July 28, 1931. V. FIORUZZI 1,816,368

APPARATUS FOR BREEDING SILKWORMS

Filed June 22, 1926 8 Sheets-Sheet 1

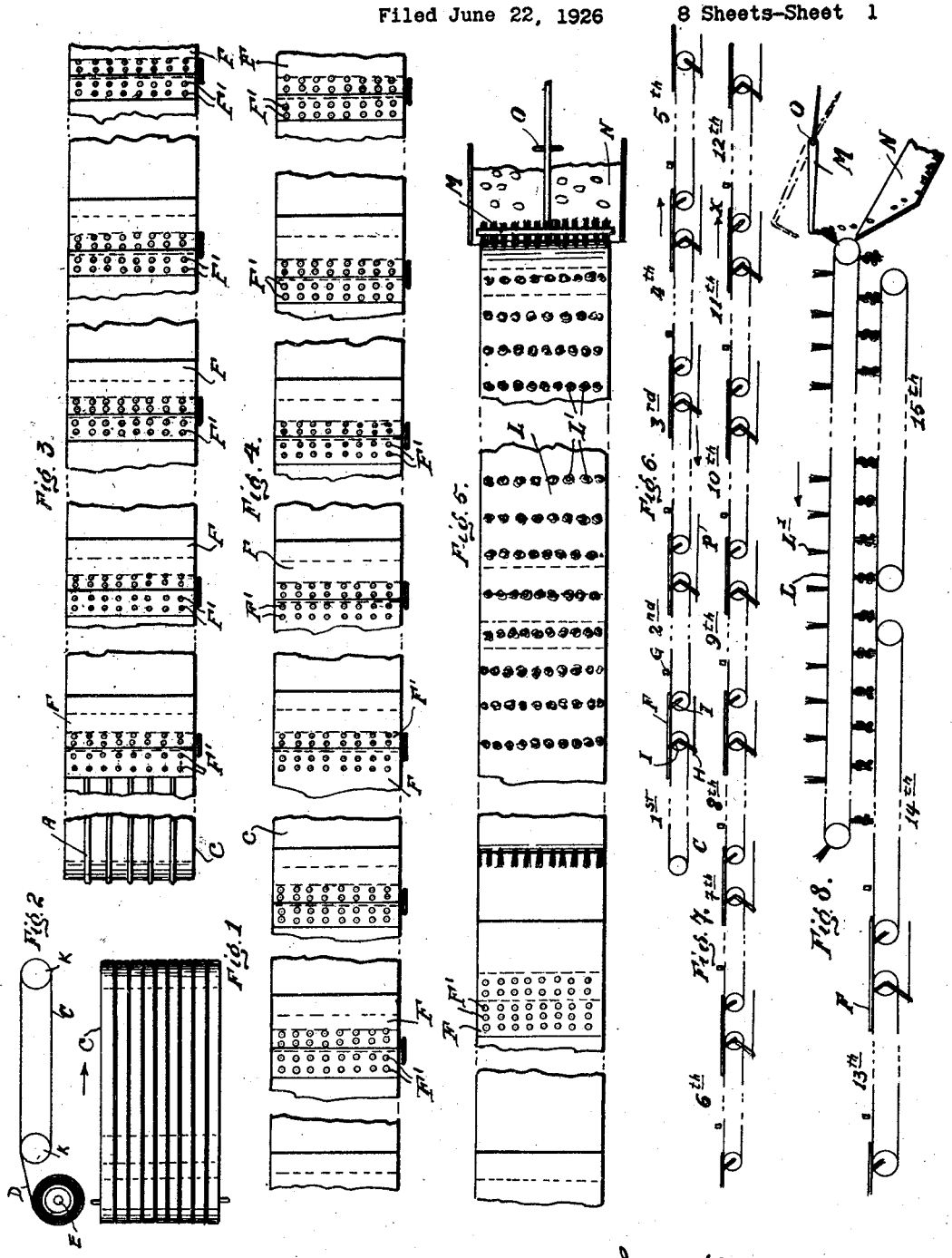

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Fig. 9.

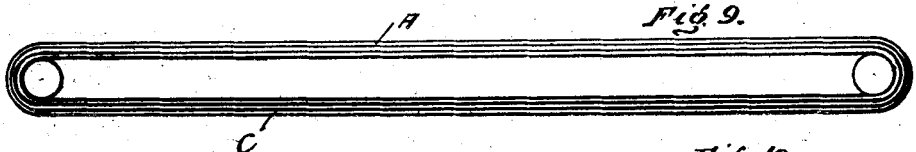


Fig. 10.

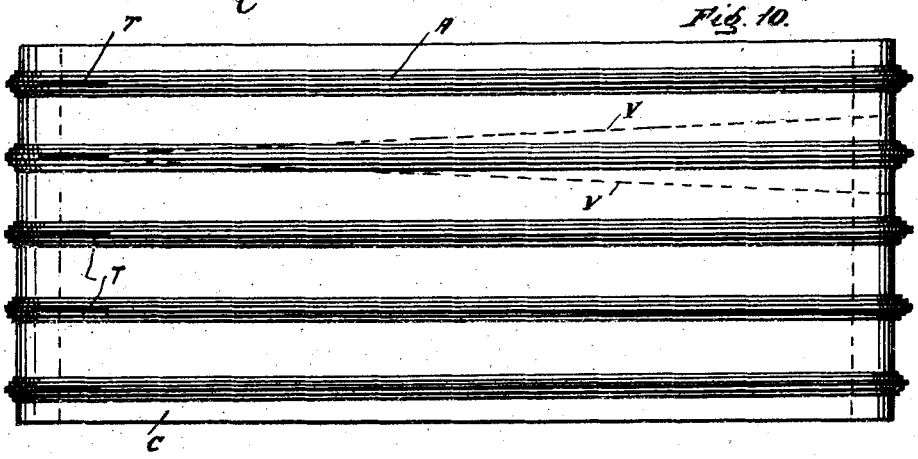


Fig. 11.

