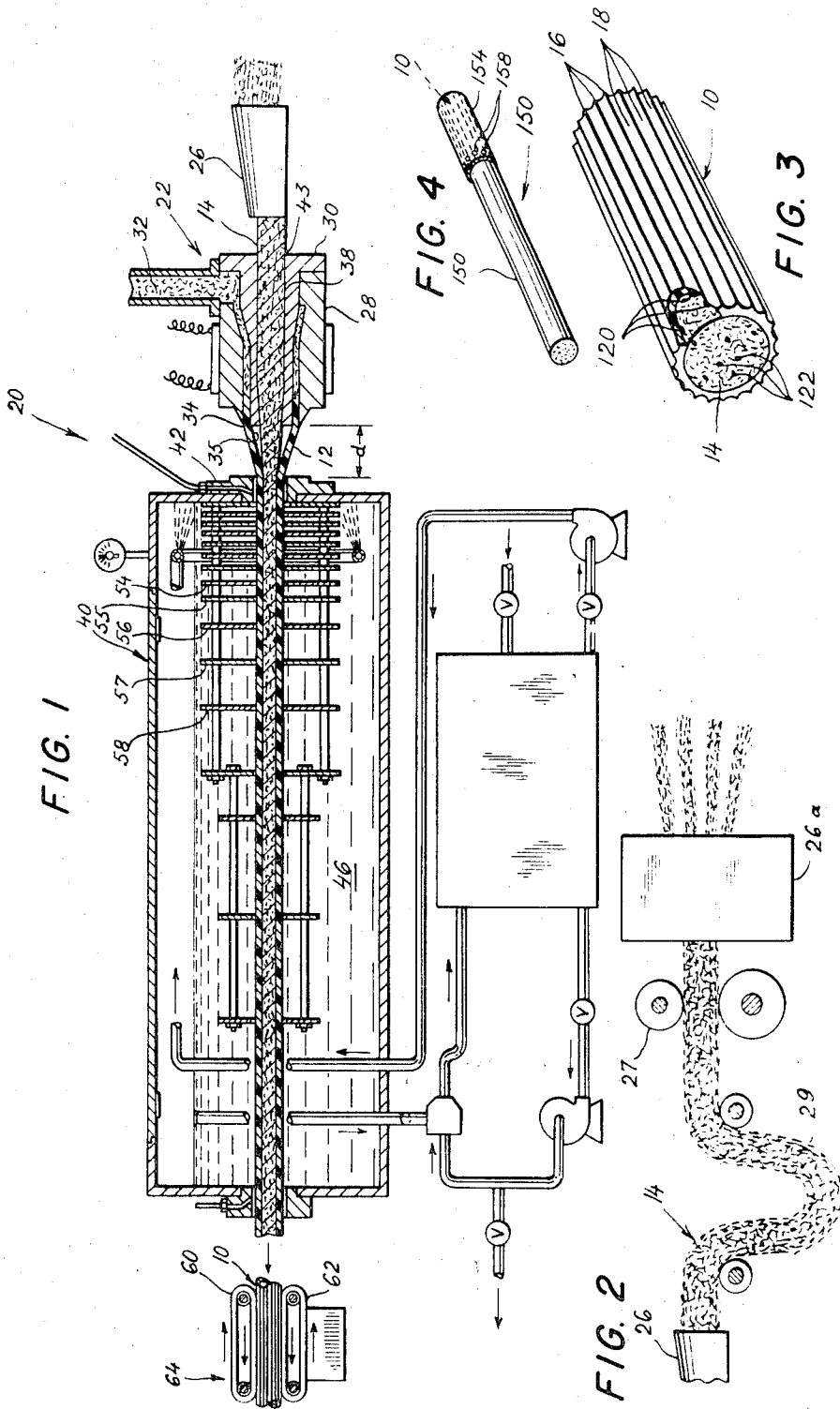


May 15, 1973

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3,733,246

FORMING FILLED CONTINUOUS PLASTIC ROD SUCH AS PLASTIC CIGARETTE
FILTER ROD FILLED WITH A TOW OF CELLULOSE ACETATE
Original Filed July 24, 1968



