Sept. 12, 1967 D. BARDENHAGEN 3,341,036

APPARATUS FOR MANIPULATING ROD SHAPED ARTICLES

Filed Oct. 26, 1964 3 Sheets-Sheet 1

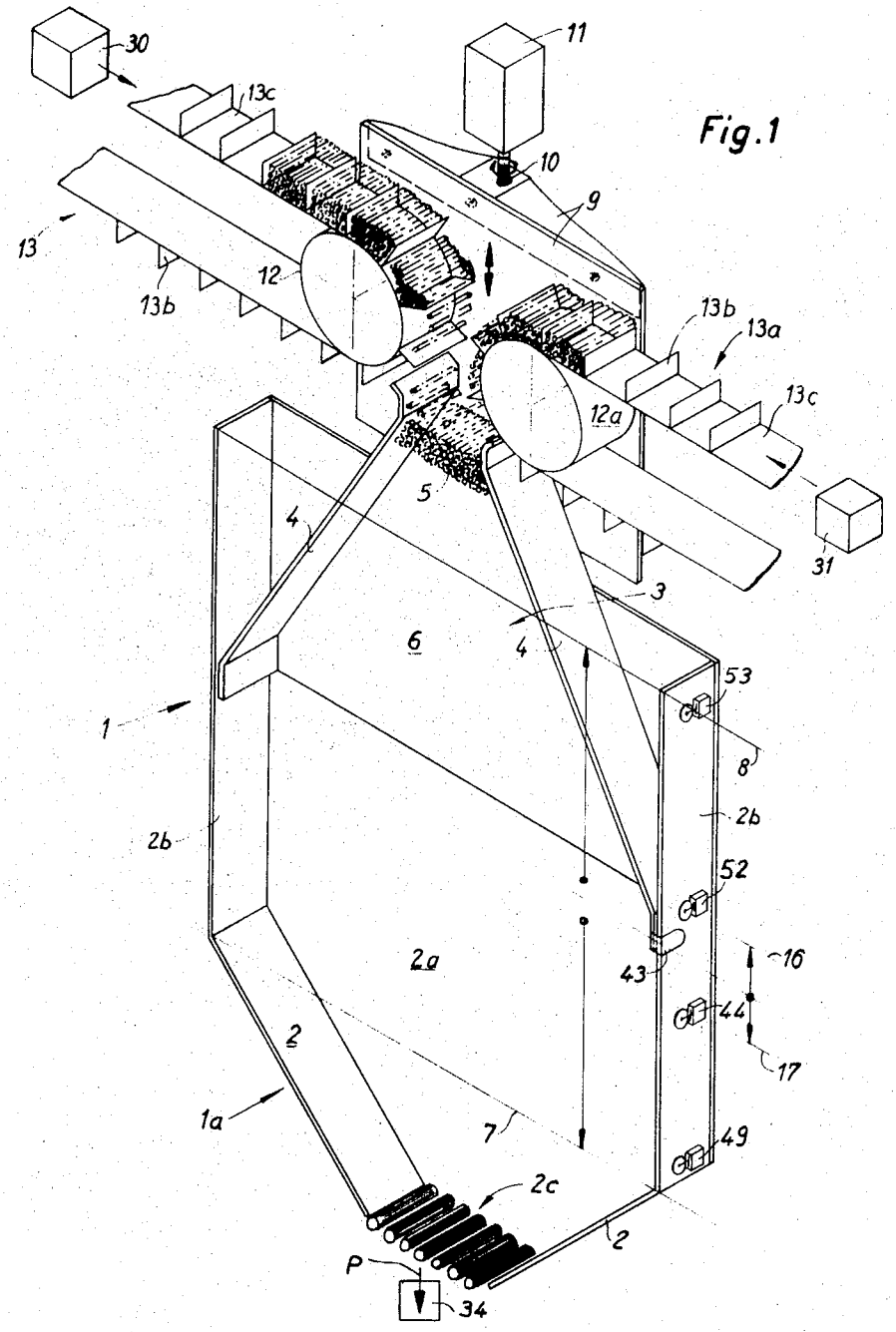

Fig. 1

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Fig. 2

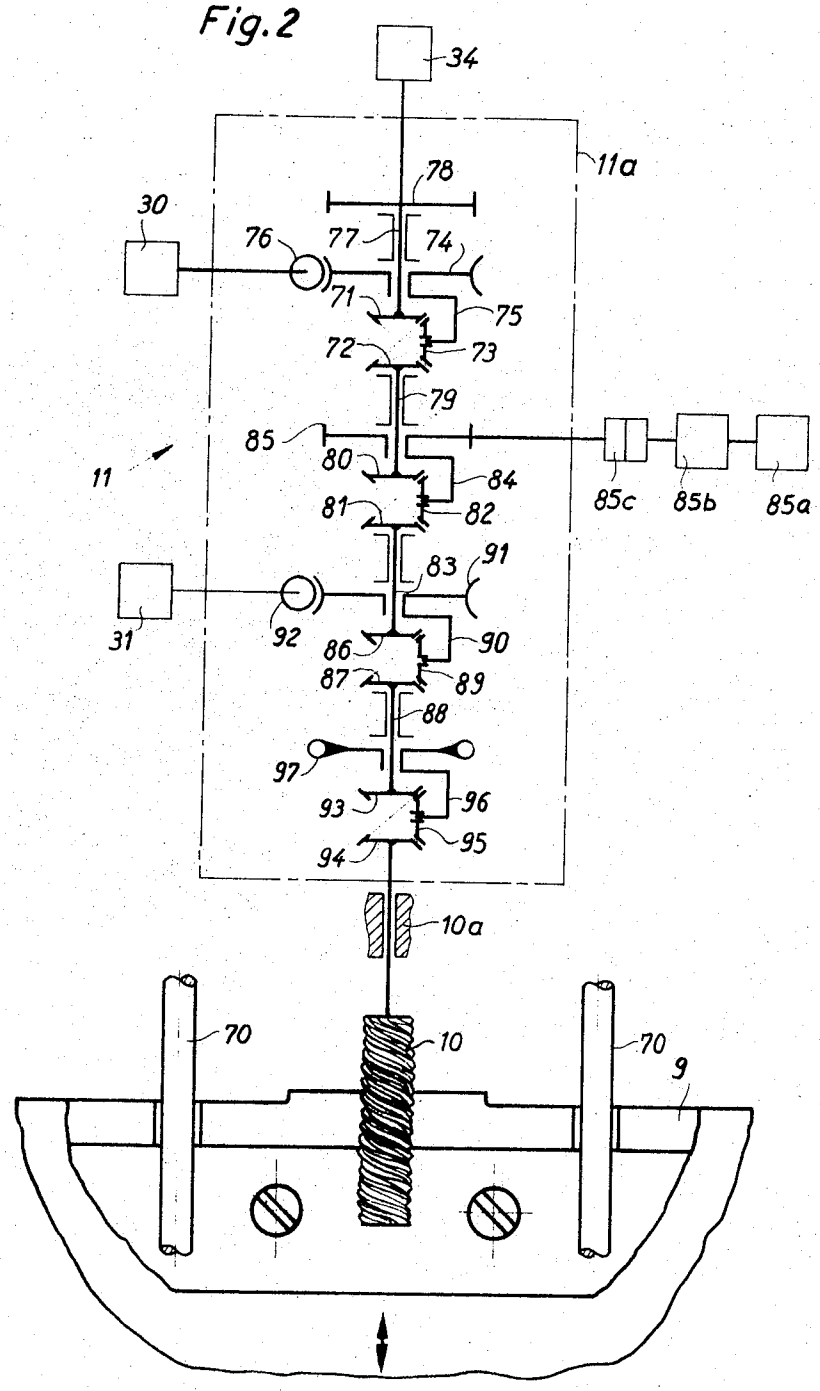

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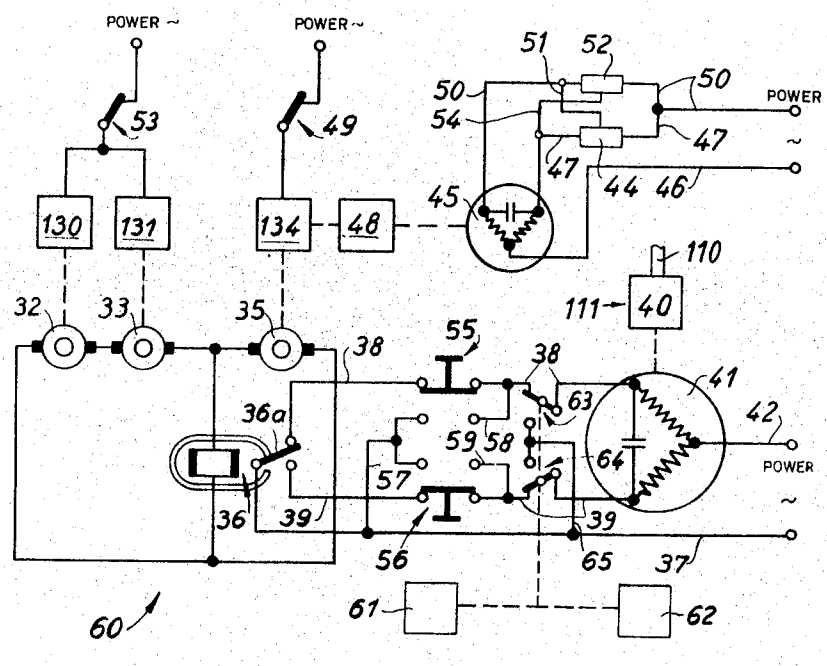
Fig.3



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3,341,036
APPARATUS FOR MANIPULATING ROD SHAPED ARTICLES

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Claims priority, application Great Britain, Oct. 25, 1963, 42,185/63
15 Claims. (Cl. 214—17)

The present invention relates to a method and apparatus for manipulating rod-shaped articles. More particularly, the invention relates to manipulation of cigarettes, filter cigarettes, cigars, cigarillos, cheroots, filter rods, filter mouthpieces and similar articles which, either by themselves or in combination with other rod-shaped articles, constitute tobacco-containing smokers' products. The invention is particularly concerned with the feed of cigarettes or similar rod-shaped articles from one or more machines which produce or assemble such articles to one or more machines for further processing of the articles, for example, from two or more cigarette machines to a single packing machine.

In the production of cigarettes, it is normally possible to deliver the output of one or more cigarette machines directly to a packing machine. As a rule, a single packing machine will be capable of receiving all cigarettes which issue from two or more cigarette machines. However, in assembling such apparatus one must consider several factors which might affect the operation of the packing machine, of one or more cigarette machines, as well as many other variables. For example, due to reasons beyond the control of supervising personnel, the output of a cigarette machine may vary from time to time; it will become necessary to arrest or to change the speed of one or more cigarette machines at the time the operators install a new reel of cigarette wrapper tape; and it is also necessary to temporarily arrest or to change the speed of the packing machine, for example, when the packing machine is clogged or when some of its component parts require minor or major repairs. The transfer assembly which delivers cigarettes from one or more cigarette machines to a single packing machine must be constructed and operated in such a way that the packing machine invariably receives a quantity of cigarettes which corresponds to its momentary operating speed, that is to say, the transfer assembly should never deliver quantities greater than can be handled by the packing machine. It is impossible to assemble all of the cooperating machines in such a way that the operation of each machine is fully synchronized with the operation of all other machines; therefore, it is customary to provide the transfer assembly with an intermediate