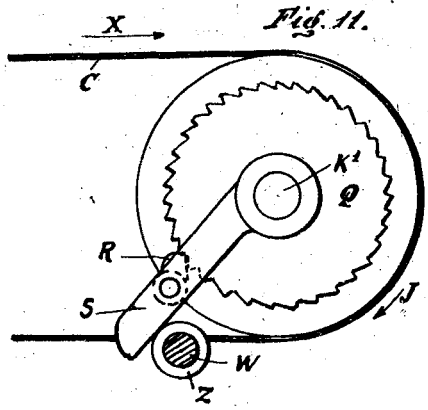
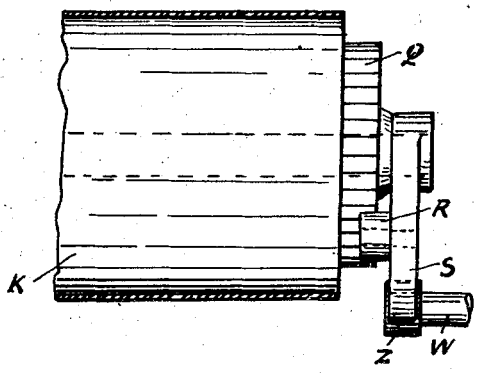


Fig. 12.



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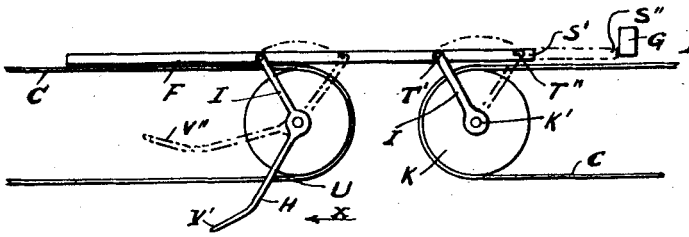

Fig. 13.

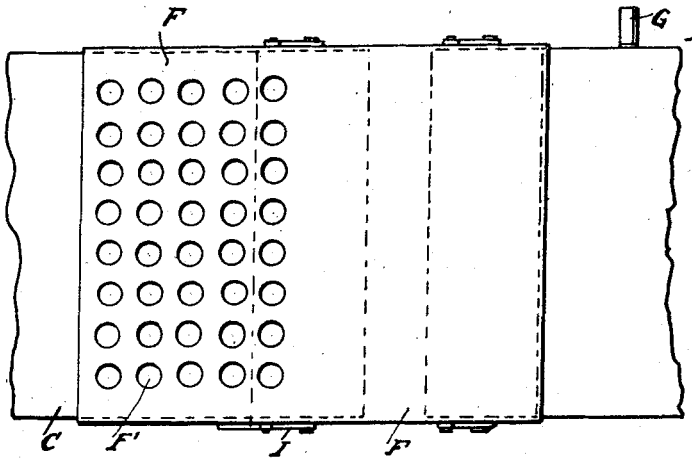

Fig. 14.

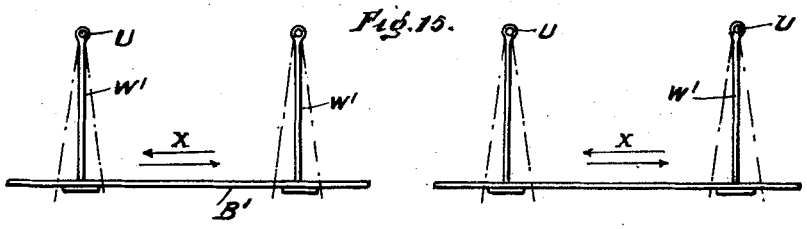

Fig. 15.

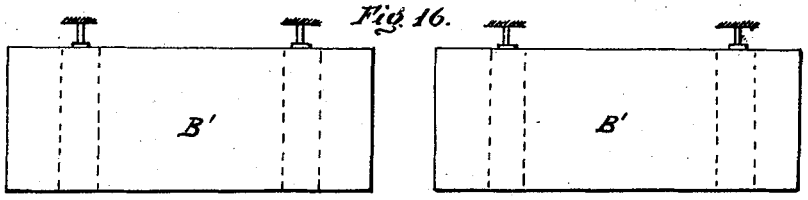

Fig. 16.

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Fig. 17.

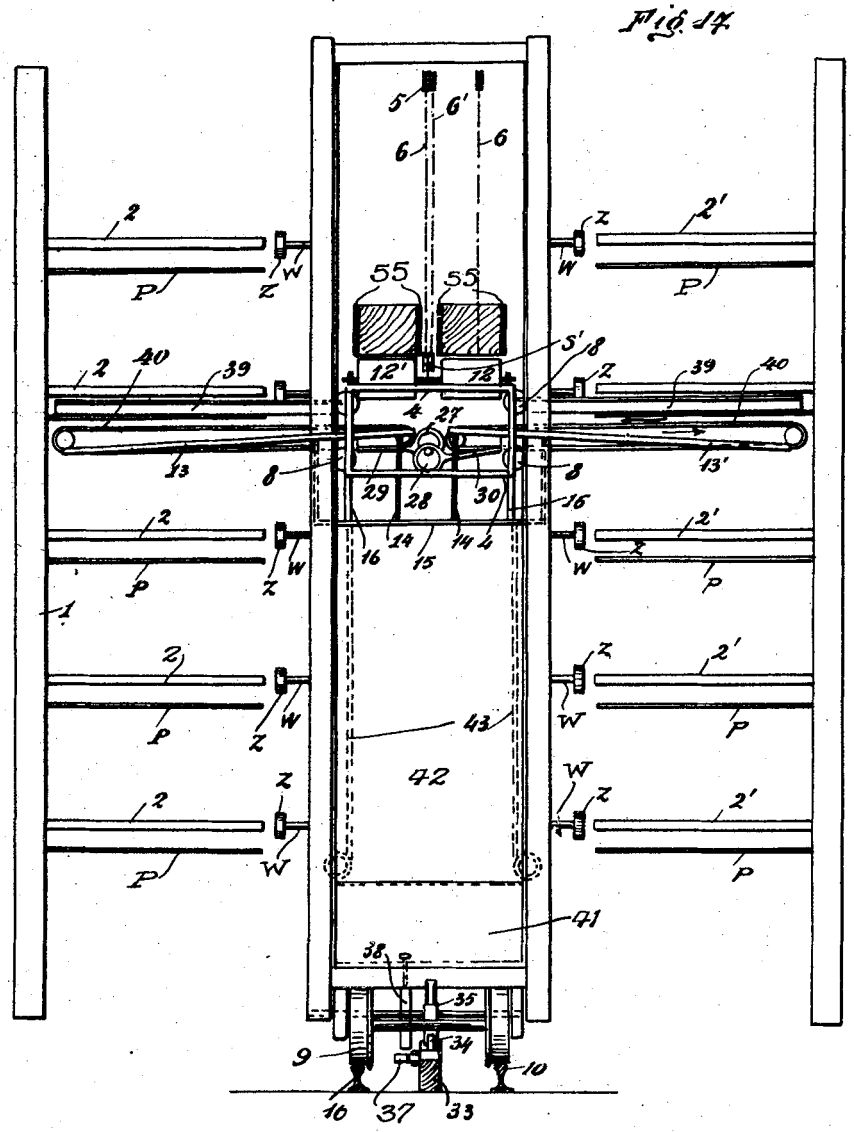

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Fig. 18.

