

June 9, 1931.

F. S. SMITH

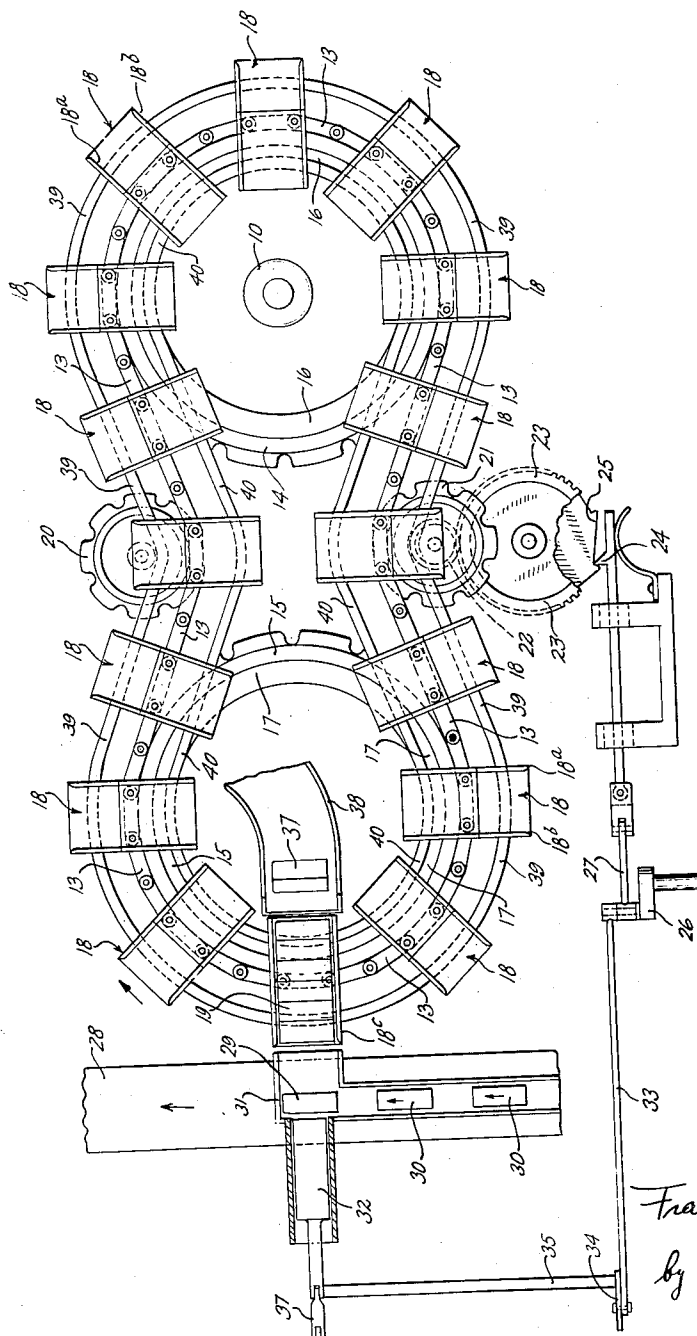
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APPARATUS FOR TREATING ARTICLES WITH X-RAYS

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Fig. 1.



