July 13, 1954 M. H. ROTTERSMANN 2,683,523

LATERAL BEND CONVEYER

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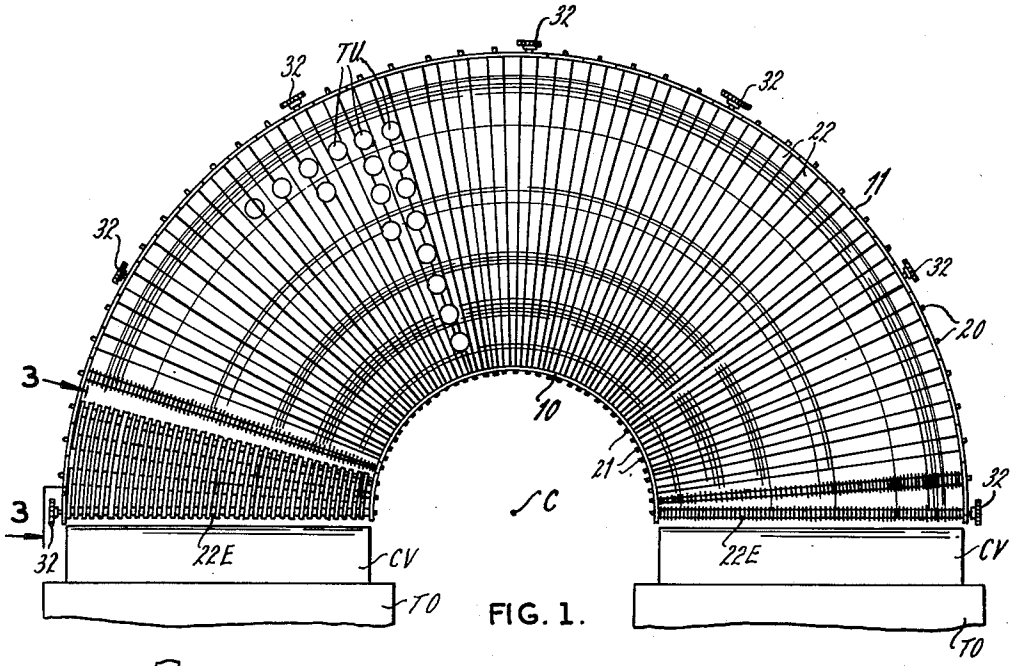


FIG. 1.

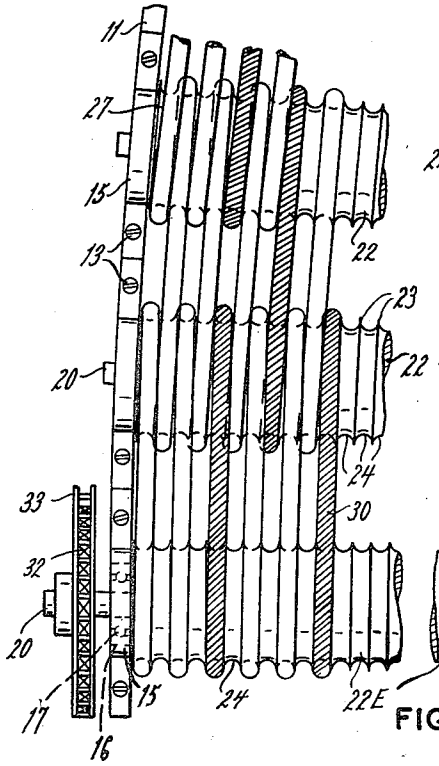
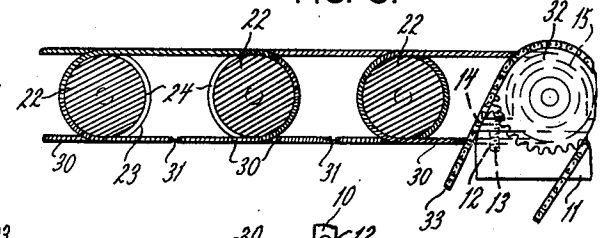
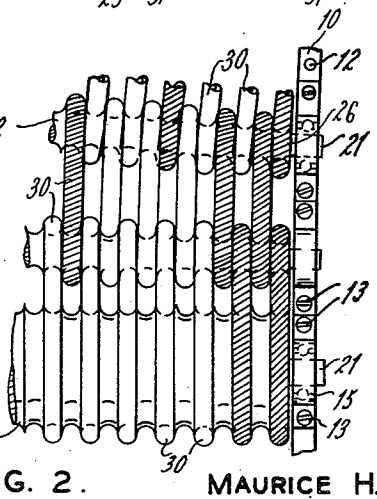


FIG. 2.

FIG. 3.





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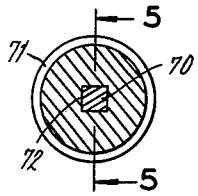


FIG. 4.

