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TARGET MANUFACTURE

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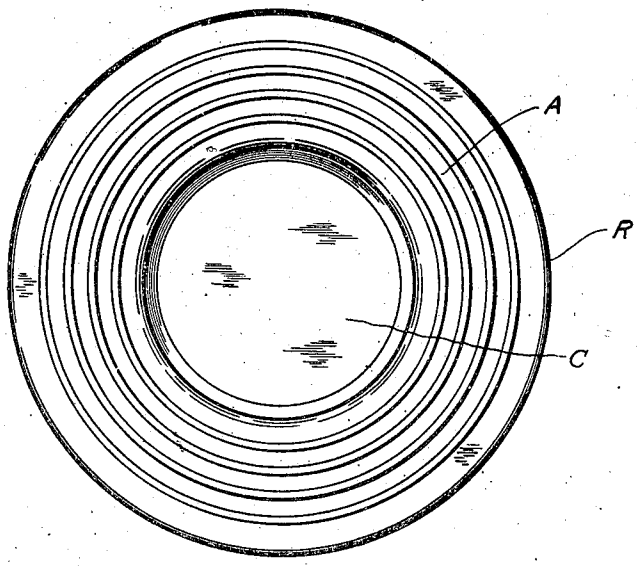


Fig. 1

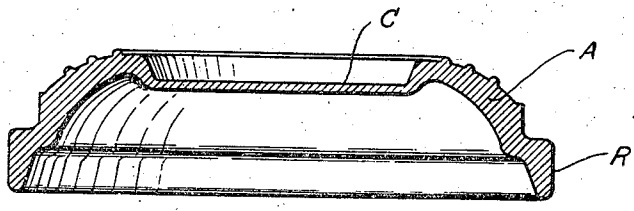


Fig. 2

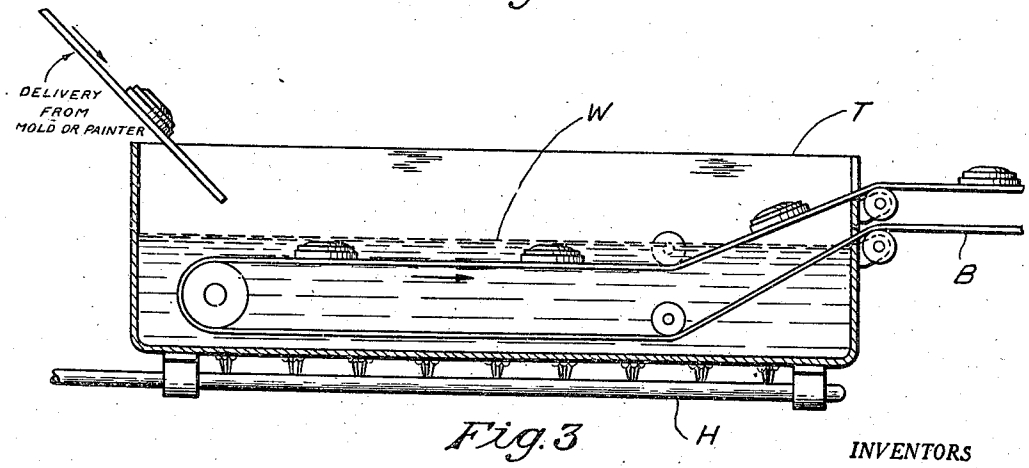


Fig. 3

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TARGET MANUFACTURE

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1 Claim. (Cl. 18—47.5)

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This invention relates to frangible targets of the type used in large numbers in the simulated wing shooting and target games known as skeet and trap shooting, and contemplates an improved target and manufacturing process by which frangible targets of superior characteristics can be rapidly produced from very low cost materials. More especially, the invention contemplates a manufacturing process including a method of annealing which is peculiar to frangible targets as distinguished from ordinary ceramic and glass articles.

In the drawings:

Fig. 1 is a plan view of a target.

Fig. 2 is a sectional elevation of a target.

Fig. 3 is a diagrammatic showing of one form of apparatus adapted to perform the process of the invention.

