No. 721,487. PATENTED FEB. 24, 1903.

C. VAN C. WHEELER & A. G. McKENNA.

PROJECTILE.

APPLICATION FILED SEPT. 12, 1902.

NO MODEL. 2 SHEETS—SHEET 1.

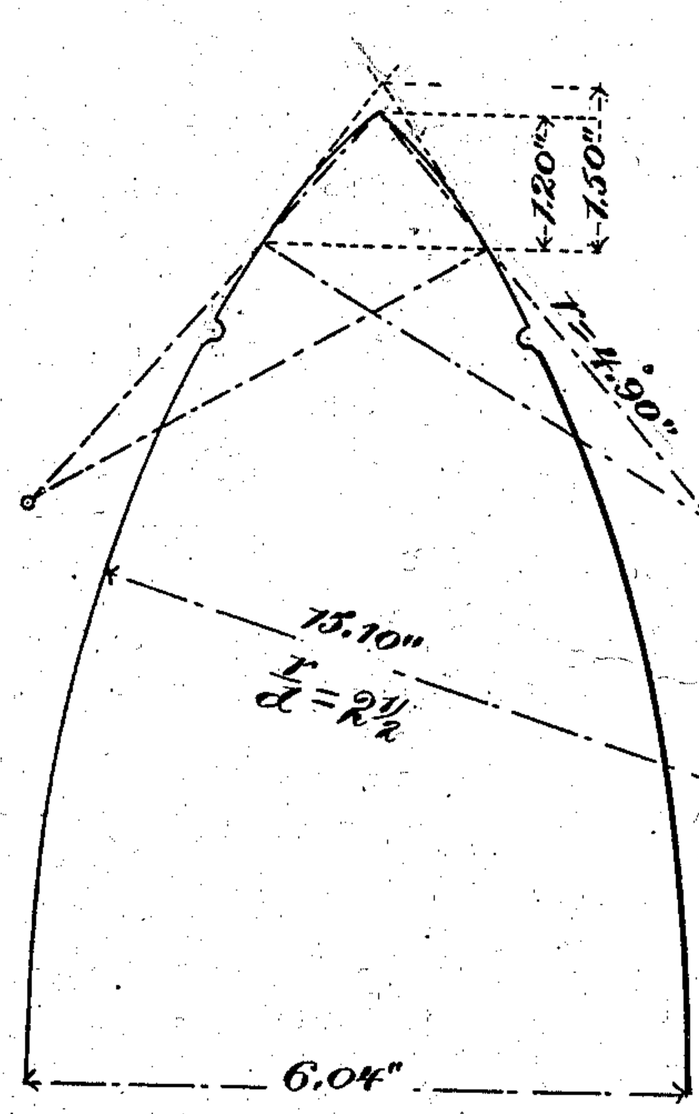


Fig. 2.

