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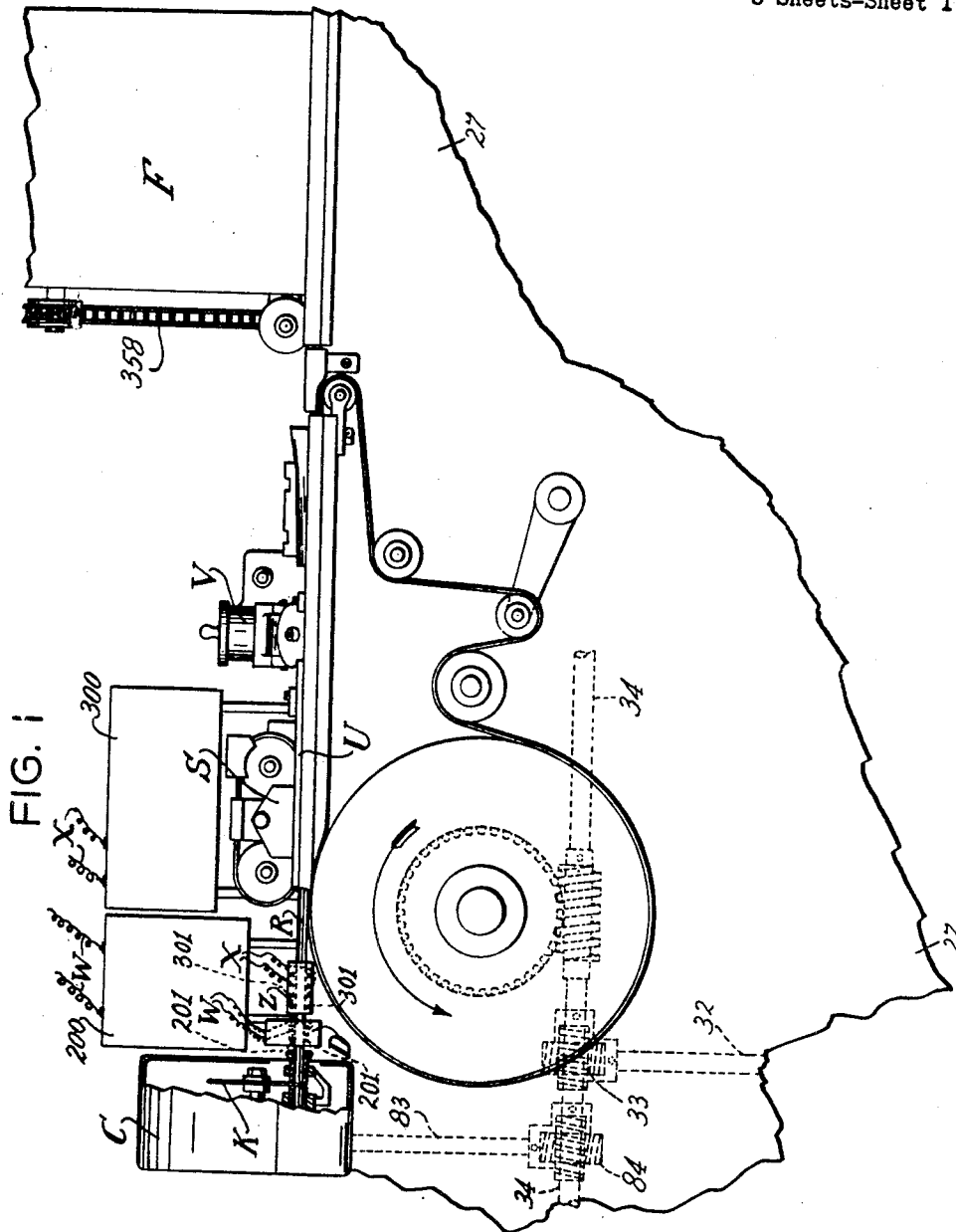
U. A. WHITAKER