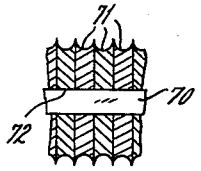
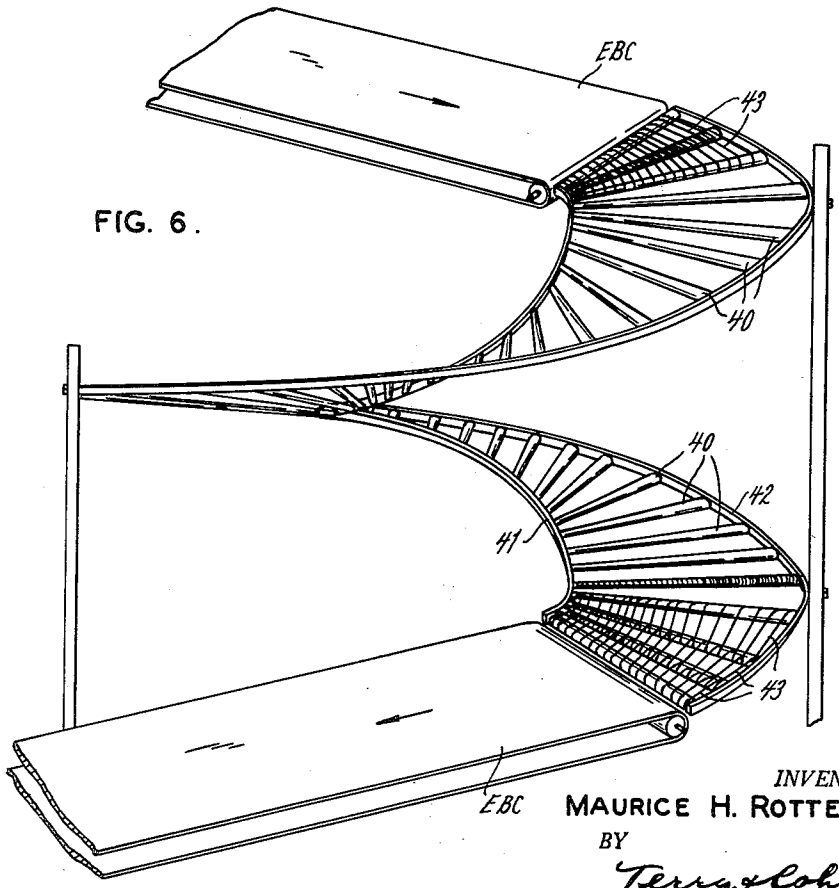


FIG. 5.

FIG. 6.



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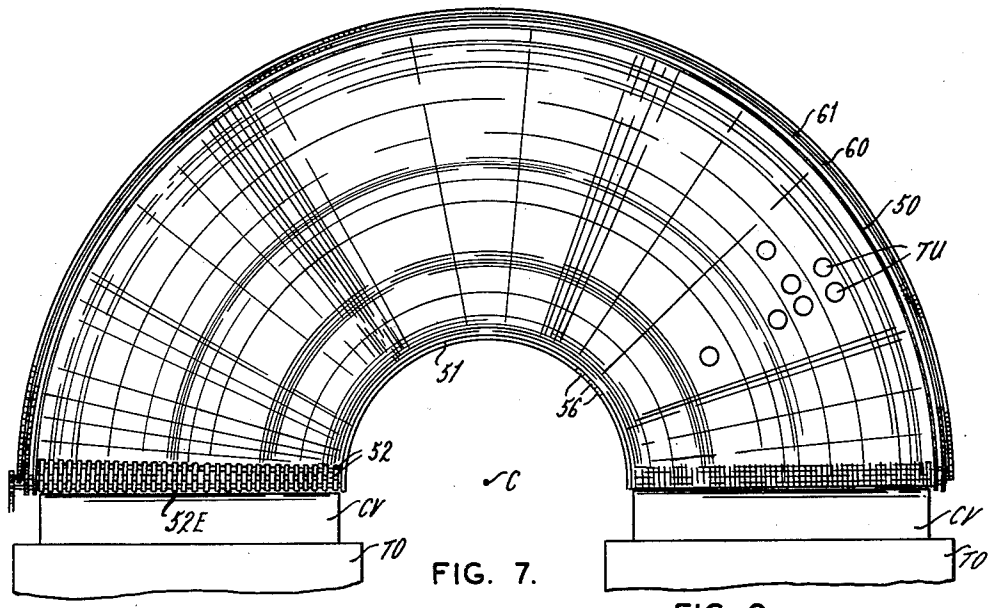


FIG. 7.

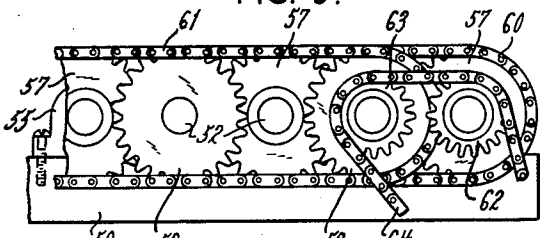


FIG. 9.

