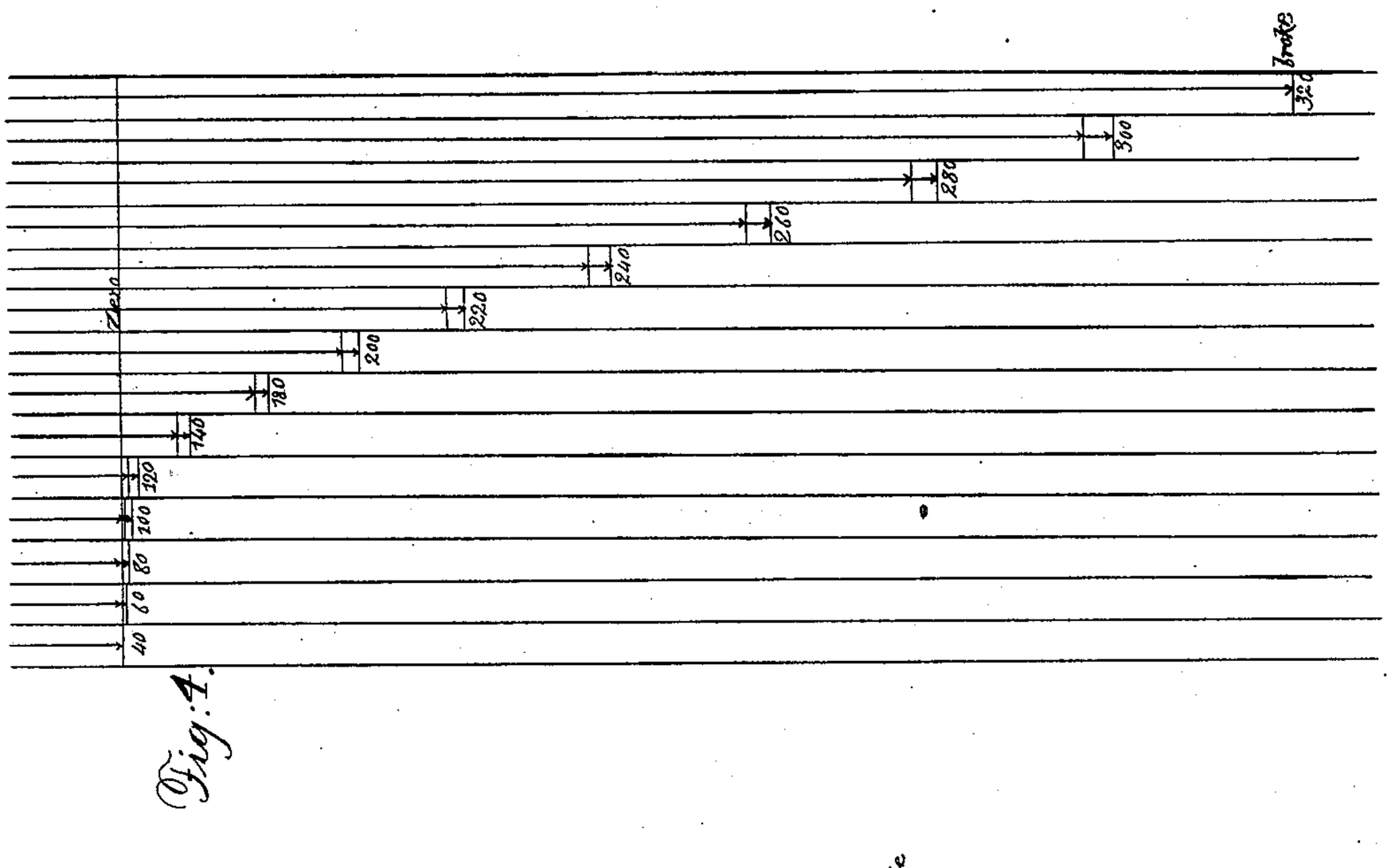

Fig: 4.

