Aug. 1, 1950 F. M. YOUNG 2,517,370

FIN ASSEMBLY MACHINE FOR HEAT-EXCHANGE CORES

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Fig. 1

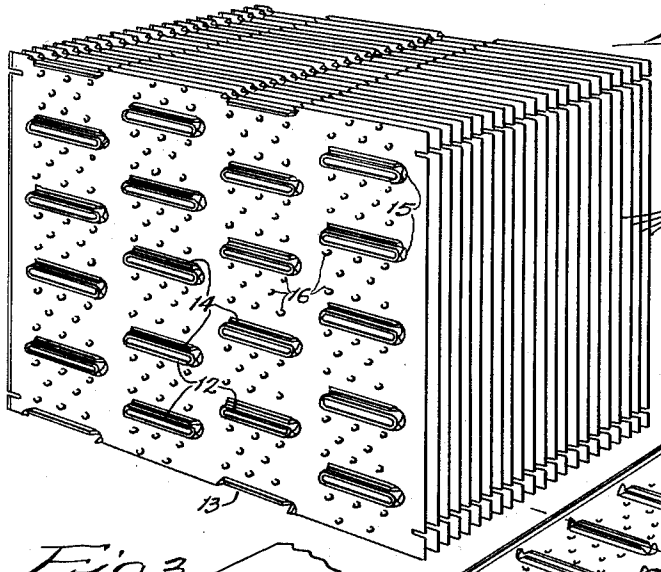


Fig. 2

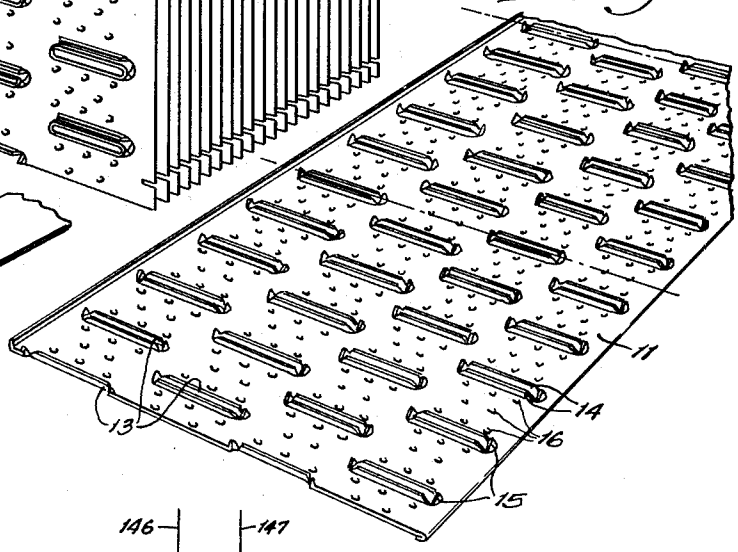


Fig. 3

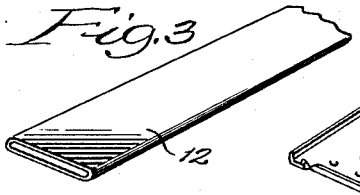
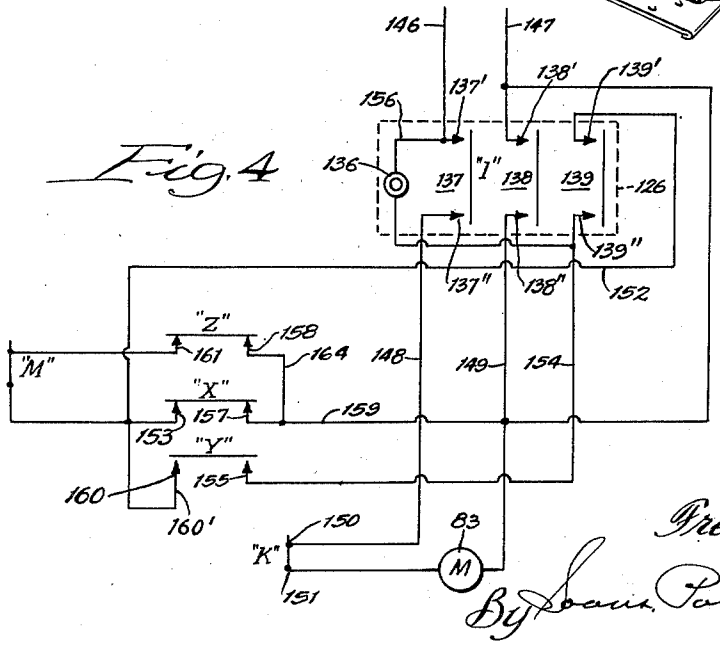


Fig. 4



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FIN ASSEMBLY MACHINE FOR HEAT-EXCHANGE CORES

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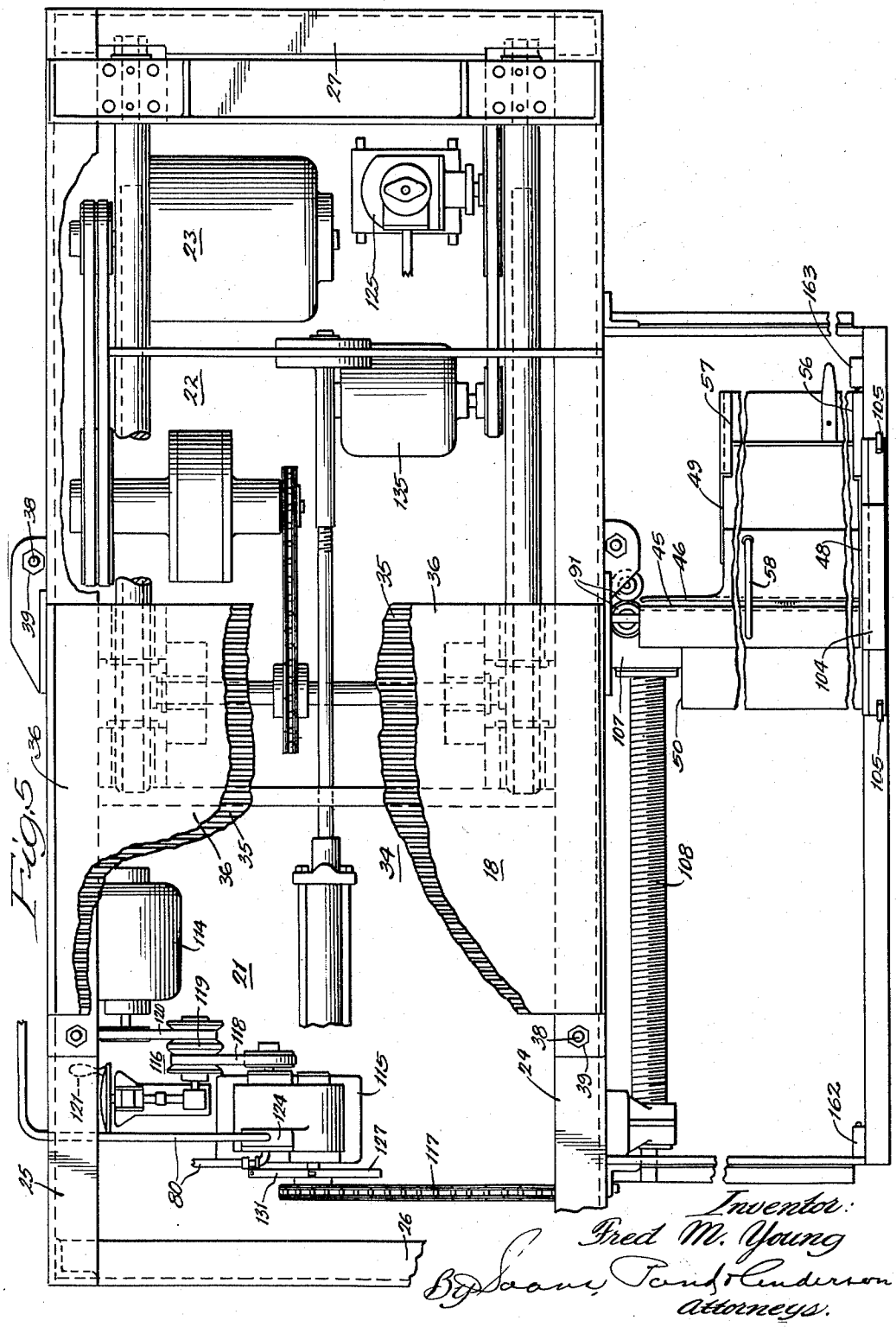