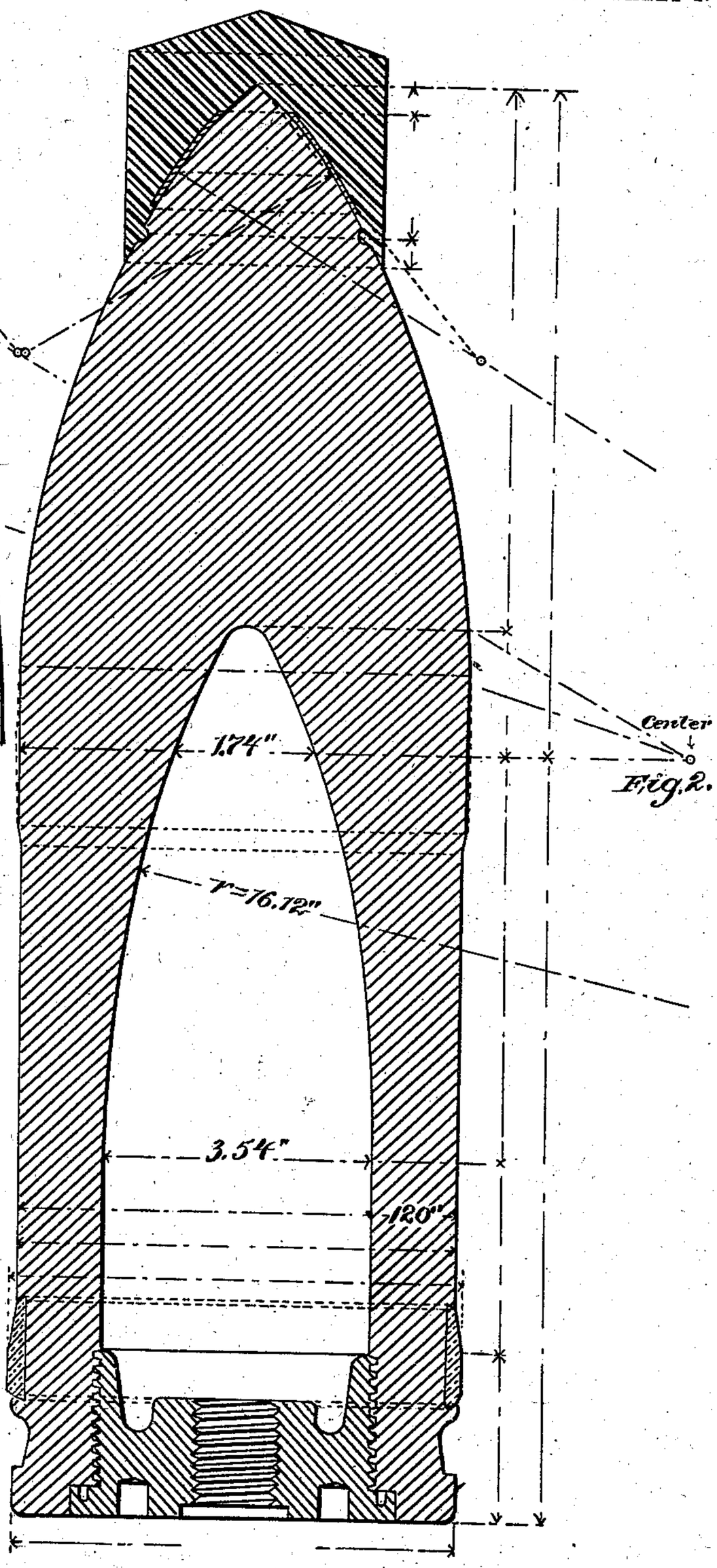


Fig. 2.

Fig. 1.

WITNESSES:
C. W. Benjamin
H. L. Edwards

INVENTORS
C. V. Wheeler and
A. G. McKenna.
BY Harold Bruce
ATTORNEY

No. 721,487. PATENTED FEB. 24, 1903.

C. VAN C. WHEELER & A. G. McKENNA.

PROJECTILE.

APPLICATION FILED SEPT. 12, 1902.

NO MODEL. 2 SHEETS—SHEET 2.

Fig. 3.

