United States Patent

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[33] **Germany**
[31] **P 16 32 208.0**

[54] **METHOD AND APPARATUS FOR DETERMINING THE FIRMNESS OF FILLERS IN CIGARETTE RODS OR THE LIKE**
28 Claims, 9 Drawing Figs.

[52] **U.S. Cl.** ..... **73/37.6,** 131/21 B
[51] **Int. Cl.** **G01b 13/08**
[50] **Field of Search** ..... 131/21, 21 B, 21 D; 73/37, 37.5—.7, 45, 38, 41, 45.1

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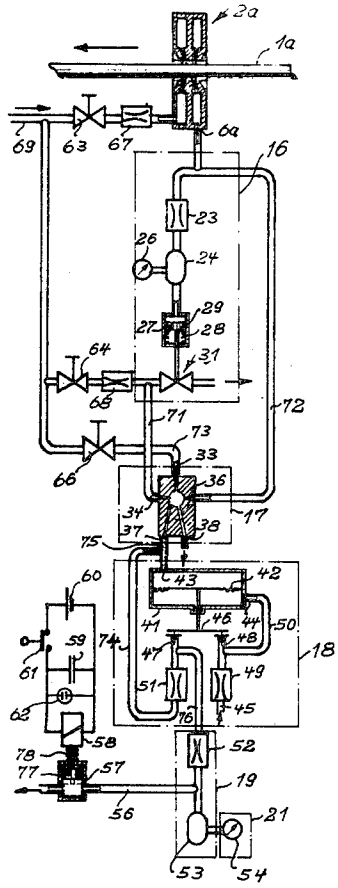
ABSTRACT: The firmness of rodlike filters in cigarettes or cigarette rods is determined by directing an air stream against the wrapper of a cigarette or cigarette rod and by measuring the extent of deformation which the filler undergoes in response to deforming pressure of the air stream. The results of measurements can be utilized to furnish visual indications of firmness, to furnish visual indications of differences between a desired firmness and the measured firmness, to furnish visual indications of average firmness of predetermined adjustment of the machine which produces the filler.



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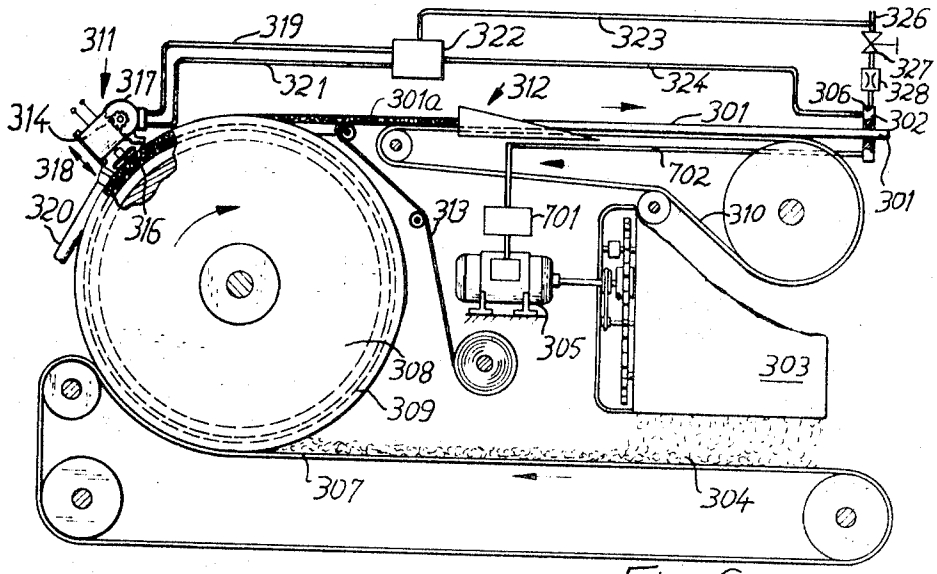

Fig. 6

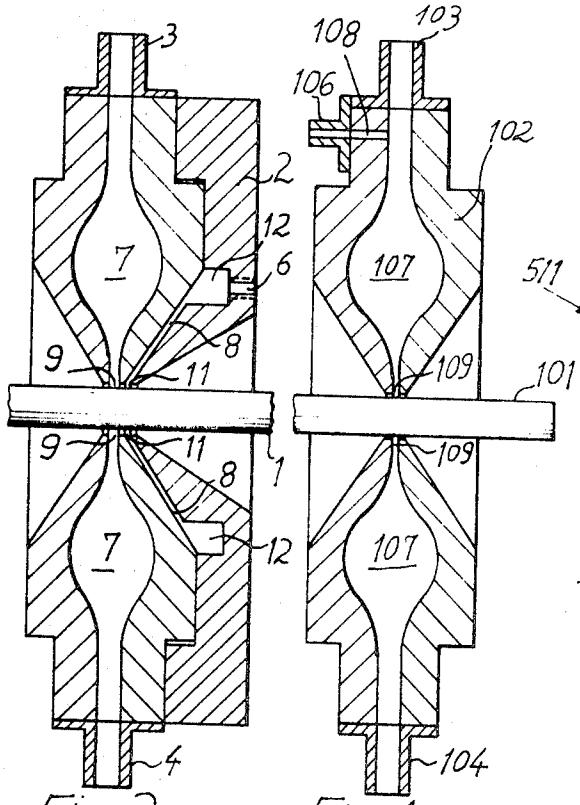

Fig. 2

Fig. 1

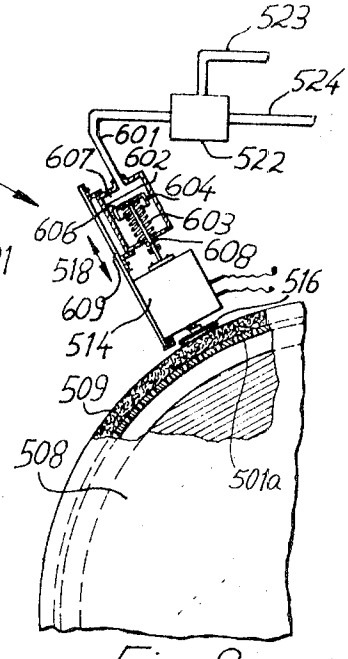

Fig. 8

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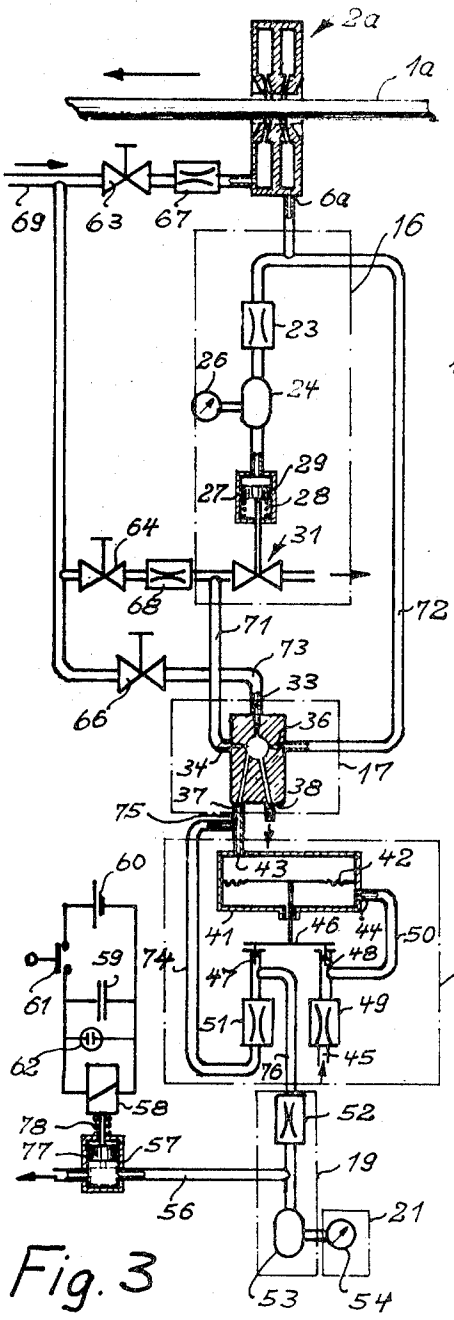

