

Sept. 13, 1960

F. POCOCK ET AL
MANUFACTURE OF CIGARETTES

2,952,262

Filed Jan. 20, 1958

8 Sheets-Sheet 1

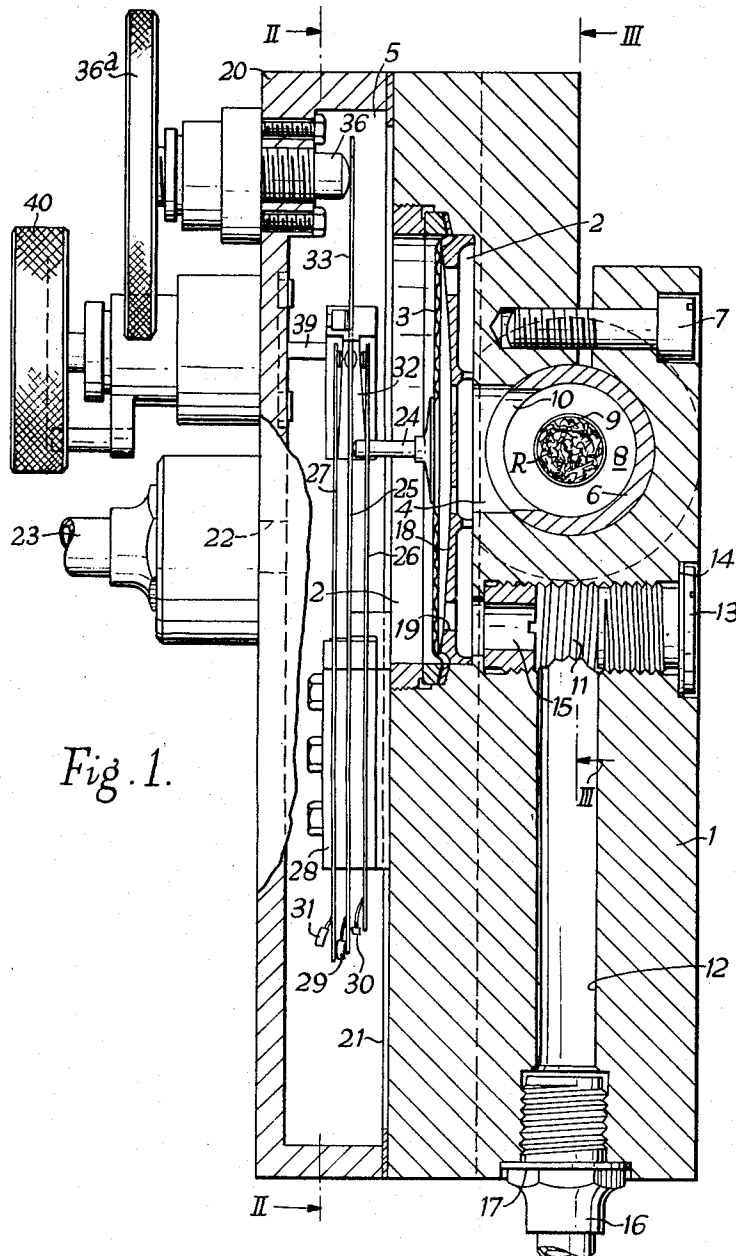


Fig. 1.

INVENTOR
Frederick Pocock & Cyril Best
BY
Nelson, Cole, Shindle & Watson
ATTORNEYS

Sept. 13, 1960

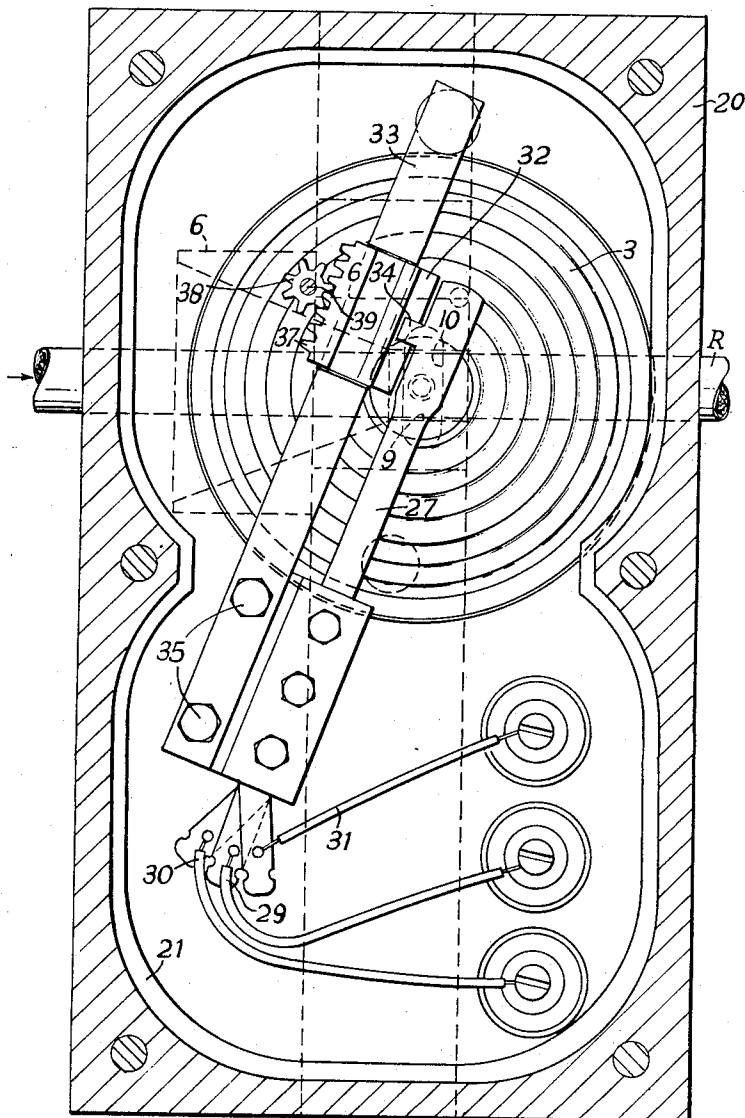
F. POCOCK ET AL
MANUFACTURE OF CIGARETTES

2,952,262

Filed Jan. 20, 1958

8 Sheets-Sheet 2

Fig. 2.



INVENTOR

Frederick Pocock - Cyril Best

BY

Nelson, C. L., Shindler, Watson

ATTORNEYS

Sept. 13, 1960

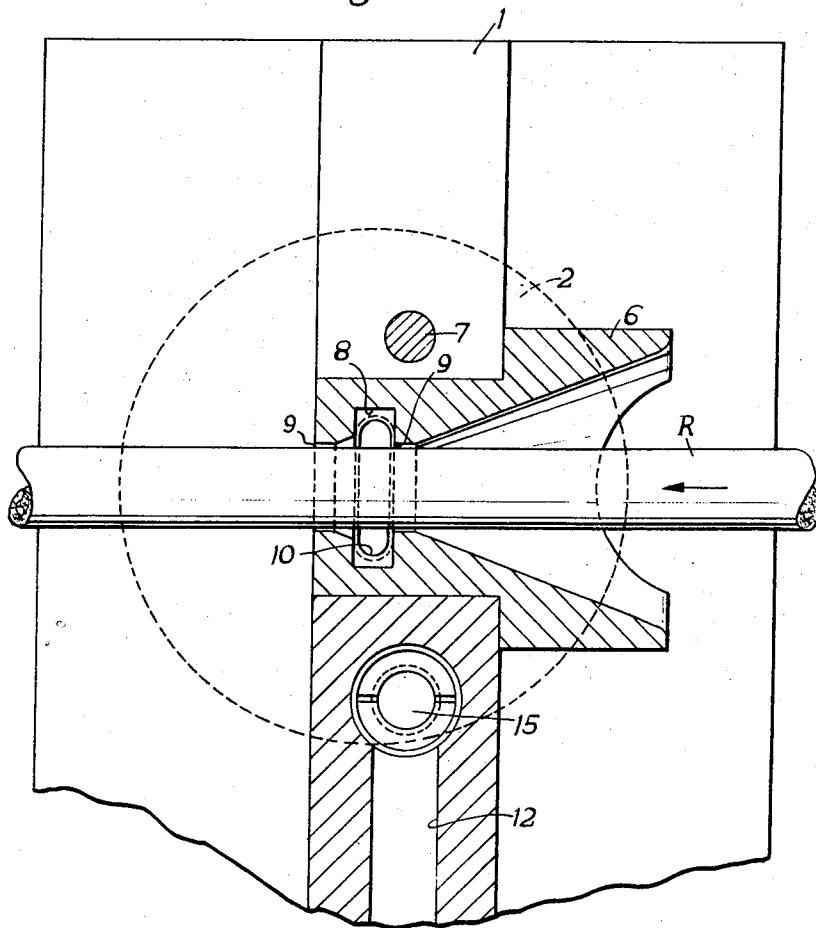
F. POCOCK ET AL
MANUFACTURE OF CIGARETTES