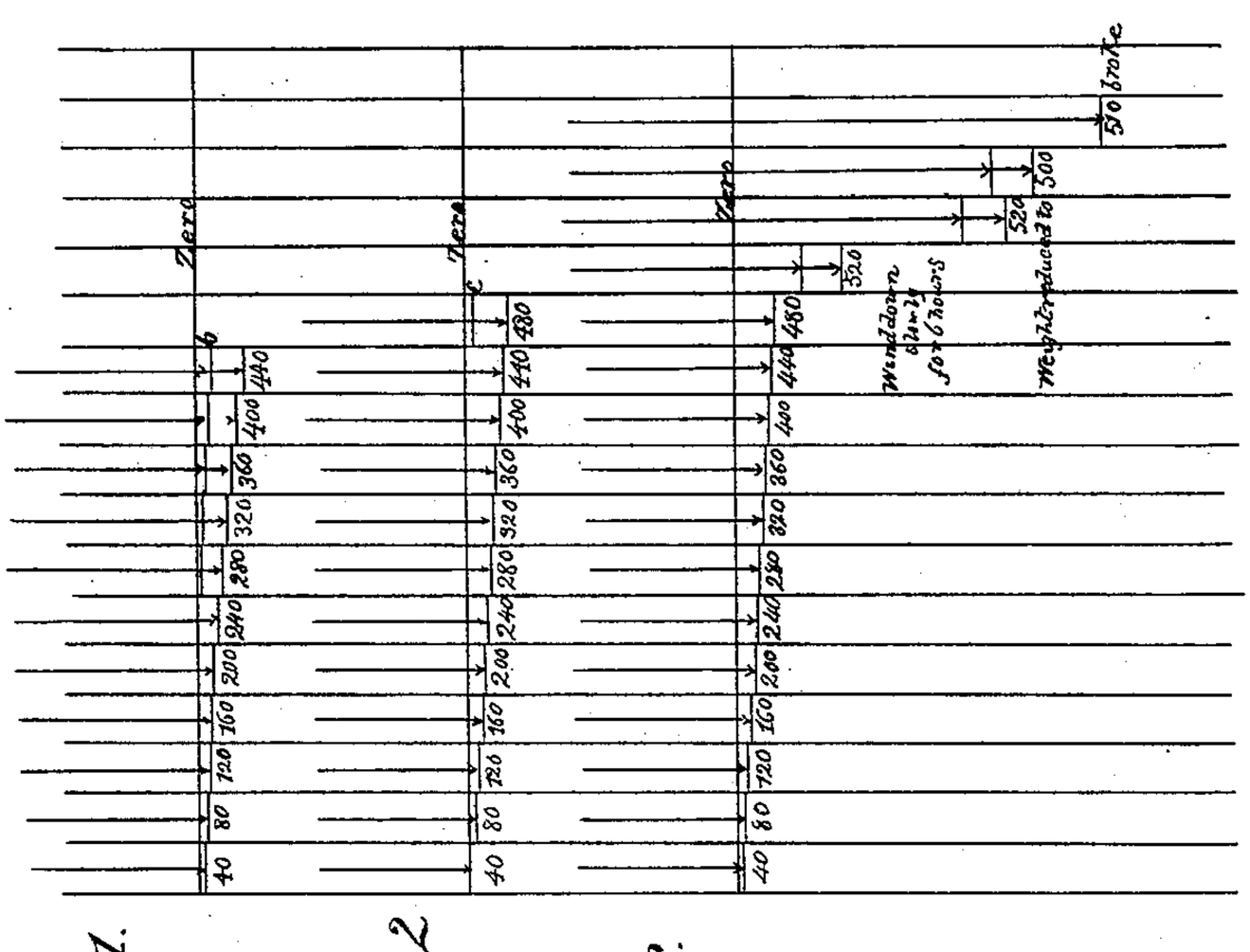

Fig: 1. Fig: 2. Fig: 3.

Witnesses.
Thos Hubbard
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Inventor:
Dan'l Treadwell

2 Sheets—Sheet 2.

D. TREADWELL.

Ordnance.

No. 42,701. Patented May 10, 1864.

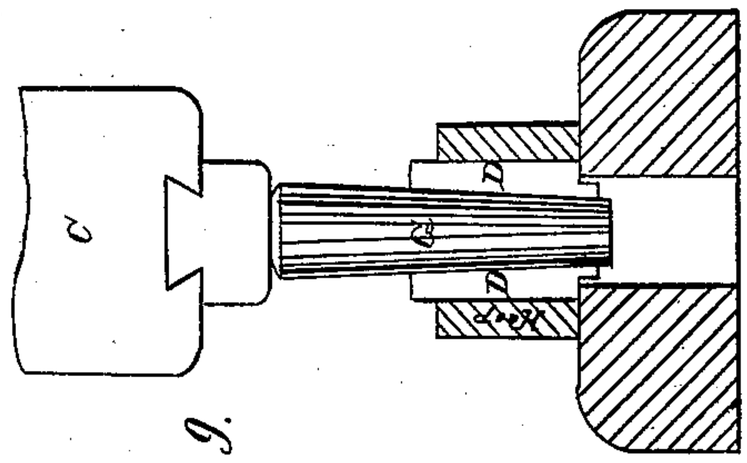

Fig: 9.