2,519,089

TOBACCO FEED CONTROL MECHANISM

Original Filed April 2, 1941

3 Sheets-Sheet 1



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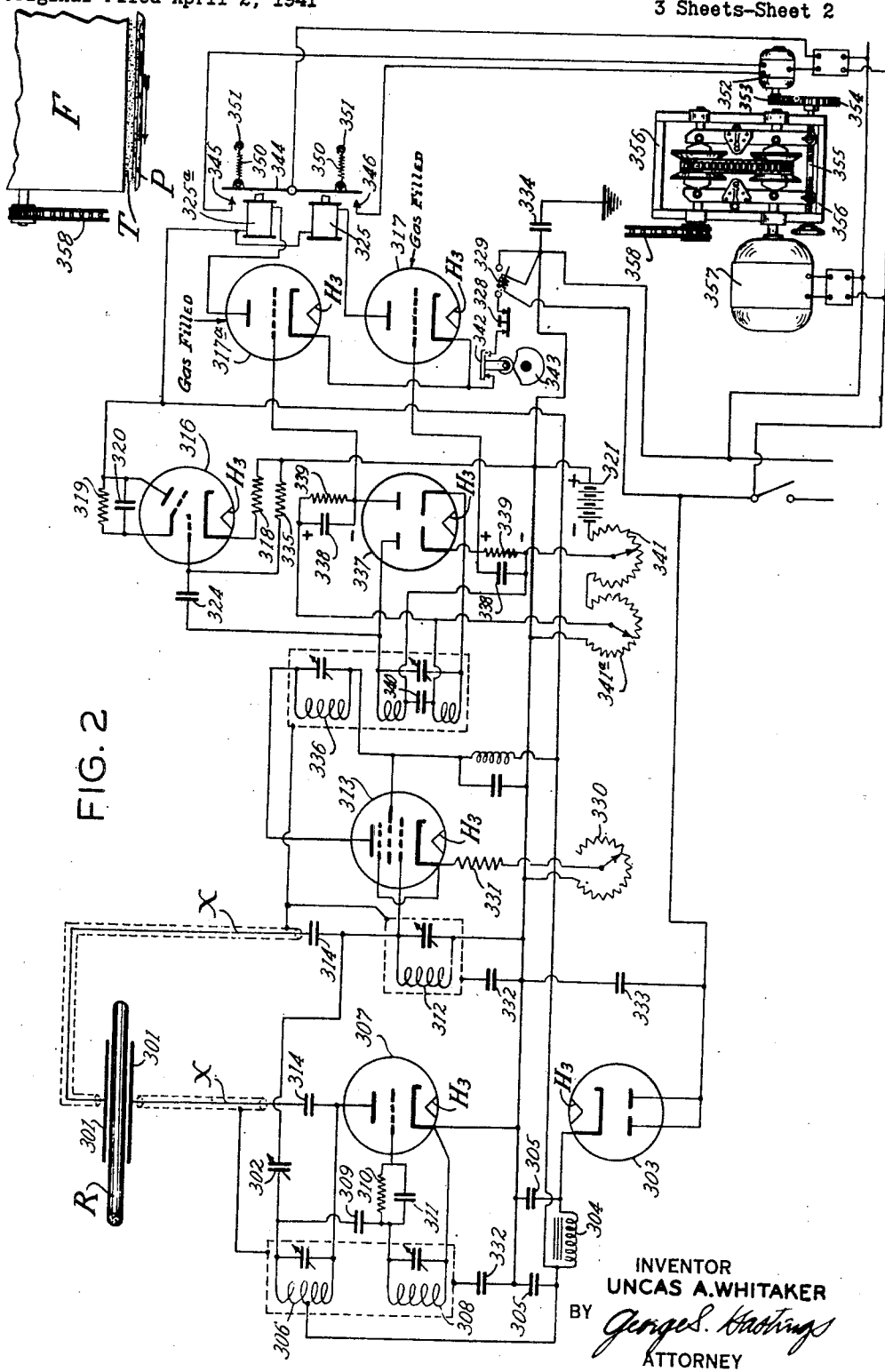
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FIG. 2