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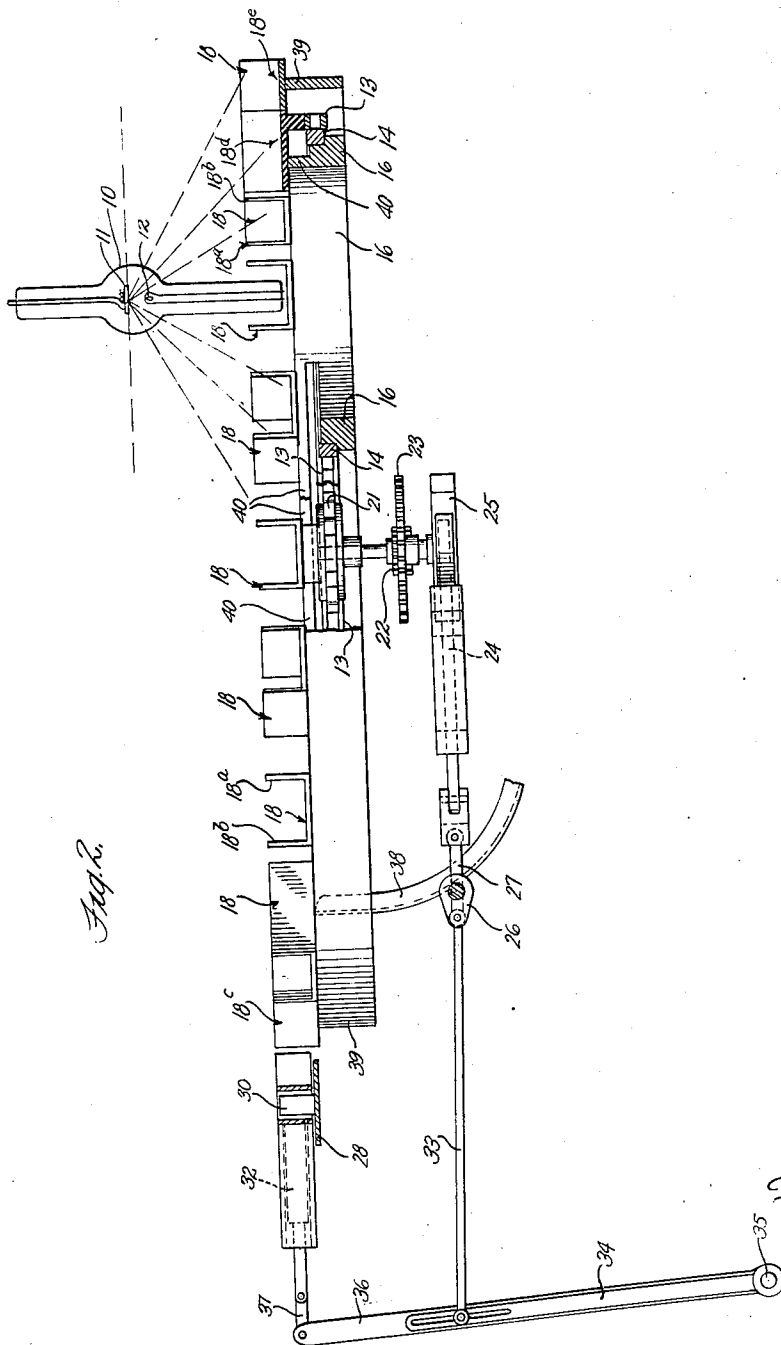
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UNITED STATES PATENT OFFICE

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APPARATUS FOR TREATING ARTICLES WITH X-RAYS

Application filed August 2, 1928. Serial No. 296,981.

This invention relates to X-ray apparatus and more particularly to an apparatus for subjecting articles to X-rays for purposes of sterilization.

5 One of the objects of this invention is to provide a simple and thoroughly practical apparatus for effecting, at high speed of operation, low cost, and with thoroughly effective results, the sterilization by X-rays of articles such as packaged tobacco products, food products, and the like. Another object is to provide an apparatus well adapted for quantity treatment of articles to X-rays in order to effect a destruction of the eggs, larvæ and pupæ of insects or bugs, or by destroying the insects or bugs themselves, and which is capable of embodiment in thoroughly practical and durable form and which will be of thoroughly reliable and dependable action. Another object is to provide an apparatus of the above-mentioned nature in which a highly efficient use is made of the available X-ray beam from an X-ray tube and in which the varying intensities of the X-ray beam may be effectively utilized to effect sterilization. Another object is to provide an apparatus of the above-mentioned nature particularly adapted for the handling, and treatment with X-rays, of packaged goods like packaged cigars, tobacco, cigarettes, and the like. Another object is to provide an apparatus of the above-mentioned nature well adapted to meet the varying conditions of hard practical use. Other objects will be in part obvious or in part pointed out hereinafter.

The invention accordingly consists in the features of construction, combinations of elements, and arrangements of parts as will be exemplified in the structure to be hereinafter described and the scope of the application of which will be indicated in the following claims.

45 In the accompanying drawings, in which are diagrammatically illustrated a possible embodiment of the mechanical features of my invention,

50 and Figure 1 is a plan view of the apparatus,

Figure 2 is a front elevation, certain parts being shown in section in order to show certain features of the construction more clearly.

