

United States Patent

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 [33] **Germany**
 [31] **H 63159**

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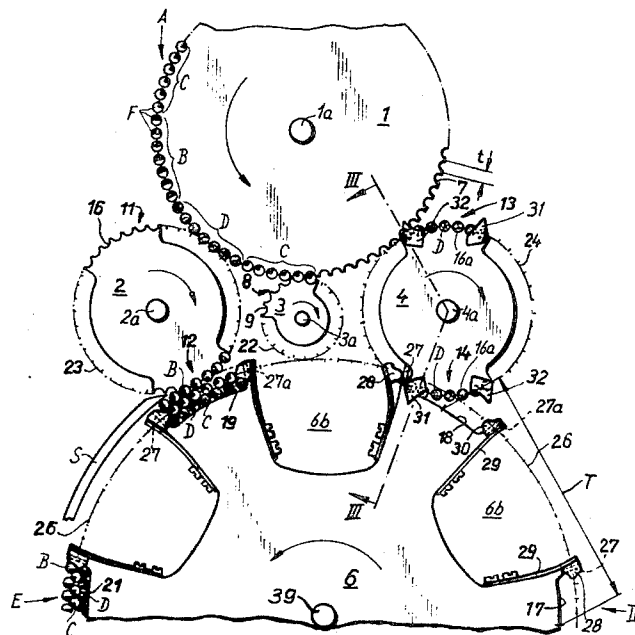
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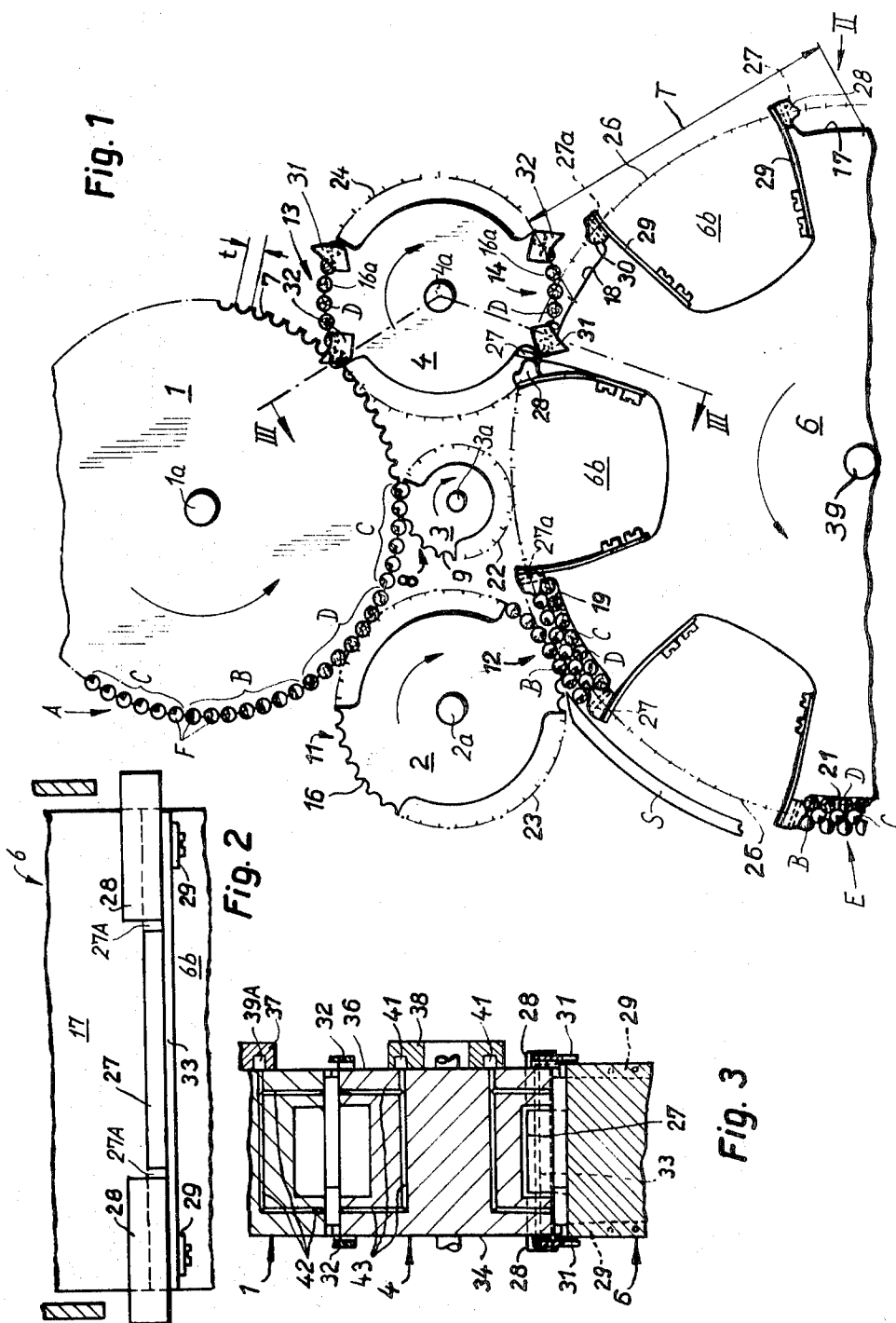
[54] **APPARATUS FOR MANIPULATING ROD-SHAPED ARTICLES**
 27 Claims, 10 Drawing Figs.

[52] U.S. Cl..... **198/31 AA,**
 198/20
 [51] Int. Cl..... **B65g 47/30**
 [50] Field of Search..... 198/31, 31
 AA, 20, 35; 53/148, 149, 150, 236, 151

[56] **References Cited**
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ABSTRACT: Apparatus for delivering cigarettes from a cigarette machine to a packing machine comprises a supply conveyor which advances a succession of cigarettes past three transfer conveyors each of which removes from the succession a series of groups in such a way that the first transfer conveyor permits predetermined numbers of cigarettes which can form two groups to advance to the second transfer conveyor and that the second transfer conveyor removes a group from each predetermined number and allows a group of cigarettes to reach the third transfer conveyor. All of the transfer conveyors supply groups to the pockets of an assembly conveyor which forms blocks of 20 cigarettes each and delivers such blocks to hollow mandrels in the conveyor of the packing machine. The supply conveyor receives cigarettes from a feed which in turn receives cigarettes directly from a cigarette machine.





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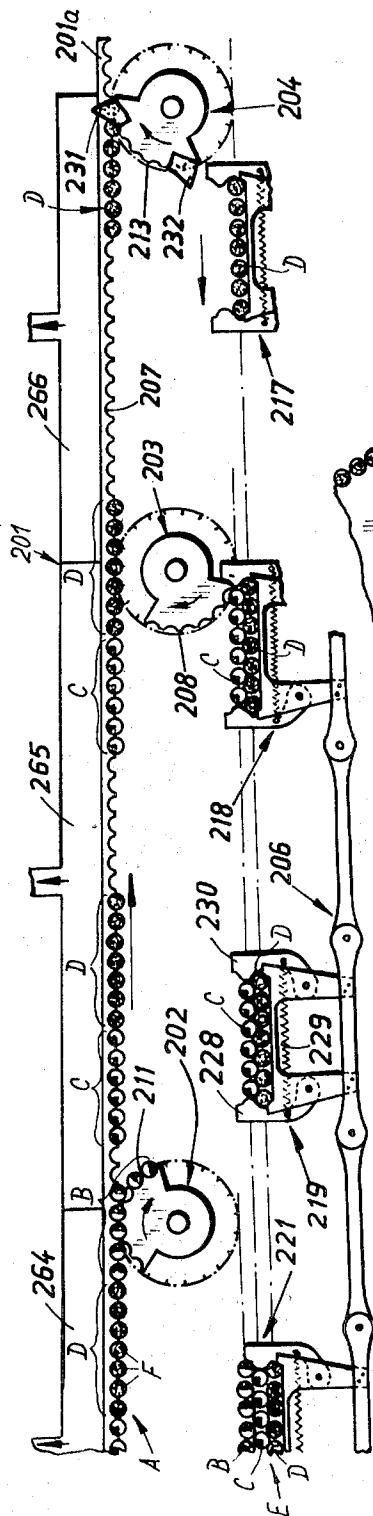