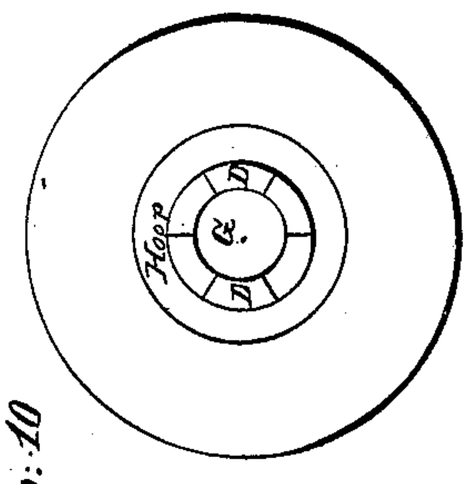

Fig: 10

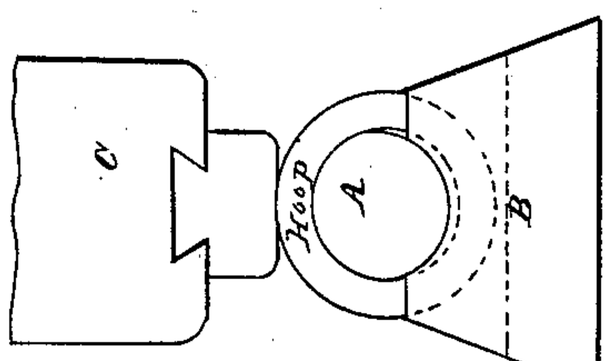

Fig: 6.

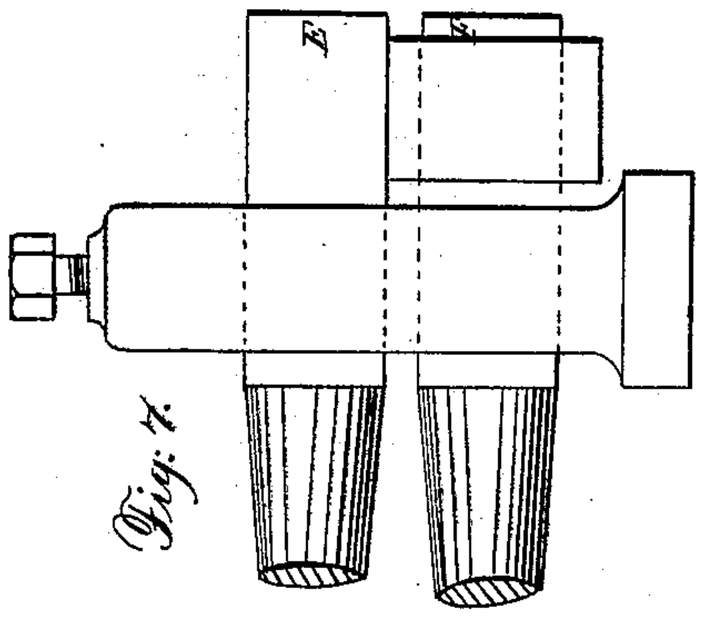

Fig: 8.

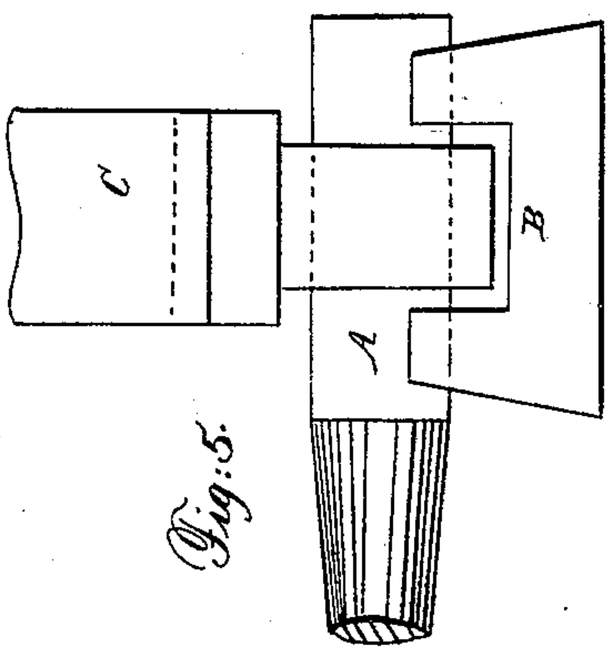

Fig: 5.