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3,733,246

FORMING FILLED CONTINUOUS PLASTIC ROD SUCH AS PLASTIC CIGARETTE FILTER ROD FILLED WITH A TOW OF CELLULOSE ACETATE
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Original application July 24, 1968, Ser. No. 747,279.
Divided and this application July 23, 1970, Ser. No. 63,996

Int. Cl. A24c 5/50; B01d 27/00
U.S. Cl. 161—176

1 Claim

ABSTRACT OF THE DISCLOSURE

A method with which a continuous length, tubular article filled with a gas or liquid pervious filler material such as a tow filled plastic cigarette filter rod is formed by extruding plastic as a sheath around an advancing bloomed tow of fibrous filter material, heat from the plastic extrudate being utilized in the course of the forming operations to accelerate curing of a plasticizer impregnating the tow. A crosshead type extrusion die is utilized for the forming operation and is provided with a central tube extending longitudinally therein for receiving the advancing tow and isolating it from the molten plastic with which the extrudate is formed, the latter entering the die laterally and issuing from the mouth thereof as a continuous tubular sheath which makes first contact with the tow at a distance downstream of the die mouth. The extrudate on leaving the crosshead die is then sized by passing it through a cooling chamber wherein the external dimension of the plastic sheath is accurately controlled within predetermined limits.

This is a division of application Ser. No. 747,279 filed July 24, 1968, now Pat. No. 3,579,623.

BACKGROUND OF THE INVENTION

The present invention is concerned with forming in continuous operation, a filled tubular article, as for example, cigarette filter rod. It is common practice in the cigarette making art to form filter rod in a continuous operation by wrapping a continuous tow of filaments of a filter medium, most usually cellulose acetate, in a continuous paper wrapper customarily referred to as "plug wrap." This generally involves advancing the tow and paper wrap on which the former is laid through a forming device which shapes the paper wrap around the tow in the form of a parti-cylindrical enclosure wherein the tow is compressed to a degree, the operation being such as to leave an edge outstanding tangentially from the paper at one side so that it thereafter may be overlapped or folded against the main body of the rod to form the seam of the finished rod. The outstanding part of the wrap is then coated with an adhesive and as the partly formed rod passes through a final folder device the outstanding edge is folded against the main body of the rod and held for a short period to allow an adhesive bond to be effected. If a heat activated adhesive is used, the final folder device can be provided with a heater to activate the adhesive. It is also possible to coat the inner surfaces of the wrapper with adhesive so that the tow confined therein will adhere to the wrapper. However, this known method of making cigarette filter rod has shortcomings which makes it unsuitable for use in modern cigarette making technology where very high manufacturing speeds are commonplace. For example, the use of an adhesive joint or seam usually limits production line speed to a speed not greater than about 300 feet per minute. Also the device with which adhesive is applied to the outstanding

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edge part of the plug wrap must be accurately controlled so that neither an overabundance or inadequacy of adhesive is applied to the edge part particularly since in the advent of either condition the seam of the formed rod has a tendency to pull open. A further disadvantage is that the overlapped seam formed on the filter rod has a generally flattened surface giving the finished product some degree of out-of-roundness. This flatness detracts from the appearance of smoking articles in which the filter rod is used and also can create problems in the cigarette making machines by causing upset of the process with which the filter plug is joined to the tobacco cylinder, as well as wrinkling of the tipping paper used for that purpose. Also, filter rod made according to the described known method would not easily be adapted for forming the mouthpiece part of a ventilated cigarette similar to the type described in presently pending application Ser. No. 632,336, now U.S. Pat. 3,499,461. The cigarette described in said application has a mouthpiece with a fluted external surface formed such that when it is joined with a tobacco cylinder by means of tipping paper, the tipping paper and flutes enclose ventilation passages through which cooling air streams are aspirated by the smoker in the course of puffing the cigarette. The mouthpiece described in said application is preferably made of plastic by an extrusion process, for example that described in the patent application of Charles Gatto filed on even date herewith and entitled "Method and Apparatus for Forming Plastic Tubing," now U.S. Pat. 3,538,210.

