ABSTRACT: Apparatus for inverting filter cigarettes end for end comprises a rotor which is turnable about a vertical axis and supports a set of equidistant two-armed levers rotatable therein about vertical axes. The upper arms of the levers carry fluted coplanar horizontal holders which receive filter cigarettes from the flutes of a horizontal feeding drum and deliver inverted filter cigarettes to the flutes of a horizontal receiving drum after a freshly filled holder travels with the rotor through an angle of about 180°. A stationary cam cooperates with followers on the lower arms of the levers to turn such levers with reference to the rotor so that the flutes of the holders are substantially parallel to the flutes of the feeding drum during acceptance of filter cigarettes from the feeding drum and that the flutes of the holders are substantially parallel to the flutes of the receiving drum during transfer of inverted cigarettes.
APPARATUS FOR INVERTING CIGARETTEs OR THE LIKE

BACKGROUND OF THE INVENTION

The present invention relates to apparatus for inverting rod-shaped articles end for end, particularly for inverting filter cigarettes which are obtained by subdivision of filter cigarettes of double-unit length.

It is customary to produce filter cigarettes by placing mouthpieces of double-unit length between two cigarette rod sections of unit length, by inverting. A method employs an adhesive-coated uniting band around the mouthpiece and the adjoining ends of cigarette rod sections to form filter cigarettes of double-unit length, and by severing the uniting band midway between the ends of the mouthpiece whereby each cigarette of double-unit length yields two cigarettes of unit length whose filter tips are adjacent to each other. It is therefore necessary to invert one of each pair of coaxial cigarettes of unit length so as to change its orientation in order to place its filter tip into the same position as the filter tip of the noninverted cigarette.

U.S. Pat. No. 3,215,250 discloses an inverting apparatus which includes a horizontal drum carrying a set of holders for filter cigarettes. Each holder is rotatable about an axis which extends radially of the drum and is provided with suction ports to hold cigarettes during inversion. A drawback of such apparatus is that it must be provided with complicated means for evacuating air from the ports of holders. The evacuating means includes channels machined into the holders, their shafts, the drum and the shaft of the drum.

Another inverting apparatus is disclosed in the pending application Ser. No. 655,151 now U.S. Pat. No. 3,972,535, of Menge which is assigned to the same assignee. The inverting conveyor of this apparatus comprises an endless flexible band which is provided with fixedly mounted holders for the cigarettes. The holders receive cigarettes during travel along one stretch of the band and deliver inverted cigarettes to a receiving drum during travel along the other stretch of the band. Such apparatus is quite satisfactory; however, the orientation of holders for cigarettes depends too much on tensioning of the band. Moreover, it is desirable to change the orientation of holders with reference to their conveyor during certain stages of transport of articles between two stations at one of which the holders receive noninverted cigarettes and at the other of which inverted cigarettes are removed from their holders.

SUMMARY OF THE INVENTION

An object of the invention is to provide an inverting apparatus for filter cigarettes, cigarillos, cigars, filter rod sections, plain cigarettes or analogous rod-shaped articles which is simpler, more reliable and faster than presently known apparatus.

Another object of the invention is to provide an apparatus wherein the articles need not be held by suction during inversion, even if such articles are transported at a high speed, and which can automatically discard defective articles during inversion.

A further object of the invention is to provide an apparatus for inverting filter cigarettes or like rod-shaped articles end for end in a small area, at a higher rate of speed than in presently known apparatus, and with reduced expenditures for parts and assembly or maintenance work.

An additional object of the invention is to provide the above outlined apparatus with a novel inverting conveyor which is simpler than presently known inverting conveyors.

The improved inverting apparatus for rod-shaped articles comprises a rotor turnable about a preferably vertical first axis, a plurality of equidistant carriers mounted in and turnable with reference to the rotor about second axes which are at least substantially parallel to the first axis, article-accommodating holder means provided on each carrier and rotatable with the rotor between and beyond two angularly spaced stations, turning means (preferably including a fixed cam cooperating with followers provided on the carriers) for turning the carriers with reference to the rotor in rotation of the rotor about the first axis, feeding means for supplying articles to successive holder means at one of the stations, and receiving means for accepting inverted articles from successive holder means at the other station.

The aforementioned cam is designed to turn the carriers at different angular speeds as relatively second axes in predetermined angular positions of the rotor. This renders it possible to hold the flutes of holder means in substantially parallelism with the flutes of feeding and receiving means and the two stations. The holder means are preferably located in a common plane which is normal to the first axis and each holder means is preferably offset with reference to the respective second axis. This renders it possible to accommodate a large number of holder means in a small area and to permit substantial angular movements of each holder means about the corresponding second axis without interfering with movements of adjoining holder means.