Fig. 5

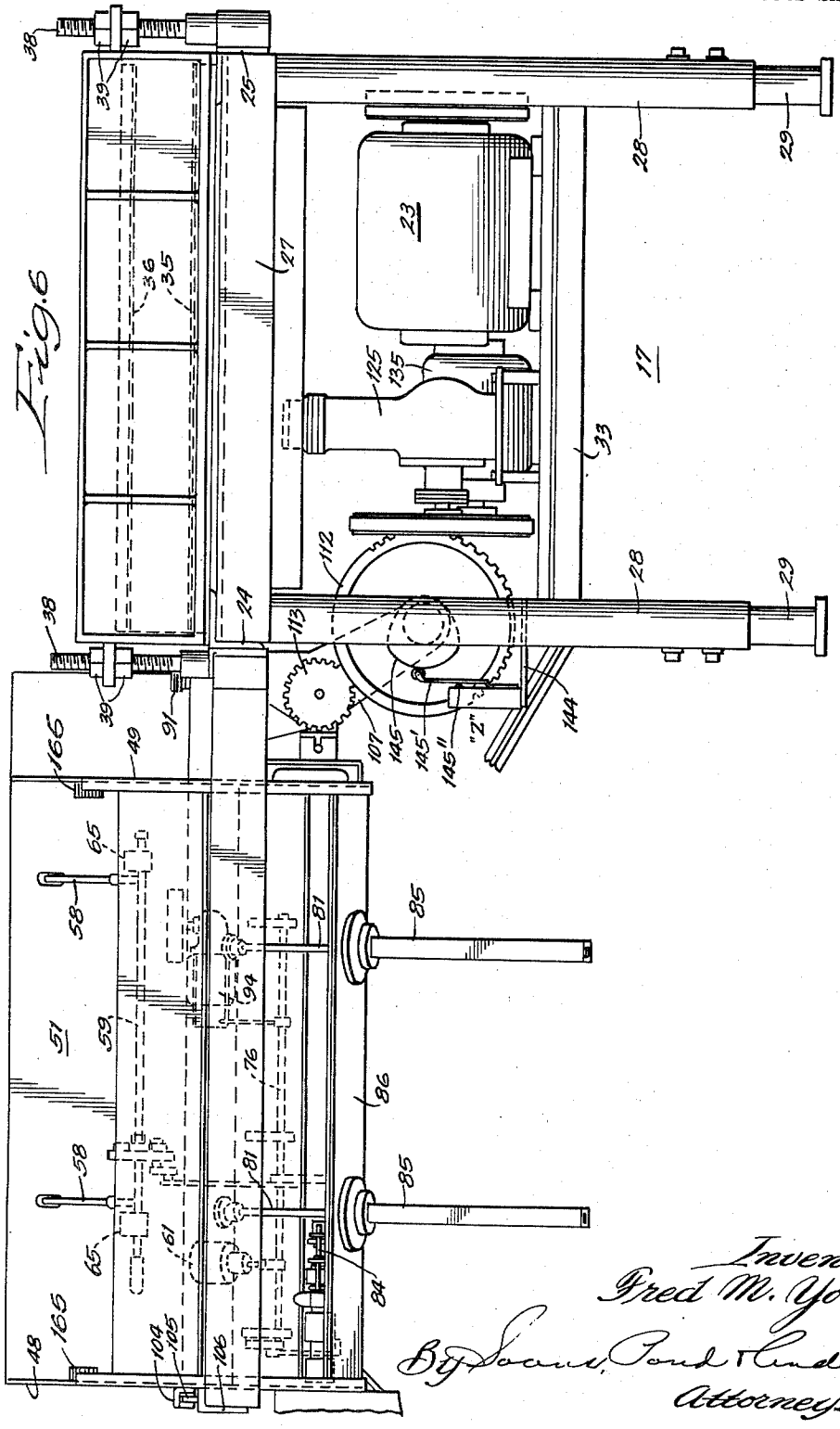
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FIN ASSEMBLY MACHINE FOR HEAT-EXCHANGE CORES

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Fig. 6



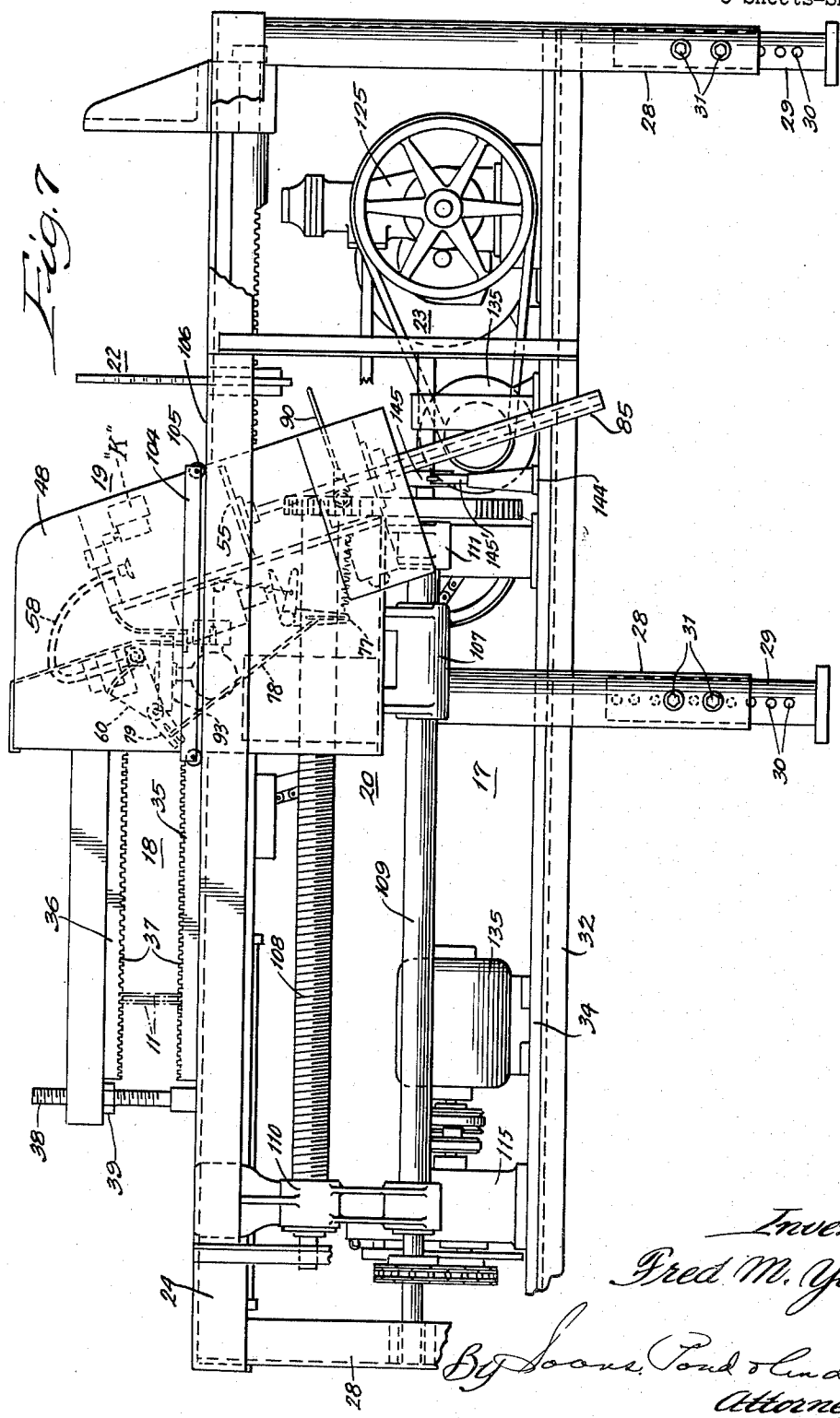
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FIN ASSEMBLY MACHINE FOR HEAT-EXCHANGE CORES

