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MOLDED PULP WAD

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Fig. 1

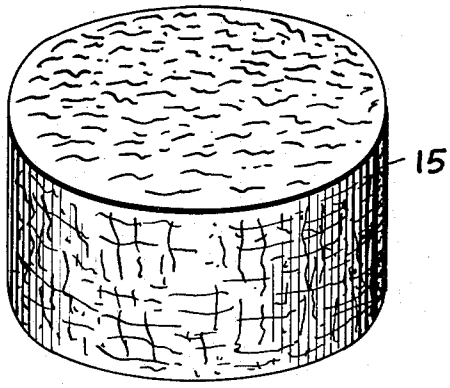
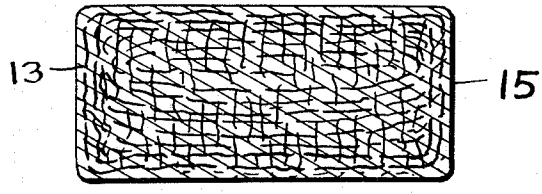


Fig. 2



Inventor

WALTER H. RANDALL

By Arthur G. Connolly

Attorney

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Fig. 3

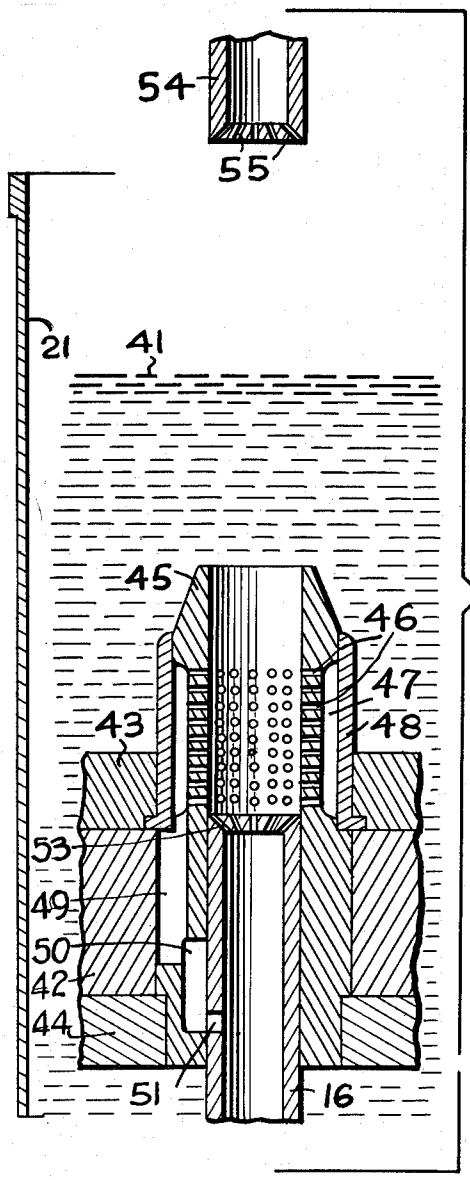
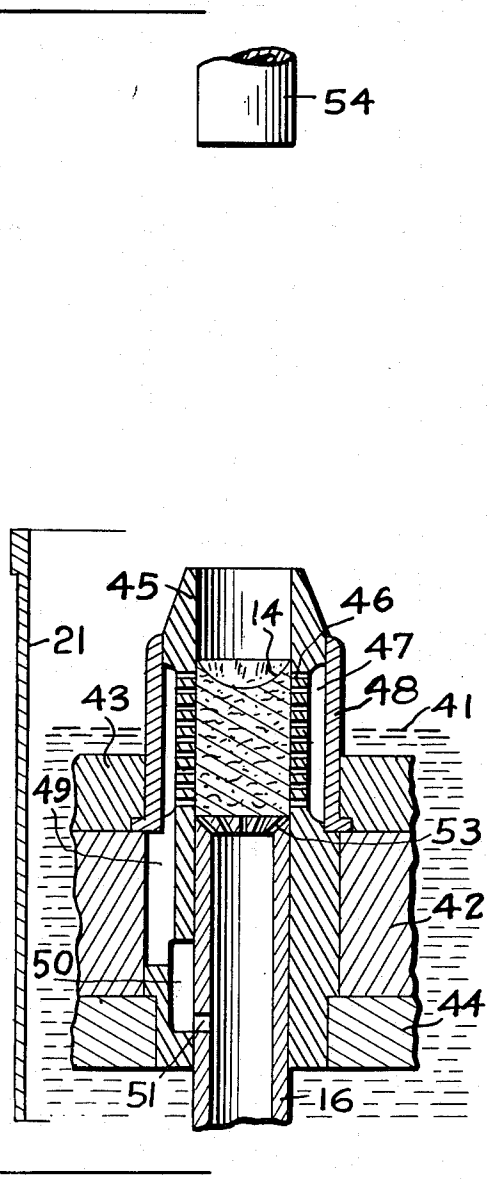