The novel features which are considered as characteristic of the invention are set forth in particular in the appended claims. The improved inverting 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 certain specific embodiments with reference to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a side elevational view of an inverting apparatus for filter cigarettes which embodies the invention;

FIG. 2 is a plan view of the inverting conveyor as seen in the direction of arrow II in FIG. 1;

FIG. 3 is a vertical sectional view as seen in the direction of arrows from the line III-III of FIG. 2;

FIG. 4 is an elevational view of a two-armed carrier which forms part of the inverting conveyor; and

FIG. 5 is a schematic view of the drive for the inverting conveyor and receiving means of the apparatus.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to FIG. 1, there is shown an inverting apparatus which is incorporated in a filter cigarette machine including a cutting drum 1 which receives filter cigarettes of double-unit length and cooperates with a rotary cutter (not shown) serving to subdivide each such cigarette into two filter cigarettes F1, F2 of unit length. The cigarettes of double-unit length are severed midway across their centrally located filter tips of double-unit length so that the filter tips of cigarettes F1, F2 are adjacent to each other. The flutes of the cutting drum 1 transfer pairs of cigarettes F1, F2 into alternating flutes of a transfer conveyor or drum 2 which rotates in a clockwise direction. Cigarettes F1 are transported directly into the flutes of a second transfer conveyor or drum 3. The cigarettes F2 are supplied into the flutes of a feeding conveyor here shown as a drum 5 which is adjacent to the rear half of the transfer drum 2, as viewed in FIG. 1 (see the phantom-line position of the drum 5 in FIG. 2). The feeding drum 5 delivers cigarettes F2 to an inverting conveyor 7 which inverts each cigarette end for end in a horizontal plane and delivers the thus inverted cigarettes F2 to the flutes of a receiving conveyor or drum 6.

The latter delivers inverted cigarettes F2 to alternate flutes of the second transfer drum 3 so that the latter accumulates a row of alternating cigarettes F1, F2 which are delivered into the flutes of a testing drum 4. This testing drum 4 may be constructed in a manner as disclosed, for example, in German Pat. No. 1,205,434.

The drums 5 and 6 are axially offset with reference to each other in a manner as shown in FIG. 2. This enables the apparatus to place the inverted cigarettes F2 into those flutes of the transfer drum 3 which alternate with flutes containing...
cigarettes F1. The axial length of the drum 5 or 6 equals or approximates half the axial length of the drum 2. It is preferred to use a feeding drum 5 whose dimensions are identical with the dimensions of the receiving drum 6. The shafts of drums 1 to 6 are horizontal and are mounted in an upright wall 41 constituting a portion of the frame in the filter cigarette machine. All of the drums are driven at the same peripheral speed. The reference character T denotes the distance between the centers of adjoining flutes in the periphery of the feeding drum 5; this distance is the same as that between the flutes of the drum 1 or 6. The distance between the centers of flutes in the drums 1 and 5 of the drum 2, 3 or 4 is T/2.

The inverting conveyor 7 is mounted at a level below the drums 5 and 6. This inverting conveyor comprises a stationary housing or casing 8 for a rotor or turntable 9. The latter is rotatable about a vertical axis and supports eleven carriers 11 each of which constitutes a two-armed lever with vertically spaced upper and lower arms 12, 15 (see also FIGS. 2, 3 and 4). Each carrier 11 can turn with reference to the rotor 9 about a vertical axis but shares angular movements of the rotor with reference to the housing 8. The arms 12 of the carriers 11 extend upwardly beyond the rotor 9 and each thereof supports or is provided with a fluted horizontal receptacle or holder 13 for a filter cigarette F2. These holders 13 are located in a common horizontal plane immediately below the drums 5 and 6 (see FIG. 1). In order to move a holder 13 from registry with the lowermost flute in the drum 5 into registry with the lowermost flute of the drum 6, the rotor 9 must turn through an angle of 180° or close to 180°. The lower arm 15 of each carrier 11 is accommodated in the interior of the housing 8 and is provided with a roller follower 31 (FIGS. 2—4) tracking the internal surface of a fixed ring-shaped turning cam 16 cutout to an internal shoulder of the housing 8.

Each holder 13 is provided with a longitudinally extending flute 13a (see FIGS. 2 and 3) which can receive a filter cigarette F2 from a flute of the feeding drum 5. Each holder 13 is further provided with a stop or abutment 34 which is adjustable with reference to the arm 12 in the longitudinal direction of the respective holder and serves as a stop for that end of a filter cigarette F2 which remote from the axis of the rotor 9. This is best shown in FIG. 2.