Fig. 3

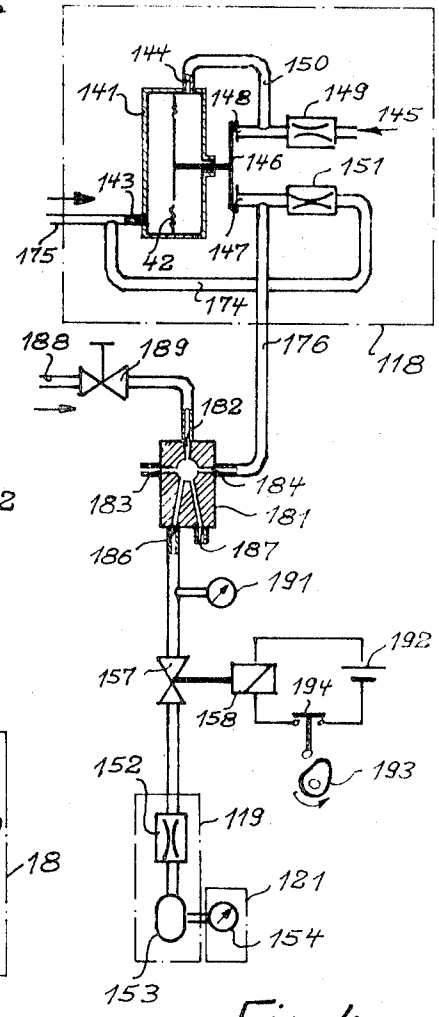

Fig. 4

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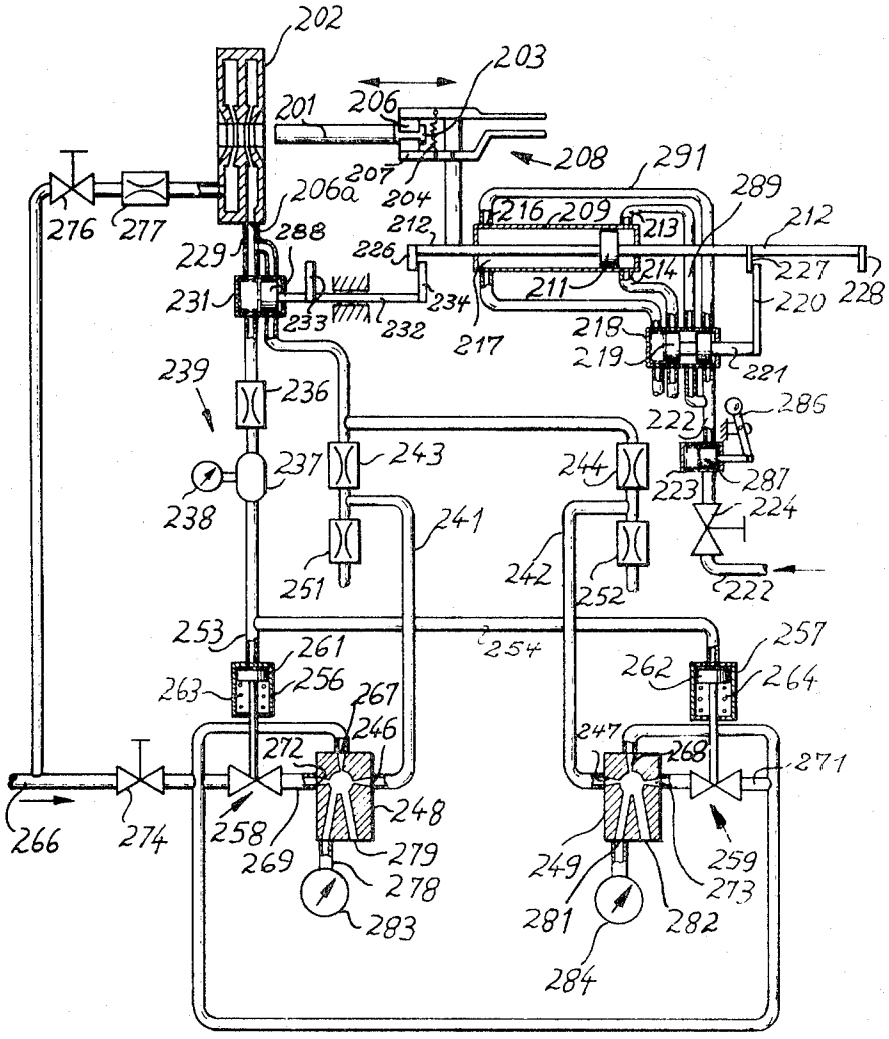

Fig. 5

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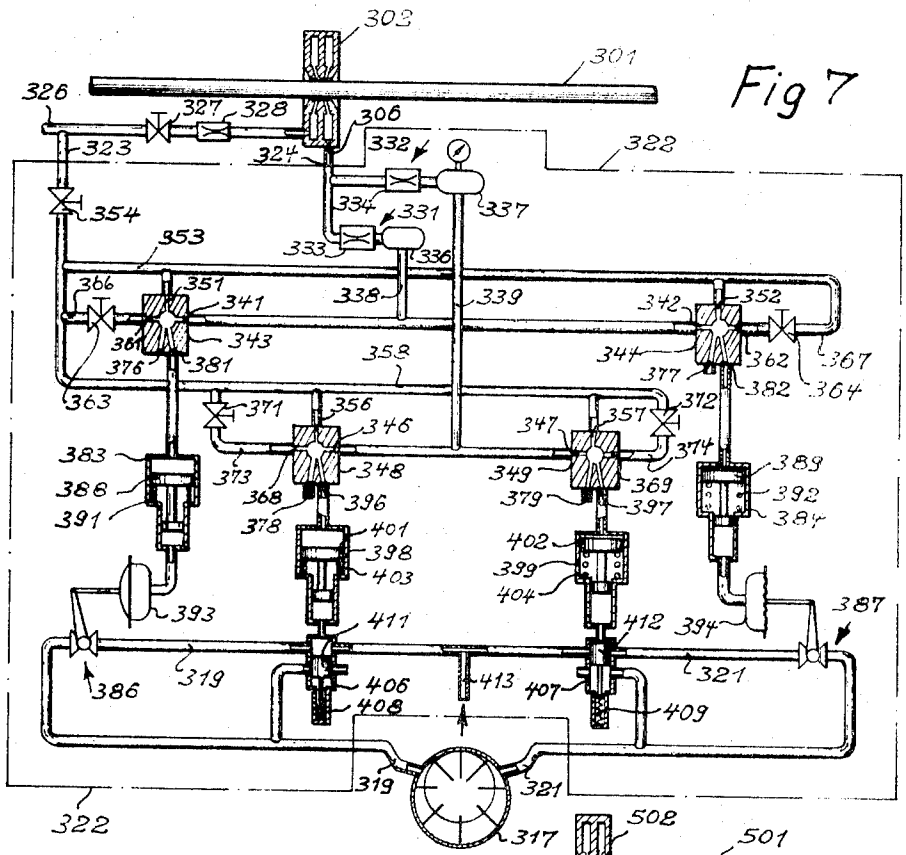

Fig 7

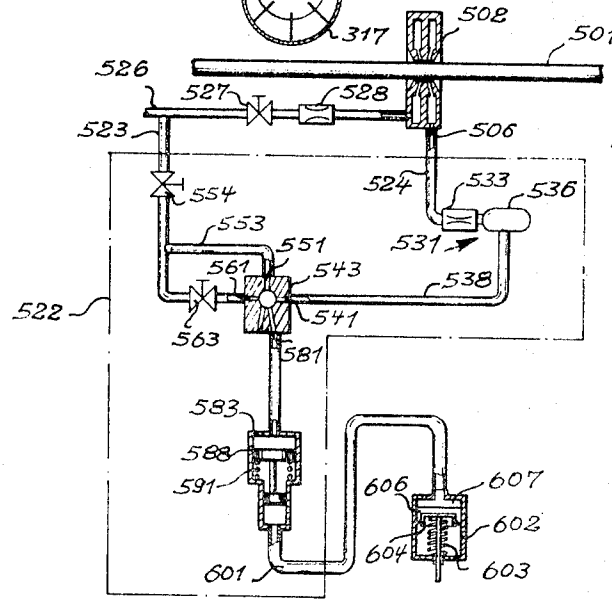

Fig. 9

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METHOD AND APPARATUS FOR DETERMINING THE FIRMNESS OF FILLERS IN CIGARETTE RODS OR THE LIKE

BACKGROUND OF THE INVENTION

The present invention relates to a method and apparatus for testing of cigarettes or analogous tobacco-containing articles, and more particularly to a method and apparatus for determining the firmness or "feel" of tobacco fillers in cigarettes, cigarette rods or the like. Still more particularly, the invention relates to improvements in a method and apparatus for automatically determining the firmness of fillers in wrapped continuous tobacco-containing rods or in tobacco-containing rods of finite length. The invention also relates to a method and to a machine for automatically regulating the production of fillers for cigarette rods or the like so that the firmness of such fillers remains within a desired optimum range.

Manufacturers of cigarettes, cigarillos or similar wrapped rod-shaped tobacco-containing articles must take particular care to insure that the firmness of the filler is satisfactory to the consumer. In other words, the firmness of the filler must be such that a smoker holding the cigarette between two fingers gains the impression that the wrapper is properly filled and will not yield to a certain finger pressure. Moreover, the manufacturer must insure that the firmness of the filler in each of a batch of smoking articles is the same, i.e., that a pack or another receptacle for cigarettes does not contain cigarettes having fillers of different firmness. The average smoker is not concerned with the weight of a cigarette; all that counts to him is that the touch or feel of the cigarette be satisfactory.