or floating store to act as a reserve and to allow for momentary stoppage of one or more cigarette machines and/or of the packing machine, for example, due to faulty operation or when it becomes necessary to insert a new supply of tobacco, of cigarette wrapper tape, of blanks for cigarette packs or other components. Also, it should be borne in mind that faulty cigarettes issuing from a cigarette machine are subjected to one or more testing operations to determine the presence of and to eject all defective cigarettes so that the rate at which a cigarette machine delivers satisfactory cigarettes will vary even though the machine operates at constant speed.

Accordingly, it is an important object of the present invention to provide a novel transfer assembly which may be installed between a packing machine and one or more cigarette machines and which insures that the packing machine invariably receives an exactly determined quantity of cigarettes per unit of time such as is necessary when the packing machine operates at a given speed.

Another object of the invention is to provide a transfer assembly between a packing machine or another machine which consumes or otherwise processes cigarettes or other rod-shaped articles and one or more cigarette machines or other machines which produce or assemble such articles, and to provide the transfer assembly with an improved floating store or magazine which serves to accommodate a variable quantity of rod-shaped articles and which thus insures that the consuming machine may continue to operate, at least temporarily, independently of the operation of the machines which produce the articles, or vice versa.

A further object of the invention is to provide the transfer assembly with a novel control unit which enables the assembly to automatically regulate the operation of the consuming and/or producing machines without necessitating any attention on the part of the operators and which can effect such control in response to a large number of factors including manual adjustment.

An additional object of the instant invention is to provide a transfer assembly of the above outlined characteristics and to construct the transfer assembly in such a way that articles advancing from one or more assembling or producing machines to a consuming or processing machine are protected against deformation or destruction, that such articles invariably enter the consuming machine in optimum position for further processing, and that the articles are not likely to lose their contents.

An additional object of the invention is to provide a novel method of transferring cigarettes and similar rod-shaped articles from one or more producing machines to a consuming machine.

Still another object of the invention is to provide a transfer assembly wherein a single adjustment will suffice to take care of two or more factors which might influence the quantity of articles stored between the producing and consuming machines.

