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APPARATUS FOR REGULATING THE TRANSFER OF HEAT

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APPARATUS FOR REGULATING THE TRANSFER OF HEAT

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ABSTRACT OF THE DISCLOSURE

Apparatus for regulating the transfer of heat to thermoplastic wrappers applied around cigarette packs in wrapping machines which operate at several speeds. Regulates the transfer of heat from heating elements to overlapping or abutting edges and/or flaps of thermoplastic wrappers in such a way that each portion of the wrapper which must be sealed into response to the application of heat receives exactly the same amount of heat energy, irrespective of changes in the speed at which the wrapping machine processes successive packs. The heating means may comprise several heating units with different heat energy outputs each of which is movable into heat exchanging position with successive wrappers in response to changes in operating speed of the wrapping machine, one or more heating units whose temperature may be varied as a function of changes in speed of the wrapping machine, and/or a series of heating units which can be turned on individually or in groups of two or more, again as a function of changes in speed of the wrapping machine.

Cross-references to related applications

The apparatus of the present invention can be incorporated in machines of the general class disclosed in the copending application Ser. No. 566,073, filed July 18, 1966, by Alfred Sebelin for “Apparatus for Wrapping Cigarette Packs and the Like” or in my copending application Ser. No. 580,558, filed Sept. 21, 1966, for “Heat Sealing Apparatus.” Another machine which can embody the apparatus of my invention is disclosed in U.S. Patent No. 3,200,555 to Kurt Liedtke.

Background of the invention

The invention relates to apparatus for regulating the transfer of heat in general, and more particularly to improvements in apparatus which can be incorporated in wrapping machines serving to apply heat-sealable envelopes or wrappers around cigarette packs or other commodities which are advanced past one or more heating zones. Still more particularly, the invention relates to apparatus which may be utilized in wrapping machines serving to apply transparent outer envelopes or wrappers around the inner envelopes of cigarette packs or other commodities which are supplied to the wrapping machine at several speeds whereby the wrapping machine, too, operates at two or more speeds to be in a position to process the arriving commodities at the same rate at which they are being fed thereto.

In presently known machines which apply and seal thermoplastic wrappers around cigarette packs and similar commodities, the operation of the heat-sealing devices is most satisfactory when the wrapping machine operates at normal or full speed. If the speed decreases, the transfer of heat energy to successive wrappers is often excessive which can result in curling of heat-sealed portions, discoloration of wrappers and/or partial or total destruction of commodities. The heat energy transferred by such heating devices may be used to actually weld overlapping or abutting portions of wrappers or to promote the sealing action of adhesive coats which are applied to wrappers prior to entry into or during travel through the wrapping machine. The wrappers may be used to provide with tear strips.

A machine which applies transparent wrappers around the inner envelopes of cigarette packs or like commodities is normally capable of processing the output of two or more packaging machines which apply inner envelopes around bunches of arrayed cigarettes. If one of such packaging machines is out of commission, the number of packs which reach the wrapping machine per unit of time is reduced and, therefore, the wrapping machine normally comprises a variable-speed drive which is adjustable by hand or responds automatically to idling of one of a packaging machine to apply the wrappers at the same rate at which the packs arrive from the remaining packaging or machine. The heating devices of the wrapping machine are regulated by the drive and are normally moved into and away from heat-transmitting engagement with successive wrappers whereby the duration of their dwell at the heating zones where the come in actual contact with wrappers increases in response to a reduction in operating speed of the wrapping machine. This might result in the above-outlined drawbacks, such as curling, discoloration and/or burning of wrappers.

Accordingly, it is an important object of the present invention to provide an apparatus which can regulate the transfer of heat to successive commodities in such a way that variations in the speed at which the commodities travel past one or more heating zones cannot influence the quality of seals which are produced in response to heat transfer between such commodities and the heating devices.

Another object of the invention is to provide an apparatus which can be used with particular advantage in machines which apply and seal transparent synthetic thermoplastic wrappers around cigarette packs coming from two or more packaging machines.

A further object of the invention is to provide novel and improved heating devices which can be utilized in an apparatus of the above-outlined character.

A concomitant object of the invention is to provide novel adjusting means which can regulate the dissipation of heat by heating devices as well as the heat-sealing stations of a wrapping machine for cigarette packs or the like as a function of changes in operating speed of such wrapping machine.

Still another object of the invention is to provide an apparatus which can regulate the transfer of heat as a function of two or more changes in the speed of a wrapping machine for cigarette packs or the like.

Another object of the invention is to provide an apparatus which can be installed in presently known wrapping machines by necessitating minor changes in the design and/or operation of such machines.

A further object of the invention is to provide a heat transfer regulating apparatus whose operation is very economical and which can respond automatically to any and all changes in the operating speed of the wrapping machine.

Summary of the invention

The invention resides in the provision of an apparatus for regulating the transfer of heat to successive commodities which travel at varying speeds past a heating zone, particularly for regulating the transfer of heat from heating or heat-sealing units to the envelopes of grouped tobacco-containing articles, such as cigarettes, filter cigarettes or like commodities which are wrapped in a packaging machine. The apparatus comprises variable-speed
drive means operative to effect movement of commodities past a heating zone at a plurality of speeds, heating means regulatable to dissipate in the heating zone varying amounts of heat each corresponding to a different speed of the drive means, and adjusting means responsive to changes in operation of the drive means to regulate the heating means so that the amounts of heat transferred to successive commodities passing the heating zone vary as a function of changes in speed of the drive means. The arrangement is preferably such that the amounts of heat energy dissipated by heating means per unit of time are reduced in response to a reduction in the speed of the drive means but that the total amount of heat energy transmitted to each of a succession of commodities remains substantially unchanged, irrespective of the speed at which the commodities advance past the heating zone.