2,952,262

Filed Jan. 20, 1958

8 Sheets-Sheet 3

Fig. 3.



INVENTOR
Frederick Pocock & Cyril Lee
BY
Watson, Cole, Gendler & Watson
ATTORNEYS

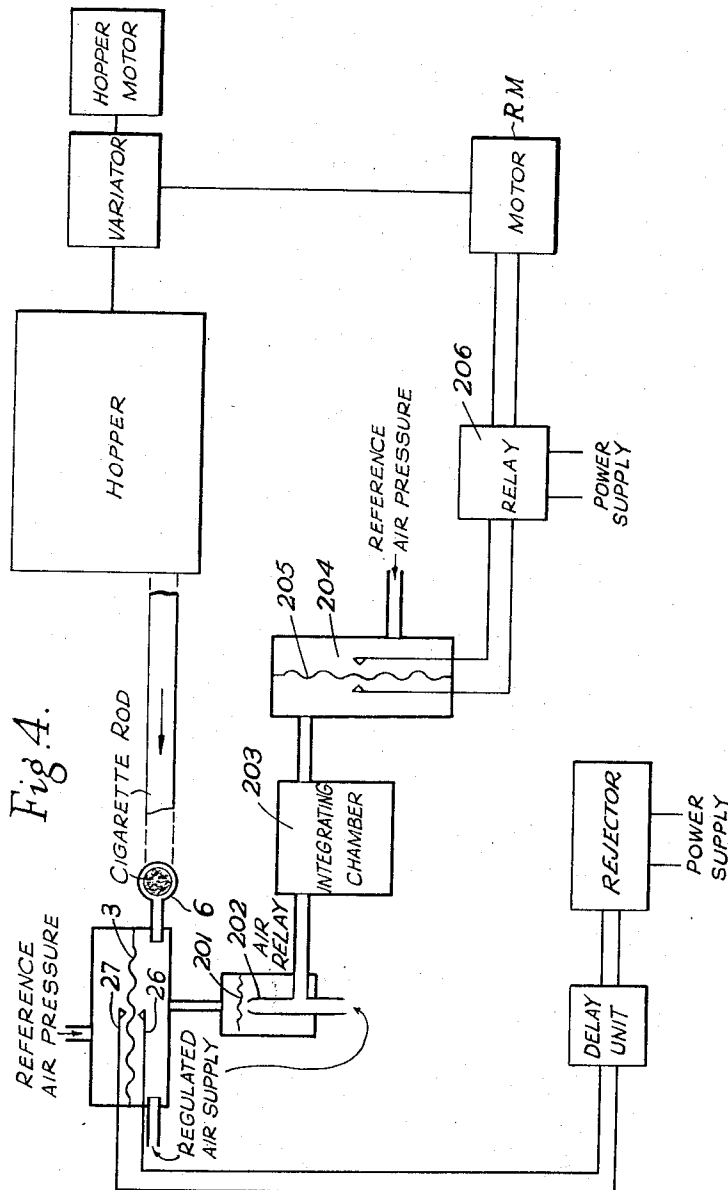
Sept. 13, 1960

F. POCOCK ET AL
MANUFACTURE OF CIGARETTES

2,952,262

Filed Jan. 20, 1958

8 Sheets-Sheet 4



INVENTOR
Fredrick Pocock & Cyril West
BY
Walter, Lake, Grandle & Watson
ATTORNEYS

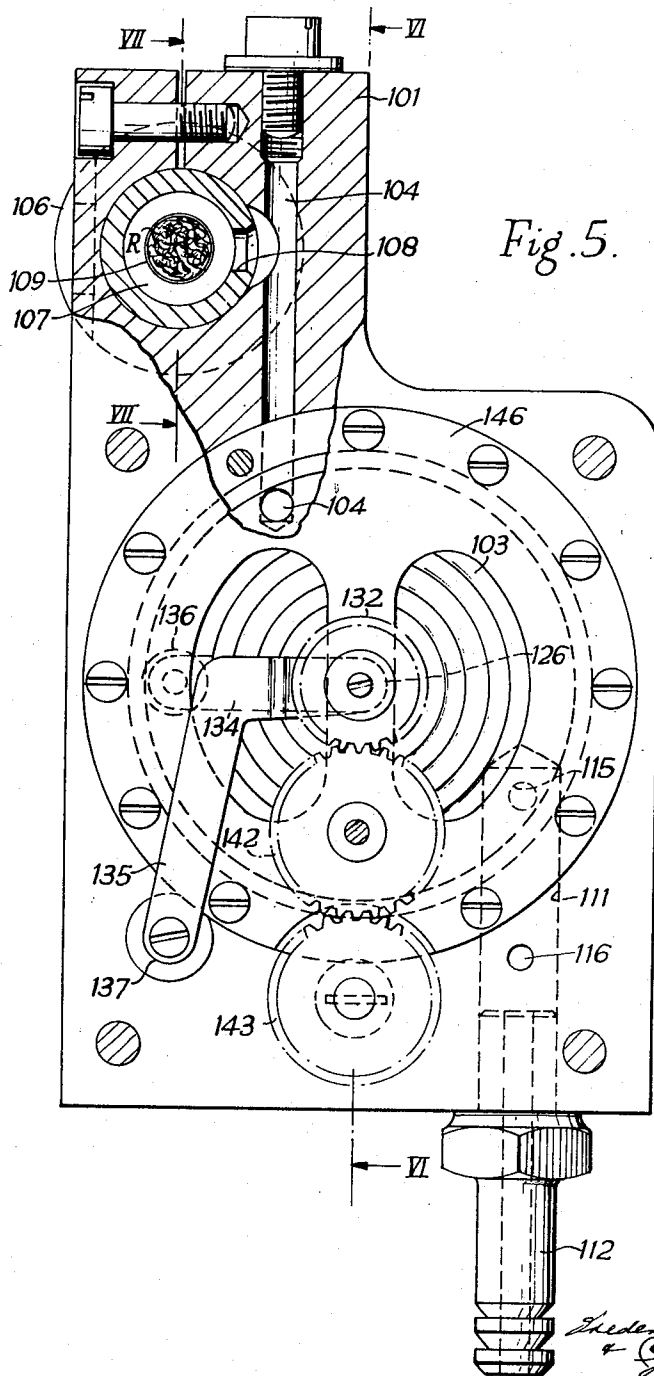
Sept. 13, 1960

F. POCKOCK ET AL
MANUFACTURE OF CIGARETTES

2,952,262

Filed Jan. 20, 1958

8 Sheets-Sheet 5



INVENTOR
*Frederick Pockock
& Cyril Best*
BY
*Nelson, Cole, Shumille, &
Hanson*
ATTORNEYS