Briefly stated, one feature of my invention resides in the provision of a novel method of manipulating cigarettes and similar rod-shaped articles. This method comprises the steps of conveying a variable supply of articles from a producing station (e.g., from one or more cigarette machines) to a processing station (e.g., to a packing machine), accumulating a floating store of stacked articles intermediate the two stations, and changing the number of articles in the floating store in direct proportion to the article requirements at the processing station and in direct proportion to the output at the producing station.

In its basic form, the apparatus of my invention comprises conveyor means for advancing a supply of articles, a processing machine for receiving such articles, and a novel assembly for transferring the articles from the conveyor means to the processing machine. This assembly comprises a magazine preferably located in a vertical plane and including a fixed portion and a second portion which is movable with reference to the fixed portion. The two portions define between themselves an article receiving chamber whose volume varies in response and in direct proportion to movement of the second portion with reference to the fixed portion. One of the two portions is provided with an inlet through which articles advanced by the conveyor means are admitted into the chamber, preferably by gravity feed, and the other portion is provided with an outlet through which the articles are discharged or withdrawn for delivery to the processing machine. The assembly further comprises control means for moving the second portion of the magazine with reference to the fixed portion in response to a sum of a plurality of different factors including the rate at which the magazine respec-

tively receives and discharges the articles. The control means may adjust the second portion in response to changes in the operating condition of the processing machine, in response to changes in the operating condition of one or more producing machines which feed articles to the conveyor means, in response to determination of the exact level of articles which are stacked in the magazine when the actual level of stacked articles deviates from the expected level, in response to counting of articles which are being fed into the inlet of the magazine and when the counter mechanism indicates that the actual number of articles entering the chamber differentiates from the expected number, in response to manual adjustments of the control means, and in response to two or more of the just outlined factors.

It is preferred to construct the magazine in such a way that one of its portions comprises two inclined walls which converge downwardly toward the outlet, that its other portion comprises two inclined walls which converge upwardly toward the inlet, and that one of the two portions comprises a pair of parallel vertical walls which slidably accommodate the inclined walls of the other portion so that the chamber in the magazine comprises a zone of rectangular outline which extends between the two pairs of inclined walls and whose volume varies in direct proportion to changes in the position of the second portion with reference to the fixed portion. If the inlet is provided on the second portion, the discharge end of each conveyor is preferably connected with this second portion so that the distance between such discharge ends and the inlet remains unchanged regardless of the position of the second portion with reference to the fixed portion. This insures that the articles descending into the chamber invariably drop through the same distance.

The novel features which are considered as characteristic of the invention are set forth in particular in the appended claims. The improved assembly 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, in which:

FIG. 1 is a perspective view of an apparatus which embodies an assembly constructed in accordance with a first embodiment of my invention;

FIG. 2 is a diagrammatic section through a control unit which may be utilized in the assembly of FIG. 1; and

FIG. 3 is a diagram of a modified assembly.

Referring first to FIG. 1, there is shown an apparatus which includes two cigarette machines **30**, **31** of conventional construction. The machines **30**, **31** feed cigarettes to a pair of conveyors in the form of endless feed belts **13**, **13***a* which are trained around rollers **12**, **12***a* mounted on a vetrically reciprocable carrier **9**. This carrier forms part of a magazine or container **1** which constitutes an element of the improved transfer assembly. The belts **13**, **13***a* are provided with transverse baffles **13***b* which define between themselves a series of compartments **13***c* each adapted to accommodate a predetermined number or batch of cigarettes **5**. The belts **13**, **13***a* are driven in a sense to advance the cigarettes toward a gap between the rollers **12**, **12***a* so that such cigarettes descend by gravity into the magazine **1**.

The magazine **1** comprises a fixed first portion or base **1***a* and a movable second portion or hood **3**. The base **1***a* includes a vertical rear wall **2***a*, two vertical parallel side walls **2***b*, and two converging downwardly inclined base walls **2** which define between themselves an outlet **2***c* for discharge of cigarettes **5** to an adjustable packing machine **34**, the arrow P indicating the direction in which the cigarettes are being fed on to the packing machine. The exact construction of the packing machine **34** forms no part of the present invention.

The hood **3** comprises a substantially triangular rear wall **6** which is slidable in front of the fixed rear wall **2***a*

and two upwardly inclined converging side walls **4** the lower end portions of which are slidable along the inner sides of the fixed side walls **2***b*. The upper ends of the side walls **4** are located beneath the rollers **12**, **12***a* and define the aforementioned gap serving as an inlet through which the cigarettes may descend into the chamber defined by the walls **2**—**2***b*, **4** and **6** of the magazine **1**. The side walls **4** insure that the cigarettes **5** are distributed uniformly in a series of superimposed layers without gaps or free spaces save for such gaps which are due to honeycombed stacking of cigarettes. The front side of the container **1** may but need not be closed. As a rule, the stack of cigarettes accommodated in the magazine **1** fills the latter up to a level closely below the rollers **12**, **12***a* so that cigarettes descending from the upper stringers of the belts **13**, **13***a* will fall through a short distance and are not likely to become damaged or misaligned. The upper level of stacked cigarettes is horizontal.

The hood **3** is movable rectilinearly between a lower end position indicated by a horizontal line **7** and an upper end position indicated by a line **8**. Thus, when the lower end faces of the side walls **4** reach the line **7**, the volume of the chamber defined by the magazine **1** has been reduced to a minimum. The volume of this chamber is increased to a maximum value when the hood **3** rises to the level indicated at **8**. The carrier **9** is a plate-like member which is permanently or detachably connected with and serves to transmit motion to the hood **3**. In addition, the carrier supports the rollers **12**, **12***a* so that the position of the discharge ends of the belts **13**, **13***a* with reference to the inlet defined by the hood **3** remains unchanged, regardless of the momentary position of the hood with reference to the fixed portion **1***a* of the magazine **1**. The carrier **9** has a tapped bore which receives a portion of a threaded member **10** here shown as a spindle **10**, and this spindle is rotatable in a clockwise or counterclockwise direction by a control unit **11**. When the spindle **10** is rotated in a sense to lower the carrier **9**, the volume of the chamber defined by the magazine **1** is decreased; on the other hand, the volume of the chamber will increase if the spindle **10** is rotated in a sense to lift the carrier **9** and hood **3** with reference to the fixed portion **1***a* of the magazine.

The control unit **11** is illustrated in FIG. 2. It comprises a casing **11***a* (indicated by phantom lines) which accommodates a composite transmission capable of rotating the spindle **10** and of thereby lifting or lowering the carrier **9**, together with the rollers **12**, **12***a* and hood **3**. In order to make sure that the carrier **9** will move vertically, the apparatus comprises a pair of vertical guide rods **70** which extend into suitable apertures of the carrier. The guide rods **70** are fixed to a stationary frame member (not shown). The spindle **10** is held against axial movement and is rotatable in suitable bearings **10***a*. The upper end of this spindle is connected to an output bevel gear **94**. A spur gear **78**, shown at the top of FIG. 2, is driven by the packing machine **34** at a speed which is identical with or proportional to the speed of the packing machine. Thus, the gear **78** is the input gear of the transmission in the control unit **11** and may be driven directly by the main drive shaft of the packing machine **34** or by a separate motor whose operation is synchronized with the operation of the packing machine. All that counts is to make sure that the rotational speed of the gear **78** reflects the momentary speed (and hence the momentary cigarette requirements) of the packing machine.

