Aug. 17, 1943. M. P. CHAPLIN ET AL 2,326,758

METHOD OF AND APPARATUS FOR PRODUCING PULP ARTICLES

Filed Oct. 26, 1937 4 Sheets-Sheet 1

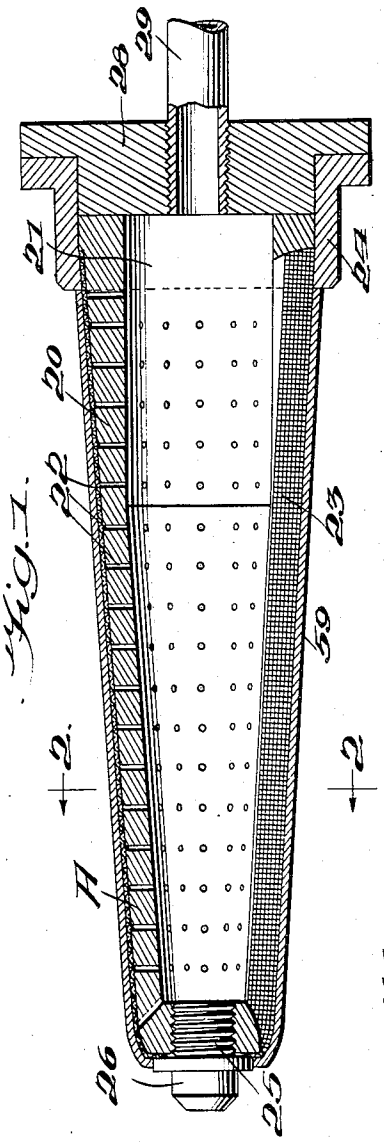


Fig. 1.

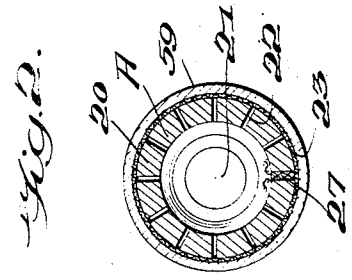


Fig. 2.

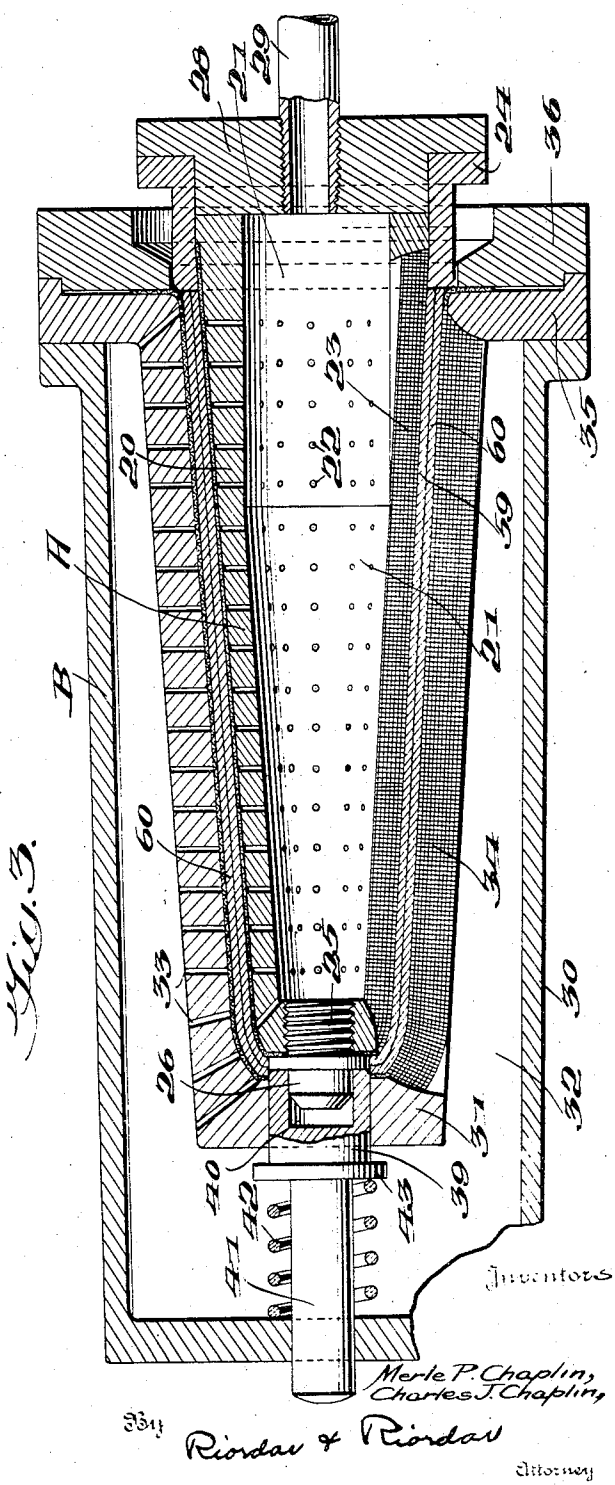


Fig. 3.