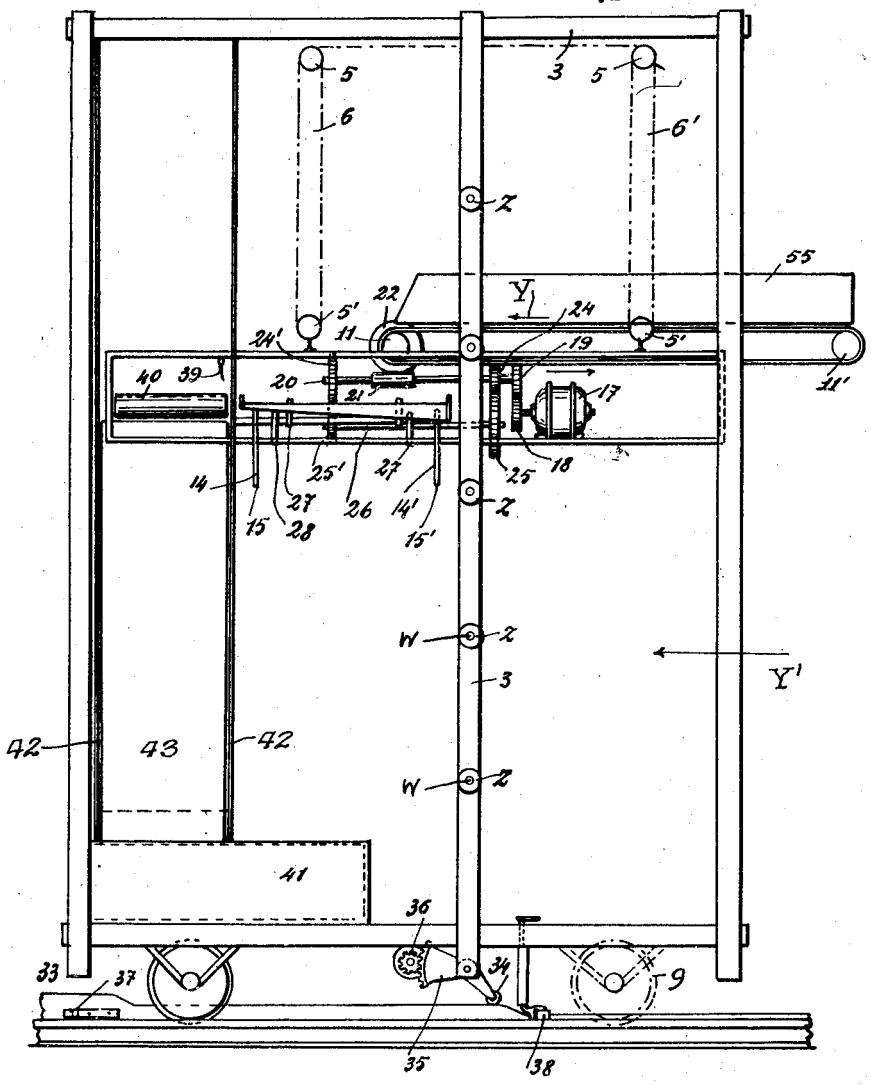

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Fig. 19.

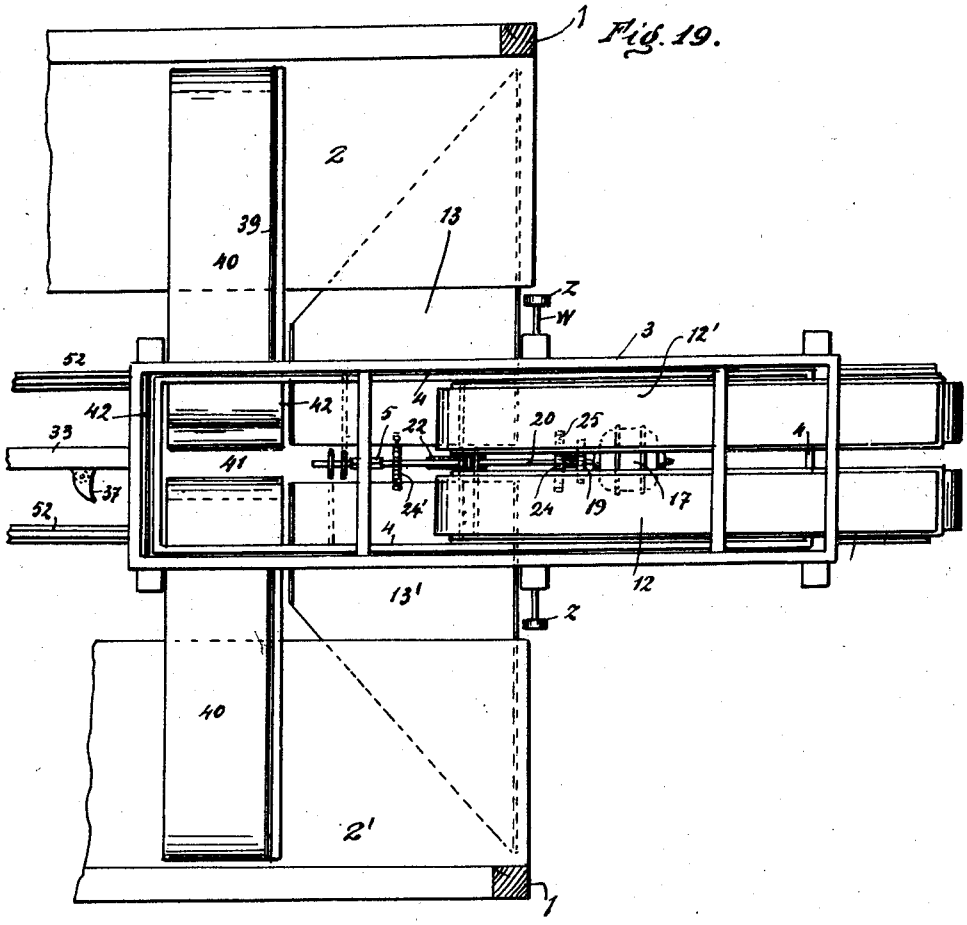

Fig. 20.