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Fig. 7



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FIN ASSEMBLY MACHINE FOR HEAT-EXCHANGE CORES

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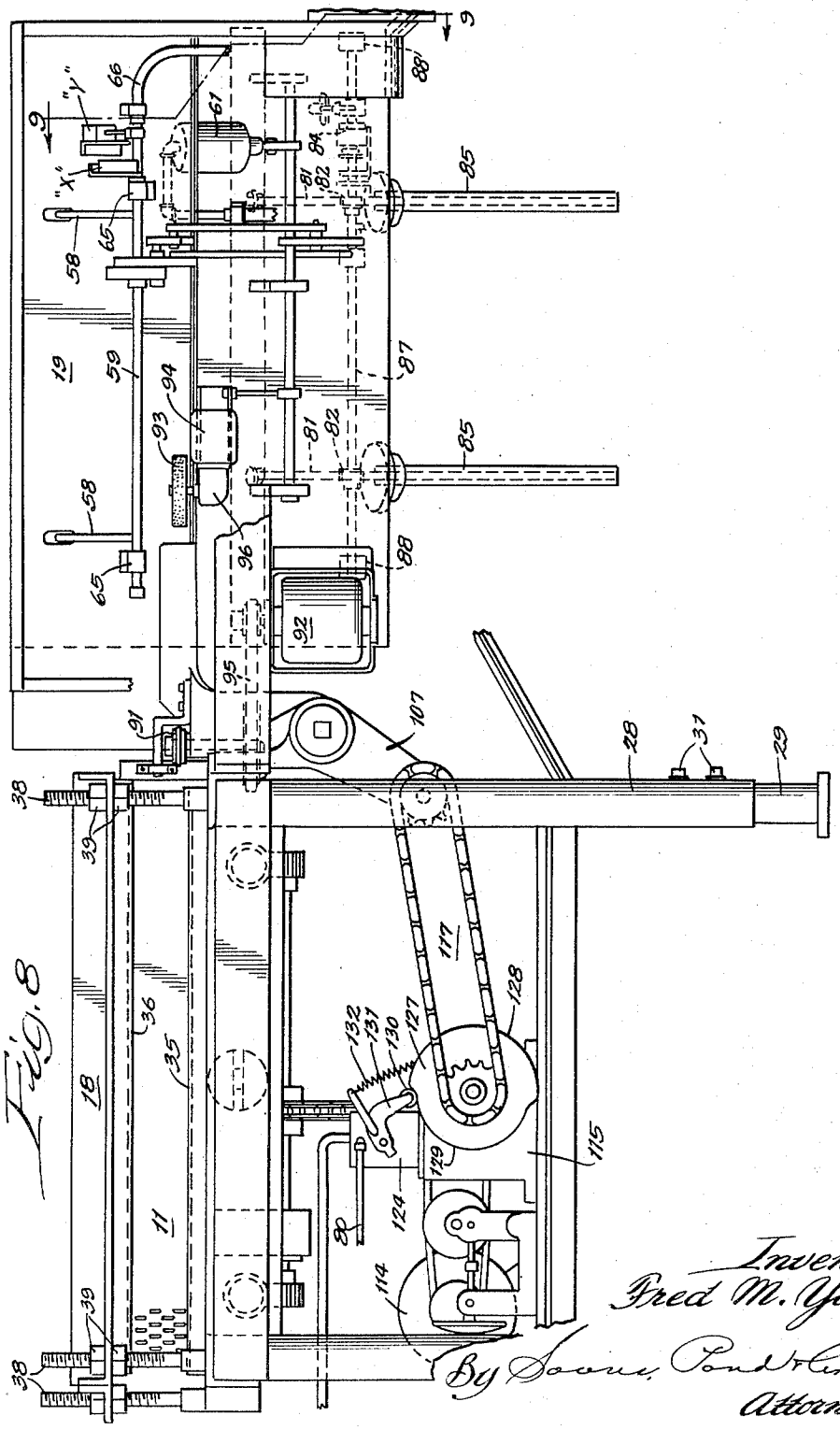


Fig. 8

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FIN ASSEMBLY MACHINE FOR HEAT-EXCHANGE CORES

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Fig. 9

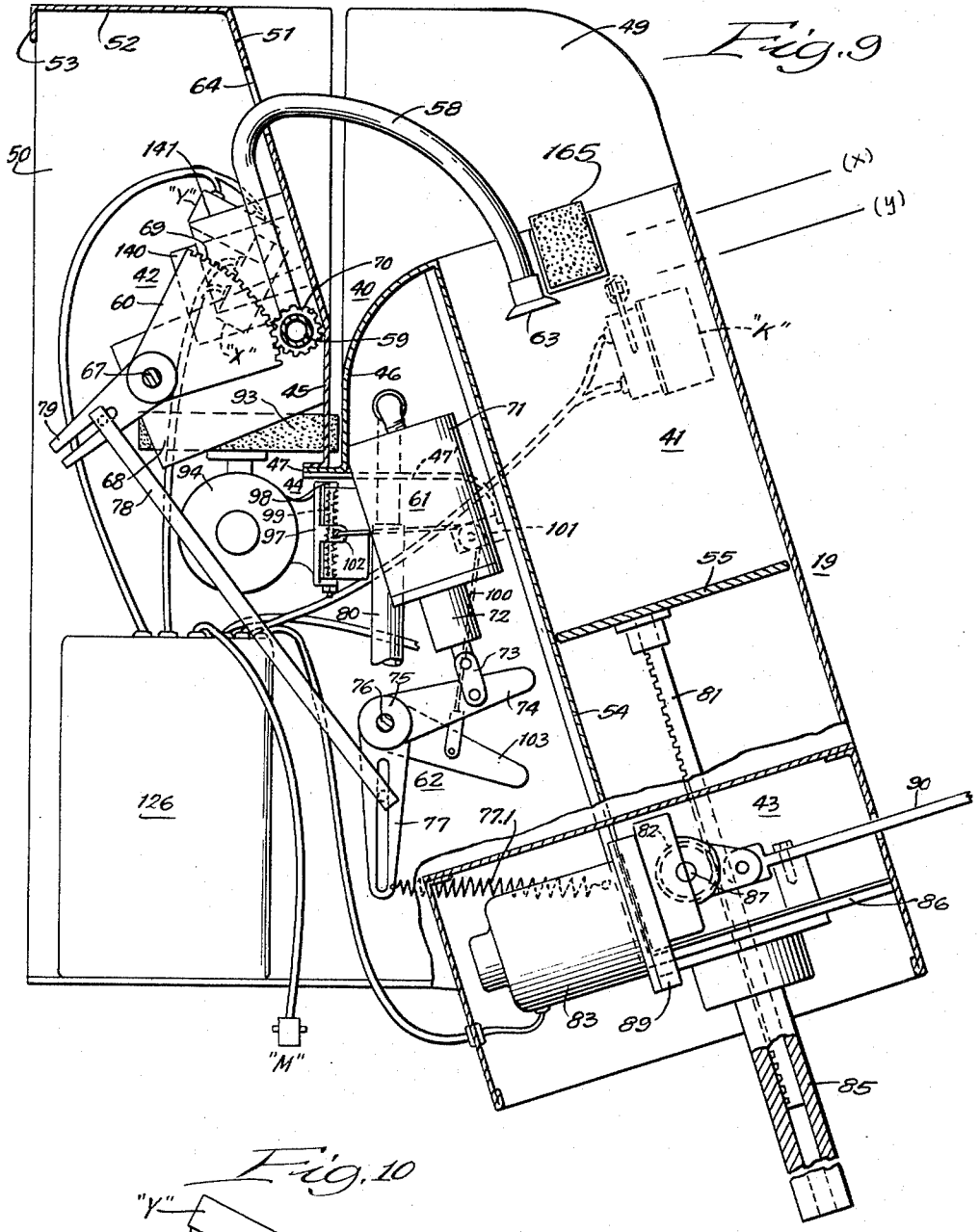
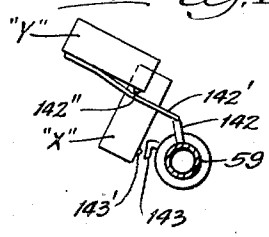


Fig. 10



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Patented Aug. 1, 1950 2,517,370

UNITED STATES PATENT OFFICE

2,517,370

FIN ASSEMBLY MACHINE FOR HEAT-EXCHANGE CORES

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Application May 14, 1945, Serial No. 593,671

19 Claims. (Cl. 214—8)

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This invention relates to a machine adapted to assemble laminae of a type which in the manufacture of heat-exchange equipment are described as "fins." In a heat-exchange unit a predetermined number of these laminae or "fins" are arranged in closely-spaced parallel relationship for support on and in heat-dissipating contact with a plurality of transverse tubes extending through registering holes formed in the several laminae. A heat-exchange unit comprising such assembled tubes and laminae thus is adapted for use with fluids of different temperatures, one of which flows through said tubes and the other of which flows cross-wise of and around the tubes between said laminae. The heat from the fluid of higher temperature is thereupon transferred to the fluid of lower temperature.

These laminae, or fins, are comparatively thin, having a thickness of around .004 of an inch. Generally they are hemmed along their lateral edges for the purpose of reinforcement. Moreover, the slots or holes for the tubes are formed by striking up the metal to form perimetral flanges around the holes designed to increase the area of contact between the fins and tubes and thereby accelerate the transfer of heat between the tubes and the fins. The length and width of these laminae or fins vary, depending upon the size of the heat-exchange unit to be formed therewith.

Preparatory to inserting the tubes through the fins to make up the heat-exchange unit, a predetermined number of laminae or fins has to be assembled in a jig in such a way that the tube slots or holes are brought into alignment to permit the subsequent forcing of the tubes through the registering slots or holes in the assembled fins.

Heretofore it has been necessary to assemble these laminae or fins in a jig by hand. As dexterous as men have become at the task, it is slow and consequently expensive as compared with what would be the case if they could be assembled by machine.

The main objects of this invention, therefore, are to provide an improved form of laminae- or fin-assembling machine wherein laminae are selected from a magazine and injected into an assembling jig preparatory to having such assembled fins mounted on a plurality of transverse tubes to form a complete heat-exchange core; to provide, for the laminae magazine improved means for supporting, selecting, and advancing mechanisms so constructed and so correlated in their operation that a predetermined number of laminae are successively advanced into position for individual selection and subsequent injection into the laminae-assembling jig; to provide improved control means for synchronizing the operation of the several means by which the laminae are advanced, selected, and subsequently injected into the laminae-assembling jig with each other, and with means for advancing the magazine along said jig; to provide an improved carriage for the laminae-supporting, -advancing, -selecting, and -injecting mechanisms; to provide improved means for advancing said carriage along said assembling jig so as to permit the seriatim injection of the laminae into said jig; and to provide an improved mechanism of this kind which, although involving many means and mechanisms for accomplishing these various purposes, is comparatively simple in construction, certain in operation, and which results in a material saving in time and expense in the assembling of a predetermined number of laminae or fins as the first step in the subsequent construction of heat-exchange cores of varying size and capacity.