The transmission in the casing **11***a* of the control unit **11** is a so-called integrator transmission which can adjust the carrier **9** in response to a large number of different factors all of which will be reflected in the movement or non-movement of the output bevel gear **94**. In other words, the transmission may cause the spindle **10** to remain stationary, to rotate in a clockwise direction, or to rotate in a counterclockwise direction. Consequently,

the hood **3** may remain in a given position of vertical adjustment, or the hood will move up or down, depending on the number of cigarettes which are stacked in the magazine **1**, on the cigarette requirements of the packing machine **34**, on the output of the cigarette machines **30**, **31** and/or on the exact rate at which the belts **13**, **13***a* deliver cigarettes into the magazine **1**.

The transmission in the casing **11***a* of FIG. 2 comprises four serially arranged bevel gear differentials which allow for five adjustments, each in response to a different factor which can influence the quantity of cigarettes in the magazine **1**. These five factors include (a) changes in the operating condition of the cigarette machine **30**, (b) changes in the operating condition of the cigarette machine **31** (c) changes in the operating condition of the packing machine **34**, (d) changes indicated by one or more counters which actually count the numbers of cigarettes delivered by the belts **13**, **13***a* and (e) manual adjustments. Of course, if the packing machine **34** receives cigarettes which are delivered by three or more cigarette machines, the transmission of FIG. 2 is changed accordingly so that it will respond to six, seven or more adjustments.

The counter or counters, to be described in greater detail in connection with FIG. 3, are necessary because it is not always sufficient if the speeds of the cigarette machines **30**, **31** are correlated to the speed of the packing machine **34**. For example, and if the cigarette machine **30** operates at normal speed and continuously delivers to the belt **13** the same number of cigarettes per unit of time the quantity of cigarettes delivered by the belt **13** into the magazine **1** will fluctuate because the apparatus normally comprises a testing device which tests the cigarettes issuing from the machine **30** and ejects all such cigarettes which are leaky or which are otherwise defective and should be removed from the apparatus prior to reaching the packing machine. Thus, even though the cigarette machine **30** will operate at constant speed, the number of cigarettes delivered by the belt **13** may fluctuate within a certain range and, after one or more hours of uninterrupted operation, the total number of ejected defective cigarettes might be so high that it causes unexpectedly large changes in the number of cigarettes accommodated in the magazine **1**. This will explain the need for the provision of mechanisms which actually count the cigarettes entering the inlet between the rollers **12**, **12***a*.

The first bevel gear differential comprises two coaxial bevel gears **71**, **72** which are rotatable about a fixed axis (shafts **77**, **79**), and a third bevel gear **73** which meshes with the gears **71**, **72** and is mounted to orbit about the common axis of the shafts **77**, **79**. Thus, the gear **73** rotates about its own axis and may orbit about the common axis of the gears **71**, **72**. The gear **73** is rotatable about its own axis with reference to a holder **75** which in turn may orbit about the shafts **77**, **79**. The holder **75** is connected with the hub of a worm wheel **74** which meshes with a worm **76**. The latter is driven by the cigarette machine **30** at a speed which reflects the speed (and hence the output) of this machine. Of course, it is clear that the worm **76** may be driven by a separate motor whose operation is synchronized with the operation of the machine **30**. All that counts is that the rotational speed of the worm wheel **74** should be identical with or proportional to the rotational speed of the cigarette machine **30**. As a rule, the worm **76** will be driven by an extension of the main drive shaft in the cigarette machine **30**. The spur gear **78** drives the bevel gear **71** which in turn drives the bevel gear **73**. The latter drives the gear **72** in dependency on the rotational speed of the gear **78** (i.e., on the speed of the packing machine **34**) and also in dependency on the rotational speed of the worm **76** (i.e., on the speed of the cigarette machine **30**).

The second differential of the transmission shown in FIG. 2 includes two coaxial bevel gears **80**, **81** and an intermediate bevel gear **82** which is driven by the gear **80** to drive the gear **81**. The gear **80** is driven by the shaft

79 and the gear **81** drives a shaft **83**. The gear **82** rotates about its own axis and orbits about the axis of the shafts **79**, **83**. Its holder **84** is connected to the hub of a spur gear **85**, and this spur gear rotates at a speed which is controlled by a twin counter mechanism **85***a* for cigarettes delivered by the belts **13**, **13***a*. In other words, the rotational speed of the gear **85** reflects the exact number of cigarettes which are actually fed through the gap between the rollers **12**, **12***a* shown in FIG. 1. For example, the counter mechanism **85***a* controls the rotational speed of an adjusting motor **85***b* which is operatively connected with and drives the gear **85**. Alternatively, the counter mechanism **85***a* may be replaced by a sensing device which scans the level of the uppermost layer of cigarettes which are stacked in the magazine **1**. It will be seen that the shaft **83** is driven at a speed which reflects the speed of the cigarette machine **30** (worm **76**), the speed of the packing machine **34** (gear **78**) and the actual rate at which the belts **13**, **13***a* deliver batches of cigarettes **5** into the magazine **1** (gear **85**).

The third differential comprises a first bevel gear **86** which is driven by the shaft **83**, a second bevel gear **87** driving a shaft **88** which is coaxial with the shaft **83**, and an intermediate bevel gear **89** which meshes with the gears **86**, **87** and is rotatable about its own axis with reference to a holder **90** which is attached to the hub of a worm wheel **91** meshing with a worm **92**. Thus, the gear **89** may orbit about the common axis of the shafts **83**, **88**. The worm **92** is driven by the second cigarette machine **31** in the same way as described in connection with the worm **76** so that the rotational speed of the shaft **88** depends on as many as four different factors including the speed of the machines **30**, **31**, **34** and the exact rate at which the belts **13**, **13***a* deliver cigarettes into the container **1**.

It is to be noted here that if the spur gear **85** is not driven, neither the shaft **79** nor the shaft **83** can turn the drive mechanism (**85***c*, **85***b*), so that no reaction of torque from out of the spur gear **85** on its drive mechanism (**85***c*, **85***b*) will be possible. This is necessary to insure satisfactory adjustments of the hood **3**. This may be achieved in a number of ways, for example, by a brake which is applied automatically as soon as the motor **85***b* comes to a halt, by a positive locking device which arrests the gear **85** in response to idling of the motor **85***b*, or by a ratchet-and-pawl mechanism of any known design.