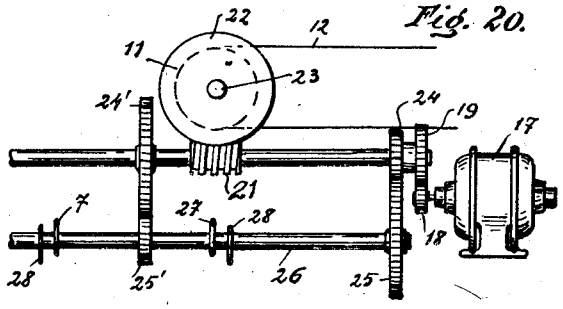

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Fig. 21.

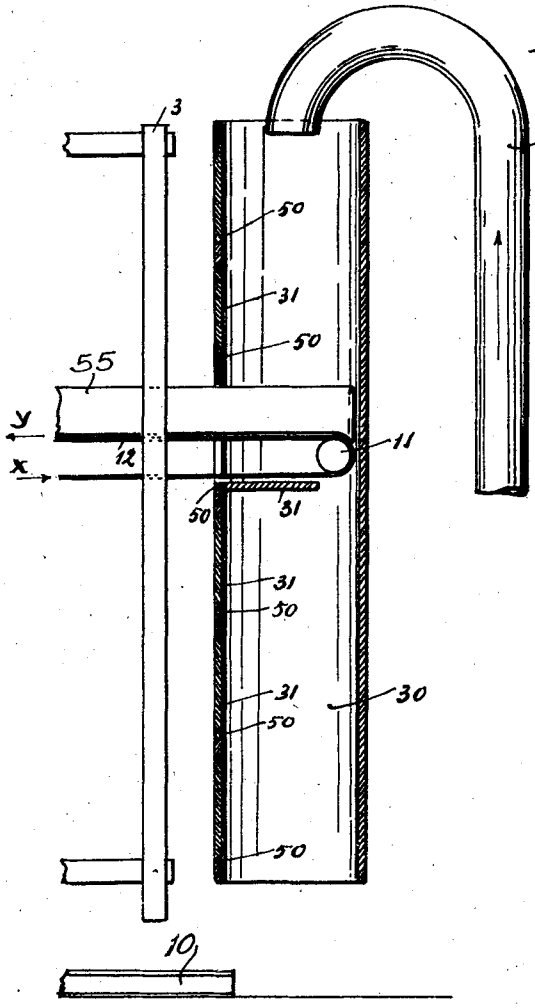
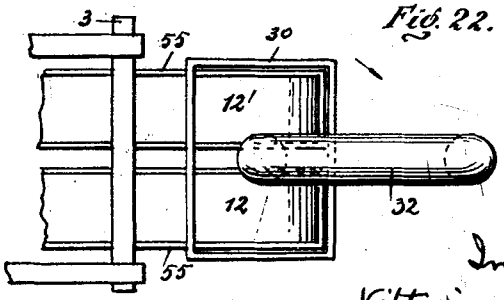


Fig. 22.



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APPARATUS FOR BREEDING SILKWORMS

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Fig. 23.

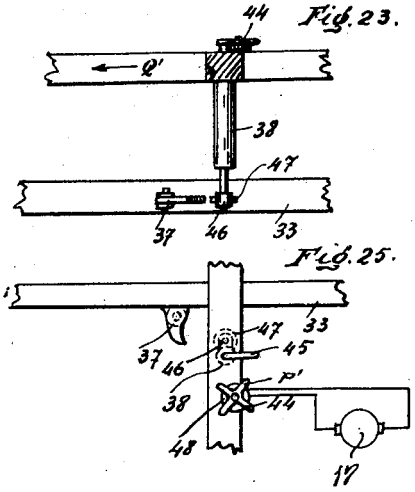


Fig. 24.

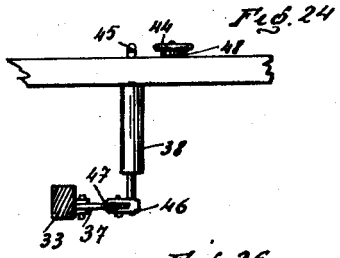


Fig. 25.

Fig. 26.

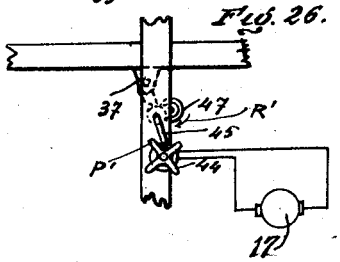


Fig. 27.

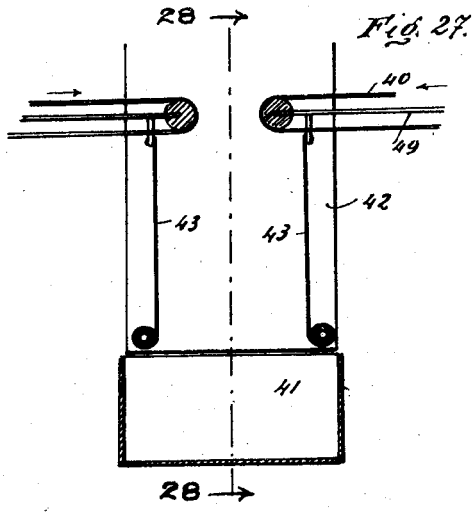
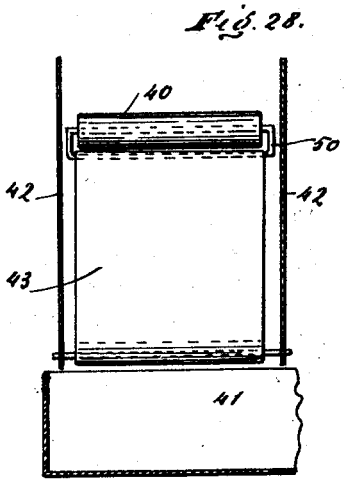


Fig. 28.



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Patented July 28, 1931 1,816,368

UNITED STATES PATENT OFFICE

VITTORIO FIORUZZI, OF PIACENZA, ITALY

APPARATUS FOR BREEDING SILKWORMS

Application filed June 22, 1926, Serial No. 117,820, and in Italy September 16, 1925.

This invention relates to the art of breeding silkworms; and it relates more particularly to the art of handling silkworms from the time of their birth to the time they have completely spun their cocoons, with substantially complete elimination of the human intervention hitherto necessary at various stages in the development of the silkworms.