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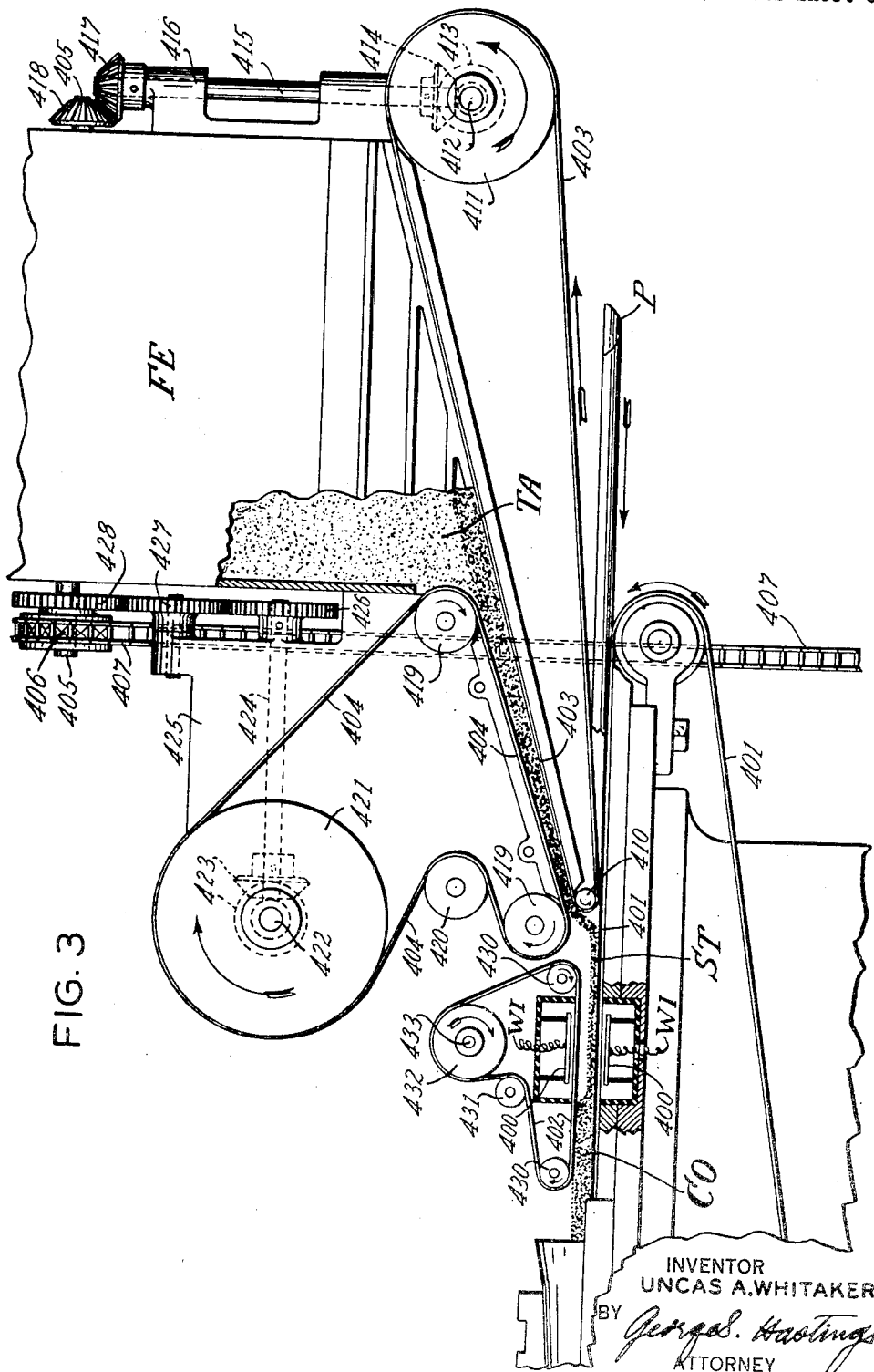
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UNITED STATES PATENT OFFICE

2,519,089

TOBACCO FEED CONTROL MECHANISM

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Original application April 2, 1941, Serial No.
386,487. Divided and this application July 20,
1944, Serial No. 545,806

10 Claims. (Cl. 131—21)

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This invention relates to the manufacture of cigarettes and constitutes a division of my patent application, S. N. 386,487 filed April 2, 1941, on which Patent No. 2,357,860 was issued September 12, 1944. In this connection one of the main objects is to provide an apparatus for determining variations in the density of a cigarette rod.

Still another object is to provide in a cigarette machine mechanism controlled from apparatus for electrically detecting the density of the cigarette rod, for varying the operation of the tobacco feed of the machine to increase or diminish the rate at which tobacco is delivered to the cigarette rod-forming mechanism.

The detecting apparatus of the tobacco feed controlling mechanism may be arranged to determine the density of the stream of tobacco being advanced into the rod former for enfoldment within the cigarette paper to form the cigarette rod. In this connection another object of the invention is to deliver a stream of tobacco between opposed members at a rate such that a column of tobacco of uniform density will be formed between said members, and to determine the length of said column and control the tobacco feed to maintain a predetermined volume of tobacco in said column so that the end of said column will remain at a predetermined position between said members.

