United States Patent

[11] **3,575,041**

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[32] Priority **Dec. 7, 1967**
[33] **Germany**
[31] **P 16 32 216.0**

[54] **APPARATUS FOR TESTING CIGARETTES OR THE LIKE**
20 Claims, 5 Drawing Figs.

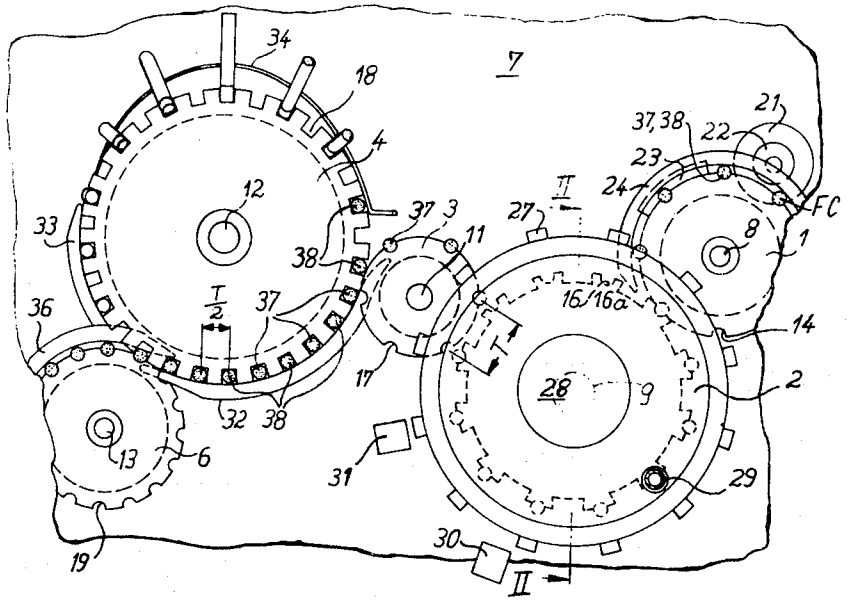
[52] **U.S. Cl.** **73/45.1**
[51] **Int. Cl.** **B07c 5/12**
[50] **Field of Search** 209/72, 73, 74, 75; 73/37.5, 37.6, 37.7, 38, 45.1, 45.2

[56] **References Cited**
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ABSTRACT: Two rows of filter cigarettes which move sideways are tested simultaneously while traveling in the flutes of a testing drum past a testing station where both ends of each cigarette receive testing fluid from a stationary source. The drum is provided with an annular flange between the two rows of flutes and with two rows of nipples which engage the outer ends of cigarettes during travel past the testing station to urge the inner ends of such cigarettes against the flange. Testing fluid is admitted by way of the nipples and through passages provided in the flange, and the passages of the flange are connected with an electronic or pneumatic testing unit during travel past the testing station. The testing unit controls an ejector which expels defective cigarettes from their flutes downstream of the testing station. One row of cigarettes is thereupon inverted end for end so that the cigarettes of the one row are deposited between the cigarettes of the other row.



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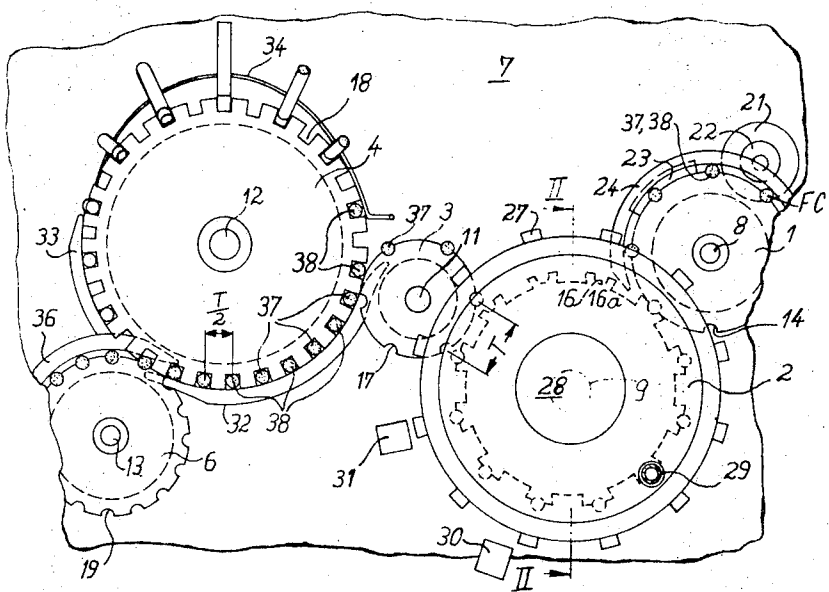


Fig. 1

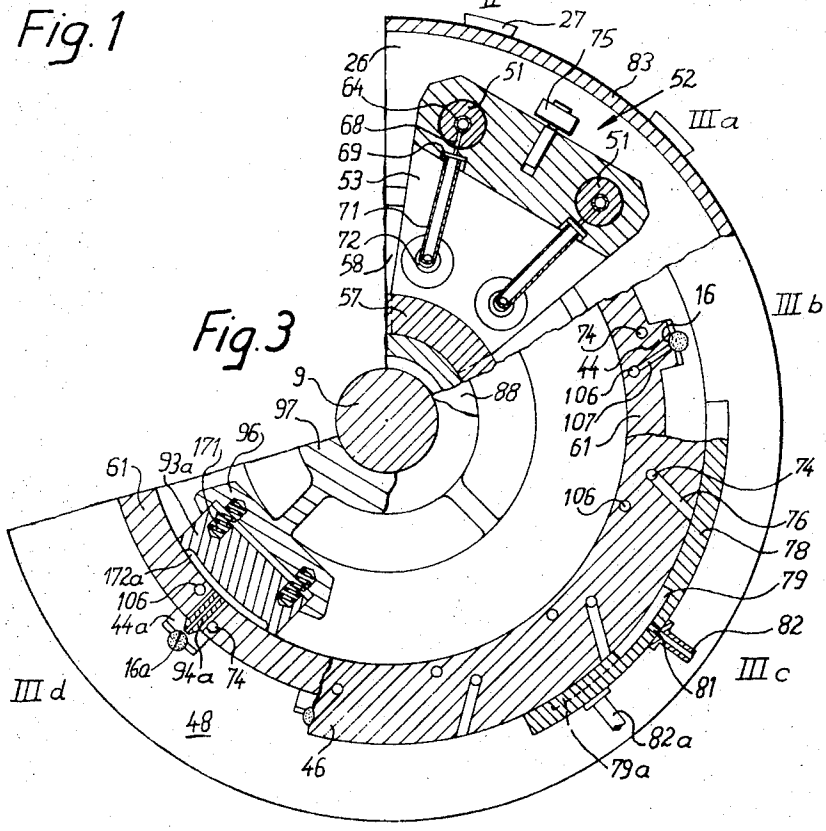


Fig. 3

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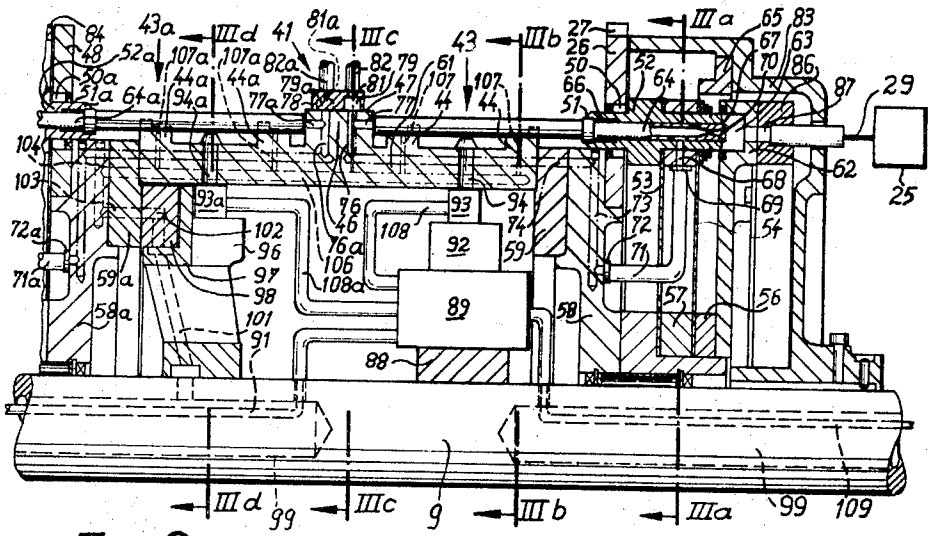