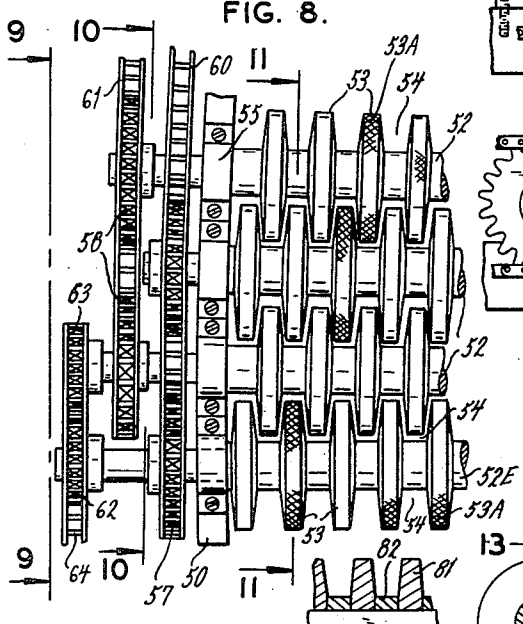


FIG. 8.

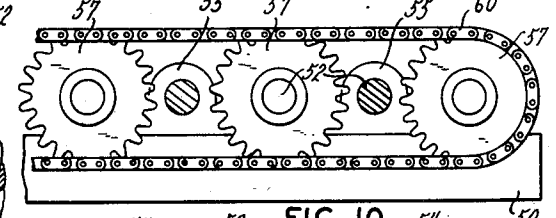


FIG. 10.

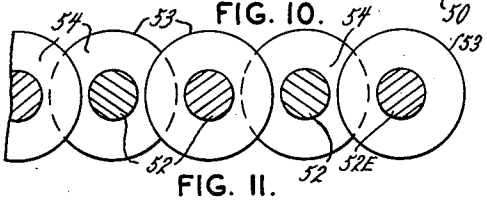


FIG. 11.

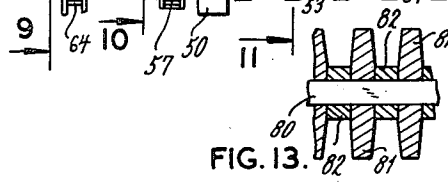


FIG. 13.

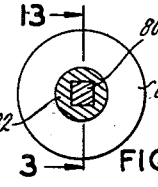


FIG. 12.

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UNITED STATES PATENT OFFICE

2,683,523

LATERAL BEND CONVEYER

Maurice H. Rottersmann, Webster Groves, Mo.

Application May 3, 1950, Serial No. 159,774

4 Claims. (Cl. 198—182)

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This invention relates to improvements in conveyors, and more particularly to a table type of conveyor as distinguished from those of overhead, others of flight, chain and many other types. The present improvements are particularly directed to table conveyors other than endless belt or endless chain or wire types, and considered in respect to results attained, the present improvements are more particularly directed toward realizing uniformity of paths of travel of a number of smaller articles being transported, for example, cookies, cakes and similar units of bakery goods, although being by no means limited to such fields of usage.

The present applicant is aware of the many and diverse attempts toward the design of conveyors suitable for units of the kind referred to, and by reason of long experience with many and perhaps all of those now or heretofore available to the trade, reports a universally prevalent shortcoming in the operation of all of such commercial devices, namely, their inability to transfer from point to point, and particularly incident to a turn or return conveyor path, to maintain an orderly progression of the transported units, as from oven to oven, or between other processing zones. It is accordingly a primary objective of the present improvements to attain a conveyor and particularly a so-called transfer table of such advanced design that, despite even a 180 degree or greater change in direction of the conveyor, it will still serve to maintain a predetermined and orderly arrangement, as in columns and rows, of cakes or other bakery units, and will similarly preserve a predetermined pattern of other transported articles.

The present invention may be summarized by reference to the present principal embodiment and a minor modification thereof, as consisting of a series of shafts unidirectionally power rotated in timed relation, each such shaft being characterized by an axial series of head formations or units. The proximate such heads or units of the adjacent shafts are by preference so located and proportioned that they may be bridged over by each unit transported by the conveyor, and so that, incident to a minor advance by one or more heads of a given shaft, the article will be frictionally picked up and further advanced by other shaft-carried formations or heads, and so through the sequence of shafts in the conveyor. In a preferred embodiment, the adjacent shafts of the conveyor are operatively bridged by endless, flexible tension bands exemplified as coil spring belts. The invention importantly includes a novel individual journalling provision for each of the several shafts, enabling the removal of the shafts and replacement thereof, one, two or three at a time, whereby to facilitate replacement of any of the shaft-carried elements such as the spring bands, without necessarily disturbing others of the shafts.

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A further and important object realized by the present improvements consists in a transfer table construction for use in conveyor systems, such that the conveyor path or course may be given a much more abrupt change in direction without adversely affecting the paths of travel of the transported article, than is possible with conveyors of heretofore known types.

A still further objective, and by certain standards perhaps the most outstanding achievement realized by present improvements, is found in facilities for realizing a rate of travel of any given transverse zone of an arcuate transfer table, which is virtually directly proportionate to the distance of such line of travel from the center on which the curve of the conveyor course or path is drawn, thus assuring beyond the transfer table, an identical arrangement or pattern of articles under transport, beyond the transfer table, as obtained in advance of such table.

