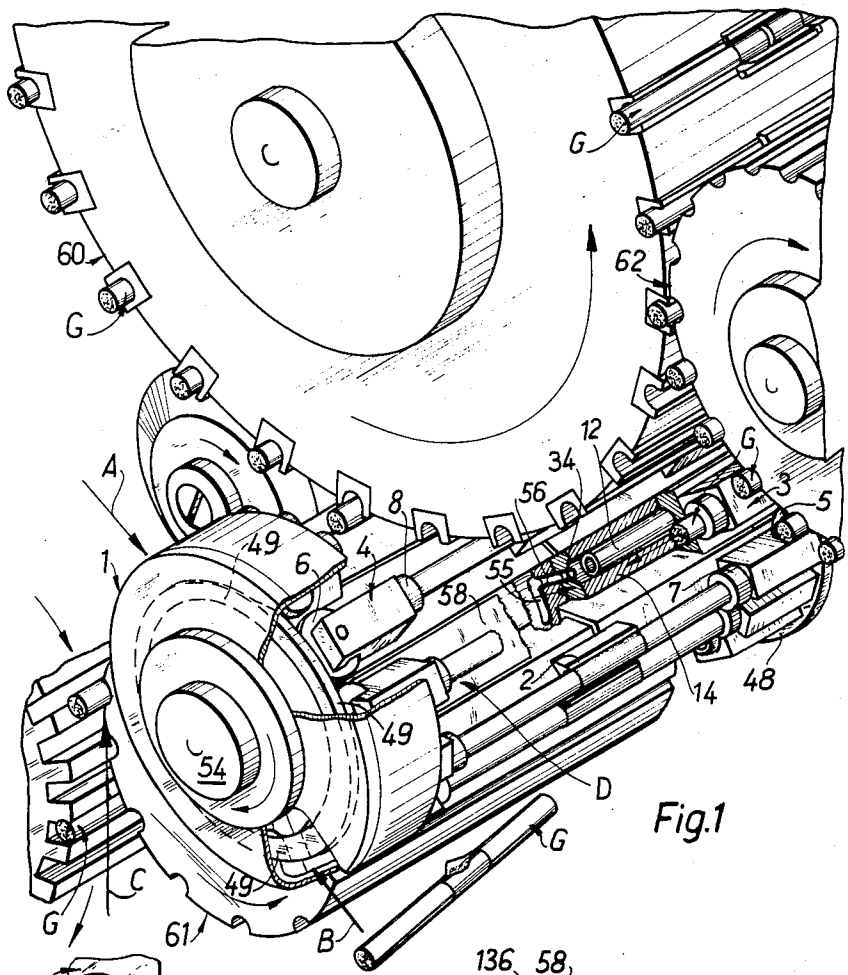
March 1, 1966 H. KAEDING ETAL 3,237,444

METHOD AND APPARATUS FOR TESTING THE INTEGRITY OF, AND RESISTANCE TO FLOW THROUGH HOLLOW ARTICLES, SUCH AS CIGARETTES AND THE LIKE

Filed July 30, 1962 4 Sheets-Sheet 1



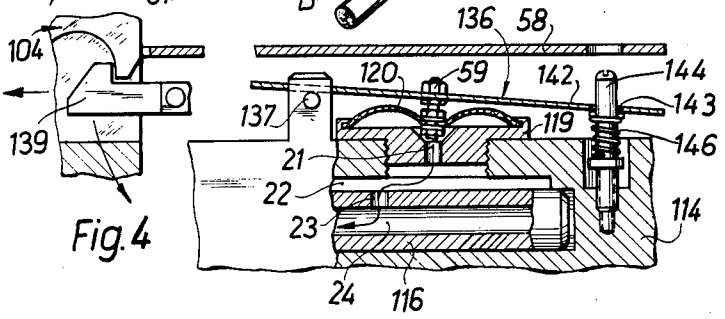
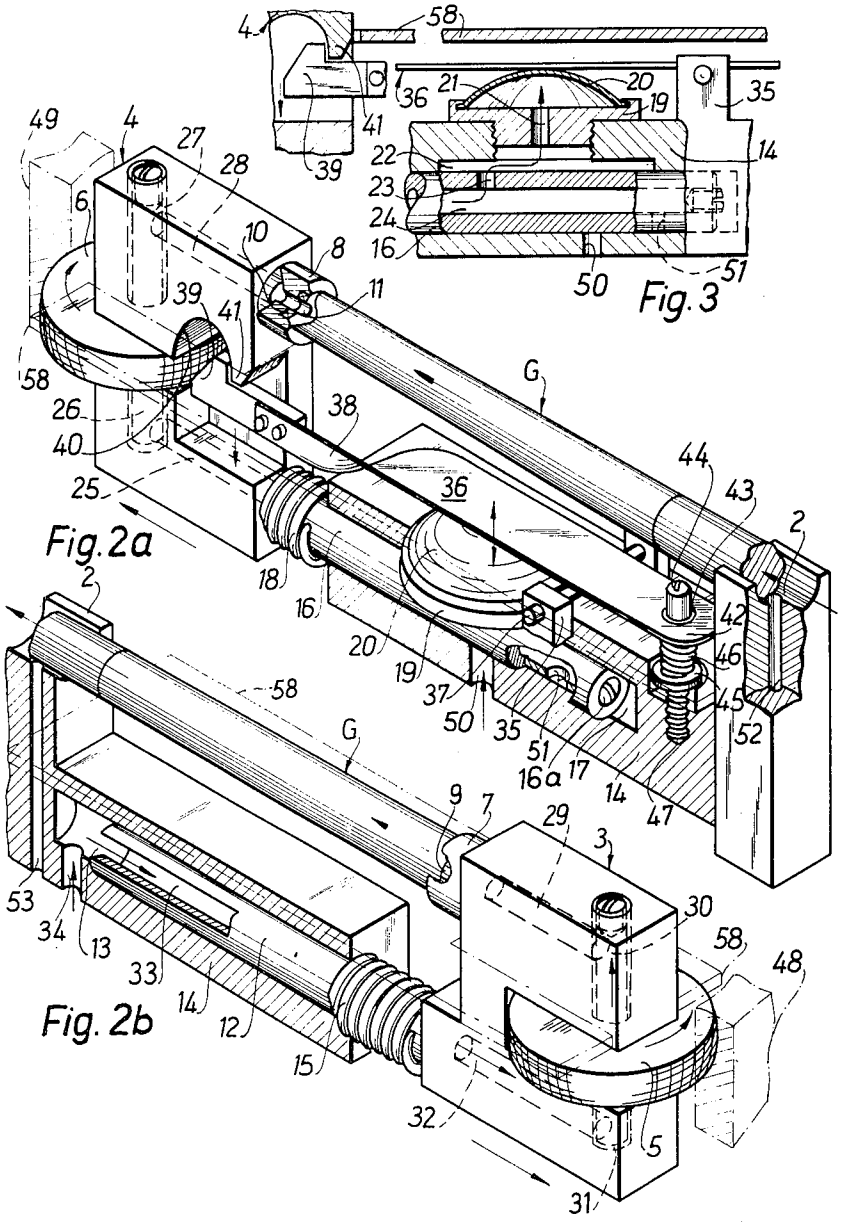


Fig.4

March 1, 1966 H. KAEDING ETAL 3,237,444

METHOD AND APPARATUS FOR TESTING THE INTEGRITY OF, AND RESISTANCE TO FLOW THROUGH HOLLOW ARTICLES, SUCH AS CIGARETTES AND THE LIKE

