July 28, 1970 H. J. NUNGESSER ET AL 3,522,342

APPARATUS AND METHOD FOR MAKING BRISTLES HAVING A FILLER

Filed July 3, 1967 2 Sheets-Sheet 1

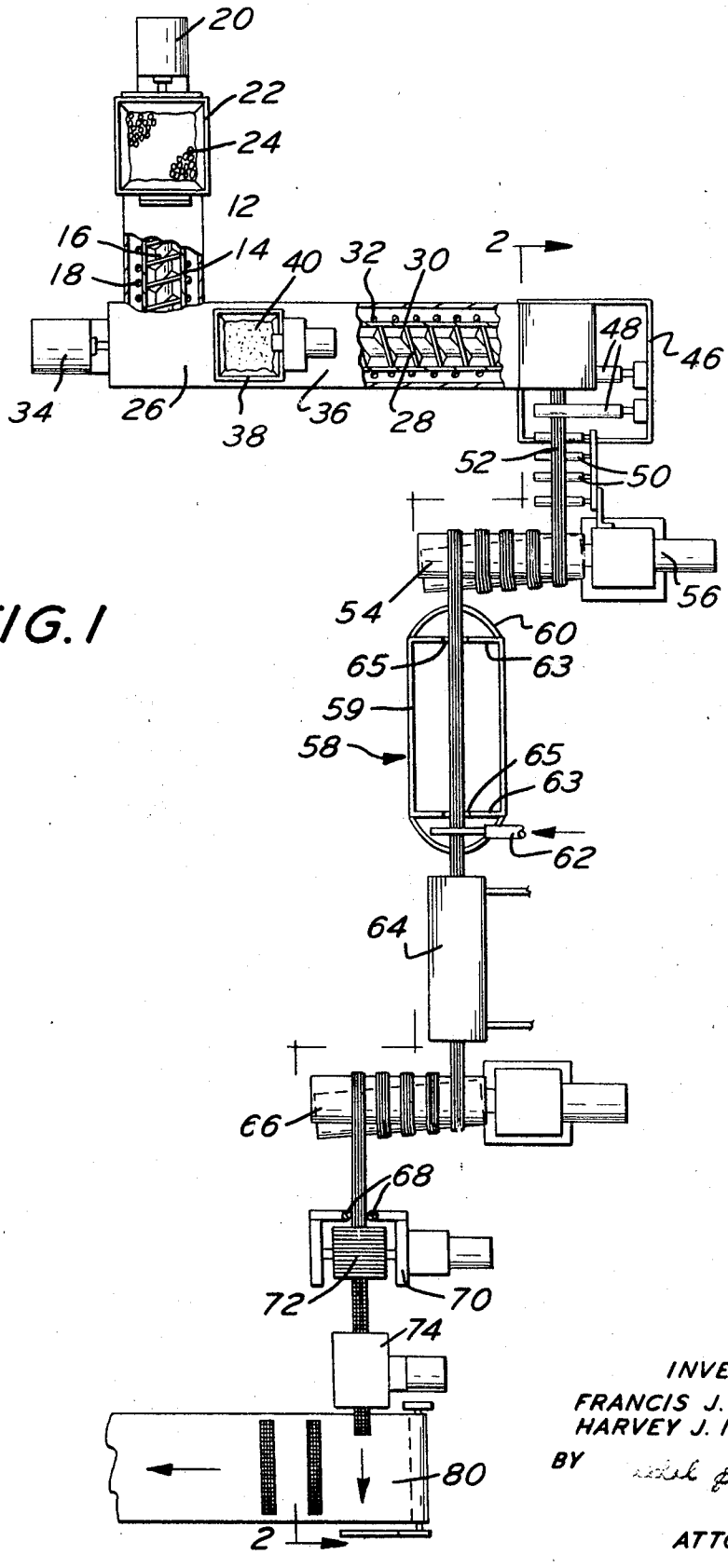

FIG. 1

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FIG. 2A

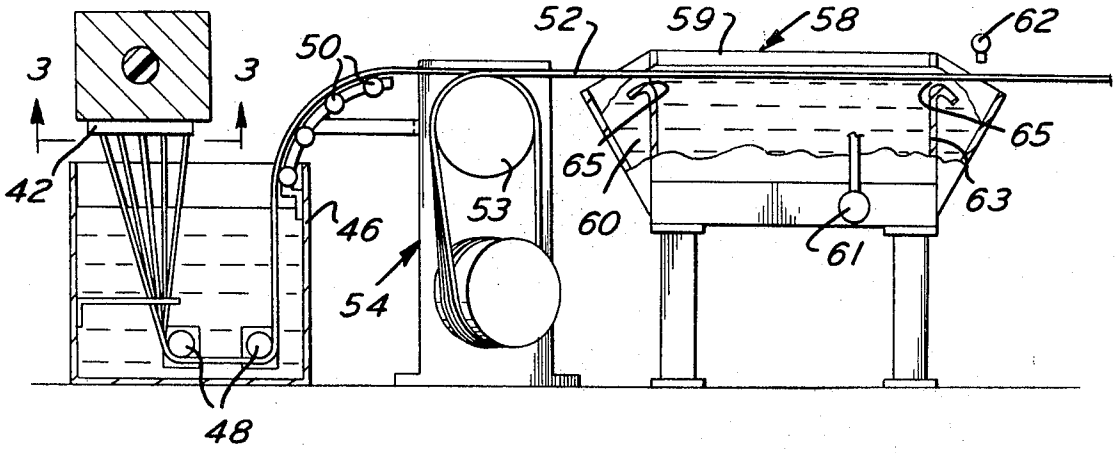
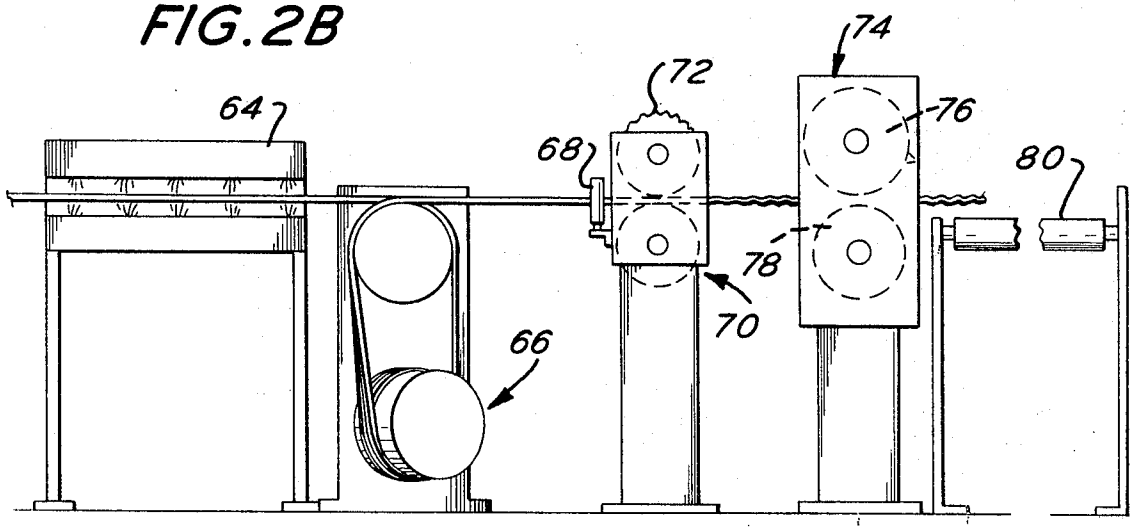


FIG. 2B



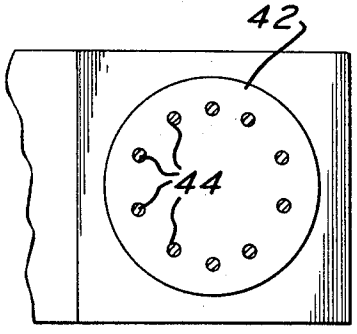


FIG. 3

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APPARATUS AND METHOD FOR MAKING BRISTLES HAVING A FILLER

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U.S. Cl. 264—210 9 Claims

ABSTRACT OF THE DISCLOSURE

Producing bristles by pre-plasticizing and liquifying a plastic material, adding a filler to the plasticized plastic, extruding the mixture through a die directing into a bath, arranging the extruded material into a ribbon of material, stretching the ribbon of material over godet rolls having sacrificial surfaces thereon, passing the ribbon through a hot water bath, removing the excess water from the ribbon as it exits from the hot water bath by a blast of air, thoroughly drying the ribbon by passing the same under a radiant heater, passing the ribbon over a second set of godet rolls having sacrificial surfaces thereon, crimping the ribbon on a conventional crimping mechanism, cutting the crimped ribbon into individual bristles and conveying the bristles from the cutter to a desired location. The apparatus is constructed and arranged so that all operations are performed in a continuous process.

