This invention relates to novel apparatus and processes for transporting materials through treating media. More particularly, it relates to rotary carriers for supporting closed lengths of strip material so as to shift the material lengthwise during carrier rotation, and to fluid treatment of materials so supported.

Some devices are known that are capable of supporting lengths of material in such a way that the material does not remain indefinitely in contact with the supports at any particular regions. In supporting materials for fluid treatment, some such arrangement is essential to even contact of fluid with all parts of the material. Devices that provide a net unidirectional circumferential shifting of the supported material with respect to the supports may be said to "advance" or "progress" it. However, no existing advancing or progressing systems afford the benefits of the present invention.

A primary object of this invention is construction of rotary carriers adapted to support material in closed length and to advance the supported material so that no part of it remains in contact with any support for an appreciable number of rotations. A further object is provision of a rotary carrier with means whereby gravitationally induced motion of supporting bars during rotation of the carrier advances material supported by the bars. Another object is provision of a rotary carrier with means for loading and supporting material in a star pattern, as viewed along the carrier axis.

An object of this invention is fluid treatment of an endless length of material supported on a rotating carrier and shifting position, with respect to the supports, under the influence of gravity. Another object is liquid treatment of material supported on a carrier rotating partly immersed and effecting an intermittent unidirectional shifting of the strip so as to advance it around the carrier. A further object is progression of strip material supported in star pattern on a rotary carrier through a liquid bath so as to effect uniform contact of all the material with the bath over an appreciable number of rotations of the carrier. Still another object is progression of a closed endless length of strip, supported in open width on a rotary carrier partly immersed in a liquid bath, by periodic entrapment and discharge of liquid by pendent portions of the strip. A further object is fluid treatment of fabric in open width and substantially tension free. Other objects of this invention will be apparent from the following discussion and the accompanying diagrams.

Figure 1 is a perspective view of a rotary carrier (not loaded) according to this invention.

Figure 2 is a cross-sectional side view of the apparatus of Figure 1 showing it loaded with one wrap of material at an instant during rotation partly immersed in a liquid bath.

Figure 3 is a cross-sectional side view of another rotary carrier showing it loaded with one wrap of material at an instant during its rotation in the treating direction.

Figure 4 is a similar view of the carrier of Figure 3 showing it being loaded with three separate wraps of material.

Figure 5 is a cross-sectional side view of another modification of rotary carrier loaded with one wrap of material at an instant during its rotation while partly immersed in a liquid bath.

Figure 6 is a side view of mechanism for loading supporting bars shown in juxtaposition to a carrier being loaded.

Figure 7 shows alternative slot patterns and orientations for slot-forming guides holding the various bars of the rotary carriers of this invention.

In a simple form, a rotary carrier of this invention consists of two concentric circularly located sets of horizontal, cylindrical bars with suitable means for holding them in this pattern and for causing them to revolve about the common axis. The composition of the parts of the carrier is not critical so long as the treating fluids to be employed will not attack or corrode it. Stainless steel is preferable, but iron, plastics, wood, and glass may be used.

Conveniently, the carrier comprises two circular flanges mounted on a horizontal axle parallel to each other and perpendicular to it. The opposite ends of each bar are secured in indentations or lateral extensions of the two flanges. Material loaded on the carrier passes over a bar in the outer set, then under a corresponding bar in the set nearer the axle, and over and under succeeding bars in turn. At the starting point, the material is joined end to end to form a complete "wrap," i.e., a closed or endless length.

Here, this sort of configuration of the loaded material will be called a "star" from the appearance it presents from the side, i.e., when viewed in the direction of a line coinciding with the carrier axis which is preferably substantially horizontal. This term is meant to comprehend not only the familiar five- or six-pointed star patterns consisting of ten and twelve straight zigzag lines, respectively, connecting alternate points located on a circle inscribed in the star and on a circle circumscribing the star, but also multipointed figures generally that present a closed zigzagging pattern about a center point. The zigzag lines, which form the star "arms," need not be straight or of the same length throughout any one complete pattern. Inasmuch as the material customarily is loaded somewhat slack, many of the arms commonly are curved. Differences in the arm lengths may be even more pronounced when some of the supporting bars are movable to various positions with respect to the carrier axis. However, a broadly recognizable star-like pattern is apparent in a side view of material once it has been loaded on a carrier according to this invention. Subsequent rotation of the carrier causes the material to shift position in its lengthwise direction so that no portion of it remains in contact with any supporting bar for long. Several novel ways in which this advancing or progression may be brought about are explained below.