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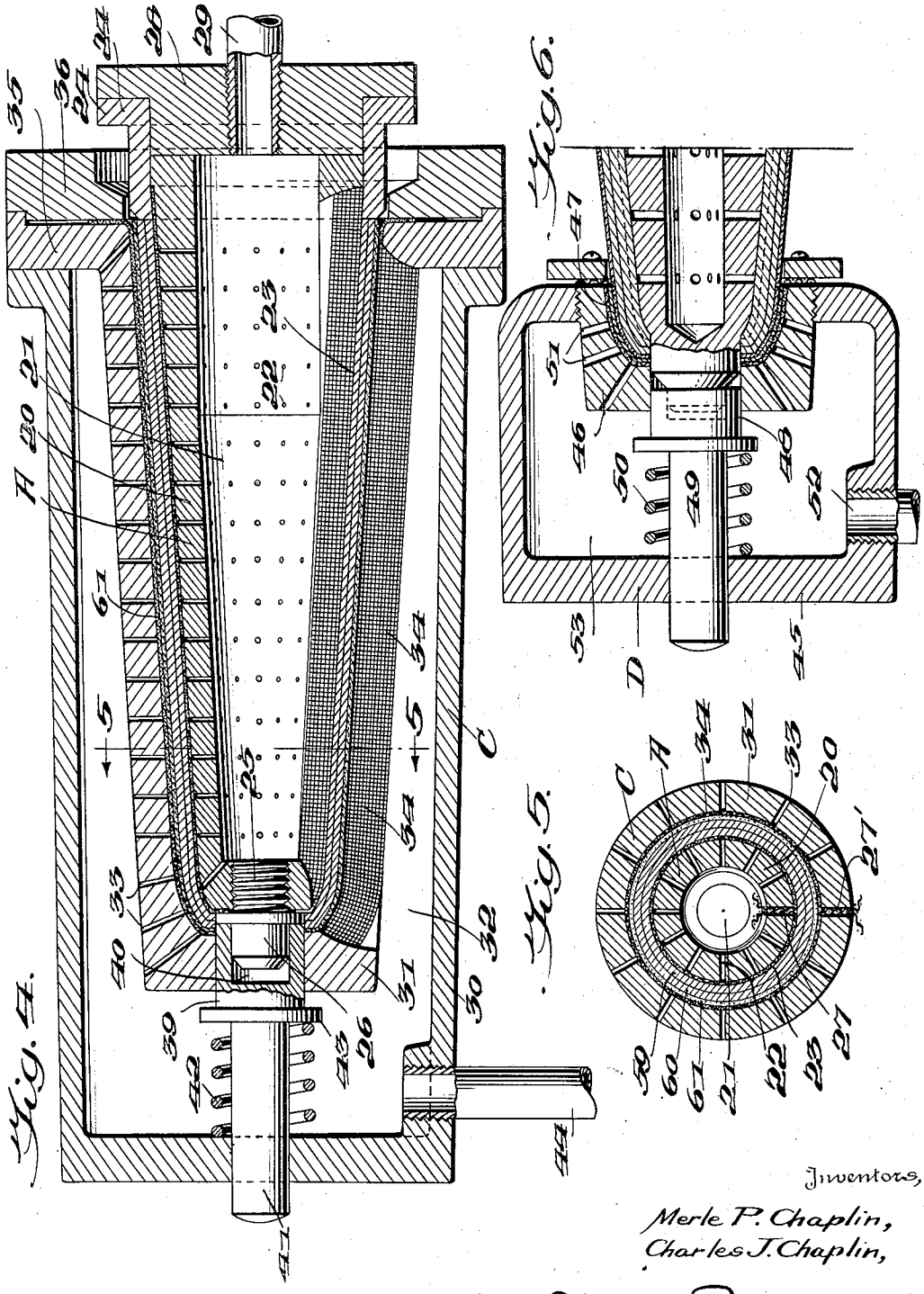


Fig. 4.



Fig. 5.



Fig. 6.

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METHOD OF AND APPARATUS FOR PRODUCING PULP ARTICLES

Filed Oct. 26, 1937 4 Sheets-Sheet 3

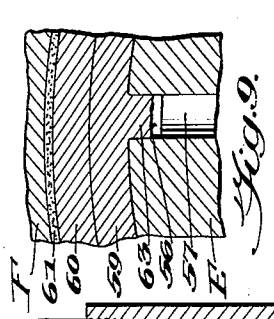



Fig. 9.

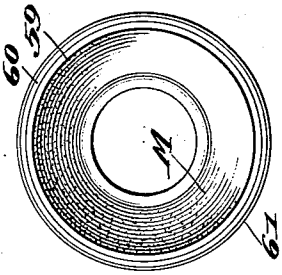



Fig. 11.