The condition of the cigarette rod may be determined by electrostatic apparatus comprising spaced pick-up plates sufficiently spaced to admit a cigarette rod therebetween and connected to a high frequency electric circuit which will be affected by the characteristics of the section of the cigarette rod between plates so as to vary the current in the circuit. In accordance with the invention, variations in this current are utilized to measure variations from normal in the density of the rod. The circuit may be adjusted by inserting a cigarette conforming to a predetermined standard between the pick-up plates and adjusting the current to respond to variations in the cigarette rod from said standard. It is believed that variations in this circuit result mainly from variations in the moisture content of the tobacco in the rod. Thus if a cigarette rod having a predetermined moisture content is advanced past the plates, underfilled or overfilled portions thereof will contain greater or less moisture and correspondingly vary the characteristics of the circuit and the current flowing therein.

By this means it is possible to detect underfilled or overfilled spots which constitute a minor fraction of a cigarette length. Moreover no me-

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chanical feelers are used, whose inertia must be overcome before discrepancies in the cigarette rod will be detected. It may be noted that mechanical feelers, which have been used heretofore, do not give a true determination of the condition of the cigarette, inasmuch as they tend to modify or compress the cigarette being tested, and also due to the relatively high speed of the rod and this inertia of the feelers they are not sensitive to short, low or high spots a fraction of a cigarette length long but tend to ride over such spots without responding to them.

Since the moisture content of the tobacco constitutes an index of the density of the tobacco, as it is proportional to the weight of a given mass of tobacco of uniform moisture content, variations in the density of the cigarette rod, and in the stream of tobacco fed into the rod former, may be detected and utilized to control the feeding of the tobacco to the rod former.

It is noted that the moisture content of well prepared and mixed tobacco is ordinarily quite uniform throughout a given mass at a given time, due it is believed, in part, to the fact that tobacco is very hygroscopic and in the mass relatively dry parts tend to absorb moisture and damp parts to give up moisture until the moisture content of adjoining portions is substantially uniform.

With these and other objects not specifically mentioned in view the invention consists in certain constructions and features hereinafter fully described and then specifically set forth in the claims hereunto appended.

In the accompanying drawings which form a part of this specification and in which like characters of reference indicate the same or like parts:

Fig. 1 is a side elevation of a continuous rod cigarette machine in conjunction with a capacitatively controlled flaw detecting mechanism;

Fig. 2 is a diagram of the circuit for the detector control unit of the tobacco feed for the continuous rod cigarette machine; and

Fig. 3 is a side elevation, partly shown in section, of a tobacco feed for, and the tobacco stream conveying portion of, a continuous rod cigarette machine in conjunction with an electric detector control unit for said tobacco feed and said cigarette conveyor.

Shaft 32, which drives the cigarette ejecting mechanism (not shown) is driven through a pair of meshing spiral gears 33 (Fig. 1), one gear 33 being mounted on shaft 32 and the other on the main drive shaft 34 of the cigarette machine. The cigarette cutoff C is driven through shaft 33

and a pair of spiral gears 84 from the main shaft 34 and supported by bed 27.

The continuous cigarette rod R emerging from the cigarette rod former U (Fig. 1) passes through a detector box D into the cut-off mechanism C, which may be of construction similar to that shown in Patent No. 1,075,274, wherein a knife K cuts off individual cigarettes. Within the detector box D are supported a pair of condenser plates 201 which may be connected by wires W to an electrostatic detector control unit mounted in a box 200 conveniently held on top of the bed. This detector control unit forms no part of the present invention and is fully disclosed in my above mentioned patent of which this application constitutes a division.

Since in manufacturing of cigarettes the average density of the cigarette rod may be of even greater importance than the detection of over-filled or underfilled spots, the cigarette machine is equipped with an electrostatic control of the tobacco feed, with the object of increasing or decreasing the amount of tobacco fed into the cigarette rod. For this purpose the cigarette rod R passes between a pair of detector plates 301 (Fig. 2), which may be supported within a detector box Z (Fig. 1) conveniently attached to the bed of the cigarette machine. Said plates 301 by means of wires X are connected to an electrostatic control unit supported in box 300. The circuit of said tobacco feed control unit is disclosed in Fig. 2. The detector plates 301, however, are of much greater length, axially of the cigarette rod, than plates 201. The capacity between plates 301 may be balanced against the capacity of an adjustable air condenser 302.

The circuit of this detector unit is of the so-called universal, or A. C.-D. C. type, in which the power from the line passes through a half-wave rectifier tube 303 and a filter consisting of choke coil 304 and condensers 305. The cathode heaters H₂ of the various tubes are connected in series across the line in the usual manner (not shown), but it will be understood that the cathodes may be directly heated if desired.