This invention relates to an apparatus and method for making bristles having a filler and more particularly to an apparatus and method adapted to make bristles having an abrasive filler in a continuous process.

Many difficulties have been encountered in producing bristles having an abrasive filler. The difficulties have been encountered primarily due to the deleterious effect of the abrasive filler. The abrasive not only creates excessive wear of extruding equipment but also causes excessive wear of all apparatus which it contacts, including serious dulling and chipping of the knife blade which cuts the filament having the abrasive encapsulated therein into individual bristles.

It is an object of the present invention to overcome the above-discussed problems and provide an apparatus and method wherein bristles containing an abrasive may be produced in a continuous process.

It is another object of the present invention to provide a novel apparatus and method for making bristles containing abrasives.

It is a further object of the present invention to provide apparatus and method for producing bristles having abrasives therein in a continuous process while minimizing wear of the apparatus.

It is a further object of the present invention to provide apparatus and method for evenly crimping a plurality of filaments containing abrasive filler which are maintained in ribbon form.

It is still another object of the present invention to provide apparatus and method which utilizes a high speed pinch cutting apparatus to provide bristles of the desired length.

It is still a further object of the present invention to provide apparatus and method wherein removable liners are utilized on godet rollers for stretching filaments having abrasives encapsulated therein.

It is still a further object of the present invention to provide apparatus and method for producing bristles comprising thermoplastic materials having abrasives encapsulated therein in a manner which is simple, reliable and relatively inexpensive.

Other objects will appear hereinafter.

The above stated and other objects are accomplished by means of the present invention. Plastic molding pellets which may be thermoplastics are rendered into a semi-liquid state in a first screw extruder before the filler which may be an abrasive is introduced. The filler utilized in the present invention will normally be an abrasive although the invention is not limited thereto. The liquid thermoplastic is fed to a second screw extruder wherein the filler is added. The liquid or semi-liquid state of the plastic envelops the filler so as to reduce wear on the components of the apparatus. Uniformity of distribution of filler throughout the plastic carrier is attained by means of the extrusion screw.

The outlet end of the second screw extruder is provided with an extruding die. The product is extruded into a water bath. The water bath facilitates solidification of the product. The filler is firmly encapsulated in the filaments. The extrusion die will normally have multiple orifices and will therefore extrude a plurality of rods or filaments.

The rods or filaments are wound about a guide roller at the bottom of the water bath. The filaments are arranged in ribbon form and are drawn over guide rollers. The ribbon is wound several times over godet rolls. The godet rolls may be lined with an easily replaceable lining and are rotated at different speeds to stretch the filaments. It is essential that the various elements of the apparatus be easily replaceable since the wear by the abrasive in the filaments cannot be totally avoided.

After the ribbon of filaments is stretched by the godet rolls it is immersed into a hot water bath. The hot water bath partially plasticizes the filaments and promotes further stretching thereof. The hot water also penetrates the filaments. Stretching is further aided by a second set of godet rolls which pull the ribbon through the hot water bath. After the ribbon exits from the bath, it is passed under an air jet which blows excess water off the surface of the filaments. The ribbon is then subjected to radiant heat to dry the surface of the filaments.

The ribbon is thereafter wound about the second set of godet rolls which may be substantially identical to the first set of godet rolls. The ribbon is fed to a mechanical crimper which both crimps and pulls the ribbon. The crimper insures movement of the ribbon at a constant speed to a cutter. The ribbon is fed to the cutter which cuts the ribbon into desired bristle lengths. The cutter utilizes a fly knife which cooperates with an anvil roller to pinch cut the filaments. It has been found necessary to pinch cut the filaments since the abrasive will dull most conventional cutting blades. The pinch cut is effected by insuring solid contact between the blade and the anvil roller. Preferably, there will be approximately fifteen to twenty thousandths interference between the cutting blade and the anvil. It has been found that this interference is necessary in order to insure effective cutting through the filaments containing abrasives. A conveyor may be provided adjacent the cutter to carry the bristles to a desired location.

The thermoplastic which can be utilized may be nylon (Type 6, 6–6, 6–10, or a blend of nylons), polypropylene, polycarbonate, acetals, acrylics, polyethylene, polyurethane, polyvinylchloride, combinations of nylon and a polyester, etc. The foregoing list is illustrative and the invention is not limited to the enumerated thermoplastics. The filler may be aluminum oxide, chopped glass fibers, asbestos particles, diamond particles, ceramic particles, etc. The preferred range of filler in the final product is from 1–50% by weight. The mesh size of the filler may be from 36–1000 mesh.