Filed July 30, 1962 4 Sheets-Sheet 2

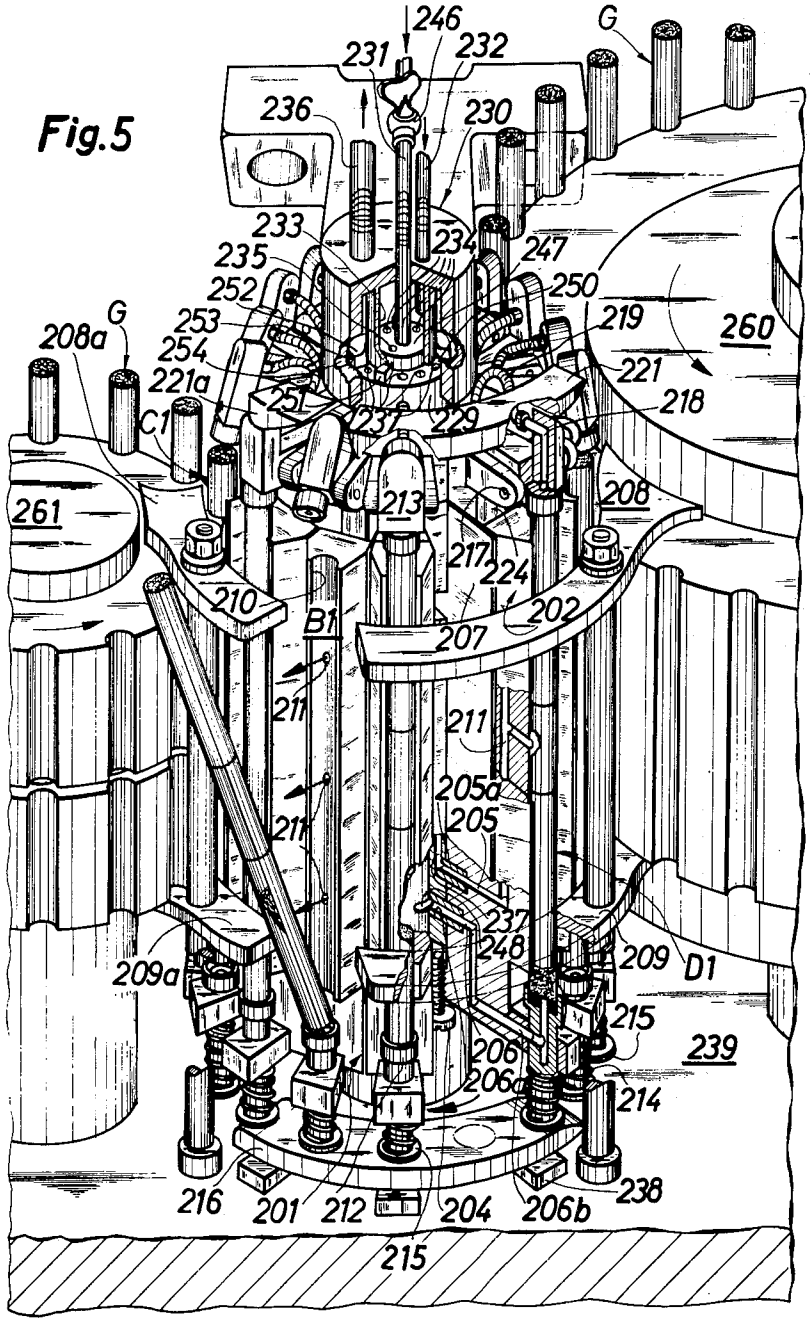


March 1, 1966 H. KAEDING ETAL 3,237,444

METHOD AND APPARATUS FOR TESTING THE INTEGRITY OF, AND RESISTANCE TO FLOW THROUGH HOLLOW ARTICLES, SUCH AS CIGARETTES AND THE LIKE

Filed July 30, 1962 4 Sheets-Sheet 3

Fig.5



March 1, 1966 H. KAEDING ETAL 3,237,444

METHOD AND APPARATUS FOR TESTING THE INTEGRITY OF, AND RESISTANCE TO FLOW THROUGH HOLLOW ARTICLES, SUCH AS CIGARETTES AND THE LIKE

Filed July 30, 1962 4 Sheets-Sheet 4

Fig. 6

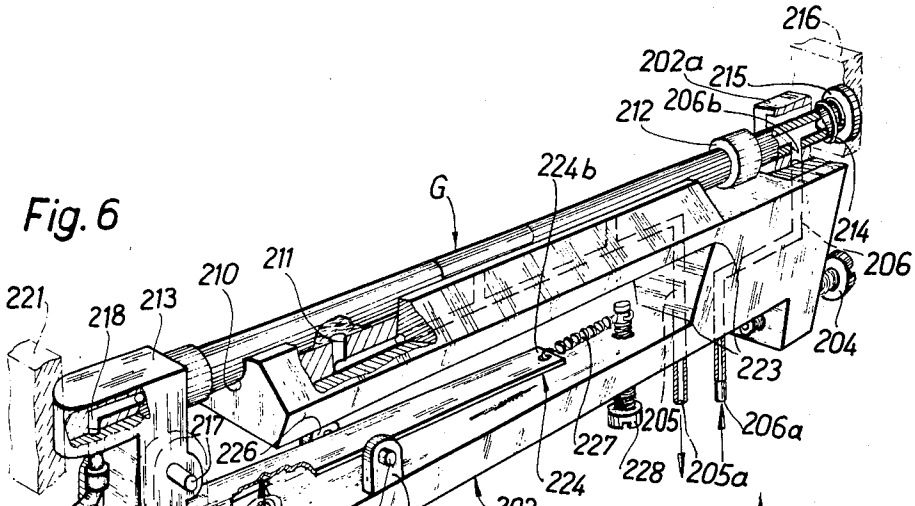


Fig. 7

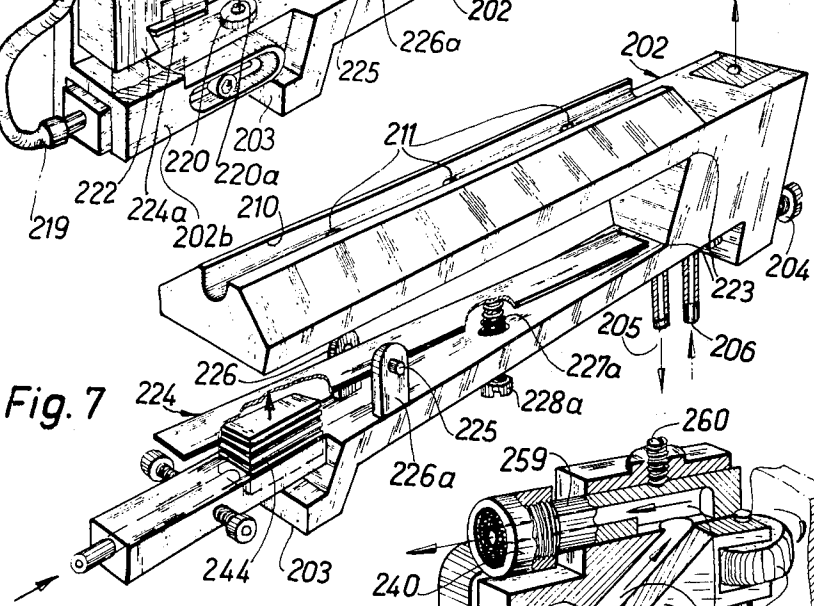
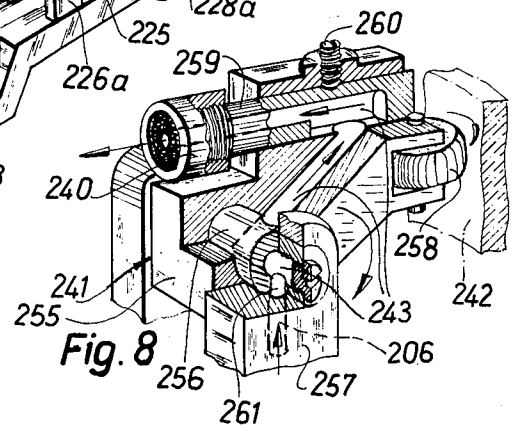


Fig. 8



United States Patent Office

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METHOD AND APPARATUS FOR TESTING THE INTEGRITY OF, AND RESISTANCE TO FLOW THROUGH HOLLOW ARTICLES, SUCH AS CIGARETTES AND THE LIKE

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Claims priority, application Great Britain, Aug. 3, 1961, 28,213/61; Sept. 15, 1961, 33,252/61

23 Claims. (Cl. 73—45.1)

This invention relates generally to a method and apparatus for testing the integrity of, and the resistance to flow through hollow articles, such as, cigarettes and the like, which have only two openings at their opposite ends connected by a restricted flow path therebetween. In addition to cigarettes, the improved method and apparatus embodying this invention may be employed for testing a wide variety of rod-shaped tobacco products and components thereof, including wrapped rods of tobacco from which a plurality of cigarettes are to be cut, filter cigarettes, filter tubes, sleeves or mouthpieces, with or without filter plugs therein, assemblies of cigarettes and filters from which filter cigarettes are to be cut, and cigars, cigarillos and the like, with or without mouthpieces or filters. Wherever the term "cigarette" is employed in the following description and claims, that term is intended to include any of the above identified tobacco products or components thereof.

When manufacturing filter cigarettes, damages or defects may occur in the paper wrapper of the cigarette or in the connection of the cigarette to the paper sleeve which extends around the filter and joins the latter to the cigarette, and such damages or defects produce leaks through which atmospheric air may enter and thereby adversely affect the smoking properties of the cigarette. Since it is desirable to eliminate all such defective cigarettes from the manufacturing process, devices have been proposed, for example, as in United States Letters Patent No. 2,951,364, issued September 6, 1960, to Joseph H. Sherrill, for testing each cigarette for leaks in its outer wall and for withdrawing or rejecting those cigarettes in which leaks are found to exits.