A cleaning device including a nozzle 42 is installed at a level above the plane of the holders 13 between the drums 5 and 6. The orifice of this nozzle 42 can receive compressed air by way of a supply conduit 42a which is connected with a compressor or the like (not shown). The purpose of streams of air issuing from the orifice of the nozzle 42 is to clean the flutes of holders 13 before such flutes return into registry with the flutes of the drum 5 to receive fresh filter cigarettes F2.

FIG. 3 shows that the rotor 9 comprises a sleeve like or cylindrical central portion 17 which is rotatable in antifriction bearings 19, 21 provided therefore in the lower portion of the housing 8 and an annular upper portion or flange 18 which is rigid or integral with the central portion 17 and is provided with eleven equidistant vertical bores or openings 23 for pairs of vertically spaced antifriction bearings 24, 25. Each pair of these bearings supports the central portion or shaft 14 of a carrier 11. The drive means for rotating the rotor 9 comprises a spur gear 22 which is fixed to the lower end of the central portion 17 and is accommodated in a chamber provided in the lower base of the housing 8. The latter has a cutout (not shown) for a portion of a second spur gear 35 (FIG. 5) which meshes with the spur gear 22 and is mounted on a vertical shaft fixed to a bevel gear 36. The bevel gear 36 meshes with a second bevel gear 37 on a horizontal shaft which is affixed to a spur gear 38. This spur gear meshes with a spur gear 39 on the shaft 6a of the feeding drum 6. The remaining drums 1—5 of the apparatus shown in FIG. 1 are driven in a customary way as known from the art of filter cigarette machines.

Referring again to FIGS. 3 and 4, each carrier 11 is a composite two-armed lever wherein the arms 12, 15 are secured to the rotor 9 by a vertical bolt 28 extending through an axial bore of the shaft 14 and meshing with a nut which biases its head against the underside of the lower arm 15. The nut biases the upper arm 12 against the adjoining end face of the shaft 14. The shaft 14 has trunnions 26, 27 which respectively extend into bores of the arms 15, 12. The lower arm 15 has a pin 29 for the roller follower 31. A helical spring 33 operates between a post 32 of the flange 18 and the lower arm 15 to bias the roller follower 31 against the internal surface of the turning cam 16. FIGS. 2 to 4 show that the arms 12, 15 of each carrier 11 are angularly offset with reference to each other to insure that each carrier can turn in the corresponding bearings 24, 25 without interfering with adjoining carriers. In other words, each upper arm 12 is offset from the corresponding nut 14.

If desired, the testing drum 4 can be installed between the drums 1 and 2 so that the drums 2, 3, 5 and 6 receive tested cigarettes. If the inverting conveyor 7 is installed in a manner as shown in FIG. 1, i.e., ahead of the testing drum 4, as considered in the direction of travel of cigarettes F2, it performs the additional purpose of segregating or discarding at least some defective cigarettes F2 so that cigarettes wherein the filter tips do not adhere to tobacco rod sections or cigarettes exhibiting similar defects are ejected ahead of the receiving drum 6.

The operation:
The cutting drum 1 receives filter cigarettes of double-unit length wherein filter tips of double-unit length are located between and are connected with two wrapped cigarette rod sections of unit length. The drum 1 cooperates with the aforementioned rotary knife which sever each cigarette to produce pairs of coaxial filter cigarettes F1, F2 of unit length but with the filter tips of cigarettes F1 adjacent to filter tips of cigarettes F2. The flutes of the transfer drum 2 receive successive pairs of cigarettes F1, F2 and deliver the cigarettes F1 to the transfer drum 3 as those pairs of cigarettes are separated. The flutes of the transfer drum 3 deliver filter cigarettes F1 to alternate flutes of the testing drum 4.