The invention comprises apparatus for breeding silkworms as will be hereinafter disclosed. While the apparatus to be hereinafter described is particularly useful in carrying out the purposes of the invention, its use is not necessarily restricted thereto.

The invention is characterized by the fact that the breeding and removal of the worms to new beds at the various stages of their development is automatically and continuously performed at predetermined points of time. The worms first hatch, are then successively and mechanically advanced from one to another of a series of movable breeding devices (replacing the usual hurdles or latticeworks) and finally are allowed to mount to a spinning hut device from the last of the movable breeding devices. The invention also includes mechanical means for removing spun cocoons and as an important feature includes means for automatically feeding cut mulberry leaves to the breeding devices at predetermined intervals of time.

All of these steps are performed in such a way that each hatching of worms is segregated from other hatchings and are performed without the use of any manual work in the distributing of cut mulberry leaves, changing of beds, bringing the silkworms to the spinning hut or collecting spun cocoons, all of these operations being mechanically performed at predetermined times.

The apparatus in its essentials comprises a plurality of horizontal conveyor means arranged end to end, with bridging means associated with the discharge and receiving ends of each conveyor except the first and last of the series. The conveyor means are preferably in the form of endless belts or cloths and are driven by any suitable means at predetermined appropriate speeds which may be regulated at will. Devices for feeding cut mulberry leaves to the conveyor means are associated therewith. A spinning hut device is associated with the last of the conveyor means together with means for removing spun cocoons therefrom.

As an alternative the conveyor means may be in the form of hurdles or lattices in the nature of reciprocating shelves, operated in such manner as to cause silkworms to progress along each shelf and eventually pass to another shelf adjacent thereto.

In order to afford a fuller understanding of the invention, a practical embodiment of the process, and of apparatus that may desirably be employed in carrying it out will now be described in detail, it being understood, however, that the description of these specific embodiments of the invention is merely illustrative and is not restrictive.

Referring to the accompanying drawings, which illustrate more or less diagrammatically a desirable practical form of apparatus that may be employed in carrying the invention into effect,

Fig. 1 shows, in plan, a device upon which silkworm eggs are hatched,

Fig. 2 is a side view of Fig. 1,

Figs. 3, 4 and 5 show, diagrammatically in plan, an apparatus for carrying the invention into effect, the apparatus, with bridging devices omitted for the sake of clearness, being shown in three parts, which are to be considered as following one another in alinement,

Figs. 6, 7 and 8 are diagrammatic side views of Figs. 3, 4 and 5, including bridging devices,

Figs. 9 and 10 show, on an enlarged scale, a side and plan view respectively, of the first conveyor means of the apparatus,

Fig. 11 shows, on an enlarged scale, an end

view of one of the rollers, which carry the conveyor means, fitted with a device for causing intermittent movement,

Fig. 12 is a view of Fig. 11 taken at right angles thereto,

Figs. 13 and 14 show, on an enlarged scale, in side view and plan respectively, a device for intermittently passing silkworms from one to another of the conveyor means,

Figs. 15 and 16 show, on an enlarged scale, in side view and plan respectively, an alternative form of conveyor means,

Figs. 17, 18 and 19 show in rear view, side view and plan respectively, an apparatus for automatically feeding cut mulberry leaves to the silkworms and for controlling movement of the conveyor means,

Fig. 20 shows diagrammatically, on an enlarged scale, a detail in elevation of the apparatus shown in Figs. 17, 18 and 19,

Figs. 21 and 22 show, on an enlarged scale, in side view and plan respectively, another detail of the mulberry leaf feeding means.

Figs. 23 and 24 show, on an enlarged scale, in side and end view respectively, the motor switch operating mechanism,

Figs. 25 and 26 are plan views of the mechanism illustrated in Figs. 23 and 24, showing the parts in two different positions,

Fig. 27 is a vertical section through the refuse receptacle and parts cooperating therewith,

Fig. 28 is a section on the line 28—28 of Fig. 27.

Referring to the drawings (Figs. 1 and 2) C is an endless conveyor belt or cloth upon which silkworm eggs are placed, such belt being suitably driven at a predetermined rate which permits hatching of all the eggs, by the time they reach the end of the belt, traveling in the direction of the arrow in Fig. 1. Belt C is carried by suitably actuated drums K. A number of paper strips, unrolling from roller E, are secured to such belt prior to the deposition of the eggs thereon. These strips are perforated at suitable points, so that portions may be torn off. As shown on an enlarged scale in Figs. 9 and 10, the first belt of Fig. 3 is provided with parallel steps or ridges extending longitudinally thereof. The silkworm eggs are deposited by any suitable means on the upper surface of belt C at the end away from which such upper surface moves. At this end of the belt the eggs, indicated by the dark portion T, are deposited on the upper step A (Fig. 10) and as the belt travels in the direction of the arrow X and the worms develop, they spread out over the various steps A and finally occupy the region indicated by the dotted lines V. The sections of the perforated strips of paper D (Figs. 1 and 2) extend between the several sets of ridges A and support the hatched silkworms thereby saving them from suffocation by cut mulberry leaves which are lying on belt C. Eggs for hatching a new generation of worms are deposited at the receiving end of belt C at intervals depending upon the length and speed of the belt and the length of the paper strips occupied by the preceding generation of worms. The portion of the apparatus indicated by Figs. 1, 2, 9 and 10 is by way of being an incubator, and, for purposes of accurate temperature regulation may be in a separate housing (not shown).

In Figs. 3 to 8 the apparatus is shown schematically, there being, in the particular embodiment shown, fourteen other endless belts, connected by suitable bridging devices, the worms advancing along the belts in the course of their development. For example, the belts may be driven at such speed and constructed of such size that the first belt serves for the first and second periods of their life (8 days), the second and third belts for the third period (4 days), the fourth to seventh belts for the fourth period (5 days) and the eighth to thirteenth belts for the fifth period (6 days). At the end of such time, the worms are ready to mount to spinning hut devices over the fourteenth and fifteenth belts, such spinning hut devices being designated L (Figs. 5 and 8). At the end of the apparatus a comb-like member M, adjacent the spinning hut device L, is pivotally mounted at O, in such manner that, when it is swung on pivot O, it gently detaches the cocoons from spinning huts L′ of belt device L. The belt spinning hut device L is so driven that the direction in which its under surface travels is identical with the direction of travel of the upper surface of the worm conveying belts.