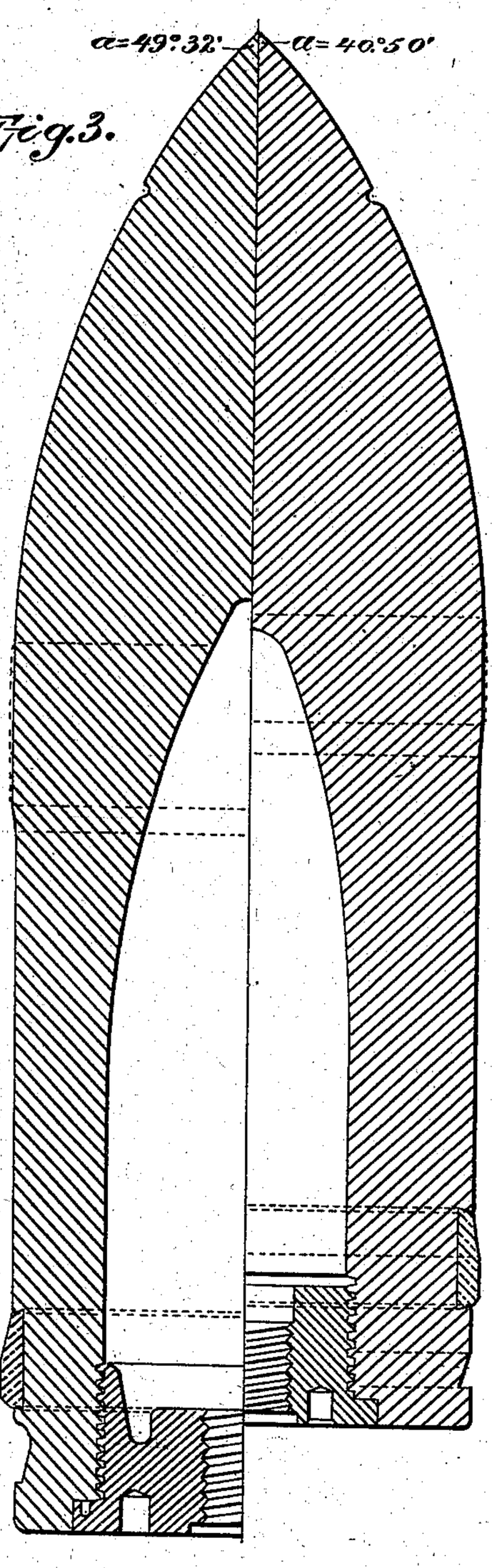


Fig. 4.