The tuned plate coil 306 of the high-frequency oscillator tube 307 is center tapped, with the tap connected to the positive output terminal of the filter. Tuned grid-coil 308 is inductively coupled to the plate coil and also capacitively, through a small condenser 309. Resistance 310 and condenser 311 are the usual grid leak and condenser for limiting the oscillation of tube 307 to the straight portion of its plate-current curve. When the tube 307 oscillates, equal H. F. voltages, 180 degrees out of phase, are generated on the two ends of coil 306.

The tuned coil 312 is connected in the grid circuit of the H. F. amplifier tube 313, which is of the pentode type. Coil 312 is tuned to the same frequency as the oscillator and is coupled to both sides of coil 306, through condensers 314 and detector plates 301. Condensers 314 are inserted in the leads to plates 301 to insulate the plates from line or D. C. power. If the capacity of condenser 302, and the capacitance between plates 301 is balanced, no voltage will be impressed on coil 312.

A tuned H. F. transformer 336 couples the amplifier tube 313 to the double-diode detector tube 337 and indicator tube 316. The tuned primary of transformer 336 is connected in the plate circuit of tube 313. The tuned secondary is divided into two equal parts, the H. F. voltages across which are rectified separately by the two

sections of detector tube 337, condensers 338 and resistors 339. Condenser 340 is a by-pass for H. F. current between the two halves of the secondary of transformer 336. The two rectified voltages appearing across condensers 338 are impressed on the grids of the two output tubes 317 and 317a. The grid bias of these two tubes is controlled individually by two potentiometers 341 and 341a connected in series across "C" battery 321. The polarity of the rectifier connections is such that when the H. F. voltage increases, the grid of the "heavy" tube 317 becomes more negative, and that of the "light" tube 317a less negative. One side of the secondary of transformer 336 is also coupled to the grid of the indicator tube 316 through condenser 324.

Indicator tube 316 is of the type in which a triode is combined with an electron-ray indicator. It is biased to zero shadow angle by resistor 318 in series with the cathode. Resistor 335 is the grid-leak. The triode plate resistor 319 is by-passed by a condenser 320. Thus the triode acts as a biased detector, and the whole tube 316 as a zero-indicator.

Output tubes 317 and 317a are gas-filled, grid-controlled rectifiers. Potentiometers 341 and 341a are adjusted to a point where, with normal output from the detector tube 337, the grids of tubes 317 and 317a are both at a sufficiently negative potential to prevent the flow of plate current. If the output from the detector tube 337 increases, the grid of the "heavy" tube 317 becomes less negative. At a certain point, plate current starts to flow in this tube, and, once started, the grid has no further control over it, and it can only be stopped by interruption of the plate current. The coil of a relay 325 is connected in series with the plate of tube 317. If the output from the detector tube 337 decreases, the grid of the "light" tube 317a becomes less negative, till plate current starts to flow. Another relay 325a is connected in the plate circuit of this tube 317a. Push button 328 is for manual interruption of the plate current in both tubes 317 and 317a. A thermal time delay unit 329 prevents the flow of plate current in tubes 317 and 317a till the cathodes are at full emission temperature. Switch 342, which also interrupts the plate current in both tubes 317 and 317a is controlled by a cam 343.

A variable rheostat 330 in series with a fixed resistor 331 and the cathode of amplifier tube 313 regulates the degree of amplification of tube 313. The shields around the oscillator coils 306 and 308, grid coil 312, transformer 336, and around the leads to plates 301 are connected to the negative side of the filter through condensers 332, which by-pass any H. F. currents, but reduce feed-back and interference from surges in the power line. Condenser 333 is connected across the power line, and condenser 334 between the negative side of the filter and ground, for the same purpose.

The operation of the circuit is as follows:

After all tuned circuits are aligned to the same frequency (500,000 cycles/second has been found to be a suitable frequency) condenser 302 is adjusted till zero output is obtained from the amplifier, as indicated by tube 316, without any cigarette between plates 301. Then with a cigarette of the desired average density between the plates 301 and potentiometer 330 set for maximum amplification, the potentiometers 341 and 341a are adjusted just below the tripping points of tubes 317 and 317a. When set this way,

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"heavy" tube 317 will trip for any cigarette heavier than this average, and "light" tube 317a for any cigarette lighter than this standard. The "spread" between the upper and lower limits can be increased by reducing the amplification with potentiometer 330. Condenser 302 does not necessarily have to be set for balance without any cigarette between plates 301, but must be set for balance outside the limits between which it is desired to control the feed. If adjusted for balance above the maximum density, the designation "light" and "heavy" should be interchanged.