In Figs. 11 and 12 a device for controlling the intermittent travel of each belt is shown. In the particular embodiment, the exteriorly toothed ratchet wheel Q is fitted on one end of the drums K carrying the endless belts, lever S is pivotally mounted at one of its ends on the shaft of drum K at K′, and a pawl R is pivotally mounted at a suitable point intermediate of the length of said lever S. The other end of lever S is pivotally associated with rod W, suitably actuated as hereinafter described. It will be understood that when lever S is swung on pivot K′ in a clockwise direction, the pawl R will engage a tooth of ratchet wheel Q causing drum K to rotate in the same direction and thereby advancing the belt C a distance corresponding to the length of the arc bounded by the angular displacement of drum K. It is to be understood that each belt is actuated by mechanism such as indicated in Figs. 11 and 12.

A bridging device, referring to Figs. 13 and 14, is arranged between each pair of endless conveyor belts, in order that the worms may pass from the discharge end of each belt

to the receiving end of the adjacent belt. This device comprises a sheet F, of any suitable rigid material, carried by one end of the levers I which are pivotally mounted intermediate of their lengths on shafts K′ of the adjacent drums K. It is assumed in Figs. 13 and 14 that the worms have reached the end of the belt to the left in such figure and that they are to be conveyed to the belt to the right. Integral with levers I, on the drums carrying the belt, from which the worms are to be removed, are arms H. By applying to arms H, a force acting in the direction of the arrow, sheet F is moved in the opposite direction until its forward edges encounter stop G when the inertia of the worms causes them to fall to the belt adjacent the stop G. As shown in Figs. 3, 4, 5 and 14, the portion of sheet F which normally lies on the belt from which the worms are to be removed is of very light material and is provided with holes F′. Such holes progressively increase in diameter, to permit the silkworms as they increase in size, to pass through such holes and so reach the upper surface of sheet F.

Beneath the adjacent ends of each pair of belts C, table P is arranged to catch any worms that may accidentally fall from the belts. (See Figs. 6 and 17.)

When, as hereinabove suggested, it is desirable to substitute hurdles or lattice like devices in the nature of swinging shelves for the endless belts, such shelf-like devices B′ may be employed in the manner shown in Figs. 15 and 16, wherein they are shown suspended from shaft U by rod W′. These shelf-like structures are intermittently swung, by any suitable reciprocating mechanism as indicated by the arrows X, the shelves being first swung to the left and then to the right whereby the inertia of the worms causes them to travel to the right and eventually to be deposited on an adjacent swinging shelf, it being understood that a series of such shelves are arranged in alinement as are belts C hereinabove described.

Apparatus shown in Figs. 17 to 22, for feeding cut mulberry leaves to the belts or shelves, will now be described. It comprises a rectangular framework or carriage 3 consisting of suitable uprights and crosspieces any may be arranged between two series of parallel rows of belts or shelves, vertically arranged in tiers in a supporting frame 1, 1′ as shown diagrammatically at 2 and 2′. Frame 3 acts as a carriage for the leaf feeding mechanism and is mounted on wheels 9 which travel on track 10. The frame may also have top or lateral guides. A smaller frame 4 is arranged in cooperative relation with frame 3 and travels vertically by rollers 8 and 8′ on guides or track fitted to large frame or carriage 3. Frame 4 will be hereinafter referred to as the small frame.

Small frame 4 is suspended from the top of carriage 3 by means of pulleys 5 and 5′ and ropes 6 and 6′, so that it may be raised or lowered to serve belts 2 on different levels of the tiers.

Two plates 13 and 13′ are yieldingly connected to small frame 4 by resilient rods 14 and 14′. Plates 13 and 13′ may have the form of right trapezoids, with their acute angles farthest removed from the center of the leaf feeding mechanism. Cut mulberry leaves are deposited on the upper surface of plates 13 and 13′ by endless belt mechanism 11, 11′, 12 and 12′. Plates 13 and 13′ are reciprocated by eccentrics 27 and 28. Leaves distributed on plates 13 and 13′ by the belts 12 and 12′ are first distributed on the surface of such plates by their oscillatory movement and then are scattered from their oblique edges on belts or shelves 2, 2′. Plates 13 and 13′ are slightly inclined downwardly from their receiving ends to their discharge ends. The lower ends of rods 14 and 14′ are connected to horizontal cross-pieces 15 and 15′ which are connected by brackets 16 and 16′ to the small frame 4.

Belts 12 and 12′ convey mulberry leaves from the apparatus shown in Figs. 21 and 22, which comprises essentially a vertical channel 30, preferably of rectangular cross section, which may be fitted to a wall of the room containing the apparatus. The side of this channel facing frame or carriage 3 is provided with openings which are closed by doors 31 hinged at 50 along their lower sides, so that the doors open inwardly and swing downwardly. Suitable means such, for instance, as springs (not shown) are provided to keep the door normally in a yieldingly closed position. At the upper end of channel 30 is tube 32, through which mulberry leaves are pneumatically conveyed from a leaf cutting machine (not shown). Carriage 3 may be backed, so that belt 12 strikes and passes through an opening closed by a door 31 and belts 12 may then be pneumatically loaded with leaves, which will be retained thereon by side walls 55.

Referring to Fig. 20, mechanism is shown for driving said belts 12 and 12′ to cause them to deposit leaves on plates 13 and 13′ and for reciprocating or shaking such plates so as to spread the leaves thereon and to scatter the same on belts 2, 2′ from the oblique edges of said plates. Such mechanism comprises electric motor 17 mounted on small frame 4 with pinion 18 keyed to its shaft. This pinion engages gear 19 which forms part of double gearing 19, 24, the latter being mounted free on shaft 20. Gear 24 engages gear 25 keyed to shaft 26, which is parallel to shaft 20. Two pairs of eccentrics 27 and 28 and gear 25′ are keyed to shaft 26; gear 25′ engaging gear 24′ which is keyed to shaft 20. Shaft 20 also has keyed thereto worm 21

which engages worm wheel 22, keyed on shaft 23, which is common to drums 11 and 11′ carrying belts 12 and 12′. Thus motor 17 drives belts 12 and 12′ causing the same to carry leaves to plates 13 and 13′ and also drives eccentrics 27 and 28 which are connected to plates 13 and 13′ and import reciprocating movement thereto, by means of rods 29 and 30 which are connected to the rings of such eccentrics and have their other ends hinged to brackets depending from the under surfaces of plates 13 and 13′. The apparatus also includes means, hereinafter described, for regulating the distribution of leaves according to the needs of the silkworms and for suspending such distribution when necessary.