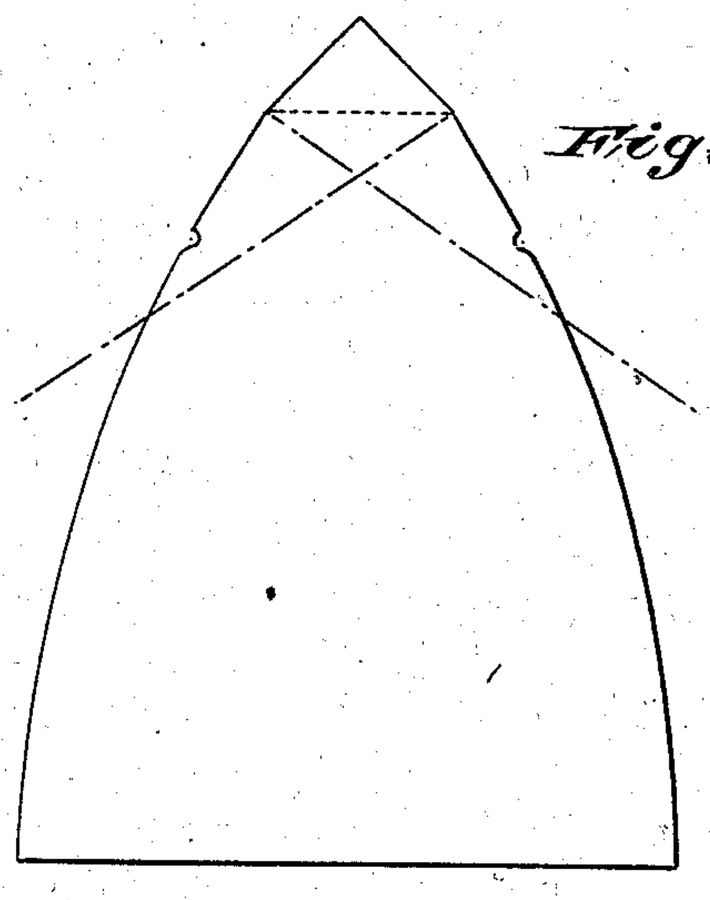
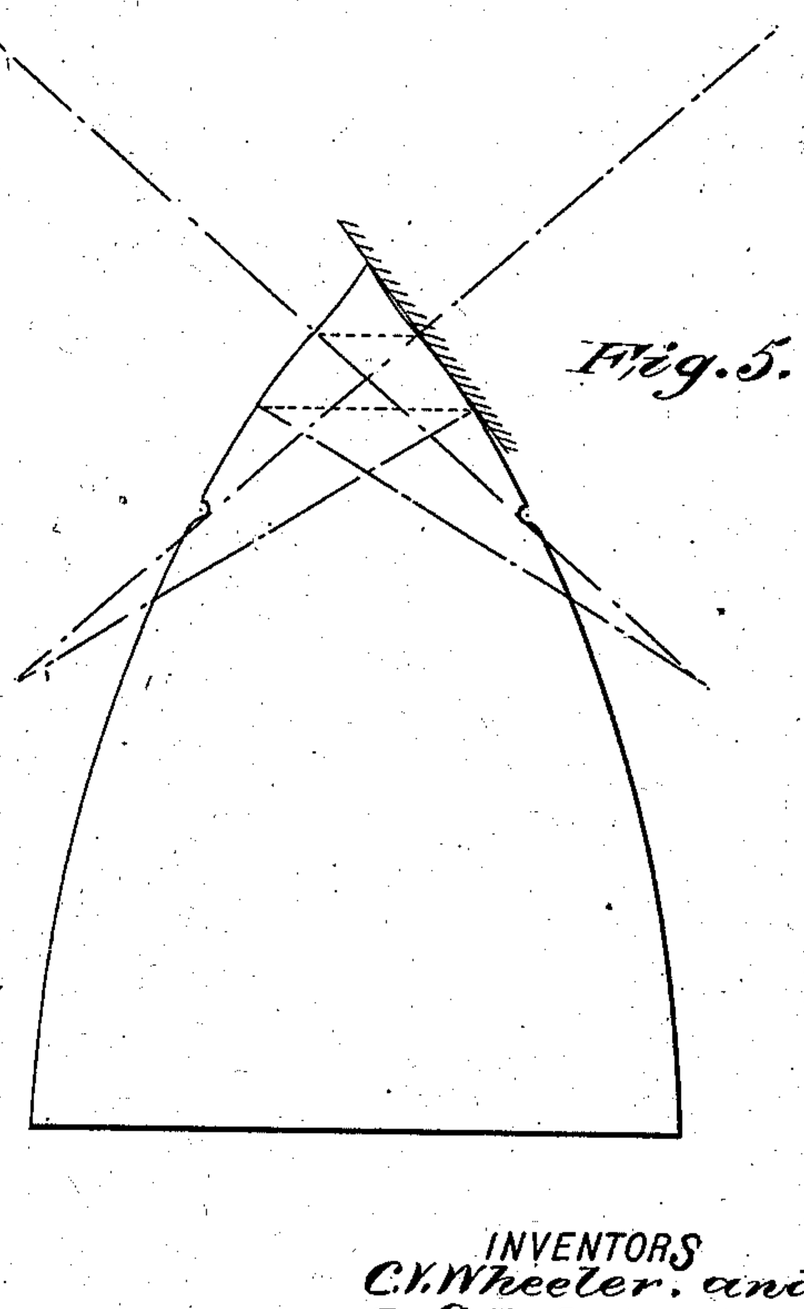


Fig. 5.



WITNESSES:
C. V. Benjamin
H. C. Lydiard Jr.

INVENTORS
C. V. Wheeler, and
A. G. McKenna,
BY
ATTORNEY

UNITED STATES PATENT OFFICE.

CHARLES VAN CISE WHEELER, OF ALLEGHENY, AND ALEXANDER GEORGE McKENNA, OF PITTSBURG, PENNSYLVANIA.

PROJECTILE.

SPECIFICATION forming part of Letters Patent No. 721,487, dated February 24, 1903.

Application filed September 12, 1902. Serial No. 123,153. (No model.)

To all whom it may concern:

Be it known that we, CHARLES VAN CISE WHEELER, of Allegheny, and ALEXANDER GEORGE McKENNA, of Pittsburg, in the State of Pennsylvania, citizens of the United States, have invented certain new and useful Improvements in Projectiles, of which the following is a specification, accompanied by drawings.

The object of the invention is to improve the modern armor-piercing projectile, and in accomplishing this result it is possible to virtually do away with the distinction at present recognized between "common" or "explosive" shells and "armor-piercing" shells.