In the arrangement proposed in the above identified patent, carriers, each adapted to support a cigarette or a group or unit from which two filter cigarettes may be cut, are linked together to form a conveyor belt. The opposite ends of each carrier further support a test device, in the form of a rubber balloon, and an air supply coupling mechanism. As the conveyor moves the successive cigarette units through a test zone, the coupling mechanisms of the carriers moving through the zone are communicated with a supply of compressed air so that a stream or flow of air is conveyed through the cigarette unit for inflating the balloon of the associated test device. If there is no leak in the cigarette unit, the flow of air through the cigarette unit to the test device is sufficient to fully inflate the rubber balloon of the latter, and a photoelectric checking device is located alongside the path of travel of the conveyor and senses whether or not the balloons associated with the successive carriers are fully inflated and thereby indicate the presence of satisfactory cigarette units. Further, electrical signals from the checking device are employed for actuating a mechanical memory device which retains indications characteristic of the condition of the cigarette units supported by the successive carriers, and which are, in turn, employed for actuating an ejector mechanism which removes the defective cigarette units from the related carriers as the latter successively pass an ejector station.

It will be apparent that the above described existing arrangement does not employ the flow of air through each cigarette unit during the testing of the latter for directly controlling the ejection of defective cigarette units, but rather uses the characteristics of the flow of air through the cigarette unit for establishing a sequence of electrical and mechanical signals or indications which eventually control the ejection or retention of the cigarette units. Such indirect control through a sequence of electrical and mechanical signals can easily result in control errors, and also requires a relatively complicated series of devices for effecting the control. Further, in the above described known arrangement, the supply of compressed air is simultaneously communicated with the coupling mechanisms of several carriers in the testing zone, so that parallel air flows occur simultaneously through several cigarette units from the supply of compressed air to the related test devices and the air pressures acting on the latter tend to be an average of the results that would be obtained with the individual cigarette units. Accordingly, the previously proposed arrangement does not permit the accurate testing of each individual cigarette unit, and tends to reject those satisfactory cigarette units which are adjacent to a defective cigarette unit on the conveyor.

It is an object of this invention to provide a method and apparatus for testing the integrity of, and the resistance to flow through cigarettes and the like which avoid the above mentioned disadvantages of the devices and arrangements previously proposed for that purpose. More specifically, it is an object of this invention to provide a cigarette testing apparatus capable of accurately detecting and rejecting defective cigarettes and the like while operating at a high rate of speed.

In accordance with an aspect of the invention, the successive cigarette units to be tested are delivered to equally spaced carriers on a conveyor, preferably in the form of a drum, and coupling members are associated with each carrier and are movable toward and away from each other for respectively engaging the opposite ends of the cigarette unit supported by the related carrier and freeing the cigarette unit for ejection or discharge from the carrier. Further, a source of either compressed air or vacuum is communicated with one of the coupling members associated with each carrier as the latter moves through a testing zone having an extent in the direction of movement of the conveyor approximately equal to the spacing between adjacent carriers, so that only one cigarette unit at a time is communicated with the source of compressed air or vacuum, and the other coupling member communicates with a control device associated with the related carrier and operative, in response to the flow of air or pressure transmitted through the cigarette unit being tested, to control a locking device which either prevents or permits the relative movement away from each other of the associated coupling members at a subsequent ejection station for either retaining a satisfactory tested cigarette unit on the conveyor or for permitting the ejection of a defective cigarette unit from the conveyor, respectively.

In accordance with another feature of this invention, each carrier is provided with ports which are placed in communication with a source of vacuum following the delivery of a cigarette unit to the carrier so that the cigarette unit is held to the related carrier during the testing thereof, but the communication of the ports of each carrier with the source of vacuum is interrupted, and the ports are communicated with a source of compressed air, instead, during movement of the carrier past the ejection station,

at which defective cigarette units are intended to be removed.

Further, during movement of each carrier past a discharge station at which satisfactory cigarette units are removed from the conveyor, the ports of each carrier are preferably communicated with a source of auxiliary air, for example, atmospheric air, thereby to immediately release the suction holding the cigarette units to the carriers.

In accordance with another aspect of this invention, the coupling member of each carrier into which air is drawn during the testing of a cigarette unit is communicated with a source of compressed air causing a reverse flow of air through that coupling member following the movement of the related carrier past the discharge station thereby to clear out any tobacco or other particles which might eventually clog the coupling member and thereby adversely affect the subsequent testing of cigarette units supported by the carrier. Further, following the movement of each carrier past the discharge station, the ports of the carrier are preferably also communicated with a source of compressed air for similarly removing any tobacco or other particles that may have become lodged therein during the communication of such ports with the source of vacuum for holding a cigarette unit in the carrier.

The locking device associated with each carrier for preventing movement away from each other of the coupling members at the ejection station may be in the form of a latch lever yieldably urged to a released position and being moved to an engaged or locking position either by a flexible diaphragm which is acted upon by either air pressure or vacuum transmitted thereto through the cigarette unit being tested, or by a jet of air issuing from a nozzle which receives the air under pressure flowing through the cigarette unit being tested.

The above, and other objects, features and advantages of the invention, will be apparent in the following detailed description of illustrative embodiments thereof which is to be read in connection with the accompanying drawings forming a part hereof, and wherein:

FIG. 1 is a perspective view, partly broken away and in section, showing a portion of a filter cigarette making machine that includes a testing apparatus constructed in accordance with one embodiment of this invention;

FIG. 2*a* and 2*b* together constitute an enlarged perspective view, partly broken away and in section, of one of the carriers included in the testing apparatus of FIG. 1, and of the coupling members, control devices and locking device associated with that carrier;

FIG. 3 is a fragmentary sectional view showing details of the control device and locking device illustrated on FIG. 2*a*;

FIG. 4 is a view similar to that of FIG. 3, but showing a modification of the control and locking devices employed when the cigarette unit is placed in communication with a source of vacuum, rather than with a source of compressed air, during the testing thereof;

FIG. 5 is a perspective view, partly broken away and in section of a portion of a filter cigarette machine including a testing apparatus constructed in accordance with another embodiment of this invention;

FIG. 6 is a perspective view, partly broken away and in section, of one of the carriers, and associated coupling members and control and locking devices, included in the testing apparatus of FIG. 5;

FIG. 7 is a perspective view of a carrier similar to that of FIG. 6, but having a modified form of control and locking devices; and

FIG. 8 is a perspective view, partly broken away and in section of a modified form of coupling member that may be substituted for one of the coupling members associated with the carrier in the embodiments of FIGS. 6 and 7.

Referring to the drawings in detail, and initially to FIG. 1 thereof, it will be seen that a testing apparatus embodying the present invention and generally identified

by the reference numeral **1** is shown included in a filter cigarette making machine and is intended to test the integrity of, and resistance to flow through filter cigarette units G each having a pair of axially aligned cigarettes with a double filter plug interposed therebetween and joined to the cigarettes by a sleeve of paper or other wrapping material.

The testing apparatus **1** is preferably in the form of a drum, as shown on FIG. 1, and receives the successive filter cigarette units G to be tested at the station A from a rolling drum **60**. The rolling drum **60** receives the successive filter cigarette units G from a transfer drum **62**, but with the connecting sleeve of each unit in the form of a section of paper or other wrapping material which is rolled to provide the connecting sleeve of each unit G during transport of the latter by drum **60** to the location of the receiving station A. The testing drum **1** normally transports the successive units G from rolling drum **60** to a cutting drum **61** on which each unit G is cut, at the center thereof, so as to form two filter cigarettes. During such transport by testing drum **1**, each filter cigarette unit G is tested for leaks in the wrappers of the cigarettes or filter or in the connection of the sleeve with the cigarettes, and also for excessive resistance to flow through the filter cigarette unit, for example, as a result of excessively compact packing of the tobacco or of the filter medium, and those cigarettes which are found to be defective are ejected from the testing drum **1** prior to their arrival at the location where satisfactory units are transferred from testing drum **1** to cutting drum **61**.

The testing drum **1** is suitably rotated on a fixed axle or spindle **54** and has a circumferentially arranged series of axially extending carriers **14** which are integral with or rigidly secured to the body of the drum. Each carrier **14** is generally of elongated bar-shaped with its ends terminating short of the adjacent ends of drum **1**, and is formed with a central, radially outward directed projection having an axial groove **2** in its outer surface adapted to accommodate the central portion of a filter cigarette unit G received from the rolling drum **60**.

As shown particularly on FIGS. 2*a* and 2*b*, coupling members **3** and **4** are mounted adjacent the opposite ends of each carrier **14** and are free to move axially toward and away from each other. The mounting of the coupling members **3** and **4** is preferably effected by means of guide tubes **12** and **16** extending from coupling members **3** and **4**, respectively, and being axially slidable in bores **13** and **17** which are formed in the related carrier **14** parallel to the axis of rotation of testing drum **1** and which open at the opposite ends of the carrier. Helical compression springs **15** and **18** are provided on the guide tubes **12** and **16**, respectively, between the ends of each carrier **14** and the associated coupling members **3** and **4** to yieldably urge the latter axially away from each other. The movements of the coupling members **3** and **4** axially towards each other are affected by stationary cams **48** and **49** mounted adjacent the opposite ends of testing drum **1** and being engageable, at predetermined portions of the circular path of travel followed by each carrier in response to turning of the testing drum, by cam follower rollers **5** and **6** which are rotatably carried by the coupling members **3** and **4**, respectively. As is apparent in FIGS. 2*a* and 2*b*, the cam follower rollers **5** and **6** are disposed within outwardly opening slots formed in the respective coupling members **3** and **4** and are mounted on hollow axles **31** and **27**, respectively, which extend across such slots.

