June 26, 1973 H. GREVE 3,741,846

MACHINE FOR THE PRODUCTION OF FILTER ROD SECTIONS OR THE LIKE

Filed April 5, 1971 3 Sheets-Sheet 1

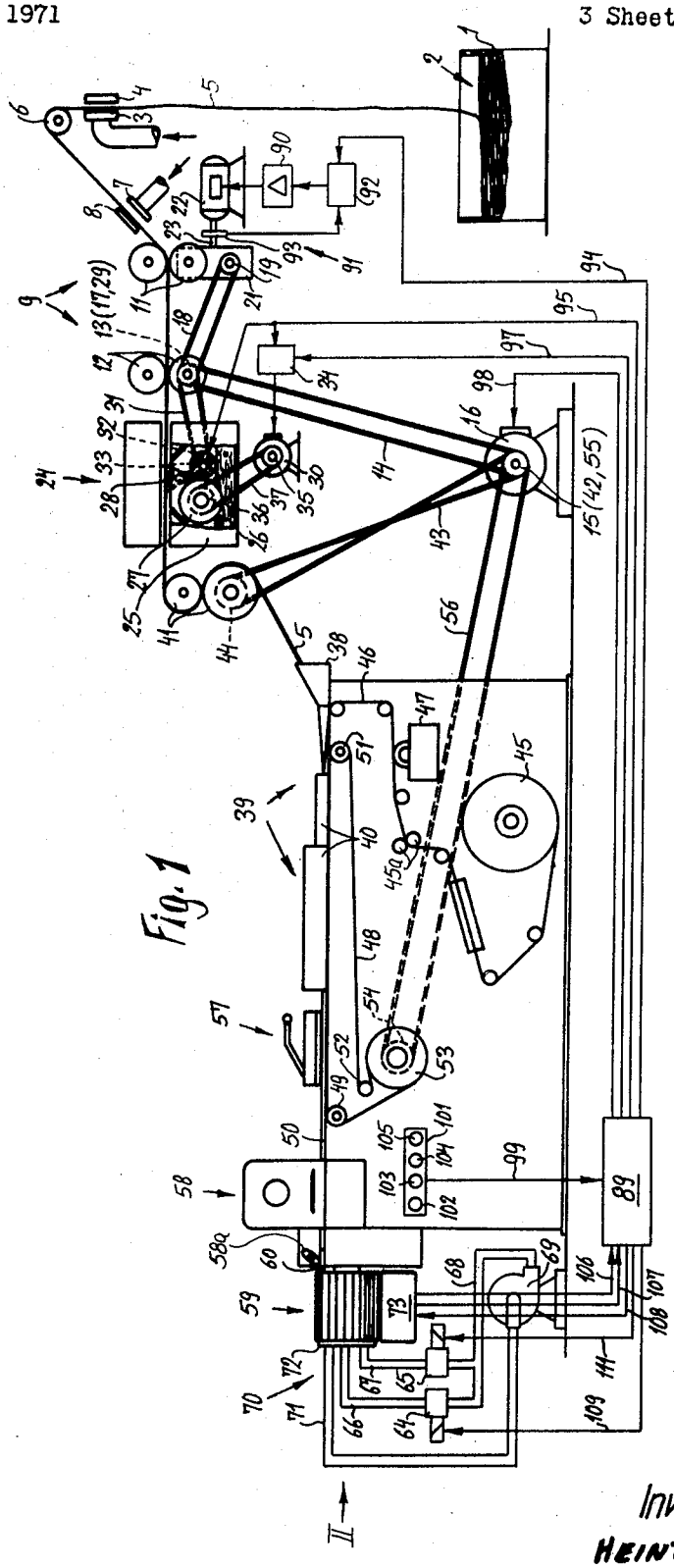


Fig. 1

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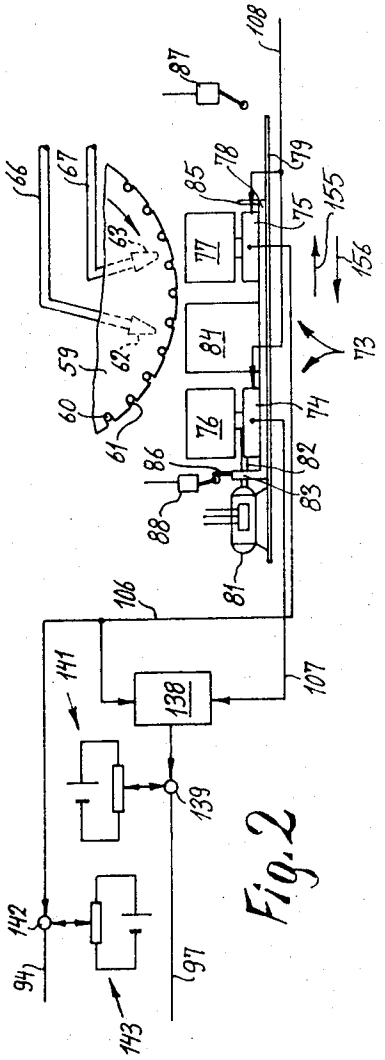