The fourth differential comprises a first bevel gear **93** which is driven by the shaft **88**, the bevel gear **94** which drives the spindle **10**, a third bevel gear **95** which meshes with the gears **93**, **94** and rotates about its own axis which is perpendicular to the common axis of the gears **93**, **94**, and a holder **96** which supports the gear **95** and is connected to the hub of a manually adjustable wheel **97**. It is clear that the wheel **97** may be adjusted by a servomotor or by remote control, as long as it is capable of regulating the rotational speed of the gear **94** independently of the cigarette machines **30**, **31**, of the packing machine **34** and of the counter mechanism **85***a*. As in the case of the spur gear **85**, the wheel **97** must be arrested if it is not driven, i.e., it is preferably provided with a brake, locking device or any other known arresting means to insure that no reaction of torque from the holder **96** to the wheel **97** will be possible.

The transmission ratios of the first worm drive **74**, **76** which is operated by the first cigarette machine **30** and the second worm drive **91**, **92** which is operated by the second cigarette machine **31** are correlated in such a way that, when the spur gear **85** is idle and when the wheel **97** is also idle, the rotational speed of the gear **78** minus twice the rotational speed of the worm wheel **74**, minus twice the rotational speed of the worm wheel **91** equals zero. Under these conditions, the rotational speed of the spindle **10** driving the hood **3** of the magazine **1** equals the rotational speed of the gear **78** minus twice the rotational speed of the worm wheel **74**, plus or minus (de-

pending on the direction of rotation) twice the rotational speed of the gear **85**, minus twice the rotational speed of the worm wheel **91**, plus or minus (depending on the direction of rotation) twice the rotational speed of the wheel **97**.

The integrator transmission of FIG. 2 operates as follows:

In normal operation, i.e., when the rate at which the cigarettes **5** enter through the gap between the rollers **12**, **12***a* equals the rate at which the cigarettes are discharged through the outlet **2***c*, the level of the stack of cigarettes in the magazine **1** remains unchanged. The gear **85** is idle and so is the wheel **97**. The cigarette machines **30**, **31** drive the worms **76**, **92** and the packing machine **34** drives the gear **78** at such a speed that the output gear **94** does not rotate and the spindle **10** is idle. Thus, the hood **3** remains in a given position of adjustment.

However, if the condition of equilibrium is changed, for example, if one or more of the machines **30**, **31**, **34** come to a standstill, the gear **94** begins to rotate in a clockwise or counterclockwise direction and causes a corresponding vertical movement of the hood **3** in such a way that the position of the hood reflects the exact level of cigarettes in the magazine **1**. The operator is in a position to adjust the carrier **9** independently of the operation of the machines **30**, **31**, **34** and independently of the motor **85***b* by manipulating the wheel **97** or by starting a motor which then orbits the holder **96** about the axis of the shaft **88**.

FIG. 3 illustrates a modified apparatus wherein the control unit **11** of FIGS. 1 and 2 is replaced by an electrically operated control unit **111**. As in the apparatus of FIG. 1, the transfer assembly serves to regulate the level of cigarettes **5** which are stacked in its magazine **1**. The hood **3** of this magazine (not shown in FIG. 2) is adjustable by a spindle **110**. The apparatus comprises two cigarette machines **130**, **131** and a packing machine **134**. The cigarette machines **130**, **131** respectively drive two tachometer generators **32**, **33** of known design and the packing machine **134** drives a third conventional tachometer, generator **35**. The output of the generators **32**, **33**, **35** is fed to a bridge circuit **60** which controls a polarized relay **36**. This relay **36** comprises a contact arm **36***a* which is maintained in a neutral (central) position but will swing upwardly or downwardly (as viewed in FIG. 3) so as to respectively connect a first conductor **37** with a second conductor **38** or a third conductor **39**. The conductors **38**, **39** are connected in the circuit of a reversible control motor **41** which drives a transmission **40** in the control unit **111** to thereby effect clockwise or counterclockwise rotation of the spindle **110**. The control motor **41** is also connected with a conductor **42** leading to one pole of a source of electrical energy. Another pole of the source is connected to the conductor **37** which is connected to the arm **36***a* of the relay **36**. When the arm **36***a* contacts the conductor **39**, the spindle **110** is rotated in a sense to lower the hood, and the motor **41** will cause the spindle **110** to raise the hood when the arm **36***a* contacts the conductor **38**.

The machines **130**, **131** normally deliver such quantities of cigarettes as are required by the packing machine **134** so that the level of cigarettes in the magazine **1** remains unchanged. The bridge circuit **60** is then balanced and the arm **36***a* of the relay **36** is maintained in a neutral position in which it remains out of contact with the conductors **38**, **39**. The control motor **41** is idle and the hood **3** remains in a given position of adjustment.

It is now assumed that one of the cigarette machines **130**, **131** is arrested or breaks down. The level of cigarettes in the magazine **1** begins to descend and the generator **32** or **33** fails to deliver electrical energy to the bridge circuit **60**, i.e., the circuit **60** is unbalanced. The relay **36** then causes its arm **36***a* to move into contact with the conductor **39** whereby the motor **41** drives the transmission **40** in a sense to lower the hood **3**. Such descent of the hood **3** is exactly proportional to the rate at which the level of cigarettes **5** in the magazine **1** descends toward the outlet **2***c*. If the one cigarette machine remains out of order or is intentionally arrested for an interval of time which is long enough to cause the hood **3** to descend to the line **17** shown in FIG. 1, an actuating member or trip **43** on the hood **3** closes a normally open limit switch **44** which is connected in the circuit of a reversible adjusting motor **45** (see the conductors **46**, **47** in FIG. 3) for the packing machine **134**. The motor **45** adjusts the speed of the packing machine **134** through a suitable transmission **48**. The speed of the packing machine **134** is now reduced so that it requires a smaller quantity of cigarettes per unit of time. In other words, the requirements of the machine **134** then match the output of a single cigarette machine. The switch **44** opens automatically after a predetermined interval of time to arrest the adjusting motor **45**. Once the speed of the packing machine **134** is reduced, the level of cigarettes in the magazine **1** remains unchanged and, of course, the machine **134** then drives the generator **35** at a reduced speed. This balances the circuit **60** so that the arm **36***a* of the relay **36** returns to its neutral position, i.e., the motor **41** is arrested and the hood **3** remains in the newly selected position of vertical adjustment.

If the operator decides to arrest the other cigarette machine or if the other cigarette machine breaks down for reasons beyond the control of the operator, the arm **36***a* of the relay **36** again moves into contact with the conductor **39** and the motor **41** again causes a rotation of the spindle **110** in a sense to lower the hood **3** toward the outlet **2***c* of the magazine **1**. Such downward movement of the hood **3** continues until the hood reaches the lowermost level **7** (see FIG. 1) at which time the trip **43** engages a normally closed second limit switch **49** which is connected in the circuit of the packing machine **134** and opens to thereby arrest the packing machine. If desired, the switch **49** may simultaneously open the circuits of the cigarette machines **130**, **131**. When the machine **134** is arrested, the generator **35** is also arrested and its energy output drops to zero whereby the arm **36***a* automatically returns to neutral position and the motor **41** is arrested.