The invention combines great wall strength and piercing qualities necessary to armor-piercing projectiles with the chamber capacity necessary for the bursting charge of common shell. Projectiles now carried on warships include usually these two distinct classes of armor-piercing and of common shells. The latter are not relied upon to pierce armor and retain their envelop intact for explosion behind the armor; but they are useful when no considerable thickness of armor opposes them and against shore defences. The present armor-piercing shell is thicker in the walls and is consequently of too small powder capacity to be useful as an explosive shell. The weights of these two classes of projectiles are identical, and as full complements of each are usually required for each ship this duplication adds considerable dead-weight to the ship's equipment, which it is highly desirable to avoid, if possible.

To best understand the invention in view of the highly technical character of the new technical effects and the advance in this art which it provides, some preliminary understanding of the manner in which we were led to make certain discoveries, and thereby to produce the invention, should assist.

The major portion of the modern armor-piercing projectile consists of a chambered cylindrical body of steel with an integral hardened ogival point. We shall refer to the apex of the point as the "tip" or "nose" of the projectile, so as not to confuse it with the ogival point as a whole. The length of the modern projectile is usually about three calibers, and the usual approved radius of curvature of the longitudinally-curved elements of the ogival point is two diameters. This standard has undergone little, if any, change in the last decade. By means of certain experiments we have discovered that the extreme tip of the projectile may without apparent detriment be as sharp or sharper than is the said standard, but that in the vicinity of one-tenth of a caliber length from the tip where the diameter reaches about one-sixth caliber it should be blunter or less sharp, so that the cross-sectional area increases rapidly, giving added strength; but to make the point as a whole blunter and shorter, as we have just stated, increases the velocity and energy required for penetration, while, on the other hand, sharpening the point within limits decreases the required velocity and energy.

These experiments have resulted in our present invention. In its most preferred, complete, and desired form, as demonstrated by firing tests, the point of the projectile where its diameter reaches about one-sixth caliber, usually in the vicinity of one-tenth of a caliber length or thereabout from the tip of the point, is blunter than the standard, but is superposed on a longer and sharper base portion. As a result also the total length of the shell is increased for a given weight, and the walls of the explosion-chamber may be decreased in thickness, thus enlarging the chamber capacity without detriment. The center of gravity is brought farther forward. There results a greater strength to resist the compression stresses and also the shearing stresses produced in the shell by the inertia of the various parts of its mass on striking. To penetrate a given plate or obstruction, the new shell requires less velocity and less energy for any given weight and caliber. In other words, for a given weight, caliber, and velocity the improved projectile will penetrate a thicker plate or greater depth. Unlike the standard armor-piercing projectile it has adequate chamber capacity for use as an explosive-shell to be burst after penetration, because it has both the powder

capacity of the common shell and the armor-piercing qualities of the best armor-piercing projectiles.

In the drawings, Figure 1 is a longitudinal central section of our most approved form of shell as designed for a six-inch projectile. Fig. 2 is a diagram showing some details of shape of the point. Fig. 3 is a central longitudinal section showing on the left hand of the axial line one-half of the shell shown in Fig. 1 and on the right hand side of the axial line one-half of a standard armor-piercing shell exactly of the same weight and diameter. Fig. 4 shows a modified form of one part of the invention, and Fig. 5 shows another modification of the invention.