The processes of this invention depend upon the transfer of slack existing in material hanging between two or more supporting bars of a rotary carrier to areas between other nearby supporting bars at some time in the rotation cycle. At the end of each complete rotation of the carrier the entire wrap of material will have advanced in position with respect to the supporting bars.

For greater simplicity in construction, operation, and maintenance, the apparatus of this invention is designed to produce this action upon the material being treated.
solely through the effect of gravitational and frictional forces acting during carrier rotation.

A simple form of carrier 7 useful according to this invention appears unloaded in Figure 1. Figure 2 shows a cross-section of this carrier loaded with a wrap of material 1. Axle 5, flanges 3, and outer supporting bars 2 are readily identifiable in both of these drawings. The opposing faces of each of the two flanges and their mirror images, easily observed in the case of rolls 64, one or both of which may be driven to facilitate the unwinding from the beams, which are supported in position by suitable means, such as a rack or carrier (omitted for clarity). The leading ends of the material are held by spring clips 65 around outer bars 66. An inner bar 67 has been released on top of the uppermost strip of material to slide toward the inner end of the slot formed by guide 68. Rotation of the carrier is about to bring the next outer bar 69 into contact with the material. When the next guide 70 passes under the end of the track the waiting bar 71 will be released into the slot. By suitable linkage the releasing of the bars may be synchronized with the carrier rotation so as to make the loading substantially automatic.

The length of material contained in one complete wrap around the carrier is much greater than the circumference of the circle formed by the outer bars, and therein lies one of the great advantages of proceeding according to this invention. Of course, the total length of material in a wrap is a function of the number of supporting bars, as well as of the separation between outer and inner bars. For example, a carrier 6 ft. in diameter with 64 bars in each set loads about 100 yds. of material in each wrap, thus 1000 yds. in ten wraps; one 10 ft. in diameter with 100 bars per set (not at all excessive) would carry three times as much. In the treating of fabric in an open width of several feet, this considerable capacity in equipment of a moderate size is a great advantage. When shorter lengths of material are to be processed, not all the supporting bars need be used, e.g., every second or third inner bar may be bypassed or omitted.

To obviate the necessity of inserting restraining pins or other fastening devices to keep the inner bars from falling out of their guides at subaxial positions, the guides may be so shaped as to curve or bend back toward the main body of the slot so as to retain the bar solely by the action of gravity. Such a guide for the inner bars appears in Figure 1 of Figures 3 and 4, which present another type of carrier according to this invention. As there shown, the guides may form a slot with the shape of a J. When the carrier rotates with the curved part of the J in the forward direction, the bars remain within the curved part. The location of the bars at the various orientations of guide slots is shown in Figure 3. The curve must exceed a half circle by at least the radius of the bar (when the guides are oriented radially) in order to prevent the bar from falling out of the guide before the outer end of the J slot rises above a horizontal line with the S axis at the rising side of the carrier. As shown, the bars merely oscillate back and forth in the curve of the J throughout rotation of the carrier in the treating direction, indicated by an arrow in the diagrams. Of course, even with this type of bar-retaining means, pins or other fasteners may be used also. The J-shaped slot should be so proportioned that it is suitable for use with rotary carriers generally.

The purpose of the reference of the carrier shown in Figures 3 and 4 are explained below. These two figures appear in applicant's patent application Serial No. 289,177, filed May 21, 1952, now abandoned. For all subject matter disclosed in common with that prior copending application, applicant claims the same benefit and effect as though the present application had been filed on May 21, 1952.

When removable inner bars are used in suitable guides,
A carrier can be unloaded easily by severing the loaded material at the junction of the wrap, removing any pins or fastening other material forward, and letting the bars direct down at the lower positions during rotation. Or, pulling on an end of the material will lift the bars out as the material is wound up; this second unloading method works best with strong strip materials extending substantially the width of the carrier so that each inner bar is subjected to the lifting force in turn without appreciably deflecting the material. To remove the bars from J slots in this way, the direction of rotation must be the opposite of the treating direction. If a loading mechanism is employed, it may be lowered to receive the bars as they fall out or be juxtaposed to the carrier to receive bars lifted out by removal of the treated strip under adequate tension.