Fig. 2

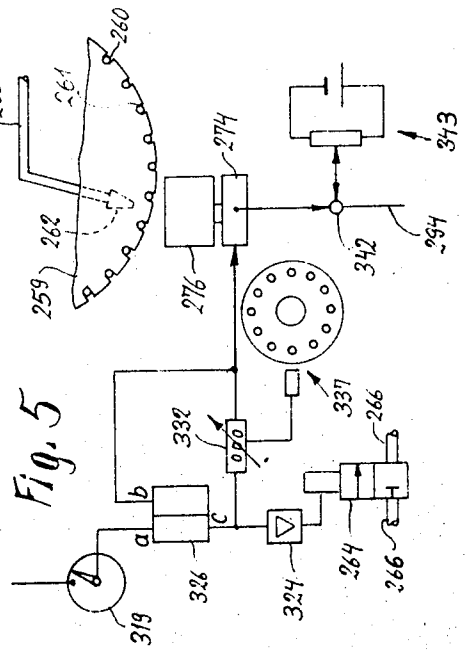


Fig. 5

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MACHINE FOR THE PRODUCTION OF FILTER ROD SECTIONS OR THE LIKE

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Fig. 4

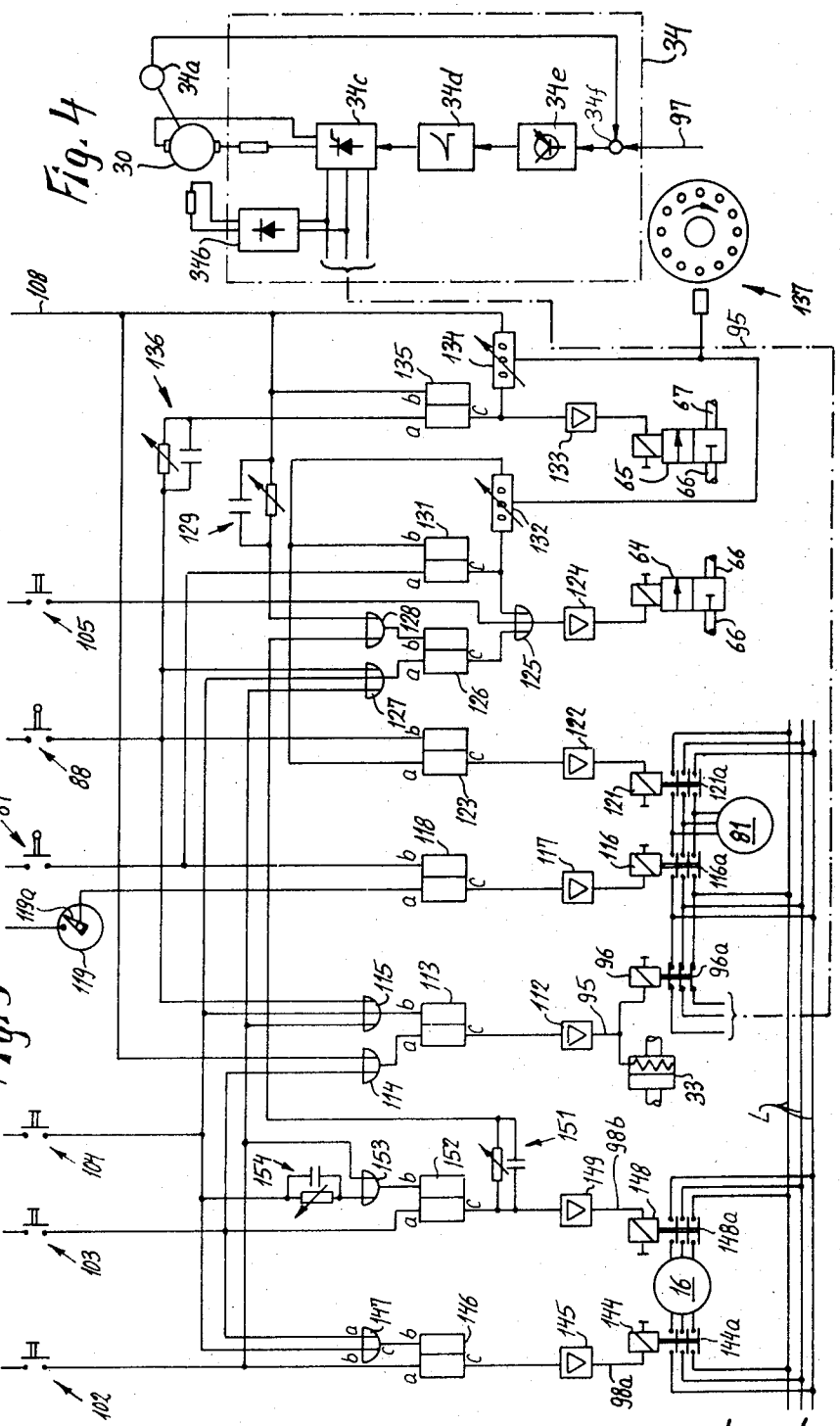


Fig. 3

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3,741,846

MACHINE FOR THE PRODUCTION OF FILTER ROD SECTIONS OR THE LIKE

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Claims priority, application Germany, Apr. 11, 1970, P 20 17 360.8
Int. Cl. G05g 15/00
U.S. Cl. 156—360 22 Claims

ABSTRACT OF THE DISCLOSURE

Filter rod sections are produced by moving a tow of filamentary filter material past a device which showers the filaments with atomized plasticizer and by thereupon converting the thus treated tow into a rod-like filler which is wrapped to form a filter rod. The latter is severed to yield a succession of filter rod sections which are transported by a fluted drum to storage or to a machine for the production of filter-tipped smokers' products. Groups of filter rod sections are withdrawn from the flutes of the drum at regular intervals for weighing to thus determine the quantity of filter material and/or plasticizer. The results of the weighing operation are utilized to adjust the feeding mechanism for the tow and/or plasticizer if the measured quantities deviate from desired quantities. The feeding mechanism for the tow employs rolls which can be driven at a variable speed to thereby subject the filaments of the tow to a more or less pronounced stretching action. The feeding mechanism for the plasticizer employs a rotary brush which removes plasticizer from the periphery of a drum dipping into a supply of plasticizer, and a variable-speed drive for the drum.

BACKGROUND OF THE INVENTION

The present invention relates to a machine for the production of rod-shaped articles, particularly such rod-shaped articles which constitute or form part of smokers' products including plain or filter-tipped cigarettes, cigarillos and cigars. More particularly, the invention relates to improvements in a machine for the production of rod-shaped articles of the type wherein one or more main components are contacted by or otherwise treated or assembled with one or more secondary components to form a rod-shaped intermediate product which is thereupon subdivided into articles of desired length. Typical examples of such articles are filter rod sections wherein the main components consists of a tow of filamentary filter material and the secondary or auxiliary component is a plasticizer or bonding medium which is applied to the tow in a liquid state and is thereupon caused or allowed to set in order to impart to the filter rod sections a desirable resistance to deformation as well as to enhance the smoke-filtering characteristics of such sections.

As a rule, the density of a tow of filamentary filter material which constitutes the main component of filter rod sections or filter elements varies within a wide range. Therefore, it is necessary to regulate the density of the tow prior to formation of a filler which is thereupon wrapped to form a rod and severed to yield filter rod sections of desired length. The filaments of the tow are crimped and the number of crimps per unit length of the tow determines the density of the respective portions of the tow. In the absence of any regulating action, the density of filamentary filter material in filter rod sections would vary not only from increment to increment of a particular filter rod section but also from section to section. This would mean that the resistance which the filter rod sections would offer to the passage of smoke would also vary from filter cigarette to filter cigarette or from filter-tipped cigar to filter-tipped cigar. Such differences in the resistance of filter rod sections are highly undesirable.

It is already known to provide a filter rod making machine with means for subjecting the tow to a variable stretching action for the purpose of reducing the difference between the densities of successive increments of the tow. Each German Pat. No. 61,974 discloses a detector which scans the tow and produces signals which are utilized for regulation of the stretching action. The detector is is a pneumatic detector which determines the resistance to the flow of an air stream across successive increments of the tow or a beta ray detector which includes a source of beta rays at one side of the path of the tow and an ionization chamber which is located opposite the source and furnishes signals indicating the rate at which the beta rays penetrate through the tow. A drawback of pneumatic detectors is that they are not always reliable, i.e., a minor leak in a single one of several conduits which convey the air stream or streams is likely to cause the generation of signals which are not truly indicative of the density of measured portions of the tow. Beta ray detectors are quite expensive and they must be provided wih complicated safety devices to protect the attendants.

SUMMARY OF THE INVENTION

An object of the invention is to provide a novel and improved machine for the production of rod-shaped articles, particularly sections of filter rods wherein one or more main components are assembled with or contacted by one or more secondary components, wherein the quantity of one or more components in the articles can be measured or determined in a novel and improved way and the result of measurements used to insure that the quantity of such component or components does not appreciably deviate from a desired quantity.

Another object of the invention is to provide a novel and improved machine which produces filter rod sections or filter elements for use in the production of filter cigarettes, cigars or cigarillos.

A further object of the invention is to provide a machine for the production of filter rod sections or like rod-shaped articles wherein not only the average quantity of one or more components per rod-shaped article but also the quantity from increment to increment of any given article is more uniform than in articles which are produced in presently known machines.

An additional object of the invention is to provide a machine for the production of rod-shaped articles, particularly filter rod sections or filter elements, with novel and improved means for regulating the quantity of one or more components in successive increments of the rod which is produced from such components to be thereupon subdivided into sections or elements of desired length.

Another object of the invention is to provide a machine for the production of filter rod sections with novel and improved means for determining the quantity of one or more components in sections which are withdrawn directly from the stream of articles leaving the machine for transport to storage or to a consuming machine.

The machine of the present invention is employed for the making of filter elements or analogous rod-shaped articles which constitute or form part of rod-shaped smokers' products and are composed of at least one main component (such as the aforementioned tow of filamentary filter material) and at least one secondary or auxiliary component (such as the aforementioned plasticizer or bonding medium), especially a secondary component which influences the condition of the main component (thus, the plasticizer softens portions of filaments and causes them to adhere to each other prior to setting). The machine comprises means for converting effective quantities of the main and secondary components into

a rod, means for subdividing the rod into a succession of rod-shaped articles of predetermined length, means for conveying the articles along a predetermined path, means for repeatedly removing selected articles or groups of selected articles from such path, means for measuring the quantity of at least one component in the thus removed articles, and means for regulating the quantity of at least one component in the course of the converting operation in accordance with the results of such measurements.

If the main component is a tow of stretchable crimped filamentary material and the regulating means includes means for regulating the quantity of filamentary material, the machine further comprises means for storing a supply of filter material, means for continuously withdrawing from the supply a tow of filter material, and means for subjecting the tow to a variable stretching action to thus determine the quantity of filter material in successive increments of the tow prior to the converting operation. The regulating means then comprises means for changing the stretching action upon the filaments of the tow in accordance with the results of measurements.

The measuring means preferably comprises means for producing signals which are indicative of the measured quantity, and the regulating means comprises means for utilizing such signals to change the stretching action when the signals deviate from a predetermined signal.

In accordance with an advantageous feature of the improved machine, the measuring means comprises means for weighing the removed selected rod-shaped articles; such articles are preferably removed by means of one or more pneumatic ejectors which can be actuated at regular intervals or at desired intervals to expel from the path for the rod-shaped articles a desired number of articles for weighing.

If the secondary component is a liquid which is applied in the form of finely dispersed droplets, the regulating means for such secondary component may comprise a device which insures that the main component receives a predetermined quantity of secondary component per unit of time.

In accordance with a more specific feature of the invention, the machine may further comprise means for converting effective quantities of all but one component into a second rod and means for subdividing the second rod into second rod-shaped articles of the same size and shape as the normally produced articles. The measuring means then comprises means for separately weighing equal numbers of normally produced second articles, means for comparing the combined weight of the normally produced articles with the combined weight of the second articles, and means for producing signals which are indicative of the difference between the two weights. The regulating means then comprises means for regulating the quantity of at least one componetn in the first-mentioned converting operation in accordance with such signals.