An additional objective of the present invention is realized in an improved spiral conveyor utilizing the principles heretofore mentioned in connection with a transfer table, it being noted that such spiral conveyor is or may be essentially an extension of the principles of construction of a transfer table, but characterized by a slope from top to bottom or vice versa, which slope may be and usually is of a uniform order.

Yet another object of the invention is realized in a novel construction of the shaft elements of a conveyor of the general type referred to, which may be designated as a sectional or built-up type of shafting, resulting in an axial series of alternate larger and smaller diameter portions, and in which one or a plurality of the larger portions may be constituted of elements threaded over a one-piece shaft body or core.

The foregoing and numerous other objects and advantages will more clearly appear from the following detailed description of a preferred embodiment of the improvements and certain minor variants thereof, particularly when considered in connection with the accompanying drawing, in which:

Fig. 1 is a top or plan view of a conveyor section, specifically a 180 degree transfer table for use in a conveyor system, and embodying pres-

ent improvements, Fig. 1 being partly diagrammatic;

Fig. 2 is an enlarged fragmentary plan view of opposite end portions of the transfer table, and particularly representing a portion of the entrance end of the table;

Fig. 3 is a fragmentary sectional view taken along line 3—3 of Fig. 1;

Fig. 4 is a transverse sectional view of a modified form of shaft such as may be used in the structure of Figs. 1 and 2;

Fig. 5 is a fragmentary sectional view taken in an axial plane and particularly located by line 5—5 of Fig. 4;

Fig. 6 is a diagrammatic perspective view of a spiral conveyor embodying present improvements;

Fig. 7 is a top or plan view of a 180 degree transfer table similar to Fig. 1, but showing a somewhat modified arrangement of cross shafts;

Fig. 8 is an enlarged fragmentary plan view showing end portions of a few of the shafts such as utilized in the structure of Fig. 7, together with certain shaft driving and interconnecting elements;

Fig. 9 is a fragmentary, enlarged side elevational view of the structure of Fig. 8, as taken along line 9—9 thereof;

Fig. 10 is a view similar to Fig. 9, but taken along line 10—10 of Fig. 8;

Fig. 11 is a fragmentary sectional elevation taken along line 11—11 of Fig. 8, through certain of the shaft elements thereof;

Fig. 12 is a transverse sectional elevational view of a modified form of one of the shaft elements of Figs. 7 and 8, and

Fig. 13 is a fragmentary sectional view of the modified shaft as taken in an axial plane along line 13—13 of Fig. 12.

Referring now by characters of reference to the drawing, and first to a preferred form of 180 degree transfer table as shown in plan by Fig. 1, there is provided, suitably supported as from a floor or other subjacent support (not shown) an inner bearing rail 10 in the form of a regular arc shown as of 180 degrees, drawn on a center C. A similar such rail of considerably greater linear extent, since an outside rail, is indicated at 11. Each of the rails 10 and 11 is of a cross section sufficient to resist any deforming stresses such as bending, warping and the like, and further each of the rails 10—11 is of a sufficient width to provide therein while maintaining the requisite section for strength, a considerable number of depthwise screw seats 12, these being preferably vertical tapped recesses for the reception of screws 13 each engaging an aperture 14 in one of the oppositely extended ends of a unitary bearing or journal member 15 provided with a circular aperture or eye 16 for the snug reception therein of a ball race 17 in which is journalled one of the free ends 20 or 21 respectively at the outer and inner ends of each of the shafts to be described.

It will now have appeared from this arrangement that the provision of individual bearings at each end of each of the shafts, or at least a considerable number thereof, permits individual removal of the shafts, either singly or a pair of such shafts or perhaps at times by small groups, for the purpose of enabling service thereto.

For brevity of present description there will be described a conveyor section which consists of a transfer table such as employed for realizing a full reversal of direction, say of 180 degrees, in the course or path of the conveyor. It will of course be understood that the same principles are equally applicable for effecting a greater or less change in direction, for example, as in a transfer table of 45 degrees, 90 degrees, or as exemplified by the spiral conveyor to be described, a transfer through one or several 360 degree changes of course. Accordingly, the term "transfer table" as employed herein, is not to be considered as restrictive of degree or extent of change in course.

Referring now to the individual shaft elements of the transfer table, the surface formations of each of which are best seen in Fig. 2, it will appear that each such shaft, generally designated at 22, is characterized by a series of axially spaced head portions 23, being portions of somewhat larger diameter than the intervening grooves 24 which axially alternate with the heads 23. As will later appear, each of the circular recesses 24 constitutes a belt groove, and the heads 23 serve as spacers between the grooves and constitute shaft formations which act to maintain each of a plurality of flexible endless tension bands 30 operating in a predetermined axial position along each shaft engaged thereby. The bands will be hereinafter described in more detail.