As shown in the drawings, the amount of slack present in a complete wrap of material on a carrier is at least an appreciable fraction of the greatest separation between a pair of corresponding inner and outer bars in their operating positions. It should not be so great as to cause the material to become fouled about other bars, the axle, or against any housing (not shown) used to retain the treating fluid. The amount of slack necessary to assure positive progression of the treated material around the carrier during rotation varies somewhat with the weight and stiffness of the material and its reaction to the treatment. The amount of slack at any wrap can be determined easily by observing the degree of progression of a number of wraps of several different lengths.

During rotation of carriers of this invention a difference arises in the relative amounts of slack present in portions of the material forming adjacent arms of the star at some location in the pattern, either because of the gravitational movement of some of the supporting bars or because of the action of a liquid bath on the material being treated, or through a combination of these factors. For advancing or progression of the material with respect to the carrier itself, it is necessary that this slack differential be localized at a fixed region, i.e., a locality fixed by reference to a fixed external coordinate system rather than to the rotating carrier itself. In this discussion, the polar coordinates of a clock face are employed for simplicity; thus 12 o’clock means the vertical position above the axle, while 9 o’clock is directly to the left of the axle, and so on. The treating direction is shown in the diagrams as counter-clockwise. This localization of the slack differential results in transfer of slack from one location to another on the rotating carrier itself. One outstanding advantage of this invention is that by subjecting the material to the gravitational and frictional forces arising because of the presence of the material on the carrier are necessary to accomplish this, once rotation has begun.

In the embodiment shown in Figure 2, which is most useful when strip material of appreciable width is treated in a liquid bath in which the carrier is partly immersed, the take-up of slack occurs between about the 3 and 5 o’clock positions, i.e., in the vicinity of the bath level at the rising edge of the carrier. The level of slack take-up may rise or fall somewhat with any change in the bath level 17, which should be high enough so that the lengths of material forming the pattern of the carrier are not parallel to the surface as they leave the bath. Effectiveness of progression with lower bath levels than that shown in Figure 2 may be improved by offsetting the winding pattern to bring the arms of material at the rising edge of the carrier more nearly horizontal at a location below the axis. This may be accomplished by passing each outer bar not to the closest trailing inner bar but to the next inner bar following that or by displacing the inner bars backward about the axis. This has the effect of skewing the star pattern about its axis. When used with removable inner bars, this offset pattern destroys the radial orientation of the guide slots so as to produce the desired angle of offset in the loaded pattern. A suitable orientation of this kind for the guides is shown at A in Figure 7.

The progression of the treated material is shown in Figure 2 by the arrows near the inner bar at about the 4 o’clock position. The effect of this progression is to increase the movement of the material in the direction of rotation of the carrier. As each pair of inner and outer bars leave the bath, the buoyant effect of the bath upon the arm of material supported between them disappears; also the increase in net weight is augmented by presence of some liquid partially trapped on the upper surface of the arm of the material. The submerged arms of the strip are not pulled downward by such forces; consequently the emergent arm sags, pulling slack from the following one. With further rotation, this following arm of material sags also as it leaves the bath, pulling forward slack from the one following it. The arm preceding the most recently emerged arm is not disturbed appreciably because the effective weights of the two are about the same. In one complete rotation of the carrier, the whole wrap shifts forward about the supporting bars by the average amount of slack taken up at each occurrence.