The flutes of the feeding drum 5 deliver filter cigarettes F2 to the flutes 13a of successive holders 13 on the upper arms 12 of carriers 11 which rotate with and turn with reference to the rotor 9. Angular movements of carriers 11 relative to the rotor 9 are determined by the configuration of the internal surface on the fixed turning cam 16 which is tracked by the roller followers 31. The station where the drum 5 delivers cigarettes F2 to the flutes 13a of holders 13 is denoted by the character A. The character B denotes the station where inverted cigarettes F2 are delivered to the flutes of the receiving drum 6. The configuration of the internal surface on the turning cam 16 is selected in such a way that each holder 13 is substantially parallel to lowermost flute of the feeding drum 5 when such holder reaches the first transfer station A. At the same time, a holder 13 occupying the station A is caused to move slightly longwise so that its stop 34 moves into abutment with the adjoining end face of the cigarette F2 which is deposited in the flute 13a of such holder. In other words, such a holder 13 is caused to move in parallelism with the lowermost flute of the drum 5. The rotor 9 rotates in a clockwise direction, as viewed in FIG. 2, and the turning cam 16 causes the carrier 11 whose holder 13 received a cigarette F2 at the station A to maintain the holder in parallelism with the flutes of the drum 5 while the holder 13 is terminated when the corresponding cigarette F2 moves away from the drum 5 sufficiently to permit its inversion during travel toward the second transfer station B. Such inversion is effected in response to rotation of the rotor 9 and in response to some angular displacement of the carrier 11 with reference to the rotor while the corresponding holder 13 travels from the station A toward the station B. The cam 16 causes the carrier 11 which travels toward the station B to turn in a clockwise direction, as viewed in FIG. 2. The inversion of cigarette F2 is completed shortly before the corresponding holder 13 reaches the station B. While the holder 13 approaches the station B the cam 16
causes the corresponding carrier 11 to turn in the rotor 9 so that the inverted cigarette F2 moves in substantial parallelism with the flutes of the receiving drum 6. A slight axial movement which is imparted to a holder 13 which approaches the station B causes the corresponding stop 34 to move away from the adjoining end of the inverted cigarette F2. This results in slight misalignment between the flute 13a of the holder 13 and the lowest flute of the receiving drum 6; however, such minor misalignment can be readily compensated for by making the flutes of the drum 6 slightly wider than the diameter of a filter cigarette F2. The same applies for the flutes of the drum 5. The misalignment is very small. The drums 5 and 6 are preferably suction drums and are designed to respectively hold cigarettes F2 by suction during delivery toward and during withdrawal from the flutes 13a of holders 13.

An important advantage of the inverting conveyor 7 is that it maintains filter cigarettes F2 in a substantially horizontal plane so that the cigarettes are held in their flutes by gravity during inversion while traveling from the station A toward the station B. Each inverted cigarette F2 which enters a flute of the receiving drum 6 is parallel with the cigarettes F1 in the flutes of the transfer drum 3. Therefore, the inverted cigarettes F2 can be placed into empty flutes of the drum 3 to accommodate with cigarettes F1 and to share their movements toward the testing drum 4.

Even though the inverting conveyor 7 comprises an odd number (11) of carriers 11, and even though each of the drums 5, 6 is provided with an even number of flutes, the lowermost flute of the drum 5 delivers a noninverted cigarette F2 to the adjoining holder 13 when the foremost empty flute of the drum 6 receives an inverted cigarette F2 at the transfer station B. This is due to the fact that the drum 6 is angularly offset with reference to the drum 5 by a distance T/2. Such angular displacement of the drum 6 insures that the latter can deliver inverted cigarettes F2 into empty flutes of the transfer drum 3.

All such cigarettes F2 which are not properly deposited in the flutes 13a of the holders 13 drop in the space outside of or within the rotor 9 without affecting the operation of the inverting conveyor 7. As shown in FIG. 1, the flange 18 of the rotor 9 is formed with a downwardly and outwardly sloping conical surface which directs descending filter cigarettes F2 or portions of such cigarettes away from the housing 8. Also, the central portion 17 of the rotor 9 is preferably formed with a relatively large axial passage (shown in FIG. 2) which permits improperly transferred or defective cigarettes F2 to descend and to be collected in a suitable receptacle, not shown. Many defective cigarettes F2 are ejected from the carriers 11 by centrifugal force so that they are automatically removed from the inverting conveyor. Defective cigarettes F2 are likely to be produced when the filter cigarette machine which includes the cutting drum 1 is started. At such time, the filter cigarette machine is likely to produce filter cigarettes wherein the filter tips do not adhere to the adjoining cigarette rod sections so that the filter tips and the cigarette rod sections are likely to become separated during transfer onto the holders 13 or during rotation of such holders between the stations A and B.

The flute 13a of each empty holder 13 which travels from the station B back toward the station A is cleaned by compressed air which is discharged by the orifice of the nozzle 42.