Similar reference characters refer to similar parts throughout the several views of the drawings.

Referring now to the drawings, there is shown at 10 an X-ray tube preferably mounted with its axis extending substantially vertically and with its anode 11, from which the X-rays emanate, uppermost and having its active face extending substantially transversely to the vertical axis of the X-ray tube 10. The X-ray tube may conveniently be of the hot cathode tube and may therefore have as a cathode a filament 12, as is more clearly shown in Figure 2. The X-ray tube 10 may be energized from any suitable source of energy and may be insulatingly supported by any suitable means (not shown).

With the X-ray tube thus constructed and mounted, as shown in Figure 2, the X-rays emanating from the anode 11 are directed in a general downward direction and will extend over a range substantially 90° to each side of the vertical axis of the X-ray tube, as is diagrammatically indicated in Figure 2. The intensity of the X-ray beam in a horizontal plane, as viewed in Figure 2, will thus vary progressively with the distance from the anode 11 and, in a broader sense, the intensity will vary with the distance from the vertical axis of the X-ray tube 10.

Referring now to Figure 1, there is shown at 13 a flexible endless member, conveniently in the form of a link chain and passing about the sprockets 14 and 15 appropriately mounted to rotate about substantially vertical axes. These sprockets 14 and 15 may conveniently be of a generally annular shape, as is clearly indicated in Figure 1, and may be rotatably supported by the members 16 and 17 respectively. The members 16 and 17 are also of annular shape in order thereby to make available the space within the sprockets 14 and 15 and the members 16 and 17 may be of any suitable construction.

tion to provide appropriate bearings or bearing surfaces to take care of not only the rotation of the sprockets but also to take care of the thrust in a downward direction of the sprockets 14 and 15 and the load carried thereby.

The flexible endless member 13, hereinabove noted as being preferably in the form of a chain, has secured to it and spaced lengthwise thereof a number of carriers 18; these carriers, forming in general a series of successive platforms, may be attached to the chain 13 by any suitable construction. The carriers 18, as will be clear from Figure 1, extend transversely of the chain 13 and are shaped to provide front and rear flanges 18a and 18b, being thereby better adapted to hold a series of articles or packages arranged face to face across the carriers 18, as is indicated by the series of packages at 19. The lateral end portions of the carriers 18 are preferably unrestricted and left open.

Intermediate of the two spaced sprockets 14 and 15, and engaging the chain 13 from the outer face thereof, are two sprockets 20 and 21, positioned so that, as is clear from Figure 1, the chain 13 may be made more completely to wrap itself about the sprocket 14. The sprocket 20 may be an idler while, in order to effect a movement of the chain 13 with its carriers 18, the sprocket 21 is preferably driven from any suitable source of power. Preferably, the drive of the sprocket 21 is intermittent and is of such a nature that the chain 13 is intermittently advanced along its path of travel by a distance substantially equivalent to the effective distance between any two adjacent carriers 18, the latter being preferably equidistantly spaced along the chain 13.

The X-ray tube 10 is mounted, as will be clearly seen from the drawings, so that its axis is preferably substantially coincident with the axis of the sprocket 14. Accordingly, as the carriers 18 are progressively brought by the chain 13 into a relation overlapping the sprocket 14, the carriers 18 assume positions such that they extend in a direction substantially radially toward the X-ray tube 10 and hence toward the axis of the X-ray beam emanating from the anode 11.

As diagrammatic merely of a possible mechanism for intermittently moving the endless carrier bearing chain 13, I have illustrated the sprocket 21 as being provided with a coaxial gear 22 adapted to mesh with and be driven by a larger gear 23. The larger gear 23 is in turn driven by the pawl 24 coacting with a ratchet 25, the latter being mounted in any suitable way to rotate the gear 23 therewith. The pawl 24 may be given a reciprocating movement by any suitable mechanism and may conveniently be reciprocated by a crank 26, driven from any

suitable source of power, and connected to the pawl 24 by the connecting rod 27.