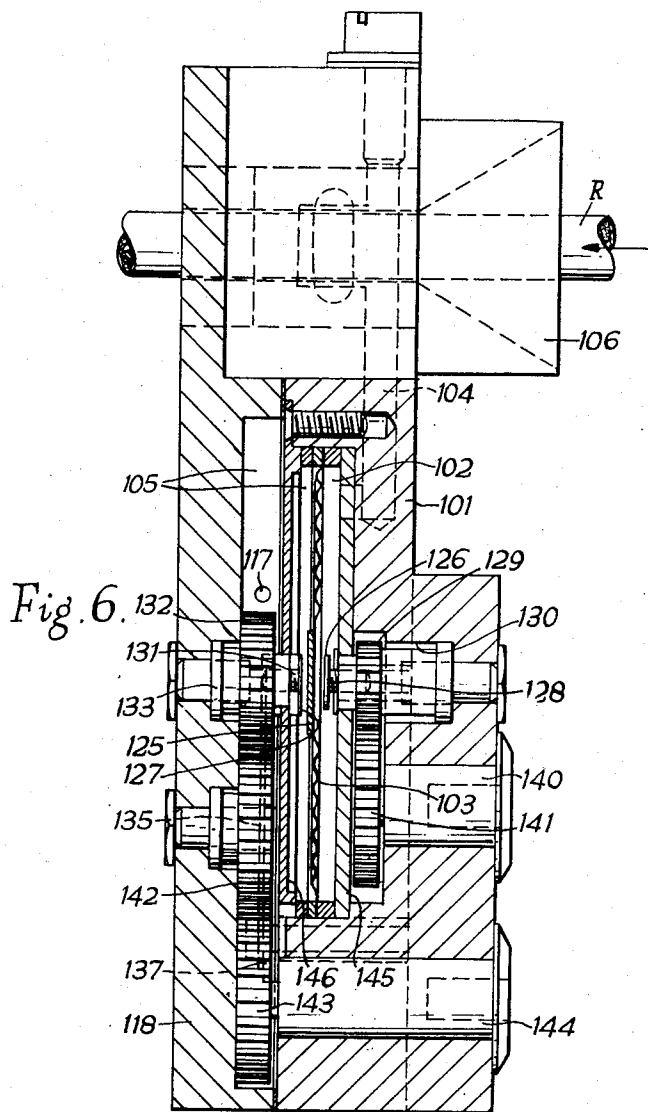
Sept. 13, 1960

F. POCOCK ET AL
MANUFACTURE OF CIGARETTES

2,952,262

Filed Jan. 20, 1958

8 Sheets-Sheet 6



INVENTOR

Frederick Pocock & Cyril Best.

BY

Watson, Cole, Hamble & Watson
ATTORNEYS

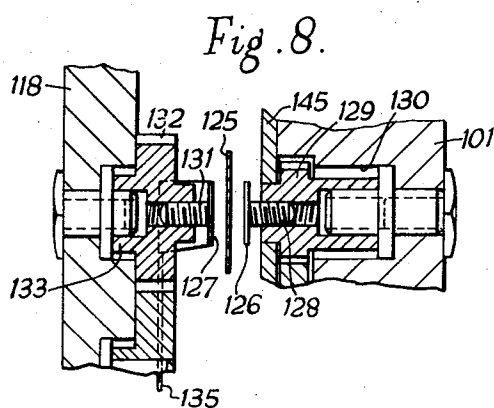
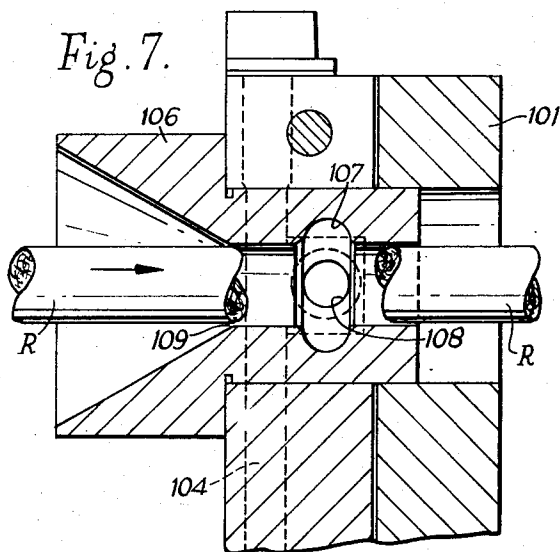
Sept. 13, 1960

F. POCKOCK ET AL
MANUFACTURE OF CIGARETTES

2,952,262

Filed Jan. 20, 1958

8 Sheets-Sheet 7



INVENTOR

Frederick Pockock et al

BY

Watson, Cole, Chandler & Watson

ATTORNEYS

Sept. 13, 1960

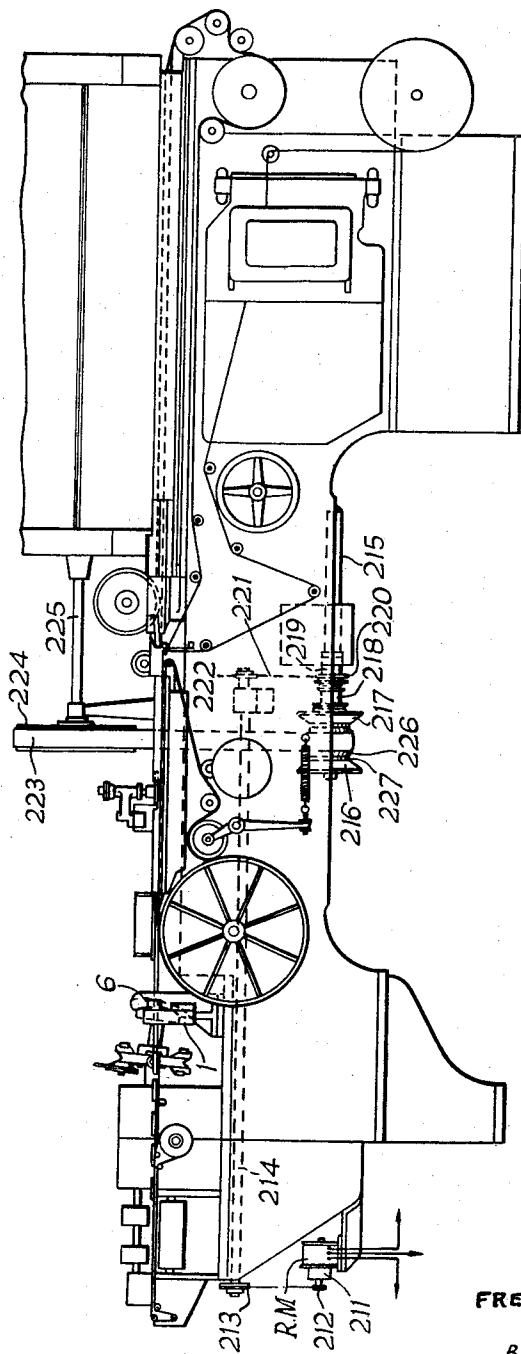
F. POCOCK ET AL
MANUFACTURE OF CIGARETTES

2,952,262

Filed Jan. 20, 1958

8 Sheets-Sheet 8

Fig. 9.



INVENTORS
FREDERICK POCOCK
CYRIL BEST
BY
Watson, Cole,
Grindle & Watson
ATTORNEYS

1

2,952,262

MANUFACTURE OF CIGARETTES

Frederick Pocock and Cyril Best, Deptford, London, England, assignors to Molins Machine Company Limited, London, England, a company of Great Britain

Filed Jan. 20, 1958, Ser. No. 710,032

Claims priority, application Great Britain Jan. 30, 1957

14 Claims. (Cl. 131—21)

This invention concerns improvements in or relating to the manufacture of cigarettes, and in particular, methods of testing a length of cigarette rod (e.g. testing a continuous rod).