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In the drawings, Fig. 1 is a perspective view of a section of a heat-exchange core, the laminae or fins for which are adapted for assembling on a laminae-assembling machine constructed in accordance with this invention;

Fig. 2 is a perspective view of a section of an individual lamina;

Fig. 3 is a perspective view of a section of one of the tubes, a plurality of which are subsequently inserted through the registering apertures of the assembled laminae thereby constituting a heat-exchange core as shown in Fig. 1;

Fig. 4 is a diagrammatic view of the electrical circuit and switches by which the advance of the laminae in the laminae-magazine is controlled through the coaction of control means actuated by the laminae-selecting mechanism and the magazine-advancing mechanism;

Fig. 5 is a plan view of a heat-exchange core-assembling machine embodying a fin-assembling mechanism constructed in accordance with this invention and a tube-assembling mechanism constructed in accordance with applicant's co-pending application Ser. No. 589,790, filed April 23, 1945, issued as Patent No. 2,410,140, October 29, 1946. Parts of the fin-assembly jig and the frame are broken away in order to reveal more clearly the power operating units for the machine;

Fig. 6 is a right-hand elevation of the combined machine;

Fig. 7 is a side elevation of the same;

Fig. 8 is a left-hand elevation of the combined machine;

Fig. 9 is an enlarged, partly sectional, elevation

of all of that part of the machine related to the advancing of the laminae in the magazine, transferring them to the chute through which they are injected into the assembly jig;

Fig. 10 is an enlarged detail view of the microswitches and the operating means actuated by the laminae-selecting mechanism for controlling the laminae in the laminae magazine.

The section of a heat-exchange core shown in Fig. 1, for the assembling of which the machine, embodying this invention and that of the aforesaid co-pending application, was constructed, comprises a plurality of parallelly-arranged laminae or fins 11 which are supported on a plurality of parallelly-arranged tubes 12. When such a core section is associated with suitable headers connecting the opposite ends of the tubes and with plates (not shown) attached on two sides of the assembled fins a fluid passing longitudinally through the tubes 12 and another fluid passing transversely of and around the tubes 12 between the laminae 11 the heat of the fluid with the higher temperature is transferred to the fluid of the lower temperature.

The laminae 11, as more fully appears from Fig. 2, is in the form of a strip of thin sheet metal. A plurality of parallel series of slots or holes 13 are punched therein in such a way as form lateral flanges 14 and end flanges 15. These flanges 14 and 15 tend to grip the flat tubes 12, when they are inserted through the registering apertures in an assembly of the laminae 11, so as to increase the surface contact of the fins on the tubes and thereby facilitate the transfer of heat between the differently-temperatured fluids passing through and around the tubes 12. The laminae 11, in between the holes 13, have spots 16 up-set to enlarge the surface contact of the metal with the fluid passing between the fins whereby to facilitate the transference of heat. These up-sets also have a tendency to reinforce the laminae.

The tubes 12 are likewise formed of a thin sheet metal similar to that out of which the laminae 11 are formed. They are preferably flat, as shown in Fig. 3, since in that form there is a higher coefficient of heat transfer between the fluid and the tube.

The preferred embodiment of the heat-transfer core-forming machine shown in the drawings comprises a main supporting frame 17 on which is positioned a fin-assembling jig 18 adapted to receive laminae or fins 11 from a laminae- or fin-handling mechanism 19 mounted on a carriage 20 and movable along the jig 18 by a power-driven unit 21 mounted on a frame 17. Following the assembly of a predetermined number of laminae 11 the appropriate number of tubes 12 are pressed through the registering holes 13 by means of tube-assembling mechanism 22 arranged on the frame 17 and operated by power means 23, likewise supported on said frame 17, and which constitutes the subject matter of the previously identified co-pending application.

The main supporting frame 17 comprises a pair of lateral angle bars 24 and 25 and a pair of end bars 26 and 27, forming the top of said supporting frame and intermediate lateral bars 32 and end bars 33 forming a support for a platform 34 mounted on legs 28. The platform 34 provides a support for the power units 21 and 23 as will more fully hereinafter appear. The lower ends of the legs are provided with telescopic extensions 29 which have apertures 30 registering with appropriate apertures in said main leg members through

which bolts 31 extend to permit the height from the floor of the mechanism supported on the frame to be adjusted.

The laminae- or fin-assembling jig 18 comprises lower and upper members 35 and 36 having their opposed faces formed with grooves 37. These members are supported in adjustably spaced relationship by suitable bolts 38 and nuts 39, fixed on the angle bars 24 and 25 at the four corners of the members 35 and 36. These grooved members 35 and 36 constitute a type of jig commonly used for hand-assembling of laminae 11. Jigs 18, with a varying spacing of the grooves, may be mounted on the frame 17 and the distance between the grooved faces may be altered by adjusting the bolts and nuts 38 and 39 to accommodate laminae of varying widths.

The laminae-handling mechanism 19 comprises a chute 40 associated with a laminae-magazine 41 so that a laminae-selecting mechanism 42 transfers the laminae one at a time from the magazine 41 to the chute 40 as laminae-advancing mechanism 43 keeps the uppermost lamina in the magazine 41 in position to be transferred from the magazine 41 to the chure 40 whence each lamina is injected into the assembly jig 18 through the action of a laminae-injecting mechanism 44.

The laminae-injection chute 40 and the laminae magazine 41 are contiguously arranged on the carriage 20 which is adapted to move the chute 40 along the assembly jig 18 so that the laminae 11, upon delivery to the chute 40, are successively injected into the registering pairs of grooves 37 of the members 35 and 36.

The chute 40 comprises a pair of vertical walls 45 and 46 having their lower ends flanged and nested as at 47, so as to form a bottom for the chute, and having their outer ends secured to a vertical end wall 48 and at their inner ends by walls 49 and 50 beyond which said walls 45 and 46 extend into juxtaposition with the assembly jig 18. The wall 45 is formed with an extension 51 disposed slightly at an angle, and terminating in a horizontal shelf 52 with a dependent flange 53. The extension 51, ledge 52, and flange 53 are secured to the outer end wall 48 and to the inner end wall 50. The upper end of the chute wall 46 is arched outwardly from the extension 51 and at its lateral edge is secured to the back 54 of the laminae magazine 41. A bracket 47' secured to the magazine back 54 affords a support for the chute 40.

The laminae- or fin-magazine 41 comprises the back wall 54 associated with the end plates 48 and 49 and a movable platform or elevator 55. The back wall 54 extends at an angle outwardly and downwardly from the upper end of the chute wall 46 practically parallel with the extension 51 of the chute wall 45. The end walls 48 and 49 are provided with inwardly-extending flanges 56 and 57 which coact with the back wall 54 and the platform 55 to complete the laminae-magazine 41.

The laminae-selecting mechanism 42, whereby laminae 11 are transferred one at a time from the magazine 41 to the chute 40, comprises a pair of selector arms 58 mounted on a tubular rocker shaft 59 and actuated by a rack 60 operated by a motor 61 through lever-link mechanism 62.

The arms 58 are of tubular construction and equipped at their lower ends with suction or vacuum cups 63 whereby a suction through the hollow rocker shaft 59 will cause the laminae 11 to be picked up, in a manner common with

printing press mechanisms. The arm 58 has the form of an arc about the center of the rocker shaft 59 and extends through holes 64 in the extension 51 which serves to strip the laminae from the suction cups 63, to fall into the chute 40, when the cups 63 recede back of said extension 51.

The rocker shaft 59 is journalled in bearings 65 on the back of the chute wall 45 and has a tube 66 connected to a source of vacuum or suction 125. The rack 60 is mounted on a shaft 67 journalled on a plate 68 secured to the chute back 45 so that the teeth at 69 thereof mesh with the teeth on a gear 70 secured to the rocker shaft 59.

The motor 61, which operates the rack 60 for actuating the rocker arms 58, is shown here in the form of an air pump. The cylinder 71 is secured to the back 54 of the magazine 41 and the plunger stem 72 is connected by a link 73 to operate the lever-link mechanism 62.

The lever-link mechanism 62 includes a bell crank lever 75 journalled on a shaft 76, one arm 74 of which is connected to the link 73 and the other arm 77 of which is connected by a link 78 to an arm 79 secured to the shaft 67 on which the rack 60 is mounted. As will be clearly observed from Fig. 9, the link 78 is adjustably connected to the bell-crank lever-arm 77 and to the arm 79 so as to insure the proper action of motor 61 on the rocker arms 58 through the coaction of the rack 60 and pinion 70.

The cylinder 71 of the air motor 61 is connected by a pipe or tube 80 to a suitable source of air pressure through a valve mechanism hereinafter described. A spring 77.1 connects the arm 77 with the back 54 of the magazine 41 so as to normally shift the link mechanism 62 against the action of the air motor 61.

The laminae- or fin-advancing means for the magazine 41 comprises, a pair of racks 81 and a pair of gears 82 driven by a motor 83 under the control of a clutch mechanism 84 (see Figs. 6 and 8). The racks 81 are connected at their upper ends to the platform 55 and are supported in extended bearings 85 secured to a plate 86 supported between the end plates 48 and 49 below and near their lower ends. The gears or pinions 82 are mounted on a shaft 87 journalled in bearings 88 and which is connected to the motor 83 through a suitable reduction gear 89.