To insure a distribution of leaves proportional to the requirements of the silkworms and also to insure suspension of such distribution at times when it is not required, guide bar 33 is arranged. This bar supports roller 34 (Fig. 18) pivotally mounted on one end of bell crank 35 which in turn is pivotally mounted on a suitable bracket fitted on a lower cross bar of frame 3. The distance of roller 34 from the floor and the position of bell crank 35 vary according to the height of the guide bar 33. In its various positions the bell crank 35 may control the closure of various contacts (not shown) of a rheostat 36 and thus control the speed of an electric motor (not shown) driving main frame 3.

In order to stop the leaf distributing apparatus, pawls 37 project from the side of guide bar 33. A lever 38 is provided, formed with a cylindrical portion rotatable in an aperture in a cross-bar of the frame and having at its upper part a finger 45 and at its lower part a fork 46, between the arms of which a roller 47 is rotatably mounted. On the same cross-bar of the frame is a rotary electric switch 48 having a four-armed member 44 secured thereto. As the frame moves in the direction of the arrow Q^1, the roller 47 strikes against the projection 37 on the guide bar 33, thereby rotating the lever 38 about its axis in the direction of the arrow R^1. This turning movement of the lever causes the finger 45 to strike against the arm P^1 of the switch member 44 and turn the latter through an angle of 45°, thereby alternately opening and closing the circuit of electric motor 17. Pawls 37 are so mounted that during the return travel of frame 3, they cannot act on levers 38, and are also arranged to be movable along guide bar 33, so that the periods during which the leaf distribution is to be suspended may be adjusted at will.

For the purpose of cleaning the tables P on which mulberry leaf beds from belts 2 have fallen, the following apparatus (Fig. 17) is provided. Two rods 39, long enough to reach the outer side of tables P, project laterally from main frame 3 and are supported by small frame 4. Beneath rods 39 are endless belts 40 also supported by small frame 4 and spaced therefrom. Belts 40 are so driven as to discharge matter falling upon them into the receptacle 41 arranged in the main frame 3. As shown in Figs. 27 and 28, the stationary walls 42 and the movable walls 43 from a vertical chamber through which the material falling from the belts 4 passes to the receptacle 41, the endless belts being vertically movable together with the frame 4, the walls 43 must follow the frame 4 and be raised and lowered therewith, as such walls 43 are fastened at their upper end to a carrier 50 rigidly connected to the carrier 49 of the belt 40. To enable the walls 43 to move vertically their lower ends are wound on drums 51 rotatably mounted on stationary axles and equipped with springs, whereby as the frame 4 is lowered, the lower portions of the walls 43 wind themselves on the rollers 51 and conversely unwind as the frame rises.

In the operation of the novel breeding apparatus, silkworms reaching the discharge end of the first belt, crawl through holes F′ of sheet F, and reach the upper surface of such sheet which may be preliminarily covered with cut mulberry leaves; table P collecting mulberry leaves falling from the first belt 2. Table P is automatically and intermittently cleaned by the device projecting from frame 3, as hereinabove described or by any other suitable means. And as hereinabove described sheet F is reciprocated so that its forward edge encounters stop G, causing the silkworms to be inertially deposited upon the receiving end of the next belt.

The movement of all bridging sheets F, as well as the movement of all belts 2 is automatically performed by projections W carrying rollers Z on frame 3, which in the forward movement of such frame act upon arms H of levers I and upon levers S, hereinabove referred to with reference to Figs. 11 to 14, the projections referred to move the fingers V^1 at the end of arms H to the dotted line positions V^{11}, shown in Figure 13. This movement of the arms H causes the ends T^1 of levers I to move to T^{11} through the arc-shaped trajectories shown in dotted lines. The sheets F, being supported by the arms I, move through similar paths so that the ends S^1 of these sheets shift to the position S^{11}.

In this manner the silkworms pass from one endless belt 2 to another until they reach, for instance, the 14th of such belts, from which they are ready to pass into the spinning huts L′, lying thereabove.

During the growing period of the silkworms on belts 2, cut mulberry leaves are supplied for their nourishment, the distribu-

tion being regulated so that it is suspended at periods when the worms are asleep, the recurrence of such periods being readily calculated as a function of the room temperature and the speed of belts C.

Distribution of leaves, hereinabove referred to, is automatically performed in the following manner:

Leaves are loaded on belts 12 and 12′ and retained thereon by side walls 55, by backing frame 3 until the end of belts 12, 12′ strike against a door 31 in channel 30′ (Figs. 21 and 22), through which it passes. Pneumatic means (not shown) for driving cut leaves through tube 32, cause leaves to be deposited on the end of belts 12, 12′ which may be driven as soon as they are completely loaded.

Loading of cut leaves having been completed, frame 3 is propelled by means of an electric motor (not shown) which, by any suitable transmission means, drives the wheels upon which such frame is supported. At the same time motor 17 is started thereby driving belts 12 and 12′. Leaves on such belts advance in the direction of arrows Y (Figs. 18 and 21) and upon reaching the ends of such belts fall upon plates 13, 13′, which are reciprocated horizontally, thereby causing leaves to be scattered on such plates and to be discharged from their oblique edges, thence falling upon worm conveying belts thereunder.

Since the main frame 3 is automatically caused to travel at the proper speed, by means of the device comprising guide bar 33 and roller 38 above referred to and which acts upon the motor driving said frame, the leaves are distributed regularly and in proper quantities on all the worm conveying belts. As above stated, pawls 37 and levers 38, cooperating with other mechanism, serve to suspend the distribution of leaves at points where the silkworms are asleep.

As above stated, the movement of the fifteen worm conveying belts, the movement of the silkworms from one belt to another, and the removal of the leaf beds, are automatically caused by the travel of the leaf distributing apparatus in cooperation therewith. More specifically these movements are caused as now described. Referring to Fig. 11, W indicates a short rod projecting from main frame 3, such rod having roller Z pivotally mounted thereon. A plurality of such rods and rollers are arranged in a row on frame 3 at an elevation proper to insure contact with the various levers which actuate the endless worm conveying belts and bridging devices. Where several sets of worm conveying devices at different elevations are used, as shown in Fig. 17 an equal number of rows of rods and rollers, of corresponding elevation on frame 3, are employed.

As frame 3 travels in the direction indicated by the arrow Y′ in Fig. 18, the rollers Z strike against the arms H of levers I supporting the bridging sheet F, thus actuating the same and causing the silkworms to be moved from one belt to a succeeding one. The rollers Z then strike against the levers S, mounted on axes K′ of drums K which carry the worm conveying belts C. (See Figs. 11 and 12.) Lever S is rotated about K in the direction of the arrow J and pawl R engages a tooth of ratchet wheel Q, thus rotating drum K on its longitudinal axis K′, with a translation of movement to worm conveying belt C. When it becomes desirable to have the speed of the worm conveying belts gradually increased in order to give the worms the increased space made necessary by their growth, the mechanism can be readily adjusted for such purpose.