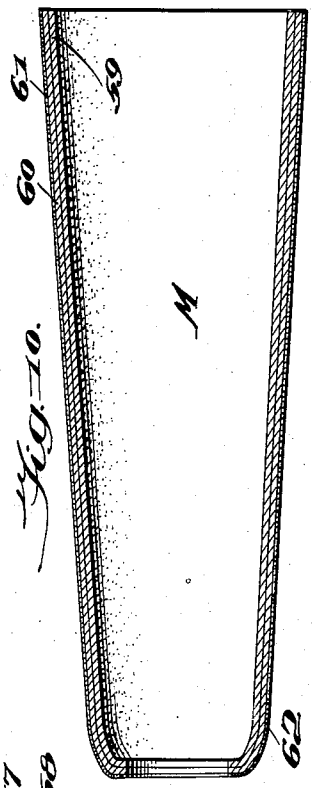



Fig. 10.

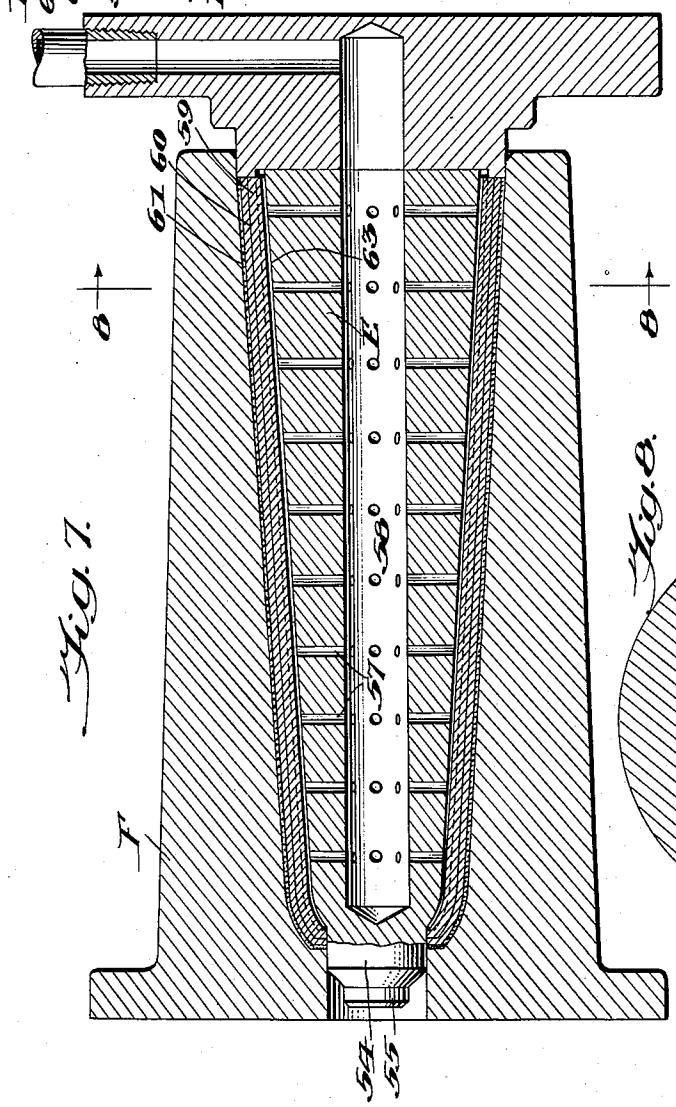



Fig. 7.

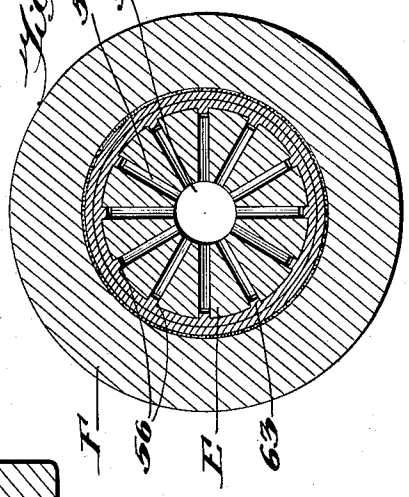



Fig. 8.

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METHOD OF AND APPARATUS FOR PRODUCING PULP ARTICLES

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Fig. 13.

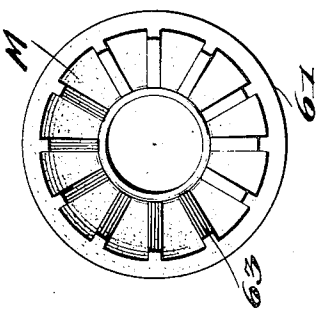



Fig. 15.

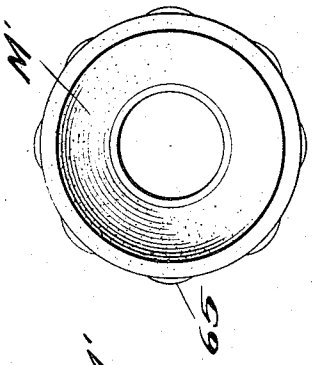



Fig. 12.