If the operator then starts the cigarette machines **130**, **131**, the output of the generators **32**, **33** is fed to the circuit **60** whereby the relay **36** moves its arm **36***a* into contact with the conductor **38** so that the motor **41** rotates the spindle **110** in a sense to lift the hood **3** at a speed proportional to the rate at which the level of the cigarette stack in the magazine **1** rises. As the hood **3** rises above the lowermost level **7**, the trip **43** releases the switch **49** which closes to complete the circuit of the packing machine **134** so that the latter again receives cigarettes through the outlet **2***c*. The machine **134** operates at a reduced speed because of previous adjustment by the motor **45** via transmission **48** (i.e., at the time the hood **3** has descended to the level **17** shown in FIG. 1 and has actuated the limit switch **44**). In other words, the packing machine **134** receives only such quantities of cigarettes as can be furnished by a single cigarette machine whereby the level of the stack in the magazine **1** rises while the motor **41** continues to lift the hood **3** at the same rate at which the quantity of cigarettes in the magazine **1** increases. This is due to the fact that the circuit **60** remains unbalanced since the generator **35** is driven at less than full speed because the packing machine **134** does not operate at full capacity.

The hood **3** continues to rise and approaches the level **17** so that the trip **43** engages the limit switch **44** which completes the circuit of the reversible motor **45** in a sense to effect an adjustment of the packing machine **134** back to normal speed. The circuit of the motor **45** is completed through conductors **46**, **50**, **51** and **47**, and this motor operates the transmission **48** which in turn adjusts the speed of the packing machine **134**. The switch **44** opens after a predetermined interval of time to arrest

the motor 45 when the packing machine 134 is readjusted to operate at normal speed.

For certain reasons, the cigarette machines should operate temporarily at higher than normal speed, i.e., at a speed which insures maximum output of cigarettes per unit of time. Such adjustments of the machines 130, 131 will be necessary when the operator desires to compensate for production losses due to temporary idling of one or more cigarette machines. If the machines 130, 131 are adjusted to operate at maximum (higher-than-normal) speed, the level of cigarettes 5 in the magazine 1 rises because the packing machine 134 continues to operate at normal speed. Of course, the machines 130, 131 drive the generators 32, 33 at a higher speed whereby the equilibrium in the circuit 60 is destroyed and the arm 36*a* of the relay 36 connects the conductor 37 with the conductor 39 to start the motor 41. This motor rotates the spindle 110 in a sense to lift the hood 3 whereby the hood entrains the trip 43 which engages a third limit switch 52 at the time the hood rises to a level 16 indicated in FIG. 1. The switch 52 starts the motor 45 by completing the circuit of this motor through the conductors 46 and 50. The motor 45 drives the transmission 48 which in turn adjusts the packing machine 134 for maximum-speed operation. The switch 52 opens automatically after a given interval of time which suffices to enable the motor 45 to effect adjustments of the packing machine 134. Since this machine now operates at maximum speed, it drives the generator 35 at a speed which is high enough to balance the circuit 60 whereby the arm 36*a* moves to its neutral position and arrests the motor 41, i.e., the hood 3 comes to a halt in a new position of adjustment.

In the event that the level of cigarettes in the magazine 1 continues to rise because the packing machine 134 breaks down or because the packing machine fails to operate at maximum speed, the hood 3 continues to move upwardly (because the generator 35 does not operate at maximum speed and the arm 36*a* connects the conductor 37 with the conductor 38 to complete the circuit of the motor 41 in a sense to lift the hood 3) and the trip 43 engages a normally closed limit switch 53 at the time the hood rises to the uppermost level 8 shown in FIG. 1. The switch 53 opens the circuit of the cigarette machines 130, 131 so that these machines come to a halt and the generators 32, 33 are arrested whereby the arm 36*a* of the relay 36 returns to its neutral position to arrest the motor 41 and the hood 3. If the packing machine 134 is now started at maximum speed, the level of cigarettes in the magazine 1 begins to sink and the arm 36*a* connects the conductor 37 with the conductor 39 to start the motor 41 in a sense to lower the hood 3 whereby the trip 43 releases the switch 53 which closes to start the cigarette machines 130, 131. If the level of cigarettes in the magazine 1 continues to descend, the trip 43 will engage the switch 52 which effects an adjustment in the speed of the packing machine 134 back to normal. The switch 52 opens automatically after a given interval of time and the packing machine 134 continues to operate at normal speed.

In order to enable the operator to control the level of cigarettes in the magazine 1 independently of the relay 36, the transfer assembly of FIG. 3 comprises manually operable means for starting the motor 41 in either direction. For example, the operator will resort to such manual adjustment in order to fill the magazine 1 to a level somewhere between the lines 16 and 17 shown in FIG. 1, or for completely filling the magazine 1 prior to arresting one or both cigarette machines. The cigarette machines might be of the type which is not provided with automatic splicing means for connecting the trailing end of a spent wrapper tape with the leading end of a fresh wrapper tape. To make sure that the packing machine 134 may operate while a cigarette machine receives a new supply of wrapper tape, the operator will cause the transfer assembly to fill the magazine 1, and the volume of this magazine is large enough to accommodate a supply of cigarettes which will suffice to meet the requirements of the packing machine 134 for an interval of time which is necessary to insert a fresh wrapper tape.

The manual operating means comprises two pushbuttons 55, 56. The pushbutton 55 is actuated to complete the circuit of the motor 41 through the conductors 37, 57, 58, 38 and 42 so that the hood 3 moves upwardly. The pushbutton 56 is depressed to complete the circuit of the motor 41 through conductors 37, 57, 39 and 42 whereby the spindle 110 rotates in a sense to lower the hood 3.

As explained in connection with FIGS. 1 and 2, it is not sufficient to synchronize the operation of the packing machine 134 with that of the cigarette machines 130, 131 because, even if the cigarette machines deliver cigarettes at a constant rate, the belts 13, 13*a* will feed cigarettes at a different rate because the apparatus normally comprises testing devices which eject defective cigarettes prior to entry of such defective cigarettes into the magazine 1. Instead of resorting to automatic testing devices, an operator might from time to time remove a batch of cigarettes from the belt 13 or 13*a* to make spot checks in order to determine the presence of leaks or other defects. Even though the testing devices normally remove small numbers of cigarettes (as compared with the number of cigarettes issuing from the machines 130, 131), the total number of thus removed or ejected cigarettes rises considerably when the apparatus is in use for several hours. The heretofore described parts of the transfer assembly shown in FIG. 3 cannot and do not respond to a reduction in the level of cigarettes in the magazine 1 which is due to ejection of defective cigarettes or to removal of cigarettes by hand. Since a reduction in the level of cigarettes in the magazine 1 (without a corresponding lowering of the hood 3) results in a greater distance through which the cigarettes must fall from the belts 13, 13*a* onto the stack in the magazine, it is necessary to provide means for adjusting the hood in response to such changes in the level of stacked cigarettes which are not compensated for by the heretofore described parts of the transfer assembly shown in FIG. 3. If the cigarettes were allowed to drop through a considerable distance, they would be likely to undergo deformation and at least some tobacco would escape from one or both ends of such cigarettes. Also, a cigarette could become misaligned and would eventually clog the outlet 2*c*.