In the manufacture of cigarettes on machines of the continuous rod type, there is a tendency for the cigarette rod to contain varying quantities of tobacco at different points along its length, due to irregularities in the tobacco filler from which the rod is formed. Various methods have been proposed for detecting such variations. According to one such method, batches of newly made cigarettes were collected and weighed. Another method involves subjecting the rod, or the upwrapped filler, to penetrative radiation (e.g. beta radiation) in order to measure the mass of the tobacco passing. In either of these two methods, it has been proposed to utilise the results of the testing operations to correct or alter the formation of the cigarette rod, for example by adjusting the rate of feed of tobacco from which the rod is formed. Where the rod is tested or measured by penetrative radiation, it has also been proposed to make use of the testing operation to actuate means to eject unsatisfactory cigarettes from the product of the machine. Another proposal (which as far as the present applicants are aware has never been satisfactorily put into practice) was to employ a mechanical feeling device having a part or parts in contact with the moving rod in an attempt to detect in this way irregularities in the filling of the rod.

It has been found that in the manufacture of cigarettes on at least some types of continuous rod machines, the cross-sectional size of the wrapped cigarette rod tends to vary minutely along its length, and it appears that these variations are caused, at least in part, by variations in the quantity of tobacco in the rod. The explanation of this phenomenon may be that the tobacco filler, having been compressed laterally before the cigarette-paper web is wrapped around it, expands, if permitted to do so, to a greater or less extent according to the density to which it has been compressed, and to the nature and condition of the tobacco, and the filler is able to enlarge the paper tube which has been formed around it, during the short period in which the adhesive which holds the overlapping marginal areas of the paper together is still moist enough (before being fully dried) to permit those overlapping parts to slip relatively to each other. Assuming that the adhesive is applied fairly uniformly to the paper, it is believed (assuming tobacco of a given condition), that the extent of enlargement of the paper tube by the expanding tobacco is to a great extent determined by the quantity of tobacco within the paper. Thus although other factors may have some effect, it would appear that the cross-sectional size of any part of the final rod can in general be taken to give some close indication of the quantity of tobacco contained in that part, although variations in cross-sectional size may not be in exact proportion to variations in quantity of tobacco. In any case, any enlargement of the cross-sectional size of the rod,

2

such as discussed above, appears to be due to the pressure exerted by the tobacco on the paper tube which encloses it. It is this pressure of the tobacco in a cigarette which determines the "feel" or degree of firmness or compactness of the cigarette as judged by touch. Thus whether the pressure of the tobacco in any part of the rod is determined entirely by the quantity of tobacco present (i.e. the weight per unit length), or whether it is also influenced by other factors such as the length of the tobacco shreds, coarseness of cut, proportion of birdseye, springiness of tobacco, or moisture content, it seems that the cross-sectional size of such part of the rod does give a close indication of the compactness of the tobacco in that part at the moment when it was compressed to the desired size. It can therefore be said that variations in the cross-sectional size of the rod from a desired standard can be taken as indicating variations from a desired standard in the quantity of tobacco (of a given condition) required to produce a standard-sized rod possessing the desired degree of firmness or compactness.

It has been proposed to measure the diameter of wire by allowing air to flow through an aperture which is partially blocked by the wire, in such a way that the rate at which the air flows past the wire is determined by the cross-sectional size of the wire.

The present invention provides a method of testing a length of cigarette rod (e.g. a continuous cigarette rod) by causing a gas (e.g. air) to flow past the said length at a rate determined by the cross-sectional size of the said rod, the pressure of gas used being such as to be not greater than the desired minimum pressure of tobacco within the cigarette paper wrapper.

In the manufacture of cigarettes on a continuous cigarette rod making machine, it is customary to apply a certain amount of compression to the tobacco particles before the paper wrapper is secured around the tobacco filler. The tobacco rod so formed is delicate and easily deformed or spoiled, and therefore if any mechanical or physical measurement of the rod is to be made it must be effected by means which do not damage the rod in such a way as to make the product unsaleable. It has been found that the cigarette rod, though delicate, is so formed that the tobacco inside the paper has a degree of compression equal to about three to five pounds per square inch. Such a pressure exerted by the tobacco against the paper wrapper is greater than one would imagine would be the case in such a delicate article, and it is this fact which makes it possible to subject the rod to an external gas pressure high enough to enable an accurate assessment of minute localised variations in the cigarette rod to be made, without causing any noticeable deleterious or harmful effect on the product of the machine. It will be appreciated that there are, on very rare occasions, portions along the length of a rod in which the tobacco pressure is negligible, or far less than the average of three to five pounds per square inch, and such portions of cigarette rod would be of course be considered unsatisfactory in the trade. Thus, even though damage might be caused by the external gas pressure on such a portion of rod, such damage does not have any harmful effect because it is confined to part of the rod which is, in any event, an unsaleable product, and in fact, the susceptibility of such low-pressure portions of the rod to damage or deformation by external gas pressure makes their detection more definite.

The gas may be introduced under pressure into a confined space from which it can escape through an orifice only by flowing past the rod, which passes through the orifice so as partially to block it. In the case where a continuous rod is being tested, the rod may be passed continuously endwise through a chamber into which the

gas is introduced under pressure and from which the gas escapes through two orifices through which the rod enters and leaves the chamber respectively. In such a case, variations in the cross-section of the rod cause variations in the pressure of the gas in the chamber, and these variations of pressure may be utilised, in a continuous rod cigarette-making machine, to cause actuation of control means whereby cigarettes containing lengths or portions of a cigarette rod, which lengths are shown by the said variations to be unsatisfactory, to be segregated from others, or whereby the formation of the cigarette rod can be corrected or altered, for example by altering the rate of the feed of tobacco. Actuation of such control means may be effected by a pressure-sensitive device such as a flexible diaphragm in contact with the gas in the chamber.

Still further according to the invention there is provided in a continuous rod cigarette-making machine, a device for testing the cross-sectional size of the cigarette rod, comprising a chamber through which the rod can be passed, and means to supply to the interior of said chamber a gas (e.g. air) under a pressure not greater than the desired minimum pressure of the tobacco within the cigarette wrapper, said chamber having an orifice adapted to be partially blocked by the rod (e.g. an orifice through which the rod can pass lengthwise), and through which the gas can escape from the chamber, by flowing past the rod, at a rate determined by the cross-sectional size of the rod, whereby variations in the cross-sectional size of the rod can be detected.

It has further been found that for given conditions of tobacco it is possible, by using a device such as that mentioned above, to obtain from the varying pressure readings a direct translation into readings of mass or weight per unit length, and that although the pressure in the device is determined by the cross-sectional size of the rod, where measurements of mass are desired one can calibrate the gauge readings direct to mass instead of to size of the rod as such. On the other hand, where it is desired to control by size, then the pressure readings can be translated directly into size quantities. There will be variations in the general results but, nevertheless, they are a sufficiently close approximation to be suitable for practical conditions. Where therefore the statement is made herein that variations in the cross-sectional size of the rod can be detected, it is to be appreciated that these words are to be taken as referring to any of the measurements into which pressure readings can be translated as mentioned above. It is clear that it is, in fact, the cross-sectional area of the rod which, by determining the quantity of air which can escape at any given time, determines the pressure that is exerted at such given time in the device, and therefore the expression "variations in the cross-sectional size of the rod can be detected" is merely one way of expressing the fact that various different kinds of readings can be made from a suitably calibrated gauge.