The various arms of the star-like configuration presented by the material, i.e., the portions extending from each two adjacent inner bars around the intermediate outer bar, are denoted in Figure 2 by numbers 21 to 28 inclusive, proceeding clockwise from the vertical at this instant in the rotation of the wrap. But arm 27, 28, 21, 22, 24, and 25 have left the bath in that order; arm 26 is entering the bath; and arms 24 and 25 are mostly submerged. The most recently emerged arm 23 has not yet accumulated as much slack as is present, on the average, in the several immediately preceding arms. As indicated by the arrow at the junction of arm 23 with arm 24, the material is progressing from the latter into the former. Thus, just before arm 24 emerges from the bath, it will be practically taut, having lost its slack to heavier arm 23. With the exception of this localization of slack differential between arms 23 and 24, the amounts of slack present in all the other arms are roughly identical. Of course, gravity pulls the various arms into slightly different configurations, and the resistance presented by the bath to the movement of material through it reflects or bows the arms as they enter (arm 26) and pass through (arm 25) the bath until the slack is removed at a later position (arm 24). Of course, when one arm has partly emerged from the bath, i.e., when the outer bar supporting it is about at the bath level, progression around the outer bar takes place to increase the amount of slack in the upper part of the arm at the expense of the lower or submerged part. With a fairly rapid rotation of the carrier or with a small number of arms in the star pattern, the progression generally occupies more than two arms simultaneously. The simplified discussion can easily be extended to include those situations.

As directional buoyancy of the material is essential to this particular progressing system, a well defined interface must exist between a dense fluid surrounding the lower part of the carrier and a lighter fluid above it. Commonly a liquid is the treating fluid, and the lighter fluid is air or vapor, although two liquid phases having greatly different densities could be used. Of course, when the usual liquid and air system is used the liquid is the treating fluid; however, a treating vapor or gas can be employed above an inert liquid bath. Furthermore, as positive entrapment of liquid gives more definite action than mere drainage along the emergent surface of the material being treated, strips of material if not too sieve-like works best. Successful operation with yarn and like funicular structures is possible, but this process is most advantageous in the processing of fabrics or other strip materials of appreciable width.
used for the inner bars, the curves of the various J's may be placed on two or more concentric circles so as to allow adequate spacing for the curved ends, as shown at 3 in Figure 7. Use of fewer than six or eight bars in each set is not advisable because the large angle this imposes between adjacent arms of material in the star pattern enhances drainage of the liquid from the emergent material, presenting the possibility that the emergent arm will carry enough liquid to weigh much more and thus pull some slack back from the preceding arm, as well as from the submerged one following it. In fact, with a shallow bath and only a few bars in each set the contact angle may be so great that this action may predominate, with the result that the material shifts opposite to the rotation of the carrier, instead of with the direction of rotation. However, the treating of customary lengths of material is an appreciable amount of bath usually suggests the use of several dozen bars per set, reducing the angle so the phenomenon of backward shifting is rare. Of course, net movement in either direction is acceptable for the purpose of progressing the material.

Another carrier embodiment operable with a liquid bath is shown in Figure 5. The carrier 57, which has outer bars 52 capable of little or no radial movement, mounted in flanges 53 carried on axle 55, similar to those of the first bar described above, as well as inner bars 54 held in guides 56 by pins 58, also has a second set of concentrically located bars 50 preferably placed nearer to the outer bars than to the inner ones. These second outer bars cooperate with the first outer bars in supporting a pendent section of material, scooping up an appreciable amount of liquid at the rising side of the carrier. The progressing action of the strip material 51 is obtained through the abrupt discharging of the entrapped pool as rotation of the carrier tends to raise the pool surface above the height of the restraining intermediate bar, which will occur somewhere between about the 5 and 1 o'clock positions. Discharge of liquid from the angle of arc between the bars supporting the pendent portion of wrap, and upon the level of the bath. A second pool of liquid along the preceding arm of material results largely from drainage inward toward the axle so that when the first pool is completely held by the material resting on two cooperating bars spills inward toward the axle, the slack is taken up by a sagging of the preceding arm under the weight of the drainage pool.

At the instant of rotation shown in Figure 5, entrapped outer pool 75 is about to begin spilling over the re-entrant intermediate bar against which the entrapped pendent portion of the material rests. An inner or drainage pool 76 can be seen forming in the preceding inner loop of material. The surface of another entrapped pool 78 can be seen just rising above the bath level 77. Of course, spillage of liquid over the sides of the material occurs continually, both somewhat before and for a time after a pendent portion of material rises above the bath level until the entrapped pool is completely spilt out. In Figure 5, progression of the material about the intermediate and outer bars located between the drainage pool and the entrapped pool is about to occur to further slacken the portion of material in the vicinity of the drainage pool, thus in the direction of rotation of the carrier.