For the purpose of illustrating the invention there is shown in the drawings a form which is presently preferred; it being understood, however, that this invention

is not limited to the precise arrangements and instrumentalities shown.

FIG. 1 is a top plan view of the apparatus of the present invention with portions broken away for purposes of illustration;

FIGS. 2A and 2B are sectional views taken along line 2—2 in FIG. 1;

FIG. 3 is a view of the multiple orifice extrusion die taken along line 3—3 in FIG. 2A.

Referring now to the drawings in detail, wherein like numerals indicate like elements throughout the several views, there is shown in FIG. 1 apparatus in accordance with the present invention designated generally as **10**.

The apparatus **10** includes an extruder **12** having an extrusion cylinder **14** disposed therewithin. An extruder screw **16** is rotatably mounted within the cylinder **14**. A heating device **18** surrounds the cylinder **14**. Heater **18** is preferably adjusted so as to have a temperature between 20° and 100° F. above the melting point of the thermoplastic material. As an example, if the thermoplastic is nylon, the temperature of heater **18** would be between 500° and 525° F.

A motor **20** is connected to one end of the extruder screw **16** to rotate the same about the longitudinal axis thereof. Conventional means for varying the screw speed is provided and is not shown in detail. A hopper **22** communicates with one end of the screw extruder **16** as clearly shown in FIG. 1. Control of flow of molding pellets **24** from the hopper **22** into the cylinder **14** is effected by an adjustable valve member (not shown). The pellets **24** are preferably thermopalstic molding pellets. Any thermoplastic can be used including but not limited to nylon (Type 6, 6–6, 6–10, or a bldn of nylons), polypropylene, polycarbonate, acetals, acrylics, polyethylene, polyurethane, polyvinylchloride, combinations of nylon and a polyester, etc.

A second extruder **26** communicates with the first extruder **12**. An extruder screw **28** is disposed within an extruder cylinder **30** surrounded by a heating device **32**. Device **32** corresponds to device **18** described above.

A motor **34** is connected to the lefthand end of the screw **32** (FIG. 1). Motors **20** and **34** are preferably variable speed motors. Motor **34** preferably has a speed which is up to 50% greater than the speed of motor **20**, so that screw **28** may rotate at a speed up to 50% greater than the speed of screw **16**.

The cylinder **30** is disposed within a housing **36**. A hopper **38** communicates with the cylinder **30**. Hopper **38** may be provided with a vibrator. Control of flow of filler **40** from the hopper **38** into the cylinder **30** may be effected by means of a valve member in addition to varying the speed of the vibrator (not shown). A wide variety of devices are commercially available for controlling the relative rate of flow of filler **40** with respect to the rate of feed of the molding pellets **24** into the cylinder **14**.

A heated multi-orifice die **42** is sealed to the end of the barrel **30** of the extruder **36**. For purposes of illustration the die **42** as shown in FIG. 3 has ten orifices indicated generally by the numeral **44**. A lesser or greater number of orifices could be provided. Thus, for purposes of illustration, the apparatus **10** is extruding ten solid rods or filaments of thermoplastic material containing a filler.

A water bath **46** is provided immediately adjacent to the die face **42**. The temperature of the water in the bath may be maintained at approximately between 75°–150° F. The filaments are immersed into the water bath **46** upon extrusion through the die **42**. The filaments will solidify in the bath **46**. The filaments are drawn around guide rolls **48** over guide rollers **50** and are formed into a ribbon **52**.

The fiiaments will be maintained in ribbon form until after they are cut. The ribbon **52** is wound several times about a plurality of godet rolls **54**. For illustrative purposes, only two godet rolls **54** have been shown. However, a greater number of godet rolls may me utilized. The

godet rolls **54** are provided with a suitable driving mechanism for rotating the various rolls at different speeds. The godet rolls impart a desired amount of stretch to the filaments which comprise the ribbon **52**. The total stretch imparted to the filaments is approximately 2–4 times their original length.

A readily removable liner **53** is provided for the godet rolls **54**. While any metal or wear resistant non-metal may be used, copper lines are utilized in the preferred embodiment. The copper will flow rather than wear and thus down time or replacement of the liners will be kept to a minimum.

