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2,861,683

MEASUREMENT OF CIGARETTE ROD DENSITY BY RADIATION

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1 Claim. (Cl. 209—72)

This invention relates to apparatus for measuring the density of material of at least two dimensional cross-section as it is produced continuously by a machine and is particularly well suited for measuring the density of a cigarette rod as it is manufactured continuously in a cigarette making machine.

When radiation has been employed for measuring the density of a cigarette rod, it has been found that the readings obtained may vary with the side at which the rays traverse the rod, even though all the readings are taken through one cross-sectional area. This reaction may be due to a number of factors including the positioning of the strands in the rod. Since the distribution of tobacco shreds in a cigarette rod is not always uniform, it will have an effect on the amount of radiation absorbed by the shreds. Applicant has found that he can compensate or correct for this non-uniform distribution and arrangement of tobacco shreds by taking measurements transversely through the same cross-section of the rod from a plurality of angles relative to each other. By penetrating the rod at different angles and then averaging these measurements, it is possible to obtain measurements which are relatively free from being affected by the distribution and arrangement of tobacco threads.

Other objects and features of the invention will appear as the description of the particular physical embodiment selected to illustrate the invention progresses. In the accompanying drawings, which form a part of this specification, like characters of reference have been applied to corresponding parts throughout the several views which make up the drawings.

Figure 1 is a front elevation, with part broken away of a continuous rod cigarette machine equipped with radiation type detectors arranged at angles to each other for operating the correcting and rejecting controls of a cigarette making machine.

Figure 2 is a diagrammatic representation of two radiation type measuring devices arranged at 90 degrees with respect to each other around a cigarette rod in combination with various circuits and control mechanisms for operating the defective cigarette ejecting apparatus and the feed control mechanism of a cigarette making machine.

Figure 3 is a diagrammatic illustration of a modified form of arrangement of a pair of radiation type measuring devices around a cigarette rod.

For purposes of illustrating our invention, I have shown in Figure 1 a conventional continuous rod cigarette making machine such as shown in co-pending application Serial Number 239,975, filed by William C. Broekhuysen on August 2, 1951, which consists of a tobacco feed designated generally by the symbol F and a cigarette maker designated generally by the symbol M. The principal components of cigarette maker M consist of a rod folder tongue U, rod former V, a cigarette rod paster P, a rod sealer S, a cutoff device C, and a cigarette catcher or collector B. The manner in which these components of

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a cigarette making machine function may be briefly described as follows:

The tobacco feed F showers tobacco continuously onto a travelling tape and paper web W. The paper web W is guided through the rod folder tongue U, through the rod paster P, which applies a strip of paste to the lap edge of the cigarette rod, through the rod former V and through the rod sealer S, by a continuously moving holding belt 4 driven by the drum 6. Drum 6 is secured to a shaft 8 having a gear 10 driven by a worm 12 secured to the main drive shaft 14 of the cigarette making machine.

When the cigarette rod R emerges from the rod former V, it passes through the cigarette cutoff C such as shown in U. S. Patent 1,075,274 wherein a knife 16 driven, in proper time relation with the movement of the cigarette rod, from the shaft 18 through a pair of spiral gears 20 from the main shaft 14, cuts off individual cigarettes L of a predetermined length from the cigarette rod.

These cigarettes are delivered and pushed through a guide channel 22 onto a continuously driven collector belt 24. The guide channel 22 is held by a bracket 26 adjustably attached to a lug 28 fastened to the bed 30 of the cigarette machine. Belt 24 is driven from the main drive of the machine in a conventional manner (not shown).

Between the sealer S and the cutoff C the rod passes between suitable sources of radiation and suitable detectors which will be more fully described later on. While we have chosen to illustrate the invention by measuring the density of tobacco in the rod, it will be understood the same method may be applied anywhere along the stream of tobacco where the flow is sufficiently confined and the density sufficiently high to cause measurable absorption.

A suitable ejecting mechanism such as shown in Figure 1 is actuated by means of a relay which corresponds with the relay 225 disclosed in U. S. Patent 2,357,801 from the detector circuit each time a defective cigarette is detected. When the ejecting relay is energized, it effects the setting in operation of a timing disc and indexing mechanism which performs the same function and is of the same construction as the one disclosed in the above mentioned patent and is driven in synchronism with all other units of the cigarette making machine. If desired an ejecting mechanism of the type disclosed in copending application of William C. Broekhuysen and Vincent J. Petrucelly, filed March 9, 1950, Serial Number 148,662, now Patent 2,729,214, could also be employed for this purpose. The circuitry for such an arrangement is shown in Figures 2 and 3.