Fig. 2

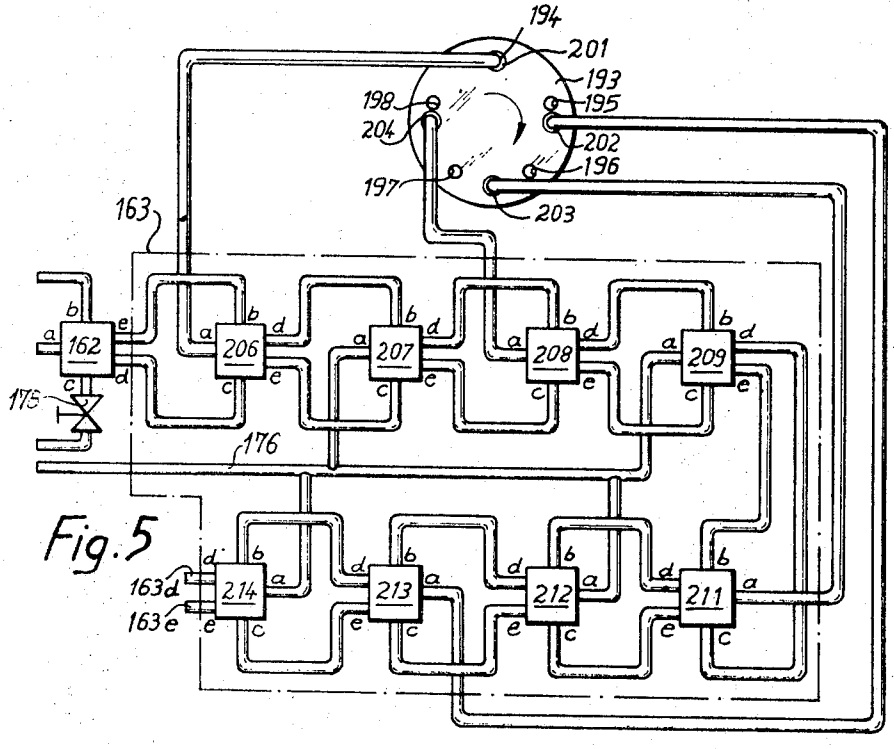


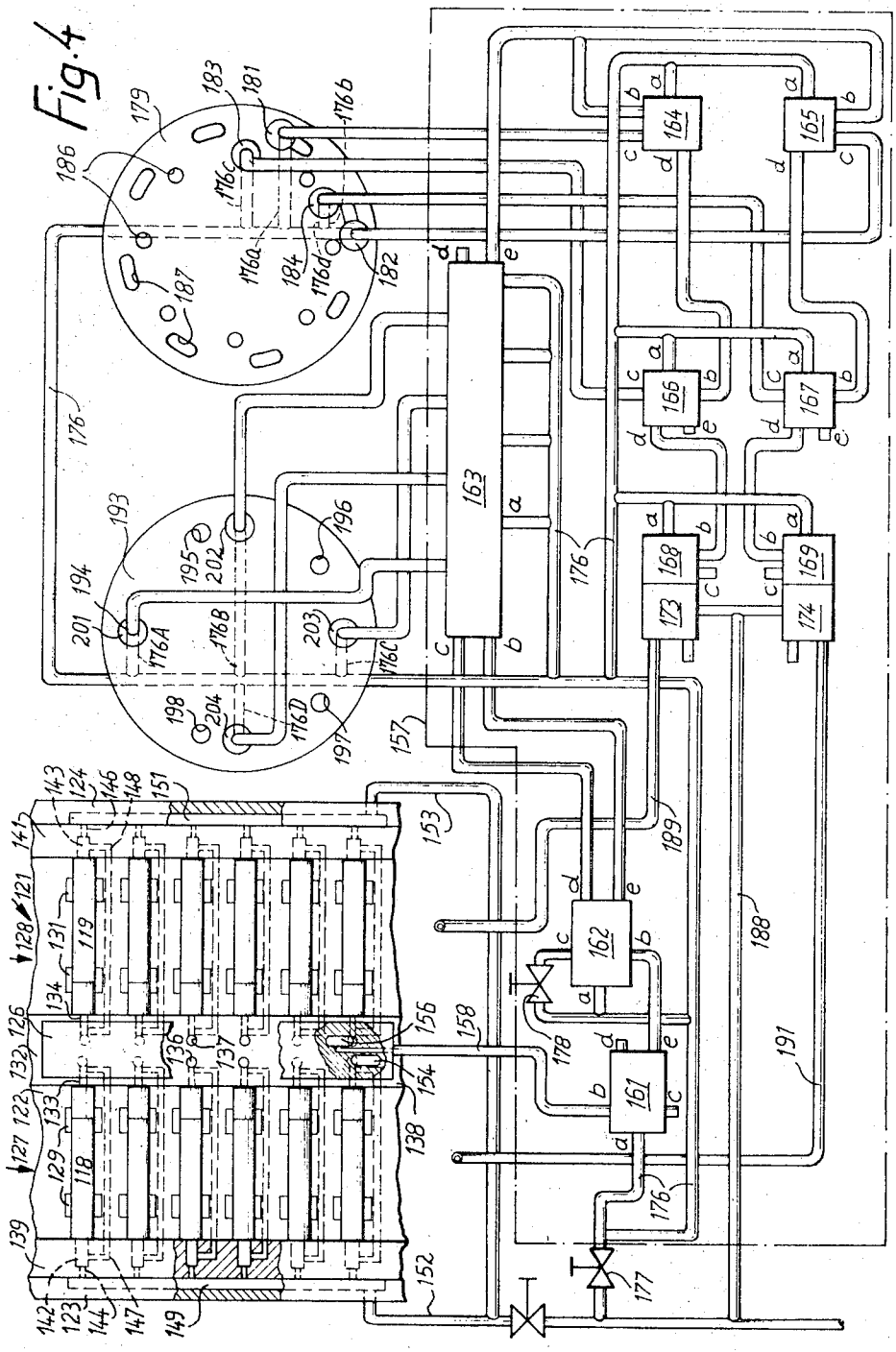
Fig. 5

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Fig. 4



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APPARATUS FOR TESTING CIGARETTES OR THE LIKE

BACKGROUND OF THE INVENTION

The present invention relates to apparatus for testing cigarettes or analogous articles wherein a rod-shaped gas-permeable filler is surrounded by one or more open-ended tubular wrappers of cigarette paper, cork or the like. More particularly, the invention relates to improvements in apparatus which can be utilized to test and otherwise treat or manipulate filter cigarettes, cigars or cigarillos of unit length and/or multiple unit length.

It is already known to test filter cigarettes subsequent to subdivision of a single row of filter cigarettes of double unit length into two rows of filter cigarettes of unit length and after inversion of one row of cigarettes so that the filter tips of inverted cigarettes face in the same direction as the filter tips of cigarettes in the other row. A drawback of such procedure is that all of the cigarettes in the one row must be inverted, i.e., also those which include defective fillers and/or wrappers. Inversion or attempted inversion of defective cigarettes often leads to complete destruction of such articles which results in contamination of the apparatus or lengthy interruptions in production.