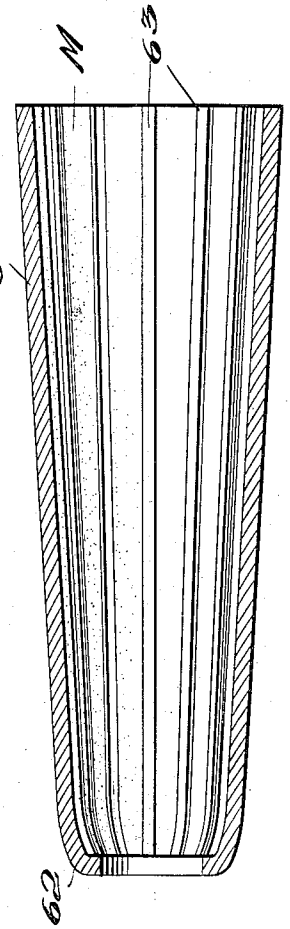
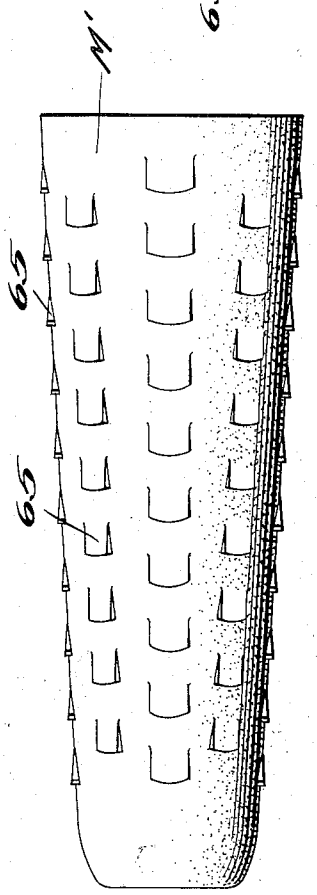



Fig. 14.




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# UNITED STATES PATENT OFFICE

2,326,758

## METHOD OF AND APPARATUS FOR PRODUCING PULP ARTICLES

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Application October 26, 1937, Serial No. 171,156

5 Claims. (Cl. 92—56)

This invention relates to the moulding and forming of various articles from pulp, and more particularly to methods of and apparatus for producing such articles.

For purposes of illustration, a method and apparatus are described herein, which are particularly adapted to the production of textile cones, or cops such as are used in the textile industry for storing or transferring thread and yarn from one machine to another, and for other purposes. These cones or cops are usually made slightly tapering to enable them to be placed on mandrels or arbors, both for winding and unwinding purposes.

It will be understood, in the following description, that reference is made to textile cones or cops simply by way of illustration, as both the method and apparatus herein described are well adapted to production of a wide range of products, and hence the illustrations given herein are not to be construed as limiting the invention to textile cones.

In the manufacture of articles of this nature many considerations arise; it is necessary that the article be light in weight, uniform in thickness and size, and be reasonably strong and stiff so that in use, when the cone or cop is removed from its arbor after being wound, it will hold the thread or yarn thereon firmly and without danger of becoming loosened, due to collapse or shrinkage of the cone itself.

It is also desirable, along with strength and rigidity, to have at least a portion of the surface of certain types of cone velvety in texture, that is relatively soft and yielding to provide a surface which the first layers of thread or yarn may grip, whereby to obviate any danger of loosening by downward slippage on the taper of the cone.

In unwinding the thread or yarn on conventional machinery, the strands are drawn over the small end of the cone, and during the latter part of unwinding come in contact with the tip of the cone. This tip, after continued use, is apt to become worn and roughened, thereby interfering with the proper unwinding of the thread, and it is necessary that the tip of the cone be smooth and hard and have a surface which will resist abrasion or roughening due to contact with the thread of the yarn during such unwinding process.

Previous expedients have been either to make the cone structure of a soft material, with reinforcements of metal or other hard material at such portions of the cone surface as are subject to wear. This is undesirable, both from a cost standpoint and from a structural standpoint, since the reinforcing material is apt to become loosened from the main body of the cone thereby defeating the very purposes for which it is intended. Further, a cone structure made up of a soft material does not have the necessary strength and rigidity to properly support the thread or yarn when the cone is removed from the winding arbor.

Another expedient of the prior art is to make the cone of a strong, hard material wound up in layers, with an adhesive to secure the layers together and to stiffen the cone structure, the entire structure being placed in an oven to dry and harden the adhesive. After drying, such cone is placed on an arbor and its surface abraded, ground and brushed up to raise a nap of fibers on its surface, thereby producing a surface which will assist in retaining the thread or yarn in position. The tip or small end of the cone is then softened and rounded or burnished by a special operation which includes the application of hardening and stiffening materials effective to produce the necessary hardness and smoothness in the finished tip.

Difficulties have been experienced with such laminated articles, which are usually made from paper wound and held together by adhesives, e. g., since the tip of the cone is reshaped or reformed by burnishing it is almost impossible to maintain same in its new shape. The cone as originally wound from paper has a straight uniform taper, but in rounding the uniform tip as is necessary to facilitate removal or unwinding of the threads or yarns, the paper material of the cone is distorted, bent and generally disrupted. Hence the material has a greater tendency to return to its original condition, particularly due to dampness or other unfavorable conditions under which the cones may be stored or used.

These cones, as stated, are usually formed of tapered sections, and the makeup of the article from sheets of paper not only involves expensive operations, use of adhesives, etc., but what is even more objectionable, there is a very large waste of material, because the cone cannot be wound from straight edged sheets, but must be wound from sheets cut on a circle or arc; all of the material outside of the particular shape of sheet is waste.

