UNITED STATES PATENT OFFICE.

KNUT KARL ADOLF CHRISTIANSON, OF STOCKHOLM, SWEDEN, ASSIGNOR TO PETTER ADOLF ÖSTBERG, OF SAME PLACE.

PROCESS OF MANUFACTURING BILLIARD-BALLS FROM IRON OR STEEL.

SPECIFICATION forming part of Letters Patent No. 530,257, dated December 4, 1894.

Application filed May 29, 1894. Serial No. 512,918. (No specimens.) Patented in England August 24, 1893, No. 16,024.

To all whom it may concern:

Be it known that I, KNUT KARL ADOLF CHRISTIANSON, a subject of the King of Sweden and Norway, residing at No. 39 Handtverkarzatan, Stockholm, Sweden, have invented certain new and useful Improvements in the Manufacture of Billiard-Balls from Steel or Iron, (for which I have obtained a patent in Great Britain, No. 16,024, dated August 24, 1893;) and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

It is well known, that it becomes more and more difficult to procure good billiard-balls, as ivory becomes more and more scarce, and attempts to make billiard-balls from other materials, such as hard wood, rubber, celluloid, and the like, have not proved successful.

I am aware from the United States Patent No. 275,923 of April 17, 1883, that attempts have been made to produce billiard-balls by soldering together segments of sheets of metal (steel), although apparently without any practical success. It is evidently impossible to make billiard-balls, equal to those made from ivory, in that way, as it is impossible under those circumstances to accomplish either the necessary uniformity as regards heaviness, depending upon the center of gravity coinciding with the center of the sphere; or the perfect elasticity necessary on every spot of the surface of the ball.

I have succeeded in making billiard-balls from iron or steel quite equal to those made from ivory, both as regards their elasticity and their correct evenness or uniform heaviness. As far as my experience goes, my billiard-balls are moreover more durable than those made from ivory. Further, I can make them at the same time equal in size and weight to those of ivory.

I make the billiard-ball by casting it from steel or iron, hollow, and as nearly as possible of even thickness all around. Both the mold and the core must be made with the utmost care so that the cast shell will be free from blowholes, smooth, and of as regular a thickness as possible. For the purpose of supporting the core during the operation of casting as well as for the purpose of removing the core afterward, the shell is cast with a small hole. When the ball is cast, the core is carefully removed from the casting, and the hole is carefully filled up with a plug from the same raw material and of about the same thickness as the shell, the plug being carefully fixed preferably by means of electric welding. The ball is then turned perfectly round and well polished, so that the surface is smooth. Out of several hundred balls already made, I have not as yet found a single one, which after being thus turned is of a truly uniform heaviness, without special adjustment. I have always found that the center of gravity does not coincide with the center of the sphere. The ball is therefore examined on a horizontal polished metallic plane, whereby the heavier half of the ball turns down and the lighter half turns up. The ball is then adjusted. If the irregularity is only extremely small, the adjustment may be effected simply by drilling in the center of the heavier half a very small perforation, which if sufficiently small, does not injure the ball; or several small holes may be drilled regularly around the center of the heavier half. If the irregularity is greater, as is usual, the adjustment may be effected by drilling a hole in the center of the lighter half of the ball and filling the hole with a plug of just sufficient weight to shift the center of gravity so much that it coincides with the center of the sphere. The adjustment however may be effected by again turning the ball, for which purpose it is so placed in the lathe that by taking away the least amount of material from the center of the lightest half, and the most from the center of the heaviest half, the center of gravity is made to coincide with the center of the sphere. The two last mentioned methods of adjusting the ball, although they may appear difficult and unreliable, are in fact quite easy for a skillful workman after some practice. After turning the adjusted ball into its proper size and polishing it perfectly, it is hardened, if made from steel, and case-hardened if made from soft iron.

The characteristic properties of a billiard ball are: First, it must be perfectly spherical,

so as to roll easily and smoothly; second, it must be perfectly elastic, so as not to change its form permanently on striking against another ball or other hard body; third, it must be perfectly correct or uniform as regards its heaviness, depending upon the center of gravity coinciding with the center of the sphere, so as to make the ball roll in a perfectly straight line, when rolling either quickly or slowly, the word "perfectly" here indicating such a high degree of the respective qualities, as is practically possible to obtain, or as is possessed by an ivory ball.

I am well aware that spherical balls of metal have previously been cast and used for different purposes, such as shot, bullets, cartridges, balls for seats in pumps, balls for bearings and the like; but none of these metallic balls, whether solid or hollow, has possessed such qualities as are herein-above mentioned as essential for billiard-balls; viz., perfect elasticity and perfect uniformity as regards heaviness. I do not therefore claim as my invention any kind of hollow ball of steel or iron, neither any kind of hollow ball cast from steel or iron, but only the process of producing by casting and subsequent operations, such a hollow ball of steel or iron, which is both perfectly spherical, and through its hardness, perfectly elastic and perfectly adjusted so that the center of gravity and the center of the ball coincide, all of which qualities combined, make the ball a billiard-ball.

What I claim as my invention is—

The process of manufacturing metallic billiard balls, consisting in first casting them hollow and with a small hole therein to aid in supporting the core during the casting, then removing the core and filling such hole with a metal plug, next adjusting them perfectly and turning them perfectly round, and finally hardening them to make them perfectly elastic, all substantially as set forth.

In testimony whereof I affix my signature in presence of two witnesses.

KNUT KARL ADOLF CHRISTIANSON.

Witnesses:
CARL BÖÖS,
A. MATTIESSON.