Hollow caps or receptacles **7** and **8** extend from the confronting surfaces of coupling members **3** and **4**, respectively, coaxially with the semi-cylindrical groove **2** on the projecting central portion of the related carrier **14**, and the caps or receptacles **7** and **8** contain softly resilient sealing disks **9** and **10**, respectively, having central apertures **11**. The caps **7** and **8** are adapted to

effect sealing engagement with the opposite ends of a filter cigarette unit G supported in the related groove 2 when coupling members 3 and 4 are displaced axially toward each other to the positions illustrated on FIGS. 2*a* and 2*b*. The coupling members 3 and 4 further have bores 29 and 28, respectively, extending from the related caps 7 and 8 and opening into the adjacent end portions of bores 30 and 26 defined by the hollow tubular axles 31 and 27, respectively. Bores 32 and 25 are also formed in the coupling members 3 and 4, respectively, and extend from the opposite end portions of the bores 30 and 26 into passages 33 and 24, respectively, defined by the guide tubes 12 and 16. As is apparent in FIG. 2*b*, passage 33 of guide tube 12 opens into the bore 13 receiving the latter, and the bore 13 has a duct 34 extending from its inner end and communicating with a radial duct 56 (FIG. 1) extending through the testing durm. The other guide tube 16 extending from coupling member 4 (FIG. 2*a*) has its inner end closed by a screw plug 16*a* and is formed with a radial bore 23 opening from the passage 24 into a cavity 22 extending along a portion of the bore 17 at the side of the latter facing radially outward with respect to the axis of rotation of the testing drum.

In the embodiment of this invention illustrated by FIGS. 1, 2*a*, 2*b* and 3, the control device associated with each of the carriers 14 includes a diaphragm support 19 received in a tapped hole of the related carrier 14 communicating with the cavity 22. The diaphragm support 19 has a central bore 21 and effects sealing engagement with the periphery of a diaphragm 20 of rubber or the like so that, when coupling member 4 is axially displaced toward the adjacent end of carrier 14, thereby to move radial bore 23 into communication with cavity 22, a pressure of air transmitted through passage 24, bore 23, cavity 22 and bore 21, as hereinafter described in detal, causes bulging or distending of diaphragm 20 in the radially outward direction, that is, away from the axis of testing drum 1.

As shown in FIGS. 2*a* and 3, the locking device associated with each carrier 14 on the testing drum 1 includes a latch level 36 secured to a transversely extending axle 37 which is located intermediate the ends of the latch lever and which is pivotally mounted in bearing members 35 extending from the related carrier 14 at a location between the diaphragm support 19 and the central projection of the carrier having a groove 2 therein. One arm of the latch lever 36 extends over diaphragm 20 toward coupling member 4 and has a twisted and offset end portion 38 to which a locking nose 39 is secured. The locking nose 39 extends into a cavity 40 formed in the coupling member 4 and defining a projection or keeper 41 which is engageable by the nose 39, as in FIGS. 2*a* and 3, when the latch lever is rocked by bulging or distending of the diaphragm 20 with the coupling member 4 being axially displaced toward the adjacent end of carrier 14, whereby the engaged nose 39 and keeper 41 prevent movement of the coupling member 4 in the direction axially away from the carrier 14 under the influence of the spring 18.

In order to yieldably urge the latch lever 36 to rock in the opposite direction, that is, for releasing nose 39 from keeper or projection 41 of coupling member 4, the arm 42 of the latch lever extending toward the central portion of the carrier has an opening 43 in its free end portion through which the head of an adjustment screw 44 loosely projects. The screw 44 has a radial flange 45 thereon under the arm 42 and a compression spring 46 is disposed on screw 44 between flange 45 and arm 42 of latch lever 36. Screw 44 is adjustably received in a threaded bore 47 formed in the related carrier 14.

The central projecting portion of each carrier 14 has ports in the groove 2 thereof constituting the open ends of radial bores 52 which communicate, at their inner ends, with corresponding radial bores (not shown) extending through the testing drum 1. Further, each carrier 14 has a radial bore 50 also communicating with a corresponding radial bore (not shown) extending through the testing drum and opening into the bore 17 of the carrier. The guide tube 16 has a radial bore 51 at the radially inwardly facing side thereof, and the bore 51 is axially located along tube 16 for registration with the bore 50 only when the related coupling member 4 and guide tube 16 are axially displaced toward the left from the position illustrated on FIG. 3 to a position where the bore 23 is outside the range of the cavity 22.

The stationary cams 48 and 49 are axially cut away over the circumferential portions thereof corresponding to the travel of each carrier from the station C at which satisfactory groups G are transferred to the cutting drum 61, to the delivery station at which the groups to be tested are received by the testing drum from the rolling drum 60. Thus, at the delivery station, the coupling members 3 and 4 associated with each carrier are relatively widely spaced apart so that the distance between the caps 7 and 8 is greater than the axial length of the group G received by the carrier from the rolling drum 60. At the delivery station, the bores 52 of each carrier 14 and the corresponding radial bores of the testing drum are placed in communication with a source of suction through suitable channels (not shown) formed in the stationary axle 54 or in an air control ring disposed at one end of the testing drum and cooperating with passages in the latter. Thus, suction is provided at the ends of bores 52 opening in the groove 2 of the related carrier for holding the central portion of the group G to the carrier. Immediately after the reception of a group G by each carrier 14, the cam follower rollers 5 and 6 associated with the latter are actuated upon by the stationary cams 48 and 49 to axially displace the coupling members 3 and 4 toward each other and thereby urge the caps 7 and 8 into sealing engagement with the adjacent ends of the filter cigarette group or unit G. As each carrier passes a testing station D (FIG. 1) the bore 34 of the carrier and the corresponding bore 56 of the testing drum communicate with a circumferentially extending slot 55 formed in the central axle or spindle 54 and which is suitably connected, for example, through an axle bore in the axle 54, with a source of compressed air. The circumferential slot 55 has a length approximately equal to the circumferential distance between the inner ends of the radial bores 56 of the testing drum associated with adjacent carriers 14 so that only one bore 56 at a time communicates with the compressed air supplying slot 55.

Since compressed air is supplied to the bore 34 of each carrier 14 at a time when the coupling members 3 and 4 associated with the latter are urged axially toward each other, it will be apparent that the bore 23 of guide tube 16 is then communicated through cavity 22 and bore 21 with the diaphragm 20 of the related control device. Thus, air under pressure flows from bore 34 through passage 33 of guide tube 12, bores 32, 30 and 29 of coupling member 3, cap 7, the filter cigarette unit G being tested, cap 8, bores 28, 26 and 25 of coupling member 4, passage 24 of guide tube 16, bore 23, cavity 22 and bore 21 to act against the diaphragm 20 and thereby bulge or distend the latter against latch lever 36 of the locking device. If the filter cigarette unit G is satisfactory, that is, is without leaks in the wrapper of the cigarettes or in the connections between the latter and the sleeve of the double filter, and without excessive packing of the tobacco or filter medium, then the pressure of the compressed air transmitted through the filter cigarette unit and acting against the diaphragm 20 is sufficient to cause the latter to bulge and rock latch lever 36 against the action of spring 46 for engaging the nose 39 with the keeper 41 of coupling member 4. However, if the filter cigarette unit G being tested is defective, either by reason of leaks in the wrappers thereof or by reason of excessive packing of the tobacco or filter medium, then the air pressure

acting on diaphragm 20 is not sufficient to cause the latter to effect rocking of the latch lever 36 and the nose 39 of the latter remains disengaged from the keeper 41.

If the locking device associated with a carrier 14 has been rendered operative at the testing station, that is, if the nose 39 has been engaged with the keeper 41, as in FIG. 2*a*, such engagement is frictionally maintained by the action of the spring 18 on the coupling member 4 when the carrier leaves the testing station and the supply of compressed air to the bore 34 has therefore been interrupted.