SUMMARY OF THE INVENTION

The present invention is concerned with a method with which a tubular article filled with a gas or liquid pervious filler such as a tow filled cigarette filter rod can be produced in continuous length by continuous forming operation and at a production speed of 1000 feet per minute or more, the article itself being of novel character and susceptible to uses for purposes other than merely as a filtering device in a smoking article. The invention is further characterized by a constancy of processing that insures nearly perfect uniformity of dimension in the finished product as well as density of the filter medium enclosed within the tubular plastic workpiece.

In accordance with the invention, filter rod is made by extruding a tubular, preferably circular section plastic workpiece in continuous operation from an extruder die, the extrudate leaving the die at a diameter somewhat greater than that of the hardened finished workpiece but with an external shape substantially conforming to that of the finished product. Simultaneously, a partially compressed tow of filaments of a filter material is advanced axially into and in co-directional movement with the plastic extrudate as the latter leaves the forming die. The tow of filaments is not contacted by the hot extrudate until the latter has advanced some distance downstream of the exit aperture of the die from whence it issues, the first contact being made when the extrudate is drawn down against the tow, to form a sheath covering the latter and as the two enter the portal gland of a cooling chamber in which heat is removed from the plastic extrudate and the latter is sized so that its external dimension and shape are accurately controlled within prescribed limits. The apparatus and procedure by which the cooling of the extrudate to set its external surface in the manner aforesaid is the same as that described in the previously mentioned patent application of Charles Gatto filed on even date herewith, now U.S. Pat. 3,538,210.

In accordance with the invention various types of material suited to acting as filter media may be used as the filler and various types of plastic can be utilized for the tubular workpiece in which the filler is sheathed. Most

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commonly, however, cellulose acetate is employed as the filter medium, being formed from a stock of cellulose acetate in the usual manner by advancing a bloomed tow of filaments through a collecting horn to confine, partially compress, and shape the tow into a generally cylindrical shape. For the purpose of providing uniform density and overall cohesive character to the filler, it is customary as is also done in prior art filter rod making methods, to treat the filaments thereof with a plasticizer to thereby promote inter-fiber bonding of the various filaments comprising the tow. In accordance with the present invention a heat activated plasticizer may be applied to the tow only a short time prior to its entry into the collection horn.

The invention accordingly comprises the features of construction, combination of elements, and arrangement of parts, which will be exemplified in the construction hereinafter set forth and the scope of the invention will be indicated in the claims.

BRIEF DESCRIPTION OF THE DRAWINGS

A fuller understanding of the nature and objects of the invention will be had from the following detailed description taken in conjunction with the accompanying drawings in which:

FIG. 1 is a side elevational view partly in section of apparatus with which plastic cigarette filter rod of the present invention is formed.

FIG. 2 is a fragmentary view illustrating the manner in which the tow is bloomed and coated with plasticizer prior to advancing same into the apparatus shown in FIG. 1.

FIG. 3 is a perspective view of a representative length of the tow-filled filter rod made according to the invention, portions thereof being broken away for purposes of clarity.

FIG. 4 is a perspective view on reduced scale showing a cigarette in which the article of FIG. 3 is embodied as a filtered mouthpiece.