Fig. 4



Inventor

WALTER H. RANDALL

By Arthur B. Connolly

Attorney

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Fig. 4a

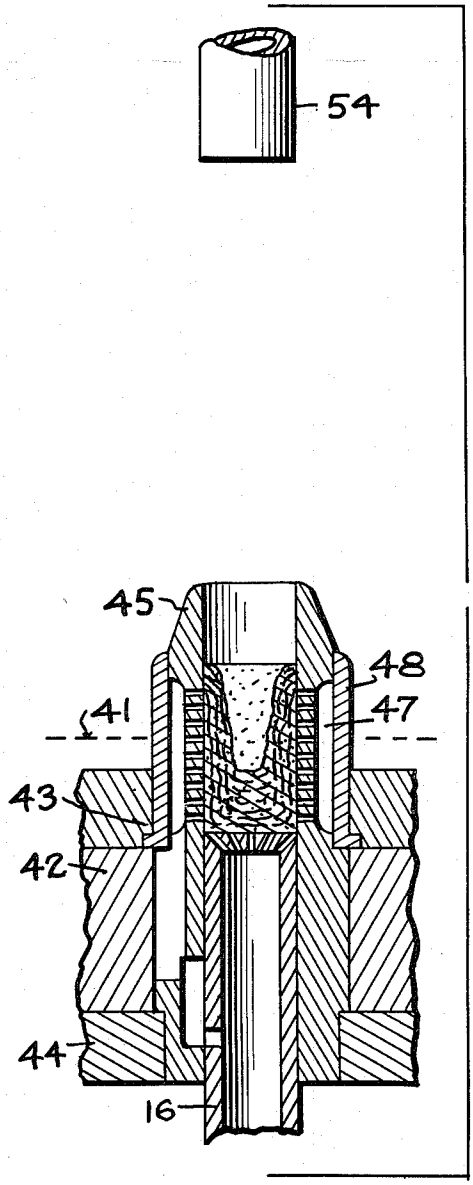
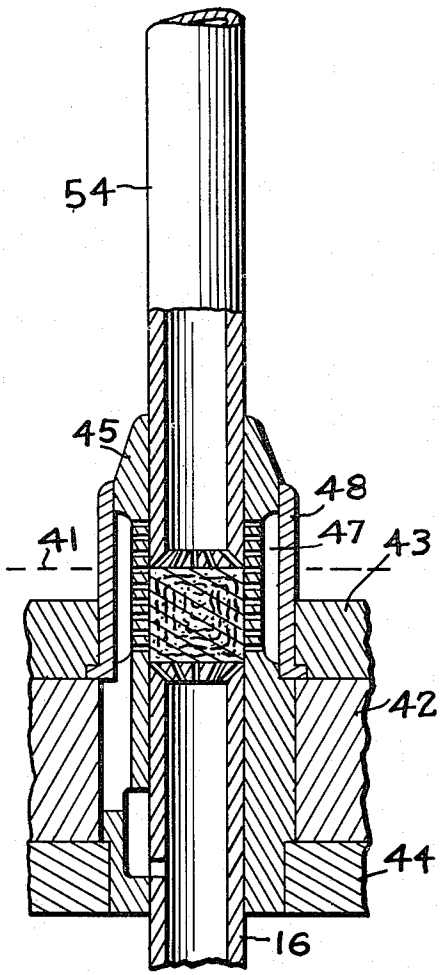