It is also known to test cigarettes of double unit length prior to subdivision into cigarettes of unit length and prior to subsequent inversion of one row of cigarettes of unit length. Such procedure is more satisfactory in one respect because defective cigarettes of double unit length are segregated prior to inversion. However, the procedure is wasteful because it happens frequently that only one-half of a filter cigarette or plain cigarette of double unit length is defective; nevertheless, the entire cigarette is discarded because the testing apparatus cannot discern the exact position of the defect, i.e., the apparatus cannot group separately those cigarettes which are defective in part so that they can yield a satisfactory and a defective cigarette of unit length. Still further, apparatus which test plain or filter cigarettes of double unit length are normally slower and/or less reliable than those which test cigarettes of unit length. This will be readily appreciated since it takes longer to convey a stream of testing fluid through the filler of a relatively long cigarette and also because the resistance of two tobacco fillers, of a filter mouthpiece of double unit length and of several coaxial wrappers is much less predictable than that of parts in a plain or filter cigarette of unit length.

It is further known to test two rows of plain or filter cigarettes in a simultaneous operation. Such mode of testing is disclosed in U.S. Pat. No. 3,270,551 to Schmalz. A drawback of the patented apparatus is that the cigarettes are accelerated axially to enter testing chambers wherein the cigarettes are braked by mechanical means. Such rough treatment often causes deformation of and/or damage to cigarettes. As a rule, each cigarette on the testing conveyor must be moved axially through distances exceeding its length, first during introduction into and thereupon during expulsion from the corresponding testing chamber. This is a time-consuming procedure which must be carried out by resorting to a bulky testing conveyor.

SUMMARY OF THE INVENTION

One of the objects of my invention is to provide an apparatus which can simultaneously test several rows of plain or filter cigarettes or analogous rod-shaped articles and wherein such testing subjects the articles to minimal deforming or other stresses.

Another object of the invention is to provide an apparatus wherein defective articles are segregated from satisfactory articles at an early stage of their manipulation so that the operation of such apparatus is less likely to be affected by defective articles.

A further object of the invention is to provide a versatile testing apparatus which can be rapidly converted for treatment of different types of articles as well as for treatment of shorter or longer articles, for example, for testing and other treatment of a single row of filter cigarettes of unit length or multiple unit length, or for testing and other treatment of several rows of such articles.

An additional object of the invention is to provide an apparatus which, in addition to being capable of accurately testing one or more rows of rod-shaped articles, is also capable of influencing the orientation of such articles as well as of converting several rows into a single row of articles.

An ancillary object of the invention is to provide an apparatus which can test and/or otherwise manipulate and treat filter cigarettes or like articles at the rate at which they issue from a mass-producing machine.

One feature of my invention resides in the provision of an apparatus for testing filter cigarettes or analogous articles wherein an open-ended tubular wrapper surrounds a rod-shaped filler of gas-permeable material. The testing apparatus comprises a testing conveyor, preferably a revolving drum having several (preferably two) groups of blocks or like receiving means each having flutes arranged to receive and to advance a row of articles sideways past a testing station, sealing means arranged to seal the ends of wrappers on articles traveling past the testing station and including movable nipples or analogous sealing portions each registering with one of the receiving means, means (e.g., cams and roller followers) for moving each movable sealing portion against the adjoining end of the wrapper in the registering receiving means, at least while the articles travel past the testing station, means for admitting streams of a testing fluid into the ends of wrappers moving past the testing station whereby the characteristics of such streams change as a function of the condition of respective articles, and testing means for determining the characteristics of such streams. Thus, instead of employing a testing conveyor whereon the articles must be moved lengthwise through considerable distances, the apparatus of my invention comprises several groups of movable sealing portions which can engage the adjoining ends of wrappers with a negligible axial displacement of respective articles. If the conveyor is provided with two rows of receiving means, the sealing means preferably comprises a centrally located annular flange or an analogous sealing member against which the wrappers are urged by the movable sealing portions during travel past the testing station, and the testing fluid is preferably admitted by way of the flange and by way of the movable sealing portions.

In accordance with another feature of my invention, the testing of two or more rows of filter cigarettes takes place ahead of an inverting station where at least one row of filter cigarettes is inverted end for end so that the filter tips of cigarettes in such one row face in the same direction as the filter tips of cigarettes in the remaining row or rows. The apparatus of my invention segregates defective articles from satisfactory articles upstream of the inverting station so that only those articles which are satisfactory can reach the inverting station. This reduces the likelihood of malfunction of the inverting unit and of contamination of the apparatus by fragments of filters and/or tobacco rods of defective articles.

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

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a schematic side elevational view of a first apparatus which embodies one form of the present invention;

FIG. 2 is an enlarged fragmentary axial sectional view of the testing conveyor in the first apparatus, the section being taken in the direction of arrows as seen from the line II–II of FIG. 1;

FIG. 3 is a composite transverse vertical sectional view of the testing conveyor as respectively seen in the direction of arrows from the lines IIIa–IIIa, IIIb–IIIb, IIIc–IIIc and IIId–IIId of FIG 2;

FIG. 4 is a fragmentary plan view of a portion of a second apparatus and a diagrammatic view of the testing unit in this apparatus; and

FIG. 5 is a diagrammatic view of a delay device in the testing unit of the apparatus shown in FIG. 4.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The apparatus which is shown in FIGS. 1 to 3 comprises a conveyor system which transports filter cigarettes of multiple unit length and unit length. As shown in FIG. 1, the conveyor system comprises a first conveyor which includes a rotary drum 1 (hereinafter called cutting drum) cooperating with a rotary knife 21 to subdivide filter cigarettes FC of double unit length into pairs of filter cigarettes 37, 38 of unit length, a second conveyor which includes a second drum 2 (hereinafter called testing drum) whereon the cigarettes 37, 38 are tested for integrity of their fillers and/or wrappers, a transfer conveyor which includes a third drum 3 (hereinafter called transfer drum) which receives satisfactory cigarettes 37 and/or 38 from the testing drum 2, a fourth conveyor including a fourth drum 4 (hereinafter called inverting drum) which receives cigarettes from the transfer drum 3 and whereon the cigarettes 37 or 38 are inverted end for end so that their filter tips face in the same direction as those on the cigarettes 38 or 37, and a fifth conveyor including a drum 6 (hereinafter called receiving drum or takeoff drum) which accepts cigarettes 37, 38 from the inverting drum 4 and delivers them to storage, to a collecting device or to other destination. The drums 1, 2, 3, 4, 6 are respectively mounted on shafts 8, 9, 11, 12, 13 which are supported by a platelike frame member or wall 7 forming part of a filter cigarette machine.

The peripheries of the drums 1, 2, 3 are respectively provided with axially parallel pockets or flutes 14, 16–16*a* and 17. The distance between the flutes 14, 16–16*a* or 17 (as considered in the circumferential direction of the respective drums) is indicated at *T*. The distance between the pockets or flutes 18, 19 in the peripheries of the drums 4, 6 equals *T*/2.

The aforementioned rotary knife 21 extends into a circumferential groove or slit of the drum 1 and the central portion or hub 22 of the knife 21 resembles the frustum of a cone so that it can shift the cigarettes 37, 38 axially and away from each other. A wedgelike spreader 23 is located downstream of the knife 21, as considered in the direction of rotation of the drum 1, to increase the axial distance between the cigarettes 37, 38 of each pair. Arcuate shields or shrouds 24 are provided adjacent to the periphery of the drum 1 to hold the filter cigarettes FC of double unit length against the action of centrifugal force and to thereupon hold the cigarettes 37, 38 against ejection from flutes 14 while such cigarettes advance from the severing station (knife 21) to the transfer station where they enter the flutes 16 and 16*a* of the testing drum 2. If desired, the shrouds 24 can be replaced by or employed in addition to customary suction-operated holding means which is capable of retaining cigarettes FC, 37 and 38 in their respective flutes during travel toward, past and beyond the knife 21.