Such prior practices, and the various operations entering into the building up of a cone structure as described are slow and expensive, and fall short of providing an ideal structure,

even after all the additional work and processes have been performed.

Accordingly, it is a primary object of the present invention to produce an article which not only meets requirements but which is also of greater utility than any article of this nature at present available.

It is another and important object of this invention to provide such an article by a method which eliminates many expensive operations heretofore found necessary.

Still a further object contemplates the use of simplified apparatus as one mode of carrying out the method and which apparatus is particularly adaptable to production of an article having the characteristics set forth.

The article produced by the method and apparatus of this invention is made of pulp, integrally moulded and finished in a series of automatic operations, to the exact shape and size required by the finished article, thereby eliminating all waste of material. It has incorporated in it, as a unitary structure, pulp materials on the inside which make an article that is hard, stiff, rigid and strong, while at the same time a certain portion of the outer surface is made up of a softer fibrous material which, in the finished article, is integral with the hard, stiff structure, thus providing the necessary character of surface for retaining the thread in place, regardless of taper. The tip or end of the cone is molded and finished to the exact required shape and its surface is integral with the remainder of the surface, but the pulp material which renders this portion of the article is of a nature to furnish a smooth hard surface. The entire cone structure being thus moulded and finished as an integral unitary article having incorporated therein pulp materials fulfilling the requirements of use as regards strength and character of the surface at different parts, greatly reduces the cost of manufacture and overcomes many of the objections to the present articles made up from sheets of paper.

All of the objections to prior art practices and structures are overcome in the article, method and apparatus, e. g., any deformation or change in the shape of the tip is avoided as the article is integrally moulded in its final position and there is no tendency of the fibers in any part of the cone structure to change position, due to the integral, moulding to a final fixed position; waste is avoided, extra operations eliminated, and time and labor minimized, all of which reduces the cost.

In a copending application, Ser. No. 171,155 filed of even date herewith, there is described and claimed a pulp article made under the process and with the apparatus hereinafter described, and embodying all the desirable characteristics with none of the objections as previously set forth.

To the attainment of the foregoing objects and other objects which will appear as the description proceeds, and as illustrative of the method and apparatus by which these articles will be produced, reference may be made to the accompanying drawings in which:

Fig. 1 is a section of a primary moulding die, showing the first step of the method;

Fig. 2 is a section on the line 2—2 of Fig. 1;

Fig. 3 is a section of the first and second primary moulding dies, illustrating the second step of the method;

Fig. 4 is a section of the first and third moulding dies, illustrating the third step of the method;

Fig. 5 is a section on the line 5—5 of Fig. 4;

Fig. 6 is a section of another die arrangement, illustrating the fourth step of the method;

Fig. 7 is a section through a pair of finishing dies illustrating a final step of the method;

Fig. 8 is a section on the line 8—8 of Fig. 7;

Fig. 9 is an enlarged fragmentary detail of Fig. 8;

Fig. 10 is a section of an assembled cone prior to consolidation and finishing;

Fig. 11 is an end view of the cone in Fig. 10;

Fig. 12 is a section through a finished cone;

Fig. 13 is an end view thereof;

Fig. 14 is a side elevation of a slightly modified, finished cone; and

Fig. 15 is an end view thereof.

Referring now more particularly to the drawings in which like reference numerals designate like parts, it will be observed that the method, generally, consists in building up and assembling sections of pulp on sets of moulding dies, and thereafter compacting and integrating said sections to consolidate them into a single integral structure.

The method by which such a cone structure is built up and assembled is illustrated in Figs. 1 to 6, in which Fig. 1 shows a primary moulding, or inside, male forming die A provided with a hollow, tapered die portion **20** having an internal chamber **21**, the walls of which are perforated as indicated at **22**. Encompassing the exterior of the die is a forming screen **23** for receiving a pulp deposit, this screen being held in place by a clamping ring **24** at one end of the die and by a threaded plug **25** at the tip end. The plug **25** has the dual purpose of securing the screen **23** in place and defining the end of the moulded pulp sheet which will be formed upon the die. This plug includes a centering tip **26** cooperative with mating dies hereinafter described.

The screen **23** will be made up from a sheet of suitable size, formed to appropriate shape with overlapping edges at the seam or joint, which edges are tucked through the slot **27** cut in the side of the die.

After the screen has been formed in proper shape, and prior to placement over the tapered portion **20** of the die, the folded in edges thereof are temporarily secured together and the entire screen is given a heavy electroplating of copper, nickel, or other suitable material, rendering it stiff and sturdy so that when it is installed upon the member **20**, the folded edges may be tucked into the slot **27** to firmly secure the screen in place, and thus eliminate any joints over which it might be difficult to deposit a layer of pulp. The screen desirably will be electroplated in such a way as to accentuate the corrugations of the formed wire on the inside of the screen, i. e., next to the member **20**, to facilitate drainage between the wire or screen and the member **20**, prior to passage of such drainage through the holes or perforations **22** into the chamber **21**. The outside of the screen, however, will desirably be plated in such a manner as to render it as smooth as possible, and this smoothness may be enhanced by polishing the outside surface after plating.