It is a preference as determined by experience, calculation and experiment, so to form each of the shafts 22 within the range of usual commercial widths of conveyor, that the mean diameter of the shaft in the end region along the inside of the turn, as indicated at 26, bears a ratio to such mean diameter in the zone 27 of the shaft, of substantially the order of one to three. By mean diameter is meant a diameter representing the average between that of the head 23 and the adjacent groove 24 in the respective end regions of the shaft. As before described, the outer free ends of the shaft beyond its conformed portion, and as indicated at 20 and 21, are of a smooth cylindrical character, and constitute journalled end extensions of the shaft, each supported by and operating in the ball race 17 of one of the individual bearings 15, as above generally referred to.

As will appear from Figs. 1 and 2, each of the shafts 22 is of a generally tapered diameter, between the zone 26 and the zone 27 each such shaft gradually increasing in mean diameter, thus resulting in a tapered shaft. Each such shaft is further formed to provide a substantial number of the band grooves 24, which are of increasing diameter from the inside rail to the outside rail of the transfer table. Similarly the heads 23 are comparably graduated, with the effect that, each of the several shafts 22 being rotated together and in timed relation, the peripheral speed of those heads 23 located more closely to the outside rail 11, will exceed the speed of those on the innermost end of each shaft. This effect is, as will now be obvious, realized from the increasing diameters of the heads and grooves, from the inside rail 10 toward the outside rail 11.

It is a preference, although not strictly necessary in all cases, to provide a special end shaft such as 22E at the entrance end of the conveyor, and a similar such shaft at the delivery end of the conveyor, each of the shafts 22E being of even mean diameter, and thus provided with an axial series of heads and grooves, the several heads being of uniform diameters and the several grooves being similarly characterized. Such end shafts may be if desired, of somewhat larger

diameters than the intervening tapered shafts, and may if desired, be made of a heavier section or a more rigid stock, in order better to resist bending stresses which might otherwise result in shaft deflection by reason of the tension of the numerous endless tension bands thereon, and now to be described.

Extending about each of the shafts 22 in the regions of each of the several grooves 24 thereof, is an axial series of endless flexible tension bands 30, the relation of the bands to the shafts being best shown by Fig. 2. Although such bands may be formed of various flexible materials such as rubber or plastic compositions, reenforced if desired, or of other stretchable materials, it is a preference to employ for each of the bands 30 which serve to bring the adjacent shafts in driving-driven relation, a wire coil spring stock of stretchable nature, and of a moderate spring loading, each such band being, in service, of the nature of an endless belt, but initially being of a linear aspect, provided with looped end tangs 31 or other suitable form of connector. Thus the belts may be individually applied over the shaft, without necessarily removing others therefrom, facilitating service attention in case of breakage of any of the bands and similarly minimizing out-of-service time of the conveyor. It is a further desideratum that the several endless tension bands 30 be of such character as to exhibit a universal flexibility, by which is intended a certain lateral flexibility as well as an ability of each band to flex in curved form in the course of its movement about the shaft grooves engaged thereby, incident to shaft rotation. The nature of and reason for such lateral flexibility will appear from Fig. 2, wherein it is seen that the slightly out-of-parallel or divergent relation of adjacent shafts 22, subjects each of the bands 30 to a certain minor degree of lateral flexure.

It will of course be understood that the bands 30 may consist of flat belt members, V-belts or any other sufficiently elastic and laterally flexible units.

It is a preference to form the heads 23 of such diameter that the heads themselves may engage the articles on the conveyor, although it will be noted as an inherent advantage of the use of the coil spring stock in the bands 30, that the successive coils thereof are presented substantially across the conveyor, and thus of themselves, in service, present a series of small wire cross ribs, which serve actively to engage the articles in transport.

In order best to cover the traveling table surface of the conveyor without introducing any unnecessary hiatus, and in order best to provide each transverse linear zone of the transfer table with active transporting agencies, the speed of each of which is proportionate to the distance of such line from the center on which the table is formed, as at C, it is a preference, as to the axial series of the several tension bands 30 on each shaft, to extend the adjacent bands 30 on a given shaft, in opposite directions from such shaft, and thus operatively to tie together each shaft, to those adjacent thereto, at frequently spaced points along the axes of the several shafts. This relation will celarly appear from the arrangement of bands 30 in Fig. 2. It will therein appear that, in view of the circular section of each of the spring coil bands, the slightly staggered line of such bands in any given zone, for example such line immediately inwardly of the outside rail 11, will constitute a line of active propelling agencies the

peripheral speed of each of which is closely proportionate to its radial distance from the center C. In the construction of Figs. 1, 2 and 3, the transfer table is shown as interconnecting, with a 180 degree change of direction, a conveyor CV which operates through and extends endwise from a tunnel oven TO, similar such units being similarly designated at the entrance to a companion such oven TO. The end shafts 22E are located as closely as possible to the delivery and receiving ends respectively of the conveyors CV, so as, without delay or interruption of transport, to pick the articles up from the first such conveyor and deliver them to the second such unit CV.

Driving actuation of the arrangement shown by Figs. 1, 2 and 3 includes by way of example, an extension of certain of the cross shafts 22—22E beyond the outer conveyor rail 11, to each of which extensions is affixed a suitable sprocket 32 engaged by a drive chain 33, and which latter may, in turn, be driven by an individual motor or motor gear unit (not shown) so as to impart the requisite rotative speed to the several sprocket shafts. These latter in turn, will through the tension bands 30, serve to actuate each of the intervening tapered shafts in timed relation with those which are directly power driven.