Throughout the following description like reference numerals are used to denote like parts in the drawings.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The present invention is concerned with a method for forming filled plastic tubing in continuous operation, as for example, a continuous hollow tube having the bore thereof filled with a tow of fibrous material such as cellulose acetate rendering the article useful when sectioned into lengths as a device for filtering gaseous or liquid media including cigarette smoke. The article could also be employed as a storage and dispersing device for liquid, as for example, as an ink cartridge for a writing implement. The invention is particularly directed to a method and means with which cigarette filter rod can be produced, the composite structured filter rod itself being of novel character. It will be understood that the method of the present invention has a broad range of applicability for forming continuous rod-like articles having either a cylindrical or polygonal outer surface. The outer surface also can be of smooth or protuberant surface configuration, the latter including the structural arrangement shown in FIG. 3. Turning now to a description of a representative embodiment of the invention reference is made to FIG. 3 which depicts a short length of cigarette filter rod 10 which is comprised of a thin-walled outer plastic sheath 12 of circular section, which encloses a filler 14 such as a tow of filaments of cellulose acetate, the tow functioning as a filter medium when a short length or plug of the rod is incorporated in a cigarette. The filler 14 is depicted as substantially filling the plastic sheath although it is of pervious character and although for cigarette filter rod this is preferable, it is not essential within the scope of this invention that the filler completely fill the sheath. The overall diameter of the sheath

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12 as depicted is approximately 0.3" with a wall thickness ranging between .005" to .020" although it will be understood that a wide range in these parameters is possible depending upon the intended use of the article. The rod shown in FIG. 3 is advantageously employed in the ventilated cigarette described in the previously mentioned patent application Ser. No. 632,336, now U.S. Pat. 3,490,461, and has a fluted external surface wherein the respective flutes intersect to form peaks as at 16, the peaks being enclosingly engaged by the cigarette tipping paper customarily used to join the filter plug with the tobacco cylinder so that the arcuate-shaped longitudinally arranged grooves 18 together with the tipping paper comprise ventilation passages through which cooling streams of dilution air are aspirated and delivered separately of the smoke stream to the smoker's mouth when the cigarette is puffed, the tipping paper being provided with a suitable arrangement of perforations for communicating the respective ventilation passages with atmosphere.

The filter rod 10 shown in FIG. 3 can have an external dimension within prescribed limits but when used as a filter plug for a ventilated type cigarette of the description aforesaid, the circumference of a circle circumscribing the peaks of the flutes 16 preferably should measure 23.9 mm.±.05 mm. The reasons for controlling this circumferential dimension with such accuracy are set out more elaborately in the concurrently filed application of Charles Gatto entitled "Method and Apparatus for Forming Plastic Tubing", now U.S. Pat. 3,538,210, but in brief it is desirable so as to minimize conditions which can cause upset in cigarette making machinery when the filter plugs are joined with the tobacco cylinders.

FIG. 1 illustrates apparatus denoted generally at 20 with which cigarette filter rod 10 of the present invention can be made. The apparatus 20 is generally similar to that described in said concurrently filed Gatto application being modified to the extent of the construction of the extrusion die 22 details of which will be given shortly herein. As a preliminary to forming the cigarette filter rod 10, the filter medium which is described in representative form as being a tow of filaments of cellulose acetate is prepared as shown in FIG. 2. Thus a stock of filaments is fed through a blooming and coating chamber 26 wherein the filaments are coated with a plasticizer comprising by way of example, a solution of 9% triacetin. The plasticizer is employed to promote inter-fiber bonding in the tow at the points of crossing or contact of the respective fibers and thereby produces cohesiveness in the mass of the tow. Upon leaving chamber 26, the tow is advanced through a feed roll set 27 and undergoes a loop transit as at 29 to relieve tension in the tow feed in the longitudinal direction since it is preferable that the tow thereafter be processed without any tension being present therein. The tow then enters into collection horn 26 in which the relatively loose fibrous mass is partially compressed and shaped into a generally continuous cylindrical body, the tow issuing from the collection horn 26 in the manner indicated and follows a course which leads it into the crosshead die 22. The tow issuing from horn 26 has a diameter larger than the intended final internal dimension of the sheath but, and for reasons as will appear, has a diameter smaller than the internal diameter of the extrudate leaving the die 22. Crosshead die 22 includes a body part 28 wherein is supported in known manner a mandrel 30, the mandrel being spaced from the internal bore of the body part 28 so as to define therewith an annular space in the body part in which can be received molten plastic 32 entering the crosshead die laterally from a reservoir (not shown). Depending on the speed with which the extruder screw (not shown) feeding the molten plastic 32 is rotating, a continuous tubular stock 12 of heated plastic issues from and is conveyed away from the mouth or extrusion aperture of the extruder die as at 34 (by means of puller unit 64 to be described later), the extrudate at that point having