Fig. 6

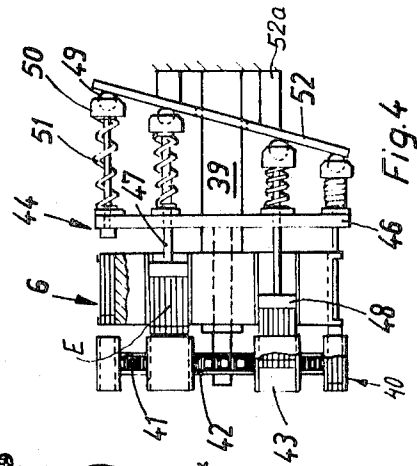


Fig. 4

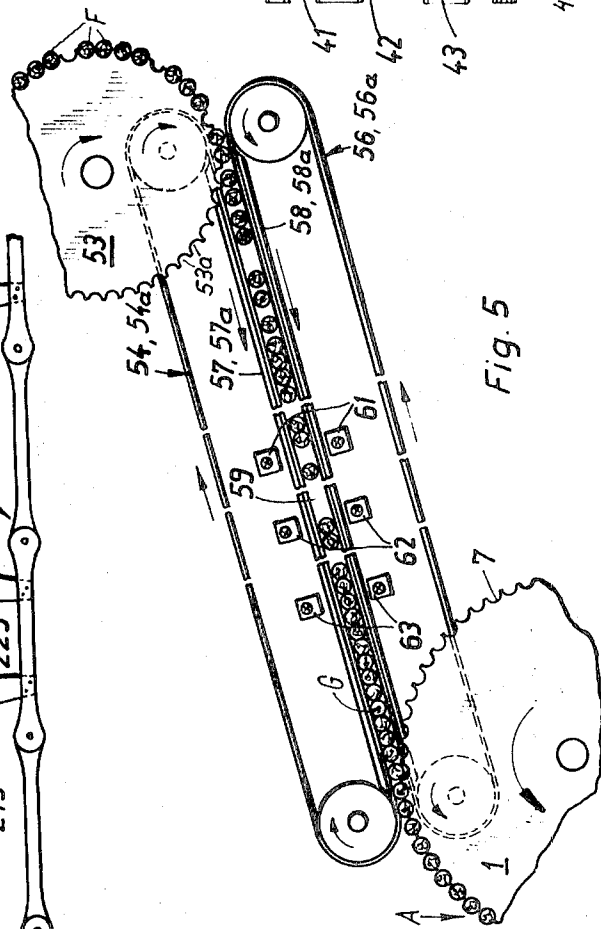
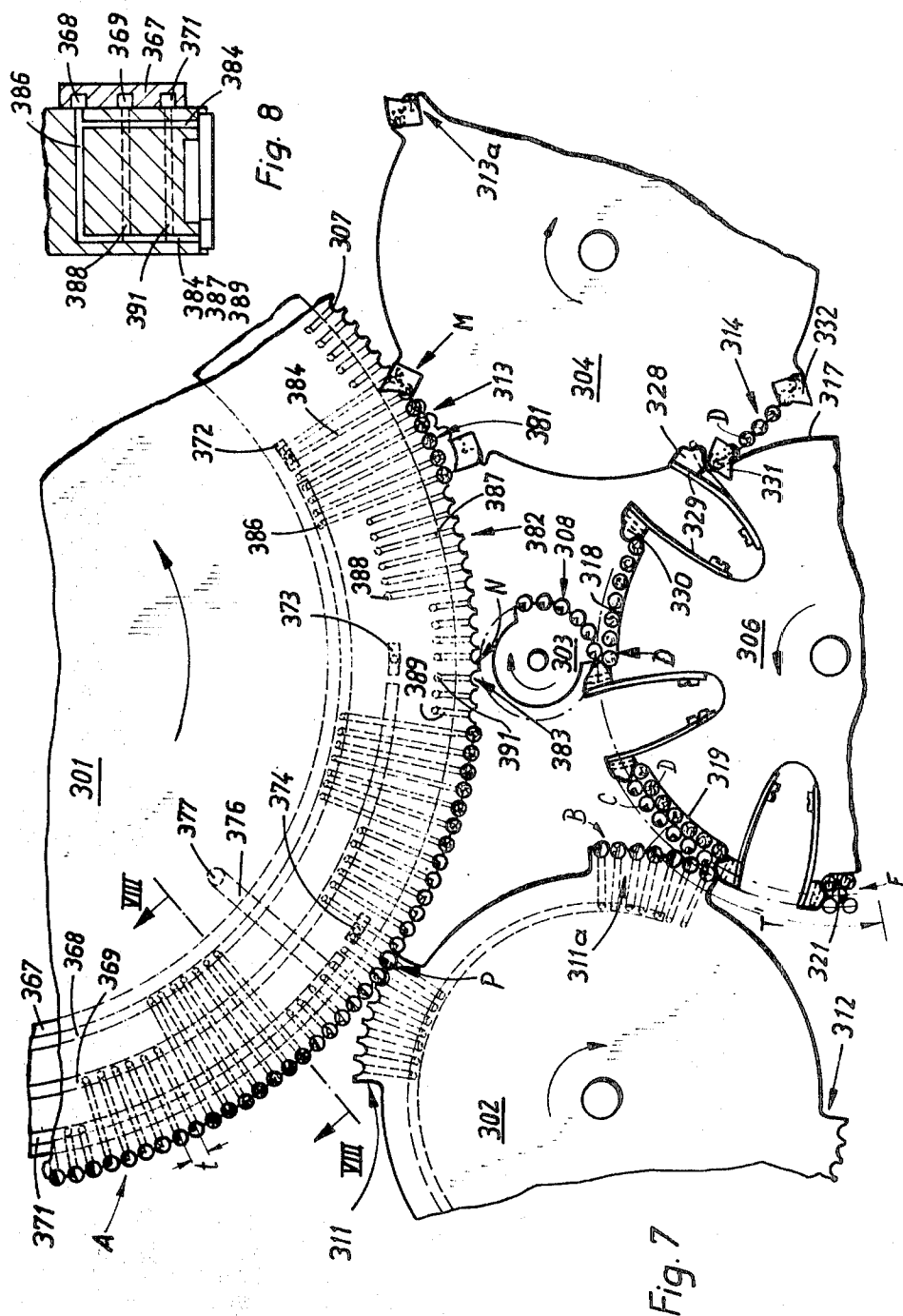