As the crank 26 is rotated, the pawl 24, when moving to the left as viewed in Figure 1, advances the ratchet 25 sufficiently to effect such a rotation of the sprocket 21, by the interposed speed change gearing, as to bring about a movement of the carrier bearing chain 13 by a distance substantially equivalent to the effective spacing between adjacent carriers 18. As the pawl 24 moves to the right, as viewed in Figure 1, the carrier chain 13 remains at rest.

Suitably positioned adjacent the path of travel of the carriers 18 and at substantially the same height as the latter (see Figure 2) is a conveyor belt 28 driven in any suitable manner in the direction of the arrow shown on Figure 1 and at an appropriate speed. The conveyor belt 28 is adapted to transport the articles to the apparatus above described, and in Figure 1 a number of such articles or packages are indicated at 29 and 30. Extending across the conveyor belt 28 is a stop 31 positioned so that an article, such as the article 29, carried by the belt will be halted by the stop 31 at such a position that, when the carrier bearing chain 13 halts, one of the carriers indicated at 18c will be positioned adjacent the conveyor belt 28 and so that the article 29 thus stopped will be substantially aligned with respect to the front and rear flanges 18a and 18b of the carrier 18c. During this interval of stoppage of the carrier bearing chain 13, a plunger 32 moves in a direction toward the axis of the sprocket 15 and moves the article 29 from the conveyor belt 28 onto the halted carrier 18c.

Any suitable mechanism may be employed for operating the plunger 32 in timed relation with respect to the remaining apparatus. As diagrammatically illustrative of such a mechanism, the plunger 32 may be operated from the crank 26. Thus, for example, a connecting rod 33, connected at one end to the crank pin of the crank 26, may effect through the lever 34 an oscillation about its axis of the shaft 35 which extends toward the plunger 32; adjustably secured to the oscillating shaft 35 is a lever 36 connected through the link 37 to the plunger 32. Thus, as the pawl 24 is making its stroke in a direction toward the left, the plunger 32 is withdrawn into the position shown in Figure 1, permitting the package 29 to be carried up against the stop 31. Upon the subsequent movement of the pawl 24 to the right, and during which movement the carrier bearing chain 13 is at rest, the plunger 32 is moved toward the right, as viewed in Figure 1, and transfers the package 29 from the belt 28 onto the carrier 18c thus halted in alinement therewith.

This movement of the plunger 32, acting

to add the package or article 29 to the left-hand end of the series 19 of articles, also acts to effect a movement of the entire series 19 of the articles on the halted carrier 18c but in a direction across the carrier 18c and transversely of the carrier bearing chain 13. The movement necessary to thus position the added package 29 onto the halted carrier, in thus effecting a movement of the entire series of articles, effects the discharge of the article at the other end of the carrier thus being loaded. An article thus being discharged from the carrier is indicated at 37.

The discharged article 37 drops into a chute 38 or other appropriate conveying device, and guides the package away.

As the carriers 18 are thus intermittently moved about the axis of the X-ray tube 10, each will be seen to be supporting a complete series of substantially aligned articles, between the front and rear flange members 18a and 18b. The length of the carriers 18 in a direction transversely of the carrier bearing chain 13 is preferably such that the series of articles carried thereby into the range of the X-ray beam emanating from the X-ray tube 10 will be so positioned that the innermost article of the series will be in the closest possible proximity to the anode 11 or the vertical axis of the beam of X-rays therefrom while the outermost article or package of the series will be more distant therefrom but nevertheless within effective range of those portions of the X-ray beam which are of lesser intensity. However, each time that the carriers are halted so that the innermost package (for instance the article or package 37) of a single series on a carrier (already subjected to the most intense portions of the X-ray beam) is discharged from the carrier, the remaining packages of the series on the carrier are advanced inwardly by a distance substantially equivalent to the width or thickness of a package, while a new or untreated package (like the package 29) is given a position outermost of the series on the carrier.

This readjusted series of articles with a new article added thereto is thereupon passed into the X-ray beam and each article that had previously been passed through the X-ray beam during a preceding cycle of operation is now positioned to be subjected to more intense portions of the X-ray beam.