Following movement through the testing station D, each carrier 14 moves past an ejection station B (FIG. 1), at which the cam 49 is axially cut away. Thus, if a carrier 14 arrives at the ejection station B which is located at the bottom of the testing drum 1 with the nose 39 of its locking device disengaged from the keeper 41, thereby indicating the presence of a defective filter cigarette unit G on such carrier, then the cam 49 permits axial movement of the coupling member 4 away from the carrier 14 under the influence of the spring 18 and thereby releases the adjacent end of the defective filter cigarette unit for downward ejection from the testing drum. Preferably, such downward ejection of defective cigarettes at the ejection station B is assisted by interrupting the communication of the bores 52 of the carrier with the source of vacuum, and by communicating the bores 52 with a source of compressed air so that jets of air under pressure issue from the bores 52 at the ejection station to assist the ejection of the defective unit G which has been released, at one end thereof, from the cap 8 of coupling member 4. The switching of the bores 52 of each carrier 14 from communication with a source of vacuum to communication with a source of compressed air during movement through the ejection station B may be effected by extending the guide tube 16 and by forming the extended portion of the guide tube as a slide valve which, when in the position illustrated on FIG. 2*a*, connects the bores 52 with a source of vacuum, and when axially displaced from such position in the direction away from carrier 14, communicates the bores 52 with a source of compressed air.

When each carrier 14 arrives at the ejection station B with its locking device in the operative condition thereof, that is, with the nose 39 engaged with the keeper 41, the coupling member 4 associated with the carrier is unable to move axially away from the carrier 14 at the cutaway portion of the cam 49 and, therefore, its cap 8 continues to engage the adjacent end of the filter cigarette unit G which has been previously indicated to be satisfactory. Thus, defective units G are ejected or removed from the testing drum 1 at the ejection station B, while perfect or satisfactory filter cigarette units are carried on the testing drum past the ejection station.

After the ejection station B, the cam 49 again acts on the cam follower roller 6 associated with each carrier 14 and moves the related coupling member 4 axially toward the carrier a slight distance beyond the original position at which the coupling member 4 is held by engagement of the nose 39 with keeper 41 so that the frictional resistance to return of the latch lever 36 by the spring 46 is thereby eliminated and the latch lever is rocked to disengage nose 39 from keeper 41.

At the discharge station C, at which the perfect or satisfactory filter cigarette units G are transferred to the cutting drum 61, both cams 48 and 49 are axially cut away and thereby permit movement of the coupling members 3 and 4 axially away from each other under the influence of the springs 15 and 18, respectively. Thus, at the discharge station C, the ends of each unit G are released by the caps 7 and 8 associated with the carrier to permit the transfer of the tested unit to the cutting drum. Preferably, at the discharge station C, the bores 52 of each carrier again have their communication with a source of vacuum cut off or interrupted so that suction will not be available at the ends of the bores 52 opening in the groove 2 for resisting transfer of the tested unit to the cutting drum.

Since the cams 48 and 49 are axially cut away between the discharge station C and the delivery station at which each carrier again receives a unit to be tested from the rolling drum 60, it will be apparent that, during the movement of each carrier 14 between those two stations, for example, past an intermediate cleaning station A, the bore 51 of the related guide tube 16 is in communication with the bore 50 of the carrier. During movement of each carrier past the cleaning station A, the bore 50 and the bores 52 of the carrier are placed in communication with a source of compressed air, for example, through suitable channels in the testing drum 1 or in the spindle or axle 54 supporting the latter, whereby jets of air issue from the ports 52 to clean out any tobacco or other particles previously lodged therein during communication with the source of vacuum, and simultaneously a flow of air occurs through passage 24, bores 25, 26 and 28, and out of cap 8, that is, in the direction opposed to the normal flow of air therethrough during testing of a filter cigarette unit G, for similarly removing any tobacco or other particles lodged in the bores or passages during the testing operation. By reason of the described reverse flows of air through components of each carrier 14 prior to the reception of a filter cigarette unit G to be tested, assurance is provided that the accuracy of the testing operation will not be influenced by the clogging of passages.

Preferably, as shown on FIGS. 1 and 3, and as represented by broken lines on FIGS. 2*a* and 2*b*, the control and locking devices associated with each carrier 14 are preferably enclosed by a removable cover 58 through which the central portion of the carrier and the coupling members 3 and 4 at the opposite ends of the latter project radially outward.

In the embodiment of the invention described above with reference to FIGS. 1, 2*a*, 2*b* and 3, testing of each filter cigarette unit G has been effected by air under pressure supplied to the bore 34 of each carrier 14 at the testing station D. However, the same test result may be achieved by communicating the bore 34 with a source of vacuum at the testing station D and by modifying the control and locking devices of each carrier, as shown on FIG. 4. In such modification, the diaphragm support 119 engaging the periphery of the diaphragm 120 is located at the side of the pivot 137 of the latch lever 136 remote from the locking nose 139 which is engageable with the keeper or projection of the coupling member 104. Further, the arm 142 of the latch lever 136 is positively connected, through a screw 59 with the center of the diaphragm 120, whereby suction acting against the under or inner side of the diaphragm 120 results in a force transmitted through screw 59 to the arm 142 of latch lever 136 for rocking the latter in the direction opposed to the action of the spring 146 carried by the screw 144.

With the arrangement described above with reference to FIG. 4, the communication of the bore 34 of each carrier 14 with a source of vacuum at the testing station D produces a relatively low pressure or suction at the underside of diaphragm 120 when a perfect or satisfactory filter cigarette unit G is being tested, which relatively low pressure is sufficient to overcome the action of spring 146 and thereby move the nose 139 of the latch lever into engagement with the keeper of coupling member 104. However, if a defective cigarette filter unit is being tested, for example, a unit having leaks in the wrapper thereof, the suction acting therethrough on diaphragm 120 is reduced, that is, a relatively higher pressure acts against the underside of the diaphragm, so that the force exerted by the latter on the latch lever 136 cannot overcome the force of spring 146 and the latch lever remains in its inoperative position with its

nose 139 disengaged from the keeper of coupling member 104.

A testing apparatus having the arrangement shown on FIG. 4 is otherwise similar to the testing apparatus previously described in detail herein with the exception that the bore 51 is eliminated from the guide tube 116 and the bore 50 is eliminated from the carrier 114, and further that, at the cleaning station A, the bore 34 of each carrier is placed in communication with a source of compressed air to cause the reverse flow of air through the passages associated with coupling member 3.

Referring now to FIG. 5, it will be seen that a testing drum 201 constructed in accordance with another embodiment of this invention is there illustrated as receiving successive filter cigarette units G from a rolling drum 260 for the purpose of testing such units, and rejecting or ejecting the defective units prior to the transfer of satisfactory filter cigarette units to a cutting drum 261. Arranged around the circumference of the testing drum 201 is a series of axially extending carriers 202 which, as shown on FIG. 6, each have a substantially elongated, C-shaped configuration. The base portion of each carrier 202 has a depending foot 203 projecting therefrom adjacent one end for reception in an axially opening annular slot provided in a radial flange extending from the testing drum 201 adjacent one end of the latter, while a clamping screw 204 is threaded through a downward projection at the other end of the carrier 202 and is adapted to be secured in a related tapped hole opening axially at the other end of the testing drum, thereby to removably secure each carrier 202 on the testing drum. Each C-shaped carrier 202 defines an elongated slot 223 opening axially at one end between the base and radially outer portion of the carrier, while the radially outer portion of the carrier is formed with a semi-cylindrical groove 210 extending along its outer surface and intended to receive a filter cigarette unit G, as in FIG. 6.

Each of the carriers 202 has associated coupling members 212 and 213 disposed adjacent the opposite ends thereof and provided with sealing caps movable axially toward and away from each other for engagement with, and release of the ends of a filter cigarette unit G received in the related groove 210, as in the previously described embodiments of this invention.

The coupling member 212 is axially slidable in a bearing member 202*a* projecting radially outward from one end of the carrier and is urged axially in the direction away from the coupling member 213 by a helical compression spring 214 extending therearound and being interposed between the bearing member 202*a* and a head 215 at the outer end of coupling member 212. Further, the coupling member 212 has an axial bore communicating, at one end, with the hollow sealing cap and a radial bore 206*b* extending from the axial bore and registering with a bore 206 of the carrier 202 when coupling member 212 is displaced axially toward the other coupling member 213 against the influence of the spring 214, as hereinafter described in detail.

The other coupling member 213 is rockably mounted on an axle 217 carried by a bracket 202*b* which is longitudinally adjustable with respect to an extension of the base of the carrier 202. The coupling member 213 has a bore 218 extending from its hollow sealing cap and communicating with a resiliently flexible tube 219 which acts as a spring to rock the coupling member 213 about its axle 217 in the direction moving the sealing cap of coupling member 213 away from coupling member 212, and which further communicates with a bore (not shown) formed in the extension of the base of the carrier 202 and opening into a nozzle 220 adapted to direct a jet of air 220*a* radially outward, with respect to the axis of rotation of testing drum 201, into the slot 223. The nozzle 220 constitutes the control device of each carrier 202, while the locking device of the latter is constituted by a latch lever 224 disposed within the slot 223 and mounted, intermediate its ends, on a laterally extending axle 225 which is pivotally supported by bearing members 226 and 226*a* projecting from the base of the carrier. One arm 224*a* of the latch lever 224 overlies the nozzle 220, and therefore is adapted to be impinged against by a jet of air issuing from such nozzle, while the opposite arm 224*b* of the latch lever is connected to a spring 227 which is, in turn, connected to an adjustment screw 228 extending threadably through the base of carrier 202. The tension spring 227 tends to maintain the latch lever 224 in a position where the free end of the arm 224*a* is located relatively close to the base of the carrier and hence does not interfere with movement of a projection 222 at the radially inner end of coupling member 213 in the direction in which coupling member 213 is urged by the resilience of flexible tube 219. However, when a jet of air of sufficient force issues from nozzle 220 and impinges against latch lever 224, the latter is rocked against the influence of spring 227 so that the end of its arm 224*a* is engageable with the projection 222 of coupling member 213 to hold the latter against rocking movement from the position illustrated on FIG. 6, that is, where the sealing cap of member 213 is axially displaced toward the sealing cap of coupling member 212.