Fig: 7.

Witnesses
Wm C Hobbs
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Inventor
Dan'l Treadwell

UNITED STATES PATENT OFFICE.

DANIEL TREADWELL, OF CAMBRIDGE, MASSACHUSETTS.

IMPROVEMENT IN THE MANUFACTURE OF HOOPS FOR CANNONS.

Specification forming part of Letters Patent No. **42,701**, dated May 10, 1864.

To all whom it may concern:

Be it known that I, DANIEL TREADWELL, of Cambridge, in the county of Middlesex and State of Massachusetts, have invented a new and Improved Method of Preparing Hoops for the Construction of Hooped Cannons and other Similar Structures; and I do hereby declare that the following is a full, clear, and exact description of the same, taken in connection with the accompanying drawings, in which—

Figures 1, 2, 3, and 4 represent graphically the results of four sets of experiments upon iron rods subjected to tension, which will be hereinafter explained. Figs. 5 and 6 represent two views of the apparatus designed to be used in connection with a steam-hammer for condensing and hardening the hoops. Figs. 7 and 8 represent the manner of arranging rolls in a rolling-mill to accomplish the same purpose, and Figs. 9 and 10 represent an apparatus for distending the hoops by internal pressure.

The subject-matter of my invention is an improvement in the method of making and applying the hoops employed in the construction of hooped cannons, by means of which they are more perfectly adapted to their purpose than when constructed in the manner heretofore practiced. The principles involved in this method of manipulation will be more readily understood from a brief description of four sets of experiments that I have tried, among many others, the results of which are represented in the accompanying drawings, and show readily to the eye the action of wrought-iron under the several conditions noted, and which have an important bearing upon the question of how to construct the hoops for hooped cannon in the best manner.

In my experiments I operated upon pieces of iron wire one hundred and forty inches long and about one-tenth of an inch in diameter, some of them in the condition in which they are left by the drawing-dies, some of them annealed, and others subjected to intermediate temperatures. The wire experimented upon was secured in a frame and subjected to various tensions of a determined amount, increasing by degrees until the wire was broken. The smallest force (forty pounds) was first applied, and the extent of the elongation of the wire was carefully marked upon a scale. The tension was then released to see if the elasticity was sufficient to restore the wire to its former length. Then an increased tension of eighty pounds was applied and the elongation marked, and the weight then removed as before, and so on. The result of this series of experiments is delineated in Fig. 1 of the drawings, and shows that with a tensile strain of two hundred and forty pounds the wire was elongated the amount shown at *a*, and when the weight was removed the elasticity of the material was sufficient to restore it to its original length; but with a greater tension of two hundred and eighty pounds a small permanent elongation of the wire was produced, of an amount shown by the first line near the zero-line in that column. The results with the succeeding weights that were applied up to four hundred and forty pounds are graphically represented, and show the amount of elasticity and of permanent elongation in each experiment. The same wire was then taken for a second series of experiments, and the length after the last experiment, as indicated at *b*, Fig. 1, was taken as the zero of the scale of Fig. 2. The weights were applied as before, and the results are noted upon the scale. The same wire was then taken for a third series of experiments, and the length left by the preceeding experiment at *c* was taken for the zero of this. The wire was then heated sufficiently to cause oil to blaze upon it throughout its entire length, and then subjected to successive weights, as before, till it broke. The result is graphically represented in Fig. 3.

In Fig. 4 is represented the results of a series of experiments with a wire of the same size and length, as in previous experiments, after it had been annealed by simply heating it to a full red heat. The weights noted were then successively applied and removed, as before, and the results recorded, as is shown in Fig. 4, which shows the permanent elongation and elasticity exhibited by each experiment in a very striking manner. Other facts having an immediate connection with these experiments are noted upon the drawings, which sufficiently explain themselves. These experiments demonstrate and show with precision several notable physical facts, all of which are of high importance in the construc-