The clutch mechanism 84 may be of any suitable type designed to connect and disconnect the shaft 87 in driving relationship with the motor 83, depending upon the position of the clutch as shifted by lever 90.

The laminae- or fin-injecting mechanism 44 comprises a pair of feed rollers 91 located at the mouth of the chute 40 and driven by a motor 92 and a constantly rotating brush 93 driven by a motor 94. The brush 93 and feed rollers 91 coact to inject the laminae 11 into the fin-assembling jig 18 as said laminae are dropped into the chute 40 after being stripped from the rocker arms 58.

The feed rollers 91 are journalled on vertical axes at the inner end of the chute 40 adjacent to the assembly jig 18. They have their peripheries spaced apart approximately the thickness of a laminae 11 so that when a lamina is brought into contact with said rollers it is snapped into a pair of registering grooves 37 in the assembly jig 18. The shafts for these rollers 91 are connected together at their lower ends by means of suitable gears so that they revolve in opposite directions,

and one of these shafts is connected with the motor 92 by means of a belt 95.

The brush 93 is mounted on an extension 96 of the motor housing 94 wherein is contained suitable reduction gear connecting the brush to the motor 94. The motor 94 in turn is mounted on a bracket 97 which is hinged on a pin 98 fixed to the underside of the chute 40 so that the brush 93 may be horizontally shifted to intermittently project the periphery thereof through a slot in the chute wall 45 into contact with a lamina 11 in the chute 40 for the purpose of advancing the lamina into contact with the feed rollers 91.

The reciprocal movement of the brush 93, to bring the periphery into and out of such contact with the laminae, results from a coaction of the spring 99 and a cable 100. The spring 99 embraces the pin 98 and is connected so as to normally retract the brush. The cable 100 extending over an idler 101 connects a lug 102 on the bracket 97 with an arm 103 connected to the shaft 76. Thus, the movement of the brush 93 into contact with a lamina in the chute 40 is synchronized with the operation of the fin-selecting means 42 under the influence of the motor 61. Obviously, the angular position of the arm 103 on the shaft 76 with respect to the arms of the bell crank lever 75 may be adjusted so as to ensure the proper synchronization of the swing of the brush 93 with the stripping of the laminae from the rocker arms 58 by means of the stripper plate 51.

The carriage 20 upon which is supported the fin-handling mechanism 19, is mounted for travel along the frame 17 by means of a roller-supported bar 104 and a bracket 107. The bar 104 is secured to the end plate 48 of the laminae-handling mechanism 19 and at its ends are journalled rollers 105 traveling on a track 106. The track 106 is part of an auxiliary frame supported at one side of the frame 17. The bracket 107 is secured to the end 50 of the laminae-handling mechanism 19 and slidably supported on shafts 108 and 109 which are journalled on bearings 110 and 111 at the adjacent side of the supporting frame 17.

The shaft 108 has screw-threaded connection with the bracket 107. The pitch of the shaft thread is equal to that of the grooves 37 in the members 35 and 36 of the laminae-assembly jig 18. The shaft 108 is driven by a gear and pinion mechanism 112 and 113 through the medium of the shaft 109 which is connected to the power unit 21 as will be more fully hereinafter pointed out.

As will be observed from Fig. 6, the gear 112 and pinion 113 are of the intermittent type so that for one-half the revolution of the gear 112 the pinion 113 remains stationary while during the other half revolution of the gear 112 the pinion makes a complete revolution. Thus, when the teeth of the gear 112 and pinion 113 are in mesh, the carriage 20 is moved the distance between adjacent grooves 37 in the assembly jig 18. When the flat parts of the gear 112 and pinion 113 are in mesh, the carriage remains stationary with respect to assembly jig 18, during which time the laminae-injecting mechanism is functioning for the purpose of inserting a lamina 11 into a registering pair of grooves 37 of the assembly jig 18.

The power unit 21 comprises, a motor 114 which is connected to the shaft 109 through the medium of a conventional reduction gear 115, a conventional speed-adjusting mechanism 116 and a chain and sprocket mechanism 117. The re-

duction gear 115 is connected by a belt 118 to the cone pulleys 119 of the speed-adjusting mechanism 116 which, in turn, are connected by belt 120 to the motor 114 mounted on the platform 34. The effective ratio of the cone pulleys 119 is altered by the turning of the crank 121 in a manner that is well-known with this conventional type of device.

The tube-insertion mechanism 22 with its power-driven means 23 constitutes the subject matter of applicant's co-pending application hereinbefore identified.

Two sets of control mechanisms are employed for synchronizing the functioning of the motor 61, which actuates the laminae- or fin-selecting mechanism 42, and the motor 83, which actuates the fin-advancing mechanism 43. The former control mechanism comprises, a cam-actuated valve 124 (see Figs. 5 and 8) for controlling the admission of air to the cylinder 71 through the air line 80 to a source of compressed air. The latter control mechanism employs a standard type of magnetic switch 126 (see Figs. 4 and 9) connected to the motor 83 and controlled by specially-arranged micro-switches actuated by the laminae- or fin-selecting mechanism 42 and the carriage-advancing mechanism 20, as will more fully hereinafter be pointed out.

The valve mechanism 124 is positioned so as to be operated by a cam 127 driven by the power means 21. As herein shown, the valve 124 is mounted on the reduction gear housing 115 and the cam 127 is mounted on the shaft driven by said reduction gear 115 and which is connected to the shaft 109 by the gear and sprocket mechanism 117. The cam is formed with approximately circumferentially-equal high and low cam surfaces 128 and 129 upon which rides a roller 130 supported on an arm 131 connected to the valve mechanism 124. A spring 132 holds the rocker arm 131 to keep the roller 130 in contact with the cam 127. The cam 127 is so positioned on the shaft of said reduction gear 115 that the opening and closing of the valve mechanism 124, to admit air to or cut off the air from the cylinder 71 of the motor 61, is synchronized with the periods of movement and rest of the carriage 20 as effected by the intermittent gear and pinion 112—113.

The valve mechanism 124 is interposed in the pipe or tube 80 leading from the cylinder 71 of the air motor 61 to a suitable source of air pressure.

The magnetic switch 126, through which the operation of the motor 83 of the fin-advancing mechanism 43 is controlled, employs a solenoid 136 (see Fig. 4) connected to mechanically actuate simultaneously switch means 137, 138, and 139, which switches are connected in circuits, as will be hereinafter pointed out, so as to control the operation of the motor 83 under the influence of micro-switches x, y, and z, and k, and a push-button switch m (see Figs. 4, 9, and 10).

The micro-switches x and y are adapted to control the starting and stopping, respectively, of the motor 83 so as to keep the uppermost lamina in the magazine 41 within the effective range of the rocker arm 58. That range is indicated by the lines (x) and (y) on Fig. 9. These switches x and y are mounted in close juxtaposition to each other on supports 140 and 141 on the back of the stripper plate 51, which forms an extension to the chute wall 45, so as to be actuated by arms 142 and 143 (see Fig. 10) connected to the tubular rocker shaft 59.

The micro-switch z is arranged to coact with the switch x to stop the motor 83 (as will be more fully hereinafter pointed out) when the uppermost lamina in the magazine 41 has reached the upper limit of the effective range of the rocker arm 58 as indicated by (x) in Fig. 9. This switch is mounted on a support 144 secured to the frame 17 so as to be operated by a cam 145 connected to the shaft 109. The cam 145 is of such a shape and so positioned on the shaft 109 that its contact with the roller on the spring arm 145′ shifts the button 145″ of the micro-switch z so as to be constantly opening and closing the circuit across the terminals 158 and 161. The cam holds the switch z open at all times when the arm 143 of the switch x is moving over the button 143′—during the recurring reciprocation of the rocker arm 58—except when the uppermost laminæ in the magazine is approaching the line (y).

The micro-switch k is mounted on the end plate 49 and is adapted to break the circuit to the motor 83 when the platform 55 for the magazine 41 has reached the upper limit of its movement.

As shown in the diagrammatic view of Fig. 4, the terminals 137′ and 138′ of the switches 137 and 138, respectively, are connected with the positive and negative terminals 146 and 147 of a suitable plug for connection to the usual power line. The terminals 137″ and 138″ of the switches 137 and 138 respectively, are connected by lines 148 and 149 to one terminal 150 of the micro-switch k and one of the terminals of the motor 83; the other terminal 151 of the micro-switch k being connected to the other terminal of the motor 83. The terminal 139′ is connected by the line 152 to the terminal 153 of the micro-switch x and to one of the terminals of the manually-operated switch m. The terminal 139″ of the switch 139 is connected by a line 154 to one of the terminals 155 of the micro-switch y.

The solenoid 136 is inserted in a line 156 leading from the incoming line 146 to the line 154. The terminal 157 of the micro-switch x is connected by a line 159 to the line 149 and to the negative incoming line 147. The terminal 158 of the switch z is connected by a line 164 to the line 159. The other terminal 161 of the micro-switch z is connected through the manually-controlled switch m to the terminal 153 of the micro-switch x.