The two relays 325 and 325a control the movements of an armature 344, centrally pivoted at a point between the two magnets. Said armature 344 is normally held in a balanced or neutral position by means of a pair of light springs 350 each of which is anchored to a stationary pin 351. Therefore armature 344 can only make contact when attracted by one or the other relay. If the "light" magnet 325a is energized, contact 345 closes, and if the "heavy" magnet 325 is energized, contact 346 closes, but the two contacts can never close at the same time. Contacts 345 and 346 control a reversing motor 352 on whose shaft is mounted a pinion 353 driving a gear 354 (Fig. 2) on the regulating screw shaft 355 of a variable speed transmission 356, such as the Reeves drive fully described in the patents granted to Wilford J. Hawkins on June 28, 1932, No. 1,864,728, and Stein, No. 1,810,932, June 23, 1931, through which the motor 357 drives the tobacco feed F. The turning of the motor 352 in one direction will increase, and in the other direction will decrease, the rate of feed of tobacco T being showered on cigarette paper P by a proportional amount. From the Reeves drive 356 is driven the tobacco feed F by means of a chain 358. The Reeves drive includes a drive shaft driven by motor 357 and a driven shaft whereon the sprocket driving chain 358 is mounted. On the drive and driven shafts of the Reeves drive are axially movable pulleys which engage with an endless belt running over these pulleys. Thus, when the screw shaft is turned, the spacing of the pulleys on the shafts of the Reeves drive is varied and the sprocket chain 358 is driven at a different speed to vary the volume of tobacco showered on paper P. Since the construction of the Reeves drive is old and well known, further description thereof is deemed unnecessary. The cigarette paper is wrapped about the tobacco deposited thereon to form a continuous cigarette rod by means of a rod former U (Fig. 1), the seam of said rod being pasted by a paster V and sealed by a sealer S.

Cam 343 is driven continuously from the main drive of the machine (not shown). When one of the tubes 317 or 317a is tripped, energizing its corresponding relay, the latter remains energized, continuing to change the rate of tobacco feed, until cam 343 opens switch 342 and breaks the plate current. The timing of cam 343 is such that switch 342 remains open for a sufficient length of time for the effects of the correction to become noticeable between plates 301. If the correction was insufficient, a second correction in the same direction will take place when switch 342 recloses.

With reference to Fig. 3, the drawing discloses a pair of detector plates 400 placed above and below the tobacco guide channel which, in this instance, is formed by means of a rod-forming tape 401 and a top belt 402. The tobacco TA is fed from a tobacco feed FE into a tobacco feed

channel formed by an inclined bottom belt 403 and a top belt 404 having an inclined run coacting with the upper run of belt 403 to deposit the tobacco stream ST on to a paper web P which rests upon and travels with the rod-forming tape 401. The tobacco feed FE has a shaft 405 carrying a sprocket 406 whereby the feed is driven by a chain 407 from a variable speed transmission of the same type and construction as the one disclosed in Fig. 2. The detector plates 400 by means of wires WI are connected with exactly the same circuit of an electrostatic control unit for a tobacco feed as disclosed in Fig. 2, in this case the detector plates 400 replacing plates 301. As disclosed in Fig. 3, a thin stream of tobacco ST, or a stream of little density, is fed at a relatively higher speed to the slower moving channel formed by belts 401 and 402 with the object of building up a tobacco column CO of greater volume and density. It is of course very desirable and important to keep this tobacco column which builds up between belts 401 and 402 at a uniform length, and it is therefore essential to control the density and amount of tobacco present in stream ST. As illustrated in Fig. 3, the tobacco stream ST passes in between the two detector plates 400 to build up the larger column CO. If too much tobacco is fed, the latter will cause said column to increase in length until upon reaching the detector plates 400, it unbalances the circuit of the electrostatic control unit which in turn operates the variable speed drive. Thus in this case the rate at which tobacco is delivered by the tobacco feed is decreased.

In the construction shown in Fig. 3, the tobacco will be always "overfed" a little in order to form a full column of tobacco at all times.