tion of cannon upon the principle of that patented to me December 11, 1855, and reissued February 4, 1862, in which the hoops are put upon the body of the gun with a great permanent tension by expanding them by heat and placing them upon the gun, when, by cooling, they compress the part inclosed. These facts are, first, that with a piece of iron hardened by compression and tension, in the condition of the hard wire, the amount of permanent extension is far smaller than the elasticity up to near the breaking-point, and also that the permanent elongation does not commence until about one-half of the breaking-strain is applied—a greater tension than would be applied in ordinary practice; second, that the amount or extent of the elasticity is increased by the permanent elongation of the rod by tension up to near the breaking-point; third, that when the material has been subjected to a tension of a given amount—say, four hundred and eighty pounds, as in Fig. 2—the repeated application of a tension within that amount produces no further permanent elongation; fourth, that the subjecting of the same material to a heat sufficient to burn oil (supposed to be about 800° Fahrenheit) will not impair its elasticity; fifth, that with the iron annealed the permanent elongation commences at a comparatively low tension, far below what it would be subjected to in a gun, and that its extent is very large in proportion to its elasticity, which shows how inappropriate to its use upon a cast-iron body is the condition of a hoop placed upon a gun if it has been heated to an annealing-temperature, and also that a hoop thus put on would probably be loosened by the discharges of the gun before the cast-iron body reached its fracturing-point.

Now, a temperature below that of burning oil will expand the hoops sufficiently to enable them to be placed upon the gun, although made three one-thousandths less in diameter than the body it is intended to inclose, and by cooling to compress the body and produce that condition of the gun that is contemplated by my patent reissued February 4, 1862.

My improved method of constructing the hoops for hooped cannon is founded upon these facts, and the manipulation hereinafter described is designed to impart to the hoops those qualities which the foregoing experiments show to be indispensable in the construction of such cannons, to enable the material to produce the best results. I make the hoops of coiled bars or concentric rings welded up and formed substantially as is described in my patent dated July 26, 1844, but of considerably less internal diameter than the hoop is to have after it has been hardened and stretched, as hereinafter directed. I prefer that manner of coiling the bar shown in Fig. 3 of the last-named patent. After the bar has been coiled or wound and welded up and forged into the hoop of proper shape or form by any suitable means, I place it, when cold, or at a temperature decidedly below the annealing-point, upon a mandrel or cylinder, A, Figs. 5 and 6, and placing it upon a suitable anvil-block, B, under a heavy steam-hammer, C, I hammer it, stretching or drawing it until the iron becomes hard and condensed and in a condition similar to the hard wire; or the same effect may be produced by rolling the hoop between a pair of rollers, E and F, arranged as is shown in Figs. 7 and 8, or by any other mechanism that will produce the result. I then place within the hoop the segmented swages or blocks D, Figs. 9 and 10, to the center of which is fitted the conical plug G. In this condition they are placed under a steam-hammer and upon an annular anvil-block, as is shown, and the plug G is driven in until the internal diameter of the hoop is enlarged, say, one one-hundredth part of its former diameter; or if the iron be of a soft and tough quality, it may be enlarged one-twentieth of its diameter. Instead of commencing this last operation with the hoop entirely cold, it may be heated to 600° Fahrenheit and continued slowly as the hoop cools, thus producing the effect of increasing the hardness and elasticity of the iron. After this operation, the hoop is finished by the lathe to the exact size required to give the appropriate compression to the body of the gun contemplated in my aforesaid patent, reissued February 4, 1862, which, if the imperfections of workmanship are small, should be from two one-thousandths to three one-thousandths of the measured diameter less than the part that it incloses. The hoop is then heated in an oven or muffle, or by any other suitable means, to a temperature not up to the annealing-point, and put in its place upon the gun and allowed to cool.

From the results of the experiments hereinbefore described it will be seen that the hoops thus prepared will have a high degree of elasticity, with the ability to resist permanent extension from any force to which they are intended to be subjected in use, which qualities are of the highest importance, especially where the hoops are placed upon a cast-iron body, which has very little extensibility, as is contemplated by my aforesaid patent, reissued February 4, 1862, as without these properties, as is the case when annealed hoops are used, the hoops may become loosened by the act of firing.

I do not intend to limit my invention to the preparing of the hoops by means of the mechanism mentioned or by any particular mechanism, the sketches of machinery shown in the drawings being designed only to show the nature of the modifications that may be made in machines in common use to adapt them to the purpose. Nor do I intend to confine my method to wrought-iron alone, as the same operations will apply to steel or other metals, varying the operations in each case to conform to the inherent properties of the metal, according to the principles hereinbefore set forth.

What I claim as my invention, and desire to secure by Letters Patent, is—

The method herein described of preparing hoops for hooped cannons or other similar purposes by condensing and hardening the material thereof, when below an annealing-temperature, by means of compression or extension, or both, substantially as described, and also, in connection therewith, in heating the same to a degree less than the annealing-point, for the purpose of placing them upon the gun, substantially as described.

Executed at Boston this 24th day of February, A. D. 1864.

DANL. TREADWELL.

Witnesses:

BENJ. F. BROOKS,

WM. C. HIBBARD.