The heating means may comprise one or more heating units which are bodily movable with reference to the heating zone by a motion transmitting device of the adjusting means. Alternatively, the heating means may comprise two or more heating units which may be turned on singly or together so that the number of operative heating units determines the total amount of heat energy transmitted to the heating zone. It is also possible to use a single heating unit whose heat energy output is variable, for example, an electric resistance heater whose heat energy output is variable by regulating the flow of electric current through, either by means of a transformer, a potentiometer or a tachometer-controlled generator.

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.

Short description of the drawing

FIG. 1 is a diagram of a production line including a wrapping machine for cigarette packs which embodies one form of the improved apparatus, the heating means of the apparatus being constituted by a single multiplex heating unit which is movable with reference to the heating zone; and FIG. 2 is a fragmentary perspective view of the heating zone and of the heating unit in the apparatus of FIG. 1;

FIG. 3 is a horizontal section as seen in the direction of arrows from the line III—III of FIG. 2 and further showing the connection of the multiplex heating unit to the adjustable means for the single multiplex heating unit;

FIG. 4 is an end elevational view of a portion of a modified apparatus wherein the heating means comprises a battery of simultaneously movable multiplex heating units;

FIG. 5 is an enlarged cross-sectional view of a multiplex heating unit in the apparatus of FIG. 4;

FIG. 6 is a fragmentary perspective view of the apparatus of FIG. 4, further showing the motion transmitting means of the adjusting means for the heating units;

FIG. 7 is a fragmentary perspective view of a third apparatus wherein a single multiplex heating unit extends in parallelism with the direction of travel of commodities past a heating zone;

FIG. 8 is a diagram similar to the one shown in FIG. 1 but illustrating a different apparatus which comprises an electric heater, a transformer, and a differential transformer which regulates the flow of electric current through the heater;

FIG. 9 is a fragmentary diagrammatic view of a further apparatus wherein the heating means comprises two heaters with different heat output and the adjusting means is arranged to operate one heater at a time;

FIG. 10 is a fragmentary diagrammatic view of still another apparatus which comprises two heaters with identical output one of which is in operation at all times and the other of which is turned on in response to increasing speed of the drive means; and

FIG. 11 is a fragmentary diagrammatic view of a further apparatus wherein the heat energy output of a heater is regulated by a tachometer-controlled generator.

Description of the preferred embodiments

FIG. 1 illustrates a production line including two packaging machines 2, 4 each of which is arranged to turn out a series of successive cigarette packs P. Such machines are of known design and their exact construction forms no part of the present invention. The production line further comprises a wrapping machine 10 which receives cigarette packs P from the packaging machines 2 and 4 and is arranged to provide each pack P with an outer envelope or wrapper of transparent or translucent synthetic theroplastic material. The wrapping machine 10 is preferably similar to that which is disclosed in the aforementioned copending application Ser. No. 566,073 of Sebelin but is provided with different heating means whose construction and operation will be described in connection with FIGS. 2 and 3. Furthermore, the wrapping machine 10 comprises novel adjusting means responsive to changes in the speed of drive means for various web-supplying, folding, tucking and pack-transporting devices. The adjusting means regulates the dissemination of heat by the heating means in such a way that the amounts of heat transferred to successive packs (and more particularly to the outer envelopes of such packs) in each heating zone of the wrapping machine 10 will be the same regardless of whether the drive means of the wrapping machine operates at a normal high speed or at a reduced speed. The drive means of the wrapping machine 10 will be caused to change its speed if the packaging machine 2 or 4 is arrested or breaks down as well as if the combined output of the two packaging machines is reduced due to partial breakdown or for another reason.

The packaging machines 2, 4 respectively comprise drive means constituted by constant-speed electric motors 6, 8. The drive means of the wrapping machine 10 comprises a variable-speed electric motor 12 which, in the embodiment of FIG. 1, can operate at a higher or normal operating speed and at a reduced or second operating speed. The electric circuit of the motors 6, 8 and 12 comprises two power leads 14, 16 whose terminals 18 are connected to a suitable source of electrical energy, not shown. Two conductors 20, 22 connect the motor 6 with the power leads 14, 16 and the conductor 20 contains a master switch 24 which must be closed in order to start the packaging machine 2. Two further conductors 26, 28 connect the motor 8 with the power leads 14, 16 and the conductor 26 contains a master switch 30 which can start or arrest the packaging machine 4.