Another important feature of the invention disclosed in Fig. 3 is the speed with which the change of the tobacco flow can be effected. Heretofore, the inclined feed belts 403 and 404 were driven from the driving mechanism of the cigarette maker, requiring a considerable time before a change of the tobacco feed was noticeable in the tobacco stream or cigarette rod. By driving said belts directly from tobacco feed drive shaft 405, a change of the speed of the tobacco feed will also immediately change the speed of the feed belts 403 and 404. Belt 403 is supported by an idler roller 410 and driven by a pulley 411 mounted on a shaft 412 and carrying a bevel gear 413 meshing with a bevel gear 414 mounted on a vertical shaft 415 held by a bearing bracket 416 attached to the housing of the tobacco feed FE. Shaft 415 is driven by a bevel gear 417 meshing with bevel gear 418 which is mounted on the feed drive shaft 405. Belt 404 runs over a pair of guide rollers 419 and an idler roller 420 and is driven by a roller or pulley 421 mounted on a shaft 422 driven by means of a pair of bevel gears 423 from a shaft 424 supported in suitable bearings of a bracket 425. To shaft 424 is fastened a gear 426 which through an intermediate gear 427, is driven by a gear 428 attached to the feed driving sprocket 406 on shaft 405.

Another important feature lies in the use of the top guide belt 402 which, together with belt 401 forms the slower moving guide channel in which the heavier tobacco column CO is built up. Said belt 402 is not only a guide belt but also acts as a retainer, its more or less rough surface not allowing the tobacco to slide, thus assuring a firm grip on the tobacco column and

a positive movement of the same. Said belt 402 runs over a pair of guide rollers 430 and an idler roller 431 and is driven by means of a roller 432 mounted on a shaft 433 which is driven, just as belt 401 from the main drive of the cigarette maker. By supporting all rollers 430, 431 and 432 on an adjustable bracket (not shown) the channel may be adjusted to different heights.

I have referred to the plates 301 and 400 as condenser plates and have referred to a capacitative coupling between said plates which varies the current in the circuit because of the variations in the rod or tobacco stream operating adjacent or between them. Actual test with the construction disclosed shows there is a variation in current but it is not possible to be certain as to what are all the factors which cause this current change as a result of rod variations. Therefore, I do not wish to be confined to any particular theory as to how the current is varied in the circuit as a result of the coaction of these plates and the rod or tobacco stream. While it is believed that the effect is mainly or in part a capacitative or condenser effect, nevertheless other effects may be present such as an induction effect or some power loss or conductivity effect, and it is possible that these or other electrical effects constitute a substantial or even a major part of the cause of current variations as the result of changes of density in the rod.

For purposes of illustration I have shown specific embodiments of my invention. However, it will be apparent to those skilled in the art that changes and modifications can be made therein without departing from the true spirit of my invention or the scope of the appended claims.

What is claimed is:

1. In a cigarette machine, the combination with a rod former for folding a web of cigarette paper about a stream of tobacco to form a cigarette rod, of mechanism for advancing a cigarette paper web supporting a continuous stream of tobacco into said rod former for formation of a cigarette rod, means for delivering tobacco to the cigarette paper web advanced on said mechanism to form a continuous layer of tobacco thereon, an electric circuit including spaced condenser plates arranged adjacent the cigarette rod formed by said rod-former, the capacitative coupling between said plates being varied by the proximity of a section of the cigarette rod, and a device responsive to variations in the capacitative coupling of said condenser plates due to variations in the condition of the cigarette rod for varying the rate at which tobacco is delivered to said mechanism by said means.

2. The combination with a rod former adapted to continuously advance a cigarette paper web and fold the same about a continuous stream of tobacco to form a cigarette rod consisting of said stream wrapped in said web, of a traveling member for supporting and advancing said continuous stream of tobacco into said rod former, an electric circuit responsive to an overfilled or underfilled section of the continuous stream of tobacco and so constructed and arranged with respect to the advancing stream of tobacco that the latter forms an element of said circuit and affects the flow of current through said circuit in accordance with changes in the distribution of tobacco in said stream, mechanism for delivering tobacco to said member to form a continuous tobacco stream thereon, and a device responsive to variations in the flow of current in said circuit

created by variations in the distribution of tobacco in said stream for increasing or decreasing the rate at which said mechanism delivers tobacco to said member to maintain a uniform density of the tobacco stream on said member, said circuit being adjustable to vary limits between which an underfilled or overfilled section of the tobacco stream will sufficiently affect said circuit to vary the rate of operation of said mechanism.

3. The combination with a rod former adapted to fold a continuous cigarette paper web about a continuous stream of tobacco, of a traveling member constituting a part of the rod former for supporting and advancing a continuous stream of tobacco in the form of a rod, of means for determining variations in the density of the tobacco stream before it enters said rod former and while it is supported and advanced on said member, said means including a detector responsive to the density of the tobacco stream and disposed within proximity to the tobacco stream on said member and out of contact therewith and within proximity of said rod former, mechanism for delivering tobacco to said member to form a continuous tobacco stream thereon, and a device controlled by said means for increasing or decreasing the rate at which tobacco is delivered to said member by said mechanism when variations in the density of said tobacco stream are detected by said detector to maintain a uniform density of the tobacco stream on said member.