As subsequently formed outer pools are discharged, a progressive shift of the released portions of material occurs in the direction of rotation of the carrier. Liquid in the drainage pool in turn runs off toward the axle as the arm of material along which it collected approaches the vertical, whereupon the slack hangs more or less evenly forward and behind the inner bar. This modification (using a second set of outer bars), which distorts the star-like, greatly considerably, may aid progression, as it is easy to accommodate different liquid levels to the angle of emergent material. The location of the second outer bar may be adjusted for the bath level by mounting each one in elongated guides with pins or other means to secure the bar at selected locations in the slot so formed.

Treatment of fabrics according to this invention is especially advantageous because the only tension present is induced by the weight of the wet or impregnated fabric itself and by frictional forces accompanying its motion around the supporting bars. In particular, where the fabric is submerged in liquid it is substantially tension-free. Unusually even dyeings are secured according to this invention. Stretching or uneven distortion in the fabric is at a minimum, which is often desirable for level dyeing. There is no tendency for strips of fabric to rope up as occurs in the conventional beck, nor to wind into creases as in a jig.

The carrier shown mainly in Figures 3 and 4 does not have to be operated in a split-density medium to bring about progression of the material being treated; therefore, it is useful with gaseous fluids or finely divided liquids, as well as with liquid baths. For example, it may be employed in steam heating materials or spraying them with liquid droplets, and thus it can accomplish a broad range of fabric finishing in addition to dyeing.

During rotation of the loaded carrier 37, as shown in Figure 5, the slack differential occurs on the falling, rather than the rising side of the bars next to the inner bars 34 held at the ends by indentations or protuberances of the flanges 39. Collars 41 near the ends of the bars next to the outer bars are held at the ends by indentations or protuberances on the flanges 39. Additional collars (not shown) spaced on the bars may be used to separate wraps of material loaded side by side. The outer extremity of the Y path, i.e., the "base" of the Y, may abut on the periphery of the flange so as to permit removal of the outer bar if desired, but in this case suitable retaining means, such as a pin 38 inserted in aperture 42, customarily will block the exit during treatment. The action of the inner bars does not differ from that described above, and the movement of the outer bars under the influence of gravity is the primary cause of progression.

With the configuration of Y shown in Figure 3, in which the secondary branch 45 makes an angle of about 60° with the primary branch 44, trailing it during the treatment rotation of the carrier about its axis it will be clear that once an outer bar is in a secondary branch, it will remain at the end of that branch until about the 10 o'clock position. At this point in the rotation of the carrier the outer bar will roll or slide into the primary branch or body of the Y and thence to the end nearest the axle, slackening the material supported by it. Arrows about the outwardly falling outer bar at about the 4 o'clock position and the stationary trailing inner bar at about the 3 o'clock position indicate the progression of the material. Upon further rotation of the carrier, a preceding outer bar will move outward toward the base 43 of its Y path, taking up the slack released by this following bar. Similarly, each outer bar in turn releases slack in the wrapped material and then takes up slack released by a subsequently inwardly falling bar, shifting the material around the carrier in the direction of rotation.

The guides defining the path for the outer bars to move in should permit some movement from one position to a position nearer the axle, but a wide variety of path shapes is suitable. One that is describable by the term Y is useful because it provides three well-defined rest positions for the bar. However, the base or one of the branches of the Y may be eliminated to render the branched path more convenient. Examples of suitable alternative shapes appear at C and D in Figure 7. As suggested by C, a mere recess constituting a
trailing branch large enough to retain the bar until it reaches a point between about the 3 and 11 o'clock position, or the 12 o'clock position is passed is adequate. Thus, under preferred operating conditions, the carrier turns through an arc of at least 270° while any outer bar is near the periphery of its path. The interval between release and take-up of slack may be decreased by lessening the inward angle between the branches or may be decreased by making the angle greater. A small angle of the bar is desirable with large numbers of bars because it tends to localize the progression about only one or, at most, a few bars.

As with all the embodiments, when a great many bars are used, the progression usually will take place over a number of bars simultaneously. When treating several wraps of relatively impermeable material, spacer bars 47 may be desirable to separate the adjacent wraps, inserted preferably in the slots carrying the outer bars because this is the treating region when liquid baths are used. The spacer bars may be small enough in diameter to pass through a constriction present at the base of the Y for preventing the outer bars from escaping.