Fig. 5

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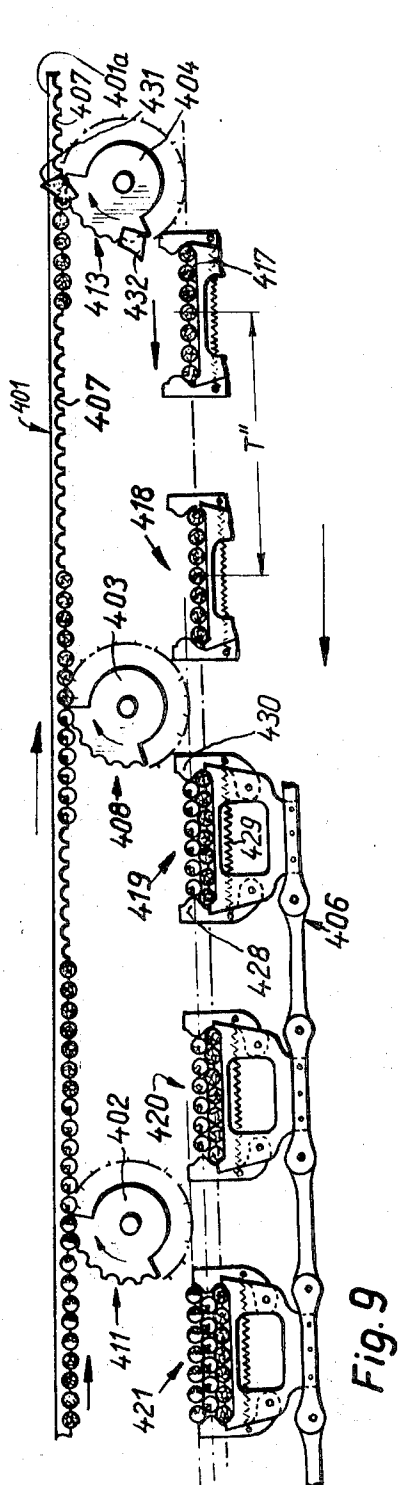


Fig. 9

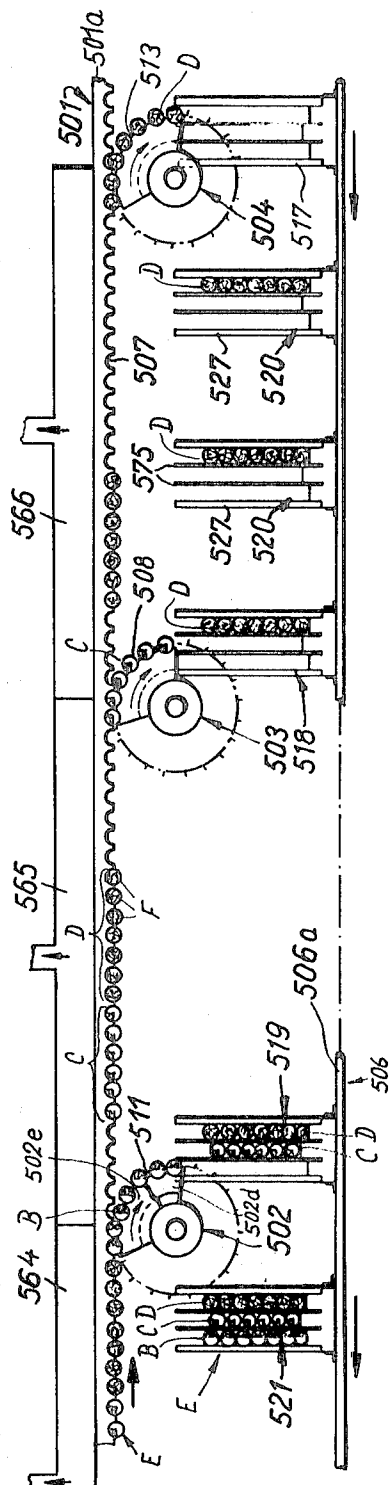


Fig. 10

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APPARATUS FOR MANIPULATING ROD-SHAPED ARTICLES

BACKGROUND OF THE INVENTION

The present invention relates to apparatus for manipulating rod-shaped articles. More particularly, the invention relates to improvements in apparatus which may be utilized to transfer cigarettes from a cigarette machine or filter cigarette machine to a packing machine and which converts a succession of cigarettes coming from the cigarette machine into groups of each of which contains a predetermined number of cigarettes. Still more particularly, the invention relates to improvements in apparatus which can convert a succession of cigarettes or like rod-shaped articles into batches, arrays or blocks wherein the articles are held in predetermined positions with reference to each other and are ready to be introduced into envelopes to form cigarette packs or the like.

Heretofore-known apparatus for delivering batches or blocks of cigarettes to a packing machine normally comprise intermittently operated transfer conveyors or counting conveyors which assemble groups or layers of cigarettes and can deliver such groups into shafts or into hollow mandrels of a packing machine. The operation is slow, i.e., the assembly of a block consumes more time than the wrapping of a block so that the packing machine is not used to capacity.

SUMMARY OF THE INVENTION

It is an object of our invention to provide an apparatus which can convert a succession of rod-shaped articles into batches or blocks of such articles in a fraction of the time required for such operation in conventional apparatus.

Another object of the invention is to provide an apparatus which can treat the articles gently and which can convert a succession of articles into blocks wherein the articles are in an optimum distribution for immediate introduction into a packing or like consuming machine.

A further object of the invention is to provide the apparatus with novel holding, withdrawing and transferring means for rod-shaped articles and to assemble and design such means in a way to insure rapid assembly of blocks without any damage to or deformation of articles.

An additional object of the invention is to provide an apparatus which can assemble blocks of articles wherein certain articles are automatically staggered with reference to the remaining articles of the block.

An ancillary object of the invention is to provide a novel feed for delivery of articles to the improved apparatus and to provide the apparatus with novel means wherein or whereon the articles are assembled to form blocks containing a desired number of articles disposed in two or more layers or groups.

A further object of the instant invention is to provide an apparatus which occupies little room, wherein the moving parts can be operated by a simple drive, and which can deliver to a packing or other consuming machine blocks of articles at the rate which is warranted by the momentary operating condition of the consuming machine.

The improved apparatus is utilized to convert a succession of articles, particularly plain or filter cigarettes or analogous rod-shaped articles, into plural series of groups each of which contains a fixed number of articles. The apparatus comprises a supply conveyor means which preferably includes a single supply conveyor and is arranged to advance a succession of preferably equidistant closely adjacent articles in a predetermined path, first transfer conveyor means adjacent to a first portion of the path and having withdrawing means for removing from the path successive groups of a first series of groups while permitting a predetermined number of articles (which can form at least one additional group) to advance into a second portion of the path between successive removals of complete groups of the first series, and additional transfer conveyor means adjacent to the second portion of the path and having at least one additional withdrawing means for

removing from the predetermined numbers successive groups of at least one additional series.

The apparatus further comprises assembly conveyor means which is provided with a plurality of receiving means adapted to receive a group from each transfer conveyor means while the assembly conveyor means is at a standstill or in motion. The receiving means may constitute pockets each of which can receive two or more groups of articles. Such pockets may deliver arrays or blocks consisting of two or more groups to a packing machine wherein the blocks are provided with wrappers to form cigarette packs or the like.