The ribbon is then immersed into a hot water bath **58**. The temperature of the water in the bath may be approximately between 175°–250° F. The hot water bath will heat the ribbon to facilitate stretching thereof. The water will penetrate the surface of the filaments and improve the properties thereof. Preferably, the ribbon **52** will not contact any stationary components of the bath **58**. The bath **58** includes a first compartment **59** and a second compartment **60**. A pump **61** is provided in the second compartment **60** for pumping the water from the second compartment into the first compartment. The end walls **63** of the first compartment **59** have openings **65** therein through which the ribbon **52** travels. Water flows through the openings **65** in the end walls **63** of the first compartment **59** into the second compartment **60**. The water in the second compartment is pumped by means of pump **61** back into the first compartment **59**. Suitable conventional means may be provided for heating the water in the second compartment to insure that the water in the first compartment is maintained at a desired temperature.

A nozzle **62** through which air is blown is provided immediately adjacent the hot water bath **58**. The nozzle **62** is adapted to direct a blast of air toward the ribbon **52** to remove excess water from the ribbon. The excess water is blown into the second compartment **60** and pumped back into the first compartment **59**.

The ribbon **52** passes through a radiant heater **64** which thoroughly dries the surface of the ribbon. The radiant heater **64** heats the ribbon to promote stretching thereof. The heater **64** is maintained at a temperature approximately between 800°–1300° F. The ribbon is thereafter passed over a second set of godet rolls **66**. The godet rolls **66** are similar to the godet rolls **54** described hereinabove. The godet rolls **66** are also provided with an easily removable metal or non-metal liner.

The radiant heater **64** also heats the ribbon **52** to soften the ribbon prior to crimping the same. The ribbon is fed to a crimper **70** through a plurality of guides **68**. The ribbon passes through a pair of conventional mechanical crimper rolls **72**. The crimper rolls **72** not only impart a desired crimp to the ribbon but also serve to pull the ribbon through the apparatus **10**. Since the filaments are maintained in the ribbon **52** each filament will be crimped in an almost identical manner. The filaments would not receive an even crimp if bunched into a tow since the filaments in the center of the tow would not be exposed to the crimper rolls.

After the ribbon has been crimped by the crimper rolls **72** it is fed to a cutter **74**. The cutter **74** comprises a fly knife **76** and an anvil roll **78**. The cutter **74** pinch cuts the ribbon **52**. To effectuate the pinch cut approximately fifteen to twenty thousandths interference may be provided between the fly knife **76** and the anvil roll **78**. The cut ribbon **52** may thereafter be fed to a conveyor **80** and conveyed to a suitable packaging location.

The surface speed of the blade of the fiy knife **76** is synchronized with the surface speed of the last godet roll in the plurality of godet rolls **66**. By synchronizing the speed of the blade on the fly knife all bristles will be cut to the same desired length.

The bristles of the present invention after being cut into unit lengths can be utilized in making abrasive wheels. Many other uses may be made of the bristles produced by the present invention and it is to be under-

stood that the invention is not limited to any particular end use of the product.

The following is a working example of the present invention. Molding pellets composed of Type 6 and Type 6–6 nylon are supplied to the hopper **22** of the extruder **12**. Equal weights of each type of nylon may be supplied to the hopper. The nylon molding pellets are plasticized in the extruder **12** and fed to the extruder **30**. Aluminum oxide in particles of 320 size is supplied to the hopper **38** which is in communication with the extruder **30**. The aluminum oxide and plasticized thermoplastic are thoroughly mixed in the extruder **30** and are extruded through the die **42** into the both **46**. The temperature of the bath **46** is preferably 100° F.

The extruded rods or filaments are arranged in ribbon form and wound severel times over a plurality of godet rolls **54**. Since the godet rollers are rotated at different speeds stretching of the filaments is obtained. The filaments are fed into the hot water bath **58** wherein the filaments are further stretched and wherein water penetrates the surfaces of the filaments. The hot water bath is maintained at a temperature of approximately 200° F. Excess water is blown off the surface of the filaments by a jet of air which emanates from nozzle **62**. The surface of the filaments is dried by a radiant heater **64** which is maintained at a tempreature of approximately 1200° F. A ribbon of filaments is also stretched as it passes through the hot water bath **58** and through the radiant heater **64**. Stretching is facilitated by passing the ribbon over a second set of godet rolls **66**. The surface speed of the last godet roll insures that the ribbon will be traveling at approximately 340 linear feet per minute. The ribbon is fed to a crimper **70** which imparts a desired amount of crimp to each filament. The crimping rollers **72** of the crimper **70** are rotated at a speed to insure that the movement of the ribbon is maintained at 340 linear feet per minute. The ribbon is fed into a cutter **74** which is synchronized with the surface speed of the last godet roller in the plurality of godet rollers **66**. The fly knife **76** insures that the ribbon of filaments will be cut into bristles of a desired length. The individual bristles may thereafter be conveyed by a conveyor **80** to any desired location.