The firmness of the filler depends on the filling force which is a function of the elasticity and mass of tobacco particles in the filler. When a filler contains highly elastic tobacco shreds or strands, its weight per unit length can be reduced considerably without affecting the firmness. The smoker does not detect the reduced weight of the filler because the feel of a cigarette containing a filler which is composed of highly elastic tobacco shreds is the same as that of a much heavier filler which contains less elastic particles of comminuted tobacco.

It is already known to test the firmness of fillers in cigarettes by a device which comprises a row of rams and means for urging the rams against the wrapper of a cigarette with a predetermined force. The extent of displacement of rams in response to the application of such force is indicative of the firmness of the filler. This device is still in experimental stage and exhibits several serious drawbacks, especially high initial cost, complicatedness and the fact that the results are available with a considerable delay following completion of the test so that such results cannot be utilized to bring about immediate remedial action in the production of fillers.

British Pat. No. 985,491 discloses a mechanical device which utilizes a springy feeler serving to detect the dimensions of fillers and to adjust the distributor or the trimming device of a rod cigarette machine when the dimensions of the filler deviate from a desired value. This device is used exclusively as a means for detecting the mass, not the firmness, of tobacco-containing fillers.

U.S. Pat. No. 2,952,262 discloses a pneumatic apparatus for detecting variations in the quantity of tobacco contained in a paper tube. This patent relies on a procedure which is known from the art of measuring the diameters of wires and proposes to cause a gas to flow past a length of cigarette rod at a rate determined by the cross-sectional size of the rod. The pressure of gas is such "as to be not greater than the desired minimum pressure of tobacco within the cigarette paper wrapper." Therefore, the method and apparatus of this patent cannot determine the firmness of fillers and much less positive deviations of firmness from a desired optimum range.

SUMMARY OF THE INVENTION

One of several important objects of our invention is to provide a method of rapidly and accurately determining the firmness of masses of comminuted tobacco particles or the like, particularly of determining the firmness or "feel" of rodlike fillers in the wrappers of cigarettes, cigarette rods or like rod-shaped articles.

Another object of the invention is to provide a method according to which the firmness of fillers can be measured continuously, with a minimum of delay, and in such a way that the results of measurements indicate variations in firmness of a certain length of a rodlike filler, the average firmness of a certain length of filler, differences between a desired firmness and the measured firmness, the extent to which the measured firmness exceeds or is less than a desired firmness, and/or a combination of the above.

A further object of the invention is to provide a method according to which the results of measurements to determine the firmness of fillers can be immediately utilized to bring about remedial action in the production of fillers if the results indicate that the firmness is excessive or insufficient.

An additional object of the invention is to provide a simple and reliable automatic apparatus for testing the firmness or feel of fillers in cigarette rods or the like and to construct the apparatus in such a way that it can furnish readily detectable readings indicating the firmness, either at regularly recurring intervals or at the will of the person in charge.

A further object of the invention is to provide an apparatus which can be built into or combined with a rod cigarette machine or another suitable filler-producing machine to monitor the firmness of the filler and to effect appropriate adjustments of the machine when the firmness is unsatisfactory.

Still another object of the invention is to provide an apparatus which can determine the firmness of rodlike fillers in cigarettes or cigarette rods without defacing the wrappers, without unduly deforming or otherwise affecting the appearance and/or quality of tested articles, and with a degree of accuracy which is unmatched by presently known apparatus.

The method of our invention is employed to determine the firmness or "feel" of a mass of tobacco, particularly to determine the firmness of rodlike tobacco fillers which are confined in tubular wrappers of cigarette paper or the like. The method comprises the steps of directing a gas (preferably a stream of air) against and thereby subjecting the mass of tobacco to a deformation whose extent is inversely proportional to the firmness, and measuring the extent of such deformation. The pressure of gas which is directed against the mass of tobacco is preferably less than required to bring about permanent deformation of the mass, i.e., the deformation of the mass is preferably within the elastic limits of its material.

The measuring step preferably comprises producing pneumatic signals whose magnitude is indicative of the extent of deformation of the mass. Such pneumatic signals can be produced in response to determination of changes in that characteristic of the gas (e.g., the pressure of gas) which is variable as a function of the resistance offered by the mass to deformation by the gas.

If the mass is a rodlike filler, the gas is preferably directed against a circumferentially complete portion of the external surface of the filler, i.e., against an annular portion of the wrapper which surrounds the filler of a continuous cigarette rod or a cigarette rod of finite length (e.g., a plain cigarette or a filter cigarette). The gas can be directed substantially radially toward the wrapper and is then deflected by the wrapper substantially radially outwardly, i.e., in a direction counter to the direction of gas flow toward the filler. The measuring step then comprises determining the characteristics of the thus deflected gas stream. The testing operation is preferably carried out in such a way that the filler is caused to travel with reference to the station where the stream of gas is directed thereagainst, or vice versa, so that the stream of gas is directed against successive increments of the filler.

The measuring step may comprise producing—in response to impingement of the gas stream against successive increments of the filler—first pneumatic signals whose pressure is indicative of the firmness of successive increments, storing the first signals, and producing a second signal representing the average pressure of the thus stored first signals whereby the second signal indicates the average firmness of the tested length of the filler.

The just described method can be employed to regulate the firmness of articles which consist of or comprise comminuted tobacco. For example, the method of producing a continuous cigarette rod can comprise the steps of converting a stream of comminuted tobacco leaves into a rodlike filler, wrapping the filler into cigarette paper tape to form a cigarette rod, directing a gas against successive increments of the wrapper and thereby subjecting the filler therein to a deformation whose extent is inversely proportional to the firmness of the filler, measuring the extent of such deformation of the filler, and utilizing the result of the measurement to regulate the quantity of comminuted tobacco in the filler. This last mentioned step may comprise adjusting the position of the trimming device with reference to the tobacco stream so that the trimming device removes greater or lesser quantities of tobacco during conversion of the stream into a filler, and/or adjusting the distributor of a rod cigarette machine so that the distributor furnishes greater or lesser quantities of tobacco particles which form the stream.

The novel features which are considered as characteristic of the invention are set forth in particular in the appended claims. The improved testing apparatus 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 an axial sectional view of a deforming nozzle forming part of a testing apparatus which embodies the invention;

FIG. 2 is a similar axial sectional view of a second deforming nozzle;

FIG. 3 is a diagrammatic partly sectional view of a testing apparatus which employs the deforming nozzle of FIG. 2 and is utilized to automatically determine differences between measured average firmness of a filler rod and the desired average firmness;

FIG. 4 is a similar diagrammatic party sectional view of a testing apparatus which constitutes a modification of the apparatus shown in FIG. 3;

FIG. 5 is a diagrammatic partly sectional view of a testing apparatus which is utilized to determine the differences between measured firmness and the desired maximum or minimum firmness of a filler rod of finite length;

FIG. 6 is a schematic partly elevational and partly sectional view of a rod cigarette machine whose operation is regulated by a testing apparatus similar to the one shown in FIG. 5;

FIG. 7 illustrates the testing apparatus for the machine of FIG. 6;

FIG. 8 illustrates a portion of a modified rod cigarette machine; and

FIG. 9 illustrates a testing apparatus which can be utilized to regulate the operation of the machine shown in FIG. 8.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIG. 1 illustrates a portion of an apparatus which determines the firmness of a mass of tobacco, namely, the firmness of the rodlike filler in a continuous cigarette rod 101. The rod 101 comprises a filler of shredded tobacco which is enclosed in a tubular wrapper of cigarette paper. The apparatus includes an annular deforming nozzle 102 which admits a stream of gas, preferably air, against the external surface of the wrapper in the cigarette rod 101. The deforming nozzle 102 comprises two inlets 103, 104 for compressed air and an outlet 106 which is connected with a testing or evaluating device serving to determine the characteristics of air in the annular chamber 107 of the nozzle 102. The chamber 107 communicates with the outlet 106 by way of a channel 108. The central portion of the chamber 107 communicates with an annular opening 109 extending into the surface surrounding the central passage or orifice for the cigarette rod 101.

The Operation

The inlets 103, 104 are connected with a source of compressed air so that a stream of air flows into the chamber 107 and against the peripheral surface of that circumferentially complete portion of the wrapper which is surrounded by the opening 109. Depending on the firmness of the filler in the cigarette rod 101, air which impinges against the wrapper in the region of the opening 109 effects a greater or lesser elastic deformation of the filler in the cigarette rod so that the wrapper is formed with an annular constriction or neck which causes the cigarette rod to develop two annular beads flanking the constriction and to produce a more or less pronounced sealing action between the wrapper and the annular surfaces flanking the opening 9. Thus, when the filler is relatively soft (readily deformable), the wrapper of the cigarette rod 101 produces a stronger sealing action so that the pressure of air which flows into the channel 108 rises because compressed air admitted at 103, 104 cannot escape by way of the opening 109. When the tobacco filler is firm, the sealing action of the wrapper in the region of the opening 109 is less pronounced and the pressure of air in the channel 108 decreases. A very firm tobacco filler can withstand the pressure of air in the chamber 107 and does not permit any appreciable deformation of the wrapper. The air stream is then free to flow around the wrapper and to escape from the opening 109 with a minimum of obstruction so that the pressure in the channel 108 does not increase at all. Thus, the chamber 107 and the channel 108 constitute that portion of the nozzle 102 which can measure elastic deformation and hence the firmness of the filler in the cigarette rod 101. The firmness is inversely proportional to the extent of deformation of the filler. The outlet 106 discharges a series of pneumatic signals which form an air stream and whose magnitude (pressure) is indicative of the firmness of corresponding increments of the filler in the rod 101. The pressure of testing air is preferably less than required to effect a permanent deformation of the filler.