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

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a fragmentary side elevational view of a first apparatus which is utilized to convert a succession of cigarettes into blocks of twenty cigarettes each;

FIG. 2 is a fragmentary end elevational view of the apparatus as seen in the direction of arrow II in FIG. 1;

FIG. 3 is a fragmentary sectional view as seen in the direction of arrows from the line III—III of FIG. 1;

FIG. 4 is a fragmentary end elevational view of a portion of a packing machine and of a mechanism which expels blocks of cigarettes from the assembly conveyor means of the apparatus into the packing machine;

FIG. 5 is a fragmentary side elevational view of a feed which supplies cigarettes to the supply conveyor means of the apparatus shown in FIG. 1;

FIG. 6 is a fragmentary side elevational view of a second apparatus wherein the supply conveyor means and the assembly conveyor means comprise endless flexible elements;

FIG. 7 is a fragmentary side elevational view of a third apparatus which is similar to the apparatus of FIG. 1 but wherein the assembly conveyor means is operated intermittently, and further showing a presently preferred embodiment of pneumatic holding means for rod-shaped articles on the supply conveyor means;

FIG. 8 is a fragmentary sectional view as seen in the direction of arrows from the line VIII—VIII of FIG. 7;

FIG. 9 is a fragmentary side elevational view of a fourth apparatus which is similar to the apparatus of FIG. 6 but wherein the assembly conveyor means is driven intermittently; and

FIG. 10 is a fragmentary side elevational view of a fifth apparatus which is similar to the apparatus of FIG. 9 but comprises modified intermittently driven assembly conveyor means whose receiving means accept groups of articles while the assembly conveyor means is at a standstill.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring first to the embodiment of FIGS. 1 to 5, and more particularly to FIG. 1, there is shown a portion of an apparatus which can convert a succession A of plain or filter cigarettes F into three series of groups or layers B, C, D and which thereupon assembles successively formed groups B with successively formed groups C and D to form blocks, arrays or batches E each of which contains 20 cigarettes F. The apparatus comprises a single endless rotary drum-shaped supply conveyor 1, three rotary endless drum-shaped transfer conveyors 2, 3, 4, and a single endless rotary drum-shaped assembly conveyor or collecting conveyor 6. The transfer conveyors 2, 3, 4 are adjacent to three successive portions of an elongated arcuate path defined by the supply conveyor 1 for the succession A of cigarettes F. The cigarettes on the supply conveyor 1 are equidistant from each other and travel sideways, i.e., in parallelism with the axis of a horizontal shaft 1a which forms part of

a drive means for continuously rotating the supply conveyor at a predetermined speed and in a counterclockwise direction, as viewed in FIG. 1. The periphery of the supply conveyor 1 is provided with axially parallel flutes 7 which are equidistant from each other, the distance between the centers of two adjoining flutes being indicated at t . The median or second transfer conveyor 3 has a single withdrawing means 8 comprising six equidistant flutes 9 distributed in the same way as the flutes 7 of the supply conveyor 1. Each of the two outer transfer conveyors 2, 4 has two withdrawing means 11, 12 and 13, 14, and each of these withdrawing means comprises seven equidistant flutes 16, 16a whose distribution is the same as that of the flutes 7 or 9.

The assembly conveyor 6 has six equidistant receiving means or pockets including the pockets 17, 18, 19 and 21 which are visible in FIG. 1. The pitch T between the centers of successive pockets (e.g., between the pockets 17, 18) is the same as the pitch between the centers of withdrawing means 11, 12 or 13, 14 as well as the circumferential length of the second transfer conveyor 3. In other words, the distance from the center of the withdrawing means 8, around the circumference of the transfer conveyor 3, and back to such center equals T . The pitch T equals $20t$ because each pocket of the assembly conveyor 6 should receive 20 cigarettes F and because no cigarette should advance beyond the transfer station where the flutes 16a of the third transfer conveyor 4 remove cigarettes from successive flutes 7 of the supply conveyor. The circumferential length of the pitch circle 22 of the second transfer conveyor 3 equals T ; the circumferential length of each of the pitch circles 23, 24 of the transfer conveyors 2, 4 equals $2T$; and the circumferential length of the pitch circle 26 of the assembly conveyor 6 equals $6T$. Since the length of the pitch circles 23, 24 is twice that of the pitch circle 22, the two outer transfer conveyors have pairs of withdrawing means 11, 12 and 13, 14 whereas the median transfer conveyor 3 comprises a single withdrawing means 8. The shafts 2a, 3a, 4a, 39 drive the respective conveyors 2, 3, 4, 6 at a constant speed in synchronism with the supply conveyor 1. The drive means for the five conveyors comprises a train of meshing gears (not shown) whose pitch circles are the same as those of the respective conveyors.

The pockets of the assembly conveyor 6 should receive the groups B, C, D in such a way that the cigarettes F of the median group C are staggered with reference to the cigarettes in the adjoining groups B and D. This is the customary distribution of cigarettes in a pack which contains 20 cigarettes. The means for staggering the groups C with reference to the adjoining groups B and D comprises six pairs of movable projections 28, 30 and each pair of projections 28, 30 normally extends into a pocket of the conveyor 6. The projections 28 extend rearwardly (as considered in the direction of rotation of the assembly conveyor 6) through openings 27a (FIG. 2) provided therefor in the front walls or leading walls 27 of the respective pockets, and the projections 30 extend forwardly through openings provided in the rear walls or trailing walls 27a of the respective pockets. Each projection is carried by the outer end of a resilient element here shown as a leaf spring 29 which is affixed to the assembly conveyor 6 and is accommodated in one of six chambers or recesses 6b provided in the periphery of the conveyor 6 between successive pockets. The inner ends of the leaf springs 29 are bolted to the body of the supply conveyor 6. Each of the two receiving means 13, 14 on the last transfer conveyor 4 is flanked by two displacing cams 31, 32 which can respectively engage the projections 28, 30 in successive pockets of the assembly conveyor 6 when the apparatus is in use whereby the cams spread the projections and permit introduction of the respective groups D into the bottom zones or deepest zones of the adjoining pockets.

FIG. 2 is a plan view of a portion of the pocket 17 in the assembly conveyor (see the arrow II in FIG. 1). The leading wall 27 of this pocket 17 has two openings or cutouts 27a which communicate with the adjoining chamber 6b and each of which accommodates one-half of a projection 28. The lobes of

the projection 28 extend into the pocket 17. The two halves of the projection 28 are secured to a common carrier 33 which is connected to the outer end of the adjoining leaf spring 29. This spring may comprise two halves or two prongs each of which is connected with one end of the carrier 33. It is clear that the carrier 33 can be supported by a simpler leaf spring 29 or by three or more discrete springs. The projections 30 are similar to the projections 28 and are mounted on similar carriers and leaf springs.

FIG. 3 illustrates certain details of the apparatus in section. The displacing cams 31 and 32 are adjacent to the end faces 34, 36 of the transfer conveyor 4 so that each cam 31 can shift one-half of the projection 28 and that each cam 32 can shift one-half of the projection 30 when one of the withdrawing means 13, 14 travels along a pocket of the assembly conveyor 6. A stationary disk-shaped valve member 37 is adjacent to one end face of the supply conveyor 1 and a similar stationary disk-shaped valve member 38 is adjacent to the end face 36 of the transfer conveyor 4. A channel 39a of the valve member 37 is connected with a suction-generating device (e.g., a suitable fan, not shown) and with holding means here shown as suction ducts 42 machined into the interior of the supply conveyor 1 and communicating with the flutes 7 so that the cigarettes F are held in such flutes by suction while they advance along the transfer conveyors 2-4. The valve member 38 has a channel 41 which communicates with holding means or suction ducts 43 machined into the transfer conveyor 4 and communicating with the flutes 16a so that the cigarettes of groups D are also held in the flutes 16a by suction. The other two transfer conveyors 2, 3 are associated with two additional valve members (not shown) which regulate suction in the flutes 16 and 9 to insure that the groups B and C are held by suction during transfer from the path for the flutes 7 into the pockets of the assembly conveyor 6. Suction in the ducts of the transfer conveyors 2-4 is stronger than that in the ducts 42 of the supply conveyor 1 so that each transfer conveyor automatically removes a group B, C or D of cigarettes F when its flutes 16, 9, 16a travel along the flutes 7.