The switch-arms 142 and 143 are so fixed on the tubular rocker-shaft 59 that they effect the closing and opening of the switches y and x, respectively, when the foremost lamina of the magazine registers approximately with the lines (y) and (x) of Figs. 9 and 10. The closing of the normally open switch y is accomplished when the arm 142 reaches extreme limit of its arcuate path of reciprocal movement complementary of the limit of reciprocal movement of the rocker arm 58 as determined by the foremost lamina at approximately the line (y). The momentary opening of the normally-closed switch x occurs with every passage of the arm 143 over the button 143′, during the reciprocal movement of the arm 58. When the uppermost laminae in the magazine 41 register with a position comparable to the line (x) of Fig. 9 the arm 143 is temporarily at rest on the button 143′. This opens the bridge across the terminals 153 and 157 so that upon the next subsequent depression of the button 145″, by the arm 145′ as effected by the cam 145, the bridge across the terminals 158 and 161 is opened whereupon the circuit to the motor 83 is cut and

the advance of the laminæ in the magazine is arrested.

The motor 114 is a reversible motor and is connected with a suitable source of power and with micro-switches 162 and 163 positioned at opposite ends of the track 106 for the carriage 20 adapted to be contacted by suitable shoulders on said carriage so that the power to the motor 114 will be cut out as the carriage 20 reaches the respective limits of its travel along the frame 17 within the operative range for injecting laminae into the assembly jig 18.

Brushes 165 are placed on the chute walls 48 and 49 to engage the ends of the laminae so as to lessen the probabilities that more than one lamina will be carried by the arms 58 to the chute 40.

The operation of this laminæ- or fin-assembling machine involves three synchronated cycles:

a. The transferring of the laminæ into the chute and their subsequent injection into the assembly jig;

b. The intermittent advance of the carriage to bring the fin chute successively into registration with the grooves in the assembly jig; and

c. The advancing of the laminæ in the laminæ-magazine to keep the foremost lamina in the magazine within the effective range of the mechanism by which the laminæ are transferred from the magazine to the chute.

(*a*) *The laminæ-transferring operation*

The laminae 11 are transferred one at a time from the laminae magazine 41 to the chute 40 through the recurring reciprocation of the rocker arm 58 under the counter-acting impulse of the motor 61 and spring 77.1. As each lamina drops into the chute 40 it is advanced to the feed rollers 91 and injected into the assembly-jig 18. The transference of the laminæ from the magazine 41 to the chute 40 occurs during the time that the carriage 20 is moving to advance the chute from registration with one pair of grooves 37 in the assembly-jig 18 to registration with another pair. Obviously, the reception of the lamina in the chute 40 preparatory to its delivery to the feed rollers 91 occurs as the carriage comes to rest from the foregoing movement.

The movement of the rocker-arm 58 from the position shown in Fig. 9 to a point rearwardly of the stripper plate 51, to transfer a lamina from the magazine 41 to the chute 40, is controlled by the action of the cam 127. When the roller 130 of the arm 131 moves from the high spot 128 to the low spot 129, the valve 124 is opened to admit air to the cylinder 71 of the air motor 61. This shifts the plunger in the cylinder 71 so as to cause the link mechanism 62 to shift the rack 60 downward (see Fig. 9). Thereupon the pinion 70 turns the tubular shaft 59 so as to swing the arm 58, with a lamina 11 suctionally gripped by the cups 63, and retracts it through the opening 64 in the stripper plate 51. As the cups 63 pass through these openings the lamina is stripped therefrom and by gravity dropped into the chute 40.

Simultaneously with the backward swinging of the arm 58, the motor bracket 97 is swung to retract the brush 93 to clear the chute 40. Such retraction of the brush 93 is effected by means of the cable 109.

As the roller 130 on the arm 131 moves from the low spot 129 on the cam 127 to the high spot 128, the valve 124 is closed to cut off the admission of compressed air to the motor 61. Thereupon the spring 77.1 reverses the movement of the rack 60 through the action of the link mechanism 62 and causes the rocker arm 58 to be returned to the position shown in Fig. 9 to suctionally grip another lamina in the magazine 41. At the same time the spring 99 shifts the motor bracket 97 to move the brush 93 to bring the periphery thereof into contact with the lamina whch has just been dropped into the chute 40. The brush instantly advances the lamina to the feed rollers 91 which, with accelerated action, inject the lamina into a registering pair of grooves 37 of the assembly-jig 18.

(*b*) *The laminæ-handling carriage advancing mechanism*

At the instant the injection of a lamina into the assembly jig 18 has been completed the teeth on the gear 112 come into mesh with the pinion 113, giving the shaft 108 a full revolution. The pitch of the thread on the shaft 108 causes a consequent advance of the carriage 20 a distance equal to the pitch of the grooves 37 of the assembly jig 18. During this advancing movement of the carriage the above-mentioned laminæ-transferring mechanism operates to transfer lamina from the magazine 41 to the chute 40.

(*c*) *Laminæ-advancing mechanism*

As will be obvious from Fig. 9, the foremost lamina in the magazine 41 must be kept within the effective range of the rocker arm 58 to secure the best results in the inerrant pickup of the laminæ by the suction cups 63 with each downward movement of said arm. To this end, the elevator or platform 55 must be intermittently advanced so that the foremost lamina occupies a position in the range between the lines (*x*) and (*y*). Thus, when the foremost lamina is approximately on the line (*y*), Fig. 9, the motor 83 must be started to cause the elevation of the platform 55. When the foremost lamina is approximately at the line (*x*) the operation of the motor 83 must be discontinued. It is to these ends that the micro-switches *x*, *y*, and *z*, have been arranged as hereinbefore pointed out.

When the foremost lamina in the magazine 41 is approximately at the line (*y*) (see Fig. 9) the contact of the arm 142, on the rocker-shaft 59, engages the arm 142' sufficiently to cause it to depress the button 142'' and cause the switch *y* to bridge the contacts 155 and 160 (see Fig. 4). This results in a closing of the circuit through the solenoid 136 of the magnetic switch 126 and closes all three switches 137, 138, and 139 (see Fig. 4).

The circuit, upon the closing of the micro-switch *y*, may be traced as follows:

Lines 146 and 156, solenoid 136, line 154, contact 155, *y*, contact 160 and line 160' from which the current continues through line 159 to line 147 through whichever of the micro-switches *z* or *x* is closed.

Obviously, the closing of this circuit by micro-switch *y* and the consequent shifting of the solenoid 136 is instantaneous. However, the closing of the switch 139 maintains a "holding" circuit through the solenoid 136 so that the energization thereof is continued. The circuit for that purpose may be traced through the lines 146, 156, solenoid 136, contact 139'', switch bar 139, contact 139' and line 152, from which the current has the option of continuing through line 159 to line 147 depending upon which of the micro-switches *z* or *x* is closed.

The simultaneous shifting of the switches 137

and 138 closes the circuit to the motor 83 and causes it to move the elevator 55 to advance the laminæ along the magazine 41. The circuit to the motor may be traced through the line 146, contact 137', switch bar 137, contact 137'', line 148, contacts 150 and 151 of micro-switch *k*, motor 83, line 149, contact 138'', switch bar 138, contact 138', line 147. The motor 83 continues to operate to advance the laminæ in the magazine 41 until the foremost lamina approximates the position shown by line (*x*) (see Fig. 9).

When the foremost lamina is approximately at the line (*x*) the arm 143, on the tubular shaft 59, is brought to rest on the button 143' on the micro-switch *x*, retracting the bridge thereof so as to open the contacts 153 and 157 (see Fig. 4) whereby the above-described "holding" circuit to the solenoid 136 is broken and the solenoid is de-energized, allowing the conventional spring to retract simultaneously the switches 137, 138, and 139. The design and position of the cam 145 is such that the arm 145' is retracted to depress the button 155'' to open micro-switch *z* when the arm 143 is at the above position of rest on the button 143'. Thus, the simultaneous opening of both of the micro-switches *x* and *z* results in a breaking of the circuit to the motor 83, checking any further advance of the laminæ in the magazine.

When the laminæ in the magazine 41 have been advanced so that the last lamina for completing a particular assembly in the jig 18 has been transferred from the magazine 41 to the chute 40, the platform 55 will actuate the switch *k* so as to disconnect the contacts 150 and 151, thereupon opening the circuit to the motor 83 and preventing any further operation thereof for the advance of laminæ in the magazine 41.

The readying of the machine for automatically effecting the above-mentioned synchronized cycles of operation involves setting the carriage 20, with its laminæ-handling mechanisms, at one end or the other of the assembly-jig 18, and loading the magazine 41 with laminæ.

A switch (not shown) is conveniently arranged on the frame 17, forwardly or to the right of the carriage 20 and its laminæ-handling mechanisms 19, and connected to control the starting of the motor 114. Wherever the carriage 20 may have stopped with respect to the assembly-jig 18, this switch would be operated to cause the power driven unit 21 to move the carriage 20 to bring the chute 40 into registration with the first pair of grooves 37 at one end or the other of the assembly-jig 18.

In order to load the magazine 41 it is obviously necessary to reverse the operation of the motor 83 so as to lower the platform 55 to the bottom of the chute. This is effected by simply shifting the arm 90 to release the clutch 84, whereupon the platform 55 may be depressed.