The indexing mechanism, through a sprocket chain 48 drives a sprocket 46 which is loosely mounted on a shaft and to which is attached a gear 44 driving a gear 42. The gear 42 is mounted on a shaft 34 supported by an arm 37 which is pivotally attached to the shaft 38 supported in a bearing bracket 40. The latter is secured to the main frame 30 of the cigarette making machine. The free end of the shaft 34 carries a pair of ejector rods 32, which rotates when shaft 34 is driven. Arm 37 is connected to and oscillated by a suitable cam lever which forms part of the indexing mechanism fully described in U. S. Patent 2,357,801 referred to heretofore. The individual cigarettes cut off from the continuous cigarette rod emerge from the cutoff C and are delivered and pushed through a guide channel 22 held by a bracket 26 adjustably attached to a lug 28 fastened to the frame 30 of the cigarette making machine.

The machine is so timed and synchronized that the rotating ejector rods 32 are lowered by arm 37 into position to sweep off the cigarettes delivered at that moment from the guide channel 22 onto the collector belt 24. The

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cigarette to be ejected is caught by the ejector rods 32 in mid-air and thrown into an ejector chute formed by a pair of guide plates 80 and 82 which are adjustably attached to the bearing bracket 40.

My radiation detector is also adapted for operating a feed control in a manner similar to that shown in Broekhuysen application Serial Number 239,975 to increase or decrease the amount of tobacco fed in accordance with changes in the density or mass of the cigarette rod being formed. In such a case, the output of the detector would be connected to an integrating circuit which in turn is connected to an indicating meter which in turn would be used to actuate a control device in a manner broadly similar to that shown in U. S. Patent 1,864,728, issued to Mr. W. J. Hawkins et al., on June 28, 1932. This may be accomplished by mounting the contact arm 84 of the Hawkins patent on the shaft of the indicating meter. The movement of the shaft of the indicating meter controls the movement of the contact arm as shown in Broekhuysen application Serial Number 239,975.

The movement of contact arm causes the Reeves drive control to rotate in one direction or the other causing the Reeves drive to increase or decrease the speed of the feeding apparatus of the cigarette making machine. If desired, reference may be made to the Hawkins patent referred to herein for a more detailed description of the manner in which said feed control operates.

In Figs. 2 and 3 I have shown how several sources of penetrative radiation may be mounted to direct rays transversely through the rod along planes which are circumferentially distributed around the rod. While I have employed two sources of radiation which are arranged at 90 degree angles to each other in the manner hereinafter described, it should be understood that more than two sources of radiation could be used effectively and the present disclosure is not to be restricted to the 90 degree angular arrangement used to illustrate the invention.

There are various types of radiation ranging from infra-red through visible rays, X-rays, and gamma rays that can be employed in practicing this invention. I have preferred to employ rays which have a greater penetrating power than light rays but which are more readily absorbed than X-rays. Rays of this type would be beta rays which can be conveniently obtained from a source such as Strontium 90. I prefer beta rays because the absorption of beta rays depends primarily on the density or weight per unit area of a material, and is not dependent on the transparency or opacity of a material as would be the case with light rays or on the chemical composition as for X-rays nor are they affected by variations of other properties of a material such as its dielectric constant.

Beta rays have more limited penetrating power than X-rays and it is very simple to prevent penetration in any but the desired location. This type of radiation also enables a very simple source, such as Strontium 90, to be employed and thereby avoiding the necessity for using high voltage apparatus which is required for generating X-rays.

Another advantage of this type of radiation is the fact that the sources of radiation can be radially arranged around the axis of the cigarette rod because they would not require excessive amounts of space.

The beta gauges I have employed in Fig. 2 consist of beta sources 100 and 102 arranged at 90 degree angles to each other and beta ray detectors 104 and 106 arranged on the other side of the rod opposite to each of said sources of radiation.

The amount of radiation detected by the ray detectors 104 and 106 is separately amplified in suitable pre-amplifiers 108 and 110 respectively. The signals so amplified are then added and averaged in the averaging circuit 112 in a manner well known in the art.

Since the beta gauges used to illustrate the invention in Fig. 2 are disposed both radially at 90 degree angles

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to each other and longitudinally spaced from each other along the length of the rod as shown in Fig. 2, a further time synchronizing circuit 114 is included in the averaging circuit 112 so that only the measurements on the same cross sectional area of the cigarette rod are measured.

In a modified form of my invention I have illustrated in Fig. 3 how the beta gauges 139 and 142 may be radially arranged with respect to the longitudinal axis of the cigarette rod so that all of the radiation passes through the same cross-sectional area of the cigarette rod simultaneously, and the time synchronizing circuit 114 in this latter modification of the invention can be eliminated. In this modification beta ray detectors 140 and 144 are mounted on the other side of the rod opposite to each beta gauge 139 and 142. It will be understood that where more than two sources of radiation are employed the electrical circuits shown would be supplemented to the extent of the additional sources of radiation, so that a composite or average measurement is made of a particular cross-sectional area of the cigarette rod R.

