(No Model.)

C. W. KENNEDY & J. W. GRANTLAND.

MANUFACTURE OF STEEL INGOTS.

No. 473,466. Patented Apr. 26, 1892.

Fig. 1.

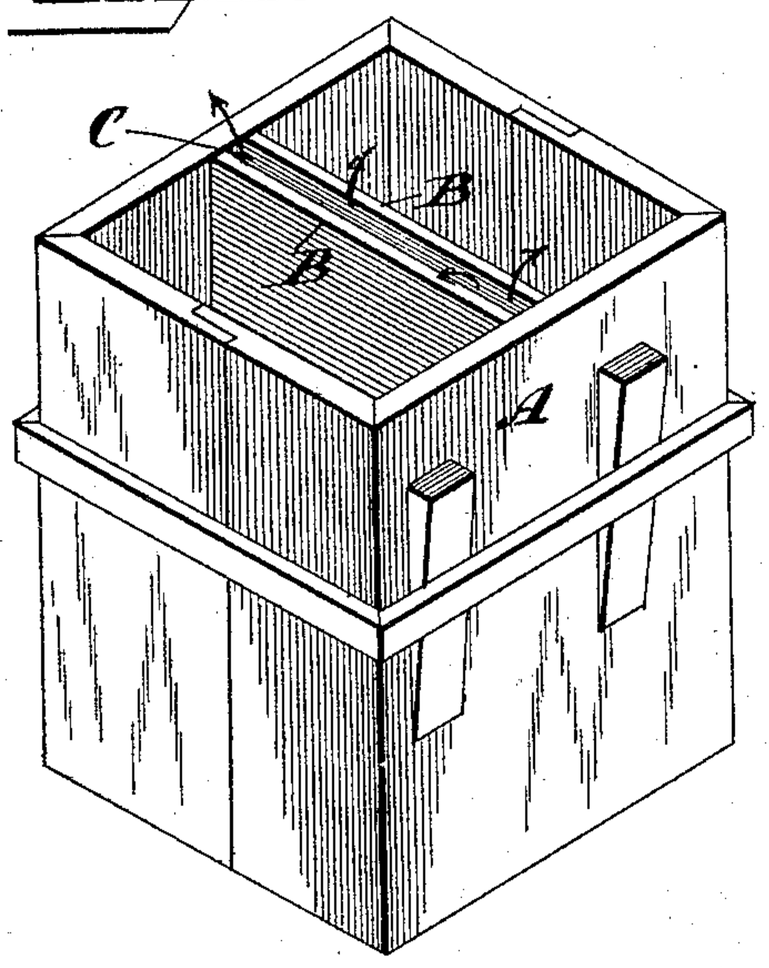


Fig. 2.

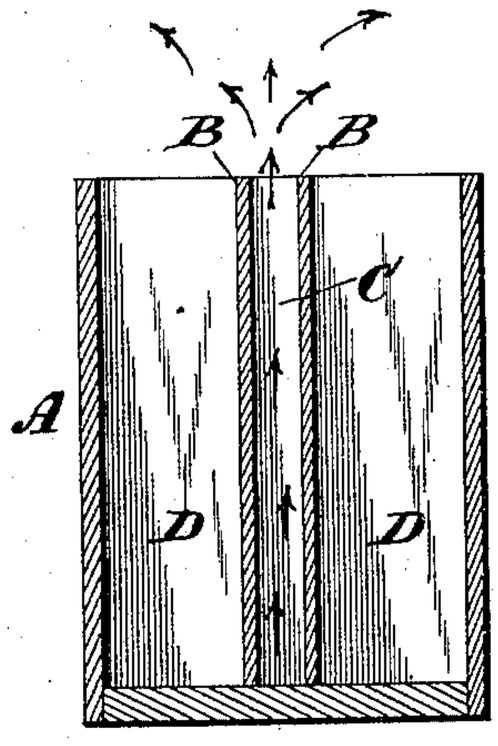


Fig. 3.