The novel features which are considered as characteristic of the invention are set forth in particular in the appended claims. The improved machine itself, however, both as to its construction and its mode of operation, together with additional features and advantages thereof, will be best understood upon perusal of the following detailed description of certain specific embodiments with reference to the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a schematic side elevational view of a filter rod making machine which embodies one form of the invention;

FIG. 2 is an enlarged fragmentary view of a detail substantially as seen in the direction of arrow II in FIG. 1;

FIG. 3 is a diagram of the control circuit and of certain other parts in the machine of FIG. 1;

FIG. 4 is a diagram of one of the two regulating units in the machine of FIG. 1; and

FIG. 5 is a fragmentary detail view, similar to that of FIG. 2, of a portion of a modified filter rod making machine.

DESCRIPTION OF THE PREFFERED EMBODIMENTS

Referring first to FIG. 1, there is shown a filter rod making machine having a refillable receptacle **1** containing a source **2** of a tow **5** of crimped filamentary filter material which is to be converted into the filler of a continuous wrapped filter rod **50**. The source **2** of filamentary material in the receptacle **1** is in the form of a bale and is drawn first upwardly and thereupon in a direction to the left by an adjustable feeding unit **9** including a pair of variable-speed advancing rolls **11**. On its way toward the nip of the advancing rolls **11**, the tow **5** passes along a nozzle **3** having orifices facing a plate **4** and connected to a source of compressed air to direct air streams across the path of the tow **5** in order to loosen or open the filaments and to impart to the tow the shape of a band which is thereupon caused to pass over a deflecting roller **6**. A second nozzle **7** having orifices which face a plate **8** is installed between the deflecting roller **6** and the advancing rolls **11** to further loosen or open the filaments of the tow **5** before the tow undergoes a stretching or tensioning action in the zone between the advancing rolls **11** and a second pair of advancing or tensioning rolls **12** which also form part of the adjustable feeding unit **9**. The tensioning rolls **12** are normally driven at a constant speed; however, the advancing rolls **11** are driven at a variable speed by a regulating unit **91** to thus determine the stretch of filaments which form the tow **5** and hence the quantity of filaments per unit length of the tow.

The drive means for the tensioning rolls **12** comprises a variable-speed electric motor **16** which drives a toothed pulley **13** on the shaft of the lower tensioning roll **12** by way of an endless toothed belt **14** trained over a toothed pulley **15** on the output shaft of the motor **16**.

The advancing rolls **11** receive motion from the motor **16** by way of the belt **14**, a toothed pulley **17** on the shaft of the lower tensioning roll **12**, an endless toothed belt **18** which is trained over the pulley **17**, and a toothed pulley **19** on the rotary input member of an infinitely variable-speed transmission **21** for the lower advancing roll **11**. The latter is connected with the output member of the transmission **21** which forms part of the aforementioned regulating unit **91**. The ratio of the transmission **21** can be changed by the output shaft **23** of an electric servomotor **22** which also constitutes an element of the regulating unit **91**.

The feeding unit **9** can change the quantity of the primary or main component (filamentary filter material) in successive increments or unit lengths of the wrapped filter rod **50**. A secondary or auxiliary component of the filter rod is a liquid bonding medium or plasticizer **26** (e.g., triacetine) which is stored in a vessel or tank **25** forming part of a second adjustable feeding or filament-treating unit **24**. The latter further comprises two applicators **27**, **28** the first of which is a rotary drum dipping into the supply of plasticizer **26** in the tank **25** to withdraw a continuous film of plasticizer which is thereupon atomized by the second applicator **28**, preferably a rotary brush which converts the film into a spray and directs the spray across the path for the opened or loosened band-shaped tow **5** in a region downstream of the tensioning rolls **12**.

The brush **28** is driven by a toothed pulley **32** by way of an electromagnetic clutch **33** (see also FIG. 3). The pulley **32** is driven by an endless toothed belt **31** which is trained over a further toothed pulley **29** on the shaft for the lower tensioning roll **12**. The drum **27** is driven by a variable-speed D-C motor **30** through the intermediary of a first toothed pulley **35** on the output shaft of the motor **30**, a second toothed pulley **36** on the shaft of the drum **27**, and an endless toothed belt **37**. The rate at which the feeding or treating unit **24** applies the plasticizer **26** to

the tow **5** is determined by a second regulating unit **34** here shown as an electric or electronic circuit the details of which are illustrated in FIG. 4. The regulating unit **34** is of the type known as Minisemi produced by the West-German firm AEG. The feeding or treating unit **24** occupies a station wherein the main or primary component (tow **5**) is contacted by the secondary component (plasticizer **26**) prior to conversion of the thus assembled components into the wrapped filter rod **50**. Such conversion begins after the properly treated tow **5** moves through and beyond the nip of two further advancing rolls **41** the lower of which has a toothed pulley **44** driven by an endless toothed belt **43**. The latter is trained over a toothed pulley **42** on the output shaft of the motor **16**. Successive increments of the tow **5** which advance beyond the rolls **41** are caused to pass through a condensing horn **38** which converts the tow into a rod-like filler ready to be provided with a tubular wrapper during transport through a wrapping or rod-forming station **39**. This station accommodates a conventional wrapping device **40** for a web **46** of paper or cork which is stored in the form of a bobbin **45** and is being withdrawn by two advancing rolls **45***a* to travel along a paster **47** which coats at least one marginal portion or an entire surface of the web **46** with a film of adhesive before the thus coated web reaches the upper stretch of an endless band **48** which is driven by the motor **16**. The band **48** is trained over several guide rollers including those numbered **49**, **51**, **52** and **53**. The latter is driven by the motor **16** by way of a pair of toothed pulleys **54**, **55** and an endless toothed belt **56**.

The seam between the overlapping marginal portions of the wrapper which is obtained in response to draping of the web **46** around the filler of plasticized filaments (treated tow **5**) is thereupon heated by a plate-like sealer **57** and the resulting wrapped filter rod **50** then moves into the range of an orbiting knife (not shown) forming part of a severing device **58** of the type known as cutoff and normally employed for severing of a wrapped cigarette or cigar rod in a cigarette rod or cigar rod making machine. The cutoff **58** severs the filter rod **50** at regular intervals to form a single file of filter rod sections or filter elements **60** of desired length (for example, six times unit length). A rotary accelerating cam **58***a* is mounted downstream of the cutoff **58** to accelerate successive filter rod sections **60** and to propel them into successive flutes **61** (see also FIG. 2) of an endless transporting conveyor here shown as a rotary drum **59** which is driven in synchronism with the band **48** and with the knife of the cutoff **58** and serves to advance the filter rod sections **60** along a predetermined path, namely, sideways in the form of one or more rows and on toward a further conveyor (not shown) which can be employed to deliver the filter rod sections into the magazine of a filter cigarette or filter cigar making machine, not shown, into a tray filling machine, or directly into storage.

The filter rod making machine further comprises a withdrawing unit **70** for repeatedly withdrawing from the path defined by the transporting drum **59** predetermined numbers of filter rod sections for measurement and for generation of signals which are thereupon transmitted to the regulating units **34** and **91**. Such signals are employed to change the quantity of the main component (filamentary filter material) and secondary component (plasticizer **26**) in the filter rod sections **60** which are permitted to leave the machine for transport to storage or to a further processing station. The withdrawing unit **70** cooperates with a measuring or weighing unit **73** which determines the quantities of components in the withdrawn rod-shaped articles and is operatively connected with the regulating units **34** and **91** by way of a control circuit **89**.

The withdrawing unit **70** comprises two ejecting or segregating nozzles **62** and **63** (see FIG. 2) which are adjacent to the path of rod-shaped articles in the flutes **61** of the transporting drum **59**. The nozzles **62**, **63** are connected with a source of compressed air (here shown as a blower **69**) through the intermediary of supply conduits **66**, **67** which respectively contain normally closed electromagnetically operated valves **64**, **65** (see FIGS. 1 and 3). The solenoids for the valves **64**, **65** are respectively connected with adjustable counters **132**, **134** shown in FIG. 2. The connection between the pressure side of the blower **69** and the supply conduits **66**, **67** comprises a further supply conduit **68** shown in FIG. 1. The suction side of the blower **69** is connected with ports (not specifically shown) which communicate with the flutes **61** of the transporting drum **59** by way of a suction conduit **71** and a suitably configurated groove (not specifically shown) in a stationary valve plate **72** adjacent to one axial end of the drum **59**. The arrangement is such that the transporting drum **59** normally retains by suction all such filter rod sections **60** which enter successive flutes **61** at the station accommodating the accelerating cam **58***a* and leave the respective flutes **61** at a second transfer station where such filter rod sections are removed from the drum **59** to be transported to storage or to a further processing station.