Thereupon the operator places a predetermined number of laminæ on the platform 55 with one hand on the push-button for the switch *m*, the operator with the other hand moves the rocker arms 58 so as to bring the suction cups 63 below the level of the line (*y*) (see Fig. 9) in order to cause the switch arm 142 to shift the arm 142' to depress the button 143'', thus closing the switch *y*. This will close the circuit to the motor 83 in exactly the same way as hereinbefore pointed out in connection with the description of the automatic operation of switch *y*. By shifting the arm 90 so as to engage the clutch 84, the motor 83 will elevate the platform 55 until the foremost lamina comes in contact with the suction cups 63 of the arms 58 and retracts said cups to approximately the line (*x*) (see Fig. 9). The switch 143 will have depressed the button 143' of the switch *x* so as to open the circuit to the motor 83 and discontinue the elevation of the platform 55. Thereupon, the operator releases the push-button switch *m*.

The machine then being ready to operate, the operator closes the general control switch to the motor 114, whereupon the machine begins its automatic operation of transferring laminae from the magazine 41 to the chute 40, from whence they are injected into the assembly-jig 18 as the machine intermittently advances along said jig, as hereinbefore set forth.

Variations and modifications in the details of structure and arrangement of the parts may be resorted to within the spirit and coverage of the appended claims.

I claim:

1. A laminæ-assembling machine comprising a horizontally-disposed laminæ-receiving element adapted to receive laminæ through an open side of said element and support said laminæ in vertical parallel disposition, a horizontally-extending chute of narrow cross section sufficient to support individual laminæ therein vertically on edge, a laminæ magazine associated with said chute, means for successively transferring laminæ one at a time from said magazine to said chute, a pair of high-speed continuously-rotating rollers located at the delivery end of said chute for injecting said vertically-disposed laminæ horizontally from said chute through said open side into said receiving element, means other than and operating independently of said selector means for advancing laminæ received in said chute into engagement with said rollers, and control mechanism for synchronizing the operation of the aforesaid means.

2. A laminæ-assembling machine comprising a laminæ-receiving element, a chute for delivering laminæ to said receiving element, a laminæ magazine associated with said chute, means for successively transferring laminæ from said magazine to said chute, a pair of high-speed continuously-rotating rollers located at the delivery end of said chute for injecting laminæ from said chute into said receiving element, a continuously-rotating brush mounted for reciprocal movement to bring the periphery thereof into and out of the path of the laminæ delivered to said chute for causing said laminæ to be advanced to said rollers, means for effecting the reciprocal movement of said brush, and control mechanism for synchronizing the operation of the aforesaid means.

3. A laminæ-assembling machine comprising a supporting frame, a jig mounted on said frame and having superimposed upper and lower plates grooved to receive vertically-disposed horizontally-moving laminæ and support the same vertically on edge, a laminæ magazine mounted to traverse said jig, a chute of narrow cross section sufficient to support individual laminæ vertically on edge and mounted on said magazine to move horizontally in the plane between said laminæ-supporting plates so as to direct laminæ in the plane of said chute lengthwise from said chute into said jig, means for intermittently advancing said magazine and chute horizontally along said jig to bring the chute into successive registration with the vertically-spaced laminæ-receiving grooves of said jig, means for successively transferring laminæ from said magazine to said chute,

a pair of high-speed continuously-rotating rollers located at the delivery end of said chute for injecting said laminæ into said jig grooves, means for advancing laminæ received in said chute into engagement with said rollers, and control mechnism for synchronizing the operation of the aforesaid means whereby said means for transferring laminæ from said magazine to said chute occurs during the intermittent advances of said chute along said jig and the advance of said laminæ in said chute occurs when said chute is stationary.

4. A laminæ-assembling machine comprising a supporting frame, a jig mounted on said frame and grooved to receive and support laminæ in a predetermined assembly, a laminæ magazine mounted to traverse said jig, a chute associated with said magazine so as to direct laminæ from said magazine into said jig, means for advancing said magazine and chute along said jig to bring the chute into successive registration with the laminæ-receiving grooves of said jig, means for successively transferring laminæ from said magazine to said chute, a pair of high-speed continuously-rotating rollers located at the delivery end of said chute for injecting said laminæ into said jig grooves, a continuously-rotating brush mounted for reciprocal movement to bring the periphery thereof into and out of the path of the laminæ delivered to said chute for causing said laminæ to be advanced to said rollers, means for effecting the reciprocal movement of such brush, and control mechanism for synchronizing the operation of the aforesaid means.

5. A laminæ-assembling machine comprising a supporting frame, a jig mounted on said frame and grooved to receive and support laminæ in a predetermined assembly, a laminæ magazine mounted to traverse said jig, a chute associated with said magazine so as to direct laminæ from said magazine into said jig, means for intermittently advancing said magazine and chute along said jig to bring the chute into successive registration with the laminæ receiving grooves of said jig, selector means operable for transferring laminæ one at a time from said magazine to said chute, means for advancing said laminæ in said magazine into the path of said selector, means other than and operating independently of said selector means for injecting laminæ from said chute into said jig, means actuated by said selector means for regulating the operation of said laminæ-advancing means, and control mechanism for synchronizing the operation of said selector means and said laminæ- and chute-advancing means and said laminæ-injecting means whereby the transfer of a lamina from said magazine to said chute occurs during the intermittent advancing movements of said chute and said laminæ-injecting means operates intermediate said intermittent advancing movements of said chute.

6. A laminæ-assembling machine comprising a supporting frame, a jig mounted on said frame and grooved to receive and support laminæ in a predetermined assembly, a laminæ magazine mounted to traverse said jig, a chute associated with said magazine so as to direct laminæ from said magazine into said jig, means for advancing said magazine and chute along said jig to bring the chute into successive registration with the laminæ-receiving grooves of said jig, a suction member mounted for reciprocating action between the foremost lamina in said magazine and a laminæ-stripping member adjacent said chute whereby laminæ are transferred one at a time from said magazine to said chute, means for reciprocating said suction member, means for injecting laminæ from said chute into said jig, means for advancing the laminæ in said magazine into the path of said suction member, and control mechanism for synchronizing the operation of the aforesaid means.

7. A laminæ-assembling machine comprising a supporting frame, a jig mounted on said frame and grooved to receive and support laminæ in a predetermined assembly, a laminæ magazine mounted to traverse said jig, a chute associated with said magazine so as to direct laminæ from said magazine into said jig, means for advancing said magazine and chute along said jig to bring the chute into successive registration with the laminæ-receiving grooves of said jig, a suction member mounted for reciprocating action between the foremost lamina in said magazine and a laminæ-stripping member adjacent said chute whereby laminæ are transferred one at a time from said magazine to said chute, means for reciprocating said suction member, means for injecting laminæ from said chute into said jig, an electrically-operated motor for advancing the laminæ in said magazine into the path of said suction member, switch means arranged to control the starting and stopping of said motor, switch-shifting means actuated by said suction member whereby the operation of said motor is regulated to maintain the foremost laminæ in the said magazine within the effective range of said suction member, and control mechanism for synchronizing the operation of said suction-member reciprocating-means with said magazine- and chute-advancing means and said laminæ-injecting means.

8. A laminæ-assembling machine comprising a supporting frame, a jig mounted on said frame and grooved to receive and support laminæ in a predetermined assembly, a carriage mounted to traverse said jig, a pair of vertically-spaced walls arranged on said carriage and forming a chute adapted to direct laminæ into said jig, said walls having their upper ends oppositely divergent with the upper end of one of said walls extending above the upper end of the other said wall, means for injecting laminæ from said chute into said jig, a magazine arranged on said carriage at one side of said chute below the upper end of said other wall, a vertically-moving lamina-supporting platform for said magazine, a suction member reciprocatingly movable through said one wall above said chute and into position to select the uppermost lamina in said magazine and bring it into contact with said one wall for stripping it from said suction member for delivery into said chute, means for reciprocating said suction member, means for elevating said platform, means for moving said carriage along said jig to bring the delivery end of said chute into successive registration with the laminæ-receiving grooves of said jig, and control mechanism for synchronizing the operation of the aforesaid means.

9. A laminæ-assembling machine comprising a supporting frame, a jig mounted on said frame and grooved to receive and support laminæ in a predetermined assembly, a carriage mounted to traverse said jig, a pair of vertically-spaced walls arranged on said carriage and forming a chute adapted to direct laminæ into said jig, said walls having their upper ends oppositely divergent with the upper end of one of said walls extending above the upper end of the other said wall, a pair

of high-speed continuously-rotating rollers located at the delivery end of said chute in position to receive laminæ for injecting them into said jig, a continuously-rotating brush mounted for reciprocal movement to bring the periphery of said brush into and out of the path of the laminæ delivered to said chute for causing said laminæ to be advanced to said rollers, means for effecting the reciprocal movement of said brush, a magazine arranged on said carriage at one side of said chute below the upper end of said other wall, a vertically-moving lamina-supporting platform for said magazine, a suction member reciprocatingly movable through said one wall above said chute and into position to select the uppermost lamina in said magazine and bring it into contact with said one wall for stripping it from said suction member for delivery into said chute, means for reciprocating said suction member, means for elevating said platform, means for moving said carriage along said jig to bring the delivery end of said chute into successive registration with the laminæ-receiving grooves of said jig, and control mechanism for synchronizing the operation of the aforesaid means.