The frangible target, as shown particularly in Fig. 2, is a saucer-shaped article comprising a relatively thick rim R joined by an arch A, likewise of substantial thickness, to a relatively thin disk center or "poker chip" C. It is essential for proper performance in use that the rim R be of substantial thickness and that the disk C be relatively thin.

The targets are projected from a throwing trap which, in addition to giving them a linear velocity, imparts to them a rapid spinning motion, and, for this purpose, the mechanical parts of the throwing trap engage the target base and rim, the rim being engaged substantially tangentially. Local stresses are thus set up in the rim and the rim must have sufficient strength to withstand such stresses without breakage. Once in flight, the target must be susceptible to breakage by impact of a very few and preferably by only one shot pellet. The ideal target is one which will break when hit anywhere by a single shot pellet. The center disk C is, therefore, made as thin as possible for added frangibility while the frangibility of the rim R is actually augmented by its mass and moment of inertia. The impact of a pellet on the spinning rim throws it off balance inducing stresses which affect target shattering.

Since such targets are consumed when used (recovery of missed targets ordinarily being impracticable) they must be produced at an absolute minimum of cost of materials, equipment and labor. Costs comparable with those which are common in ceramic arts or in glass manufacture are prohibitive. A common material is a mixture of a bituminous pitch of appropriate melting point and an inert filler such as argillaceous field clay. A filler which is more desirable

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from the standpoint of cost is ground limestone. Common proportions of these ingredients for the ordinary four and three-quarter inch target are 40% to 60% of filler, although, for certain special targets, the percentage of filler may be substantially less. The frangibility characteristics of the target are determined in part by the amount and nature of the filler and in part by the melting point of the pitch. Limestone targets tend to be brittle and their inherent brittleness has, prior to this invention, substantially precluded the manufacture of satisfactory targets of limestone. The filler-pitch composition is thermoplastic in that it gradually softens by the application of heat above certain relatively low temperatures, an effect which establishes the minimum softening temperature of the pitch. For the bituminous pitch used in targets, the minimum softening temperature is about 100° C.

A suitable machine for the manufacture of such targets is illustrated in the patent to Johnson et al., No. 2,300,290, October 27, 1942. A turret on a 45° inclined axis is provided with a mold carrying rim inclined at 45° to the turret axis so that the two part molds thereon are horizontally disposed in their uppermost position but swing into the vertical in their lowermost position. As each mold in turn passes its uppermost position, it receives a charge of a pitch-filler mixture and immediately thereafter the mold is closed and subjected to heavy pressure flowing the composition into target configuration. Thereafter the molds remain closed until they approach their lowermost position where they are opened and the surface hardened targets ejected onto a belt where they are sprayed with water for further cooling, and then conducted to the painting machine. The machine has a capacity of one hundred targets per minute, the time each target is in its mold is of the order of ten seconds and the molds are water cooled. From the molding machine, the targets are delivered to a suitable painting machine such as the one shown in the application of Reynolds, Serial No. 371,288, filed December 23, 1940; and from the painting machine the targets are discharged onto a belt which conveys them while cooling to substantially room temperature to the packing room.

As noted above, the targets comprise a rim of substantial thickness joined by an arch to a central disk which, as compared to the rim, is quite thin. This construction, necessary for proper frangibility characteristics as above described, introduces exceptional difficulties with respect to internal strains. The central disk being thin is