The aforementioned measuring or weighing unit **73** comprises two high-precision electronic weighing devices or scales **74** and **75** (see FIG. 2) which respectively comprise article-receiving containers or trays **76**, **77**. An electronic weighing device of this type, which is suitable for use as a measuring unit, is illustrated and described in Canadian Pat. No. 803,371. The trays **76**, **77** flank an intercepting or collecting receptacle **84** and the distance between the center of each of the trays and the center of the receptacle **84** at least approximates the distance between the ejecting nozzles **62**, **63**, Thus, when the tray **76** is ready to receive rod-shaped articles which are expelled from the flutes **61** by the air stream issuing from the nozzle **62**, the nozzle **63** is located at a level above the receptacle **84**. On the other hand, when the receptacle **84** registers with the nozzle **62** (as shown in FIG. 2), the rod-shaped articles which are being expelled from the flutes **61** by the air stream issuing from the nozzle **63** are caused to descend into the tray **77**. The receptacle **84** and the trays **76**, **77** are mounted on a carriage **78** which is reciprocable along a stationary guide or support **79** between the end position shown in FIG. 2 and another end position in which the tray **76** registers with the nozzle **62**.

The means for reciprocating the carriage **78** with reference to the support **79** comprises a reversible electric motor **81** whose output shaft **82** constitutes a feed screw meshing with a spindle nut **83** fixed to or integral with the adjacent end of the carriage **78**. If desired, the feed screw **82** can be driven by a transmission which receives torque from the output shaft of the motor **81**.

The carriage **78** is provided with two actuating elements or trips **86**, **85** the former of which is mounted on the nut **83** and the latter of which is mounted at the opposite end of the carriage. The trips **85**, **86** respectively serve to actuate limit switches **87**, **88** which are mounted adjacent to the path of the carriage **78** and are electrically connected with the solenoids for the ejecting valves **64** and **65**.

As mentioned before, the regulating unit **91** for the adjustable feeding unit **9** includes the infinitely variable-speed transmission **21** and the electric servomotor **22** whose output shaft **23** can be rotated clockwise or counterclockwise to thereby change the transmission ratio and hence the speed of the feeding or advancing rolls **11**. The regulating unit **91** further comprises a conventional electronic signal comparing circuit **92** whose output is connected with the servomotor **22** by way of an amplifier **90** and which has two inputs one of which is connected with the control circuit **89** by way of conductor means **94**. The other input of the signal comparing circuit **92** is connected with a feeler or scanning device **93** which scans the angular position of the output shaft

23 and produces signals which are indicative of the momentary ratio of the transmission 21. The amplifier 90 is provided with conventional polarty-reversing means, such as polarized relays, which can cause the servomotor 22 to rotate its output shaft 23 in a counterclockwise direction or in a clockwise direction, depending upon whether the output signal from the signal comparing circuit 92 indicates that the ratio of the transmission 21 is to be changed in a sense to reduce or in a sense to increase the speed of the advancing or feeding rolls 11. The feeler 93 may comprise a potentiometer whose wire is stationary and whose slider is connected with the output shaft 23 to select the resistance of the potentiometer as a function of angular position of the shaft 23 and hence as a function of the momentary ratio of the transmission 21. Other types of feelers or scanning devices can be used with equal advantage.

The regulating unit 34 for the D-C motor 30 which drives the drum-shaped applicator 27 and for the clutch 33 which transmits torque to the brush-shaped applicator is shown in greater detail in FIG. 4. As mentioned before, the illustrated regulating unit 34 is a so-called Minisemi produced by the West-German firm AEG and is a transistorized circuit including a tachometer generator 34*a* which serves to produce signals indicating the momentary speed of the motor 30 for the applicator 27, a rectifier 34*b*, a semiconductive signal transmitting device 34*c*, a pulse shaping device 34*d*, a transistor amplifier 34*e*, and a junction 34*f* for signals coming from the tachometer generator 34*a* and from a conductor means 97. The junction 34*f* transmits signals to the amplifier 34*e*. The conductor means 97 connects the junction 34*f* of the regulating unit 34 with the control circuit 89. A further conductor means 95 connects the control circuit 89 with the clutch 33 for the applicator 28 and with one input of the regulating unit 34. The conductor means 95 is connected with the regulating unit 34 by way of a relay 96 having contacts 96*a* which can connect the element 34*b*, 34*c* of the unit 34 with a source of polyphase current. The control circuit 89 is further connected with the motor 16 by way of a cable 98 including the conductors 98*a*, 98*b* (see FIG. 3). Still further, the control circuit 89 is connected with a control panel 101 by way of a three-conductor cable 99. The control panel 101 supports three speed changing devices in the form of pushbuttons 102, 103, 104 which can be actuated by the person in charge in order to change the speed of the motor 16. The pushbutton 102 constitutes a starting device which can initiate completion of the circuit of the motor 16 and thereby causes the motor 16 to be accelerated to the lower of two speeds. The pushbutton 103 constitutes an accelerating device which is actuated (depressed) by a person in charge in order to accelerate the motor 16 from the lower speed to a higher or normal speed. The pushbutton 104 constitutes an arresting or decelerating device for the motor 16; the latter is decelerated to zero speed within a certain interval of time when the pushbutton 104 is actuated while the motor 16 is driven at the normal speed. A further pushbutton 105 on the control panel 101 is actuated when the operator wishes to withdraw samples of rod-shaped articles 60 by way of the removing unit 70.

The control circuit 89 is further connected with the measuring unit 73 by way of conductor means 106, 107, 108. Additional conductor means 109, 111 connect the control circuit 89 with the solenoids of the valves 64, 65 in the supply conduits 66, 67 for the ejecting or segregating nozzles 62, 63 of the removing unit 70.

The details of the control circuit 89 are illustrated in FIGS. 2 and 3. That portion of the control circuit 89 which is connected with the electromagnetic clutch 33 for the applicator 28 and with the regulating unit 34 includes an amplifier 112, a signal storing circuit 113 and two logical circuits in the form of OR-gates 114, 115. That portion of the circuit 89 which is connected with the reversible motor 81 for the carriage 78 of FIG. 2 includes a relay 116, an amplifier 117, a signal storing circuit 118, an adjustable clockwork mechanism or timer 119, the aforementioned limit switches 87, 88, a further relay 121, a further amplifier 122, and a further signal storing circuit 123. That branch or portion of the control circuit 89 which is connected with the solenoid for the valve 64 includes an amplifier 124, an OR-gate 125, a signal storing circuit 126, additional OR-gates 127, 128, an adjustable time-delay device 129, a further signal storing circuit 131, the aforementioned counter 132 and the pushbutton 105. The control circuit branch which is connected with the solenoid for the valve 65 includes an amplifier 133, the aforementioned counter 134, a signal storing circuit 135 and an adjustable time-delay device 136. The counters 132, 134 can be considered as constituting component parts of the control circuit 89 or of the removing unit 70; they are associated with a timer or pulse generator 137 of conventional design which is rotated in synchronism with the transporting drum 59 and transmits to the counters 132 and 134 signals at intervals which correspond to intervals between introduction of successive filter rod sections into the flutes 61 of the drum 59.

That portion or branch of the control circuit 89 which is connected with the measuring unit 73 includes a differential circuit 138 (FIG. 2), a signal comparing junction 139 and a potentiometer 141 which is adjustable to furnish to the junction 139 a signal of preselected magnitude or intensity. A second adjustable potentiometer 143, and a further junction 142 which is connected with the conductor means 94, with the conductor means 106 and with the potentiometer 143. The junction 139 is connected with the conductor means 97, with the potentiometer 141 and with the output of the differential circuit 138.

That branch or portion of the control circuit 89 which is connected with the speed changing devices 102, 103, 104 for the motor 16 comprises a relay 144, an amplifier 145, a signal storing circuit 146, an OR-gate 147, a further relay 148, a further amplifier 149, an adjustable time-delay device 151, a further signal storing circuit 152, a further OR-gate 153 and a further adjustable time-delay device 154. Each of the OR-gates (see, for example, the OR-gate 147 of FIG. 3) has two inputs *a*, *b* and an output *c*. The output *c* transmits a signal as long as at least one of the inputs *a*, *b* receives a signal. Each signal storing circuit (see, for example, the circuit 146 of FIG. 3) has a first input *a* which causes the output *c* to transmit a signal until the other input *b* receives an erasing signal. Thus, the output *c* of each signal storing circuit transmits a signal in response to momentary or continued reception of a signal at the input *a* and the transmission of the signal continues until the input *b* receives an erasing signal.