Although the terms "transfer table" or "conveyor table" are at times utilized herein, such terminology is intended primarily to distinguish devices of the present improved construction from such apparatus as flight conveyors, overhead conveyors and the like, but without intended restriction to any necessity for utilizing the conveyor in a horizontal plane. In fact the present improvements lend themselves admirably to an arrangement of cross shafts of tapered mean diameters in the form of a spiral conveyor, wherein each such shaft is indicated at 40 (Fig. 6) and is journalled in or on suitable bearing elements (not shown) carried by an inner rail 41 and an outer rail 42. The rails 41 and 42, although in parallel relation, and each arcuately formed about centers in a vertical line, the height of the rails 41—42 is gradually increased (or decreased, considered in descent) so that the conveyor exhibits a spiral form. It otherwise possesses the characteristics in usage as above described in connection with the arrangement of Figs. 1, 2, and 3. As illustrating one application, the spiral conveyor of Fig. 6 is shown as operatively interconnecting an upper conveyor of endless belt type indicated at EBC, and a similar conveyor one end of which is located immediately adjacent the lower end shaft of the spiral structure. The cross shafts 40 of the spiral conveyor may be connected by endless bands such as the coil spring belts 43, similarly or identical to the bands 30 of Figs. 2 and 3. The several shafts 40 are located in side-by-side although slightly divergent relation, and are merely diagrammatically shown in Fig. 6. The belts 43 may be omitted, and in lieu thereof cross shafts may consist of elements of the form and interconnected in accordance with the arrangement shown by Figs. 8, 9 and 10, hereinafter described.

A somewhat modified form of the shaft elements, according to which the flexible endless bands 30 may be obviated, is shown by Figs. 8, 9, 10 and 11, and a partly diagrammatic plan view of a 180 degree transfer table thus constructed is shown by Fig. 7. Similarly to Fig. 1, the arrangement of Fig. 7 serves to provide a 180 degree change in direction of course of the conveyor and transported articles, between a tunnel

oven TO, a conveyor CV and a second such assembly similarly designated.

In this modification, an outside rail 50 and an inside rail 51, each being formed on a regular arc about the center C, are bridged by a plurality of shafts 52 arranged in side-by-side relation and each provided with a slightly spaced series of heads 53 intervened by grooves 54, the heads 53 being, if desired, cross-ribbed or knurled as at 53A, to enhance their frictional relation to the transported units TU. Individual journal elements for each end of each of the shafts 52 are provided, one in engagement with the rail 50 as indicated at 55 and a similar bearing element not shown in detail, but indicated at 56 (Fig. 7) at the opposite end of and serving the shaft 52. The bearings 55 may be of anti-friction such as ball type, and in all respects identical with the journal members serving the shafts 22 heretofore described.

The several shafts 52 are of tapered mean diameters, and of increasing or diminishing diameters (according to the direction of reference) similarly to the shafts 22. The arrangement of the several shafts 52 is quite like that of shafts 22, in that adjacent shafts are slightly divergently related, although arranged essentially in side-by-side relation. As will best appear from Fig. 8, the divergence and relation of the several heads 53 on the adjacent shafts, is such that the heads on each shaft intervene a pair of adjacent heads on both adjacent shafts, and thus each head extends into a pair of grooves 54 on the laterally adjacent rotatable elements, as will clearly appear from Fig. 8.

In the arrangement of Fig. 8 and following, means are provided for the operative connection of the several shafts which operate unidirectionally, similarly to the shafts 22, and in timed relation to each other through the transfer table, as in the assembly of Fig. 7. Also, similarly to the shafts 22E of Fig. 1, it is a preference to provide end shafts of the assembly of Fig. 7, which are of even mean diameters, and are indicated at 52E, there being one such shaft at the entrance end of the conveyor of Fig. 7 and a similar shaft at the delivery end thereof.

Certain of the shafts 52, 52E are provided with outer end extensions somewhat beyond the journalled portion of each shaft, certain such extensions being provided with a pair of shaft-interconnecting sprockets such as 57 (Figs. 9 and 10), outwardly of which certain of the shafts are provided with other sprockets 58. A plurality of the sprockets 57 are interconnected as by a chain 60, and a plurality of the sprockets 58 interconnected as by a chain 61. The series of sprockets and chains may be powered as by one or a pair of driven sprockets shown at 62 and 63 (Figs. 8 and 9), these latter being served by a drive sprocket 64, powered from a suitable motorgear unit or other prime mover (not shown). The arrangement of sprockets and chains exemplified by Figs. 8, 9 and 10, is continued about the periphery of the table, and at desired intervals about such periphery, there may be provided a suitable number of the sprocket assemblies 62, 63, 64 together with drive chains, so as to minimize power losses through the drive assembly, and to assure uniformity of both direction and speed of shaft rotation through the table.