Thus, the repeated movement of the carriers 18 through the X-ray beam is accompanied by a progressive movement of the articles carried thereby into progressively more intense portions of the X-ray beam, and thus all portions of the X-ray beam, even though of varying intensity, are effectively utilized in bringing about a sterilization of the products carried upon the carriers 18. Furthermore, each article will be

seen to be repeatedly subjected to the X-rays, while at the same time the wide expanse of the X-ray beam is most effectively made use of in that a large number of articles or packages to be treated are continuously within its scope or range.

Because of the relatively high potentials that may be employed in operating the X-ray tube 10, the carriers 18 are preferably constructed so that the inner half portions, indicated at 18d in Figure 2, are made of a solid dielectric material, such as hard rubber, bakelite, or the like, the outer half portions, indicated at 18e and which are not brought within such close proximity to the X-ray tube as are the inner half portions, are preferably made of any suitable metal. Also, any suitable and appropriate guides or supports along which the carriers 18 may slide as they are moved by the carrier-chain 13 may be employed; such supports are indicated diagrammatically at 39 and 40.

It will thus be seen that there has been provided by this invention an apparatus in which the several objects of this invention, as well as many thoroughly practical advantages, are successfully achieved. It will be seen that the apparatus is of a thoroughly practical nature, is well adapted for highly efficient sterilization action by the X-rays and is, moreover, capable of high speed of operation.

As many possible embodiments may be made of the above invention and as many changes might be made in the embodiment above set forth, it is to be understood that all matter hereinbefore set forth or shown in the accompanying drawings, is to be interpreted as illustrative and not in a limiting sense.

I claim as my invention:

1. In apparatus of the character described, in combination, an X-ray tube mounted with its axis substantially vertical and having an anode whose active face extends transversely to said axis, a member having a plurality of carriers thereon and movable substantially about the vertical axis of said X-ray tube, said carriers extending in a direction toward the axis of said X-ray tube and each adapted to support a series of packages substantially aligned so that successive packages of each series are at greater distances from the axis of said X-ray tube, means for intermittently advancing said member by a distance substantially equivalent to the effective spacing between adjacent carriers, and means operative at substantially each stoppage of said member for adding a package to the series of packages on one of said carriers and for correspondingly advancing said series of packages thereon to cause an end package thereof to be discharged from said carrier.

2. In apparatus of the character described, in combination, an X-ray tube mounted with its axis substantially vertical and having an anode whose active face extends transversely to said axis, a member
 5 having a plurality of carriers thereon and movable substantially about the vertical axis of said X-ray tube, said carriers extending in a direction toward the axis of said X-ray
 10 tube and each adapted to support a series of packages substantially aligned so that successive packages of each series are at greater distances from the axis of said X-ray tube, means for intermittently advancing
 15 said member by a distance substantially equivalent to the effective spacing between adjacent carriers, means forming a source of supply of packages, and means governed by the intermittent movement of said mem-
 20 ber for transferring a package from said last-mentioned means to one of said carriers and to thereby effect a movement of the series of packages on the latter sufficient to cause the end package of said series to
 25 be discharged from said carrier.

3. In apparatus of the character described, in combination, a pair of spaced rotary members each mounted to rotate about a substantially vertical axis, a flex-
 30 ible member about said rotary members and provided with a plurality of spaced carriers, each adapted to support a series of substantially aligned packages extending in a direction toward the axes of said members,
 35 an X-ray tube positioned substantially centrally with respect to one of said rotary members, whereby the packages on said carrier are brought within range of X-rays from said tube, and means for periodically
 40 adding a package to the series on a carrier and adapted to advance said series by a distance sufficient to discharge an opposite end package from said carrier.

4. In apparatus of the character described, in combination, a pair of spaced rotary members each mounted to rotate about a substantially vertical axis, a flexible member about said rotary members and provided with a plurality of spaced carriers,
 50 each adapted to support a series of substantially aligned packages extending in a direction toward the axes of said members, an X-ray tube positioned substantially centrally with respect to one of said rotary members,
 55 whereby the packages on said carrier are brought within range of X-rays from said tube, means for intermittently advancing said flexible member thereby to effect a repeated passage of said carriers about said
 60 X-ray tube, and intermittently operative means adapted to advance the series of packages on a carrier by a distance sufficient to effect the discharge of an end package therefrom.