FIG. 4 is a side elevational view of the assembly conveyor 6. This conveyor is mounted between the conveyor 40 of a packing machine and an evacuating or ejecting mechanism 44. The movable portion of the evacuating mechanism 44 is mounted on the shaft 39 of the conveyor 6 and comprises a bearing disk 46 carrying six equidistant axially parallel rods 47 whose front ends carry ejectors or plungers 48. The rear ends of the rods 47 carry spherical followers 49 mounted in sockets 50 and tracking the face of an inclined plate cam 52 which is fixedly mounted in a frame 52a. Helical springs 51 operate between the bearing disk 46 and the sockets 50 to bias the followers 49 against the face of the cam 52. Each ejector 48 registers with one of the pockets in the periphery of the assembly conveyor 6 and with one of a succession of hollow mandrels 43 mounted on an endless link chain 42 trained around a sprocket wheel 41 mounted on the shaft 39. The parts 41-43 together constitute the conveyor 40 of the packing machine. The inclination of the cam 52 is such that the ejectors 48 are retracted when the adjoining pockets of the conveyors 6 receive groups B, C, D from the transfer conveyors 2-4 and that the ejectors 48 perform working strokes and expel freshly assembled arrays or blocks E into the registering mandrels 43 when the respective pockets advance beyond the transfer conveyor 2. The manner in which the blocks E in the mandrels 43 are wrapped into single- or multiple-ply envelopes to form therewith cigarette packs is well known from the art of cigarette-packing machines.

FIG. 5 shows a feed which delivers cigarettes F into successive flutes 7 of the supply conveyor 1 wherein such cigarettes form the succession A shown in FIG. 1. This feed includes a drum-shaped feed conveyor 53 which forms part of a conventional cigarette machine and is located downstream of a suitable cigarette-testing device (not shown) which expels therefrom defective cigarettes F so that certain flutes 53a of the feed conveyor 53 are empty. The ends of cigarettes F ex-

tend beyond the end faces of the feed conveyor 53 so that they can be readily removed from the flutes 53a to enter an elongated downwardly inclined channel 59 defined by a condensing conveyor which includes two pairs of endless belts 54, 54a and 56, 56a. The channel 59 is flanked by the lower stretches 57, 57a of the upper belts 54, 54a and by the upper stretches 58, 58a of the lower belts 56, 56a. This channel 59 is tangential to the conveyors 53 and 1. Three photosensitive detectors 61, 62, 63 are mounted in the region between the stretches 57, 57a and 58, 58a; each of these detectors comprises a light source and a photosensitive receiver.

The feed of FIG. 5 is but one of several devices which can be utilized to deliver a succession of equidistant cigarettes to the flutes 7 of the supply conveyor 1. For example, the feed of FIG. 5 can be replaced by a feed which is disclosed in British Pat. No. 1,056,841 and comprises means for admitting cigarettes into gaps formed in a layer of parallel cigarettes.

The operation is as follows:

The feed conveyor 53 of the cigarette machine delivers into the channel 59 of the condensing conveyor 54, 54a, 56, 56a a substantially uninterrupted series of cigarettes F; however, certain flutes 53a are empty because all defective cigarettes are removed therefrom at a testing station located upstream of the intake end of the channel 59. The stretches 57, 57a, 58, 58a of the condensing conveyor travels at a speed which is somewhat higher than the peripheral speed of the feed conveyor 53 whereby the cigarettes F in the channel 59 form a layer G of closely adjacent cigarettes. When the trailing end of the layer G reaches the foremost detector 63, the latter sends a signal which starts the packing machine (including the conveyor 40 of FIG. 4) so that the packing machine operates at a low speed. When the layer G extends all the way to the median detector 62, the latter adjusts the drive for the packing machine to operate it at full speed. If the trailing end of the layer G reaches the rearmost detector 61, the latter adjusts the drive for the cigarette machine so that the cigarette machine delivers cigarettes F at a reduced speed. The drive including the shafts 1a-4a and 39 is synchronized with the drive of the packing machine. Successive cigarettes F at the leading end of the layer G are caused to enter successive flutes 7 of the supply conveyor 1 by suction and to form therein the succession A which is shown in FIGS. 1 and 5. The withdrawing means 11, 12 of the first transfer conveyor 2 permit thirteen cigarettes F at the leading end of the succession A to pass and the withdrawing means 8 of the second transfer conveyor 3 thereupon removes the first six cigarettes F to form a group or layer C. FIG. 1 illustrates the conveyors 1 and 3 in positions they assume when the flutes 9 of the withdrawing means 8 begin to remove cigarettes F from the leading end of the succession. When the rearmost flute 9 receives the sixth cigarette F of the succession A, the 13th cigarette F of the succession advances beyond the withdrawing means 11 and the flutes 16 of the withdrawing means 11 then begin to collect a layer or group B, i.e., the 14th to 20th cigarettes of the succession A. The foremost seven cigarettes F of the succession A advance toward and are removed by the flutes 16a in the withdrawing means 14 of the third transfer conveyor 4. FIG. 1 shows the transfer conveyor 4 in an angular position in which the rearmost flute 16a of its withdrawing means 13 is about to remove the last cigarette F of the preceding series of 20 cigarettes from the adjoining flute 7 of the supply conveyor 1. The foremost flute 9 of the withdrawing means 8 on the median transfer conveyors 3 is about to receive the first cigarette of the succession A, and the foremost flute 16 of the withdrawing means 11 on the transfer conveyor 2 approaches the adjoining portion of the path in which the succession A advances with the conveyor 1.

When the packing machine is started, the first two pockets of the assembly conveyor 6 respectively receive a single group and two groups of cigarettes F. This is of no consequence because the first series of packs issuing from the packing machine is discarded so that the absence of one or two layers in the first two packs can be accepted without risking that such defective packs would reach the consumer.

The withdrawing means 14 of the third transfer conveyor 4 is shown in an angular position in which its cams 31 press against the adjoining halves of the projection 28 in the pocket 18 so that the layer or group D in the flutes 16a of the withdrawing means 14 can be deposited in the bottom zone of the pocket 18. The configuration of the channel 41 in the valve member 38 (FIG. 3) is such that the ducts 43 for the flutes 16a of the withdrawing means 14 are sealed from the suction-generating device when such flutes reach the bottom zone of a pocket in the assembly conveyor 6. Consequently, the group D can enter the pocket 18 by gravity (but it is equally possible to connect the suction ducts 43 with a source of compressed air so that the cigarettes F of the group D are expelled or propelled from the flutes 16a into the adjoining pockets. The displacing cams 32 at the trailing end of the withdrawing means 14 depress the halves of the trailing projection 30 in the rear wall 27a of the pocket 18 when the last flute 16a is about to deposit a cigarette F in the bottom zone of this pocket so that the delivery of a complete group D is then completed. The springs 29 return the projections 28, 30 into the pocket 18 as soon as the latter advances beyond the withdrawing means 14. The lobes of these projections then hold the two outermost cigarettes F of the group D and at the same time reduce the width of the space directly adjacent to the group D so that the width of such space is just sufficient for a group C of six cigarettes. This group C is delivered by the flutes 9 of the withdrawing means 8 because the second transfer conveyor 3 rotates continuously and its speed is synchronized with that of the assembly conveyor 6 in such a way that each group C comes to rest on top of a group D whereby the lobes of the respective projections 28, 30 compel the cigarettes of the group C to come to rest in the gaps between the cigarettes of the group D, i.e., the cigarettes of the two groups are staggered with reference to each other. The flutes 16 of the withdrawing means 11 or 12 on the first transfer conveyor 2 then deposit on the group C a group B of seven cigarettes F, and each cigarette of the group B is staggered with reference to each other. The flutes 16 of the withdrawing means 11 or 12 on the first transfer conveyor 2 then deposit on the group C a group B of seven cigarettes F, and each cigarette of the group B is staggered with reference to the cigarette of the group C but not with reference to the cigarettes of the deepest group D. The deposition of a group B into the pocket 19 of the assembly conveyor 6 is shown in FIG. 1. A shield S is placed adjacent to the periphery of the assembly conveyor 6 to hold the cigarettes F of the outermost groups B against ejection from the respective pockets by centrifugal force while the blocks E advance toward the ejecting station (FIG. 4). When a block E moves into registry with an empty mandrel 43, the corresponding ejector 48 begins to perform a working stroke (in a direction to the left, as viewed in FIG. 4) and expels the block from the respective pocket of the assembly conveyor 6.