Figure 4 illustrates the loading of this carrier with three wraps of material illustrated as solid, dashed, and dot-dashed lines with two spacer bars in each Y slot to separate them. No special retaining means is required to keep the spacer bars in the carrier because each outer bar traps the accompanying spacer bars from the time of the first downsweep until the direction of rotation is reversed for unloading, but pins may be inserted to block the exit if desired. The material progresses in the direction of rotation during the treatment, but it can be made to go in the opposite direction by altering the design shown. Permanent slots are inserted preferably in the exit and J pattern or fixed locations near the outside edge of the flanges. Backward rotation will accompany a sufficient decrease of the arc through which the carrier turns from takeup to release of slack at the same location on the carrier. Progression in either direction is acceptable.

Scouring and desizing, as well as dyeing are promoted by the vigorous motion of the open width of fabric within the treating bath according to this invention. The housing for the treating fluid may completely enclose the carrier so that superatmospheric pressure and accompanying high temperature may be employed, which is particularly useful in dyeing synthetic fibers. Many other uses that do not depart from the invention will be apparent. Furthermore, many structural modifications falling within the scope of this invention beyond those illustrated can be visualized readily by anyone having ordinary skill in the art.

What is claimed:

1. The process comprising forming a closed length of flexible material into a zig-zag pattern substantially symmetrical about a point, moving the material about the point with a composite motion including rotation about the point and progression within the pattern about the point, the flexible material being slackened at intervals within the pattern and simultaneously exposing the material to a treating fluid.

2. The process comprising forming a length of flexible material into an endless wrap in a zig-zag pattern substantially symmetrical about a point, placing bars in slots with respect to the wrapping configuration by the wrap, exposing part of the material to treating liquid, and progressing the material within the pattern about the point while substantially maintaining the symmetry, the flexible material being slackened at intervals within the pattern and thereby bringing all the material into uniform contact with the treating liquid.

3. The process comprising forming a length of flexible material into a closed zig-zag pattern, exposing the material to treating fluid, and progressing the material within the pattern by gravitational pull of the wet material emerging from the treating fluid, while rotating the material about a point surrounded by the pattern.

4. The process comprising supporting a closed wrap of flexible material loosely so as to form it into the pattern of a star, rotating the wrap about the center of the star, and progressing successive portions of the wrap lengthwise along the arms of the star, and simultaneously exposing the material to treating fluid over at least part of the path of the material, whereby all the material comes into essentially the same total contact with the fluid.

5. The process comprising supporting a closed wrap of flexible material loosely so as to form it into the pattern of a star in a vertical plane, rotating the wrap about the center of the star, localizing a slack portion of the wrap in one arm of the star, transferring the slack to an adjacent arm of the star, and retransferring the slack to successive arms of the star so that the wrap progresses lengthwise around the star, and applying a treating fluid to the moving material.

6. The process of claim 5 in which the wrap is partly immersed in a liquid bath, and localization and transfer of slack to progress the wrap are accomplished without entrapment of liquid by gravitationally induced sagging at each portion of the wet wrap upon emergence from the bath during rotation.

7. The process of claim 5 in which the material is in the shape of a wide strip, the wrap is partly immersed in a liquid bath, and localization and transfer of slack to progress the wrap are accomplished by entrapment of pools of liquid by pendent portions of the wrap upon emergence from the bath followed by abrupt gravitationally induced discharging of each pool soon after its formation.

8. The process of claim 5 in which localization and transfer of slack to progress the wrap are accomplished by gravitationally induced movement of supports for the wrap during rotation, and fluid is applied to the progressing and rotating wrap.

9. The process comprising supporting a closed wrap of flexible strip material in open width over and under parallel horizontal outer and inner bars respectively so as to form the wrap into the pattern of a star when viewed parallel to the supporting bars, revolving the supporting bars about the center of the star to rotate the wrap continuously, and immersing the wrap partly into a liquid bath so that the increased buoyancy of the submerged portion of the wrap and symmetrical presence of liquid on an emergent portion of the wrap sags the emergent portion, pulling some of the submerged portion out of the liquid, whereupon repetition of this pulling by successive emergent portions of the wrap at the expense of following submerged portions of the wrap causes the wrap to progress lengthwise around the bars and along the arms of the star during rotation so that all portions of the wrap contact the bath equally.