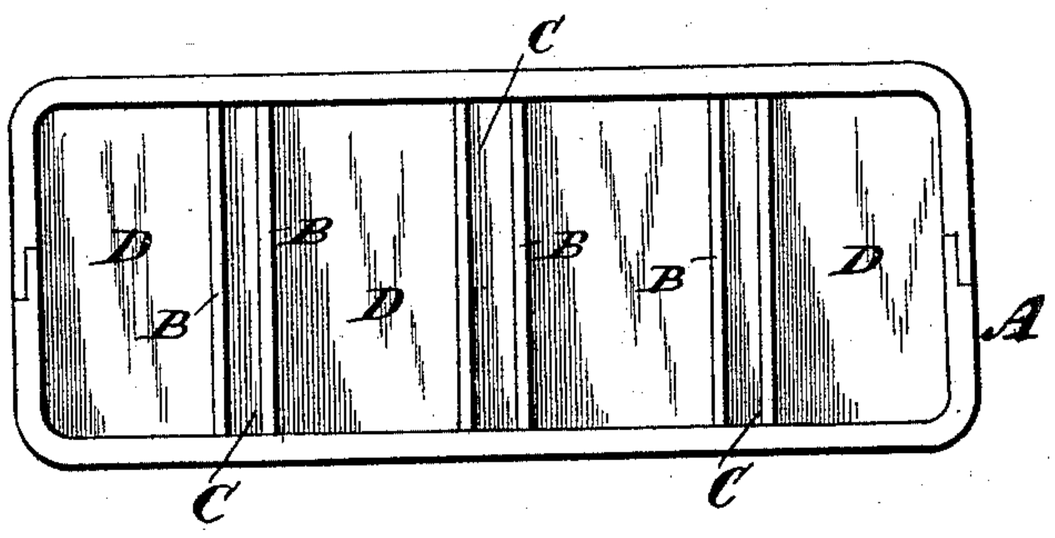
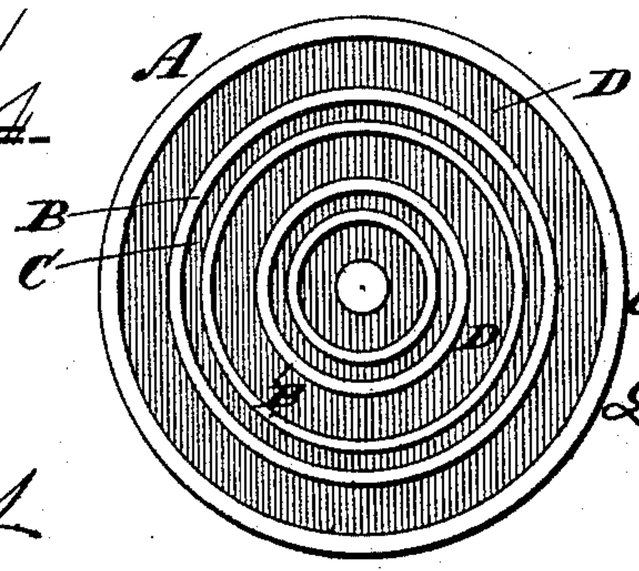


Fig. 4.



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MANUFACTURE OF STEEL INGOTS.

SPECIFICATION forming part of Letters Patent No. 473,466, dated April 26, 1892.

Application filed May 20, 1891. Serial No. 393,487. (No model.)

To all whom it may concern:

Be it known that we, CHARLES W. KENNEDY and JOHN W. GRANTLAND, both residents of Philadelphia, in the county of Philadelphia and State of Pennsylvania, have invented certain new and useful Improvements in the Manufacture of Steel Ingots; and we do hereby declare that the following is a full, clear, and exact description of the invention, which will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, which form a part of this specification, and in which—

Figure 1 is a perspective view of an ingot-mold as used by us in carrying out our invention. Fig. 2 is a longitudinal sectional view of the same on a vertical plane. Fig. 3 is a plan or top view of a similar mold adapted for the casting of ingots containing three or more perfectly and inseparably united strata of steel or other metal of varying degrees of hardness, and Fig. 4 is a plan view of a cylindrical mold for casting ordnance or ingots of cylindrical or tubular shape.

Like letters of reference denote corresponding parts in all the figures.

Our invention relates to the production of (chiefly) steel ingots adapted for the manufacture of armor-plates, railway-rails, ordnance, projectiles, and numerous other articles of manufacture and commerce where it is a desideratum to produce an ingot composed of two or more stratified masses of steel containing different percentages of carbon—*i. e.*, of varying degrees of hardness—or two or more qualities of the same malleable metal or different metals; and our improvement consists in the hereinafter-described method of manufacturing by casting an ingot of that peculiar character.

In order to arrive at a correct understanding of the exact nature of our improvement, a brief reference to the art as it now exists will, it is believed, not be out of place.

In casting ingots of this type two methods (with some modifications) have heretofore been employed and proved successful for certain purposes and to a certain extent. The first of these consists, briefly, in first running into an open or closed mold molten steel of one temper or hardness, and then upon its upper surface running a second layer of molten steel of another temper or hardness, repeating this operation as often as required, so as to form as many layers or strata of different-tempered steel as may be desired, forming thereby when the mass has set one solid and compact ingot to be subsequently rolled or otherwise worked into plates, rails, &c. This method is, however, open to the objection that while it provides (when properly carried out) for an inseparable union of the several strata of metal to one another, yet these strata or layers are apt to become merged into one another as the mold is gradually being filled with molten steel, the fluid steel becoming mixed in the mold, so that the result is an ingot of homogeneous steel of a degree of temper or hardness based upon the average of the qualities of steel with which the mold was filled; or, if the ingot thus produced is not homogeneous in its texture the several mixtures will commingle and settle in the mold unevenly, resulting in the production of an ingot containing uneven lumps of steel of varying degrees of hardness, instead of regular well-defined strata. To obviate this difficulty, a second method has been devised, which consists, briefly, in dividing the mold by one or more vertical diaphragms or partitions of thin metal into adjacent and parallel compartments, all of which are filled simultaneously with the molten metal, each with its appropriate kind or quality. The object of this is to keep the different qualities or grades of metal so far distinct and separate while in a molten state that one shall not become seriously intermingled with the other, and yet, after gradually fusing the thin metal partitions, commingle to a sufficient extent to form an ingot containing well-defined but inseparably-united strata of the different qualities or grades of metals employed in the casting of the ingot; but here again we meet with the difficulty that in the first place there is no certainty that these metallic partition-plates will be completely fused and merged in the adjacent strata of metal, experience having demonstrated that these plates sometimes fuse in holes, sometimes in vertical or horizontal