FIG. 2 illustrates a modified annular deforming nozzle 2 which surrounds a travelling cigarette rod 1. The nozzle 2 comprises inlets 3, 4, an annular chamber 7, a central opening 9 surrounding the rod 1, and an annular inlet 11 which is machined into one of the surfaces flanking the opening 9 and communicates with a second annular chamber 12. The latter communicates with an outlet 6 which is connected with a testing or evaluating device. A channel 8 connects the chamber 12 with the inlet 11.

The operation of this deforming nozzle is similar to that of the nozzle 102. Compressed air which issues from the opening 9 causes deformation of the filler and wrapper in the cigarette rod 1 whereby the extent of such deformation depends on the firmness or lack of firmness of the filler. Tobacco shreds which are displaced in response to a constriction of the wrapper in the area surrounded by the opening 9 cause the wrapper to bulge radially outwardly at both sides of the constriction and to thus furnish a more pronounced sealing action against the escape of air by way of the opening 9. If the sealing action of the wrapper is pronounced, the inlet 11 receives a greater amount of air and the pressure of air in the second chamber 12 increases. Such pressure is detected by the evaluating or testing device which is connected to the outlet 6.

Since the rod 1 is transported lengthwise, the pressure in the outlet 6 is indicative of the firmness of successive increments of the filler in the rod 1. The outlet 6 can be said to produce a series of pneumatic signals whose magnitude reflects the ex-

tent of deformation and hence the firmness of those increments of the filler which advance through the area surrounded by the opening **9**. The aforementioned evaluating or testing device determines the changes of that characteristic (pressure) of air issuing from the outlet **6** which is variable as a function of the resistance offered by corresponding increments of the filler to deformation by the air stream entering the opening **9** of the deforming nozzle **2**. In this embodiment of our testing apparatus, the opening **9** admits a stream of air radially inwardly against the wrapper of the cigarette rod **1**, and the thus admitted stream is deflected in the opposite direction (i.e., substantially radially outwardly) to enter the channel **8** and the second chamber **12**.

FIG. **3** illustrates a testing apparatus including an annular deforming nozzle **2***a* which surrounds a travelling cigarette rod **1***a* and cooperates with a pneumatic testing or evaluating device serving to determine deviations of the firmness of successive increments of the rodlike filler from an optimum standard value. The testing device includes a pneumatic testing unit **16** which receives from the outlet **6***a* of the nozzle **2***a* signals indicating the firmness of successive increments of the filler and comprises an averaging unit which produces and stores signals indicating the average firmness of several increments of the travelling filler. The testing unit **16** is connected with an integrator unit **17** and the latter is connected with a signal amplifier unit **18**. The testing apparatus further comprises a second pneumatic averaging unit **19** and a reducing or indicating unit **21**.

The averaging unit of the testing unit **16** comprises a so-called laminar resistor **23** in series with an air tank **24** provided with a pressure gauge **26**. The tank **24** is in series with an adjusting cylinder **27** which accommodates a piston **29** biased by a helical spring **28**. The piston **29** can actuate an adjustable setting or regulating valve **31** which is adjusted in dependency on the average firmness of the filler in the rod **1***a* to thereby regulate an air stream whose rate of flow is proportional to the firmness of the filler. The construction of the laminar resistor **23** is such that its resistance does not change in response to changes in air pressure or in response to changes in quantity of the air flowing therethrough.

The integrator unit **17** comprises an inlet **33** for compressed air, two inlets **34, 36** for reference air streams and two outlets **37, 38** the latter of which is in communication with the atmosphere. Integrator units which can be utilized in the apparatus of FIG. **3** normally operate on the principle known as Coanda effect. Such units are known as fluidic summing junctions and are manufactured by Corning Glass Works of Corning, New York (see item No. 19071 in Catalogue of Jan. 1967).

The amplifier unit **18** comprises a housing **41** with an amplifier diaphragm **42** and two openings **43, 44** for air. The diaphragm **42** is coupled with a flap **46** which is mounted externally of the housing **41** and controls two nozzles **47, 48**. The nozzle **48** is connected to the opening **44** by a pipe **50** and with a laminar resistor **49**. The latter is connected to the atmosphere by way of a pipe **45**. The other nozzle **47** is connected with the opening **43** of the housing **41** by way of a further laminar resistor **51**. The intensity of the signal furnished by the nozzle **47** is the square of the intensity of the signal at the opening **43**. The pipe **45** admits to the laminar resistor **49** air for admission into the nozzle **48**. The pipe **50** admits air to the underside of the diaphragm **42** in the housing **41**. A similar amplifier unit is shown, for example, in FIG. **27** on page 151 of the publication entitled "Regelungstechnik," Volume 4, published in 1967.

The second averaging unit **19** comprises a laminar resistor **52** and an air tank **53**. The reducing unit **21** comprises an appropriately calibrated pressure gauge **54**. The pipe connecting the laminar resistor **52** with the tank **53** communicates with a pipe **56** which contains a valve **57** operated by a solenoid **58** and having a valve member **77** which moves to the broken line position when the solenoid **58** is energized. A return spring **78** urges the valve member **77** to the solid-line position of FIG. **3**. The circuit of the solenoid **58** includes a time-lag device here shown as a capacitor **59** which is charged by an energy source **60** in response to closing of a master switch **61** to maintain the solenoid **58** in energized condition for a predetermined interval of time. The exact moment when the capacitor **59** is fully charged following closing of the master switch **61** is indicated by a lamp **62**.

The testing or evaluating device of FIG. **3** further comprises adjustable valves **63, 64, 66** and laminar resistors **67, 68**. A supply conduit **69** furnishes compressed air from a compressor, pump or blower. The pressure of air entering the inlet **33** of the integrator unit **17** is indicative of the desired optimum firmness of the filler in the rod **1***a*. The pressure of air at the inlet **34** is indicative of measured average firmness, and the pressure of air at the inlet **36** varies as a function of the firmness of successive increments of the filler in the rod **1***a*.

The operation is as follows:

The cigarette rod **1***a* is moved lengthwise through the area surrounded by the central opening of the nozzle **2***a*, and the outlet **6***a* of the nozzle discharges a series of pneumatic signals which form an air stream and whose pressure is indicative of the firmness of the corresponding increments of the filler in the cigarette rod **1***a*. A portion of the thus discharged air stream enters the tank **24** by way of the laminar resistor **23**. The tank **24** serves as an averaging element, i.e., as a means for damping the signals, in that it eliminates short-lasting fluctuations in the pressure of incoming air stream. This is due to inertia of the series-connected parts **23, 24**. Pressure in the tank **24** changes in response to longer-lasting deviations of firmness from a standard value so that readings furnished by the gauge **26** represent an average value of the pressure which depends on the firmness of the filler in the cigarette rod **1***a*. The pressure of air in the tank **24** causes the piston **29** in the cylinder **27** to assume a position which is a function of the firmness of the filler, and the piston **29** adjusts the setting valve **31** to regulate the air stream which flows through this valve. It can be said that this air stream constitutes a pneumatic output signal whose characteristics vary as a function of changes in average firmness of the filler in the rod **1***a*. A pipe **71** is connected with the supply conduit **69** upstream of the valve **31** and serves to deliver a stream of compressed air to the inlet **34** of the integrator unit **17**. As stated before, the pressure of such air stream is proportional to the pressure of air in the tank **24**. The other inlet **36** of the integrator unit **17** is connected with a pipe **72** which receives air from the outlet **6***a* so that the pressure of air in the inlet **36** fluctuates in the same way as the firmness of successive increments of the filler in the rod **1***a*. The inlet **33** admits to the integrator unit **17** compressed air from the conduit **69** by way of a pipe **73** which contains the valve **66**. The valve **66** is adjusted in such a way that the pressure of air at the inlet **33** corresponds to or reflects the desired optimum firmness of the filler. The air stream which enters via inlet **33** is deflected to the right or to the left, as viewed in FIG. **3**, depending on the pressure of air which is admitted by way of the inlets **34, 36**. The pressure at the outlet **37** is indicative of the difference between the pressures in the inlets **34, 36**. Air issuing at **37** flows through a pipe **75** which is connected to the opening **43** so that such air exerts pressure against the upper side of the diaphragm **42** in the housing **41**. A pipe **74** which branches from the pipe **75** upstream of the opening **43** is connected with the laminar resistor **51** in the amplifier unit **18** to admit air into the nozzle **47**. The stream of air issuing from the orifice of the nozzle **47** impinges against the flap **46**. A pipe **76** which is connected with the pipe **74** in the region between the laminar resistor **51** and nozzle **47** transmits signals whose intensity is the square of the intensity of pneumatic signals emitted by the outlet **37** of the integrator unit **17**. The air tank **53** of the averaging unit **19** has a large time constant and the pressure therein is indicative of the average value of amplified pneumatic signals furnished by the pipe **76**. The gauge **54** of the reducing unit **21** indicates the pressure of air in the tank **53**.