Bores 211 open at the groove 210 of each carrier and communicate with a passage or bore 205 which is selectively communicated with a source of vacuum and with a source of air under pressure during movement of the carrier with the rotated testing drum. Thus, when bore 205 communciates with a source of vacuum, suction is available at the openings of the bores 211 for holding a filter cigarette unit G in the related groove. On the other hand, when bore 205 is communicated with a source of air under pressure, then jets of air issue from the openings of bores 211 for causing ejection of a defective filter cigarette group or unit G from the related groove 210.

Pipes 205*a* and 206*a* project radially inward from the bores 205 and 206, respectively, of each carrier 202, and are received in corresponding radial bores formed in the hollow cylindrical body 229 of testing drum 201.

The hollow cylindrical body 229 of testing drum 201 is rotatably mounted on a stationary axle or spindle 247 which is supported, at one end, by a vertical wall 239 forming part of the frame of the filter cigarette making machine. The opposite end of the axle or spindle 247 and the adjacent end of the body 229 extend into a stationary air control cap 230 supported by a suitable bracket. A pipe 231 conveying air under pressure from a suitable source thereof extends centrally through the cap 230 and opens into a central axially extending bore formed in the fixed spindle 247, and the end of that axial bore remote from the cap 230 opens radially into a circumferentially extending slot 248 (FIG. 5) formed in the surface of spindle 247. Slot 248 is located for communication with the pipe 206*a*, and hence with the bore 206, of each of the carriers 202 as the latter successively pass through the testing station B_1. The circumferential extent of the slot 248 is preferably approximately equal to the circumferential distance between the inner ends of the pipes 206*a* of adjacent carriers 202 on the testing drum 201. Thus, air under pressure is supplied only to the bore 206 of one carrier as the latter passes through the testing station.

As shown on FIG. 5, the air control cap 230 has an outer wall extending closely around the adjacent end of the cylindrical body 229 of the testing drum, and a cylindrical partition extending around the projecting end of the fixed spindle 247 and dividing the interior of the cap into an inner chamber 233 receiving the end surface of spindle 247 and an outer chamber 250 receiving the end surface of body 229. The body 229 has axially extending bores 237 opening, at one end, into the outer chamber 250. The opposite end of each bore 237 opens into the pipe 205*a* of an associated one of the carriers 202. A pipe

236 extends from a source of vacuum into the chamber 250 of air control cap 230 for applying suction to that chamber. A sealing block 251 is interposed between the outer wall and the cylindrical partition of air control cap 230, and is in sealing engagement with the end surface of body 229 within chamber 250, to isolate the open end of each bore 237 from the suction in chamber 250 as the associated carrier 202 moves through an ejection station B_1. Similarly, an arcuate sealing member 252 in chamber 250 isolates each bore 237 from the suction in chamber 250 as the related carrier arrives at the discharge station C_1, at which filter cigarette units G are transferred to the cutting drum 261, and during movement of the associated carrier 202 from such discharge station to a location in advance of the receiving station, at which the filter cigarette units G to be tested are transferred from the rolling drum 260 to the testing drum 201. The arcuate sealing member 252 has a bore 253 communicating with the bore 237 associated with the carrier 202 at the discharge station C_1 and opening to the atmosphere through a vent passage 254 in the outer wall of air control cap 230. Thus, as each carrier moves from the receiving or delivery station to the ejection station B_1, and from the ejection station to the discharge station C_1, the bore 205 and bores 211 of the carrier are connected to a source of vacuum through the related bore 237, thereby to provide suction at the openings of the bores 211 for holding a filter cigarette unit G in the groove 210 of the carrier. Further, at the discharge station C_1, the bores 211 of each carrier are vented to the atmosphere through the related bores 205 and 237, the bore 253 sealing member 252 and the vent opening 254, thereby to immediately release the suction at the openings of the bores 11 which would otherwise resist transfer of the units G to the cutting drum.

Further, as shown on FIG. 5, the spindle 247 has an axial bore 235 opening into the chamber 233 and being angularly aligned with the sealing block 251, that is, with the ejection station B_1, and additional axial bores 234 also opening into the chamber 233 and being angularly located between the discharge station C_1 and the station at which the testing drum receives filter cigarette units G to be tested from the rolling drum 260. A pipe 232 extending from a source of air under pressure opens into the chamber 233 for supplying compressed air to the bores 234 and 235. The ends of the bores 234 and 235 remote from chamber 233 open radially into circumferential slots (not shown) in the surface of spindle 247, similar to the previously described slot 248, but being located for registration with radial bores extending inwardly from each of the axial bores 237 of body 229 when the related carrier 202 passes through the ejection station B_1 and along the portion of the path of travel between the discharge station C_1 and the receiving or delivery station. Thus, as each carrier passes through the ejection station B_1, the communication of its bores 211 with the suction chamber 250 is interrupted, and the bores 211 are supplied with compressed air from the chamber 233 to assist the removal from the groove 210 of a defective filter cigarette unit which is to be ejected at the station B_1, as hereinafter described in detail. Further, during travel of each carrier between the discharge station C_1 and the receiving or delivery station, the communication of the bores 211 with the source of vacuum is again interrupted, and compressed air is once more supplied to the bores 211 for cleaning out the latter.

Arcuate guides 208 and 209 are suitably supported from the frame wall 239 and extend along the lower portion of the path of travel of the successive filter cigarette units G from the receiving or delivery station to the ejection station B_1 to assist the suction applied to the bores 211 of each carrier in retaining the filter cigarette units in the grooves 210. Further guides 208*a* and 209*a* are also suitably supported from the frame wall 239 and extend from the ejection station B_1 to the discharge or transfer station C_1 to once again assist the suction applied to the bores 211 of each carrier in retaining the satisfactory filter cigarette units G in the grooves 210 prior to the transfer thereof to the cutting drum 261.

An arcuate cam 216 supported on the frame wall 239 is engageable with the head 215 of the coupling member 212 of each carrier 202 during movement of the latter past the testing station D_1, which follows the receiving or delivery station, and past the ejection station B_1. Preferably, as shown on FIG. 5, the arcuate cam 216 and the arcuate guides 208*a* and 209*a* overlap circumferentially to a small extent so that the head 215 of the coupling member 212 of each carrier 202 is not released by the cam 216 until a filter cigarette unit G in the groove 210 of the carrier has moved into the effective range of the guides 208*a* and 209*a*. The cam 216 is effective to axially displace each coupling member 212 engaged thereby in the direction toward the related coupling member 213, for example, to the position shown on FIG. 6.

The arrangement shown on FIG. 5 further includes a stationary arcuate cam 221 suitably mounted adjacent the end of the testing drum remote from frame wall 239 and engageable with the coupling member 213 of each carrier 202 as the latter moves past the testing station D_1 and up to the ejection station B_1. The cam 221 is effective to rockably displace each of the coupling members 213 engaged thereby to the position shown on FIG. 6. Further, a cam extension 221*a* is disposed after the ejection station B_1 and terminates at a location in axial alignment with the end of the cam 216. Thus, during the movement of each carrier 202 through the ejection station B_1, the related coupling member 213 may rock into the gap between the cams 221 and 221*a* for movement of its sealing cap axially away from the sealing cap of the related coupling member 212 provided that the latch lever 224 of the carrier 202 has not been previously rocked into engagement with the projection 222 of the coupling member 213. Further, the cam extension 221*a* is preferably axially dimensioned so that, as each coupling member 213 is acted upon thereby, the coupling member is rocked inwardly beyond the position shown on FIG. 6, thereby to permit release of the latch lever 224 from the projection 222 by the action of the spring 227.