The operation:

It is assumed that the filter rod making machine operates normally, i.e., that the motor 16 drives the belts 14, 43 and 56 at the higher of two speeds. The feeding or advancing rolls 11 draw the tow 5 at the normal speed and the applicators 27, 28 cooperate to apply an average quantity of atomized plasticizer 26 to each unit length of the tow. The carriage 78 dwells in the end position shown in FIG. 2 in which the nozzles 62, 63 respectively register with the receptacle 84 and tray 77.

The timer 119 serves to trigger or initiate successive measuring operations a preselected intervals. This timer can constitute a clockwork mechanism which completes a circuit whenever its pointer 119*a* reaches the 12-o'clock position to thus cause the transmission of a signal to the input *a* of the signal storing circuit 118. For example, the clockwork mechanism 119 may be adjusted in such a way that the input *a* of the signal storing circuit 118 receives a signal every thirty minutes. The output *c* of the circuit 118 then transmits a signal to the amplifier 117 which energizes the relay 116 so that the latter closes its contacts 116*a* and connects one winding of the reversible

motor **81** with a source of energy by way of power leads L. The motor **81** is started and begins to move the carriage **78** along the support **79** in the direction indicated by the arrow **155** shown in FIG. 2. The trip **85** actuates the limit switch **87** when the carriage **78** reaches its second end position in which the nozzles **62, 63** respectively register with the tray **76** and receptacle **84**. The limit switch **87** transmits a signal to the input *b* of the signal storing circuit **118** whereby the circuit **118** ceases to energize the relay **116** by way of the amplifier **117** so that the motor **81** comes to a halt.

The closing of the limit switch **87** by a trip **85** further results in transmission of a signal to the input *a* of the signal storing circuit **131** whose output *c* transmits a signal to the amplifier **124** by way of the corresponding input and the output of the OR-gate **125**. The amplifier **124** energizes the solenoid for the valve **64** which enables the conduit **66** to convey to the nozzle **62** a stream of compressed air to expel filter rod sections **60** from successive flutes **61** of the transporting drum **59** and to propel such filter rod sections into the tray **76** of the scale **74**. Each such filter rod section **60** is of the same quality or consistency, i.e., it contains the same quantity of plasticizer **26** and filamentary material as the preceding filter rod sections **60** which were permitted to bypass the ejecting or removing station (nozzle **62**). Thus, the expelled filter rod sections in the tray **76** are representative of the quality of filter rod sections which are being produced by the machine at the time when the clockwork mechanism **119** produces a signal or causes the generation of a signal for energization of the relay **116** and for delayed energization of the solenoid for the valve **64** by means of the limit switch **87**. The number of filter rod sections **60** which are expelled into the tray **76** depends on the setting of the counter **132** which is started in response to the signal from the output *c* of the signal storing circuit **131** simultaneously with opening of the valve **64**, i.e., in response to closing of the limit switch **87**. The counter **132** counts the signals which are transmitted thereto by the timer **137**; when the counter **132** receives *n* signals (*n* being the desired number of filter rod sections **60** which are to be expelled into the tray **76**), it transmits a signal to the erasing input *b* of the signal storing circuit **131** whereby the latter terminates the transmission of a signal to the amplifier **124** (by way of the OR-gate **125**) so that the valve **64** closes and terminates the flow of compressed air to the nozzle **62**. The counter **132** is automatically reset to zero when it ceases to receive a signal from the output *c* of the signal storing circuit **131**.

The output signal from the counter **132** is further transmitted to the input *a* of the signal storing circuit **123** whose output *c* energizes the relay **121** by way of the amplifier **122**. The relay **121** closes its contacts **121***a* to thus connect the power leads L with the other winding of the motor **81**. This motor begins to move the carriage **78** back to the end position shown in FIG. 2 (see the arrow **156**). The transmission of motion from the motor **81** to the carriage **78** takes place by way of the feed screw **82** and nut **83**. During movement of the carriage **78** back to the end position shown in FIG. 2, the transporting drum **59** is free to deliver the filter rod sections **60** (namely, those sections immediately following the sections which were caused to enter the tray **76** of the scale **74**) to their normal destination, e.g., into a tray filling machine, not shown.

When the carriage **78** reaches the end position of FIG. 2, the trip **86** actuates (closes) the limit switch **88** which transmits a signal to the erasing input *b* of the signal storing circuit **123** whereby the latter deenergizes the relay **121** and arrests the motor **81**. At the same time, the signal which is generated in response to actuation of the limit switch **88** reaches the erasing input *b* of the signal storing circuit **113** by way of the OR-gate **115**. The ouput *c* of the signal storing circuit **113** ceases to transmit a signal to the amplifier **112** so that the clutch **33** is deenergized to stop the applicator **28** and the relay **96** is deenergized to open the circuit of the motor **30** for the applicator **27**. Thus, the connection between the control circuit **89** and the regulating unit **34** is interrupted. The feeding unit **24** for the plasticizer **26** is idle. It will be seen that the limit switch **88** constitutes a means for temporarily arresting the feeding unit **24** to start the production of filter rod sections without plasticizer.

The signal which is generated in response to actuation of the limit switch **88** is further transmitted to the input *a* of the signal storing circuit **126** by way of the OR-gate **127**. The output *c* of the circuit **126** energizes the solenoid for the valve **64** by way of the amplifier **124** and OR-gate **125** so that the valve **64** permits the flow of compressed air to the nozzle **62**. The signal which is generated in response to actuation of the limit switch **88** is also transmitted, with a delay determined by the device **136**, to the input *a* of the signal storing circuit **135**. Since the valve **64** is open, the nozzle **62** expels into the receptacle **84** all such filter rod sections which are produced and reach the transporting drum **59** while the signal storing circuit **126** remains operative. The signal from the output *c* of the signal storing circuit **135** not only causes opening of the valve **65** but also starts the counter **134**. The counter **134** receives pulses from the timer **137** and counts such pulses to transmit a signal to the erasing input *b* of the signal storing circuit **135** and to thus effect a closing of the valve **65** when the nozzle **63** completes the ejection of a predetermined number of filter rod sections into the tray **77** of the scale **75**. It will be noted that the nozzle **63** is located ahead of the nozzle **62**, as considered in the direction of rotation of the transporting drum **59**. The tray **77** receives filter rod sections which do not contain any plasticizer because such sections are produced subsequent to deactivation of the feeding unit **24**. The counter **134** is reset to zero when the emission of a signal at the output *c* of the signal storing circuit **135** is terminated. The signal from the counter **134** is further transmitted to the input *a* of the signal storing circuit **113** by way of the OR-gate **114** whereby the amplifier **112** energizes the clutch **33** and the relay **96** which latter connects the motor **30** in the regulating unit **34** with the energy source. Thus, the applicators **27, 28** of the feeding unit **24** are operative and begin to spray atomized plasticizer **26** against successive increments of the tow **5**. The construction of the counter **134** is preferably identical with that of the counter **132**.

The output signal from the counter **134** is further transmitted to the input *b* of the signal storing circuit **126** by way of the time-delay device **129** and OR-gate **128**. Thus, the solenoid for the valve **64** is deenergized by way of the OR-gate **125** and amplifier **124** so that the valve **64** closes and disconnects the blower **69** from the nozzle **62**.

The adjustment of the time-delay device **129** is such that the nozzle **62** ceases to expel filter rod sections from the adjacent flutes **61** of the drum **59** with a delay which is necessary in order to insure that the nozzle **62** expels all such filter rod sections which were produced while the feeding unit **24** was idle, i.e., all such filter rod sections which do not contain an effective quantity of plasticizer **26**.