The electric motor 12 is a pole-changeable motor whose windings are connectable with the power leads 14, 16 and a conductor 32. The motor 12 will drive its output shaft 12a at full operating speed when the packaging machines 2 and 4 operate normally. The output shaft 12a drives the main shaft 18 of the machine 10, and such main shaft transmits motion to all parts of this machine excepting a novel heating means 78 which will be described hereinafter. When one of the packaging machines is arrested, the output shaft 12a will be driven at half the normal operating speed. The speed changer means for the motor 12 comprises a relay 34 having two relay switches 36, 38 which are respectively installed in the power lead 14 and between conductor 32 and one of which is connected with the power lead 14. The relay 34 is energizable by two control switches 48, 52 which are closed when the packaging machines 2, 4 operate at full speed and turn out a continuous supply of cigarette packs P. The path of travel of such packs is tracked by two detectors 40, 42 which respectively open the control switches 48, 52 when they fail to detect packs P. A conductor 46 connects the relay 34 with one fixed contact of the con-
control switch 48, and the other fixed contact of this control switch is connected with one fixed contact of the control switch 52 by a conductor 50. A further conductor 54 connects the other fixed contact of the control switch 52 with the conductor 26. The relay 34 is further connected with the power lead 16 by a conductor 44. The movable contact of the control switch 48 is closed by the detector 40 where the latter assumes the normal position shown in FIG. 1. If the packaging machine 2 fails to turn out cigarette packs P, the detector 40 changes its position and opens the control switch 48. The operation of the detector 42 is analogous. These detectors respond to stoppage or lengthy interruptions in the feed of packs P from the respective packaging machines or to shorter interruptions, depending on their size and their position with reference to the path of travel of cigarette packs from the machines 2, 4 to the wrapping machine 10. The packaging machines 2, 4 may be arrested in response to opening of master switches 24, 36, in response to partial or complete breakdown of their parts, or for another reason.

The wrapping machine 10 also comprises a detector 56 which supervises the output of this machine and opens a control switch 58 in the power lead 16 to arrest the motor 12 when the wrapping machine breaks down or the travel of fully wrapped cigarette packs P' is interrupted for another reason.

FIGS. 2, 3 and 4 merely show one (78) of several heating means which are utilized in the wrapping machine 10 of FIG. 1. This heating means 78 comprises a pair of electric heating units or heaters 90, 92 one of which is invariably adjacent to a heating zone HZ in the interior of a vertical duct 80 in which the packs P travel seriatim so that the overlapping edges of their wrappers W are welded to each other by the heating unit 90 or 92, depending on the speed of the motor 12. The adjusting means 64-76 of the machine 10 is arranged to bodily displace the heating means 78 with reference to the heating zone HZ and comprises a mechanical motion transmitting mechanism 66-76 including two racks 66, 74 and two coaxial gears 68, 72 which are mounted on a common shaft 70 and respectively mesh with the racks 66, 74. The adjusting means further comprises an electromagnet 64 which is connected in the electric circuit of FIG. 1. The rack 66 constitutes the armature of the electromagnet 64. The rack 74 comprises two conductors 61, 62 which are respectively connected with the power lead 16 and with one fixed contact of the relay switch 38, i.e., with the conductor 32. The rack 74 is provided on the frame or support 77 of the heating means 78 and the motion transmitting mechanism further comprises a return spring 76 which is coupled with the rack 66 and moves the rack 74 in a direction to the left, as viewed in FIG. 3, when the electromagnet 64 is deenergized in response to opening of the relay switch 38.

The heating units 90, 92 respectively comprise conductors 94, 96 and 98, 100 which are capable of sustaining a suitable source of electrical energy, not shown. The arrangement is preferably such that the conductors 98, 100 are automatically disconnected from the source when the heating unit 92 is moved away from the heating zone HZ (FIG. 3) and that the conductors 94, 96 are disconnected from the source when the spring 76 is in contact and the heating means 76 moves upwardly, as viewed in FIG. 3, to move the heating unit 92 into registry with the heating zone. The relay 34 may perform the additional function of disconnecting the heating unit 90 or 92 from the source of electrical energy.

The heater comprises two vertical walls of the conveying system which guides and advances cigarette packs P through the wrapping machine 10 and past the heating zone HZ. The packs move sideways along a lower platform 82 and are thereupon lifted stepwise to travel upwardly through the duct 80. The lifting means comprises a vertically reciprocable ram 88 which is shown in raised position. When retracted to its lower end position, the ram 88 provides room for entry of a fresh cigarette pack into the lowermost region of the duct 80. During their travel through the duct 80, the packs pass through a heating zone HZ and dwell in the duct during the intervals between intermittent upward strokes of the ram 88. The uppermost pack of the stack 86 shown in FIG. 2 is then caused to move in a direction to the left by sliding along an upper platform 84 and past two additional heating zones one of which is shown in FIG. 7. The heating means 78 constitutes one vertical wall of the duct 80 and is provided with a horizontal guide rail 102 which is slidable in ways 104. Suitable retaining devices (shown in FIG. 4) are provided in the lower region of the duct 80 to prevent downward movement of the stack 86 when the ram 88 is caused to perform a return stroke and provides room for entry of a fresh pack.

The basic purpose of the heating means 78 is to weld to each other the overlapping edges of thermoplastic envelopes or wrappers W which are partially draped around such packs P which travel upwardly through the duct 80. The pairs of overlapping flaps at both longitudinal ends of the packs P can be bonded to each other during travel along the upper platform 84.