The testing apparatus described above with reference to FIGS. 5 and 6 operates as follows:

As each carrier 202 passes the receiving or delivery station at which the testing drum 201 is tangential to the rolling drum 260, the coupling members 212 and 213 of the carrier, being free of the cams 216 and 221, are displaced axially away from each other by the related spring 214 and resilient tube 219 so that the axial distance between the sealing caps of the coupling members 212 and 213 is greater than the length of the filter cigarette unit G which is there deposited in the groove 210. At the receiving station, suction is applied to the bores 211 through the bores 205 and 237 and the suction chamber 250, whereby the filter cigarette unit is pneumatically held in the groove 210. After leaving the receiving or delivery station, each filter cigarette unit G is further held in the related groove by the guides 208 and 209, and the coupling members 212 and 213 come within the range of the cams 216 and 221 and are thereby displaced so that the sealing caps of the coupling members come into sealing engagement with the ends of the filter cigarette unit. The displacement of each coupling member 212 by the cam 216 further brings the bore 206*b* of the coupling member into registry with the bore 206 of the carrier so that, when the latter reaches the testing station D_1, the compressed air supplied to the bore 206 through the arcuate slot 248 flows through coupling member 212, the filter cigarette unit G, the bore 218 of coupling member 213 and the flexible pipe 219 to issue in the form of an air jet 220*a* from the nozzle 220. The force of the jet 220*a* is conveniently adjustable by a suitable valve 246

interposed in the compressed air supply pipe 231. If the filter cigarette unit G at the testing station is satisfactory, that is, is not too tightly packed and does not have a leak in the wrapper or connecting sleeve thereof, then the available pressure produces a jet of air 220*a* impinging on the latch lever 224 with sufficient force to cause the rocking of the latch lever into engagement with the projection or keeper 222 of the coupling member 213. However, if the filter cigarette unit G being tested is too tightly packed or has a leak, then the pressure drop in unit G is increased and the force exerted by the air jet 220*a* is decreased correspondingly so that it cannot rock the latch lever 224 into engagement with the projection or keeper 222.

As each carrier 202 reaches the ejection station B_1, the bores 211 of that carrier are placed in communication with the compressed air chamber 233 through the axial bore 235 so that jets of air issue from the bores 211 to tend to remove the filter cigarette unit G from the related groove 210. If the filter cigarette unit in a groove 210 is defective, then the latch lever 224 of the related carrier is not moved into engagement with the projection or keeper 222 of the coupling member 213 at the testing station, as described above, and such coupling member 213 is then free to rock outwardly at the ejection station B_1 in the gap between the cams 221 and 221*a* thereby releasing the defective filter cigarette unit for ejection by the air jets issuing from the bores 211, and such ejection can take place through the gap between guides 208 and 208*a* and guides 209 and 209*a*, and is assisted by centrifugal force resulting from rapid rotation of the testing drum.

When a satisfactory cigarette arrives at the ejection station B_1, the latch lever 224 of the associated carrier is engaged with the keeper 222 of the coupling member 213 so that the latter cannot rock outwardly in the gap between the cams 221 and 221*a*, and the sealing caps of the coupling members 212 and 213 remain in engagement with the ends of the filter cigarette unit and thereby prevent ejection of the latter by the air jets from the bores 211. Upon leaving the ejection station B_1, the coupling member 213 of each carrier supporting a satisfactory filter cigarette unit is acted upon by the cam extension 221*a* which further rocks the coupling member inwardly to permit release of the latch lever 224 from the keeper 222 so that, upon disengagement of the coupling members 212 and 213 from the cams 216 and 221*a*, both coupling members are free to move axially away from each other and thereby release the ends of the filter cigarette unit. As each filter cigarette unit arrives at the discharge station C_1, the bores 211 of the related carrier are vented to the atmosphere through the related bore 237, and the bore 253 and vent opening 254, thereby to relieve the suction holding the filter cigarette unit in the groove 10 and permit its transfer to the cutting drum 261. Finally, as each carrier moves from the discharge station C_1 back toward the receiving or delivery station, the bores 211 are once again placed in communication with the source of compressed air by way of bores 234, as previously described herein, so that jets of air issue from the bores 211 for cleaning the latter.

Referring now to FIG. 7, it will be seen that each of the carriers 202 of the testing apparatus in FIG. 5 may be modified by replacing the nozzle 220 with a diaphragm 244 which is expanded in the direction toward the latch lever 224 when compressed air under a predetermined pressure is supplied to the coupling member 212 at the testing station B_1. If the filter cigarette unit being tested is satisfactory, that is, is without leaks and not too tightly packed, then the pressure of air acting on diaphragm 244 expands the latter sufficiently to rock the latch lever 224 into engagement with the projection or keeper 222 of the coupling member 213. However, if the filter cigarette unit being tested is defective, then the spring 227*a* carried by an adjustment screw 228*a* and acting on the latch lever 224 resists movement of the latch lever by the diaphragm subjected to the reduced pressure resulting from the increased pressure drop and engagement of the latch lever or projection or keeper 22 does not occur.

In adjusting the testing apparatus of FIG. 5 for use in connection with filter cigarette units or other similar articles having different lengths, the coupling member 213 of each carrier 202 may be bodily adjusted toward or away from the related coupling member 212 by displacement of the bracket 202*b* relative to the base of the carrier. Further, the position of the cam 216 may be axially adjusted by interposing spacer blocks 238 (FIG. 5) between that cam and the frame wall 239 on which it is mounted. The adjustment of the axial distance between the coupling members 212 and 213 may also be conveniently effected by adding sealing caps in the form of extensions which are suitably dimensioned, for example as at 240 on FIG. 8.

FIG. 8 of the drawings further illustrates a modified form of coupling member 241 which may be used in place of each of the coupling members 212 of the testing apparatus illustrated on FIG. 5. The coupling member 241 includes a body 255 fixed on a hollow axle 256 which is turnable in bearing supports 257 projecting upwardly from the carrier in place of the bearing member 202*a* on FIG. 6. A cam follower roller 258 is rotatably carried by the body 255 for engagement with a cam 242 corresponding to the cam 216 of FIGS. 5 and 6. A tubular member 259 is secured, as by a set screw 260, in the body 255 and is spaced radially outward from the axis of the axle 256. The sealing cap extension 240 is threadably secured on a projecting end of the tubular member 259 so that, when the roller 258 engages the cam 242, the sealing cap extension 240 is axially displaced toward the sealing cap of the related coupling member 213 and, when the cam follower roller is disengaged from the cam, the body 255 is rockable, in the direction of the arrow on FIG. 8, to move the sealing cap extension 240 axially away from the sealing cap of the related coupling member 213.

The tubular member 259, body 255 and axle 256 are formed with communicating bores 243 terminating at the sealing cap extension 240 and at a radial bore 261 opening from the axle 256 within one of the bearing supports 257. The bore 206 of the related carrier also terminates at that bearing support 257 and is located for registration with the radial bore 261 when the body 255 of coupling member 241 is rocked to the position shown on FIG. 8, that is, to the position determined by engagement of cam 242 with the cam follower roller 258. Accordingly, when the related carrier arrives at the testing station B_1, the coupling member 241 is disposed for the transmission of air under pressure from the bore 206 through the bores 261 and 243 to the end of the filter cigarette unit then engaged by sealing cap extension 240. It will be noted that a testing apparatus embodying coupling members of the type illustrated on FIG. 8 will otherwise operate in the same manner as has been described in detail above with reference to the FIGS. 5 and 6.

Although illustrative embodiments of this invention have been described in detail herein with reference to the accompanying drawings, it is to be noted that the invention is not limited to those precise embodiments, and that various changes and modifications may be effected therein by one skilled in the art without departing from the scope or spirit of the invention, except as defined in the appended claims.

What is claimed is:

1. Apparatus for testing the integrity of, and the resistance to passage of a fluid through hollow articles having openings at their opposite ends with a restricted flow path therebetween, comprising

(A) conveyor means having carriers operative to transport the articles to be tested in equally spaced relation along a predetermined path from an article

receiving station to an article discharging station and past a testing station and a defective article ejecting station arranged successively therebetween,

(B) a pair of fluid conducting inlet and outlet coupling members associated with each carrier and movable with the latter along said path, said coupling members being movable toward and away from each other between operative positions, where they are engageable with the ends of an article on the related carrier for securing the article on the carrier and for communicating with the respective openings of the article, and released positions, where said coupling members are disengaged from the ends of the article to free the latter for removal from the carrier,

(C) means moving said coupling members of each carrier to said operative positions thereof during movement from said article receiving station to said article discharging station and permitting movement of at least one of said coupling members to its released position during movement of the related carrier past said ejecting station,

(D) locking means associated with each of said carriers and movable between an engaged position, where said locking means prevents movement of at least said one coupling member to said released position, and a disengaged position where said one coupling member is free to move to said released position,

(E) means operative to apply different pressures of fluid to the opposite end openings of each article by way of said coupling members engaged therewith at said testing station so that the pressure differential between said end openings is characteristic of the integrity and flow resistance of the article, and

(F) control means associated with each of said carriers and sensitive to said pressure differential between said end openings to move the related locking means to said engaged position only when the sensed pressure differential is characteristic of an article of satisfactory integrity and flow resistance.

2. Apparatus as in claim 1;

wherein said control means includes a diaphragm acting on said locking means.