As shown in FIGS. 2 and 3, the output signal from the counter **134** is further transmitted to the scales **74, 75** by way of the conductor means **108**. The transmission of such signal to the two scales takes place at a time when the tray **76** already accommodates a predetermined number of filter rod sections which contain the main component (filaments) and the secondary component (plasticizer **26**) and when the tray **77** accommodates filter rod sections which contain the main component but not the plasticizer. The number of filter rod sections in both trays is preferably the same. The scales **74, 75** then produce voltage pulses which are transmitted to the corresponding inputs of the differential circuit **138** by way of the conductor means **106, 107** (see FIG. 2). The intensity of

pulses is respectively indicative of the combined weight of filter rod sections with and without plasticizer **26**. The circuit **138** computes the incoming pulses and transmit a signal which is indicative of the difference between the two pulses. Such signal reaches the junction **139** which compares the thus received signal with that from the potentiometer **141**. The signal from the potentiometer **141** is indicative of desired intensity of the signal from the output of the differential circuit **138**. In the case of a difference between the intensities of the two signals which are transmitted to the junction **139**, the latter transmits a signal to the junction **34***f* of the regulating unit **34** by way of the conductor means **97**. The regulating unit **34** then selects a different speed for the motor **30** to thus insure that the rate at which the feeding unit **24** furnishes atomized plasticizer **26** to successive increments of the tow **5** is a function of the intensity of the signal furnished by the potentiometer **141**. The adjusted speed of the motor **30** remains unchanged during the interval between two successive signals from the clockwork mechanism **119**. The changes in speed of the motor **30** immediately result in a change of the rate of application of atomized plasticizer **26** because the applicator **27** withdraws more or less plasticizer from the supply in the tank **25**, depending on an increase or a reduction in the speed of the motor **30**. The acceleration or deceleration of the motor **30** depends on the sign of the signal which is furnished by the junction **139** to the junction **34***f* of the regulating unit **34**.

The signal from the scale **75** is indicative of the combined weight of filter rod sections (without plasticizer **26**) in the tray **77** and is transmitted by the conductor means **106** to the corresponding input of the differential circuit **138** as well as to one input of the signal comparing junction **142**. The latter receives from the potentiometer **143** a signal which is indicative of the desired weight of filter rod sections without plasticizer (i.e., of the quantity of main component in each filter rod section). In the case of a difference between the intensities of signals which reach the junction **142**, the latter transmits a signal to the corresponding input of the signal comparing circuit **92** in the regulating unit **91** (by way of the conductor means **94**), and the thus transmitted signal causes appropriate modification of the signal to the amplifier **90** which causes the motor **22** to bring about an appropriate change in the ratio of the transmission **21** for the advancing or feeding rolls **11**. Thus, the speed at which the rolls **11** draw the tow **5** from the receptacle **1** is changed in dependency on the nature of the signal from the junction **142** so that the tension of the tow in the zone between the rolls **11** and **12** changes with the result that the quantity of filter material per unit length of the tow conforms to the quantity indicated by the signal from the potentiometer **143**. The thus selected speed at which the advancing rolls **11** draw the tow **5** from the receptable **1** remains unchanged during the interval between two successive signals from the clockwork mechanism **119**. The adjustment of the ratio of transmission **21** is terminated when the feeler **93** transmits to the corresponding input of the circuit **92** a signal which indicates that the momentary ratio equals the desired ratio (signal from the junction **142**). The motor **22** can rotate its output shaft **23** in either direction, depending on the (positive or negative) sign of the signal from the junction **142**. If the weight of filter rod sections in the tray **77** exceeds a weight which is indicated by the signal from the potentiometer **143**, the regulating unit **91** reduces the speed of the advancing rolls **11** so that the tow **5** is subjected to a more intensive stretching action and thereupon contains a reduced quantity of filaments per unit length. Inversely, the regulating unit **91** increases the speed of the advancing rolls **11** and thus reduces the stretch upon filaments if the signal from the scale **75** indicates that the combined weight of filter rod sections (without plasticizer) in the tray **77** is less than indicated by the signal from the potentiometer **143**. The signal at the output of the circuit **92** disappears when the ratio of the transmission **21** is a function of the signal from the potentiometer **143**, and the motor **22** is then arrested. It will be seen that the change in tensioning of the tow **5** in the zone between the rolls **11** and **12** is a function of the difference between a signal from the scale **75** which indicates the weight of a predetermined number of filter rod sections without plasticizer and the signal from the potentiometer **143**. Analogously, the change in the rate of application of the plasticizer **26** is a function of the difference between the signal from the scale **74** and the signal from the potentiometer **141**. Consequently, the average quantity of filter material and plasticizer in each filter rod section which is permitted to leave the machine by the normal route is within a desired range because periodic adjustments by the regulating units **91** and **34** insure that deviations from the desired weight cannot last longer than the length of an interval between successive signals from the clockwork mechanism **119**. The quantities of filter material and plasticizer are selected with a view to insure that the density and firmness of each finished filter rod section **60** are best suited for appropriate filtering of smoke when the filter rod sections are united with sections of wrapped tobacco rods in a machine for the production of filter-tipped cigarettes, cigars or cigarillos.

As mentioned before, the removing or withdrawing unit **70** automatically segregates or expels those filter rod sections which are produced while the speed of the motor **16** is being changed from zero speed to a lower speed, from a lower speed to a higher speed, and from a higher or lower speed to zero speed. This is achieved as follows:

When the operator actuates the starting pushbutton **102** while the motor **16** is idle, the signal which is generated in response to actuation of the pushbutton **102** is transmitted to the input *a* of the signal storing circuit **146** to cause energization of the relay **144** by way of the amplifier **145**. The relay **144** moves its contacts **144***a* to closed positions to thereby connect a first winding of the motor **16** with the energy source by way of power leads L. The motor **16** is accelerated to the lower of two speeds within a certain interval of time. Even though the motor **16** is running, the feeding unit **24** is inactive because the clutch **33** and the relay **96** are deenergized so that the applicators **27** and **28** are at a standstill.

The signal which is generated in response to actuation of the starting pushbutton **102** is farther transmitted to the input *a* of the signal storing circuit **126** by way of the OR-gate **127**. Therefore, the circuit **126** causes energization of the solenoid for the valve **64** by way of the OR-gate **125** and amplifier **124**. The nozzle **62** receives compressed air and expels successive filter rod sections (which are without plasticizer because the feeding unit **24** is idle) into the receptacle **84**. The ejection of filter rod sections into the receptacle **84** is continued as long as the motor **16** is operated at the lower of two speeds. This is obviously desirable since the filter rod sections which are produced during such stage of operation are without plasticizer.

When the operator thereupon decides to actuate the accelerating pushbutton **103**, the input *b* of the signal storing circuit **146** receives a signal by way of the OR-gate **147** whereby the circuit **146** deenergizes the relay **144** to disconnect the first winding of the motor **16** from the energy source. At the same time, the signal which is generated on actuation of the pushbutton **103** reaches the input *a* of the signal storing circuit **152** whose output *c* transmits a signal to the amplifier **149** to energize the relay **148** which closes its contacts **148***a* and thus connects the energy source (leads L) with the second winding of the motor **16**. The latter is thereby accelerated from the lower to the higher or normal speed. Such acceleration takes up a certain interval of time.

The input *a* of the signal storing circuit **152** receives a signal simultaneously with the input *a* of the signal storing circuit **113**. Therefore, the amplifier **112** energizes the clutch **33** and the relay **96** to couple the rotating pulley **32** to the applicator **28** and to connect the motor **30** with

the energy source whereby the applicators **27**, **28** begin to spray atomized plasticizer **26** against successive increments of the tow **5** while such increments pass through the feeding unit **24**. The input *a* of the signal storing circuit **113** receives the signal from the pushbutton **103** by way of the OR-gate **114**. The connection of the second winding of the motor **16** with the energy source takes place simultaneously with deenergization of the relay **144** so that the motor **16** is accelerated, without any delay, from the lower speed to the higher speed which is needed to insure that each increment of the tow **5** receives an optimum percentage of plasticizer. Thus, successive increments of the tow **5** are not expected to receive an optimum quantity of plasticizer during the interval which elapses between energization of the relay **148** and the completed acceleration of motor **16** to the higher speed. Therefore, it is desirable to continue with the ejection of filter rod sections until the filter rod sections which reach the nozzle **62** invariably contain optimum quantities of plasticizer.

The solenoid for the valve **64** (nozzle **62**) is deenergized in response to a signal from the output *c* of the signal storing circuit **152** but with a delay which is determined by the time-delay device **151** which transmits the delayed signal to the erasing input *b* of the signal storing device **126** by way of the OR-gate **128**. Thus, the valve **64** closes and the filter rod sections **60** can travel past the nozzle **62** without being expelled into the receptacle **84**. The machine then continues to turn out satisfactory filter rod sections **60** as long as the energy source remains connected with the second winding of the motor **16** (relay **148**) and with the motor **30** for the applicator **27**. Thus, the feeding unit **24** is operative and each increment of the tow **5** (which is subjected to a requisite stretching action during travel in the zone between the rolls **11** and **12**) is provided with a predetermined quantity of plasticizer **26**. As mentioned above, the closing of valve **64** takes place with a delay which is determined by the time-delay device **151** and is preferably selected in such a way that the valve **64** closes subsequent to acceleration of the motor **16** to normal speed and by further insuring that all filter rod sections which do not as yet contain the desired quantity of plasticizer are expelled into the receptacle **84**.