The heating means 78 is formed by a single multiplex heating unit whose heating units 90, 92 are installed in a common plate-like support or frame 77 of insulating material and each of which can transmit heat to several (for example, three, see FIG. 2) wrappers W in the duct 80. Thus, the heating unit 90 or 92 will remain in continuous contact with a wrapper W during three successive dwells and during two successive stepwise advances to such wrapper past the heating zone HZ. During their travel through the duct 80, the wrappers W of cigarette packs P may resemble tubes whose ends are still open, or the wrapping machine 10 may comprise various folding and tucking devices which are adjacent to the ends of packs in the duct 80 and close the ends of such tubes, either in part or entirely, so that each wrapper which reaches the upper platform 84 can immediately enter a further heating zone. The ways 104 restrict the heating means 78 to translatory movement transversely of the direction of movement of packs P and wrappers W past the heating zone HZ.

The operation is as follows: When the packaging machines 2 and 4 operate properly, the detectors 40, 42 are held in the positions shown in FIG. 1 and the control switches 48, 52 are closed. The wrapping machine 10 receives a maximum number of packs P per unit of time and, if its operation is satisfactory, the detector 56 remains in the position of FIG. 1 to maintain the control switch 58 in closed position. The relay 34 is energized because it is connected with the source of electrical energy by power lead 14, conductor 26 and master switch 30, conductor 54 and control switch 52, conductor 50, control switch 48, conductors 46, 44, and power lead 16. The relay switch 36 is open and the relay switch 38 is closed whereby the conductors 32, 60 connect the motor 12 with the power lead 14. This connects with the energy source that winding of the motor 12 which determines the full operating speed of the output shaft 12a. The electromagnet 64 is energized because its circuit is completed through power lead 14, conductor 60, relay switch 38, conductors 62, 61, and power lead 16. The rack 66 is held in the position shown in FIG. 3 and the return spring 76 stores energy. The heating unit 90 is adjacent to the heating zone HZ and transmits heat to three wrappers W at a time. This heating unit 90 then comprises one vertical wall of the duct 80. The overlapping rear-right-hand edges of the wrappers W are brought to each other before the respective packs P reach the upper platform 84. The total amount of heat energy transmitted to each wrapper W is determined by the normal operating speed of the motor 12 (i.e., by the speed at which the ram 88 reciprocates) and by the heating action of the unit 90.
If one of the packaging machines 2, 4 fails to operate properly or if the operator decides to open the master switch 24 or 30, the corresponding detector 40 or 42 pivots in a clockwise direction, as viewed in FIG. 1, and opens the control switch 48 or 52. The control switch 48 will interrupt the flow of electromagnetic current to the control device 16, 50 or the control switch 52 will interrupt the flow of electric current between the conductors 50, 54. The relay is deenergized and its spring 35 opens the switch 38 simultaneously with closing of the switch 36. The power leads 14, 16 then connect the source of electrical energy with another winding of the motor 15 so that the latter operates a half its normal speed and the speed of travel of cigarette packs P through the duct 80 is reduced in half. The relay switch 38 interrupts the flow of electric current through the coil of the electromagnet 64 so that the spring 76 can move the rack 66 in a direction to the left, as viewed in FIG. 5, to shift the heating unit 92 upwardly and to move the heating unit 90 away from registry with the heating zone HZ. The heating action of the unit 92 is weaker than that of the unit 90 but is sufficient to insure satisfactory bonding of overlapping edges during slower advance of wrappers W through the duct 80. Thus, the total output of heat energy during dwell of slowly advancing packs P in the duct 80 is the same as before when the motor 12 was operated at full speed.

In this way, the heating means 78 (in cooperation with the adjusting means including the electromagnet 64 and the motion transmitting mechanism 66-74) and the duct overlapping edges of the wrappers W are properly bonded to each other irrespective of variations in the speed of the motor 12.

If the operator decides to restart the packaging machine 2 or 4 at normal operating speed, the detectors 40, 42 assume the positions shown in FIG. 1 and energized again to cause energization of the electromagnet 64 and to change the speed of the motor 12 to normal operating speed. The rack 66 returns to the position of FIG. 3 and the heating unit 90 returns into registry with the heating zone HZ.

If the packaging machine 10 breaks down, the detector 36 opens the control switch 58 to arrest the motor 12. This control switch 58 (or the detector 36) can also open the master switches 24, 30 to arrest the packaging machines 2 and 4.

FIGS. 4 to 6 illustrate the heating means and the adjusting means of a heat transfer regulating apparatus of a modified wrapping machine. This wrapping machine comprises a conveying system including a lower platform 202, an upper platform 204, and a vertical duct 200 in which the cigarette packs P advance upwardly in response to upward strokes of a ram 208. FIG. 4 illustrates a stock 206 of cigarette packs P each of which is provided with a partially draped wrapper W of weldable synthetic thermo-plastic material. Each wrapper W may be provided with a tear strip (not shown) which is attached thereto in the same way as described in the aforementioned copending application Ser. No. 566,073 of Sebelin. The overlapping right-hand edge portions of the wrappers W travel stepwise past a vertically extending heating zone HZ in the interior of the duct 200. Resilient retaining devices 210, 212 in the lower region of the duct 200 prevent downward movement of the stack 206 when the ram 208 performs a downward stroke. These provide room for outward strokes of the ram 208.