The operation of the testing device is started in response to closing of the master switch **61**. The switch **61** is held in closed position until the signal lamp **62** lights up to indicate that the capacitor **59** is charged. The solenoid **58** is energized and moves the valve member **77** to the broken line position to seal the pipe **56** and to thereby seal the outlet of the tank **53**. Thus, the pressure of air in the tank **53** begins to rise above atmospheric pressure. After the elapse of a predetermined interval of time, for example, after one minute, the charge of the capacitor **59** drops sufficiently to permit the spring **78** to return the valve member **77** in the valve **57** to the solid-line position. The pointer of the gauge **54** remains in the position of maximum deflection from zero position and thus indicates the average deviation of firmness of the filler in the cigarette rod **1***a* from a desired standard firmness.

A fresh testing operation can begin as soon as the pressure in the tank **53** decreases to atmospheric pressure and in response to renewed closing of the master switch **61**. Thus, the apparatus of FIG. **3** is always ready to furnish information as to the standard deviation of firmness from desired firmness and the gauge **54** furnishes readings in response to closing of the master switch **61**.

An important advantage of the just described apparatus is that it furnishes information which is indicative of average deviations of firmness of the filler from a desired standard firmness. Thus, it is not necessary to carry out a series of short-lasting measurements and to thereby calculate the average deviation on the basis of a series of short-lasting tests. The measurements carried out by the apparatus of FIG. **3** are detected with a certain delay because the pointer of the gauge **54** indicates the average deviation of firmness from standard firmness in that portion of the filler in the rod **1***a* which has already advanced beyond the opening of the nozzle **2***a*. However, this is of no consequence because the firmness of a filler changes rather gradually.

In the apparatus of FIG. **3**, the nozzle **2***a* causes deformation of successive increments of the filler, the outlet **6***a* of the nozzle furnishes pneumatic signals which indicate the firmness of successive increments of the filler, the averaging unit **23**, **24** of the testing unit **16** produces a signal which indicates the average firmness of several successive increments of the filler, the valve **31** serves to produce an output signal which is indicative of the average firmness of several successive increments (such signal, i.e., the air stream flowing through the valve **31**, can be utilized to adjust the machine which produces the filler for the rod **1***a*), the integrator unit **17** furnishes at **37** a series of signals which indicate deviations of the firmness of successive increments of the filler from a desired standard firmness, the amplifier unit **18** amplifies such signals, and the averaging unit **19** furnishes a signal (at **54**) which is indicative of average deviation of firmness from the desired firmness. The parts **56**—**62** constitute a means for initiating and terminating the operation of the averaging unit **19** for desired periods of time.

The testing or evaluating apparatus of FIG. **4** is similar to the just described apparatus and many of its parts are denoted by similar numerals plus 100. The purpose of this apparatus is to process pneumatic signals which are admitted by way of a pipe **175** and represent the average value of differences between measurements carried out at a remote point and indicating, for example, the firmness of successive increments of a cigarette rod. Signals transmitted by the pipe **175** need not necessarily be obtained by pneumatic means in a manner as shown in FIG. **3**. Thus, it is also possible to produce pneumatic signals in response to measurements which are carried out by mechanical means and which can represent the firmness or another characteristic of the filler in a cigarette or cigarette rod. Thus, signals admitted by way of the pipe **175** can represent deviations of the weight of successive increments of a travelling cigarette rod from a standard value.

The parts in the amplifier unit **118** of the apparatus shown in FIG. **4** are identical to the corresponding parts of the amplifier unit **18** in FIG. **3**. The amplifier unit **118** is connected with a pneumatic integrator or summing junction **181** by way of a pipe **176**. The integrator **181** has an inlet **182** connected with a pipe **188** corresponding to the pipe **73** of FIG. **3** and containing a regulating valve **189**. The integrator **181** further comprises inlets **183**, **184** and outlets **186**, **187** which respectively correspond to the inlets **34**, **36** and to the outlets **37**, **38** of the integrator unit **17** in FIG. **3**. A similar integrator, called proportioning device, is described by Corning Glass Works as item No. 190040 in the Catalog dated May 1966.

The outlet **186** of the integrator **181** is connected with a pressure gauge **191** and with a valve **157** which can be opened by a solenoid **158**. The valve **157** is installed in a pipe which further contains a laminar resistor **152** and discharges into the air tank **153** of the averaging unit **119**. The circuit of the solenoid **158** includes an energy source **192** and a master switch **194** which is periodically opened by a rotary cam **193**.

Signals furnished by the pipe **175** are amplified in the unit **118** and are transmitted to the integrator **181** prior to being transmitted to the second integrator unit **119**. When the cam **193** allows the master switch **194** to close, the solenoid **158** is energized and opens the valve **157** for a predetermined interval of time so that the latter transmits pneumatic signals to the averaging unit **119**. The intensity of such signals is a function of signals which are transmitted by way of the pipe **175**.

In the manufacture of cigarettes, it is often desirable to determine deviations of firmness of fillers in cigarettes from an arithmetic average value, especially to determine whether or not the average firmness of the filler in a cigarette exceeds or is below a certain desirable maximum or minimum value. An apparatus which can furnish information whether or not the average firmness of discrete cigarettes **201** exceeds a permissible maximum value or is below a permissible minimum value is shown in FIG. **5**. This apparatus comprises a deforming nozzle **202** which corresponds to the nozzle **2** of FIG. **2**; however, it is equally possible to employ the deforming nozzle **101** of FIG. **1**. The cigarette **201** is a filter cigarette and its filter tip **203** is held by two jaws **206**, **207** which are biased thereagainst by a spring **204**. The jaws **206**, **207** form part of a gripper or holder **208** which is reciprocable by a drive including a fluid-operated cylinder **209** and serves as a means for effecting relative movement between the deforming nozzle **202** and the filler in the cigarette **201**. The cylinder **209** accommodates a piston **211** having a piston rod **212** which supports the gripper **208**. The cylinder **209** is connected with a first pair of conduits **213**, **214** which admit fluid serving to move the piston **209** in a direction to the left, as viewed in FIG. **5**, and with a second pair of conduits **216**, **217** which admit fluid to move the piston **209** in a direction to the right. The means for regulating the flow of fluid by way of the conduits **213**, **214**, **216**, **217** comprises a valve **218** having a reciprocable valve member **219** which is provided with a stem **221** connected with a follower **220**. A supply conduit **222** for compressed air accommodates a manually operated control valve **223** and an adjustable throttle valve **224**. The right-hand portion of the piston rod **212** of the piston **211** in the cylinder **209** has two axially spaced abutments **227**, **228** for the follower **220**. The control valve **223** has a plunger **287** which is reciprocable by a lever **286**.

The outlet **206***a* of the nozzle **202** serves to transmit pneumatic signals which indicate the firmness of successive increments of the filler in the cigarette **201**. This outlet **206***a* is connected with a pipe **229** which accommodates a valve **231** having a piston **288** provided with a piston rod **232** having two axially spaced followers **233**, **234**. The left-hand portion of the piston rod **212** carries a further abutment **226**. In one position of the piston **288**, pneumatic signals transmitted by the outlet **206***a* can be admitted into an averaging unit **239** including a laminar resistor **236** and an air tank **237** provided with a pressure gauge **238**. The averaging unit **239** serves as a storing means for signals indicating the arithmetic average value of firmness of the filler in the cigarette **201**. In the other position of the piston **288** in the valve **231**, the pipe **229** connects the outlet **206***a* of the nozzle **202** with pipes **241**, **242** which

respectively contain laminar resistors 243, 244 and are connected with integrators in the form of Schmitt triggers 248, 249. These integrators operate on the principle known as Coanda effect and are manufactured by Corning Glass Works (see the item No. 190462 in Catalogue of May 1966).