A modified sectional type of shafting is applicable herein in the construction of the shaft elements 22, or in the formation of shafts 52, either of which types may be employed in the construction of the spiral conveyor of Fig. 6. Such a modified form of shafts 22 applicable also to shafts 22E, is best shown by Figs. 4 and 5, wherein it will appear that a shaft proper or shaft core is of a non-circular section, shown as square, and indicated at 70. This element, despite the taper if desired in the finished shaft, may be of uniform cross section, and the graduated mean diameters of the assembled shaft may be realized by a series of head-forming sections 71, each of which is provided centrally or axially thereof, with a non-circular passage or bore 72 closely conforming to the shape and dimensions of the core. The fit between these elements may, if desired, be a driving fit, or if not, end portions of the core element 70 may be threaded and nuts (not shown) applied thereto so as axially to compact the several head or grooved units to form the built-up shaft.

The same modification of type is equally applicable to the shafting of which the units 52 are comprised, as will best appear from Figs. 12 and 13. In Fig. 12, a shaft or shaft core 80 of non-circular type, shown as square in section, has threaded thereover a number of individual head-forming units 81, intervened by spacers 82. These latter may, if desired, be formed as integral hub extensions of the heads or discs 81. The same observations heretofore made, as to fit of the individual sections over the core or manner of compacting the sections, are equally applicable to the modified form of Figs. 12 and 13.

There have been briefly referred to earlier herein, certain advantages of the individual journalled mounting of the tapered shafts, as enabling the bodily removal of each such shaft from the rails without necessarily disturbing any of the other shafts. If, however, it is necessary for any reason to service or replace a group of such shafts, the minimum number thereof may in a short time be operatively detached from the rails such as 10, 11 or 50, 51 as the case may be, and as quickly reassembled.

The function of the devices described as utilized in a conveyor system, is thought to have become evident from the foregoing detailed description of parts. It may be noted however for completeness, that although illustrated and described in their most advantageous fields of usage as in transfer tables, spiral conveyors or the like, involving a change in direction of the articles being transported, nevertheless a fully successful conveyor section may consist of a number of adjacent cross-shafts such as 22E or 52E, without tapering the shafts. It is believed the construction and operation of such arrangement will be apparent, and that a full understanding of operation of any of the described forms will be had from a description of the horizontal transfer tables. Assuming the several powered shafts to be in rotation with the system in service, it will have appeared that, in the arrangement of Figs. 1, 2 and 3, the actuation of the several sprockets 32, through chains 33 in coaction with the several flexible tension bands operating as belt elements between the adjacent shafts, will rotate all of the shafting of the series in timed relation, and in a uniform direction. Incident to rotation of the shaft 22E at the entrance end, the tension bands 33 engaging this shaft will obviously rotate the shaft 22 next adjacent, at the same speed, such number two shaft in turn similarly driving number three shaft, and so through the series to the next powered shaft,

being the next shaft of the series carrying one of the sprockets 32. The peripheral speed of the line of bands 30 in the center of the series of shafts 22, will be closely coordinated with the speed of the belt conveyors CV, for reasons which will be obvious. Such operation will, as will now be apparent, result in a somewhat increased speed of linear travel of those articles which are moving adjacent the outer rail 11 of the table, and a somewhat reduced rate of linear speed of travel of those articles which are carried near the inner end or adjacent the rail 10 of the table. However, by reason of the numerous lines of the individual propulsion agencies identified with the several series of endless spring belts, it will now have appeared that the effect will be positively to progress the transported units TU without "breaking ranks." For purposes of present illustration, but without restriction as to nature of transported units TU, it is pointed out that units of bakery goods are virtually of necessity, moved through the tunnel ovens in an orderly arrangement of rows (i. e. crosswise of the conveyor) and columns, being the linear arrangement lengthwise of the conveyor. It is only by utilization of an arrangement in which the speed of the unit-engaging portions of the conveyor are proportioned to the radial distance of each such portion from the center C on which the conveyor is formed, that the initial and desired arrangement or pattern of the units TU, as in rows and columns, may be maintained. It may be pointed out that this result has not been heretofore possible with any commercially available conveyor for any comparable field of service. From the particular characteristics of the transfer table as described, it will now appear that the arrangement of units initially given the pieces TU, which may be considered as cakes or like small units of bakery goods, will be exactly preserved throughout their travel over the transfer table, and again upon the entrance of the units to the second or any subsequent tunnel oven. It should of course be understood that the preservation of the arrangement or pattern of such units, is of vital importance in expediting packing of such units whether by manual or mechanical means, upon completion of their processing, for example, at the end of a baking and cooling cycle.

In the modified form of Figs. 7 through 11, the numerous and closely arranged heads 53, and the interfitted relation thereof in adjacent shafts, results in an operative succession of virtually aligned unit-engaging agencies of such proximity that, as in Fig. 1, a plurality of such agencies are normally bridged over by any unit TU in transport. Thus as any given unit TU is advanced by a given head 53, it leaves the head or heads earlier supporting the unit, and is progressively advanced to and by others in the same radial line. As in the case of the tension bands, the heads 53 will advance the articles or units TU faster or slower, according to their positions closer to, or farther from the center of the arc on which the table is formed.