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cross-sectional dimensions substantially larger than the intended final cross-sectional dimensions of the finished filter rod and being sufficiently heated to be plastically deformed and the inner surfaces as at 35 being tacky or in a plastic state. Also, the extrudate possesses at that point an external surface configuration in substantial conformance with that of the finished product and to that end, the crosshead die 22 may be fitted with a suitable shaping means to impart the required configuration to the extrudate. As for example, the bore passage of die body part 28 can be fluted complementally to the fluted pattern of rod 10. Simultaneously with the issuance of the tubular workpiece 12 from the die, the compressed tow 14 of filter medium transits through a central cylindrical passage formed in the mandrel as at 38. The tow upon leaving the die 22 advances axially into and codirectionally with the extrudate, the tow mass having at that point a diameter at least slightly greater than the inside diameter of the sheath when the latter is fully processed. As will be noted the co-directional movement of the extrudate 12 and tow 14 downstream of the point of exit from the crosshead die 22 is for some short distance one in which the hot extrudate does not contact the tow. The foregoing is provided to allow the extrudate to be drawn down in size in that distance of travel with the extrudate making first contact with the tow only as the composite structure enters portal gland 42 of the cooling chamber 40. While the filler (tow 14) is transiting the extruder die 22, it can be enclosed within a central sleeve (not shown) and the sleeve can be positively cooled for the purpose of inhibiting heat transfer to the tow within the extruder die so as to prevent heat discoloration to the surface of the tow. This is a consideration of some consequence when using a filler such as polyethylene or polypropylene materials since they are subject to damage from the heat present within the extruder die.

As the composite article enters the cooling chamber 40 through portal gland 42, the plastic sheath is drawn down sufficiently and uniformly tightly against the tow and to about the optimum final external dimension it is intended to have, and in so doing subjects the tow mass of filler 14 to a further and final radial compression. In this operation, the portal gland serves as a closing aperture having substantially the same diameter and shape as the final external diameter of the sheath. Thus in the finished article, the sheath 12 will enclose the tow mass with a positive constraint of the latter. The thermoplastic extrudate 12 can be extruded from the die 22 at a temperature at which it is plastically deformable and at which at least the inner wall surface or bore thereof is plastic (tacky). Thus when the plastic sheath is drawn down against the tow filler 14, the fibers at the surface of the latter become embedded in and adhered to the inner wall surface of the extrudate as at 120 in FIG. 2. The adhesion of the tow to the extrudate in this manner serves to longitudinally position the tow mass within the sheath.

In its passage through the cooling chamber, the composite article is submerged in a bath of cooling water 46 and passes through a series of apertured sizing plates 48-58 in sizing relationship therewith. The respective sizing plates together comprise a sizing die assembly, the plates being initially spaced apart at equal distance from each other and thereafter at the increasingly larger distances shown in the direction of advance of the article, the apertures of the plates having complementary configuration to that external surface of the sheath. The purpose of providing a spaced apart plurality of sizing plates is to positively expose the extrudate external surface to the cooling fluid to insure a positive and progressive setting or hardening of the external surface in correspondence to the advance of the article. In effecting the sizing of the sheath which is done in the same manner as described in the prior mentioned concurrently filed Gatto application, the sleeve is subjected to an internal pressure that tends

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to expand it radially to thus hold same tightly in sizing relationship with the sizing plates 48-50 and produce the proper sizing in the sheath. The force of expansion is provided by maintaining the cooling chamber 40 and the fluid 46 therein under a condition of vacuum whereas the space enclosed by the sheath is communicated with atmospheric pressure, the atmospheric pressure entering the assembly as at 50 by investing the low density tow mass 14 as the latter enters the extrusion die.

On leaving the cooling chamber 40, the sheathed article passes between the rotating belts 60-62 of suitable puller device 64 which feeds the article through a cutting unit (not shown) wherein the continuous length article is cut into short lengths as shown in FIG. 2 and adaptable for use in further processing such as utilization in cigarette making machines.