The numerals 251, 252 denote two additional laminar resistors. The aforementioned air tank 237 is connected with pipes 253, 254 which are respectively connected with adjusting cylinders 256, 257 for two regulating valves 258, 259. The cylinder 256 accommodates a piston 261 which is biased by a spring 263 and is connected with the valve 258. The valve 259 is connected with a piston 262 installed in the cylinder 257 and biased by a helical spring 264. The valves 258, 259 are installed in pipes 269, 271 branching from a supply conduit 266 for compressed air which is also connected with an inlet of the nozzle 202 by way of a throttle valve 276 and laminar resistor 277. The valves 258, 259 respectively admit air to the inlets 272, 273 of the Schmitt triggers 248, 249. The supply conduit 266 contains an adjustable throttle valve 274. This valve insures that the pressure of air at the inlets 267, 268 of Schmitt triggers 248, 249 represents the desired standard firmness of the filler in the cigarette 201. The Schmitt triggers 248, 249 further comprise outlets 278, 279 and 281, 282. The outlets 278, 281 are respectively connected with gauges 283, 284.

The Operation

In order to test the firmness of the filler in the cigarette 201, the latter's filter tip 203 is inserted between the jaws 206, 207 of the gripper 208 in that the jaws are moved apart against the opposition of the spring 204. The spring 204 thereupon contracts and biases the jaws against the filter tip so that the cigarette 201 is held in the position shown in FIG. 5. In the next step, the plunger 287 of the control valve 223 is moved by the lever 286 to assume its phantom-line position so that compressed air can flow through the supply conduit 222, throttle valve 224, control valve 223 and a pipe 289 to the conduit 213 and into the right-hand chamber of the cylinder 209. The piston 211 causes the piston rod 212 to move in a direction to the left and to move the gripper 208 and the cigarette 201 in the same direction. The wrapper of the cigarette 201 passes through the central opening of the nozzle 202 and the outlet 206*a* transmits pneumatic signals which indicate the firmness of successive increments of the filler. Such signals are transmitted to the averaging unit 239. When the entire filler of the cigarette 201 advances through the central opening of the nozzle 202, the abutment 226 of the piston rod 212 engages the follower 233 on the rod 232 of the piston 288 and moves the latter to the phantom-line position in which the outlet 206*a* is connected with the pipes 241, 242. The averaging unit 239 is then sealed from the nozzle 202. The pressure in the tank 237 of the averaging unit 239 is indicative of the arithmetic average value of the firmness of all increments of the filler in the cigarette 201, and such pressure causes the adjusting cylinder 256 to change the setting of regulating valves 258, 259 in the pipes 269, 271 which admit air to the inlets 272, 273 of the Schmitt triggers 248, 249.

When the abutment 226 of the piston rod 212 engages the follower 233 on the piston rod 232, the abutment 228 of the piston rod 212 engages the follower 220 and moves the valve member 219 to the broken line position of FIG. 5. Compressed air flowing through the conduit 222 is then admitted to a pipe 291 which communicates with the conduit 216, i.e., the piston 211 moves back toward the position shown in FIG. 5. During such rightward movement of the piston rod 212, the piston 288 dwells in its phantom-line position and connects the outlet 206*a* with the pipes 241, 242 which transmit pneumatic signals to the inlets 246, 247 of the Schmitt triggers 248, 249. When the deviations of average firmness (determined by the averaging unit 239 and stored in the tank 237) exceed a predetermined maximum or minimum value, the outlets 278, 281 of the Schmitt triggers 248, 249 produce signals which are indicated by the gauges 283, 284.

When the abutment 226 of the piston rod 212 reaches the follower 234, the piston 288 in the valve 231 returns to the solid-line position of FIG. 5. At the same time, the abutment 227 of the piston rod 212 engages the follower 220 and returns the valve member 219 to the illustrated solid-line position. This completes the testing operation.

The apparatus of FIG. 5 furnishes information regarding deviation of firmness of the cigarette filler above a permissible maximum firmness or below a permissible minimum firmness. However, this apparatus can be readily converted to furnish information regarding deviations of average firmness of cigarettes 201 from a desired standard average firmness. To this end, one of the Schmitt triggers 248, 249 (for example, the trigger 249) can be omitted, together with the corresponding regulating valve (259) and the other Schmitt trigger (248) is replaced by an integrator unit corresponding to the unit 17 of FIG. 3. The thus modified apparatus then further comprises an aMplifier unit (18), a second averaging unit (19) and a reducing unit (21).

In the apparatus of FIG. 5, the filler of the cigarette 201 is tested twice, namely, for the first time during leftward movement of the holder 208 (for the purpose of enabling the averaging unit 239 to determine the average firmness of the filler), and for the second time during return movement of the holder 208 (for the purpose of supplying to the inlets 246, 247 of Schmitt triggers 248, 249 signals which indicate the firmness of successive increments of the filler) in the cigarette rod 201. The Schmitt triggers 248, 249 respectively respond (i.e., the gauges 283, 284 furnish readings) when the firmness of the filler is respectively above or below a predetermined optimum range.

FIG. 6 illustrates certaln details of a rod cigarette machine wherein the trimming or equalizing device 311 is adjusted in accordance with signals furnished by a testing or evaluating device 322 forming part of an apparatus for determining the firmness of successive increments of the cigarette rod 301. The apparatus further comprises an annular deforming nozzle 302 which is similar to or identical with the nozzle 2 or 102 and is installed in the rod cigarette machine upstream of the customary cutoff (not shown) which serves to subdivide the cigarette rod 301 into cigarette rod sections of unit length or multiple unit length.

The rod cigarette machine of FIG. 6 further comprises an adjustable distributor 303 which is driven by an adjustable prime mover here shown as an electric motor 305 and showers shredded tobacco particles 304 onto the upper stretch of an endless belt 307. The latter converts showered tobacco particles into a stream which is fed into the circumferential groove 309 of a conveyor here shown as a suction wheel 308. This wheel holds the tobacco stream in the groove 309 by suction and advances it past the trimming device 311 which removes excess tobacco to convert the stream into a filler rod 301*a*. The filler rod 301*a* is then fed into a wrapping mechanism 312 wherein it is provided with a tubular wrapper consisting of cigarette paper tape 313 to be thus converted into the cigarette rod 301. The mechanism 312 comprises an endless belt 310 which constitutes a means for effecting relative movement between the deforming nozzle 302 and cigarette rod 301. The means for applying adhesive to overlapping edges of the wrapper and the means for heating the resulting seam are of conventional design and are not shown in FIG. 6.

The trimming device 311 comprises a rotary cutter 316 which is driven by an electric motor 314 and is adjustable with the motor radially of the suction wheel 308 (arrow 318) by an adjusting device including a pneumatic servomotor 317. The thus removed surplus of shredded tobacco is picked up by a collecting conduit 320. The servomotor 317 is connected with the testing device 322 by two conduits 319, 321. The testing device 322 receives compressed air by way of a pipe 323 which is connected with a main supply conduit 326. A further pipe 324 connects the testing device 322 with the outlet 306 of the nozzle 302. The inlet or inlets of the nozzle 302 are connected to the aforementioned main supply conduit 326 by way of a throttle valve 327 and a laminar resistor 328.

The details of the testing or evaluating device 322 are illustrated in FIG. 7. The aforementioned pipe 324 transmits pneumatic signals from the outlet 306 of the deforming nozzle 302 to two pneumatic averaging units 331, 332 each of which comprises a laminar resistor 333, 334 in series with an air tank 336, 337. The outlet of the averaging unit 331 is connected with a pipe 338 and by way of such pipe with the first inlets 341, 342 of two integrator units 343, 344. The output of the averaging unit 332 is connected to the first inlets 346, 347 of two Schmitt triggers 348, 349 by way of a pipe 339. The integrator units 343, 344 further comprise second inlets 351, 352 which are connected to a pipe 353 receiving compressed air from the main supply conduit 326 by way of a throttle valve 354. The Schmitt triggers 348, 349 have additional inlets 356, 357 which receive compressed air from the main supply conduit 326 by way of the throttle valve 354 and a pipe 358. The integrator units 343, 344 further comprise third inlets 361, 362 which receive air by way of adjustable throttle valves 363, 364 installed in pipes 366, 367 respectively branching from the pipes 358, 353. The Schmitt triggers 348, 349 also comprise third inlets 368, 369 receiving air from pipes 373, 374 containing adjustable throttle valves 371, 372. The integrator units 343, 344 respectively comprise first outlets 376, 377 which communicate with the atmosphere and second outlets 381, 382 which are respectively connected with cylinders 383, 384. The Schmitt triggers 348, 349 have first outlets 378, 379 which are connected with the atmosphere and second outlets 396, 397 which are connected with cylinders 398, 399. The cylinders 383, 384, 398, 399 respectively accommodate reciprocable pistons 388, 389, 401, 402 which are respectively biased by helicaL springs 391, 392, 403, 404. The pistons 388, 389 can adjust regulating valves 386, 387 by way of flexible diaphragms accommodated in housings 393, 394. The cylinders 398, 399 are amplifier cylinders and their pistons 401, 402 can adjust the position of pistons 411, 412 in control valves 406, 407. These pistons are respectively biased by springs 408, 409. The control valves 406, 407 respectively regulate the flow of air in the conduits 319, 321 which furnish pneumatic signals to the servomotor 317. A common supply conduit 413 furnishes compressed air to the conduits 319, 321 upstream of the valves 406, 407.