The amplifier 116, established the voltage and polarity of the signal to correspond with the operating requirements in any given situation. By employing a plurality of radiation sources such as 139 and 142 which pass through the cigarette rod R along angles which are radially arranged with respect to the longitudinal axis of the rod R, any non-uniform distribution of the tobacco shreds in the rod which may have a greater effect on some sources of radiation than on other sources of radiation will be compensated for by the other sources of radiation as they pass through the particular cross-sectional area of the cigarette rod being measured. The sum total of measurements from all sources of radiation will be averaged so that the effect of non-uniformity of the shreds will not have a tendency to adversely affect the measurements so that one is thereby able to attain a more accurate measurement of the density of the rod.

The measurement or signal received and amplified by the amplifier 116 may then be transmitted and used to actuate a variable speed drive 118 of a tobacco feed of a cigarette machine in order to effect adjustments in the rate at which tobacco is fed into the rod-forming mechanism of the machine.

The amplified signal passes through a control box 120, a regulator 122, a lockout 124, and a timing circuit 126, before affecting the variable speed drive 118. Since all the circuits and mechanisms contained in said boxes 118, 120, 122, 124, and 126 are fully described and shown in U. S. application Serial Number 148,662, filed by William C. Broekhuysen and Vincent J. Petrucelli on March 9, 1950, and Serial Number 148,661, now Patent 2,792,213, filed by William C. Broekhuysen and Samuel Gilman on March 9, 1950, a further description herein is not deemed necessary.

It will also be appreciated that, if desired, the signal which is received from the amplifier 116 could be utilized for actuating a defective cigarette rejecting mechanism in order to remove defective cigarettes from those produced by the cigarette making machine. In this case the amplifier 116 would be connected to a rejector 128 which is coupled with a synchronizer 130. The rejector 128 is also connected to a memory circuit 132 which records and stores the signal impulses received whenever a defective portion of the cigarette rod passes the beta gauges.

The memory circuit 132 is connected with two magnetically operated rejectors, 134 and 136, mounted underneath the cigarette delivery belts (not shown) in order to pick or reject the defective cigarettes from one or the other of the two rows of cigarettes which are collected on such delivery belts. Since the circuits and mechanisms in blocks 128, 130, 132, 134, and 136 are fully described and shown in U. S. applications Serial Number 148,661 and Serial Number 148,662, a further

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detailed description herein has not been deemed necessary.

If desired, two sets of detectors of the type described herein could be spaced along the material being produced continuously so that the density of a selected portion of the material or cigarette rod could be compared with an adjoining section of the material or cigarette rod, in a manner similar to that described in U. S. Patent 2,357,860, granted to U. A. Whitaker on September 12, 1944. Such an arrangement would not be affected by gradual changes in density and/or moisture content, which tend to affect all parts of the rod equally.

Whenever more than one beta gauge is radially arranged around the axis of a cigarette rod for passing rays of radiation through the same cross-sectional area simultaneously as shown in Fig. 3 it is desirable to employ suitable shielding 138 to prevent stray beta rays from one source of radiation from being deflected to a detector other than the one opposite that to the source of radiation.

The invention hereinabove described may be varied in construction within the scope of the claim, for the particular device selected to illustrate the invention is but one of many possible embodiments of the same. The invention, therefore, is not to be restricted to the precise details of the structure shown and described.

What is claimed is:

In a cigarette making machine, apparatus for detecting variations in the density of a moving cigarette rod comprising a source of radiation of known cross section and intensity positioned adjacent one side of the path of travel of said rod and adapted to project a beam of radiation through successive increments of said rod, at least one other source of radiation of known cross section and intensity positioned adjacent another side of the path of travel of said rod and adapted to project a beam of radiation through said successive increments of said rod, said last named source of radiation being arcuately displaced about said rod to direct radiation at an angle with respect to said first named source of radiation, means including fast responding radiation detectors positioned opposite each of said sources of radiation operable to detect substantially instantaneous variations in the mag-

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nitude of each of said beams caused by said variations in the density of each successive increment of said rod subjected to said beams, said last-named means being operable to provide output signals representative of said density changes in corresponding ones of said increments, means for averaging said output signals to provide a composite signal representative of the average amount of radiation absorbed by said increments, a cut-off device for severing said rod at selected intervals to form discrete cigarettes, a cigarette rejector, conveying means for guiding said rod past said detectors, said cutter and said rejector, and means operative in response to variations in said composite signals beyond a predetermined magnitude for actuating said cigarette rejector whereby cigarettes having undesirable density characteristics are ejected.

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