The device may include detector-means responsive to variations in the pressure of the gas within the chamber. For example it may include a pressure-sensitive device, such as a flexible diaphragm, in contact with the said gas in the chamber and adapted to move in response to variations in the pressure of the said gas in the chamber. There may further be provided control means adapted to be actuated by the detector means (for example as a result of movement of the said diaphragm) in such a way as to exercise control over the production or selection of cigarettes. For example the control means may be adapted to segregate unsatisfactory cigarettes from others, or may be adapted to correct or alter the formation of the cigarette rod being tested (e.g. by altering the rate of feed of tobacco from which the rod is formed).

Still further according to the invention there is provided a testing device for testing a length (e.g. a continuous length) of cigarette rod, comprising a chamber having an inlet to admit a gas (e.g. air) under pressure, an orifice through which the gas can escape, said orifice

being of a suitable size and shape to allow the cigarette rod to be passed through it so as partially to block the orifice and thus regulate the escape of the gas, and a pressure-sensitive device capable of movement in response to changes in the pressure of the gas in the chamber. The pressure-sensitive device may comprise a flexible diaphragm one side of which is exposed to the gas in the chamber. Means may be provided to press against the other side of the diaphragm. For example there may be provided a pressure compartment which is separated from the said chamber by the said diaphragm, the said pressure compartment being so arranged that it can contain a gas at a desired pressure, whereby the pressure on the diaphragm, of the gas in the chamber can be balanced when the gas in the chamber is at a predetermined pressure.

The said pressure compartment and the chamber may both be arranged to receive gas under pressure from a common supply, whereby fluctuations in the supply of gas affect both sides of the diaphragm substantially equally.

The testing device may comprise an element movable in response to movement of the diaphragm (e.g. movable with the diaphragm) so as to affect (e.g. to close) an electric circuit whereby control means are actuated for the purpose of rejecting an unsatisfactory cigarette or of altering the rate of feed of tobacco for forming the cigarette rod. For example the said element may be movable so as to engage one or other of a plurality of contact members so as to close a circuit.

The testing device may further comprise a tubular passage through which a cigarette rod can pass, the said chamber being in communication with the said passage. Preferably the tubular passage is flared at one end to provide a lead for the cigarette rod at its enters the passage.

Machines for making mouthpiece cigarettes are known which comprise means to make a continuous cigarette rod, means to sever the rod into lengths, and means to assemble such cut lengths of cigarette rod with mouthpieces or stubs. In some such machines, the cigarette rod lengths and mouthpieces are united whilst moving axially, and on other machines whilst they are moving laterally. All such machines are referred to herein as "machines of the type described."

It is desirable that the cigarette rod lengths should have as far as practicable the same cross-sectional size as that of the stubs or other mouthpiece portions to which they are to be united. If stubs or other mouthpiece portions of standard cross-sectional size are being used on a machine of the type described, any variations in the size of the rod made on the machine may result in sufficient differences in size between the parts to be united to affect adversely the quality of the mouthpiece cigarettes produced.

Further according to the invention there is provided a machine of the type described, comprising a chamber through which the cigarette rod can be passed, and means to supply to the interior of said chamber a gas (e.g. air) under a pressure not greater than the desired minimum pressure of the tobacco within the cigarette paper wrapper, said chamber having an orifice adapted to be partially blocked by the rod (e.g. an orifice through which the rod can pass lengthwise), and through which the gas can escape from the chamber, by flowing past the rod, at a rate determined by the cross-sectional size of the rod, whereby variations in the cross-sectional size of the rod can be detected, and means operable automatically during operation of the machine to effect reduction in variation of the cross-sectional size of the cigarette rod, e.g. by regulating the quantity of tobacco fed.

Apparatus according to the invention will now be described by way of example with reference to the

Figure 1 is a sectional end view of a testing device;

Figure 2 is a section taken on the line II—II, Figure 1;

Figure 3 is a section taken on the line III—III, Figure

5

Figure 4 is a diagram illustrating one way in which the testing device can be employed on a continuous rod cigarette-making machine.

Figure 5 is an end view, partly in section, of an alternative construction of the testing device;

Figure 6 is a section taken on the line VI—VI, Figure 5;

Figure 7 is a section taken on the line VII—VII, Figure 5;

Figure 8 is a fragmentary sectional view of part of Figure 6, and

Figure 9 is a front elevation of a continuous rod cigarette-making machine showing arrangements for varying the feed of tobacco.

Referring first to Figures 1, 2 and 3, the testing device comprises a block 1 which is provided with a wide circular recess 2 which accommodates a flexible diaphragm 3. At one side of the diaphragm the recess 2 communicates with a narrower recess 4, and on the other side of the diaphragm, with a pressure compartment 5. The diaphragm 3 is securely clamped in position so as to form an airtight division between the two parts of the recess 2.

The block 1 is also recessed to receive a cylindrical cigarette-rod guide 6 (best seen in Figure 3) which is clamped in position by a screw 7. The guide 6 has a hole extending through it, the hole being flared or funnel-shaped at one end, see Figures 2 and 3, and having a widened portion 8 (formed as an internal groove in the guide 6) which communicates, through a slot 10 in the guide, with the recess 4. The groove 8 and slot 10, with the recess 4, and with that part of the recess 2 which is to the right of the diaphragm as viewed in Figure 1, together constitute a chamber, and will when convenient be collectively referred to hereinafter as a chamber.

For a short distance in each direction from the groove 8, the hole extending through the guide 6 is cylindrical, providing a cylindrical passage 9 which is of suitable diameter to permit a cigarette rod of desired diameter to pass through it axially with a clearance of about 0.3 mm. It will be seen that as the passage 9 is in communication with the chamber mentioned above, the open ends of the passage constitute orifices to the chamber, which orifices are partially blocked by a cigarette rod extending through the passage 9.

The block 1 is also provided with a threaded hole 11 which communicates with the recess 2 and thus with the chamber, and a further hole 12 extends from one face of the block to communicate with the hole 11. The open end of the hole 11 is sealed by a screw 13 and washer 14. A threaded hollow insert piece 15 is threaded into the hole 11 to provide a narrow inlet passage for air passing for from the hole 12 to the chamber. An air pipe 16 is screwed into the hole 12, an airtight connection being made by a washer 17. The pipe 16 is connected to any suitable device (not shown in Figures 1 and 2) for supplying dry air under regulated and constant pressure, and it will thus be seen that air under pressure can be supplied by way of the holes 12 and 11 to the chamber, from which it flows through the orifices at the open ends of the passage 9 in the rod guide 6. It will also be seen that if a cigarette rod or length of rod such as R is in position as shown, the air will flow past the rod (which partially blocks these orifices) at a rate which is determined by the gap between the rod and the passage 9. (This gap is for clearness shown somewhat exaggerated in Figure 3). The extent of this gap will depend on the cross-sectional size of the rod, which thus determines the rate at which air can escape from the chamber, and therefore determines the air pressure within the chamber at any moment, if air is supplied to the chamber at a suitable constant pressure and the inlet 15 is of suitable size. The inlet 15 must be smaller in diameter than any constriction in the supply air line, since the measurement to be made is, in effect, a comparison between the resistance to the air flow offered by this inlet, and that offered by

6

the escape area around the cigarette rod. Further, the slot 10 in the guide 6 should be bigger than the largest gap which is likely to occur between the rod and the passage 9.

A circular platelike support member 18 is arranged in the recess 2, at the right-hand side of the diaphragm as viewed in Figure 1, for the purpose of supporting the diaphragm against undue movement in the direction of the chamber. The member 18 is perforated by openings such as 19, and as seen in Figure 1, its side adjacent the diaphragm is concave.

The pressure compartment 5 is enclosed by a casing 20 which is secured to the block 1, a gasket 21 being provided to make an airtight joint. The casing 20 has an aperture 22 through which air can be admitted into the pressure compartment by way of a pipe 23, which is adapted to be connected to any suitable device (not shown) for supplying air under pressure. A suitable valve device is provided to prevent air which has been supplied under pressure to the pressure compartment from escaping through the aperture 22.