Of course, it also happens that the operator or operators will add batches of cigarettes onto the belt 13 or 13*a* so that such belts deliver into the magazine 1 cigarettes at a rate exceeding the rate at which the cigarettes are delivered by the machine 130 or 131. This will take place when the operators wish to return a pile of tested cigarettes which were found to be satisfactory and can be introduced into the magazine 1 for delivery to the packing machine 134. In such instances, the level of cigarettes in the magazine 1 will rise without causing a corresponding upward movement of the hood 3. This may result in direct contact between the baffles 13*b* and the uppermost layer of cigarettes 5 in the magazine 1 whereby the baffles might damage, smudge or destroy some cigarettes.

In order to prevent such uncontrolled rise or descent of the cigarette level in the magazine 1, the transfer assembly of FIG. 2 comprises two electronic counters 61, 62 which are respectively installed between the magazine 1 and cigarette machines 130, 131. Thus, the counter 61 will actually count the number of cigarettes which are discharged by the belt 13, and the counter 62 counts the number of cigarettes which are discharged by the belt 13*a*. These two counters 61, 62 are connected with two relays 63, 64 which may start the motor 41 in a clockwise or counterclockwise direction. The construction of the counters 61, 62 is such that they determine the discrepancy between the expected number of cigarettes which should be delivered by the belts 13, 13*a* and the actual number of cigarettes. For example, if the counters detect a difference of plus or minus 100 cigarettes, they will

start the motor **41** in a sense to adjust the hood **3** upwardly if the actual number of cigarettes exceeds the expected number, or downwardly if the actual number of cigarettes entering the magazine **1** is less than the number which is contemplated. When the number of cigarettes actually delivered by the belt **13** or **13***a* exceeds the expected number, the counter **61** or **62** will energize the relay **63**. The relay **64** is energized when the counter **61** or **62** detects that the actual number of cigarettes fed to the magazine **1** per certain unit of time is less than the expected number. The relays **63**, **64** are adjusted to operate the motor **41** for a period of time which correspondes exactly to such movement of the hood **3** as is needed to compensate for the discrepancy, for example, the hood **3** will be lifted or lowered to an extent to compensate for a discrepancy of plus or minus 100 cigarettes. The counters **61**, **62** energize the relays **63**, **64** with such delay as is necessary to take into account the time required for the counted cigarettes to advance from the counters to the magazine **1**.

If the counter **61** or **62** detects a discrepancy in a sense that the belt **13** or **13***a* delivers more cigarettes than is warranted by the momentary speed of the cigarette machine **130** or **131**, it energizes the relay **63** which completes the circuit of the motor **41** through conductors **37**, **65**, **38** and **42** whereby the transmission **40** rotates the spindle **110** in a sense to lift the hood **3** and to increase the distance between the uppermost layer of cigarettes in the magazine **1** and the baffles **13***b*. If the counter **61** or **62** detects a discrepancy in a sense that the belts **13**, **13***a* deliver cigarettes at less than expected rate, the relay **64** is energized to complete the circuit of the motor **41** through conductors **37**, **65**, **39** and **42** whereby the transmission **40** causes the hood **3** to descend, together with the rollers **12**, **12***a* and to reduce the distance between the discharge ends of the belts **13**, **13***a* and the uppermost layer of cigarettes in the magazine **1**.

It is clear that the counters **61**, **62** may be replaced by a suitable sensing device which actually scans the level of cigarettes in the magazine **1** and which energizes the relay **63** or **64** if the actual level deviates from the desired level. Such sensing device may be installed on the hood **3** close to the upper ends of the side walls **4** and may comprise a mechanical sensing element or a suitable photoelectric cell. In other words, the counters **61**, **62** shown in FIG. 3 may be replaced by a single sensing device or by a set of sensing devices which will energize the relays **63**, **64** in the same way as the counters.

It is also clear that, even though the invention has been described in connection with an apparatus which comprises two cigarette machines, the improved transfer assembly is equally useful in apparatus wherein one or more cigar machines, filter machines or other machines for the production of rod-shaped articles are assembled with one or more packing or other consuming or processing machines. Furthermore, as stated above, the transfer assembly may be readily modified to control the delivery of rod-shaped articles from three or more producing machines to a single consuming machine or to two or more consuming machines.

The switches **44**, **49**, **52** and **53** are equally useful in the apparatus which embodies the control unit of FIG. 2. Thus, even if the transmission **40** of FIG. 3 is replaced by the integrator transmission of FIG. 2, the switch **44** can control the motor **45** to reduce the speed of the packing machine **34**, the switch **49** will serve to arrest the packing machine **34** when the hood **3** descends to the level **7**, the switch **52** will adjust the motor **45** to operate the packing machine at maximum speed, and the switch **53** will arrest the cigarette machines **30**, **31** when the hood rises to the level **8**. In other words, the apparatus of FIGS. 1 and 2 also comprises the motor **45**, the transmission **48** and the switches **44**, **49**, **52** and **53**.

The counter mechanism **85***a* of FIG. 2 corresponds to the counters **61**, **62** of FIG. 3.

Referring back to FIG. 1, a very important advantage of the magazine **1** is that the zone between the inclined walls **2** and **4** which accommodates the bulk of stacked cigarettes is of rectangular outline, and that the hood **3** is adjustable in such a way that this rectangular zone is increased or reduced while the volume of the remainder of the magazine (between the base walls **2** and side walls **4**) remains unchanged. Also, the cigarettes always descend from the same height so that, once the distance between the uppermost layer of cigarettes in the magazine **1** and the end turns (discharge ends) of the belts **13**, **13***a* is selected with a view to avoid any damage to or misalignment of the cigarettes, this distance will remain unchanged regardless of adjustments in the position of the hood **3**. This is due to the fact that the rollers **12**, **12***a* are mounted on the carrier **9** and, therefore, are compelled to share all vertical adjustments of the hood. The inclination of the side walls **4** on the hood **3** is selected in such a way that these walls prevent the formation of cavities in the stack of cigarettes contained in the magazine **1**.

When the apparatus operates normally, the lower end face of the rear wall **6** will be located somewhere between the lines **16** and **17**, i.e., the machines **30**, **31**, **34** or **130**, **131**, **134** will operate at normal speed. The lower end face of the wall **6** will move outside of the range between the lines **16**, **17** only at such times when the volume of the magazine **1** should undergo substantial changes, e.g., when cigarette machines should operate at maximum speed, when the cigarette machines are arrested, or when the packing machine is arrested.