As stated before, suction in the holding means or ducts which communicate with the flutes 9, 16 and 16a is stronger than the suction in holding means or ducts 42 of the supply conveyor 1. Therefore, the cigarettes F are readily removable from the flutes 7. Instead of employing the mechanical ejecting means 44 of FIG. 4, the apparatus of the present invention may be equipped with pneumatic or electromagnetically operated ejecting means.

FIG. 6 illustrates a portion of a second apparatus wherein parts similar to those shown in FIGS. 1 to 5 are denoted by similar reference numerals plus 200. Thus, the numeral 201 denotes a supply conveyor having flutes 207, the numerals 202-204 denote three transfer conveyors, and the numeral 206 denotes an assembly conveyor. The withdrawing means of the transfer conveyors 203, 202, 204 are respectively shown at 208, 211 and 213. The supply conveyor 201 comprises an endless belt or band 201a which is provided with the flutes 207 and whose lower stretch carries a succession A of cigarettes F. The assembly conveyor 206 comprises an endless link chain whose links carry receiving means or pockets including those denoted by the numerals 217, 218, 219 and 221.

The projections of the pockets are shown at 228, 230 and the displacing cams on the transfer conveyor 204, at 231, 232. The projections 228, 230 are pivotably connected to the walls of the pockets and are connected to each other by helical springs 229 which replace the leaf springs 29 of FIGS. 1 to 3. The supply conveyor 201 further comprises three suction chambers 264, 265, 266 which are adjacent to the lower stretch of the belt 201a and produce suction in the flutes 207. The belts 201a is provided with suction ducts or consists of foraminous material. Suction in the chambers 264-266 is strong enough to insure that the cigarettes F of the succession A are properly retained in the flutes 207 even though several flutes 207 are empty during travel below the chambers 265, 266.

The operation of this apparatus is similar to that of the previously described apparatus. The transfer conveyors 202-204 are disposed in a single row and are adjacent to longitudinally spaced portions of the path in which the cigarettes F of the succession A advance with the lower stretch of the belt 201a. The cams 231, 232 spread the projections 228, 230 against the opposition of springs 229 when the withdrawing means 213 delivers a layer or group D into the deepmost zone of a pocket on the assembly conveyor 206 and the projections 228, 230 thereupon move their lobes toward each other to insure that the layers or groups C deposited in the pockets by the withdrawing means 208 of the transfer conveyor 203 are staggered with reference to the cigarettes of the group D. In this embodiment of our invention, the pitch of each transfer conveyor is the same and equals the distance between the centers of two successive pockets on the assembly conveyor 206. It will be noted that the lower stretch of the belt 201a travels in a direction which is counter to that of the pockets on the upper stretch of the assembly conveyor 206.

FIG. 7 illustrates a third apparatus having a drum-shaped supply conveyor 301 with flutes 307, a drum-shaped assembly conveyor 306 with pockets including those shown at 317, 318, 319, 321, a first transfer conveyor 302 with four equidistant withdrawing means including those shown at 311, 311a 312, a second drum-shaped transfer conveyor 303 with a single withdrawing means 308, and a third drum-shaped transfer conveyor 304 having four equidistant withdrawing means including those shown at 313, 313a, 314 and further having displacing cams 331, 332 associated with each of its withdrawing means. The projections 328, 330 on the assembly conveyor 306 are mounted on leaf springs 329. In this embodiment of the present invention, the assembly conveyor 306 is rotated intermittently in synchronism with intermittent operation of the conveyor (see the conveyor 40 in FIG. 4) of the packing machine. When the conveyor 306 is at a standstill, the ejecting mechanism expels a fully assembled array E from one of its pockets. The arrangement is such that each of the transfer conveyors 302-304 deposits a layer or group B, C, D in three successive pockets of the assembly conveyor 306 during each phase of rotation of the assembly conveyor. FIG. 7 shows that the withdrawing means 311a, 308, 314 are about to deposit groups B, C, D in the pockets 317, 318, 319 of the conveyor 306. The pitch T' of the pockets on the assembly conveyor 306 is less than 20t because this conveyor dwells between each pair of successive intermittent advances in a counter-clockwise direction, as viewed in FIG. 7. The difference between the pitch T' and 20t is proportional to the duration of dwell of the conveyor 306 between successive advances.

FIGS. 7 and 8 further illustrate a presently preferred mode of holding the cigarettes F in the flutes 307 by suction. The number of flutes 307 in the conveyor 301 is a whole multiple of the total number of cigarettes F in an array E. In the present instance, the number of flutes 307 is n times twenty wherein n is a whole number.

One end face of the supply conveyor 301 is adjacent to a stationary disk-shaped valve member 367 which is formed with three concentric arcuate suction channels 368, 369, 371 which can communicate with a connecting channel 376. The latter is connected to the intake 377 of a suction generating

device. The first suction channel 368 extends close to the transfer station M where the flutes of the withdrawing means on the third transfer conveyor 304 remove cigarettes F from the flutes 307; the second suction channel 369 extends close to the transfer station N where the withdrawing means 308 of the transfer conveyor 303 removes cigarettes F from the flutes 307; and the third suction channel 371 extends close to the transfer station P where the withdrawing means of the transfer conveyor 302 removes cigarettes F from the flutes 307. The valve member 367 is further provided with three pressure channels or evacuating channels 372, 373, 374 which respectively register with the transfer stations M, N and P. These pressure channels are connected to the atmosphere or to a compressor or another source of compressed air or other gas. The flutes 307 are grouped into a series of groups or sets 381, 382, 383. When the flutes 307 of the set 381 contain cigarettes F, they are connected with the suction channel 368 by holding means in the form of suction ducts 384 and 386. When the flute 307 of a set 381 arrives at the transfer station M, it is connected with the pressure channel 372 by the corresponding ducts 384, 386. Analogously, when the flutes 307 of a set 382 contain cigarettes F, they are connected with the suction channel 369 by holding means or suction ducts 387, 388, and these ducts connect the flutes 307 of a set 382 with the pressure channel 373 when they reach the transfer station N. The flutes 307 of a set 383 are connected with the suction channel 371 by way of holding means or suction ducts 389, 391 when they deliver cigarettes F toward the transfer station P, and these flutes are connected to the pressure channel 374 by the corresponding ducts 389, 391 when they arrive at the transfer station P.

An advantage of the just-described mode of holding cigarettes F by suction during travel with the flutes 307 is that the suction in flutes 307 need not be weaker than in the flutes of the withdrawing means. Suction-generating means are expensive and the arrangement of FIGS. 7 and 8 insures that each flute 307 is sealed from the suction-generating device as soon as it is relieved of a cigarette. Still further, the pressure channels 372-374 insure that each cigarette invariably leaves the flute 307 when it reaches the station M, N or P.