The details of the testing drum 2 will be described in connection with FIGS. 2 and 3. FIG. 1 merely shows the projections or lobes 27 of a ring 26 (FIG. 2) which is mounted on the drum 2, a pneumatic testing unit 28 which is mounted on the shaft 9, and a conduit 29 which conveys gaseous testing fluid between the cigarettes in the flutes 16, 16*a* and the testing unit 28. The latter may be of the type as disclosed, for example, in the copending application Ser. No. 431,355 of Esenwein which is assigned to the same assignee. The main difference between the testing unit of Esenwein and the one shown in FIG. 1 is that the latter cooperates with two contactless initiators 30, 31 which produce signals at timely spaced intervals determined by the projections 27. Each of these initiators forms part of one of two testing assemblies each of which can test a row of cigarettes 37 or 38.

The transfer drum 3 is a suction drum and is provided with circumferential grooves receiving portions of stationary stripping or article removing blades 32, 33 which extend around the inverting drum 4. The stripping blade 32 extends to the transfer station between the drums 4 and 6. The other stripping blade 33 is longer than the blade 32. The drum 6 is shorter than and is coplanar with the front half of the inverting drum 4, as viewed in FIG. 1. The blade 33 is located behind the drum 6 and extends beyond the transfer station between the drums 4, 6, for example, to the level of the shaft 12. A stationary inverting member 34 extends from the left-hand end of the guide 33 and surrounds the upper part of the inverting drum 4 to terminate close to the transfer station between the drums 3 and 4. The flutes 18 are of polygonal cross-sectional outline and are provided with centrally located depressions. The manner in which the member 34 cooperates with the drum 4 to invert the cigarettes 37 or 38 end for end is disclosed in U.S. Pat. No. 3,172,457 to Rudszinat et al. which is assigned to the same assignee.

The front half of the inverting drum 4 is provided with a circumferential groove for an article removing or stripping member 36 which extends around the takeoff drum 6 and serves to effect transfer of cigarettes 37, 38 from the flutes 18 into the flutes 19.

The drums 1, 2, 3, 4, 6 are driven at the same peripheral speed by a system of gears which derives motion from the main drive of the filter cigarette machine.

FIG. 2 illustrates a portion of the testing drum 2 in axial section taken across the testing station. This illustration shows again the parts 9, 27 and 29 which were mentioned in connection with FIG. 1. It will be noted that the testing drum 2 comprises two mirror symmetrical halves including a rear half which is adjacent to the wall 7 (not shown but located to the left of FIG. 2) and a front half which is remote from such wall. Those elements of the rear half which are identical or clearly analogous to the elements of the front half are denoted by similar reference numerals each followed by the character *a*.

The drum 2 comprises a cylindrical body or rotor 41 which is rotatable on the shaft 9. The peripheral surface of the rotor 41 is provided with two axially spaced rows or groups 43, 43*a* of receiving means or blocks 44, 44*a* which respectively define flutes 16 and 16*a* (see FIG. 3). The two groups 43, 43*a* are separated from each other by a centrally located annular sealing member or flange 46 of the rotor 41, and this sealing member or flange has a smooth cylindrical external surface 47. The outer (right-hand) side of the group 43 is flanked by the aforementioned ring 26, and a similar ring 48 flanks the left-hand side of the group 43*a*. The rings 26, 48 are respectively provided with bores 50, 50*a* which register with the flutes 16, 16*a* and accommodate movable sealing portions or nipples 51, 51*a*. Each pair of adjoining sealing portions or nipples 51 or 51*a* is mounted in a common carrier 52, 52*a* as shown in FIG. 3 for the nipples 51. Each carrier 52 is mounted on two parallel leaf springs 53, 54 which are axially spaced from each other and permit axial movements of the respective carrier, namely, movements in the axial direction of the testing drum 2. The leaf springs 53, 54 are screwed to an annular holder 56 and a distancing ring 57 both supported by a plate 58 which, together with a distancing ring 59, constitutes one end wall of a tubular element 61 of the rotor 41. The ring 59 is screwed to the parts 58 and 61. The holder 56 is affixed to a ring 62 provided with bores 63 each of which registers with one of the nipples 51 and each of which receives a portion of a nipple in such a way that the latter is sealingly received and axially movable therein. Each nipple 51 has a central opening which receives a tube 64 having at its inner axial end an annular bead which is engaged by one end convolution of a helical compensating spring 66. The other end convolution of each spring 66 reacts against the

corresponding nipple 51. Split rings 67 are provided to limit axial movements of tubes 64 in a direction toward the adjoining flutes 16. The outer end portion of each tube 64 is provided with a restrictor or throttle 70. The interior of each tube 64 communicates with a radial bore 68 which extends through such tube, through the corresponding nipple 51, and is in communication with a fitting 69 for one end of a conduit or hose 71. The other end of each hose 71 is connected to a fitting 72 on the plate 58. The fitting 72 communicates with a radially inwardly extending bore 73 in the plate 58. The major part of the bore 73 is located in front of the plane of FIG. 2; therefore, this bore is indicated by broken lines. The bore 73 communicates with an axially parallel bore 74 extending through the plate 58, distancing ring 59 and tubular member 61 into the region inwardly of the flange 46. The flange 46 is formed with a radial bore 76 which extends inwardly from the peripheral surface 47 and communicates with the axially parallel bore 74. The bore 76 further communicates with an axially parallel bore or passage 77 provided in the flange 46 and registering with the bore of the corresponding tube 64. The bores 68, 73, 74, 76, fittings 69, 72 and hose 71 constitute a composite channel which connects the interior of a tube 64 with the passage 77, and one such channel is provided for each of the tubes 64.

The peripheral surface 47 of the flange 46 is engaged by a connecting means or shoe 78 having a first slot 79 which registers with the row of bores 76. The slot 79 is connected with a conduit 82 by way of a bore 81 in the shoe 78, and the conduit 82 is united with the conduit 82*a* of the shoe 78; the thus merged conduits 82, 82*a* are connected with the testing unit 28. The shoe 78 has a second slot 79*a* which registers with the row of bores 76*a* in the flange 46. This slot 79*a* communicates with the bore 81*a* and conduit 82*a*.

The shaft 9 is rigid with a cover member 83 which overlies the front end of the drum 2 all the way to the ring 26. The other end of the drum 2 is covered by a second cover member 84 and by the wall 7. The inner side of the cover member 83 is provided with a ring-shaped cam 65 which cooperates with roller followers 75 (FIG. 3) provided on the carriers 52 for pairs of nipples 51. The cover member 83 further carries three pins or posts (not shown) which guide a control ring 86 for movement in axial direction of the drum 2. The control ring 86 is biased by springs to bear against the aforementioned ring 62. The control ring 86 has an arcuate slot 87 whose length is a multiple of the distance *T* and which is in temporary communication with successive bores 63 and in permanent communication with the conduit 29. The source of testing gas is shown at 25. The length of the slot 87 determines the length of the testing station where the cigarettes 37, 38 are tested while moving in their flutes 16, 16*a*. The bores of tubes 64 receive testing fluid from the slot 87 while the corresponding nipples 52 move past the testing station. The same applies for the nipples 52*a*.