By way of example, the magazine **1** of FIG. 1 may be constructed and dimensioned in such a way that it will accommodate a maximum of about 7,000 cigarettes. Thus, when the hood **3** is in the median position of FIG. 1, the magazine will accommodate about 3,500 cigarettes and is then movable upwardly or downwardly through a distance of about 300 mm. in order to reach the upper level **8** or the lower level **7**. The packing machine **34** is arranged to pack **20** cigarettes at a time, i.e., this machine will consecutively receive batches each of which contains 20 cigarettes. If the machine **34** is capable of making 250 packs per minute, the magazine **1** will discharge 5,000 cigarettes per minute. If a single cigarette machine were capable of producing about 2,500 cigarettes per minute, two machines **30**, **31** would suffice to satisfy the requirements of the packing machine **34**. However, if a single cigarette machine can deliver less than 2,500 cigarettes per minute, the machine **34** must be fed by three or more cigarette machines. It is now assumed that the packing machine **34** receives cigarettes from three cigarette machines each of which is constructed to normally deliver 1,670 cigarettes per minute. Thus, and also assuming that all three cigarette machines are arrested simultaneously at the time the magazine **1** is filled halfway (i.e., at the time the magazine contains about 3,500 cigarettes because the hood **3** is in the position shown in FIG. 1), the packing machine **34** will be able to operate at normal speed for an interval of time which equals 3,500 divided by 5,000 or approximately 42 seconds (0.7 minute). As a rule, such short interval of time does not suffice to effect repairs or even to replace an empty reel with a fresh reel of cigarette wrapper tape. However, if the operator insures that the magazine **1** is filled to capacity, i.e., that the hood **3** rises to the level **8**, the interval during which all cigarette machines may remain idle (while the packing machine **34** operates at normal speed) may be doubled to about 84 seconds because the magazine then accommodates about 7,000 cigarettes whereas the packing machine requires about 5,000 cigarettes per minute. The manner in which the operator may completely fill the magazine **1** (either by manipulating the hand wheel **97** of FIG. 2 or by depressing the pushbutton **55** of FIG. 3) has been described hereinabove, Of course, the length of the interval will be increased if the

operator decides to arrest one cigarette machine or to arrest all cigarette machines at the time the packing machine operates at less than normal speed.

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 this invention and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the follow claims.

What is claimed as new and desired to be secured by Letters Patent is:

1. An apparatus for manipulating rod-shaped articles, particularly for manipulating cigarettes and the like, comprising conveyor means for advancing a supply of articles; a processing machine for receiving such articles; and an assembly for transferring the articles from said conveyor means to said processing machine, said assembly comprising a magazine having a fixed portion and a second portion movable with reference to said fixed portion, said portions defining between themselves an article receiving chamber whose volume varies in response and in direct proportion to movement of said second portion, one of said portions having an inlet through which articles advanced by said conveyor means are admitted into said chamber and the other of said portions having an outlet through which the articles are discharged to said processing machine, and control means for moving said second portion in response to a sum of a plurality of different factors including the rates at which said magazine respectively receives and discharges the articles.

2. An apparatus as set forth in claim 1, wherein said outlet is provided on said fixed portion and wherein said conveyor means comprises at least one conveyor having a discharge end operatively connected to and movable with said second portion so that the distance between said inlet and said discharge end remains unchanged in all positions of said second portion.

3. An apparatus as set forth in claim 1, wherein said fixed portion comprises a pair of downwardly inclined walls converging toward said outlet and said second portion comprises a pair of upwardly inclined walls converging toward said inlet, one of said portions further comprising parallel vertical walls connected with the respective inclined walls and slidably accommodating the inclined walls of the other portion so that said chamber comprises a substantially rectangular zone extending between said pairs of inclined walls, the volume of said zone being variable in direct proportion to movement of said second portion with reference to said fixed portion.

4. An apparatus as set forth in claim 1, further comprising at least two article producing machines arranged to feed articles to said conveyor means, said control means comprising means for moving said second portion in dependence on the operating condition of each of said producing machines so that the volume of said chamber respectively decreases and increases in response to decreasing and increasing output of said producing machines while the article requirements of said processing machine remain substantially unchanged.

5. An apparatus as set forth in claim 1, wherein said control means comprises means for respectively increasing and reducing the volume of said chamber in response to increasing and decreasing article requirements of said processing machine while the rate at which said conveyor means feeds the articles remains substantially unchanged.

6. An apparatus as set forth in claim 1, further comprising means for counting the number of articles advanced by said conveyor means to said inlet, said control means comprising means for changing the position of said second portion in response to differences between the expected and counted number of articles so that the volume of said chamber respectively increases and decreases when the number of counted articles respectively exceeds and is below the expected number.

7. An apparatus as set forth in claim 1, wherein said control means comprises manually operable means for moving said second portion with reference to said fixed portion.

8. An apparatus as set forth in claim 1, wherein said control means comprises an integrator transmission including a plurality of bevel gear differentials.

9. An apparatus as set forth in claim 1, wherein said processing machine is an adjustable packing machine for cigarettes and further comprising a plurality of adjustable cigarette machines for feeding cigarettes to said conveyor means.

10. An apparatus as set forth in claim 1, further comprising sensing means for determining the exact level of articles in said magazine, said control means comprising means for moving said second portion with reference to said fixed portion when the exact level of articles of said magazine deviates from the expected level.

11. An apparatus as set forth in claim 1, wherein said control means comprises means for arresting said processing machine in response to movement of said second portion to a position in which the volume of said chamber is reduced to a predetermined minimum value.

12. An apparatus as set forth in claim 1, further comprising at least one machine for feeding rod-shaped articles to said conveyor means, said control means comprising means for arresting said last mentioned machine in response to movement of said second portion to a position in which the volume of said chamber is increased to a predetermined maximum value.

13. An apparatus as set forth in claim 1, wherein said magazine is disposed in a vertical plane and said inlet is located at the top of said magazine, said conveyor means comprising means for delivering batches of articles to said inlet so that such batches enter the chamber by gravity feed.

14. An apparatus as set forth in claim 1, wherein said magazine comprises a carrier connected with said second portion, said control means comprising a threaded member meshing with said carrier and means for rotating said threaded member in a clockwise or counterclockwise direction to thereby effect adjustments in the position of said second portion with reference to said fixed portion.

15. An apparatus as set forth in claim 14, wherein the means for rotating said threaded member comprises a reversible electric motor.

References Cited

UNITED STATES PATENTS

2,779,592	1/1957	Hartman	214—17 X
2,845,190	7/1958	Creuzburg	214—17
2,902,196	9/1959	Pollmann	221—10
3,147,846	9/1964	Huntoon.	

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