The elements 343, 344, 348, 349 are identical with or analogous to the integrator unit 17 of FIG. 3 or to the unit 248 of FIG. 5.

The operation of the rod cigarette machine of FIG. 6 and of the testing apparatus shown in FIG. 7 is as follows:

The motor 305 drives the distributor 303 so that the belt 307 forms a continuous tobacco stream and feeds it into the groove 309 of the suction wheel 308. The stream is advanced past the cutter 316 of the trimming device 311 which removes the surplus and converts the stream into the filler rod 301*a* which is thereupon wrapped on the belt 310 of the mechanism 312 to be converted into the cigarette rod 301. The tape 313 is drawn upwardly onto the belt 310 and is converted into a tubular wrapper which is coated with adhesive and heated to form a strong seam between the overlapping edge portions. The belt 310 advances the rod 301 through the orifice of the deforming nozzle 302.

The nozzle 302 supplies air which deforms successive increments of the filler 301*a* in the cigarette rod 301 and its outlet 306 furnishes pneumatic signals which indicate the firmness of such increments. These signals are transmitted, by way of laminar resistors 333, 334, to the air tanks 336, 337 of the averaging units 331, 332. The purpose of these averaging units is to eliminate high frequency fluctuations of the pneumatic signals. The thus modified signals indicate the average value of firmness of the filler 301*a* and are transmitted by way of pipes 338, 339 to the inlets 341, 342 of the integrator units 343, 344 as well as to the inlets 364, 347 of Schmitt triggers 348, 349. The corresponding desired values of firmness of the filler rod 301*a* are furnished in the form of pneumatic signals by way of inlets 361, 362 and 368, 369, i.e., by way of valves 363, 364 and 371, 372. These valves are properly adjusted so that the pressure of air flowing into the inlets 361, 362, 368, 369 is indicative of desired average firmness of the filler rod 301*a*.

Pressures developing at the outlets 381, 382 of the integrator units 343, 344 are indicative of differences between measured and desired values of firmness of the filler rod 301*a*. The pressure at the outlet 381 is indicative of positive differences and the pressure at the outlet 382 is indicative of negative differences between the measured and desired values of firmness. Such pressures cause appropriate adjustment of pistons 388, 389 in the cylinders 383, 384 and hence a corresponding adjustment of regulating valves 386, 387.

The pressures at the outlets 396, 397 of Schmitt triggers 348, 349 develop when the intensity of signals indicating the measured firmness is different from the intensity of signals indicating the desired standard firmness. In such an instance, the pistons 401, 402 in the cylinders 398, 399 adjust the pistons 411, 412 of control valves 406, 407 against the opposition of springs 408, 409 so that the conduits 319, 321 receive compressed air from the supply conduit 413.

If the deviation of firmness is positive, i.e., if a particular section of the cigarette rod 301 contains a filler whose firmness exceeds the desired firmness (as indicated by the Schmitt trigger 348), the position of the piston 411 in the control valve 406 is changed so that the conduit 319 admits compressed air to the servomotor 317 which adjusts the trimming device 311 in such a way that the latter removes a greater quantity of tobacco from the stream in the groove 309 of the suction wheel 308. The amount of air which is admitted to the servomotor 317 by way of the conduit 319 depends on the setting of the regulating valve 386 which is installed in the conduit 319 downstream of the control valve 406 and is adjusted in accordance with the signal produced by the integrator unit 343. The signal for adjustment of the regulating valve 386 is transmitted by way of the piston 388 in the cylinder 383 and by way of the diaphragm in the housing 393. The adjustment of the regulating valve 386 is proportional to the extent of deviation of the measured firmness from the desired firmness, i.e., to the extent to which the measured firmness exceeds the desired firmness.

If the difference between the measured firmness and the desired firmness is negative, i.e., if the measured firmness is less than the desired firmness, the conduit 319 is sealed in response to closing of the valve control 406 and the control valve 407 connects the conduit 321 with the supply conduit 413 so that the latter can admit to the servomotor 317 air in the amounts determined by setting of the regulating valve 387 which is mounted in the conduit 321 downstream of the control valve 407. It will be noted that the control valves 406, 407 are shutoff valves. The servomotor 317 then adjusts the trimming device 311 in such a way that the cutter 316 removes a lesser amount of shredded tobacco so that the firmness of the filler 301*a* in the cigarette rod 301 increases.

FIGS. 8 and 9 illustrate a modified apparatus which can adjust the trimming or equalizing device 511 (FIG. 8) in a simpler way. Certain parts of this modified apparatus and of the rod cigarette machine which is adjusted by such apparatus are denoted by reference numerals similar to those employed in FIGS. 6—7 plus 200.

The testing or evaluating device 522 of FIG. 9 comprises a single pneumatic averaging unit 531, a single integrator unit 543 and a single cylinder 583. The cylinder 583 is connected with the cylinder 602 of a pneumatic servo unit by way of a pipe 601. The cylinder 602 accommodates a piston 604 which is connected thereto by a diaphragm 606. The latter seals a plenum chamber 607 in the cylinder 602. This cylinder is mounted on a supporting rail 609 (FIG. 8) which guides an electric motor 514 serving to rotate the cutter 516 of the trimming device 511. The motor 514 and the cutter 516 are reciprocable (arrow 518) as a unit by the piston rod (output member) 608 of the piston 604.

The operation is as follows:

The outlet 506 of the nozzle 502 (FIG. 9) sends pneumatic signals which are indicative of firmness of the filler 501*a* in the cigarette rod 501. The latter is moved axially through the central passage of the nozzle 502. The signals are transmitted to the averaging unit 531 which smoothes out high frequency

fluctuations of the continuously transmitting signals and transmits a signal which is indicative of average measured firmness of the filler **501***a* in the rod **501**. Such signal is transmitted to the inlet **541** of the integrator unit **543**. The inlet **561** of this integrator unit is connected with a pipe **523** which transmits pneumatic signals indicating desired firmness of the filler **501***a*. Such signal can be adjusted by the valves **554**, **563**. The outlet **581** of the integrator **543** transmits a pneumatic signal to the cylinder **583** which latter serves as an amplifier and transmits amplified signals (indicating the difference between the measured firmness and desired firmness) by way of the pipe **601** and on to the plenum chamber **607** of the cylinder **602** of the servo unit for the trimming device **511**. The output member **608** of the piston **604** adjusts the motor **514** and the cutter **516** in accordance with the intensity of signals which are amplified by the cylinder **583**.

If the difference between the measured and desired signals is positive, the pressure in the chamber **607** of the cylinder **602** rises and the output member **608** moves the motor **514** downwardly, as viewed in FIG. **8**, so that the cutter **516** removes more tobacco and reduces the firmness of the filler **501***a*. If the difference between the measured and desired values of firmness of the filler **501***a* is negative, i.e., if the desired firmness exceeds the measured firmness, the piston **588** moves upwardly, as viewed in FIG. **9**, and the pressure in the chamber **607** of the cylinder **602** decreases so that the spring **603** expands and the piston rod **608** moves the motor **514** and the cutter **516** upwardly to reduce the amount of tobacco which is removed from the stream in the groove **509** of the suction wheel **508**.

It is clear that the firmness of the filler rod can be regulated in a number of different ways without departing from the spirit of the present invention. For example, signals produced by the testing apparatus can be employed to adjust the distributor **303** of FIG. **6** so that the latter changes the rate of discharge of tobacco shreds **304** as a function of difference between the measured firmness and desired firmness of the filler rod. An apparatus which can adjust the distributor is disclosed, for example, in British Pat. No. 933,691. The device which adjusts the distributor in the rod cigarette machine of this British patent can be readily designed to effect adjustments of the distributor in dependency on the magnitude and direction (positive or negative) of signals which are furnished by a pneumatic testing apparatus of the type shown in FIG. **7** or **9**.

The just described modification is illustrated schematically in FIG. **6** wherein the variable-speed DC motor **305** of the distributor **303** is controlled by a servo unit **701** which is connected with the nozzle **302** by a pipe **702**. The servo unit **701** comprises a suitable transducer which converts pneumatic signals furnished by the pipe **702** and indicating the measured firmness of the filler **301***a* into DC voltage signals which are used to regulate the speed of the motor **305**. When the firmness determined by the nozzle **302** is less than the desired firmness, the servo unit **701** adjusts the speed of the motor **305** in a sense to reduce the output of the distributor **305** and to furnish less tobacco into the groove **309** of the suction wheel **308**. Inversely, and when the firmness of the filler **301***a* is less than the desired optimum firmness, the servo unit **701** adjusts the motor **305** in a sense to increase the output of the distributor **303** and to insure that the firmness of the rod **301***a* increases. Transducers which can convert pneumatic signals into electric signals are well known in the art; therefore, the details of the servo unit **701** are not shown in FIG. **6**. In addition to the transducer, the servo unit **701** may comprises a circuit which can compare signals furnished by the transducer with signals which indicate the desired firmness of the filler rod **301***a* and which produces signals to adjust the speed of the motor **305** when the signals furnished by the transducer are stronger or weaker than the signals indicating the desired firmness.