The tubular member 61 of the rotor 41 surrounds a ring 88 which is affixed to the shaft 9 and carries a valve 89. The latter is connected with and receives signals from the testing unit 28 by way of a conduit 91 a portion of which extends through the shaft 9. The body of the valve 89 supports a housing 92 for a shoe 93 which is biased by springs 171 (FIG. 3) to bear against the internal surface of the tubular member 61. The member 61 carries radially extending ejector nozzles 94 which can discharge compressed air between the receiving means or blocks 44 so that jets of air issuing from such nozzles can expel defective cigarettes 37 from the flutes 16. The ejector nozzles 94*a* in the rear half of the drum 2 are connected with a shoe 93*a* which is installed on a housing 96 mounted on a spoked ring 97 which is affixed to the shaft 9. The ring 97 supports an axially reciprocable ring 98 which is biased by springs to bear against the distancing ring 59*a*. The shaft 9 is formed with an axially extending bore 99 which is connected with a suction generating device, not shown. The bore 99 communicates with a radial bore 101 which extends through the rings 97, 98 and communicates with a concentric slot 102. The slot 102 is in temporary communication with an axially parallel bore 103 provided in the distancing ring 59*a* and plate 58*a* and communicating with a radial bore 104 in the plate 58*a*. The bore 104 communicates with an axially parallel bore 106 which extends through the distancing ring 59*a* and tubular member 61 into the region inwardly of the foremost block 44. The bore 106 communicates with radial bores 107 provided in the blocks 44 and 44*a* and extending into the flutes 16, 16*a*. The bores which connect the bore 99 with the bore 107 will be called holding channels.

The valve 89 is connected with the shoes 93, 93*a* by conduits or hoses 108, 108*a*. A portion of an air admitting conduit 109 for the valve 89 passes through the axial bore 99 of the shaft 9. The valve admits compressed air into the shoe 93 or 93*a* when it receives from the testing unit 28 a signal that a defective cigarette 37 or 38 approaches the ejecting station which is located downstream of the testing station, i.e., the shoes 93, 93*a* are located past the slot 87 as considered in the direction of rotation of the drum 2.

FIG. 3 illustrates certain details of the structure which was described in connection with FIG. 2. It will be noted that FIG. 3 is a section taken through four axially spaced portions of the testing drum 2 as indicated in FIG. 2 by the lines IIIa–IIIa, IIIb14 IIIb, IIIc–IIIc and IIId–IIId. The section taken along the line IIIa–IIIa illustrates the configuration of the leaf spring 53 for the carrier 52. Between the nipples 51 in the block 52, there is provided a radially extending shaft for a roller follower 75 which tracks the face of the cam 65. The section taken along the line IIIb–IIIb illustrates the bore 107 which terminates in the adjoining flute 16. The section taken along the line IIIc–IIIc indicates that the circumferential length of the shoe 78 is a multiple of the distance *T*. The length of slots 79 and 79*a* in the shoe 78 equals *T*/2 and these slots are offset with reference to each other in such a way that, as considered in the direction of rotation of the drum 2, the downstream end of the slot 79 registers with the upstream end of the slot 79*a*. The length of the shoe 78 equals that of the slot 87 in the ring 86 and this shoe overlies the bores 76 and 76*a*. The section taken along the line IIId–IIId shows the shoe 93*a* and the housing 96. The aforementioned springs 171 operate between the shoe 93*a* and housing 96 to bias the show against the internal surface of the tubular member 61. The shoe 93*a* is formed with a slot 172*a* having a length slightly less than the distance *T*. The upstream end of the slot 72*a* is spaced from the downstream end of the slot 79*a* by a distance 2*T*.

The operation:

The flutes 14 of the cutting drum 1 receive filter cigarettes FC of double unit length from a suitable supply conveyor, not shown, and each such cigarette FC comprises two tobacco rods of unit length flanking a filter mouthpiece of double unit length. The knife 21 subdivides each cigarette FC by severing the mouthpiece midway between its ends so that each cigarette FC yields two cigarettes 37, 38 of unit length. Thus, the flutes 14 which advance beyond the knife 27 accommodate pairs of cigarettes 37, 38 which are spaced axially from each other in response to engagement of their filter tips with the hub 22 of the knife 21. The axial distance between the pairs of cigarettes 37, 38 is increased while such cigarettes travel along the wedgelike spreader 23. The latter's function is to increase the distance between the cigarettes 37, 38 to insure that such distance at least equals the width of the central sealing member or flange 46 on the rotor 41 of the testing drum 2. the cigarettes are thereupon transferred onto the drum 2 so that the cigarettes 37, 38 respectively enter the flutes 16 and 16*a*. In other words, the drum 2 carries two rows respectively consisting of equidistant cigarettes 37 and 38 which move sideways. As the rotor 41 turns on the shaft 9, the follower 75 on a carrier 52 for the nipple 51 located in registry with that flute 16 which has received a freshly transferred cigarette 37 travels along a suitably configurated portion of the face on the cam 65 so that the carrier 52 moves toward the flange 46 whereby the inner end of the respective tube 64 engages the adjoining end face of the filler in the cigarette 37.

The tube 64 shifts the cigarette 37 through a rather short distance toward the flange 46 whereby the free end of the filter tip of such cigarette engages the flange and is sealed from the atmosphere. Thus, one end of the cigarette 37 is sealed by the tube 64 of the sealing portion or nipple 51 and its other end is sealed by the central sealing member or flange 46. As the rotor 41 continues to turn and moves the roller follower 75 along the cam 65, the spring 66 is compressed between the tube 64 and nipple 51 to bias the tube 64 against the adjoining end of the cigarette 37. The purpose of the spring 66 is to compensate for eventual minor differences in the length of cigarettes 37.

As the rotor 41 continues to turn about the axis of the shaft 9, that bore 63 in the ring 62 which registers with the freshly clamped cigarette 37 moves into registry with the slot 87 in the control ring 86 so that testing fluid issuing from source 25 and passing through the conduit 29 can flow through the tube 64 and enters the adjoining end of the wrapper on the cigarette 37. At the same time, such testing fluid can also flow through the aforementioned composite channel 68, 73, 74, 76, 69, 72, 71 to enter the corresponding passage 77 in the flange 46 and thence the other axial end of the cigarette 37. The outer end of the corresponding bore 76 is sealed by the connecting means or shoe 78. The manner in which testing fluid is admitted into both ends of the cigarette 38 in the adjoining flute 16*a* is the same as described for the cigarette 37.

The rotor 41 continues to turn whereby the bore 76 of the flange 46 moves into registry with the slot 79 of the shoe 78 so that the bore 81 connects the interior of the cigarette 37 with the conduit 82 and hence with the testing unit 28. The latter measures the pressure of gas in the wrapper of the cigarette 37. When the rotor 41 turns through an angle corresponding to the distance *T*/2, the bore 76 moves away from registry with the slot 79 and the bore 76*a* moves into registry with the slot 79*a* so that the testing unit 28 can determine the pressure of testing fluid in the cigarette 38.

The signals generated by unit 28 in response to determination of fluid pressure in the cigarettes 37, 38 are staggered in response to signals transmitted by contactless initiators 30, 31 which constitute time-delay means, and the thus delayed signals are transmitted to the valve 89 along separate paths. The delay with which the valve 89 receives signals is such that a defective cigarette 37 or 38 which caused the generation of a signal has time to move into registry with the shoe 93 or 93*a*. The configuration of the face on the cam 65 is such that the leaf springs 53, 54 are free to move the corresponding tube 64 away from the adjoining end of the cigarette 37 at the time such cigarette moves into registry with the shoe 93. Thus, the cigarette 37 is not clamped between the tube 64 and flange 46 so that, if defective, such cigarette can be readily expelled from its flute 16. If the cigarette 37 is defective, the corresponding nozzle 94 receives a stream of compressed air or other suitable gas by way of the conduit 108 and shoe 93 and such compressed gas ejects the cigarette from the flute 16 into a suitable receptacle or other intercepting means, not shown.