4. In a cigarette machine, the combination with a sizing passage arranged to receive a stream of tobacco sufficient for forming a cigarette rod, means for forwarding a stream of tobacco from said passage at a speed substantially equal to cigarette rod speed, mechanism for forwarding into said passage at a speed greater than the speed at which said tobacco stream is forwarded from said passage a layer of cigarette tobacco having a cross-sectional area which is less than the cross-sectional area of said passage whereby the tobacco will build up to the desired cross-section within the confines of the passage, detecting means adjacent said passage and responsive to the presence or absence of a sufficiency of tobacco in said passage to properly fill a cigarette rod, and mechanism controlled by said detecting means and coacting with said first mentioned mechanism for controlling the supplying of tobacco to said passage in accordance with the presence or absence of said sufficiency of tobacco.

5. In a cigarette machine, the combination with mechanism operating to fold a web of cigarette paper about a continuous stream of tobacco to form a cigarette rod, means for advancing a continuous stream of tobacco into said mechanism, a device disposed out of contact with the cigarette rod but responsive to variations in the density thereof, and mechanism controlled by said device for varying the rate at which tobacco is delivered to said rod-forming mechanism by said means.

6. In a cigarette machine, the combination with rod-forming mechanism operating to fold a web of cigarette paper about a continuous stream of tobacco to form a cigarette rod, of means for advancing a continuous stream of tobacco into said rod-forming mechanism, a tobacco feed for showering tobacco upon said means to form a continuous stream of tobacco thereon, an electric circuit including spaced pick up elements adapted to be electrically connected by a section of the cigarette rod,

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and mechanism responsive to variations in the electrical connection of said elements due to variations in the density along a section of the cigarette rod for varying the rate at which tobacco is showered upon said means by said tobacco feed.

7. In a cigarette machine, the combination with rod-forming mechanism for folding a web of cigarette paper about a continuous stream of tobacco to form a continuous cigarette rod, of means for forming a continuous stream of tobacco and advancing said stream into said mechanism, an electric circuit responsive to an underfilled or overfilled section of cigarette rod and including spaced pick up elements adapted to be electrically connected by the cigarette rod, and mechanism controlled by said circuit for varying the rate at which tobacco is delivered by said means into said rod-forming mechanism, said circuit being adjustable to vary the limits between which an overfilled or underfilled section of the cigarette rod will sufficiently affect said circuit to vary the rate of operation of said means.

8. In a cigarette machine having a continuously operating tobacco feed and a rod former, the combination with a column former arranged in front of said rod former for admitting and confining tobacco from said feed to form the same into a column, continuously operating tobacco delivery means for feeding tobacco from one end of said column directly into said rod former, a detector adjacent the other end of said column and responsive to the position of said end, and a control for said feed actuated by said detector.

9. In a machine for making smokable articles from tobacco and having a tobacco feed and an article former; the combination with a column former for admitting and confining tobacco from said feed to form the same into a column; tobacco delivery means for feeding tobacco from one end of said column for delivery to said article former; and detector means including an electric circuit adjacent the other end of said column and control instrumentalities which are connected to said tobacco feed and operated to vary the rate at which tobacco is fed by said tobacco feed to said column former, said electric circuit being responsive to the position of said other end of the column and operating to control said control instrumentalities and thereby vary the rate at which tobacco is fed into said column formed by

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said tobacco feed when actuated by a variation in the position of said other end of the column, said circuit being responsive to variations in the electrical properties of the tobacco in said column.

10. In a cigarette machine, the combination with a narrow endless traveling member adapted to advance a continuous stream of tobacco, of a tobacco feed adapted to shower tobacco along the length of said member and thereby form a continuous stream of tobacco thereon, a rod former adapted to fold a cigarette paper web about a continuous stream of tobacco to form a continuous cigarette rod, an endless traveling belt adapted to continuously advance a cigarette paper web into said rod former, the paper on said belt being arranged to receive the tobacco stream from said member and advance the tobacco stream into said rod former whereby a continuous cigarette rod will be formed, means for driving said member and tobacco feed, and a device responsive to variations in the density of the tobacco stream for increasing or decreasing the speed at which said member and tobacco feed are driven by said means to vary the rate at which tobacco is delivered from said member to the paper web advanced on said belt and thereby maintain a substantially uniform density of the cigarette rod formed in said rod former.

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