In the new form (shown in Figs. 1, 2, and 3) the point is calculated and designed in the following manner: Starting with 6.04 inches as a unit or constant for a six-inch naval shell we take as our radius of longitudinal curvature for the base portions of the point a multiple of this unit, which preferably should be between 2.25 and four times the said constant, though it is not apparently absolutely limited in principle to this range. In the drawings the radius divided by the constant gives 2.5. Drawing then a transverse line and marking off two points upon it at a distance of 6.04 inches, these points will correspond with the maximum gross diameter of the base of the point before it is turned down in a lathe to the smaller diameter adapted to properly fit the gun with the desired amount of clearance—for example, 5.96 inches. From these two points arcs are struck from centers lying on the same line at a distance of 15.10 inches, (equal to two and-a-half times the constant.) These arcs intersect upon the axial line of the projectile and would form the tip of the projectile if the tip were not to be further modified. From this intersection or temporary locus of the tip we draw a cross-section plane one-quarter of a caliber distant from such intersection or temporary locus. This cross-section plane, perpendicular to the axis where it intersects the two arcs, as shown in Fig. 2, locates the points from which to strike with a much shorter radius arcs truly tangential to the arcs already struck and running forward till they intersect on the axial line and form the tip of the projectile. We arbitrarily select for this point of intersection or locus of the tip a point that is one-twentieth of a caliber (.05, equaling .30 of an inch) in the rear of the temporary locus, thus shortening the tip by .30 of an inch. The radius necessary to do this is about 4.70 inches, and is of course found by simple geometry. (For example, draw a chord connecting the two ends of the small arc that is to be struck and erect a perpendicular at its mid-length. The point where this perpendicular intersects the radial line of the arc of greater radius is the center from which the arc of shorter radius is to be struck.) This completes the contour of the point with of course the exceptions of turning or cutting the groove for the attachment of the soft-steel cap, if one is to be used, and the turning down of the maximum diameter or swell at the base of the point so as to accurately correspond to the desired maximum diameter of the steel parts, which in the present instance would be 5.96 inches. The contour of the point thus formed differs from the standard naval point in being longer and sharper throughout the base portions and up to two-tenths of one caliber length of the extreme tip. Forward of such cross-section, however, it is blunter and of far shorter radius of curvature, the radius being considerably less than one caliber. The direct physical result of this is a more rapid increase of cross-section in the vicinity of one-tenth of the caliber length from the tip and a consequent greater support of each section by the sections behind it, as well as a very much greater resistance to shearing strains acting at forty-five degrees to chip off or scale off thin portions of the metal extending from the tip to a distance of one to two inches from the tip, as is commonly seen where the nose of the projectile has failed.

Having so improved the solid point of our projectile as compared with the standard or best previous projectile known, it would seem that we have increased the strength of the forward portion of the point and yet reduced the penetration energy; but as a chain is no stronger than its weakest link so a projectile is no stronger than its weakest part, and this strengthening of the point might not enable the projectile to be fired at increased velocity or at thicker plates under some conditions without failing if the projectile were still equally weak on the shearing-planes extending into the forward end of the chamber. As, however, such shearing stresses depend upon two factors—to wit, the area of the conical shearing cross-sections and the weight of metal in the rear of such section, (the inertia of which weight is the direct cause of the strains at impact,) it follows that by the bringing forward or lengthening of the point of our projectile as a whole the center of gravity or mass of the projectile is also brought forward, the chamber somewhat enlarged, and the thickness of the walls of the chamber reduced. This being done, it follows that there will be less weight or mass behind any given section—for example, behind a transverse plane one-quarter of the length from the tip than in the case of the standard projectile. In this respect also, therefore, we have improved the projectile, inasmuch as the standard projectile very commonly fails by the shearing of the walls on a cone of forty-five degrees at the extreme forward end of the chamber rather than by any weakness in the wall farther in the rear.

In Figs. 4 and 5 modifications which may be found of great value are shown. In Fig.

4 the blunt tip of the projectile is formed by a cone. With a cone having sides inclined to forty degrees to the axis the contour in the vicinity of one-tenth caliber length is even more blunt than in Figs. 1 and 2. The extreme tip of the projectile may be sharpened where it is important to bring the tip as far forward as possible in order to increase the angle of incidence at which the projectile-point will bite into an armor-plate. This is illustrated by the cross-section of a portion of the plate with which the extreme tip and the side of the point are just in contact in Fig. 5. From this it will be seen that the tip of the projectile can strike and bite into the plate at a greater angle of incidence than if the tip were not so sharpened and advanced.

We claim as the characteristic features of our invention the following:

1. The improved projectile provided with an integral point that is sharper toward its base and blunter at approximately one-tenth caliber length from the tip, for substantially the purposes set forth.