FIG. 9 illustrates a fourth apparatus which is very similar to the apparatus of FIG. 6 with the sole exception that the pockets or receiving means (including those shown at 417, 418, 419, 420 and 421) of the endless assembly chain conveyor 406 are closer to each other than the pockets 217, 218, 219, 221 of the chain conveyor 206. This is due to the fact that the conveyor 406 is operated intermittently. Suction in the flutes 407 of the belt 401a in the supply conveyor 401 can be produced in a manner as shown in FIG. 6 or as shown in FIGS. 7-8. The remaining parts of the apparatus shown in FIG. 9 are denoted by numerals corresponding to those employed in FIG. 6 plus 200. The difference between the pitch T'' of the pockets 417-421 on the assembly conveyor 406 and 20t is proportional to the duration of intervals during which the assembly conveyor dwells between successive advances in a direction to the left, as viewed in FIG. 9. Otherwise, the operation of this apparatus is practically identical with that of the apparatus shown in FIG. 6.

Referring finally to FIG. 10, there is shown an apparatus whose supply conveyor 501 (including an endless belt or band 501a with flutes 507 and suction chambers 564-566) and transfer conveyors 502-504 (with withdrawing means 511, 508, 513) are identical with the corresponding conveyors of the apparatus shown in FIG. 6. The assembly conveyor 506 is an endless conveyor having an endless flexible element 506a (e.g., a link chain) which carries modified receiving means 517, 518, 519, 520, 521. Each of these receiving means comprises a pocket with three upright compartments or shafts defined by outer walls 527 and thin intermediate walls or partitions 575. The compartments are upright during travel below the transfer conveyors 502-504 and the bottom of each median compartment is located at a level above the bottoms of the adjoining outer compartments so that the cigarettes F of the

median group or layer C in an array or block E are automatically staggered with reference to the cigarettes of the outer layers or groups B and D.

Each transfer conveyor comprises two coaxial and axially spaced disks or wheels (see the disks 502d, 502e of the conveyor 502) and such disks carry the halves of the respective withdrawing means. The walls 575, 527 of each pocket are disposed between the disks of the transfer conveyors so that they automatically remove the cigarettes F of the respective groups B, C, D while the pockets travel below the transfer conveyors. The assembly conveyor 506 is at a standstill during delivery of cigarettes F into its pockets. Complete arrays E are expelled from filled pockets while the conveyor 506 is at a standstill.

An important advantage of our apparatus over conventional apparatus wherein the supply and transfer conveyors operate intermittently is that a succession of articles can be broken up rapidly into two or more series of groups and that such breaking up or subdivision of the succession can be carried out with very simple and compact supply and transfer conveyors. The transfer conveyors actually count the articles which are to form blocks or arrays E. Since such counting can proceed without interruptions, the output of our apparatus is much higher than the output of conventional apparatus wherein the groups and blocks or arrays are formed while the conveyors are held at a standstill.

It is further clear that the improved apparatus can be modified in a number of ways without departing from the spirit of the present invention. For example, the number of transfer conveyors can be reduced below or increased above three. Thus, instead of assembling arrays or blocks E of 20 cigarettes each, the apparatus can be designed to assemble blocks each of which comprises two, four or more layers or groups and wherein the cigarettes of one or more layers may but need not be staggered with reference to the cigarettes of the other layer or layers. For example, the apparatus can be designed to assemble blocks each group or layer of which contains an odd or an even number of articles (e.g., in a so-called 8-6-8 distribution.)

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 our contribution to the art and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the claims.

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

1. Apparatus for converting a succession of articles, particularly cigarettes, into plural series of groups each of which contains a fixed number of articles, comprising supply conveyor means for advancing a succession of articles in a predetermined path; first transfer conveyor means adjacent to a first portion of said path and having withdrawing means for removing from said path successive groups of a first series while permitting a predetermined number of articles to advance into a second portion of said path between successive removals of complete groups of said first series; additional transfer conveyor means adjacent to said second portion of said path and having at least one additional withdrawing means for removing from said predetermined numbers successive groups of at least one additional series; and assembly conveyor means adjacent to said transfer conveyor means and having receiving means arranged to receive a group from each of said transfer conveyor means, said assembly conveyor means comprising a single assembly conveyor having a plurality of receiving means arranged to travel seriatim into registry with said transfer conveyor means and to receive a group of the respective series from each transfer conveyor means.

2. Apparatus as defined in claim 1, wherein the receiving means of said assembly conveyor are equidistant from each other.

3. Apparatus as defined in claim 2, wherein said receiving means comprise pockets.

4. Apparatus as defined in claim 1, wherein said articles are cigarettes and wherein said supply conveyor means comprises equidistant flutes for the cigarettes of said succession, the pitch of the withdrawing means on each of said transfer conveyor means being the same and each of said groups comprising a layer of cigarettes.

5. Apparatus as defined in claim 4, wherein the groups of cigarettes in each of said receiving means together form a block containing a predetermined number of cigarettes, and wherein the number of flutes on said supply conveyor means is a whole multiple of the number of cigarettes in a block.

6. Apparatus as defined in claim 5, wherein said supply conveyor means further comprises holding means for holding the cigarettes in the flutes, said flutes forming several series of successive sets in each of which the number of flutes corresponds to the number of cigarettes in one of said groups, each of said transfer conveyor means defining with said supply conveyor means a separate transfer station at which the respective set of flutes delivers cigarettes to the withdrawing means of the adjoining transfer conveyor means and said holding means being effective while the cigarettes in the flutes of said sets advance toward the respective transfer stations.

7. Apparatus as defined in claim 6, wherein said supply conveyor means comprises a single suction conveyor and wherein said holding means comprise suction channels and ducts provided in said suction conveyor, there being a separate suction channel for each set of series of flutes and said ducts connecting said suction channels with the respective flutes.

8. Apparatus as defined in claim 7, wherein said suction conveyor is further provided with stationary evacuating means at each of said transfer stations.

9. Apparatus as defined in claim 8, wherein said evacuating means comprise means for connecting the suction ducts for the flutes of the respective sets to a source of air.

10. Apparatus as defined in claim 9, wherein said source of air is a source of atmospheric air.

11. Apparatus as defined in claim 9, wherein said source of air is a source of compressed air.

12. Apparatus for converting a succession of articles, particularly cigarettes, into plural series of groups each of which contains a fixed number of articles, comprising supply conveyor means for advancing a succession of articles in a predetermined path and for maintaining the articles of said succession in predetermined positions with reference to each other; first transfer conveyor means adjacent to a first portion of said path and having withdrawing means for removing from said path spaced groups of adjacent articles without removing the articles between such spaced groups of adjacent articles and for maintaining the articles of each group in predetermined adjacent positions with reference to each other while permitting a predetermined number of articles to advance into a second portion of said path between successive removals of complete groups of said first series; and additional transfer conveyor means adjacent to said second portion of said path and having at least one additional withdrawing means for removing from said predetermined numbers successive groups of at least one additional series, each of said withdrawing means comprising means for maintaining the articles of the respective groups in predetermined positions with reference to each other.

13. Apparatus as defined in claim 12, further comprising drive means for continuously driving said supply conveyor means and each of said transfer conveyor means.

14. Apparatus as defined in claim 12, wherein said additional transfer conveyor means comprises two additional transfer conveyors and wherein the withdrawing means of each additional transfer conveyor is arranged to remove from said supply conveyor means a complete group of articles.

15. Apparatus as defined in claim 12, wherein said additional withdrawing means are arranged to remove all of said predetermined numbers of articles from said supply conveyor means.