The heating means of the apparatus shown in FIGS. 4 to 6 comprises a battery of three elongated multiplex heating units 214, 216, 218 which extend transversely of the heating zone (i.e., transversely of the direction of travel of wrappers W) and each of which comprises two single heating units 220, 222. As shown in FIG. 5, the heating units 220, 222 are constituted by elongated electric heaters of semicircular cross-sectional outline and are mounted on a common plate-like frame or support 224 of insulating material. Screws 226 or similar fasteners secure the heaters 220, 222 to the opposite sides of the frame or support 224. The heat energy output of the heater 222 exceeds the output of the heater 220; therefore, the heater 222 will transmit heat to the zone HZ when the wrapping machine operates at full speed and the heater 220 is between the control device 16 and the duct 80 of the heating zone HZ when the machine operates at a reduced speed. The difference between the heat energy outputs of the heaters 220, 222 is a function of the difference between the full and reduced operating speeds of the wrapping machine, and more particularly between the full and reduced speeds of the drive means for the movable parts of the wrapping machine. Each of the heaters 220, 222 may be provided with a temperature regulating device to insure constant output of heat energy. FIG. 5 illustrates, by way of example, a thermostat 228 which regulates the heat energy output of the heater 222. This thermostat is recessed into the support 224 and controls the flow of electric current through the windings of the heater 222.

The adjusting means for the heating means 214-218 comprises an electromagnet 254 and a motion transmitting mechanism which is illustrated in FIG. 6. The multiplex heating units 214, 216, 218 are respectively mounted on parallel hollow shafts 230, 232, 234 which are rotatable in a housing 236 and this housing is reciprocable in directions indicated by a double-headed arrow 270 to move the heaters 220 or 222 nearer to and further away from the heating zone HZ. The shafts 230, 232, 234 carry in their shaft housings insulated bearings 244. The shafts 230, 232, 234 further carry a bevel gear 244 meshing with a bevel gear 246 at one end of a driver shaft 248. The other end of the shaft 248 carries a pinion 250 which meshes with a rack 252 constituting the armature of the electromagnet 254. The rack 252 is reciprocable in directions indicated by arrow 256 and is permanently biased by a return spring 257. The housing 236 has a rail 264 reciprocable in ways 266 provided in a stationary frame member 268 of the wrapping machine. The driver shaft 248 is rotatable in and reciprocates with the housing 236 but the pinion 250 is long enough to remain in contact with the rack 252. The manner in which the electromagnet 254 is energizable in response to energization of the speed changer relay 34 of the drive means 12 (not shown in FIGS. 4-6) is the same as described in connection with FIG. 1.

The cables 258, 260, 262 (each including four conductors) are respectively connected with the heating elements of the multiplex heating units 214, 216, 218. The cables 258-262 pass through a flexible sheath 263 which is fixed to the housing 236 and each thereof forms one or more convolutions around the respective shaft 230, 232, 234. These shafts are provided with openings (not shown) through which the respective cables pass so that their conductors can be connected to the terminals of the corresponding heating elements. The arrangement is preferably such that the relay 34 (FIG. 1) connects with the source of electrical energy only that group of heaters (220 or 222) which is in registry with the heating zone HZ.

Contrary to operation of the wrapping machine 10 shown in FIG. 1, the multiplex heating units 214-218 are reciprocable toward and away from the heating zone HZ so that they engage the wrappers W only during the intervals between outward strokes of the ram 208. Such mode of operating the heating means is fully disclosed in the aforementioned copending application of Sebelin. This copending application discloses a system of cams and followers which can effect movements of heating means toward and away from the heating zone.

The operation of the structure shown in FIGS. 4 to 6 is as follows:

If the motor 12 of the wrapping machine is caused to change its speed to half the normal operating speed (either by hand or due to a breakdown of one of the packaging machines 2, 4), the electromagnet 254 is de-
energized by the relay 34 and the return spring 257 is free to move the rack 252 in a direction to the left, as viewed in FIG. 6. The pinion 250 rotates the drive shaft 248 and the bevel gear 246 rotates the shaft 230 whereby each of the multiplex heating units 214-218 rotates through 180 degrees and places its weaker heater 220 into registry with the heating zone HZ. The housing 236 and pinion 250 reciprocate at less frequent intervals and the heaters 220 remain in longer-lasting contact with the adjoining wrappers W.

If the relay 34 is energized again, the electromagnet 324 attracts the rack 252 and the shafts 230-234 return the stronger heaters 222 into the positions shown in FIG. 6. The intervals between successive reciprocatory movements of the housing 236 and rack 230 are shorter but the heat energy output of the heaters 222 is higher so that each wrapper W is heated sufficiently to be provided with a satisfactory welded seam. When the relay 34 is energized, it cuts off the supply of electric current to the heaters 220 and connects the current source with the heaters 222.

It will be seen that the heating means of FIGS. 4-6 is clearly analogous to the heating means of FIGS. 1 to 3 with the exception that the multiplex heating units 214-218 perform rotary movements and are movable to a plurality of angular positions in each of which they transmit a portion of heat energy to the wrappers W in the heating zone HZ.