The diaphragm 3 has fixed thereto a stem 24 which extends into the pressure chamber and is connected to a flexible contact element 25, Figure 1. Two further flexible contact elements 26 and 27 are disposed one on either side of the element 25, and the three elements are mounted in an insulated block 28 and have fixed to their lower ends wires 29, 30 and 31 respectively. These wires are connected to an electrical device to be referred to later. The arrangement is such that if the element 25 engages either the element 26 or the element 27, a circuit is closed in the electric device.

The spacing of the elements 26 and 27 from the central element 25 can be adjusted by means of a block 32 slidably mounted on a thin flexible blade 33. The block 32 is tapered as shown in Figure 1, and the elements 26 and 27 are provided with projections 34, see Figure 2, which engage the sloping outer faces of the block 32. The elements 26 and 27 are biased towards each other to urge the projections 34 against the block 32. The lower end of the blade 33 is fixed to the block 1 by screws 35, Figure 2, and its free upper end is engaged by an adjusting screw 36, Figure 1, by means of which it can be caused to move sideways so as to adjust the spacing between the central element 25 and the elements 26 and 27 respectively, by moving the block 32 bodily sideways. To permit this movement in either direction, the blade 33 is biased towards the screw 36 so as to bear against it. The screw 36 passes through the casing and can be turned by a knob 36a.

The block 32 is provided with a rack 37 which is engaged by a small gear wheel 38 fixed on a shaft 39, which passes through the casing 20 and is turned by means of a knob 40. By this means the block 32 can be moved up and down the blade so that its outer sloping faces can cause the elements 26 and 27 to be moved towards or away from each other. For this purpose the elements 26 and 27 are biased inwardly so that the projections 34 bear against the sides of the block.

The apparatus so far described functions in the following way. Air under pressure is supplied to the pressure compartment 5 and is maintained in this compartment at a certain predetermined pressure, which is kept as far as practicable constant, and is such as to maintain the diaphragm 3 working about its unstressed neutral position instead of always working on one side of its position of rest.

Air at constant pressure is supplied, by way of the pipe 16 and inlet passage 15, to the chamber. If at this stage the passage 9 in the cigarette-rod guide 6 is empty, the air will flow freely away from the chamber and pressure in the chamber will be well below that in the pressure compartment. Accordingly the diaphragm 3 will be forced to the right, Figure 1, but this movement is re-

stricted by the perforated support member 18, whose concave surface will support the diaphragm.

If now a length of cigarette rod R (for example a continuous rod being formed on a cigarette-making machine) is passed through the passage 9 in the rod guide 6, it will partially block the orifices to the chamber (namely the open ends of the passage 9) and thus restrict the flow of air from the chamber. Air can then escape from the chamber only by flowing past the cigarette rod, and the rate at which it can escape is determined by the clearance between the surface of the rod and the surfaces of the cylindrical parts of the passage 9 in the rod guide. Such clearance will depend on the cross-sectional size of the portion of the rod which is contained within the passage 9.

This cross-sectional size will, it is thought, generally be the same or substantially the same as the cross-sectional size of that portion of the rod immediately before it enters the rod guide, although it may sometimes happen, if a particular portion is sparsely filled with tobacco, that its cross-sectional size will be reduced by pressure of the escaping air.

It has been found, as explained above, that if the quantity of tobacco in the tobacco filler varies from point to point, the cross-sectional size of the rod formed from that filler will tend to vary in correspondence. Thus although the machine may be set up to produce cigarettes of a certain cross-sectional size, if the quantity of tobacco in a portion of the filler is greater or less than the correct quantity, the portion of the resulting rod containing that portion of the filler will have a cross-sectional size greater or less than the desired size.

The escape of air from the chamber is regulated by the cross-sectional size of the portion of rod which partially blocks the orifices of the chamber, and the air pressure in the chamber will accordingly vary in response to variations in the cross-sectional size of the rod as it passes through the guide 6.

Accordingly air is supplied to the chamber through the supply pipe 16 at a pressure such that when a rod of the desired or standard cross-sectional size is in the rod guide 6 the air pressure in the chamber is equal to that in the pressure compartment 5, and the diaphragm 3 is thus in a neutral position. In ascertaining the pressure at which air should be fed into the chamber, it must be borne in mind that the maximum pressure should not exceed the desired minimum pressure (for the quality of cigarette being manufactured) of the tobacco within the rod being tested. Economy of air is also a factor to be taken into consideration. In the example described air is admitted at a pressure of $1\frac{1}{2}$ lbs. per square inch, which is found sufficient, with the apparatus described, to obtain good results. If then any part of the rod passing through the rod guide is of less than the required cross-sectional size, more air will momentarily be able to escape, and the pressure in the chamber will fall. As a result, the diaphragm 3 will be forced towards the right, as viewed in Figure 1. If this movement is sufficiently large, the contact element 25, which follows the movement of the diaphragm, will make contact with the element 26.

If on the other hand the cross-sectional size of that part of the rod is too large, the clearance between the rod and the passage 9 in the rod guide is reduced and less air is able to escape. As a result, the air pressure in the chamber rises, and the diaphragm 3 is forced towards the left as viewed in Figure 1, and if this movement is large enough, the element 25 contacts the element 27.

The contact elements 25, 26 and 27 can be adjusted, as described above, so as to allow the element 25 to move a certain distance in each direction without making contact with either the element 26 or the element 27, and this adjustment is of course made in accordance with whatever may be decided to be the permissible amount of variation from the standard. They can also be adjusted so as to bring the element 25 to a neutral position when a standard rod is inserted in the rod guide 6 and subjected

to air pressure in the chamber. The standard rod may be made of metal or other suitable material, but as it is important that the standard rod should be held in axial symmetry in the rod guide to give a true reading, it is advantageous to use a rod of material which is light enough to be centred and caused to "float" by the escaping air.

The chamber, comprising the groove 8 and slot 10, with the recess 4, and that part of the recess 2 which is in communication with the recess 4, is made as small as is practicable relatively to the area of the diaphragm so as to give a rapid response to variations in pressure caused by variations in the size of the rod.

The inlet passage 11 is, in the example described, one-eighth of an inch in diameter, while the clearance between the passage 9 and a rod of desired cross-section is 0.3 mm.

Reference has been made above to an electrical device to which the wires 29, 30 and 31 are connected. This device may comprise two circuits one of which is closed by contacts between the elements 25 and 26 and the other by contact between the elements 25 and 27. The closing of these circuits can be utilised to actuate a signal of any suitable kind, indicating that the portion of rod being tested is of too great or too small a cross-sectional size, as the case may be.

In the manufacture of mouthpiece (e.g. filter tip) cigarettes the device described can be of considerable value, since it can be used to control the cross-sectional size of the cigarette rod in machines of the type described. In such machines the stubs or other mouthpiece portions to be assembled with the cigarette portions could be pre-selected for size, and separated into various tolerance groups, and a particular size or tolerance group could be used for any particular run on a machine of the type described. In such a case the pneumatic testing device or its regulation means could be so adjusted as to ensure that the size of cigarette rod produced at a particular time would be suitable for the particular size of stubs at the moment being fed in the machine. This control of size of the cigarette rod could be obtained by regulating the quantity of tobacco fed.

Figure 4 shows in diagrammatic form two ways in which the testing device may be utilised in a continuous rod cigarette-making machine. A cigarette rod is represented as moving endwise in a direction from the hopper of the machine and towards the testing device, and is also represented as extending within the guide 6 of the testing device. For convenience in diagrammatic illustration, the rod in the guide 6 is represented as being disposed at an angle of 90° to the rod shown approaching the guide, but it will of course be understood that the rod travels in a straight path toward and through the testing device. In the testing device is shown the diaphragm 3 and contact elements 26 and 27 which for simplicity are shown on opposite sides of the diaphragm. These contacts are connected through a delay unit of any suitable known kind to a rejector unit, also of a suitable known kind, which is operated with a suitable delay so as to eject cigarettes which are determined by the testing device to be unsatisfactory.