10. The process comprising supporting a closed wrap of flexible strip material in open width over and under intermediate and inner bars and under inner bars, all of which are horizontal and parallel to each other, so as to form the wrap into the pattern of a star when viewed parallel to the bars, revolving the bars about the center of the star to rotate the wrap continuously, and immersing the wrap partly into a liquid bath so that each pair of outer and intermediate bars, upon emerging from the bath, support a pendent portion of the wrap with a pool of liquid trapped on it and, as rotation continues, spilling out the pool of trapped liquid and allowing the pendent portion of the wrap to be tautened by the weight of a drainage pool of liquid collected along a preceding portion of the wrap supported between intermediate and inner bars in a preceding arm of the star, whereupon repetition of this discharging of a pool of liquid by an emerging pendent portion of the wrap and subsequent tautening of the pendent portion by the weight of a drainage pool collected on a preceding portion of the wrap causes the wrap to progress lengthwise around the bars and along the arms of the star.
star during rotation so that all portions of the wrap contact the bath equally.

11. The process comprising supporting a closed wrap of flexible strip material over and under parallel horizontal outer and inner supporting bars respectively so as to form the wrap into the pattern of a star when viewed parallel to the supporting bars, revolving the supporting bars about the center of the star to rotate the wrap continuously, periodically releasing an outer bar from its original position to a position nearer the axis of rotation to slacken a portion of the wrap, returning a previously similarly released outer bar to its original position to take up an amount of wrap from said slackened portion, releasing and returning outer bars in turn so as to progress the wrap around all the supporting bars concurrently with the rotation of the wrap around the center of the star as bars revolve, and applying a treating fluid to the progressing and rotating wrap of strip material whereupon all portions of the wrap contact the fluid equally.

12. Rotary apparatus comprising a horizontal axle, a plurality of bars, flanges spaced apart perpendicular to the axle, retaining means for holding half of the bars (in number) evenly spaced against the flanges in substantially a circle concentric with the axle near the axle, slot-forming guides affixed to the flanges near the periphery of the flanges to accommodate the other half of the bars in a branched path.

13. Rotary apparatus comprising a horizontal axle, a plurality of mounting means for holding bars parallel to the axle, a plurality of first slot-forming guides evenly spaced apart affixed to the mounting means and extending from the periphery of the mounting means to curve near the axle in a J configuration for accommodating bars inserted in the guide means from the periphery, an equal plurality of second slot-forming guides evenly spaced apart affixed to the mounting means extending from near the periphery of the mounting means in a branched-path configuration for accommodating additional bars.

14. The apparatus improvement of claim 13 in which each guide means is oriented non-radially.

15. Rotary apparatus comprising a horizontal axle, mounting means perpendicular to and separated by the axle, retaining means for holding a plurality of horizontal bars near the periphery of the mounting means and in substantially a circle concentric with the axle, slot-forming guides extending from the periphery of the mounting means to points nearer the axle than said retaining means and for holding another plurality of horizontal bars.

16. The apparatus of claim 15 in which the slot-forming guides are curved near the axle so that rotation of the apparatus in the direction of the curve will confine movable bars positioned in the guides to the curved extremities of the guides near the axle.

17. The rotary apparatus of claim 15 in which each of the slot-forming guides has a J shape when viewed perpendicular to the face of the mounting means, the hook of the J being nearer the axle.

18. The rotary apparatus of claim 15 wherein the retaining means is shaped to form a branched path for permitting reciprocation of the bars during rotation of the carrier.

Rotary apparatus comprising an axle, rotatable carrying means mounted on said axle, a plurality of first retaining means on said carrying means spaced evenly on a first circle concentric with the axis of rotation, a plurality of removable first elongated means supported by said first retaining means, a plurality of second retaining means on said carrying means spaced evenly in a second circle concentric with the axis of rotation, a plurality of second elongated supporting means supported by said second retaining means, a plurality of third retaining means mounted on said carrying means spaced evenly in a third circle concentric with the axis of rotation, lying between the other two circles and nearer the second or outer circle, and an equal plurality of third elongated supporting means supported by said third retaining means, each of said plurality of supporting means being held in parallel relationship to the axle and each other.

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