The suction slot 102 begins immediately downstream of the slot 79*a* in the shoe 78 so that satisfactory cigarettes 37 or 38 which need not be ejected by the nozzles 94 or 94*a* are properly retained in their flutes 16, 16*a* against the action of centrifugal force. However, suction which holds satisfactory cigarettes is too weak to prevent ejection of defective cigarettes 37, 38 by jets of compressed gas issuing from corresponding nozzles 94, 94*a*. The suction slot 102 extends all the way to the transfer station between the drums 2 and 3. It will be seen that the drum 2 has means for retaining by suction all of the tested cigarettes 37, 38 and means for ejecting defective cigarettes 37 and/or 38 against the retaining action of such suction.

Satisfactory cigarettes 37, 38 are transferred into the flutes 18 of the inverting drum 4. The filter cigarettes 37 merely travel along an arcuate path of about 90° and are immediately transferred into the flutes 19 of the takeoff drum 6. The cigarettes 38 continue to move beyond the transfer station between the drums 4, 6 and are inverted by the member 34 end for end so that they move from the rear ends of their flutes 18 into the front ends of such flutes, i.e., into registry with and between pairs of cigarettes 37, and the thus inverted cigarettes 38 thereupon enter the flutes 19 of the drum 6. As stated before, the manner in which the drum 4 inverts the cigarettes 38 while permitting the cigarettes 37 to enter the flutes 19 of the drum 6 without any change in orientation is fully disclosed in the aforementioned U.S. Pat. No. 3,172,457 to Rudszinat et al. The flutes 18 have centrally located depressions into which one end of each cigarette 38 extends during inversion by the member 34. The drum 4 is provided with an odd number of flutes 18 and the distance between the centers of successive flutes 18 is *T*/2; therefore, the inverted cigarettes 38 alternate with freshly transferred cigarettes 37 during travel from the 4 o'clock position to the 7 o'clock position of FIG. 1. It will be seen that the inverting drum 4 constitutes a means for converting two rows of cigarettes 37 into a single row wherein the cigarettes 37 alternate with cigarettes 38 and wherein all such cigarettes move sideways toward the transfer station between the drums 4 and 6. Since the testing drum 2 is located ahead of the inverting drum 4, the latter receives only those cigarettes whose fillers and/or wrappers are without defects. Therefore, the drum 4 is much less likely to mutilate or to otherwise deform or destroy cigarettes because it invariably manipulates rod-shaped articles which are free of defects. For example, were the cigarettes 37, 38 tested downstream of the drum 4, the member 34 would be much more likely to break or to otherwise deform or damage a cigarette 38 whose filler is too soft or whose wrapper is improperly sealed.

If the testing assembly of the apparatus shown in FIG. 1 comprised two testing units 28, one for the cigarettes 37 and one for the cigarettes 38, the length of slots 79, 79*a* can be doubled so that each cigarette is tested for a longer period of time.

The operation of each half of the testing assembly shown in FIG. 2 is somewhat similar to that disclosed in my copending application Ser. No. 758,343 for "Method And Apparatus For Testing of Cigarettes or the Like," filed Sept. 9, 1968 and assigned to the same assignee.

FIG. 4 illustrates a portion of a modified testing assembly with a pneumatic testing unit. A testing drum 121 comprise a rotor 122, stationary control members 123, 124 for admission of testing fluid, and a stationary connecting means or shoe 126. The rotor 122 is provided with two groups or rows 127, 128 of equidistant receiving means or blocks 129, 131 which are provided with flutes for filter cigarettes 118, 119. The two groups 127, 128 are separated by a central sealing member or flange 132 having axially parallel passages 133, 134 which respectively register with the flutes of blocks 129, 131. The passages 133, 134 respectively communicate with radial bores 136, 137 which extend all the way to the peripheral surface 138 of the flange 132. The shoe 126 slides along the surface 138. The bores 136, 137 are disposed in two parallel planes which are normal to the axis of the rotor 122.

The outer sides of the groups 127, 128 are flanked by rows of movable sealing portions 139, 141 formed with axially parallel bores 142, 143 each of which registers with one of the passages 133, 134. Throttles or restrictors 144, 146 connect the bores 142, 143 with slots 149, 151 of the control members 123, 124. Each bore 142, 142, 143 is respectively connected with the registering passage 133, 134 by a composite channel 147, 148 which branches from the bore 142, 143 downstream of the respective restrictor 144, 146.

The length of arcuate slots 149, 151 in the control members 123, 124 is a multiple of the distance between a pair of adjoining flutes, and the slots 149, 151 respectively communicate with several bores 142, 143 at a time. The slots 149, 151 are connected with a source of testing fluid by conduits 152, 153.

The shoe 126 overlies the bores 136, 137 in the surface 138 of the flange 132 in the region which is axially aligned with the slot 149, i.e., where the bores 142 register with the slot 149. This shoe is formed with two slots 154, 156 each having a length corresponding to or approximating half the distance between two adjoining flutes. The slots 154, 156 are angularly offset with reference to each other in such a way that the downstream end of the slot 154 is aligned with the upstream end of the slot 156. The slots 154, 156 are respectively coplanar with the bores 136, 137. A conduit 158 connects the slots 154, 156 with a testing unit 157.

The unit 157 is assembled of pneumatic low-pressure elements, known as pneumonic elements. Such elements are manufactured by the Firm Willy Vogel, Geisenauer Str. 66, 1 Berlin 61, Germany.

The testing unit 157 comprises the following serially arranged components: A proportional amplifier 161 is followed by a Schmitt-trigger 162, a delay device 163 (which will be described in greater detail in connection with FIG. 5), and two parallel-connected AND gates 164, 165 which are respectively connected with flip-flops 166, 167, OR gates 168, 169 and valves 173, 174. The characters *a*, *b*, *c*, *d*, *e* respectively denote the inputs for supply air, the first control air inputs, the second control air inputs, the first air outputs and the second air outputs. A common feed conduit 176 supplies air to the inputs *a* at a pressure determined by a regulating valve 177. The input *b* of the amplifier 161 is connected with the conduit 158, and the output *e* of this amplifier is connected with the input *b* of the Schmitt-trigger 162. The input *c* of the element 162 is connected with the feed conduit 176 by way of an adjustable pressure reducing valve 178. The outputs *d* and *e* of the Schmitt-trigger 162 are connected with the inputs *c* and *b* of the delay device 163. The output *e* of the delay device 163 has two branches connected to the inputs *b* of the AND gates 164, 165. The inputs *c* of the AND gates 164, 165 are connected with intercepting nozzles 181, 182 cooperating with a disc-shaped timer 179. The latter is provided with eight symmetrically arranged slots 187 each having a length which is somewhat less than the distance covered by the revolving timer 179 during one-half of an interval required by the drum 121 to move a cigarette 118 or 119 by the distance *T*. The distance between the nozzles 181, 182 corresponds to one and one-half times the distance covered by timer 179 during an interval.

The outputs *d* of the AND gates 164, 165 are connected with the inputs *b* of the flip-flops 166, 167. The inputs *c* of the flip-flops 166, 167 are connected with two additional intercepting nozzles 183, 184 which cooperate with the timer 179. The nozzles 183, 184 are offset radially inwardly with reference to the nozzles 181, 182 and can register with an annulus of eight equidistant axially parallel bores 186 in the timer 179. The distance between the nozzles 183, 184 is the same as that between the nozzles 181, 182. The arrangement is such that the nozzle 183 or 184 registers with a bore 186 when the nozzle 181, 182 ceases to register with the corresponding slot 187.