The improved testing apparatus exhibits a number of important advantages. Thus, the apparatus can be used for determining the firmness of fillers in discrete rod-shaped articles (such as plain or filter cigarettes, cigars, cigarillos or the like) as well as for testing the firmness of the filler in a continuous cigarette rod or other wrapped tobacco rod or filter rod. In other words, the apparatus can test the firmness of the filler upstream or downstream of the customary cutoff in a rod cigarette machine, depending upon whether the apparatus should determine the firmness of a continuous filler or the firmness of sections of a subdivided filler. The measurements carried out by our testing apparatus do not affect the quality, appearance and/or other characteristics of tested goods, and the signals furnished by the testing apparatus are produced with no appreciable delay so that, when necessary, the firmness of a filler can be adjusted immediately upon detection of excessive or insufficient firmness. Depending on the nature of remedial action (adjustment of the trimming device and/or adjustment of the distributor), the testing apparatus can furnish signals which indicate measured firmness which exceeds or is less than the desired maximum or minimum firmness or an average firmness which either exceeds or is less than the desired average firmness. As explained in connection with FIG. **7**, pneumatic signals can be amplified and otherwise treated to bring about appropriate adjustment of the producing machine without necessitating conversion of such signals into electrical, mechanical or other types of signals.

A further important advantage of the improved testing apparatus is that it can be combined with and can regulate a continuous rod cigarette machine or a like machine which forms and/or wraps a filler rod. The testing apparatus can adjust the machine in a fully automatic way, with a minimum of delay and with a high degree of accuracy so that the machine can furnish a cigarette rod wherein the firmness of the filler is within desired limits and that the "feel" of cigarettes or other smoker's articles obtained in response to subdivision of the wrapped tobacco rod is always satisfactory to the smokers. As stated before, signals produced by our testing apparatus can be used to adjust a producing machine without necessitating conversion into electrical or other types of signals even though such conversion might be desirable in certain instances, for example, when the distributor is driven by an electric motor.

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 our contribution to the art.

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

1. A method of determining the firmness of a mass of tobacco, particularly of determining the firmness of rodlike tobacco fillers which are confined in tubular wrappers, comprising the first step of directing a gas against the mass of tobacco from a location disposed at a predetermined fixed distance from the axis of the wrap and thereby subjecting the mass to a deformation whose extent is inversely proportional to the firmness of the mass; and the second step of measuring the extent of such deformation at a measuring station, including effecting a relative movement between said station and the mass of tobacco and producing pneumatic signals whose magnitude is indicative of deformation of the mass.

2. A method as defined in claim 1, wherein said gas is air which is directed against the mass at a pressure less than required to effect permanent deformation of said mass.

3. A method as defined in claim 1, wherein said second step further comprises determining the changes of that characteristic of the gas which is variable as a function of the resistance offered by said mass to deformation by such gas.

4. A method as defined in claim 1, wherein said gas is a stream of air which is caused to flow against said mass.

5. A method as defined in claim 1, wherein said mass is a rodlike filler and wherein the gas is directed against a circumferentially complete portion of the external surface of the filler.

6. A method as defined in claim 5, wherein the gas is a stream of air which is caused to flow substantially radially against the filler and is deflected by the filler substantially radially outwardly, said second step further comprising determining the characteristics of the thus deflected air stream.

7. A method as defined in claim 1, wherein said mass is a wrapped rodlike tobacco filler and wherein said first step comprises directing an air stream against successive increments of the filler.

8. A method as defined in claim 7, wherein the filler forms part of a continuous wrapped tobacco-containing rod.

9. A method as defined in claim 7, wherein the filler forms part of a wrapped tobacco-containing rod of finite length.

10. A method of determining the firmness of a wrapped rodlike tobacco filler, comprising the steps of directing an air stream against successive increments of the filler and thereby subjecting the filler to a deformation whose extent is inversely proportional to the firmness of the filler; measuring the extent of such deformation including producing—in response to impingement of said air stream against successive increments of the filler—first pneumatic signals whose pressure is indicative of the firmness of successive increments; storing said first signals; and producing a second signal representing the average pressure of the thus stored first signals and the average firmness of the filler.

11. A method as defined in claim 10, further comprising the step of producing an additional pneumatic signal as a function of said second signal.

12. A method as defined in claim 11, wherein said additional signal is an air stream.

13. A method as defined in claim 10, further comprising the steps of producing—in response to impingement of a second air stream against successive increments of the filler—third pneumatic signals whose pressure is indicative of the firmness of the respective increments, comparing said third signals with said second signal, and producing fourth signals indicating the differences between said second signal and said third signals.

14. A method as defined in claim 13, wherein the filler is of finite length and is moved lengthwise in a first direction during generation of said first signals and in the opposite direction during generation of said third signals.

15. A method as defined in claim 10, further comprising the steps of producing—in response to impingement of a second air stream against successive increments of the filler—third pneumatic signals whose pressure is indicative of the firmness of the respective increments, producing a fourth signal indicating a range of optimum values of the firmness of said increments, comparing said third signals with said second signal and with said fourth signals, and producing additional signals indicating the extent of deviation between said third signals and said range of optimum values.

16. A method as defined in claim 10, further comprising the steps of comparing said second signal with said first signals and producing third signals whose pressure is indicative of the differences between said second signal and said third signals.

17. A method as defined in claim 16, further comprising the step of amplifying said third signals, storing the thus amplified third signals, producing a fourth signal representing the average value of the thus stored amplified third signal, and indicating the value of the fourth signal.

18. Apparatus for determining the firmness of a mass of tobacco, particularly for determining the firmness of a rodlike filler which is confined in a tubular wrapper, comprising deforming means for directing against the filler a gas to thus subject the filler to a deformation whose extent is inversely proportional to the firmness of the filler; means for effecting relative movement between said deforming means and the filler so that the gas directed by said deforming means impinges again successive increments of the filler; and evaluating means for measuring the extent of deformation of the filler, including means for determining the extent of deformation of the filler, including means for determining the extent of deformation of said increments and averaging means for determining the average deformation of a plurality of said increments.

19. Apparatus as defined in claim 18, wherein said averaging means comprises means for producing output signals indicative of said average deformation and wherein said evaluating means further comprises adjustable setting means operatively connected with said averaging means and arranged to assume a condition of adjustment which is a function of the intensity of said output signals.

20. Apparatus as defined in claim 18, wherein the means for determining the extent of deformation of said increments comprises means for producing first signals indicating the extent of deformation of such increments and wherein said averaging means comprises means for producing a second signal indicating the average deformation of a plurality of increments, and further comprising integrator means for comparing each of said first signals with said second signal and for producing third signals indicating the extent of deviation of the firmness of corresponding increments from the average firmness represented by said second signal.

21. Apparatus ad defined in claim 20, further comprising means for amplifying said third signals, means for integrating the thus amplified third signals, and reducing means for indicating the magnitude of said integrated third signals.

22. Apparatus as defined in claim 18, wherein the filler is of finite length.

23. Apparatus as defined in claim 22, wherein the means for determining the extent of deformation of successive increments of the filler comprises means for producing first pneumatic signals indicative of the firmness of the respective increments and wherein said averaging means comprises means for producing a second signal indicative of the average firmness of the filler, said evaluating means further comprising integrator means for comparing said second signal with said first signals and for producing third signals indicating the differences between average firmness of the filler and the firmness of successive increments of the filler.

24. Apparatus as defined in claim 23, wherein said integrator means comprises a first integrator for producing third signals which indicate positive differences between said first signals and said second signal and a second integrator for producing third signals which indicate the negative differences between said second signal and said first signals.

25. Apparatus for determining the firmness of a mass of tobacco, particularly for determining the firmness of a rodlike filler which is confined in a tubular wrapper, comprising deforming means for directing against the filler a gas from a location disposed at a predetermined fixed distance from the axis of the filler to thus subject the filler to a deformation whose extent is inversely proportional to the firmness of the filler; and evaluating means for measuring the extent of deformation of the filler, said evaluating means including means for producing pneumatic signals whose magnitude is indicative of deformation of the filler while the filler moves with reference to the evaluating means or vice versa.

26. Apparatus as defined in claim 25, wherein said deforming means comprises a nozzle having gas-admitting inlet means and an annular gas discharge opening surrounding the filler.

27. Apparatus as defined in claim 26, wherein said evaluating means includes a portion of said nozzle, said portion having an annular inlet adjacent to said opening and arranged to admit the gas leaving said opening at a rate which is a function of the extent of deformation of the filler by such gas.

28. A method of determining the firmness of a wrapped rodlike tobacco filler, comprising the steps of directing an air stream against successive increments of the filler and thereby subjecting the filler to a deformation whose extent is inversely proportional to the firmness of the filler; measuring the extent of such deformation; and determining the average deformation of a plurality of increments of the filler.