In the drive arrangement of Figs. 8 through 10, each separately-powered section of the table, it may be considered that, if shaft 52E be considered as the first such shaft, the first, third, fifth and perhaps succeeding odd-numbered shafts are provided with sprockets 56, interconnected through chain 60, while the second, fourth and perhaps other even numbered shafts, carry sprockets 57 interconnected by chain 61. A laterally flexible chain is here utilized, and each powered section of the shafts provided with an individual prime mover of identical speed rating, from which it will appear that all of the shafts of the table are unidirectionally rotatable in predetermined timed relation.

Throughout the foregoing description, despite particularized mention of certain forms of drive, other usual or suitable types of drive members are contemplated; for example in lieu of chain and sprocket drives, belt and pulley members, direct geared connections or other equivalent power transmitting means may be utilized.

Although the invention has been described by detailed reference to certain preferred embodiments and minor variants thereof, the detail of description should be understood solely in an informative rather than in any restrictive sense, many further variants being possible within the scope of the claims hereunto appended.

I claim as my invention:

1. A conveyor transfer section for transferring articles through an angular path comprising a plurality of shafts in side-by-side relation disposed so that their axes diverge from the inside to the outside of said path, each said shaft being formed to provide an axial sequence of circular grooves, the endmost shafts of said section being of uniform diameters at the bases of the grooves thereof and the intermediate shafts each being formed so that the diameters at the bases of the grooves thereof increase from the inside to the outside of said path, a plurality of endless, elastic, article conveying bands encircling adjacent ones of said shafts and being guided by said grooves, each of said article conveying bands including opposed runs extending in opposite directions between the shafts encircled thereby, and means for rotating said shafts, whereby those article conveying bands connecting an endmost shaft with portions of an intermediate shaft having peripheral speeds different from the peripheral speed of said endmost shaft will stretch and contract on opposite runs thereof to minimize the acceleration of the conveying surfaces of the conveyor section and hence to minimize the frictional force required to accelerate the articles being conveyed without slippage of the articles relative to the conveying surfaces.

2. A conveyor transfer section for transferring articles through an angular path comprising a plurality of shafts in side-by-side relation disposed so that their axes diverge from the inside to the outside of said path, each said shaft comprising an elongated core of uniform, noncircular cross-section throughout its length and a plurality of surface-forming elements having apertures therein corresponding in shape and size to the cross-section of said core and being disposed on said core so as to provide said shaft with an axial sequence of circular grooves, the endmost shafts of said section being of uniform diameters at the bases of the grooves thereof and the intermediate shafts each being formed so that the diameters at the bases of the grooves thereof increase from the inside to the outside of said path, a plurality of endless, elastic, article conveying bands encircling adjacent ones of said shafts and being guided by said grooves, each of said articles conveying bands including opposed runs extending in opposite directions between the shafts encircled thereby, and means for rotating said shafts, whereby those article conveying bands connecting an endmost shaft with portions of an intermediate shaft having

peripheral speeds different from the peripheral speed of said endmost shaft will stretch and contract on opposite runs thereof to minimize the acceleration of the conveying surfaces of the conveyor section and hence to minimize the frictional force required to accelerate the articles being conveyed without slippage of the articles relative to the conveying surfaces.

3. A conveyor transfer section for transferring articles through an angular path comprising a plurality of shafts in side-by-side relation disposed so that their axes diverge from the inside to the outside of said path, each said shaft being formed to provide an axial sequence of circular grooves, the endmost shafts of said section being of uniform diameters at the bases of the grooves thereof and the intermediate shafts each being formed so that the diameters at the bases of the grooves thereof increase from the inside to the outside of said path, a plurality of endless, coil spring, article conveying bands encircling adjacent ones of said shafts and being guided by said grooves, each of said article conveying bands including opposed runs extending in opposite directions between the shafts encircled thereby, and means for rotating said shafts, whereby those article conveying bands connecting an endmost shaft with portions of an intermediate shaft having peripheral speeds different from the peripheral speed of said endmost shaft will stretch and contract on opposite runs thereof to minimize the acceleration of the conveying surfaces of the conveyor section and hence to minimize the frictional force required to accelerate the articles being conveyed without slippage of the articles relative to the conveying surfaces.

4. A conveyor transfer section for transferring articles through an angular path comprising a plurality of shafts in side-by-side relation disposed so that their axes diverge from the inside to the outside of said path, each said shaft being formed to provide an axial sequence of circular grooves, the endmost shafts of said section being of uniform diameters at the bases of the grooves thereof and the intermediate shafts each being formed so that the diameters at the bases of the grooves thereof increase from the inside to the outside of said path, a plurality of endless, elastic, article conveying bands encircling adjacent ones of said shafts and being guided by said grooves, each of said article conveying bands being free to stretch and contract as it passes between shaft surfaces moving at different peripheral speeds, and means for rotating said shafts at such speeds that the peripheral speed of the endmost shafts is less than the peripheral speed of the large, outer ends of the intermediate shafts but greater than the peripheral speed of the small, inner ends of the intermediate shafts, whereby acceleration of the articles on said transfer section and slippage thereof relative to the conveying surfaces are minimized.

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