The structure shown in FIGS. 4 to 6 is particularly suited for heat-sealing of hard-to-weld thermoplastic materials, such as hard polyvinyl chloride or the like. FIG. 7 illustrates a portion of an apparatus which can be incorporated in the wrapping machine of FIGS. 1-3 or 4-6. The endless conveying belt 302 of FIG. 7 receives cigarette packs 300 with partially sealed but fully draped wrappers W from the upper platform 84 or 204 (or replaces such platform) and travels at a level below a series of suitable guide members 306, 308 which define therewith a path wherein the packs 300 travel in the direction indicated by arrow 304. The apparatus comprises heating means constituted by a single elongated cylindrical multiplex heating unit 310 which is similar to the heating unit shown in FIG. 5 but extends in parallelism with the direction of travel of the packs 300. This heating unit 310 is inserted in a gap between two sections of guide member 306 opposite guide member 308 and its function is to weld the overlapping end flaps 300a, 300b of the wrappers W. The drive means of the wrapping machine which includes the apparatus of FIG. 7 is operated at two speeds and, therefore, the multiplex heating unit 310 comprises the switch 412 is connected with the other illustrated secondary winding of transformer 402 by a conductor 410. A further conductor 414 connects the other stationary contact of the relay switch 416 with a tap between two portions of the secondary winding. The primary winding of the transformer 402 is connected with conductors 404, 406. The conductor 404 is connected with the power lead 16 and the conductor 406 is connected with conductor 60 and hence with the power lead 14.

The operation of the structure shown in FIG. 8 is as follows:

When the production line operates at full capacity, the control switches 48, 52 and 58 are closed and the relay switch 416 of the control means is open. The circuit of the electric heater 400 is completed through the entire secondary winding of the transformer 402 and, therefore, this heater is heated to a high temperature because the total time allotted for travel of successive wrappers past the heating zone is relatively short. The relays 414, 416 are open so that the motor 12 operates at full speed and the conductors 414, 418 are disconnected from each other. The circuit of the heater 400 is completed through the entire secondary winding of the transformer 402, conductors 408, conductors 415, 420, relay switch 412 and conductor 410. The number of convolutions of the sec-
ondary winding determines the temperature of the heater 400, and such temperature is properly related to the full operating speed of the motor 12.

If the detector 40 or 42 opens the control switch 48 or 52, the r.p.m. of the output shaft 12c is reduced in half in the same way as described in connection with FIG. 1, whereby the relay switch 412 opens and the relay switch 416 closes. The circuit of the heater 400 is then completed through the right-hand portion of the secondary winding, conductor 408, conductor 418, relay switch 416, and conductor 414. The temperature of the heater 400 is thus reduced proportionately with reduced r.p.m. of the output shaft 12c. The total transfer of heat energy to successive wrappers advancing past the heating zone remains unchanged.

It is to be noted that the wrapping machine 10a of FIG. 8 comprises at least two additional heating means each of which can comprise a heating unit 400 or a heating unit of the type shown in FIG. 7 and serving to weld the overlying flaps 300a, 300b and 300c, 300d.

FIG. 9 illustrates a portion of the further wrapping machine 10b including a speed-changer relay 34b for a motor corresponding to the motor 10b of FIG. 1 or 8 and adjustable means for a composite heating means including two electric heating units 500, 502. The adjusting means comprises operating means including two additional switches 506, 510 of the relay 34b. The heat energy output of the heating unit 500 exceeds the output of the heating unit 506 and, therefore, the circuit of the unit 500 is completed when the wrapping machine 10b is operated at full speed. The heating action of the unit 502 is selected in such a way that it suffices to bring about satisfactory welding of wrappers when the machine 10b operates at half its normal speed.

The heating units 500, 502 have a common terminal which is connected with the power lead 16 by a conductor 514. Another conductor 504 connects the other terminal of the heating unit 500 with one fixed contact of the relay switch 506. The other fixed contact of the switch 506 is connected with a conductor 512 which connects the conductor 500 and 514. The conductor 510 is connected with one fixed contact of the relay switch 510. The other fixed contact of the switch 510 is connected with the other terminal of the weaker heating unit 502 by a further conductor 508.

When the motor of the wrapping machine 10b operates at full speed, the relay 34b is energized because the control switches 48, 52 (not shown in FIG. 9) are closed. The relay switches 36, 510 are open and the relay switches 38, 506 are closed. The circuit of the stronger heating unit 500 is completed through power lead 14, conductor 60, 512, relay switch 506, and conductor 504. If the speed of the wrapping machine 10b is reduced in half in response to opening of the control switch 48 or 52 or master switch 24 or 30, the relay 34 becomes deenergized and the spring 35 opens the switches 38, 506 by simultaneously closing the switches 36, 510. The wrapping machine 10b is operated at half its normal speed and the circuit of the weaker heating unit 502 is completed through power lead 14, conductor 60, 512, relay switch 510, conductor 508, conductor 514, and power lead 16. The heating unit 500 is turned off because the relay switch 506 is open. The total time required for travel of successive wrappers past the heating zone is longer but the heat produced by the heating unit 502 is lower so that the heat-sealing action of the heating means remains unchanged.

FIG. 10 shows a portion of a wrapping machine 10c including a speed changer relay 34c and composite heating means including two identical electrical heating units 600, 602. The adjusting means comprises operating means connected by an additional switch 608 of the relay 34c.

The heating units 600, 602 have a common terminal which is connected with the power lead 16 by a conductor 612. The other terminal of the heating unit 602 is connected with a conductor 610 which is connected with the conductor 60 (and hence with power lead 14) as well as with one fixed contact of the relay switch 608. The other fixed contact of the switch 608 is connected with the other terminal of the heating unit 600 by a conductor 614.