The electroplating not only serves to stiffen and strengthen the screen but permits the outer surface to be made as smooth as possible without weakening the screen structure. Furthermore, a coarser mesh screen may be used initially than would otherwise seem to be de irable since the

plating serves to close up the mesh somewhat, rendering it in better condition for pulp deposition and formation.

A plunger-like cover **28** having a suction or pressure line **29** leading to the interior of the die serves to complete the assembly of the primary moulding or forming die.

A female moulding or intermediate forming die B is illustrated in Fig. 3, and comprises an outer casing **30** and an inner form **31**, the space **32** between the casing and inner form serving as a vacuum and pressure chamber **32**. The perforations **33** serve to establish communication between the chamber **32** and the interior of the form or die portion **31**. A pulp forming screen **34** lining the form member **31**, is secured in position at the base of the die between a flange **35** at the base of the form portion and a clamping plate **36**. This wire mesh or screen surface is made up in a manner similar to that described in connection with the screen **23** with the exception, of course, that the mesh is secured at its joint by bending the edges outwardly instead of inwardly through a slot **27¹** extending along the die **31**.

It is not necessary to secure the end of the screen in place at the innermost end portion of the die **31** since the electroplating stiffening will render the screen sufficiently rigid to fix it in place.

A slidable plunger **39** is mounted at the inner end of the die portion **31**, and extends completely therethrough, fitting closely inside of the forming wire. This plunger is recessed, as at **40**, to an internal diameter effective to closely fit or engage the tip end **26** of the plug **25** in the die **20**. The plunger **39** has a stem **41** encircled by a spring **42**, and extending outwardly through the casing **30**, the spring **42** bearing against the inner side of the casing **30** and a flange **43** on the plunger **39**. With this arrangement, when the die A is inserted in the die member B in a manner hereinafter described, the two dies will be relatively centered and a proper fit will be insured for assembling the moulded layers of pulp formed on these dies.

Fig. 4 illustrates a female moulding or outside forming die C which is in all respects similar to the die B except for a greater internal diameter, and the same reference numerals are applied thereto. A suction or pressure line **44** completes the assemblage of the forming dies B and C.

Fig. 6 illustrates a female moulding or outside forming die D which is similar in all respects to the dies B and C, except that the longitudinal dimension thereof is considerably less. The die includes a casing **45**, an internal forming die portion **46**, a foraminous screen or mesh **47**, a plunger **48** having a stem **49** surrounded by a spring **50**, all functioning as in the case of the outside forming dies of Figs. 3 and 4, perforations **51** serving to establish communication through the die portion **46**, and a suction line **52** extending from the interior of the chamber **53** formed inside of the casing **45**. The purpose of this die is to form short tip portions for the pulp articles.

The dies thus far described are well adapted to the formation of the component portions or sections of the article and to the assemblage of such portions, as they are formed, into a composite whole. While four forming dies have been described, it will be obvious that this number is susceptible to variations, dependent upon characteristics demanded in the finished product. It will further be apparent that a series of male dies similar to die A except for size, might be used as intermediate forming dies in lieu of the female die assemblage B.

After assemblage of the component parts or sections of the article, transfer may be made to a set of finishing dies, for ultimate compacting and consolidation into the integral final product. Fig. 7 illustrates two finishing dies, of which an inside die E mates with an outside finishing die F. Both of these dies are provided with heat for the evaporation of any moisture left in the moulded article and for the accurate finishing of both inside and outside surfaces. The die E is formed with a tip having one diameter **54** to fit an opening in the die F, and another diameter at **55**, enabling cooperation with the forming die D, when the pulp is transferred. The die E also will be grooved longitudinally as at **56**, along its surface, and will be perforated, as at **57**, to establish communication with an inner vacuum chamber **58**, but the internal surfaces of the die F preferably will be smooth.

In a copending application, Ser. No. 171,157 filed of even date herewith, an apparatus including forming and finishing dies, and the mode of making same is described and claimed, such apparatus being particularly adapted to the purposes herein set forth.

The production of certain articles of the nature contemplated herein can frequently be most economically produced by moulding them to the approximately desired shape from a liquid pulp mixture, and dies A, B, C and D lend themselves most readily to such moulding. These articles after being moulded may be subsequently dried, and in some cases are finished by being compressed between smooth and heated dies of which the dies E and F are examples.

With ordinary pulp moulding methods, where the pulp fibers are deposited on a foraminous die by suction, the fibers collect rapidly and compactly until a certain thickness of deposit is attained over the die, after which deposit is relatively small, or ceases altogether. During the latter part of this deposit the fibers are not compacted as firmly together as initially, and any extra thick moulded pulp article or sheet does not have the density, hardness or strength throughout as is sometimes necessary for particular conditions and results.

Where, as in the present instance, it is desired to provide a strong, dense wall in the moulded pulp structure, which wall is both thicker and stronger than ordinary methods and apparatus will produce, special means are necessary to secure the desired result. It is for this reason that the series of forming or moulding dies A, B, C and D are provided, and upon which separate portions of the completed article may be formed, for subsequent consolidation. The dies E and F lend themselves readily to the subsequent consolidation or integration of the separately formed portions, under conditions which render the finished article homogeneous and of proper density throughout.