If the operator actuates the arresting pushbutton **104** while the motor **16** is operated at the lower speed (in response to actuation of the pushbutton **102**), the OR-gate **147** transmits a signal to the erasing input *b* of the signal storing circuit **146** so that the latter deenergizes the relay **144** and causes immediate stoppage of the motor **16**.

If the arresting pushbutton **104** is actuated while the motor **16** is operated at the normal or higher speed, the OR-gate **115** transmits a signal to the erasing input *b* of the signal storing circuit **113** which deenergizes the clutch **33** and the relay **96** by way of the output *c* and amplifier **112** to immediately arrest the applicators **27** and **28**. At the same time, the OR-gate **127** immediately transmits a signal to the input *a* of the signal storing circuit **126** which energizes the solenoid for the valve **64** so that the nozzle **62** begins to expel filter rod sections into the receptacle **84**. The signal from the pushbutton **104** is further transmitted to the erasing input *b* of the signal storing circuit **152** by way of the OR-gate **153** but with a delay which is determined by the time-delay device **154**. Therefore, the signal at the output *c* of the signal storing circuit **152** disappears to deenergize the relay **148** with such a delay that the nozzle **62** invariably expels into the receptacle **84** all filter rod sections which are produced subsequent to deactivation of the feeding unit **24**. Thus, the machine does not contain any such portions of the tow **5** which are treated with plasticizer **26** when the motor **16** is idle. This eliminates problems during starting of the motor **16** when the production is resumed.

It will be seen that the machine is arrested immediately if the pushbutton **104** is actuated while the motor **16** is running at the lower speed. This is due to the fact that the feeding unit **24** is then idle so that the tow which remains in the machine when the motor **16** is idle does not contain any plasticizer. On the other hand, when the pushbutton **104** is actuated while the motor **16** is running at full speed, stoppage of the motor **16** (deenergization of the relay **148** and opening of contacts **148***a*) takes place with a delay (device **154**) which is long enough to insure that the nozzle **62** expels all filter rod sections which might contain at least some plasticizer. Therefore, the tow which remains in the machine while the motor **16** is idle is always free of plasticizer to thus insure that the machine can be started without any difficulties which normally arise if the starting takes place while the wrapping mechanism and/or other parts of the machine contain portions of tow which are impregnated with hardened plasticizer. The feeding unit **24** is deactivated in immediate response to actuation of the pushbutton **104** while the motor **16** is running at normal speed. The feeding unit **24** is not active when the motor **16** is running at the lower speed; therefore, the motor **16** can be arrested in immediate response to actuation of the pushbutton **104**.

If an operator wishes to withdraw samples of filter rod sections **60** at a time other than that determined by the clockwork mechanism **119**, for example, to examine the appearance of the filter rod sections, the operator actuates the pushbutton **105** to transmit a signal to the amplifier **124** directly through the OR-gate **125** so that the amplifier **124** energizes the solenoid for the valve **64** which opens and enables the nozzle **62** to expel successive filter rod sections **60** from the flutes **61** of the transporting drum **59** into the receptacle **84**. The ejection of sections **60** into the receptacle **84** continues as long as the operator maintains the pushbutton **105** in depressed position. Thus, the machine permits withdrawal of any desired number of samples at any desired time, merely by depressing the pushbutton **105** while the motor **16** continues to run at the normal speed.

The provision of a regulating unit **91** for the feeding unit **9** which controls the quantity of filamentary filter material per unit length of the tow **5** is particularly important because the filamentary material consitutes the main component of each filter rod section **60**. Reliable operation of the regulating unit **91** is also important because the weight of successive increments of the tow **5** is much more likely to fluctuate within a very wide range than the quantity of plasticizer per unit length of the tow since the filaments are crimped and the number of crimps is likely to vary from filament to filament as well as between successive lengths of a single filament. However, the accuracy of regulating action upon the feeding unit **9** cannot be increased beyond a certain limit, mainly due to technological reasons as well as due to inertia of moving parts and limits in the accuracy of finish of machine parts. Therefore, it is desirable to provide the machine with discrete regulating means for each component of the filter rod or at least for the two most important components (filter material and plasticizer). The quantity of plasticizer per unit length of the tow **5** is likely to fluctuate for a number of reasons. For example, if the opening or spreading action of nozzles **3** and **7** is not uniform, the tow **5** is likely to reach the feeding unit **24** in the form of a band whose width varies from increment to increment and, therefore, the band will intercept different quantities of atomized plasticizer during travel past the applicators **27** and **28**. The differences in the width of opened tow during transport through the feeding unit **24** are likely to influence the weight of the filter rod sections **60**. The quantity of applied plasticizer is also likely to fluctuate due to temperature changes which influence the viscosity of the supply in the tank **25**. Furthermore, the atomizing action of the applicator **28** is affected by wear on its bristles. Thus, there are many reasons to warrant a measurement of the quantity of plasticizer in the filter rod sections **60** which are about to leave the

machine and to regulate the feeding unit **24** in accordance with signals to the regulating unit **34**.

The weighing unit **70** is but one of several measuring units which can be utilized in the machine of the present invention. As a matter of fact, certain other types of measuring means (such as devices which employ beta rays and ionization chambers) exhibit the advantage that they can continuously measure the quantity of one or more components in successive increments of the rod **50** so that the removing or withdrawing means **73** can be dispensed with. The same holds true for aforementioned pneumatic measuring or detecting devices which determine the resistance offered by successive increments of the tow to the passage of an air stream. It is further possible to employ a pair of electrodes which are connected with a source of high-frequency current and are placed at the opposite sides of the path for the filter rod **50** or filter rod sections **60**. Nevertheless, one or more precision weighing devices are preferred at this time because they are capable of determining the quantities of one or more components with an extremely high degree of accuracy, especially if the articles are not weighed singly but in groups each of which consists of a substantial number of articles. Removal of groups at predetermined intervals in response to signals from the clockwork mechanism or timer **119** is advantageous because the samples can be withdrawn automatically without necessitating any attention on the part of the operators.

As described above, the machine of FIGS. 1 to 4 is provided with two regulating units **91** and **34** which respectively adjust the feeding unit **9** for the tow **5** (main component) and the feeding unit **24** (source of the secondary component **26**). However, it is equally within the purview of the invention to modify the machine of FIGS. 1 to 4 in such a way that the regulating unit **91** is either omitted or rendered inactive so that the advancing rolls **11** are driven at a constant speed and the regulating unit **34** adjusts the rate of application of the plasticizer **26** in response to signals by way of the conductor means **97**. In addition to omission or deactivation of the regulating unit **91**, the thus simplified machine can operate properly by omitting the junction **142**, the potentiometer **143** and the conductor means **94**. Also, the transmission **21** can be replaced with a simpler transmission. In all other respects, the operation of the thus modified machine is clearly analogous to operation of the machine shown in FIGS. 1 to 4.

If it is desired to use a feeding unit which is designed to furnish a constant quantity of plasticizer **26** per unit of time, i.e., to operate the machine with the regulating unit **91** but without the regulating unit **34**, that regulating unit **34** can be deactivated or omitted together with the scale **74**, and the other scale can be fixedly mounted to receive filter rod sections in response to operation of the withdrawing or removing unit. A portion of such modified machine is shown in FIG. 5. All such parts of the structure shown in FIG. 5 which are identical with or clearly analogous to the corresponding parts of the machine shown in FIGS. 1 to 4 are denoted by similar reference characters plus 200.

The withdrawing or removing unit of FIG. 5 comprises a single ejector nozzle **262** which is connected with a source of compressed air by way of a supply conduit **266** and is adjacent to the path of filter rod sections **260** which travel in the flutes **261** of the transporting drum **259**. The valve **264** in the supply conduit **266** is normally closed and its solenoid is energized in response to a signal from the timer or clockwork mechanism **319** by way of the signal storing circuit **326** and amplifier **324**. The clockwork mechanism **319** is connected with the input *a* and the amplifier **324** is connected with the output *c* of the circuit **326**. The output *c* is further connected with an adjustable pulse counter **332** which receives pulses from a timer **337** at the frequency which is proportional to the rate of travel of flutes **261** past the nozzle **262**. The output of the counter **332** is connected with the erasing input *b* of the signal storing circuit **326** and with the scale **274** which is stationary and whose tray **276** is positioned to intercept filter rod sections which are expelled by the air stream issuing from the nozzle **262**. The scale **274** transmits signals to a junction **342** which is connected with the regulating unit **91** (not shown) by way of a conductor means **294** and with a potentiometer **343** which corresponds to the potentiometer **143** of FIG. 2.