The aforementioned angular displacements of holders 13 with reference to the rotor 9 during travel of holders at the stations A and B are desirable and advantageous because they ensure that the holders 13 can hold their flutes 13a in substantial parallelism with the flutes of the drums 5 and 6 during reception and delivery of cigarettes F2. It will be readily understood that the delivery of cigarettes F2 into the flutes 13a of holders 13 and into the flutes of the drum 6 would be much more difficult if the holders 13 would be rigidly connected to and would extend radially or substantially radially with reference to the central portion 17. This would reduce the length of intervals during which a holder 13 would remain parallel to the flutes of the drum S or 6. It is further to be noted that the inverting apparatus is designed to invert a large number of filter cigarettes F2 per unit of time so that the provision of turnable carriers 11 and of a specially configured turning cam 16 is of added importance. Many presently known inverting conveyors are unreliable when they operate above a certain relatively low speed, even if the cigarettes which are transferred into the flutes of the inverting conveyor are held by suction. Such retention by suction is not necessary in the inverting apparatus of my invention because the cigarettes are inverted during travel in a horizontal plane and are held against the action of centrifugal force by stops 34.

The improved apparatus can be used with advantage for inversion of other types of rod-shaped articles, for example, for inversion of filter cigar, filter cigarillos, plain cigarettes of unit length of multiple unit length, filter rod sections of unit length or multiple unit length, or the like.

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 I claim as new and desire to be protected by Letters Patent is set forth in the appended.

1. Apparatus for inverting cigarettes or like rod-shaped articles end for end, comprising an inverting conveyor including a rotor turnable about a first axis, a plurality of equidistant carriers mounted in and turnable with reference to said rotor about second axes which are at least substantially parallel to said first axis, each of said carriers comprising article-accommodating holder means rotatable with said rotor in a substantially horizontal plane between and beyond first and second angularly spaced stations; turning means for turning said carriers with reference to said rotor, said turning means comprising means for turning said carriers—in at least one predetermined angular position of said rotor in which the respective carriers are located in the region of said first station—at such a rate that the orientation of successive carriers with reference to said first station remains at least substantially unchanged during travel past said first station; feeding means for supplying articles to successive holder means at one of said stations; and receiving means for accepting inverted articles from successive holder means at the other station.

2. Apparatus as defined in claim 1, wherein said holder means are offset with reference to the respective second axes.

3. Apparatus as defined in claim 1, wherein each of said carriers comprises a lever.

4. Apparatus as defined in claim 3, wherein each of said levers comprises a first arm rigid with the respective holder means and a second arm receiving motion from said turning means.

5. Apparatus as defined in claim 4, wherein said turning means comprises stationary cam means and each of said second arms is provided with follower means tracking said cam means.

6. Apparatus as defined in claim 1, wherein each of said holder means is provided with an elongated article-accommodating first flute and wherein said feeding means comprises a second conveyor having a plurality of equidistant article-accommodating second flutes moving serially past said one station, each second flute at said one station being at least substantially parallel to the nearest first flute.

7. Apparatus as defined in claim 1, wherein each of said holder means is provided with an elongated article-accommodating first flute and wherein said receiving means comprises a second conveyor having a plurality of equidistant article-accommodating second flutes moving serially past said other station, each second flute at said other station being at least substantially parallel to the nearest first flute.

8. Apparatus as defined in claim 1, wherein each of said holder means is provided with an elongated article-accommodating flute having a first end nearer to and a second end more distant from said first axis, each of said carriers further
comprising stop means adjacent to the second ends of the respective flutes and arranged to serve as an abutment for the outer end of an article which is admitted into such flute at said one station.

9. Apparatus as defined in claim 8, wherein said turning means further comprises means for imparting to said holder means at each of said stations a movement in longitudinal direction of the respective flute.

10. Apparatus as defined in claim 1, wherein said rotor comprises an annular portion and wherein said first axis is vertical.

11. Apparatus as defined in claim 10, wherein said holder means are located at a level above said annular portion.

12. Apparatus as defined in claim 1, further comprising means for cleaning said holder means during movement from said other station toward said one station.

13. Apparatus as defined in claim 12, wherein said cleaning means comprises nozzle means and a source of compressed gas connected with said nozzle means so that said nozzle means discharges compressed gas against successive holder means.

14. Apparatus as defined in claim 1, further comprising second conveyor means arranged to transport two rows of rod-shaped articles and to admit successive articles of one of said rows to said feeding means, and third conveyor means for receiving the articles of the other row from said second conveyor means, said receiving conveyor means being arranged to deliver inverted articles of said one row between the articles of the other row on said third conveyor means.

15. Apparatus as defined in claim 14, wherein said second and third conveyor means comprise fluted drums and wherein each of said receiving and feeding means comprises a further drum, one of said further drums being axially offset with reference to the other further drum.