lines, and sometimes the plate will fuse only half-way up the mold, leaving the remainder to be solidly embedded in the ingot between adjacent strata, and, in the second place, even if complete fusion takes place the metal of the partition plate or plates will in its fused state intermingle with the fused metal on both sides, thus producing an intermediate thin layer or stratum of different metal or texture, and thereby destroying the homogeneity of the compound ingot as a whole. In other words, in the use of a single partition plate or diaphragm of fusible metal it is either necessary to have it of such thickness that there will not be sufficient latent heat in the molten metal poured into the mold to perform the double function of fusing the partition-plate and forming a union with the metal on the other side of the plate at the same moment, and, on the other hand, if instead of the thick diaphragm a very thin plate is used the fusion of this (on account of its thinness) is apt to be so rapid that the two qualities of metal on opposite sides of the plate not only unite, but do this so rapidly and thoroughly as to become commingled to too great an extent, and thereby practically destroy the object sought to be attained by the use of the diaphragm. Now the object of our improvement is to overcome these several drawbacks and produce a compound ingot possessing absolute homogeneity in so far as its several strata are concerned, and yet uniting or joining said strata to one another into one solid and inseparable mass. This we attain by providing for the absolute disintegration and removal of the substance of the dividing partition or partitions in the following manner:

The mold A, which in Figs. 1 and 2 is shown as arranged for the casting of a compound ingot containing only two different qualities of metal, is divided transversely by two plates B B, of thin steel or other suitable material, set closely together, so as to form a narrow space C between them. In other words, instead of the single diaphragm heretofore employed, we use a double diaphragm B B, with an intermediate narrow air-space C. Various materials may be used for this double diaphragm, provided that the plates comprising it are of an even texture throughout and of a predetermined unalterable resistance to a known degree of heat, at which point the substance of the plates will volatilize, so that the resulting vapor will be carried up through the chimney formed by the narrow air-space C and be disseminated into the air, instead of intermingling with the mass of the ingot. In practice plates made of thin steel will be found to answer the purpose admirably. As the large compartments D D are being simultaneously filled with molten steel containing different percentages of carbon the air contained in the intermediate narrow chamber C is heated rapidly and violently, causing it to expand and create a strong upward draft or current, as indicated by the arrows, which intercepts and carries with it the vapors caused by the volatilization of the plates B B. As these disappear the metal contained in the compartments D D flows together, filling up the intervening space C and forming therein a perfect and inseparable union or juncture along the median line of the space occupied by the air-chamber. Each of the two plates B B being subjected to direct heat on one side only—viz., the side on which the molten metal is poured—very thin plates may be used without causing their too rapid fusion, and the commingling of the two separate masses in the intervening chamber C, after this has ceased to serve its function as a chimney, results in an absolutely-perfect juncture of the adjacent masses, so that the product when set and removed from the mold will be found to be an ingot in which the strata are united inseparably in the same manner as in an ingot of homogeneous metal. This ingot may afterward be rolled, hammered, pressed, or treated in any other of the well-known ways for producing the article it is intended for. In the casting of ordnance and other cylindrical solid or tubular articles the double diaphragms B C B are arranged concentrically to the axis of the cylindrical ingot, as illustrated in Fig. 4, the number of these double diaphragms, with intervening air-spaces, depending of course upon the numbers of strata which the compound casting is to have. Thus in Fig. 3 we have shown the top view of a mold adapted for the simultaneous casting of four different qualities, grades, or kinds of metal into a single compound block or ingot.

In order to provide for the rapid and perfect fusion of the plates B B, they are covered on both sides with a flux of silicate of soda, which is allowed to dry on the plates before they are inserted into the mold.

Having in the foregoing fully described our invention, we claim and desire to secure by Letters Patent of the United States—

The described method of manufacturing compound ingots of inseparably-united strata of metal of different grades, qualities, or kinds, consisting in first separating a suitable mold into adjacent compartments by means of a double wall or partition of fusible material with an intermediate air-space, and subsequently pouring the different grades, qualities, or kinds of metal into said compartments, substantially as described.

In testimony that we claim the foregoing as our own we have hereunto affixed our signatures in presence of two witnesses.

CHARLES W. KENNEDY.
JOHN W. GRANTLAND.

Witnesses:
FRANK P. KENNEDY,
THEO. H. M'CALLA.