cooled in the mold to a condition of substantial rigidity throughout its thickness while the heavy rim receives only a surface cooling and rigidifying. The time of the molding cycle is inadequate to permit the heat exchange from the interior of the rim to its surfaces which is necessary to cause interior temperature of the rim to approach mold temperature. Further surface cooling takes place under the water spray applied to the targets as they leave the molding machine, but this merely augments the temperature differential between the rim surfaces and the rim interior. As the rim interior subsequently cools, complex stresses are set up, the interior tends to shrink away from the rigid exterior placing the interior under tension and the exterior under compression. At the same time, the entire rim tends in cooling to contract inwardly, but this contraction is opposed by the rigidity of the previously cooled center disk, and, as a consequence, the rim is placed under tangential tensile strain. The tensile strength of the material is low which may be due, in part, to the inert filler material in the pitch, and hence the final air cooling itself may fracture the targets, and, even when manufacturing processes and formulas are arranged to avoid such fracture, incipient rim cracks and fissures develop. Such cracks are radial and indicative of an over stressed condition of the target rim, hereinafter termed rim stress, which renders the target liable to fracture or shattering under the application of external heat such as the sun's rays or a very small external force, such as the jars incident to even careful handling and transportation and the local stresses incident to trapping. Although stresses are set up between the inner and outer surfaces of the target, as distinguished from the rim or radial stresses between the poker chip and rim of the target, the former are relatively small and do not contribute to any appreciable extent to the formation of radial cracks in the rims of the targets.

The present invention compries the discovery and application of a controlled process for annealing frangible targets in such a manner as to substantially insure adequate strength for handling and trapping while preserving the requisite frangibility under shot impact.

At a convenient point in manufacture, the targets are exposed for an appropriate time to an annealing medium maintained at a temperature approaching but not exceeding the temperature at which the composition loses its rigidity. The annealing time for the targets may vary from as low as ten seconds to as high as five minutes depending upon such considerations as target compositions and weights, and the temperature of the annealing medium. The range of annealing temperatures is from about 55° C. to about 100° C. depending upon whether the annealing is performed before or after target painting. When, as in existing installations, the painting machine is placed closely adjacent to the molding machine it is desirable that the targets be annealed while being conveyed from the painting machine to the packing room. In this case, the annealing temperature is about 60° C. to 70° C., and the annealing time is about one minute. However, it may be desirable to place the annealing operation between the molding and painting operations, in which instance, the annealing temperature is preferably about 100° C.

One typical and convenient form of annealer is diagrammatically shown in Fig. 3, in which the end section of a conveyor belt B is arranged to

pass beneath the surface of a water bath W in a suitable container T, the targets being delivered from the molding machine or the painter directly into the water bath and upon the belt B. The water or other suitable medium is maintained at the desired temperature by any convenient source of heat H and the speed of the conveyor belt and the length of reach thereof which is held below the surface of the annealing medium W are so determined as to give the desired annealing time with the result that the rigidity of the center disk and rim surface is, during the cooling of the rim interior, reduced by an amount sufficient to partially or wholly relieve the radial stresses otherwise induced by the differential cooling of the disk and rim interior.

It will be understood that the annealing medium is not necessarily a liquid. Satisfactory results are secured by passing the targets in transit through a chamber of appropriate length containing air at the desired annealing temperature. Infrared rays supplied by a suitably arranged bank of lamps have also been found a desirable annealing means.

While the invention has been applied to clay targets with beneficial results, it finds its greatest utility in enabling the use of lower cost limestone compositions in the manufacture of thin center targets of the type illustrated where otherwise such targets yield a high percentage of fracture and breakage in cooling, handling and trapping. Limestone targets comprising substantially 43% pitch and annealed following painting are found to be remarkably free from incipient cracks after being immersed in a water bath at a temperature of about 65° C. for thirty seconds. If the annealing is done immediately following molding, then the immersion time may be as low as ten or fifteen seconds at a temperature of about 100° C. Limestone targets produced by these methods are uniformly free from cracks and the nice balance between strength and fragility is substantially undisturbed.

What is claimed is:

In the manufacture of a frangible target comprising a rim portion of substantial thickness surrounding a relatively thin disk from an admixture of a pitch and a filler having a softening temperature not lower than 100° C., the method comprising the steps of compressing and cooling a charge of a hot and fluid admixture of the pitch and filler in a cooled mold to form the target, removing the target so formed after a time interval sufficient to substantially rigidify said thin disk and the surface portion only of said thick rim, and thereafter annealing the target by subjecting the target to a temperature between 55° C. and 100° C. for a time between ten seconds and five minutes.

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