Each of the intercepting nozzles 181—184 registers with one of four blowing nozzles (not shown) located at the opposite side of the timer 179 and each connected to the feed conduit 176 by branches 176*a*, 176*b*, 176*c*, 176*d*.

The outputs *d* of the flip-flops 166, 167 are connected with the inputs *b* of OR gates 168,169. The outputs *e* of these flip-flops communicate with the atmosphere. The inputs *c* of OR gates 168,169 are not connected to other parts. The valves 173, 174 are directly connected with the OR gates 168, 169 and are further connected with a feed conduit 188 and with discharge conduits 189, 191 which terminate radially inwardly of the groups 128, 127. These discharge conduits terminate downstream of the slots 156, 154 at a distance corresponding to half the distance between two adjoining flutes in the blocks 129 or 131. The rotor 122 carries two groups of ejector nozzles (not shown) and each row of such nozzles registers with the discharge end of one of the conduits 189, 191.

The delay device 163 is combined with a second rotary disc-shaped timer 193 provided with equidistant axially parallel bores 194 to 198 each located at the same distance from the axis of the timer 193. Four intercepting nozzles 201 to 204 are adjacent to one side of the timer 193 at the same radial distance as the bores 194—198. Blowing nozzles are located at the opposite side of the timer 193, and each such blowing nozzle registers with one of the nozzles 201—204. The blowing nozzles are connected to the feed conduit 176 by branch conduits 176A, 176B, 176C, 176D. The construction of the delay device 163 is shown in FIG. 5. This delay device comprises four serially arranged assemblies which respectively comprise amplifiers 206, 208, 211, 213 and flip-flops 207, 209, 212, 214. The characters *a*, *b*, *c*, *d* and *e* shown in FIG. 5 have the same meaning as described in connection with FIG. 4. The inputs *a* of the amplifiers 206, 208, 211, 213 are respectively connected with the intercepting nozzles 201, 204, 203, 202 in the just outlined sequence. The inputs *a* of the flip-flops 207, 209, 212, 214 are connected with the feed conduit 176. The outputs *d*, *e* of the schmitt-trigger 162 are connected with the inputs *c*, *b* of the amplifier 206. The outputs *d*, *e* of this amplifier are connected with the inputs *b*, *c* of the flip-flop 207, and the outputs *d*, *e* of the flip-flop 207 are connected with the inputs *b*, *c* of the amplifier 208. The same holds true for the connections between the other elements of the delay device 163 as can be readily determined by looking at FIG. 5. The outputs *d*, *e* of the last flip-flop 214 constitute the outlets 163*d*, 163*e* of the delay device 163.

The operation of the testing apparatus shown in FIGS. 3, 4 and 5 is as follows:

Filter cigarettes 118, 119 are fed into the flutes of the receiving means or blocks 129, 131 on the rotor 122 to form two rows wherein the cigarettes travel sideways. At the testing station (slots 149, 151), the end faces of the cigarettes 118, 119 respectively abut against the movable sealing portions 139, 141 and against the side faces of the central sealing member or flange 132. The manner in which the sealing portions 139, 141 are movable axially of the testing drum 121 is not shown in FIG. 4; for example, these sealing portions may include nipples and tubes similar to the parts 51, 51*a* and 64, 64*a* shown in FIG. 2. Those cigarettes which move along the slots 149, 151 receive testing fluid at both ends by way of restrictors 144, 146, bores 142, 143, passages 133, 134 and the aforementioned channels 147, 148 which respectively connect the bores 142 with passages 133 and the bores 143 with passages 134. The pressure in the wrappers of cigarettes 118, 119 rises above the pressure of surrounding atmospheric air. Since the wrappers which consist of cigarette paper or like material are porous, some of the entrapped testing fluid can escape through such pores. However, a substantially greater amount of testing fluid can escape if a wrapper has a hole or a leak, for example, along an imperfect seam where the marginal portions of wrapping paper overlap. The restrictors 144, 146 are designed in such a way that a predetermined pressure develops in the wrapper of a satisfactory cigarette and that the pressure in the slots 149, 151 does not decrease below a predetermined value if a cigarette happens to be missing, i.e., if a pair of registering passages and bores 133, 142 or 134, 143 is free to discharge testing fluid into the atmosphere. This insures satisfactory testing of cigarettes even through a cigarette 118 or 119 happens to be missing, i.e., if a set of blocks 129 and/or 131 moving past the testing station (namely, along the slots 149, 151) does not accommodate any cigarettes.

When a cigarette 118 or 119 respectively moves along the slot 154, 156 of the connecting means or shoe 126, a stream of testing fluid flows into the conduit 158. Due to the fact that the slots 154, 156 are angularly offset with reference to each other and also due to the fact that the length of each of these slots approximates half the distance between two adjoining flutes in the blocks 129 or 131, a substantially continuous stream of testing fluid flows through the conduit 158 when each of the sets of blocks 129, 131 moving past the slots 149,

151 accommodates a cigarette 118 or 119. Such stream of testing fluid is admitted into the proportional amplifier 161 of the testing unit 157 and is amplified to leave the amplifier 161 and to be admitted into the Schmitt-trigger 162 by way of the input *b*. The input *c* of the Schmitt-trigger 162 receives a reference airstream at a constant pressure which is determined by the reducing valve 178. The Schmitt-trigger 162 compares the two streams, i.e., it determines the difference between the pressures of streams respectively entering at the inputs *b* and *c* of the element 162 and such difference is indicative of the condition of the corresponding cigarette 118 or 119. If the pressure of fluid (normally air) entering at *b* exceeds the pressure of air which enters the Schmitt-trigger 162 at *c*, the corresponding cigarette 118 or 119 is satisfactory. The Schmitt-trigger 162 then discharges a stream of air at *d* and such stream enters the delay device 163. The latter discharges a signal (a stream of compressed air) with a delay of 1⅛ intervals, and such signal is transmitted via outlet 163*d*. If the airstream entering the input *b* of the Schmitt-trigger 162 is weaker than the reference airstream entering at *c*, this indicates the presence of a defective cigarette 118 or 119; the Schmitt-trigger 162 then discharges a stream of air at the output *e*. The delay device 163 produces a signal with a delay corresponding to 1⅛ times the length of an interval, but such signal is discharged at the outlet 163*e*. This signal is then transmitted to the inputs *b* of the AND gates 164, 165. The gate 164 transmits a signal to the flip-flop 166 only when its input *c* receives a simultaneous signal from the intercepting nozzle 181. The AND gate 165 transmits a signal to the flip-flop 167 only when its input *c* receives a simultaneous signal from the intercepting nozzle 182.

A slot 187 of the timer 179 moves into registry with the intercepting nozzle 181 with a delay which corresponds to the aforementioned delay (1⅛ times later than the corresponding bore 137 moves past the slot 156). The same hoids true for the delay with which a slot 187 moves into registry with the intercepting nozzle 182 following movement of the corresponding bore 136 past the slot 154 in the shoe 126. In other words, the AND gate 164 transmits signals which indicate defective cigarettes 119 and are received from the slot 156, whereas the AND gate 165 transmits signals which are transmitted by slot 154 and indicate defective cigarettes 118. The flip-flops 166, 167 immediately transmit such signals to the OR gates 168, 169 which actuate the valves 173, 174 so that these valves admit airstreams into conduits 189, 191 which in turn admit compressed air to ejector nozzles (not shown) to bring about expulsion of defective cigarettes 118, 119 from their flutes.