Fig. 4b



Inventor

WALTER H. RANDALL

By

Arthur G. Connolly

Attorney

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Fig. 6

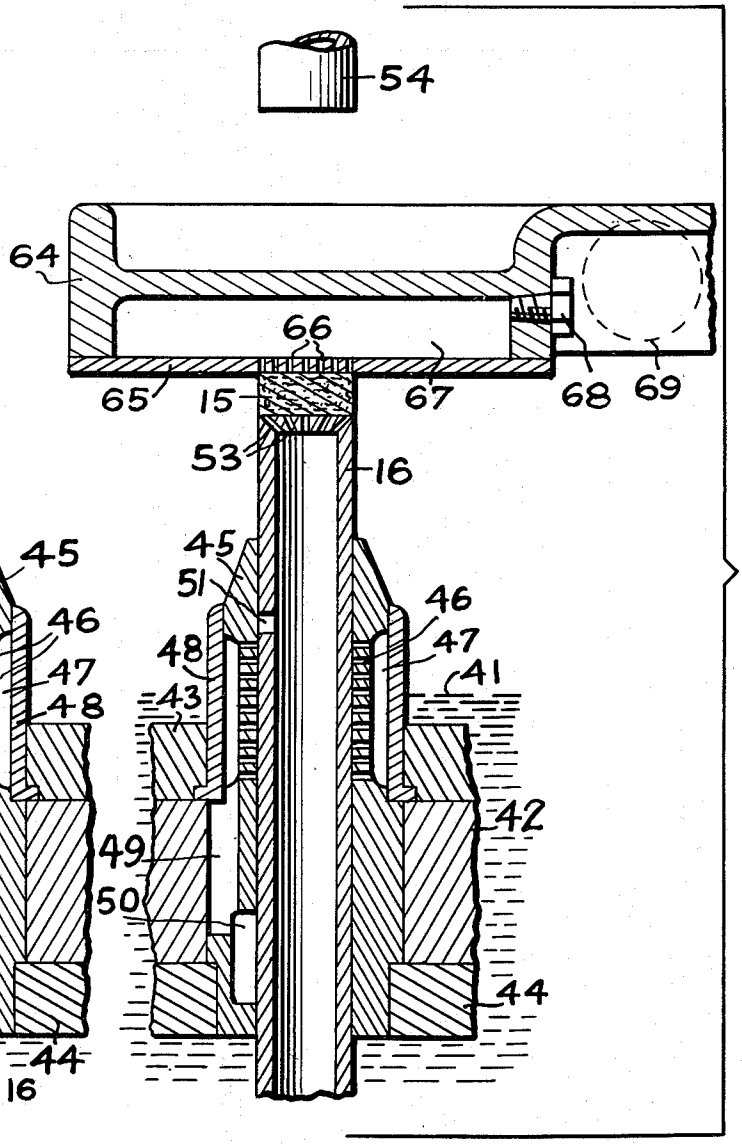

Fig. 5

Inventor
WALTER H. RANDALL

By Arthur B. Connolly
Attorney

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2,628,560

MOLDED PULP WAD

Walter H. Randall, Waterville, Maine, assignor to Keyes Fibre Company, Portland, Maine, a corporation of Maine

Application January 26, 1952, Serial No. 268,431

2 Claims. (Cl. 102—95)

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This invention relates to improvements in molded pulp articles of relatively small size, such as wads or discs, which must be produced in large quantities and at low cost. This application is in part a continuation of copending application Serial Number 650,292, filed February 26, 1946.

For the purposes of this application I shall discuss my invention in connection with the production of molded pulp wads or discs for use in shot shells and other small arms ammunition. It will be understood however, that such discussion is illustrative and not limiting and that the principles of my invention are applicable to the production of other molded pulp articles.

Shell wads of the above type have been used to satisfy ballistic requirements for the effective discharge of the shot particles by the exploding shell charge. While wads made of cellulosic pulp are less expensive than most other available materials, the cellulosic wads heretofore used lack the physical characteristics desired to make wads of this type acceptable or entirely satisfactory for their intended function.

The main object of my invention is to provide wads, discs or other molded pulp articles that avoid the above difficulties. Other objects and advantages will appear as this description proceeds.

In the accompanying drawings wherein I have illustrated a preferred embodiment of my invention.

Fig. 1 is a perspective view of a shot shell wad in accordance with the present invention;

Fig. 2 is an enlarged sectional view of the wad of Fig. 1 showing its felted construction; and

Figs. 3, 4, 4*a*, 4*b*, 5 and 6 are diagrammatic views illustrating successive stages in the manufacture of the molded pulp wad of Figs. 1 and 2,.