When the wrapping machine 10c operates at full speed, the relay 34c is energized and the relay switch 608 is closed so that the heating units 600, 602 are connected to the source of electrical energy in a manner clearly evident from FIG. 10. If the relay 34c is deenergized in response to opening of the control switch 48 or 52 or master switch 24 or 30 (not shown in FIG. 10), the motor 10 of the wrapping machine 12c is driven at half the normal operating speed and the spring 35 opens the relay switch 608. The heating unit 600 is disconnected from its source but the heating unit 602 remains in operation because its circuit is completed through power lead 14, conductors 60, 610, 612, and power lead 16. If the reduced speed of the wrapping machine 10c is not exactly half its full operating speed, the heat energy output of the heating unit 600 is greater or less than the heat energy output of the heating unit 602. The combined heat energy output of the heating unit 600 of FIG. 10 and power lead 15 is insufficient to do satisfactory bonding of wrapper edges when the wrapping machine 10c operates at full speed. If the wrapping machine receives cigarette packs from three or more packaging machines, the heating means will comprise three or more heating units whereby the heating unit 602 remains in operation as long as the wrapping machine is running but the other heating units are connected or disconnected from their sources in response to changes in the speed of the drive means. Thus, when the wrapping machine operates at full speed, all of the heating units will be effective but at least one heating unit will dissipate heat energy when the machine operates at lowest speed.

The same holds true for the wrapping machines 10, 10a and 10b wherein the heating means may be constructed to provide a range of three or more heating actions, depending on the number of speeds at which the wrapping machine is driven and on the number of packaging machines which supply packs to each wrapping machine.

Referring finally to FIG. 11, there is shown a portion of a further wrapping machine wherein the heating means comprises a heating unit 700 which is analogous to the heating unit 400 of FIG. 8 and can be heated to different temperatures in response to changes in the speed of drive means. The heating unit 700 is driven by a motor and the adjusting means comprises control means for regulating the temperature of the heater 700 as a function of changes in the speed of the drive means. The control means comprises a tachometer-controlled generator 702 which is connected with the terminals of the heater 700 by conductors 704, 706. Two additional conductors 708, 710 connect the generator 702 with power leads 716, 714. The terminals 712 of the power leads 714, 716 are connected to a suitable source of electrical energy.

The drive means of the wrapping machine which embodies the device of FIG. 11 comprises a constant-speed electric motor 730 which is connected with power leads 714, 716 by conductors 710, 712 and an adjustable-speed transmission 726. The speed of the output shaft 724 of the transmission 726 is regulable by an actuating member 729. The output shaft 724 transmits torque to the main shaft of the wrapping machine and to a gear train including the gears 720, 722 which drive the input shaft 718 of the generator 702.

The construction of the generator 702 is well known from the art. It is arranged to reduce the flow of electric current through the coils of the generator when the operator manipulates the actuating member 729 in a sense to reduce the speed of the output shaft 724. In this embodiment of my invention, the heater 700 is adjustable infinitely because the output shaft 724 can be driven at an infinite number of different speeds. Each
speed of the shaft 724 corresponds to a different heat energy output of the heater 700.  
In addition, the generator 702, the input shaft 718 may constitute the main shaft of the wrapping machine.

It will be seen that FIGS. 1-7 illustrate apparatus for regulating the transfer of heat by resorting to heating means which comprise one or more movable heating units whereby such heating units extend transversely of or in parallelism with the direction of travel of commodities past the heating zone. In FIGS. 1 to 3, the heating units 90, 92 are arranged to perform translatory movements whereas the heating units 214-218 and 310 which are respectively shown in FIGS. 4-6 and 7 perform angular movements. In addition, such heating units can perform reciprocatory movements in directions toward and away from the heating zone (arrow 270 in FIG. 6).

FIGS. 8 to 11 illustrate four embodiments of apparatus for regulating the transfer of heat from stationary heating means. Such transfer can be regulated by resorting to heating units whose heat energy output may be varied in a manner as described in connection with FIGS. 8 and 11, or to heating means which comprise a battery of fixed heaters which may be turned on or off in dependency on changes in operating speed of the wrapping machine (FIGS. 9 and 10). The structures shown in FIGS. 9 and 10 are particularly suited for use in wrapping machines whose drive motions are operated at a limited number of speeds so that the number of heating units in the respective heating means is limited. Thus, when the drive means operates at two speeds, two heating units suffice for each heating zone of the wrapping machine.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can, by applying current knowledge, readily adapt it for various applications without omitting features which fairly constitute essential characteristics of the generic and specific aspects of my contribution to the art and, therefore, such adaptations should and are intended to be comprehended within the meaning and range or 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 regulating the transfer of heat to successive commodities which travel at varying speeds, particularly for regulating the transfer of heat in the envelopes of grouped tobacco-containing articles, comprising variable-speed drive means operative to effect movement of commodities past a heating zone at a plurality of speeds; heating means to dissipate heat in said heating zone varying amounts of heat with each amount corresponding to a different speed of said drive means; and adjusting means responsive to changes in operation of said drive means to regulate said heat means so that the amounts of heat transferred to successive commodities passing said heating zone vary as a function of changes in speed of said drive means.

2. Apparatus as defined in claim 1, wherein said heating means comprises a plurality of heating units each having a different heat energy output and wherein said adjusting means comprises motion transmitting means for bodily displacing said heating units in response to changes in the speed of said drive means so that each of said heating units dissipates heat in said heating zone in response to a different speed of said drive means.