With reference to Figs. 15 and 16, it will be understood that the rod and roller mechanism Z, W′ may be used when reciprocating or swinging shelves are used instead of endless belts, to contact with levers or crank arms (not shown) suitably mounted on U, thereby imparting the desired reciprocating movement to such shelves.

Leaf beds falling on tables P are removed therefrom by rods or blades 39, which scrape them clean and cause the beds to fall on belt 40, whereby they are conveyed to receptacle 41, from which they may be removed when frame 3 returns to the starting end of the device.

When main frame 3 of the leaf distributing apparatus has reached the end of the worm conveying belts, electric motor 17 stops and frame 3 is pushed back to the starting point. Small frame 4 is then raised in the manner of an ordinary lift to an elevation corresponding to that of the next series of worm conveying belts. The process of loading and distributing leaves may then be repeated.

When the silkworms reach the last two of the worm conveying belts, they encounter spinning huts L′ carried by endless belt L, disposed above the worm conveying belts, the lower portion of which moves in the same direction and at the same speed as the worm conveying belts, so that the relative movement of such belts is zero. The silkworms may then go into spinning huts L′, of gorse or other suitable material, which is not of sufficient length to injure the worms. The length of the apparatus L and its speed must be such as to permit the cocoons to be fully completed by the time its under surface reaches the drum toward which it travels. At such point rake M gently detaches the cocoons which fall into hopper N, whereby they are conveyed to the drying room.

What is claimed is:

1. Apparatus for handling silkworms comprising silkworm conveying means, mechanism for feeding mulberry leaves to said con-

veying means, and mechanically actuated means for the reception of cocoons moving adjacent to and with said conveying means.

2. Apparatus for handling silkworms comprising silkworm conveying means, means for mechanically feeding cut mulberry leaves to said conveying means, mechanically actuated means for the reception of cocoons moving adjacent to and with said conveying means, and means for removing cocoons therefrom.

3. Apparatus for handling silkworms comprising silkworm conveying means, means for mechanically feeding cut mulberry leaves to said conveying means, mechanically actuated means for the reception of cocoons moving adjacent to and with said conveying means, means for removing cocoons, and means for removing and collecting mulberry leaf beds.

4. Apparatus for handling silkworms comprising a plurality of silkworm conveying means arranged end to end, means for transferring silkworms from one of said conveying means to the next in the series, mulberry leaf feeding means cooperating with said silkworm conveying means, and means for actuating said mulberry leaf feeding means and said worm conveying means.

5. Apparatus for handling silkworms comprising a plurality of horizontally disposed endless conveyor belts for carrying silkworms, a plurality of bridging devices connecting such conveyor belts, a device for feeding cut mulberry leaves to said conveyor belts and operable to actuate said conveyor belts and said bridging devices.

6. Apparatus for handling silkworms comprising a plurality of horizontally disposed endless conveyor belts for carrying silkworms, a plurality of bridging devices joining the ends of said conveyor belts, mechanism for distributing cut mulberry leaves on said conveyor belts, means for actuating said conveyor belts and said bridging devices, a spinning hut device in which silk worms may spin cocoons, and means for collecting cocoons therefrom.

7. Apparatus for handling silkworms comprising a plurality of horizontally disposed endless conveyor belts for carrying silkworms, the first of such belts being provided with a plurality of series of step-like ridges, bridging devices joining the ends of said conveyor belts, and mechanism for distributing cut mulberry leaves to said conveyor belts comprising means for holding a supply of leaves, a reciprocating plate for distributing leaves to said silkworm conveying belts, means for carrying mulberry leaves from such supply of mulberry leaves to said reciprocating plate and means for operating such leaf carrying means and said reciprocating plate.

8. Apparatus for handling silkworms comprising a plurality of horizontally disposed endless conveyor belts for carrying silkworms, a plurality of bridging devices therebetween, mechanism for distributing cut mulberry leaves on said conveyor belts, means associated with said conveyor belts for receiving leaf beds discharged from such belts, and means for collecting the discharged leaf beds.

9. Apparatus for handling silkworms comprising a plurality of horizontally disposed endless conveyor belts for carrying silkworms, a plurality of drums on which such conveyor belts are mounted, ratchet means on the ends of said drums, a carriage for carrying mechanism for feeding cut mulberry leaves to said conveyor belts, a track on which said carriage travels, means projecting from said carriage adapted to engage said ratchet means on said drums to impart intermittent rotation thereto, and means for driving said carriage.

10. Apparatus for handling silkworms comprising a plurality of horizontally disposed endless conveyor belts for carrying silkworms, a plurality of drums carrying such belts, a plurality of bridging devices between such belts, comprising sheets of rigid material pivotally mounted on the axes of such drums, a carriage carrying mechanism for distributing cut mulberry leaves on such belts, a track on which said carriage travels, means projecting from said carriage adapted to impart reciprocating movements to said bridging devices, and means for driving said carriage.

11. Apparatus for handling silkworms comprising a plurality of horizontally disposed endless conveyor belts for transporting silkworms, means for transferring silkworms from one of said conveying means to the next in the series, means for slowly moving said belts to transfer the silkworms from one end to the other of said series of belts, mechanism for distributing cut mulberry leaves on such belts, and means for automatically starting and stopping such leaf distributing mechanism at predetermined intervals.

12. Apparatus for handling silkworms comprising a plurality of horizontally disposed endless conveyor belts for carrying silkworms, mechanism for automatically distributing cut mulberry leaves on such conveyor belts comprising a carriage, belt means thereon associated with a mulberry leaf supply, a reciprocating plate for distributing mulberry leaves fed by said belt means, means for driving said belt means and said reciprocating plate; a track on which carriage travels, a guide rail associated with said track, and means on said carriage adapted to cooperate with said guide rail in stopping and starting said leaf distributing mechanism.

13. Apparatus for handling silkworms comprising a plurality of endless conveyors for transporting silkworms, said conveyors

being in alinement with the end of one conveyor spaced from the end of the adjacent conveyor, means for distributing mulberry leaves to said conveyors, and mechanically driven means for transferring silkworms from one conveyor to another without transferring leaves thereto.

Signed at Milan, Italy, this 28th day of May, 1926.

VITTORIO FIORUZZI.