According to the present invention a fibrous cellulosic wad highly resistant to disintegration is provided when the wad has its exterior formed as a felted layer extending substantially completely around the entire wad surface. To this end the wad is felted first in the shape of a cup having a height larger than the desired wad height, after which the upper portions of the cup are folded together and down into the hollow of the cup to become interlocked there. The outer fibers shown at 13 in Fig. 2 thereby form a capsule-like container for the wad and make the wad highly resistant to delamination or disintegration.

As one technique for forming the wad of the present invention, there can be used a pair of dies one male and the other female. The female

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die consists of a stationary imperforate cylinder enclosing and spaced from a stationary sleeve having circumferential drainage perforations. Slidable axially within said sleeve is a tubular member, the upper end of which is closed and perforated. When the wad is being formed, the tubular member is at the bottom of its stroke and constitutes the bottom of the die. After the article has been formed, the tubular member is moved upwardly through the sleeve to carry the formed article out of the sleeve in position to be removed from the machine.

The male pressing die consists of a hollow member closed and perforated at its lower end and dimensioned to slide freely into and out of the perforated sleeve of an alined female die.

Stock in the form of a fibrous pulp slurry can be supplied to the female dies by a vertically reciprocable stock tank. In the raised position of the tank, the female die is immersed in the aqueous pulp mixture. When the tank is lowered, the supply of stock to said die is shut off. After the wad has been formed and partially drained in the female die, the male die is inserted and lowered to compress the formed article therein, and then retracted. The tubular bottom forming member of the female die is then raised to carry the formed article out of the stationary sleeve, and the article is removed from said tubular members by a horizontally reciprocable transfer unit which is advanced to a position slightly above the raised formed articles. After the articles have been transferred to the transfer unit, said unit is retracted and the tubular members are lowered to their original position for the formation of another article. The formed articles may be discharged from the transfer unit onto a conveyor belt or the like and this belt may carry the articles through a dryer.

Conventional means are provided for supplying vacuum and air to the several dies and to the transfer unit, and for timing to one another the operation of the several different mechanisms which actuate the stock tank, the male dies, the tubular members of the female dies, and the transfer unit.

The slidable bottom-forming members of the female dies are designated in Figs. 3 to 6 inclusive at 16, the registering male pressing dies at 54, the stock tank at 21, and the transfer unit at 64.

The several elements 16, 54, 21 and 64 are adapted to be reciprocated in time to the operation of each other by any suitable actuating means which may be either mechanical or hy-

draulic. The bottom-forming members 16 of the female dies slide vertically within stationary sleeves 45 which are circumferentially perforated at 46 and enclosed within imperforate stationary cylinders 48. Sleeves 45 are spaced from cylinders 48 to provide chambers 47 through which the water of formation passing through perforations 46 may drain.

The female forming die is mounted in a platen 42 which includes an upper plate 43 and a lower plate 44. The platen and plates are bored and counterbored to receive respectively the sleeves 45 and cylinders 48. Chambers 47 are connected by passages 49 in platen 42 with chambers 50 in sleeves 45 and chambers 50 connect with the interior of members 16 through holes 51 in said members. Members 16 are evacuated or provided with air pressure as may be required, and are perforated at their closed upper ends at 53. The level of the stock is indicated at 41. The male pressing dies 54 are hollow and are closed and perforated at their lower ends at 55. These dies are dimensioned to slide freely into and out of the sleeves 45 of the female forming dies. The upper ends of dies 54 are provided with suction or air pressure as may be required.

Transfer unit 64 includes a transfer plate 65 perforated on its under face as at 66 and defining with member 64 a vacuum and air pressure chamber 67 adapted to be connected as at 68 to either a vacuum pump or an air pump (not shown).

Transfer unit 64 reciprocates in a horizontal plane between the male and female dies when said dies are separated. Unit 64 is provided with rollers 69 which track in a suitable guide way, and is reciprocated by means of a motor, not shown.

The operation is as follows:

The stock tank is first raised (see Fig. 3) sufficiently to submerge the upper open ends of the female forming die in the pulp mixture and vacuum is applied to said die for the suction formation of articles therein. After sufficient stock has been supplied to the forming die, depending upon the thickness wanted for the final articles, the stock tank is lowered (see Fig. 4) thereby cutting off further supply of stock to the forming die. Sufficient drainage time is allowed to permit the suction drainage of as much water as practicable from the stock mixture remaining in the forming die and from the articles being formed in said dies. This water is carried out of the machine through the hollow members 16 of said die and leaves the article in the form shown in Fig. 4*a*.