The tubular article produced according to the present invention is advantageously employed as the mouthpiece component of a ventilated cigarette and accordingly can be sectioned into small lengths as indicated previously for that use. The tow of filters preferably is comprised of a plurality of filaments of cellulose acetate extending longitudinally and coextensively of the tow mass. It can be and preferably is treated with a plasticizer which causes adhesion between the respective fibers of the tow and hence produces a cohesive character in the tow. In addition to providing means for achieving adhesion between the fibers, the plasticizer may be used to adhere smoke treating substances such as filtrant or flavouring substances to the tow, as for example, particles of charcoal 122 as seen in FIG. 3. When used in conjunction with a polyethylene mouthpiece for a ventilated cigarette of the type previously described the cellulose acetate preferably should have a total denier of 25,000 to 75,000 but more preferably in the range of 30,000 to 50,000 the foregoing being based on a filter denier of about 1 to 16 and preferably 3 to 6 denier. Other materials are suitable for use as filler and can include polyalkenes, polyethylene, and paper tows. The plastic sheath 12 can be formed from various types of thermoplastic materials including polyolefins, polypropylene, cellulose acetate and polyethylene, and can have various external and internal dimensions depending on the use. As was mentioned earlier for filtered cigarettes with the circumference of a circle circumscribing the peaks of the flutes formed in the surface of the rod should be 23.9 mm. with a variation no greater than ± 0.5 mm. In accordance with the present invention it is not essential that the filler materials be positively secured to the inner surface of the sheath since it is normally constrained therein by virtue of the tendency of the filler to expand. However, as mentioned earlier, the external or outer surface of the filler becomes adhered to the inner surface of the sheath as the latter is pulled down against the tow, the adhesion occurring at the time the still tacky inner surface of the sheath makes contact with the filler.

FIG. 4 shows a ventilated cigarette embodying the mouthpiece structure of FIG. 3. The cigarette 150 includes a wrapped cylinder of tobacco 152 which is aligned with the mouthpiece 10, the outer surface of the sheath being enclosed in a wrapper sheet 154 which also serves to join the mouthpiece to the tobacco cylinder. Perforations 158 are provided in the wrapper sheet to admit air as ventilated streams in the course of smoking.

An important advantage of the filled tubular article of the present invention is that it allows for extrusion and accurate external dimensional sizing of continuous tubular element having very small wall thickness the latter characteristic being desirable, for example, where reduction in overall article weight is sought. Such advantage accrues in that the filler serves as an internal support for the tubular element during the critical sizing and cooling procedures. It will be appreciated that relatively thin-wall, i.e., .004" thick tubing is most susceptible to collapse during cooling said sizing particularly where the travel

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attending these procedures is prolonged. On the other hand, collapse of the tubing when filled with a compressed tow filler under similar sizing and cooling does not occur.

It will thus be seen that the objects set forth above among those made apparent from the foregoing description, are efficiently attained and, since certain changes in carrying out the above method and in the construction set forth, which embody the invention may be made without departing from its scope, it is intended that all matter contained in the above description shall be interpreted as illustrative and not in a limiting sense.

What is claimed is:

1. An article of composite structure comprising a fluid pervious mass comprised of a plurality of cellulose acetate fibers extending generally longitudinally of and coextensively of said mass, at least some of said fibers being held to others of said fibers at points of contact by adhesive, said mass being of generally circular cross section and having a total denier in a range of 30,000 to 50,000 and a seamless tubular sheath of polyethylene longitudinally coextensive with and enclosing said mass under condition of constraint uniformly radially compressing

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said mass, said sheath being of substantially uniform cross section from end to end and having a smooth wall inner surface and a fluted outer surface, the fibers at the surface portion of said mass being embedded in the inner surface of said sheath along the full length of said sheath, the fibers in said mass being substantially untensed longitudinally of said mass.

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U.S. Cl. X.R.

131—268; 156—244; 161—172