3. Apparatus as in claim 2;

wherein said means operative to apply different pressures of fluid to the opposite end openings includes means for communicating said inlet coupling member of the carrier at said testing station with a source of fluid under pressure;

and said control means further includes means defining a chamber closed by said diaphragm and communicating with the related outlet coupling member.

4. Apparatus as in claim 2;

wherein said means operative to apply different pressures of fluid to the opposite end openings includes means for communicating one of said coupling members of the carrier at said testing station with a source of vacuum;

and wherein said control means further includes means defining a chamber closed by said diaphragm and communicating with the other of said coupling members of the related carrier.

5. Apparatus as in claim 1;

wherein said locking means includes a rockable latch lever engageable with said one coupling member in said engaged position, and spring means acting on said latch lever to urge the latter to said disengaged position; and

wherein said control means includes a diaphragm operated by said pressure differential and acting on said latch lever to move the latter in opposition to said spring means.

6. Apparatus as in claim 1;

wherein said means operative to apply different pressures of fluid to the opposite end openings includes means for communicating said inlet coupling member of the carrier at said testing station with a source of compressed air;

wherein said locking means include a rockable latch lever engageable with said one coupling member in said engaged position, and spring means urging said latch lever to said disengaged position; and

wherein said control means includes a nozzle communicating with said outlet coupling member and opening toward said latch lever to direct a jet of air against the latter tending to rock the latch lever to said engaged position in response to the streaming of air through the article on the related carrier from said source of compressed air.

7. Apparatus as in claim 1;

wherein each carrier has a groove therein for receiving an article to be tested, and ports opening at said groove; and

further comprising means for communicating said ports of each carrier with a source of suction to hold the article in said groove during movement of the carrier from said receiving station to said ejecting station and from the latter to said discharging station, and means interrupting the communication of said ports with said source of suction and supplying air under pressure to said ports during movement of the related carrier past said ejecting station so that jets of air issue from said ports to assist the ejection from a carrier of a defective article.

8. Apparatus as in claim 7;

further comprising means venting said ports of each carrier to the atmosphere as said carrier reaches said discharging station.

9. Apparatus as in claim 8;

wherein said conveyor means is endless so that said carriers are returned from said discharging station to said receiving station; and

further comprising means supplying air under pressure to said ports of each carrier during return of the latter from said discharging station to said receiving station, thereby to clean out said ports.

10. Apparatus as in claim 1;

wherein said conveyor means is endless so that each carrier is returned from said discharging station to said receiving station, and said means operative to apply different pressures of fluid to the opposite end openings of each article includes means for supplying compressed air to said inlet coupling member of the carrier at said testing station; and

further comprising means for supplying compressed air to said outlet coupling member of each carrier during return of the latter from said discharging station to said receiving station, thereby to provide a reverse flow of air through each outlet coupling member for cleaning out the latter.

11. Apparatus for testing the integrity of, and the resistance to passage of a fluid through hollow articles having openings only at their opposite ends and a restricted flow path therebetween, comprising

(A) a rotatable testing drum having equally spaced apart, axially extending carriers thereon adapted to carry successive articles to be tested from a receiving station, past successively arranged testing and defective article ejecting stations to a discharging station,

(B) a pair of fluid conducting inlet and outlet coupling members mounted at the opposite ends of each carrier for relative movement toward and away from each other between operative positions, where they are engageable with the ends of an article on the related carrier for securing the article on the carrier and for communicating with the respective openings of the article, and released positions, where said coupling members are spaced from the ends of the article to free the latter for removal from the carrier,

(C) cam means disposed adjacent the opposite ends of said testing drum and moving the inlet and outlet coupling members of the successive carriers to their operative positions during movement of each carrier from said article receiving station to said article discharging station and permitting movement of at least one of said coupling members to its released position during movement of the related carrier past said ejecting station,

(D) locking means on each carrier including a latch lever rockable thereon between an engaged position and a disengaged position, spring means urging said latch lever to said disengaged position, and a keeper on said one coupling member engageable, in said operative position thereof, with said latch lever upon rocking of the latter to said engaged position to retain said one coupling member in said operative position at said ejecting station,

(E) means operative to apply different fluid pressures to the opposite end openings of each article by way of said coupling members engaged therewith at said testing station so that the pressure drop between said coupling members is characteristic of the integrity and flow resistance of the article engaged thereby, and

(F) control means on each carrier sensitive to said pressure drop and operative to rock said latch lever of the related locking means to its engaged position only when said pressure drop has a value characteristic of a satisfactory article, whereby only defective articles are released by said coupling members for removal from the related carriers at said ejecting station.

12. Apparatus as in claim 11;

wherein said control means includes means defining a chamber communicating with one of said coupling members, and a diaphragm extending across said chamber and movable to rock said latch lever upon a change in the pressure within said chamber.

13. Apparatus as in claim 12;

wherein said means operative to apply different fluid pressures to the opposite end openings of each article includes means for supplying compressed air to the other of said coupling members at said testing station.

14. Apparatus as in claim 12;

wherein said means operative to apply different fluid pressures to the opposite end openings of each article includes means for connecting the other of said coupling members at said testing station to a source of vacuum.

15. Apparatus as in claim 11;

wherein said control means includes a nozzle connected with said outlet coupling member for directing a jet of air against said latch lever; and

wherein said means operative to apply different fluid pressures to the opposite end openings of each article includes means for connecting said inlet coupling member of the carrier at said testing station to a source of compressed air so that the force of the jet of air issuing from said nozzle is determined by the integrity and flow resistance of the tested article.

16. Apparatus as in claim 11;

wherein said means operative to apply different fluid pressures to the opposite end openings of each article includes means for connecting said inlet coupling member of the carrier at said testing station to a source of compressed air so that air flows through the article and into said outlet coupling member for transmission to said control means;

and further comprising means for communicating said outlet coupling member of each carrier with a source of compressed air to cause a cleansing air flow out of said outlet coupling member during return of the related carrier from said discharging station to said receiving station.

17. Apparatus as in claim 16;

further comprising valve means movable with said outlet coupling member of each carrier to selectively communicate the related coupling member wtih said control means and with said source of compressed air when said outlet coupling member is in said operative and released positions, respectively.

18. Apparatus as in claim 17;

wherein each carrier has a groove therein for receiving an article to be tested, and ports opening at said groove; and

further comprising means for communicating said ports of each carrier with a source of suction to hold the article in said groove during movement of the carrier from said receiving station to said ejecting station and from the latter to said discharging station, and means interrupting the communication of said ports with said source of suction and supplying air under pressure to said ports during movement of the related carrier past said ejecting station so that jets of air issue from said ports to assist the ejection from a carrier of a defective article.

19. Apparatus as in claim 18;

further comprising means venting said ports of each carrier to the atmosphere as said carrier reaches said discharging station.

20. Apparatus as in claim 19;

further comprising means supplying air under pressure to said ports of each carrier during return of the latter from said discharging station to said receiving station for cleaning out said ports.

21. Apparatus as in claim 11;

wherein each carrier has bores opening at the opposite ends thereof, and said inlet and outlet coupling members have guide tubes extending therefrom and axially slidable in said bores; and

wherein said inlet and outlet coupling members communicate with said means for applying different fluid pressures and with said control means by way of the respective guide tubes and the bores slidably receiving the latter.

22. Apparatus as in claim 11;

wherein said carrier includes means rockably mounting at least said outlet coupling member thereon.

23. An apparatus for testing the integrity of and the resistance to passage of a fluid through cigarettes and similar hollow rod shaped articles having openings at their opposite ends with a restricted flow path therebetween, comprising conveyor means including carriers operative to transport the articles to be tested and arranged to advance along a predetermined path from an article receiving station past a series of additional stations including a testing station, an ejecting station and a discharging station, said testing station being located ahead of said discharging and ejecting stations; pairs of fluid conducting inlet and outlet coupling members associated and movable with each carrier along said path, the coupling members of said pairs being movable with reference to each other between operative positions in which they engage the ends of an article on the associated carrier for securing the article to the carrier and for communicating with the respective openings of the article, and released positions in which said coupling members are disengaged from the ends of the article to free the latter for removal from the associated carrier; actuating means for moving said coupling members to said operative positions thereof during movement from said article receiving station to said article discharging station, said actuating means being arranged to permit movement of at least one of a pair of coupling members to said released position during movement of the associated carrier past said ejecting station; locking means associated with said one coupling member of each pair and movable between an engaged posi-

tion in which said locking means prevents movement of said one coupling member to said released position, and a disengaged position in which said one coupling member is free to move to said released position; means operative to apply different pressures of fluid to the opposite end openings of each article by way of said coupling members engaged therewith at said testing station so that the pressure differential between said end openings is characteristic of the integrity and flow resistance of the article; and control means associated with each of said carriers and responsive to pressure differential between said end openings to move the related locking means to said engaged position only when the pressure differential is characteristic of an article of satisfactory integrity and flow resistance.

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