5. In apparatus of the character described,

in combination, a pair of spaced rotary members each mounted to rotate about a substantially vertical axis, a flexible member about said rotary members and provided with a plurality of spaced carriers, each
 70 adapted to support a series of substantially aligned packages extending in a direction toward the axes of said members, an X-ray tube positioned substantially centrally with respect to one of said rotary members,
 75 whereby the packages on said carrier are brought within range of X-rays from said tube, means positioned within the periphery of the other rotary member adapted to receive packages as they are discharged from
 80 said carriers, and means operative upon a carrier while the latter is passing about said other-mentioned rotary member for positioning a package at the outer end of the series of packages upon a carrier and
 85 for advancing said series in a direction toward the center of said rotary member by a distance sufficient to cause the inner end package to be discharged into said receiving means.

6. In apparatus of the character described, in combination, an X-ray tube, means having a carrier adapted to support a series of substantially aligned articles thereon and movable in a path to repeatedly
 90 bring said carrier into the range of X-rays emanating from said tube, said carrier being adapted to support said series of articles aligned in a direction transversely of the path of movement of said carrier, and means
 95 adapted to progressively advance said series of articles crosswise of said carrier.

7. In apparatus of the character described, in combination, an X-ray tube, means having a carrier adapted to support a series of substantially aligned articles thereon and movable in a path to repeatedly bring said carrier into the range of X-rays emanating from said tube, said carrier being adapted to support said series of articles aligned in a direction transversely of the path of movement of said carrier, and means operative at each complete cycle of movement of said carrier past said X-ray tube to effect a movement of said series of articles relative to said carrier and in a direction transversely of the path of movement thereof.

8. In apparatus of the character described, in combination, an X-ray tube, means having a carrier adapted to support a series of substantially aligned articles thereon and movable in a path to repeatedly bring said carrier into the range of X-rays emanating from said tube, said carrier being adapted to support said series of articles aligned in a direction transversely of the path of movement of said carrier, and means for adding an article to the series of articles on said carrier and adapted to move said series of articles relative to said carrier and in a

direction substantially transversely of the path of movement of the carrier.

9. In apparatus of the character described, in combination, an X-ray tube, means having a carrier adapted to support a series of substantially alined articles thereon and movable in a path to repeatedly bring said carrier into the range of X-rays emanating from said tube, said carrier being adapted to support said series of articles alined in a direction transversely of the path of movement of said carrier, means governed by the complete cyclic movement of said carrier past said X-ray tube adapted to add a package to one end of the series of packages on said carrier and adapted simultaneously to advance said series in the direction in which the articles are alined, thereby to cause an opposite end package to be discharged from said carrier.

10. In an apparatus of the character described, in combination, an X-ray tube, means having a carrier adapted to support a series of substantially alined articles thereon and movable in a path to repeatedly bring said carrier into the range of X-rays emanating from said tube, said carrier being adapted to support said series of articles alined in a direction transversely of the path of movement of said carrier, a platform positioned adjacent the path of travel of said carrier, means operative each time that said carrier passes said platform for transferring an article from the platform to the end of the series of articles on said carrier and thereby to effect a movement of said series of articles relative to said carrier by a distance sufficient to cause the opposite end article to be discharged from said carrier, and means for receiving an article discharged from said carrier.

11. In apparatus of the character described, in combination, an X-ray tube, movable means provided with a plurality of carriers and extending transversely of the path of movement thereof, guiding means for said movable means adapted to guide the latter past said X-ray tube and with said carriers extending in a direction toward said X-ray tube, means for intermittently advancing said movable means by a distance substantially equivalent to the effective spacing between said carriers thereon, and means effective at substantially each stoppage of said movable means for moving an article onto a carrier and thereby advancing an article already on said carrier transversely of the latter.

12. In apparatus of the character described, in combination, an X-ray tube, movable means provided with a plurality of carriers and extending transversely of the path of movement thereof, guiding means for said movable means adapted to guide the latter past said X-ray tube and with said

carriers extending in a direction toward said X-ray tube, said carriers being adapted each to support a series of articles alined thereon in a direction substantially transversely of said path of movement, and means for progressively advancing the articles on a carrier relative thereto and in a direction substantially transversely of the path of movement of said carrier.