The rejector device may be constructed and operated, for instance, substantially as disclosed in the U.S. patent to Arelt 2,357,801, granted September 12, 1944, in which cigarettes to be rejected are deflected to one side of the path through which they are fed in response to energization of a relay and after an appropriate delay period. The details of the rejector device form no part of the instant invention and may be varied as desired.

In addition Figure 4 shows an arrangement for varying the feed of tobacco in response to relatively long-term variations in pressure in the chamber of the testing device. This comprises an air relay which may be of any suitable known kind, whereby the pressure in the chamber of the testing device at any instant may be reproduced in amplified form. The air relay device comprises a dia-

phragm 201 one side of which is exposed to the pressure in the chamber of the testing device, while the other side is exposed to pressure due to the regulated air supply (which is preferably the same as the supply to the testing device). Changes in pressure in the testing device cause movement of the diaphragm which in turn operates a valve device formed by a surface of the diaphragm 201 which restricts the flow of air from an orifice in a pipe 202 connected to the regulated air supply thus varying the pressure in the relay.

The relay is connected to an integrating chamber 203 of known kind, in which variations in air pressure produced in the relay are averaged to a suitable time constant, and which in turn communicates with one side of a chamber 204 containing a diaphragm 205, the other side being supplied with a reference air pressure as indicated in Figure 4. Variations in the pressure from the integrating chamber cause movement of this diaphragm 205, which movement, when it reaches a predetermined extent in one direction or the other, causes an electrical circuit to be closed, and thereby actuates a relay 206. Closure of one of the relay contacts causes current from the power supply to be fed to a small reversible motor RM, which shifts one way or the other the regulator of a variator device, which may comprise an infinitely variable speed gear such as disclosed in British Patent No. 618,774 and United States patent application Serial No. 659,349 filed May 15, 1957, in the name of G. F. W. Powell. This device is coupled to the drive shaft of the hopper in such a way as to be capable of altering the speed of the hopper, and thereby altering or varying the feed of tobacco from which the cigarette rod is formed.

Figure 9 shows an arrangement of a cigarette machine whereby the reversible motor RM varies the speed of the hopper, the arrangement shown being substantially the same as that disclosed in Figure 1 of United States Patent 2,704,079 to Molins and Powell, granted March 15, 1955. The reversible motor RM, which includes a reduction gear 211, has a sprocket wheel 212 on its shaft and this drives a further sprocket 213 on a shaft 214. On a shaft 215, which is driven by the hopper motor, there is provided a variator in the form of an expanding pulley device. This consists of a fixed cone 216 and a movable cone 217 slidable on a spline on the shaft 215. Between the cones are a number of curved segments 226 which can slide in grooves in the cones as the latter move toward and away from one another and are held to the cones by spring rings 227. The cone 217 is moved by a screwed bush 218 which runs on a fixed screw 219, the bush being rotated by a sprocket wheel 220 driven from the shaft 214 by a chain 221 and sprocket 222. Suitable thrust rings are provided, and as the bush rotates one way the cone 217 is moved in toward the cone 216. A belt 223 runs over the expanding pulley and opens the cones when the bush is moved in the reverse direction. The belt 223 also passes over a large pulley 224 on a shaft 225 which is the driving shaft for the hopper, a jockey pulley (not shown) being provided to take in the slack in the belt.

Thus when the reversible motor is started in one direction or the other by the action of the relay 206 when energized by the movement of the diaphragm 205, the cone 217 is moved either toward or away from the cone 216, and in consequence the drive to the shaft 225 of the hopper is speeded up or slowed down, thus increasing or decreasing the rate of feed of tobacco from the hopper to form the cigarette rod.

An alternative construction of testing device is illustrated in Figures 5, 6, 7 and 8. This construction differs from that already described in that the pressure compartment, instead of being sealed and maintained at constant pressure, is connected to the same air supply as the chamber, whereby variations in the supply pressure affect both the chamber and the pressure compartment equally. A further difference is that the contact element movable

with the diaphragm (corresponding to the element 25, Figure 1) is disposed between contact elements which correspond to the elements 26 and 27, Figure 1, but are rigidly mounted to avoid the oscillation which may occur with the flexible elements 26 and 27.

Referring to Figures 5, 6 and 8, a block 101 is provided with a circular recess 102 in which is fixed a metal diaphragm 103. The recess 102 communicates, at one side of the diaphragm, with a conduit 104, and on the other side is a pressure compartment 105. A rod guide 106, corresponding to the guide 6 in Figures 1, 2 and 3, and having an internal slot 107 communicating by way of a hole 108 with the conduit 104, is clamped in the block 101. That part of the recess 102 which is to the right of the diaphragm as viewed in Figure 6, together with the conduit 104 and slot 107, constitute a chamber, which is in communication with a passage 109 extending through the rod guide.

A hole 111 in the block 101 receives an air pipe 112. A narrow inlet passage 115 extends from the hole 111 to that part of the recess 102 which forms part of the chamber just mentioned. A further passage 116 extends from the hole 111 to the pressure compartment 105. The inlet passages 115 and 116 have nearly the same diameter so as to admit air at approximately the same pressure to both sides of the diaphragm, the inlet 115 being slightly larger than the inlet 116 in order to compensate for the pressure drop in the hole 111 between the inlet 116 and the inlet 115. An outlet passage 117, Figure 6, extends from the pressure compartment 105 to the outer surface of the block 101. This passage 117 is of a suitable diameter such as to allow air to escape from the pressure compartment at the same rate at which air can escape from the chamber when a cigarette rod of standard cross-sectional size is in the passage 109. In other words, the outlet passage 117 is of the same size as the escape gap from the chamber for a standard sized rod. Thus if the rod passing through the rod guide is of the correct size, the rate of escape of air from both sides of the diaphragm will be equal, and the diaphragm will remain in its neutral position.

This arrangement has the advantage that any fluctuations in the air supply affect both sides of the diaphragm substantially equally.

The inlet passage 115, in the example described, has a cross-sectional area of 0.113 square inch, the escape gap between the passage 109 and a rod of "standard" size being taken as 0.0079 square inch.

The pressure compartment 105 is enclosed by a casing 118 secured to the block 101.

The diaphragm 103, which is metallic, has a flat central portion 125 which acts as a contact element corresponding to the element 25 in Figure 1. Two further adjustable contact elements 126 and 127 (corresponding to the elements 26 and 27, Figure 1) are located one on each side of the element 125. The elements 126 and 127 are rigidly mounted but are adjustable towards and away from the diaphragm. The element 126 is fixed to a screw 128 which is threaded through a gear 129 freely rotatable within a recess 130 in the block 101. The element 127 is similarly fixed on a screw 131 threaded through a gear 132 located in the pressure compartment and having a boss 133 which is freely rotatable in a recess in the casing 118.

The contact elements 126 and 127 have extensions 134 and 135 respectively, which are clamped at 136 and 137 respectively to prevent rotation of the screws 128 and 131. Thus rotation of the gears 129 and 132 causes the screws 128 and 131 to move endwise so as to bring the adjustable contact elements closer to or further from the central element 125 formed on the diaphragm.

Rotation of the gear 129 is effected by turning a spindle 140, Fig. 6, on which is mounted a gear 141 meshing with the gear 129. Similarly the gear 132 is rotated by a train of gears 142 and 143, the gear 143 being mounted

11

on a spindle 144 which can be turned to adjust the position of the contact element 127.