2. The improved projectile provided with an integral point that is sharper toward its base and blunter at approximately one-tenth caliber length from the tip, and with a chamber which extends forward of the base of the point, for substantially the purposes set forth.

3. The improved projectile characterized by a point at least as long as an ogival point formed by a continuous curve of two-caliber radius and having increased diameter of cross-section near the tips as compared with said ogival point, for substantially the purposes set forth.

4. The improved chambered projectile characterized by an integral point longer than an ogival point formed by a continuous curve of two-caliber radius and sharper at its base and blunter near its tip as compared with said ogival point, and having chamber-walls integral with the point, which at their minimum thickness do not exceed one-quarter caliber, for substantially the purposes set forth.

5. The improved chambered projectile characterized by an integral point longer than an ogival point formed by a continuous curve of two-caliber radius and sharper at its base and blunter near its tip as compared with said ogival point, and having a chamber the side walls of which are integral with the point, the center of mass or center of gravity of the said projectile being farther forward as measured from the mid-length section, for substantially the purposes set forth.

6. The improved chambered projectile characterized by an integral point longer than an ogival point formed by a continuous curve of two-caliber radius and sharper at its base and blunter near its tip as compared with said ogival point, and having a chamber of increased capacity, for substantially the purposes set forth.

7. The improved projectile having an integral point the contour of which, as seen in longitudinal axial section, is characterized by at least two arcs which are truly tangent to each other and one of which nearer the tip is of greater curvature and shorter radius than the other, for the purposes set forth.

8. The improved projectile having a point the contour of which, as seen in longitudinal axial section, is characterized by at least two arcs, one of more than two-caliber radius and one nearer the tip of less than two-caliber radius, for substantially the purposes set forth.

9. The improved projectile having a point the contour of which, as seen in longitudinal axial section, is characterized by at least two arcs, one of which nearer the base is of more than two-caliber radius, and the other nearer the tip is of less than one-caliber radius, for substantially the purposes set forth.

10. The improved projectile having a point the contour of which, as seen in longitudinal axial section, is characterized by at least two arcs, one of which nearer the base is of more than one-caliber radius and the other nearer the tip is of less than one-caliber radius, for substantially the purposes set forth.

11. The improved projectile having a point the contour of which, as seen in longitudinal axial section, is characterized by at least two arcs, one of which nearer the base is of less curvature and is tangent to the other at about two-tenths caliber from the tip, while the other is of greater curvature and less radius than one caliber and extends to within one-tenth caliber of the tip, for substantially the purposes set forth.

12. The improved projectile, characterized as compared with the standard ogival point of uniform curvature radius of two calibers, by a longer integral point which is sharper at its base and blunter near its tip, and by chamber-walls integral with the point, which at their minimum thickness do not exceed one-quarter caliber, and by a chamber having a length exceeding one-half the total length of the projectile, for substantially the purposes set forth.

13. The improved projectile, characterized as compared with the standard ogival point of uniform curvature radius of two calibers, by a longer integral point which is sharper at its base and blunter near its tip, and by a chamber the walls of which are integral with the point, and the length of which exceeds one-half the length of the projectile, substantially for the purposes set forth.

14. The improved chambered projectile having a point characterized as compared with a point of uniform curvature of two calibers by its being blunter at the cross-section where the point is one-sixth caliber in diameter, whereby the strength is increased without impairing its penetrating power, for substantially the purposes set forth.

15. The improved projectile characterized by a point the base portions of which have a

radius of curvature of more than two calibers and which near the tip where the diameter is about one-sixth caliber has a radius of curvature of less than one caliber, for substantially the purposes set forth.

16. The improved projectile having a point characterized as compared with an ogival point having a uniform radius of curvature of two calibers, by an integral point which is longer and sharper at its base and blunter near its tip and by chamber-walls which are less than one-quarter caliber in thickness, for substantially the purposes set forth.

In testimony whereof we have signed this specification in the presence of two subscribing witnesses.

CHARLES VAN CISE WHEELER.
ALEXANDER GEORGE McKENNA.

Witnesses:
JAMES E. PORTER,
HELEN G. RODGERS.