The male pressing die is lowered into the female die (see Fig. 4*b*) to compress the formed articles therein and to express additional water therefrom, as well as to reduce the article to substantially uniform thickness and density (see Fig. 5). During this compression period I may, if desired, send compressed air through the perforated ends of the male pressing dies to assist the removal of free water from the articles. At the end of the compression period the male pressing die is retracted from the female die, leaving the formed and compressed but still wet articles in the female dies.

The articles are removed from the female dies by raising the slidable bottom forming members 16 of the female die (see Fig. 6) a distance sufficient to carry the articles beyond the upper ends of the sleeve 45 of said dies in position to be removed from the machine by the laterally reciprocating transfer unit 64 which has moved inwardly over the articles on the now raised members 16. The vacuum on said member 16 is now shut off and vacuum is applied to the transfer plate to cause the article to be transferred to the perforated under face of said plate, after which members 16 are retracted into the sleeves 45 of the female die in readiness to form another set of articles. The vacuum on the transfer plate holds the articles thereagainst until the transfer unit reverses its stroke and moves to a position where the articles may be dropped onto a belt, at which time the vacuum on the transfer plate is discontinued and the articles permitted to drop by gravity onto the belt. At this time, if desired, I may send compressed air through the perforations of the transfer plate to assist the release of the articles from the plate.

In cases where it is not desirable to apply pressure to the articles while they are being transferred from the raised members 16 to the transfer unit, I may accomplish such transfer by so regulating the stroke of members 16 that there will be a slight gap between the transfer plate and the upper faces of the articles when said members are at the limit of their upward stroke. At this time the articles are caused to jump across this gap and firmly adhere to the transfer plate by applying air pressure to the members 16 and vacuum to the transfer plate.

The importance of avoiding pressure on the article during its transfer is that the article is not only still wet but is generally of relatively small diameter and considerable thickness. Once the article has been moved out of sleeve 45 by member 16, it is of course no longer circumferentially confined by said sleeve and were pressure applied to it at this time, the article would bulge circumferentially as well as tend to change its thickness, which was carefully gauged initially by properly setting the stroke of the male pressing die.

Any kind of cellulosic pulp can be used to make the wad. Although ground wood pulp can be used exclusively better strength is obtained when at least about half of the pulp is a chemical pulp such as sulfite, soda or kraft pulp. Other fibrous materials that can be suction molded from a water-borne slurry can also be used.

It will be noted that in the initial formation of the wad, as shown in Fig. 4, it is in generally cup-shaped form having upper portions 14 deposited adjacent the upper section of the lateral perforations 46. This shape results from the fiber formation as accretions of interfelted layers the outermost of which extends over all the bottom and side drainage openings and the inner ones of which generally correspond.

When the male die 54 is pressed down on the cup-shaped mass the upper portion 14 is folded together and down into the hollow of the cup the fibers in these portions thereby becoming interlocked to give the final construction shown in Fig. 2.

The finished wad 15 can then be waxed if desired, and after drying is assembled into a shell in conventional manner, between the shot and the powder charge. One or more wads 15 may be used to each shell depending upon the thickness desired.

In accordance with the present invention the wads can be manufactured in sizes ranging from

No. 8 gauge to No. 410 gauge and in variable thicknesses as may be desired.

Due to the type of formation in which a cup-shaped initial mass is squeezed down to compact the side edges and fold over the top, the side walls are much denser than its center. This results in a wad that has a highly resilient core held together by a strong tough envelope of well-felted fiber. This wad with its resilient center had advantages in the shell loading processes and in the reduction in breech pressures and gun recoil.

While I have disclosed a preferred embodiment of my invention it will be understood that various modifications in structure and design may be made within the scope of the appended claims.

What is claimed is:

1. A cylindrical wad of molded fibrous cellulosic pulp having its pulp fibers oriented as interfelted successively accreted generally cup shaped layers extending as laminations along the entire bottom and side wall of said wad, said laminations being folded in and interlocked at the top, the top and bottom faces of the wad being substantially flat and parallel, and at least half of the pulp fibers are chemical pulp fibers.

2. A cylindrical shot shell wad of molded fibrous pulp having its pulp fibers oriented as interfelted successively accreted generally cup shaped layers extending as laminations along the entire bottom and side wall of said wad, said laminations being folded in and interlocked at the top and the top and bottom faces of the wad being substantially flat.

WALTER H. RANDALL.

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