The gears 129 and 132 have bosses which extend into apertures in plates 145 and 146 respectively, which plates prevent endwise movement of the gears when they are rotated.

The contact elements 126 and 127 and their extensions 134 and 135 are insulated from the metal block 101 and casing 118, and are connected to an electrical device such as is referred to above. The metal diaphragm 103 is also connected to this device through the metal block 101, the connections being such that engagement of either of the elements 126 and 127 by the contact element 125 of the diaphragm closes a circuit in the electrical device.

In the construction shown in Figures 6-8, the diaphragm 103 is made rigid enough to withstand undue movement to one side, and there is accordingly no need for a support member such as the perforated member 18, Figure 1.

The operation of this modified device is similar to that of the construction illustrated in Figures 1, 2 and 3. Air under pressure is supplied, by way of the air pipe 112 and passages 115 and 116, to both sides of the diaphragm 103. The air supplied to the chamber (to the right of the diaphragm as viewed in Figure 6) flows through the conduit 104, the hole 108 and the slot 107, and escapes by flowing past the cigarette rod R which is moving through the guide 106. As in the construction already described, the escape of air from the chamber is regulated by the cross-sectional size of the portion of rod which partially blocks the orifices of the chamber, and the pressure in the chamber will vary in response to variations in the cross-sectional size of the rod passing through the guide 6.

On the other side of the diaphragm, to the left-hand side in Figure 6, the air escapes from the pressure compartment 105 at a constant rate (assuming the supply pressure is constant) through the outlet 117. As explained above, if the supply pressure fluctuates, this affects both sides of the diaphragm equally, and when a rod of the desired or standard cross-sectional size is in the guide 106, the air pressure on both sides of the diaphragm 103 is substantially equal, and the diaphragm is in its neutral position. If any part of the rod passing through the guide is of more or less than the standard cross-sectional size, the chamber pressure will vary accordingly and the diaphragm will be moved in one direction or the other. If this movement is large enough, the central contact element 125 will make contact with one of the two elements 126 and 127. As pointed out above, the contact elements 126 and 127 can be adjusted, by rotation of the spindles 140 and 144, so as to provide a desired space between the elements 126 and 127 and the central element 125, in accordance with whatever may be decided to be the permissible amount of variation from the standard in the cross-sectional size of the rod. If this is exceeded, contact is made by the element 125 with the element 126 or 127, and an electrical circuit is closed.

It will be seen that the device just described with reference to Figures 5, 6, 7 and 8 may be used in the arrangement described above with reference to Figure 4.

What we claim as our invention and desire to secure by Letters Patent is:

1. In the manufacture of cigarettes on a cigarette-making machine in which a continuous tobacco filler is compressed in rod forming mechanism having a passageway of predetermined cross-sectional size and formed uniformly to the same predetermined cross-sectional size and enclosed in a paper web which is formed into a tube of predetermined uniform cross-sectional size around the compressed tobacco filler, which tube is sealed by applying moist adhesive between overlapping marginal areas of the web, and drying the adhesive to secure the said areas to each other, thereby forming a

12

continuous cigarette rod, a method of detecting variations in the quantity of tobacco contained in the paper tube, which method comprises passing the rod through a chamber which has an outlet which is partially blocked by the rod, and introducing air into the chamber at a pressure not greater than the desired minimum pressure of tobacco within the paper tube, the rate of escape of air from the chamber being determined by the momentary cross-sectional size of the rod passing through the chamber, which causes fluctuations in the pressure of air in the chamber and thereby indicates fluctuations in the cross-sectional size of the rod due to variations in expansion of the compressed tobacco after formation of the paper tube around it and before the overlapping marginal edges are completely secured to each other, such variations being dependent upon the quantity of tobacco contained in the paper tube from place to place along its length.

2. A method as claimed in claim 1, wherein the said fluctuations in the pressure of the air in the chamber are utilized to cause actuation of control means for the cigarette-making machine.

3. A method as claimed in claim 2, wherein cigarettes containing lengths or portions of a cigarette rod, which lengths are shown by the said fluctuations to be unsatisfactory, are caused by the said control means to be segregated from others.

4. A method as claimed in claim 2, wherein the formation of the cigarette rod is corrected or altered by said control means.

5. A method as claimed in claim 2, wherein actuation of the control means is effected by a pressure-sensitive device, in contact with the air in the chamber.

6. In a continuous rod cigarette-making machine the combination of rod forming mechanism comprising a closed passageway of predetermined cross-sectional size to compress a continuous tobacco filler and form it to a uniform cross-sectional size determined by the rod forming mechanism and to enclose the filler in a paper web while forming the paper web into a tube of said predetermined uniform cross-sectional size around the compressed tobacco filler, and to seal the tube by applying moist adhesive between overlapping marginal areas of the web, and to dry the adhesive to secure the said areas to each other, thereby forming a continuous cigarette rod, detector means operative on the said continuous rod so formed to detect variations in the quantity of tobacco contained in the paper tube, said detector means comprising a chamber through which the rod is passed, said chamber having an outlet which is partially blocked by the rod, and means to introduce air into the chamber at a pressure not greater than the desired minimum pressure of tobacco within the paper tube, the rate of escape of air from the chamber being determined by the momentary cross-sectional size of the rod passing through the chamber, which causes fluctuations in the pressure of air in the chamber and thereby indicates fluctuations in the cross-sectional size of the rod due to variations in expansion of the compressed tobacco after formation of the paper tube around it and before the overlapping marginal edges are completely secured to each other, such variations being dependent upon the quantity of tobacco contained in the paper tube from place to place along its length.

7. Apparatus as claimed in claim 6, wherein the said detector means comprises a detector device to detect fluctuations in air pressure in the chamber, and control means actuated by the detector device in accordance with the said pressure fluctuations and effective when so actuated to make the cigarettes delivered by the machine more uniform.

8. Apparatus as claimed in claim 6, comprising in combination ejector means, actuated in response to instantaneous pressure fluctuations beyond predetermined limits in the chamber, to eject cigarettes produced from

13

portions of the rod which cause the said fluctuations beyond said limits, and further means, actuated in response to long term variations in pressure in the chamber, to vary the quantity of tobacco forming the tobacco filler.

9. A device as claimed in claim 6, wherein the said detector-means comprises a pressure-sensitive device in contact with the said air in the chamber and adapted to move in response to variations in the pressure of the said air in the chamber.

10. A device as claimed in claim 6, in combination with control means adapted to be actuated by the said detector-means in such a way as to exercise control over the operation of the cigarette machine.

11. Apparatus as claimed in claim 10, wherein the control means is adapted to segregate unsatisfactory cigarettes from others.

12. Apparatus as claimed in claim 10, wherein the control means is adapted to alter the formation of the cigarette rod being tested.

13. Apparatus as claimed in claim 6, comprising an air relay directly connected to the said chamber so as to reproduce pressure fluctuations occurring in the chamber, an integrating device connected to said air relay to

14

average over a desired period pressure fluctuations produced by the air relay, mechanism to vary the quantity of tobacco forming the said tobacco filler, and means responsive to pressure fluctuations so averaged to actuate said mechanism.

14. Apparatus as claimed in claim 13, comprising a pressure sensitive device associated with the said chamber and movable in response to pressure fluctuations in the chamber, an electrical device arranged to be energized by movement of said pressure sensitive device beyond predetermined limits, and ejector means actuated by said electrical device and operative to eject defective cigarettes from the product of the machine.

References Cited in the file of this patent

UNITED STATES PATENTS

1,864,728	Hawkins	June 28, 1932
2,163,415	Stephano	June 20, 1939
2,357,801	Arelt	Sept. 12, 1944
2,407,100	Richardson	Sept. 3, 1946
2,516,932	Wainwright	Aug. 1, 1950
2,565,500	Ingham	Aug. 28, 1951