The clockwork mechanism **319** is set to transmit to the input *a* of the signal storing circuit **326** signals at predetermined intervals, for example, every hour or every thirty minutes. The output *c* of the circuit **326** then transmits a signal which energizes the solenoid for the valve **264** by way of the amplifier **324** and which also starts the properly adjusted pulse counter **332**. The latter counts the pulses which are transmitted by the timer **337** at the rate at which the nozzle **262** expels filter rod sections **260** from the flutes **261** of the drum **259** into the tray **276**. When the counter **332** receives a preselected number of pulses, i.e., when the tray **276** accumulates a predetermined number of filter rod sections **260**, the output of the counter **332** sends a signal to the input *b* of the signal storing circuit **326** to erase the signal at the output *c* and to thus deenergize the solenoid for the valve **264** with resulting deactivation of the withdrawing unit. At the same time, the counter **332** transmits a signal to the scale **274** which determines the combined weight of filter rod sections **260** in the tray **276** and transmits an appropriate signal to the junction **342**. The latter compares such signal with the signal from the potentiometer **343** (i.e., with a signal which is indicative of the desired weight of filter rod sections **260** in the tray **276**), and the conductor means **294** transmits a signal to the regulating unit **91** (if necessary) so that the unit **91** adjusts the stretch of successive portions of the tow **5** between the advancing rolls **11** and **12**. The scale **274** can complete the weighing operation prior to or in response to reception of a signal from the counter **332**.

An important advantage of the improved machine is that the quality and consistency of filter rod sections which reach a processing machine (e.g., a filter cigarette making machine) is much more uniform than in presently known filter rod making machines and also that the number of rejects is reduced considerably because any adjustments which might become necessary are carried out without requiring any attention on the part of the operators. The consistency of a satisfactory filter rod section is preferably uniform all the way from the one end to the other end, and this can be readily achieved by automatically regulating the quantity of at least one component of each filter rod section and by insuring the expulsion or segregation of all such filter rod sections which are produced during those stages of operation when the machine is likely to turn out unsatisfactory products. Another important advantage of the improved machine is that it can be rapidly converted from the production of a first type of rod-shaped articles to the production of any one of several other types of articles merely by changing the plasticizer in the tank **25**, by replacing the bale **2** with a bale consisting of or containing another material, by adjusting the potentiometer **141**, and/or by adjusting the potentiometer **143** (**343**). An advantage of the improved measuring, feeding, regulating and removing units is that they can be built into or combined with existing types of filter rod making machines or other machines wherein two or more components are to be assembled or brought in contact with each other in accurately metered quantities. Since the articles to be weighed are removed from the path wherein the articles normally leave the machine, the weighed articles are truly representative of the quality of the output of the machine.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can, by applying current knowledge, readily adapt it for various applications without omitting features which fairly constitute essential characteristics of the generic and specific aspects of my contribution to the art and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the claims.

What is claimed as new and desired to be protected by Letters Patent is set forth in the appended claims.

I claim:

1. In a machine for the production of filter elements or like rod-shaped articles which are composed of at least one main component and at least one secondary component, particularly a secondary component which influences the condition of the main component, a combination comprising discrete sources of main and secondary components; discrete feeding means for supplying effective quantities of components from the respective sources to a treating station, at least one of said feeding means being adjustable; means for converting the thus treated components into a continuous rod; severing means for subdividing the rod into rod-shaped articles of predetermined length; transporting means for conveying the articles along a predetermined path; measuring means including means for determining the quantity of at least one component in predetermined numbers of rod-shaped articles for producing signals which are indicative of the thus determined quantities; and regulating means for adjusting said one feeding means in accordance with such signals.

2. A combination as defined in claim 1, wherein the feeding means for said secondary component comprises applicator means for applying the secondary component to the main component at said treating station.

3. A combination as defined in claim 1, wherein said main component is a tow of stretchable filamentary filter material and the feeding means for said tow comprises adjustable stretching means for the tow to thereby determine the quantity of filamentary material in successive increments of the tow.

4. A combination as defined in claim 1, wherein said adjustable feeding means is arranged to supply the secondary component to said treating station.

5. A combination as defined in claim 1, wherein said measuring means comprises weighing means for said predetermined numbers of articles.

6. A combination as defined in claim 5, further comprising removing means arranged to transfer said predetermined numbers of articles from said path to said weighing means.

7. A combination as defined in claim 6, wherein said removing means comprises means for removing successive articles from said path.

8. A combination as defined in claim 1, further comprising means for temporarily arresting one of said feeding means to thus initiate the conversion of remaining components into a second rod which is without the component normally furnished by the arrested feeding means, said measuring means comprising first and second weighing means for weighing groups of equal numbers of filter elements respectively obtained in response to severing of said first mentioned rod and said second rod and for producing signals indicative of the weight of the respective groups of filter elements, and computing means for producing on the basis of said signals a further signal indicating the difference between the weights of said groups, said regulating means being arranged to adjust the feeding means for said secondary component in accordance with said further signal.

9. A combination as defined in claim 8, wherein said computing means includes a differential circuit.

10. A combination as defined in claim 8, further comprising a source of reference signals indicative of the optimum difference between the weights of said groups and means for comparing such reference signals with said further signal and for producing signals for transmission to the regulating means for the feeding means for said secondary component.

11. A combination as defined in claim 1, further comprising means for temporarily arresting the feeding means for said secondary component to thus initiate the conversion of remaining components into a second rod which is without said secondary component, said measuring means comprising first and second weighing means for weighing groups of equal numbers of filter elements respectively obtained in response to severing of said first-mentioned rod and said second rod and for producing signals indicative of the weight of the respective groups of filter elements, a source of reference signals indicative of the optimum weight of the groups of filter elements without said secondary component, and means for comparing such reference signals with the signal from the weighing means for the groups of filter eleemnts without said secondary component and for producing signals for transmission to the regulating means for the feeding means for said main component.

12. A combination as denfied in claim 1, further comprising removing means operative to transfer said predetermined numbers of articles from said path to said measuring means and means for initiating the operation of said removing means at predetermined intervals.

13. A combination as defined in claim 12, wherein said means for initiating the operation of said removing means comprises a timer.

14. A combination as defined in claim 1, wherein said transporting means comprises an endless conveyor and further comprising removing means for transferring rod-shaped articles from said endless conveyor to said measuring means, said removing means comprising pneumatic ejector means for rod-shaped articles.

15. A combination as defined in claim 14, further comprising means for initiating the operation of said removing means at predetermined intervals and counter means for terminating the operation of said removing means in response to transfer of said predetermined number of articles from said conveyor to said measuring means.

16. A combination as defined in claim 15, wherein said conveyor is a rotary drum and wherein said removing means comprises at least one nozzle and means for connecting said nozzle to a source of pressurized fluid, said nozzle being arranged to expel rod-shaped articles from said conveyor to said measuring means in response to connection with said source of pressurized fluid.

17. A combination as defined in claim 1, wherein said measuring means comprises at least one scale having means for producing electric signals indicative of the weight of said predetermined numbers of rod-shaped articles.

18. A combination as defined in claim 1, wherein said measuring means comprises first and second scales each having means for producing electric signals indicative of the weight of said predetermined numbers of articles, and further comprising means for temporarily arresting the feeding means for one of said components to thus produce a second rod without the component normally furnished by the arrested feeding means whereby the severing of such second rod yields second rod-shaped articles without a component, and further comprising removing means operative to respectively transfer identical numbers of said first-mentioned and second articles to said first and second scales, and means for evaluating the signals produced by said first and second scales for transmission to said regulating means.

19. A combination as defined in claim 18, wherein said evaluating means comprises a device for producing in response to reception of signals from said scales a further signal which is indicative of the difference between the weights of articles weighed by said first and second scales.

20. A combination as defined in claim 10, wherein said main component is a tow of stretchable filamentary filter material and the feeding means for said tow comprises first advancing means for advancing the tow lengthwise at a predetermined speed and second advancing means for advancing the tow lengthwise at a variable speed, said regulating means comprising means for adjusting the speed of said second advancing means in accordance with said signals.

21. A combination as denfied in claim 20, wherein each of said advancing means comprises a pair of rolls at least one of which is driven and said regulating means comprises a variable-speed transmission for the one roll of said second advancing means.

22. A combination as defined in claim 1, wherein the feeding means for said secondary component comprises

at least one rotary applicator and said regulating means comprises variable-speed drive means for said applicator.

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