The operation of the delay device 163:

The timer 193 is rotated by the main drive of the filter cigarette machine at such a speed that, after elapse of one-half of an interval, the bore 194 therein takes the place of the preceding bore 195. The signal furnished, for example, by the output *e* of the Schmitt-trigger 162 is transmitted to the input *b* of the amplifier 206. This signal is transmitted further when the input *a* of the amplifier 206 receives a signal from the intercepting nozzle 201. In that position of the timer 193 which is shown in FIG. 5, the intercepting nozzle 201 can receive a signal (compressed air from the registering blowing nozzle) by way of the bore 194. The signal issuing from the output *e* of the amplifier 206 is transmitted to the input *c* of the flip-flop 207, and the latter transmits a pneumatic signal until it receives a signal by way of the output *d*. The outgoing signal is transmitted to the input *c* of the amplifier 208 and the latter transmits the signal only when its input *a* receives a signal from the intercepting nozzle 204, i.e., when this nozzle registers with the bore 197 of the timer 193. The signal issuing from the amplifier 208 is emitted by way of the output *e* and such signal causes the flip-flop 209 to discharge a signal at the output *d*. Such signal is transmitted to the input *c* of the amplifier 211 and the latter's output *d* transmits a signal when the amplifier 211 receives a signal from the intercepting nozzle 203 by way of its input *a*. The nozzle 203 transmits a signal when it registers with the bore 195 of the timer 193. The signal issuing at the output *d* of the amplifier 211 causes the output *e* of the flip-flop 212 to transmit a signal to the input *c* of the amplifier 213 and the latter's output *d* transmits an amplified signal when the input *a* receives a signal from the intercepting nozzle 202, i.e., when this nozzle registers with the bore 198 of the timer 193. The flip-flop 214 transmits a signal at the output *e*, i.e., at the outlet 163*e* of the delay device 163. While a signal travels through the device 163, the timer 193 completes two full revolutions plus one-fourth of a revolution which corresponds to a delay of 1⅛ intervals.

When the delay device 163 receives a signal from the output *d* of the Schmitt-trigger 162, such signal is again caused to pass through all of the elements in the delay device but it issues at the outlet 163*d* so that it cannot cause ejection of the corresponding cigarette 118 or 119.

An important advantage of the improved testing apparatus is that it can be readily converted for testing of a single row of cigarettes or analogous rod-shaped articles of unit length or multiple unit length. Such conversion requires no adjustment between the cigarettes of the single row and the speed at which the single row of cigarettes is transported can be the same as when the apparatus tests two rows of cigarettes. The distance between successive cigarettes and the speed of the testing drum determine the length of the interval during which a cigarette is being tested, and the length of such interval is the same regardless of whether the testing drum transports a single row or two rows. The results of tests which are carried out in my apparatus are more reliable than the results of tests in apparatus which test cigarettes or filter cigarettes of double unit length because a cigarette can be damaged while a cigarette of multiple unit length is being subdivided into cigarettes of unit length. Moreover, the results of tests are more reliable if the testing fluid must pass through a relatively short filler. Still further, losses due to escape of testing fluid are negligible, particularly owing to the provision of aforementioned restrictors 70, 70*a* or 144, 146 which admit testing fluid to the ends of tested articles and prevent the pressure of such testing fluid from decreasing below a predetermined value even if a cigarette is missing while the corresponding flute travels past the testing station.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can, by applying current knowledge, readily adapt it for various applications without omitting features which fairly constitute essential characteristics of the generic and specific aspects of my contribution to the art.

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

I claim:

1. In an apparatus for testing cigarettes or analogous articles wherein an open-ended tubular wrapper surrounds a rod-shaped filler of gas-permeable material, a combination comprising a testing conveyor having a plurality of receiving means each arranged to advance a pair of axially spaced discrete coaxial articles sideways past a testing station; sealing means arranged to seal the ends of wrappers on pairs of articles in receiving means travelling past said station, said sealing means comprising pairs of movable portions each pair of which registers with one of said receiving means; means for moving each movable portion against the adjoining end of a wrapper in the registering receiving means while the respective pairs of articles travel past said station; stream admitting means for admitting streams of a testing fluid into the ends of pairs of coaxial wrappers moving past said station whereby the characteristics of such streams change as a function of the condition of the respective articles; and testing means for determining the characteristics of said streams.

2. A combination as defined in claim 1, wherein said stream admitting means comprises a single source of testing fluid and said testing means comprises a single testing unit.

3. In an apparatus for testing cigarettes or analogous articles wherein an open-ended tubular wrapper surrounds a rod-

shaped filler of gas-permeable material, a combination comprising a testing conveyor having two groups of receiving means each arranged to advance a row of articles sideways past a testing station; sealing means arranged to seal the ends of wrappers on articles travelling past said station, said sealing means comprising a central sealing member extending between said groups of receiving means and movable portions each registering with one of said receiving means; means for moving each movable portion against the adjoining end of the wrapper in the registering receiving means while the articles travel past said station; means for admitting streams of a testing fluid into the ends of wrappers moving past said station whereby the characteristics of such streams change as a function of the condition of the respective articles; and testing means for determining the characteristics of said streams.

4. A combination as defined in claim 3, wherein the receiving means of each group are equidistant from each other and wherein each receiving means of one group registers with a receiving means of the other group.

5. A combination as defined in claim 4, wherein said sealing means is arranged to share movements of said conveyor.

6. A combination as defined in claim 3, wherein the movable portions of said sealing means form two rows which flank said central sealing member.

7. A combination as defined in claim 6, wherein said fluid admitting means is arranged to admit testing fluid into the wrappers by way of said movable portions.

8. A combination as defined in claim 7, wherein said fluid admitting means comprises a source of testing fluid, control members each adjacent to the path of movement of one row of movable portions and each having an elongated slot with which the corresponding movable portions register during travel past said station, and means for conveying testing fluid from said source to said slots.

9. A combination as defined in claim 3, wherein said central sealing member is provided with passages each registering with one of said receiving means, said fluid admitting means being connected with those passages which travel past said station and further comprising connecting means for connecting said testing means with those passages which travel past said testing station.

10. A combination as defined in claim 9, wherein said connecting means comprises a fixed shoe in sealing engagement with said central sealing member.

11. A combination as defined in claim 9, wherein said passages form two rows and wherein said connecting means is provided with two slots staggered with reference to each other as considered in the direction of movement of said conveyor and each registering with one of said rows.

12. A combination as defined in claim 1, wherein said testing means comprises a plurality of pneumatic low-pressure control elements including at least one pneumatic amplifier.

13. A combination as defined in claim 1, further comprising ejector means located past said testing station and operative to segregate defective articles from satisfactory articles in response to signals produced by said testing means.

14. A combination as defined in claim 13, wherein said testing means comprises delay means for delaying said signals so that a defective article reaches said ejector means when the latter receives a corresponding signal from said testing means.

15. A combination as defined in claim 1, wherein said conveyor is a rotary drum and wherein said receiving means are provided with flutes extending in parallelism with the axis of said drum.

16. A combination as defined in claim 15, further comprising pneumatic ejector means for expelling defective articles from their flutes in response to signals received from said testing means, said ejector means comprising nozzle means provided in said drum in registry with each of said flutes and means located downstream of said testing station for admitting into said nozzle means compressed gas in response to signals from said testing means.

17. Apparatus for treatment of filter cigarettes or analogous articles wherein an open-ended tubular wrapper surrounds a rod-shaped filler of gas-permeable material, comprising conveyor means for advancing two rows of articles sideways; testing means for detecting defective articles in said rows; ejector means for segregating the thus detected defective articles; and inverting means for changing the orientation of articles in one of said rows downstream of said ejector means.

18. Apparatus as defined in claim 17, wherein said inverting means comprises means for converting said two rows of articles into a single row.

19. Apparatus as defined in claim 18, wherein said articles are filter cigarettes and wherein the filter tips of cigarettes in said one row are adjacent to the filter tips of cigarettes in the other row prior to inversion of cigarettes in said one row.

20. Apparatus as defined in claim 17, wherein said inverting means comprises means for placing successive articles of said one row between successive pairs of articles of the other row.