3. Apparatus as defined in claim 1, wherein said heating means comprises a plurality of independently operable heating units with different heat energy output, said adjusting means comprising operating means for operating said units individually in response to different speeds of said drive means.

4. Apparatus as defined in claim 1, wherein said heating means comprises a plurality of heating units including a first unit operative at each of said speeds and a second unit, said adjusting means comprising operating means for operating said second unit in response to a predetermined speed of said drive means.

5. Apparatus as defined in claim 1, wherein said heating means comprises at least one heater which is heatable to different temperatures to thereby dissipate in said heating zone different amounts of heat, said adjusting means comprising control means for regulating the temperature of said heater.

6. Apparatus as defined in claim 5, wherein said heater is an electric heater and said adjusting means regulates the flow of electric current through said electric heater.

7. Apparatus as defined in claim 6, wherein said adjusting means comprises a transformer.

8. Apparatus as defined in claim 6, wherein said control means comprises a tachometer-controlled generator.

9. Apparatus as defined in claim 1, wherein said heating means comprises at least one multiplex heating unit movable with reference to said heating zone between a plurality of positions in each of which said zone receives a different amount of heat, said adjusting means comprising motion transmitting means for bodily displacing said heating unit in response to changes in the speed of said drive means so that said unit assumes a first position with reference to said heating zone in response to a first speed and another position in response to a second speed.

10. Apparatus as defined in claim 9, wherein said multiplex heating unit comprises at least two discrete heaters and a common support for such heaters.

11. Apparatus as defined in claim 10, wherein said heaters are electric heaters.

12. Apparatus as defined in claim 9, further comprising speed-changer means for said drive means and an operative connection between said speed-changer means and said motion transmitting means.

13. Apparatus as defined in claim 9, wherein said multiplex heating unit is arranged to perform a translatory movement.

14. Apparatus as defined in claim 9, wherein said multiplex heating unit is turnable by said motion transmitting means between a plurality of angular positions.

15. Apparatus as defined in claim 1, wherein said heating means comprises a plurality of multiplex heating units turnable simultaneously with reference to said heating zone between a plurality of angular positions in each of which said zone receives a different amount of heat, said adjusting means comprising motion transmitting means for simultaneously turning said multiplex heating units in response to changes in the speed of said drive means.

16. Apparatus as defined in claim 1, wherein said heating means comprises at least one elongated multiplex heating unit extending in parallelism with the direction of movement of commodities past said heating zone, said unit being moveable with reference to said heating zone between a plurality of positions in each of which said heating zone receives a different amount of heat, said adjusting means comprising motion transmitting means for bodily displacing said unit in response to changes in the speed of said drive means so that said unit assume a first position with reference to said heating zone in response to a first speed and another position in response to a second speed.

17. Apparatus as defined in claim 1, wherein said heating means comprises at least one elongated multiplex heating unit extending transversely of the direction of travel of commodities past said heating zone, said heating unit being moveable with reference to said heating zone between a plurality of positions in each of which said heating zone receives a different amount of heat and said adjusting means comprising motion transmitting means for bodily displacing said heating unit in response to changes in the speed of said drive means.

18. Apparatus as defined in claim 1, wherein said drive means comprises electric motor means.
19. Apparatus as defined in claim 1, wherein said drive means comprises electric motor means and variable-speed transmission means driven by said motor means.

20. Apparatus as defined in claim 1, further comprising speed-changer means for said drive means and detector means arranged to track the path of movement of commodities toward said heating zone and to actuate said speed-changer means in response to changes in the rate of feed of such commodities.

21. Apparatus as defined in claim 20, wherein said speed-changer means comprises relay means and said drive means comprises electric motor means connected in circuit with said relay means, said relay means having switch means forming part of said adjusting means and movable between open and closed positions to thereby change the speed of said drive means.

22. Apparatus as defined in claim 21, wherein said adjusting means further comprises electromagnet means connected in circuit with said switch means and motion transmitting means responsive to changes in condition of energization of said electromagnet means to effect bodily displacement of said heating means with reference to said heating zone.

23. Apparatus as defined in claim 1, further comprising at least one additional heating means reguatable to dissipate varying amounts of heat in a second heating zone with each such amount of heat corresponding to a different speed of said drive means, and further adjusting means responsive to changes in operation of said drive means to regulate said additional heating means so that the amounts of heat transferred to successive commodities passing said second heating zone vary as a function of changes in speed of said drive means, said second heating zone being adjacent to the path of movement of said commodities.

24. Apparatus as defined in claim 1, wherein said adjusting means is arranged to effect greater and lesser dissipation of heat at said heating zone in response to increasing and decreasing speed of said drive means.

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U.S. Cl. X.R.
UNITED STATES PATENT OFFICE  
CERTIFICATE OF CORRECTION  

Patent No. 3,431,398  
March 4, 1969

Günter Wahle

It is certified that error appears in the above identified patent and that said Letters Patent are hereby corrected as shown below:

Column 13, line 55, "heat" should read -- heating --.

Signed and sealed this 31st day of March 1970.

(SEAL)  
Attest:

Edward M. Fletcher, Jr.  
Attesting Officer

WILLIAM E. SCHUYLER, JR.  
Commissioner of Patents