A method of building the cone structure, by use of the apparatus described above is as follows:

First, a section **59** of pulp of suitable density and compactness to give, in the finished article, a hard rigid body, is deposited upon the exterior of the screen **23** of the foraminous die A, suction being applied through the line **29** to the

chamber 21 to remove excess liquid from the pulp layer 59, through the perforations 22.

The deposit is not permitted to build up to a thickness where the outermost fibers are loosely deposited or improperly felted because of loss of suction which will necessarily occur as the thickness increases. It will be understood that this deposit is of a character effective to provide the necessary hardness and rigidity required in the finished article.

It also will be readily understood that the vacuum or suction behind or within a foraminous moulding die and a screen results in a corresponding pressure being applied on the outside of the moulding screen, either to the liquid passing through or to the fibers retained on the screen, or to the complete fiber deposit on the screen after it has been removed from its original liquid mixture.

Similarly, a section 60 of pulp having the proper constituency is deposited on the screen 34, internally of die B. The die A with its section 59 is then inserted into the portion 31, being centered by the clamping ring 24 and the plug 26, which latter is yieldingly received by the plunger 39, until the sections 59 and 60 are in nested contact, and in substantially adhering relation to each other. At this time the suction in chamber 32 is replaced by air under pressure, forced into the chamber through the line 44 (not shown in this figure). Suction is maintained in the meantime in the chamber 21 of die A, whereupon the die A may be removed with both sections of pulp 59 and 60 supported thereon.

Meanwhile, a section 61 of pulp will be formed or deposited on the screen 34 of a forming die C, the deposition being effected as in the case of the dies A and B. This die, as stated, may be identical with die B, except that its internal diameter is slightly larger to accommodate sections 59 and 60, as well as 61. The section of pulp 61 is slightly different in consistency, from that of the sections 59 and 60, since this section is to provide the exterior surface of the finished article and must present a surface of sufficient softness and velvety texture as to retain in position, threads or yarns which may be wound upon the cone when finished, without however abrading or harming them. After this outer or surface section is moulded or formed in the die C, the die A with its two sections may be inserted therein, to nest the three sections. As soon as the sections have been compacted together, pressure instead of suction is applied to the chamber 21 of die A, suction being maintained in the chamber 32 of die C and the die A is then removed from the pulp sections. The finishing die E is now inserted in place of the die A and by reversal of pressure and suction, may be removed from the interior of die C, with the three sections mounted thereon.

A compact, dense section 62 of pulp which will dry into a hard section is deposited upon the screen 47 of forming die D, and thereafter the finishing die E with its three sections is inserted as shown in Fig. 6. By suitable application of pressure from the chamber 53, the finishing die may be removed with this fourth section compressed upon the tip end of the three sections 59, 60 and 61. The finishing die E is then inserted into a mating, hollow finishing die F and all sections compacted and smoothed into a single compact, integral structure, such that there is no single, section which is separate from remaining component portions of the structure. This operation has the effect of forcing the harder tip section 62 into a smooth surface relation with the major portion of the softer section 61, and because of the added compression between the sections 62 and 61 at the tip, the tip end of the resultant article will be even more dense and compact than the remainder of the article. Both finishing dies E and F are heated by suitable means, not shown, to cause evaporation of any water remaining in the moulded pulp, this water being drawn off or escaping in the form of vapor through the central chamber or opening 58 and perforations 57, as well as through the slots 56 which extend longitudinally of the die E between perforations. By reference to Fig. 9, it will be seen that the slots 56 are of sufficient depth to provide a drainage passage under the pulp.

From the foregoing, it will be observed that a moulded cone may be made up of a plurality of separately moulded sections, assembled, compacted together and finished as an integral article. A hard stiff portion has been formed as two pieces, i. e., sections 59 and 60, with a soft surface portion 61, and a hard tip portion 62. After the several dense, compact sections or portions have been formed separately, they are then finally assembled and intergrated between the finishing dies E and F, which are heated to evaporate any moisture left in the moulded article, and to accurately finish both inside and outside surfaces of the moulded cone, in addition to consolidating all portions or sections into a single homogeneous unit.

By virtue of the grooves 56 arranged longitudinally of the exterior of the die E, small ribs or projections 63 will be formed on the interior of the moulded cone, for the purpose of forming a seat to grip a driving arbor upon which the cone will be mounted when in use, but these grooves 56, as stated above, are of such a depth that the formed ribs or projections will not completely occupy the grooves and thus a passage is left for drainage purposes.

If it is found for some uses that the rib or ridge portions 63 are undesirable, then they may be eliminated during the finishing operations by partially drying the article in one position, separating the dies E and F slightly and turning the die E to bring the smooth surfaces of the die over the ridges on the article. Subsequent pressure upon the article between the two dies will then smooth out the ridges and complete the moisture evaporation.