In the preferred embodiment two extruders are utilized as set forth in FIG. 1. However, the invention is not limited to any particular type of extrusion apparatus and other types of extruders could be utilized without departing from the scope and spirit of the invention.

The sacrificial surfaces on the godet rolls may be composed of malleable metals such as copper, brass, soft aluminum, etc. The sacrificial surfaces may also be composed of harder metals or wear resistant non-metallic materials. While copper is utilized in the preferred embodiment other materials may be utilized without departing from the scope of the invention. Furthermore, while the godet rolls have been disclosed as solid rolls having sacrificial liners, the rolls could comprise hollow tubes which may also be easily replaceable.

The present invention may be embodied in other specific forms without departing from the spirit or essential attributes thereof and, accordingly, reference should be made to the appended claims, rather than to the foregoing specification as indicating the scope of the invention.

We claim:

1. A process for continuously producing abrasive filled bristles which comprises melting a thermoplastic material of the group consisting of polyamides, polycarbonates, polypropylene, polyethylene, polyacetals, polyacrylics, polyurethanes, polyvinylchloride and combinations of polyamides and polyesters in a first screw extruder at a temperature of 20–100° F. above its melting point, feeding the molten thermoplastic to a second screw extruder wherein the thermoplastic is admixed with from 1–50% of an abrasive filler material, extruding the filled thermoplastic through a die to form a plurality of monofilaments, cooling in a first bath to solidify the monofilaments, forming a ribbon of the solid monofilaments, stretching the ribbon over a first set of godet rolls, fitted with an easily replaceable, wear-resistant lining, contacting the stretched ribbon with hot water, drying the ribbon, stretching the ribbon on a second set of godet rolls filled with an easily replaceable wear-resistant lining, crimping the ribbon and pinch-cutting the ribbon into individual bristles.

2. A process according to claim **1** wherein the speed of the blade of the cutter and the last godet roll are synchronized so as to insure a constant feed of the stretched ribbon to the cutter.

3. A process according to claim **1** wherein the abrasive filler has a particle size of from 36 to 1000 mesh.

4. A process according to claim **1** wherein the abrasive filler has a particle size of from 36 to 1000 mesh and is selected from one or more members of the group consisting of aluminum oxide, glass fibers, asbestos, diamond and ceramic.

5. A process according to claim **1** wherein the wear-resistant lining is of copper.

6. Apparatus for continuously making abrasive filled thermoplastic bristles comprising a first extruder for melting thermoplastic material, a second extruder communicating therewith and fitted with an inlet for abrasive filler material and a die to form monofilaments of the filled thermoplastic, a cooling bath immediately adjacent to said die, guide rolls to form a ribbon from a plurality of said monofilaments, stretching means for stretching the ribbon comprising at least one set of godet rolls fitted with an easily replaceable wear-resistant lining downstream from said stretching means, a hot water bath downstream from said godet rolls, dryer means next adjacent said hot water bath, a second set of godet rolls fitted with an easily replaceable wear-resistant lining downstream from said dryer, a crimper downstream from said second godet rolls and cutting means downstream from said crimper to pinch-cut the stretched ribbon into uniformly-sized bristles.

7. Apparatus as in claim **6** wherein said cutting means includes a rotating fly knife and rotating anvil; said fly knife in interference with the surface of said anvil.

8. Apparatus as in claim **6** wherein said wear-resistant lining on said godet rolls is of copper.

9. Apparatus as in claim **6** wherein the speed of said second set of godet rolls and the speed of the crimper are synchronized with the speed of said cutting means so as to insure a constant feed to said cutting means.

References Cited

UNITED STATES PATENTS

2,328,998	9/1943	Radford.	
2,324,397	7/1943	Hull.	
2,642,705	6/1953	Jensen.	
3,016,554	1/1962	Peterson.	
3,199,282	8/1965	Clarkson.	
3,217,074	11/1965	Gould et al.	
3,229,347	1/1966	Tlamicha.	
3,350,491	10/1967	Rasmussen	264—289 X
3,413,106	11/1968	Argiro	51—295
3,416,188	12/1968	Fukuma et al.	264—290 X
3,422,491	1/1969	Kihava et al.	264—290 X

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15—159.1; 18—8, 1; 51—295; 264—211, 290, 288