16. Apparatus for converting a succession of articles, particularly cigarettes, into plural series of groups each of which contains a fixed number of articles, comprising supply conveyor means for advancing a succession of articles in a predetermined path; first transfer conveyor means adjacent to a first portion of said path and having withdrawing means for removing from said path successive groups of a first series while permitting a predetermined number of articles to advance into a second portion of said path between successive removals of complete groups of said first series; additional transfer conveyor means adjacent to said second portion of said path and having at least one additional withdrawing means for removing from said predetermined numbers successive groups of at least one additional series, said additional transfer conveyor means comprising a second and a third transfer conveyor means each of which has withdrawing means arranged to withdraw complete groups from said supply conveyor means; assembly conveyor means having a plurality of receiving means arranged to travel successively into registry with said transfer conveyor means and to receive a group of articles from each such transfer conveyor means; and means for staggering the articles of one group in each receiving means with reference to the articles of each other group, each of said groups constituting a layer of articles and said one group being the median group and being flanked by the other two groups in the respective receiving means.

17. Apparatus as defined in claim 16, wherein said staggering means comprises projections mounted on said assembly conveyor means and normally extending into each receiving means, and displacing means for expelling such projections from said receiving means during delivery of a group of articles into such receiving means.

18. Apparatus as defined in claim 17, wherein said displacing means is provided on one of said transfer conveyor means.

19. Apparatus as defined in claim 18, wherein the withdrawing means of said one transfer conveyor means is first to deliver a group of articles into each of said receiving means.

20. Apparatus as defined in claim 19, wherein said projections comprise pairs of projections biased into the respective receiving means by springs and wherein said displacing means comprises cams provided on said one transfer conveyor means and arranged to displace one of a pair of projections during delivery of a first article and the other of such pair of projections during delivery of the last article of a group into the respective receiving means.

21. Apparatus for converting a succession of articles, particularly cigarettes, into plural series of groups each of which contains a fixed number of articles, comprising supply conveyor means including a suction conveyor for advancing a succession of articles in a predetermined path; first transfer conveyor means including a suction conveyor adjacent to a first portion of said path and having withdrawing means for removing from said path successive groups of a first series while permitting a predetermined number of articles to advance into a second portion of said path between successive removals of complete groups of said first series; and additional transfer conveyor means including at least one suction conveyor adjacent to said second portion of said path and having at least one additional withdrawing means for removing from said predetermined numbers successive groups of at least one additional series.

22. Apparatus for converting a succession of articles, particularly cigarettes, into plural series of groups each of which contains a fixed number of articles, comprising supply conveyor means for advancing a succession of articles in a predetermined path; first transfer conveyor means adjacent to a first portion of said path and having withdrawing means for removing from said path successive groups of a first series while permitting a predetermined number of articles to advance into a second portion of said path between successive removals of complete groups of said first series; and additional transfer conveyor means adjacent to said second portion of said path and having at least one additional withdrawing means for receiving from said predetermined numbers succe-

sive groups of at least one additional series, said additional transfer conveyor means comprising two additional transfer conveyors and the withdrawing means of each additional transfer conveyor being arranged to remove from said supply conveyor means a complete group of articles, one of said additional transfer conveyors being disposed between said first transfer conveyor means and the other additional transfer conveyor and comprising a single withdrawing means, said first transfer conveyor means and said other additional transfer conveyor each comprising a plurality of withdrawing means, each of said additional transfer conveyors being a drum and said first transfer conveyor means also comprising a drum, the dimensions of said first transfer conveyor means being identical with those of said other additional transfer conveyor.

23. Apparatus for converting a succession of articles, particularly cigarettes, into plural series of groups each of which contains a fixed number of articles, comprising supply conveyor means for advancing a succession of articles in a predetermined path and for maintaining the articles of said succession in predetermined positions with reference to each other; first transfer conveyor means adjacent to a first portion of said path and having withdrawing means for removing from said path successive groups of a first series while permitting a predetermined number of articles to advance into a second portion of said path between successive removals of complete groups of said first series; and additional transfer conveyor means including two transfer conveyors adjacent to said second portion of said path and each having additional withdrawing means for removing from said predetermined numbers complete groups of two additional series, each of said withdrawing means including means for maintaining the articles of the respective groups in predetermined positions with reference to each other, one of said transfer conveyors being disposed between said first transfer conveyor means and the other transfer conveyor and comprising a single withdrawing means, said first transfer conveyor means and said other transfer conveyor each comprising a plurality of withdrawing means.

24. Apparatus for converting a succession of articles, particularly cigarettes, into plural series of groups each of which contains a fixed number of articles, comprising supply conveyor means for advancing a succession of articles in a predetermined path and for maintaining the articles of said succession in predetermined positions with reference to each other; first transfer conveyor means adjacent to a first portion of said path and having withdrawing means for removing from said path successive groups of a first series while permitting a predetermined number of articles to advance into a second portion of said path between successive removals of complete groups of said first series; and additional transfer conveyor means adjacent to said second portion of said path and including second and third transfer conveyor means having withdrawing means for removing from said predetermined numbers successive complete groups of two additional series, each of said withdrawing means including means for maintaining the articles of the respective groups in predetermined positions with reference to each other; assembly conveyor means having a plurality of receiving means arranged to travel successively into registry with said transfer conveyor means and to receive a group of articles from each such transfer conveyor means; and means for staggering the articles of one group in each receiving means with reference to the articles of each other group.

25. Apparatus for converting a succession of articles, particularly cigarettes, into plural series of groups each of which contains a fixed number of articles, comprising supply conveyor means for advancing a succession of articles in a predetermined path and for maintaining the articles of said succession in predetermined positions with reference to each other; first transfer conveyor means adjacent to a first portion of said path and having withdrawing means for removing from said path successive groups of a first series while permitting a

predetermined number of articles to advance into a second portion of said path between successive removals of complete groups of said first series; additional transfer conveyor means adjacent to said second portion of said path and having at least one additional withdrawing means for removing from said predetermined numbers successive groups of at least one additional series, each of said withdrawing means including means for maintaining the articles of the respective groups in predetermined positions with reference to each other; and intermittently operated assembly conveyor means arranged to receive said groups from said withdrawing means and to assemble such groups into blocks each of which contains the same number of articles.

26. Apparatus for converting a succession of rod-shaped articles, particularly cigarettes, into discrete groups each of which contains a predetermined number of articles and wherein the articles are disposed in formations ready for packing or other processing, comprising supply conveyor means for continuously advancing a succession of articles along a predetermined path and for maintaining the articles of said succession in predetermined positions with reference to each other during travel along said path; transfer conveyor means including a plurality of driven transfer conveyors adjacent to said path and each having withdrawing means for removing from said path successive groups of articles and for maintaining the articles of each group in predetermined positions with reference to each other while said groups move with said transfer conveyors toward separate transfer stations; and collecting conveyor means for receiving the groups from said

transfer conveyors at the respective transfer stations and for maintaining the articles of each group in said predetermined positions with reference to each other, said collecting conveyor means having a plurality of receiving means each arranged to receive a group of articles from each of said transfer conveyors at the respective transfer stations.

27. Apparatus for converting a succession of rod-shaped articles, particularly cigarettes, into discrete groups each of which contains a predetermined number of articles and wherein the articles are disposed in formations ready for packing or other processing, comprising supply conveyor means for continuously advancing a succession of articles along a predetermined path and for maintaining the articles of said succession in predetermined positions with reference to each other during travel along said path; transfer conveyor means including at least one driven transfer conveyor adjacent to said path and having withdrawing means for removing from said path spaced groups of adjacent articles without simultaneously removing the articles between said spaced groups of adjacent articles and for maintaining the articles of each group in predetermined adjacent positions with reference to each other while said groups move with said transfer conveyor means toward a transfer station; and collecting conveyor means for receiving the groups from said transfer conveyor means at said transfer station and for maintaining the articles of each group in said predetermined positions with reference to each other.

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