13. In apparatus of the character described, in combination, an X-ray tube, movable means provided with a plurality of carriers and extending transversely of the path of movement thereof, guiding means for said movable means adapted to guide the latter past said X-ray tube and with said carriers extending in a direction toward said X-ray tube, said carriers being adapted each to support a series of articles alined thereon in a direction substantially transversely of said path of movement, and means successively adding an article to the series carried by said carriers and adapted to advance said series relative to said carrier by a distance sufficient to cause the discharge of an end article from a carrier.

14. In apparatus of the character described, in combination, an X-ray tube, movable means provided with a plurality of carriers and extending transversely of the path of movement thereof, guiding means for said movable means adapted to guide the latter past said X-ray tube and with said carriers extending in a direction toward said X-ray tube, said carriers being adapted each to support a series of articles alined thereon in a direction substantially transversely of said path of movement, means for intermittently moving said movable means with said carriers, means forming a supply of articles, and means operative at a stoppage of said movable means for transferring an article from said supply means to a carrier.

15. In apparatus of the character described, in combination, an X-ray tube, movable means provided with a plurality of carriers and extending transversely of the path of movement thereof, guiding means for said movable means adapted to guide the latter past said X-ray tube and with said carriers extending in a direction toward said X-ray tube, said carriers being adapted each to support a series of articles alined thereon in a direction substantially transversely of said path of movement, a conveyor belt positioned adjacent the path of travel of said carriers, and means for transferring an article from said conveyor belt onto a carrier and adapted to advance the series of articles on said carrier by a distance sufficient to effect a discharge of an end article of said series from said carrier.

16. In apparatus of the character described, in combination, an X-ray tube, mov-

able means provided with a plurality of carriers and extending transversely of the path of movement thereof, guiding means for said movable means adapted to guide the latter past said X-ray tube and with said carriers extending in a direction toward said X-ray tube, said carriers being adapted each to support a series of articles alined thereon in a direction substantially transversely of said path of movement, a conveyor belt adjacent the path of travel of said carriers, means for intermittently advancing said movable means with said carriers and adapted thereby to successively halt said carriers adjacent said conveyor belt, and means operative at each halting of said carriers for transferring an article from said belt to a carrier.

17. In apparatus of the character described, in combination, an X-ray tube, an endless carrier means movable in a path to carry an article supported thereon within the range of the X-ray emanations from said X-ray tube, said carrier means having a width greater than the width of the article supported thereon, and means for effecting a movement of an article on said carrier means in a direction substantially transversely of the latter, thereby to subject said article to a range of intensities of X-ray emanations.

18. In apparatus of the character described, in combination, an X-ray tube, an endless carrier means movable in a path to carry an article supported thereon within the range of the X-ray emanations from said X-ray tube, said carrier means having a width greater than the width of the article supported thereon, and means operative in timed relation with respect to the movement of said carrier means for effecting a movement of an article thereon in a direction substantially transversely of the path of movement of said carrier means.

19. In apparatus of the character described, in combination, an X-ray tube, an endless carrier means having a path of travel past said X-ray tube and having a width in a direction transversely of its path of movement sufficient to support thereon a series of packages substantially alined transversely thereof, and means for effecting movement of packages on said carrier means in a direction transversely thereof.

20. In apparatus of the character described, in combination, an X-ray tube, an endless carrier means having a path of travel past said X-ray tube and having a width in a direction transversely of its path of movement sufficient to support thereon a series of articles substantially alined transversely thereof, and means for moving an article onto said carrier mean to be added to a series of articles thereon and adapted to effect a movement of said series of articles trans-

versely of said carrier means, thereby to effect a discharge of the opposite end article of said series from said carrier.

21. In apparatus of the character described, in combination, an X-ray tube, an endless carrier means having a path of travel past said X-ray tube and having a width in a direction transversely of its path of movement sufficient to support thereon a series of articles substantially alined transversely thereof, means forming a platform adapted to hold an article and positioned adjacent the path of movement of said carrier means, and a plunger operating in timed relation with respect to the movement of said carrier means adapted to move an article from said platform onto said carrier and adapted thereby to effect a movement of a series of articles on said carrier in a direction transversely of the latter.

In testimony whereof, I have signed my name to this specification this 18th day of July, 1928.

FRANKLIN S. SMITH.