A finished, moulded pulp article, made as described above, appears in Figures 12 and 13. This article, illustrated as a cone or cop M, has a surface which is soft and velvety in nature, except for the tip portion which is, of course, very hard and rigid, and the soft surface is desirable for use with finer and more delicate threads or yarn which must be prevented from slipping down over a cone surface, but which will not stand being wound upon a rough or serrated surface.

Coarser threads or yarns may require a rough or semi-rough type of surface, as contrasted with that shown exteriorly of the cone in Fig. 12, and such a surface, in prior practice, is made by running the material of the cone over corrugated rollers or by corrugating the cone surface after the cone is formed.

A modified type of moulded cone is shown in Figs. 14 and 15, which may readily be made by the method and with the apparatus of the present invention, such modification being a cone M'

moulded with small projections 65 substantially parallel to the axis of the cone, and produced by milled recesses in the exterior finishing die F.

The foregoing embodiments are, of course, but illustrative and modification may be made further without departing from the spirit of this invention. Such modification might include the production of a straight tube, or a tube having a straight cylindrical portion with a tapered base or end portion. So far as is known, no methods or apparatus are at present available for moulding a tube, cylinder or cone except by means of a split die and one of the inherent advantages of the present construction is the elimination of split dies.

Even with split dies, there is no method of forming cones or tubes of this general nature with a central hole of uniform diameter throughout its length, such as is possible by the present method and apparatus.

While the method and apparatus have been described particularly with reference to tubular tapered articles, such as a textile cone or cop, it will be readily understood that such description is intended as illustrative rather than limiting, since both the method and apparatus are readily applicable to the production of a wide range of articles, and can be used to produce other types of tubular and non-tubular articles, such as boxes, loud speaker cones, egg-flats, etc. The range of use of the invention is almost unlimited and, accordingly, the invention herein is not to be limited in scope, other than defined in the appended claims.

Having thus described our invention, what we claim as new and desire to secure by Letters Patent of the United States is:

1. The method of moulding fibrous pulp articles which comprises separately forming a plurality of tubular fibrous pulp sections of relatively varying hardness and compactness, assembling and compacting same in nested relation while in a moist condition to unite them with the hardest, most compact section internally of the assemblage and the softest section externally thereof, forming a tip section of a hardness and compactness comparable to the hardest of said tubular sections, and of a diameter approximating that of the softest section, assembling same externally of one end of the said nested sections, and thereafter separately finishing the assemblage from a moist condition by further compacting, and consolidating all sections into a single non-laminated integral structure.

2. The method of moulding tubular fibrous pulp articles which comprises forming a hard compact tube of moulded pulp fibers, forming another tube of moulded pulp fibers with a relatively softer outer surface, nesting said tubes while moist with said soft surface exteriorly of the assemblage, forming a short relatively hard tube of lesser length than said first mentioned tubes, and of a diameter approximating that of said soft surfaced tube, each of said tubes being formed separately on different molding dies, assembling said soft short tube exteriorly of the assemblage of longer tubes while moist, and further compacting and integrating the complete assemblage from a moist condition as a separate operation under heat and pressure effective to thoroughly dry and consolidate said tubes into a single non-laminated integral structure.

3. The method of producing a fibrous pulp article of the class described which comprises moulding on a foraminous die contoured to the approximate shape of the desired article, a thin relatively dense compact conical tube, of forming on a second contoured die a thin compact conical shaped tube of lesser compactness than said first tube contoured to overlie and fit the dense tube formed on the first mentioned die, of forming on a third contoured die a thin compact tube of lesser length and greater hardness and compactness than said second tube, and contoured to overlie and fit a portion of the tube formed on the second mentioned die, assembling said tubes while in nested relation while in a moist condition, to unite them, of compacting and consolidating all of said tubes, as a separate operation, in nested relation to each other while moist, and of holding said tubes in compact condition until water or other liquid contained therein has been removed.

4. An apparatus for moulding fibrous pulp articles comprising a contoured spindle-like foraminous inside forming die adapted to receive a fibrous pulp deposit over its external surface, a hollow contoured foraminous intermediate forming die adapted to receive a fibrous pulp deposit over its internal surface, and a hollow contoured foraminous outside forming die adapted to receive a fibrous pulp deposit over its internal surface, said dies being arranged to separately mould pulp sections for nesting, assembling and uniting upon said inside forming die, means for transferring an assemblage of sections from one die to another; finishing dies for separately compacting, drying and consolidating the assemblage of formed sections into a single unitary non-laminated structure, and means for transferring said assemblage from the forming dies to the finishing dies.

5. An apparatus for moulding fibrous pulp articles comprising a contoured inside forming die having a foraminous body and a forming screen externally thereof for deposition of a section of fibrous pulp, a contoured outside forming die having a foraminous body and a moulding screen internally thereof for a deposition of a section of fibrous pulp, a foraminous tip forming die having a moulding screen for deposition of a tip section of fibrous pulp, said dies being correlated and adapted for assembly with deposited sections of pulp, one within the other, to unite the pulp depositions to each other, and for removal of the sections of pulp in assembled relation, from said dies, and with the tip section externally of one end of the assemblage, and separate die means upon which said assembled sections are finished into a single, non-laminated, integral structure.

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