10. A laminæ-assembling machine comprising a supporting frame, a jig mounted on said frame and grooved to receive and support laminæ in a predetermined assembly, a carriage mounted to traverse said jig, a pair of vertically-spaced walls arranged on said carriage and forming a chute adapted to direct laminæ into said jig, said walls having their upper ends oppositely divergent with the upper end of one of said walls extending above the upper end of the other said wall, means for injecting laminæ from said chute into said jig, a magazine arranged on said carriage at one side of said chute below the upper end of said other wall, a vertically-moving lamina-supporting platform for said magazine, a suction member reciprocatingly movable through said one wall above said chute and into position to select the uppermost lamina in said magazine and bring it into contact with said one wall for stripping it from said suction member for delivery into said chute, a motor for reciprocating said suction member, a second motor for actuating said magazine platform, an electrical circuit connected to said platform-actuating motor and including a magnetic switch for controlling the starting and stopping of said motor, a pair of micro-switches adapted to control said magnetic switch so as to effect the operation of said magazine-platform motor to maintain the foremost lamina in said magazine within the most effective operational range of said suction member, means associated with said suction member for actuating said micro-switches, means for moving said carriage along said jig to bring the delivery end of said chute into successive registration with the laminæ-receiving grooves of said jig, and control mechanism for synchronizing the operation of said carriage-advancing motor with the operation of said suction-member motor.

11. A laminæ-assembling machine comprising a supporting frame, a jig mounted on said frame to receive and support laminæ in a predetermined assembly, a carriage mounted on said frame to traverse said jig, a laminæ-magazine arranged on said carriage, a chute associated with said magazine and adapted so as to direct laminæ from said magazine into said jig, means for successively transferring laminæ from said magazine to said chute, means for injecting laminæ from said chute into said jig, means for advancing laminæ in said magazine into the path of said laminæ-transferring means, a main power unit connected to move said carriage along said jig, a motor for operating said laminæ-transferring means, a second motor for operating said laminæ-advancing means, a third motor for operating said chute-injection means, motor-actuating means connected with said main power unit and controlling the operation of the motor for said laminæ-transferring means, a magnetic switch for controlling the operation of the motor for said laminæ-advancing means, and a plurality of micro-switches connected in circuit with said magnetic switch, a pair of said micro-switches being positioned for actuation by said laminæ-transferring means and correlated with a micro-switch positioned for actuation by said carriage-advancing means so as to control the operation of the motor for said laminæ-advancing means to maintain the foremost lamina in said magazine within the most effective operational range of said laminæ-transferring means.

12. A laminae-assembling machine comprising a supporting frame, a jig mounted on said frame to receive and support laminae in a predetermined assembly, a carriage mounted on said frame to traverse said jig, a laminae-magazine arranged on said carriage, a chute associated with said magazine and adapted so as to direct laminae from said magazine into said jig, means for successively transferring laminae from said magazine to said chute, means for injecting laminae from said chute into said jig, means for advancing laminae in said magazine into the path of said laminae-transferring means, a main power unit connected to move said carriage along said jig, a motor for operating said laminae-transferring means, a second motor for operating said laminae-advancing means, a third motor for operating said chute-injection means, motor-actuating means connected with said main power unit and controlling the operation of the motor for said laminae-transferring means, a magnetic switch for controlling the operation of the motor for said laminae-advancing means, a plurality of micro-switches connected in circuit with said magnetic switch, a pair of said micro-switches being positioned for actuation by said laminae-transferring means and correlated with a micro-switch positioned for actuation by said carriage-advancing means so as to control the operation of the motor for said laminae-advancing means to maintain the foremost lamina in said magazine within the most effective operational range of said laminae-transferring means, and an additional micro-switch mounted on said magazine and actuatable by said laminae-advancing means to cut out the motor therefor when said laminae-advancing means has reached the limit of advancing said laminae.

13. A laminae-assembling machine comprising a supporting frame, a jig mounted on said frame to receive and support laminae in a predetermined assembly, a carriage, a main power unit for moving said carriage along said jig, a pair of vertical walls mounted on said carriage to form a chute having the delivery end thereof positioned to direct laminae into said jig as said carriage is moved along said jig, the back wall of said pair of walls extending above the forward wall and being inclined rearwardly to serve as a laminae-stripping plate for the hereinafter-mentioned laminae-selector, a pair of high-speed continuously-rotating rollers located at

the delivery end of said chute for injecting laminae into said jig, a continuously-rotating brush mounted for reciprocal movement to project the periphery thereof through an opening in said chute back wall into the path of laminae delivered to said chute for causing said laminae to be advanced to said rollers, a magazine mounted on said carriage forwardly of said chute front wall, a platform for supporting laminae in said magazine and movable along said magazine for advancing laminae into the path of the hereinafter-mentioned laminae-selector, a laminae-selector in the form of a pair of suction arms journalled on said chute back wall and extending through said stripper plate portion thereof and adapted to be reciprocated from a position engaging the uppermost lamina in said magazine to a position rearwardly of said stripper plate whereby in passing rearwardly of said stripper plate laminae are transferred from said magazine to said chute, a motor for operating said suction arms, means actuated by said main power unit for controlling the operation of said suction-arms motor, control means actuated by said suction-arms for effecting the operation of said magazine-platform motor, and means actuated by said suction-arms motor for shifting said constantly-rotating brush into the path of laminae in said chute.

14. A laminae-assembling machine comprising a supporting frame, a jig mounted on said frame to receive and support laminae in a predetermined assembly, a carriage, a main power unit for moving said carriage along said jig, a pair of vertical walls mounted on said carriage to form a chute having the delivery end thereof positioned to direct laminae into said jig as said carriage is moved along said jig, the back wall of said pair of walls extending above the forward wall and being inclined rearwardly to serve as a laminae-stripping plate for the hereinafter-mentioned laminae-selector, a pair of high-speed continuously-rotating rollers located at the delivery end of said chute for injecting laminae into said jig, a continuously-rotating brush mounted for reciprocal movement to project the periphery thereof through an opening in said chute back wall into the path of laminae delivered to said chute for causing said laminae to be advanced to said rollers, a magazine mounted on said carriage forwardly of said chute front wall, a platform for supporting laminae in said magazine and movable along said magazine for advancing laminae into the path of the hereinafter-mentioned laminae-selector, a laminae-selector in the form of a pair of suction arms journalled on said chute back wall and extending through said stripper plate portion thereof and adapted to be reciprocated from a position engaging the uppermost lamina in said magazine to a position rearwardly of said stripper plate whereby in passing rearwardly of said stripper plate the laminae are transferred from said magazine to said chute, an air pressure motor for reciprocating said suction arms, an air pressure valve connected to a source of air pressure and to said air pressure motor, means operated by said main power unit and synchronized with the movement of said carriage along said jig, for actuating said air-pressure valve, control means actuated by said suction arms for effecting the operation of said magazine-platform motor, and means operated by said air-pressure motor for shifting said constantly-rotating brush into the path of the laminae in said chute.

15. A laminae-assembling machine comprising a supporting frame, a grooved jig mounted on said frame to receive laminae through the open side thereof and support said laminae in a predetermined assembly with said laminae disposed vertically in a horizontal plane, a carriage, a main power unit for effecting an intermittent movement of said carriage along the open side of said jig, a laminae-magazine mounted on said carriage, a chute associated with said magazine and having its delivery end positioned to direct laminae into said jig between advances of said carriage along said jig, reciprocating selector means for transferring laminae from said magazine to said chute, means other than and operating independently of said selector means for injecting laminae from said chute into said jig grooves, a motor for advancing said laminae in said magazine into the path of said selector means, a motor other than and operating independently of said main power unit for operating said selector means, means associated with said main power unit for controlling the operation of said selector-means motor, and means associated with said selector means for controlling the operation of said laminae-advancing means.

16. A laminae-assembling machine comprising a supporting frame, a jig mounted on said frame to receive and support laminae in a predetermined assembly, a carriage, a main power unit for moving said carriage along said jig, a laminae-magazine mounted on said carriage, a chute associated with said magazine and having its delivery end positioned to direct laminae into said jig as said carriage is moved along said jig, reciprocating selector means for transferring laminae from said magazine to said chute, means for injecting laminae from said chute into said jig grooves, an electrical motor for advancing said laminae in said magazine into the path of said selector means, an air-pressure motor for operating said selector means, an air-pressure valve connected to a source of air pressure and to said air-pressure motor, means operated by said main power unit and synchronized with the movement of said carriage along said jig for actuating said air-pressure valve, and electrical means mechanically actuated by said selector means for regulating the operation of said laminae-advancing motor.

17. A laminae-assembling machine comprising, a laminae-receiving element, a chute for delivering laminae to said laminae-receiving element, means for delivering laminae one at a time to said chute, a pair of high-speed continuously-rotating rollers located at the delivery end of said chute for injecting said vertically-disposed laminae horizontally from said chute into said receiving element, a continuously-rotating brush mounted for reciprocal movement to bring the periphery thereof into and out of the path of the laminae delivered to said chute for causing said laminae to be advanced to said rollers, means for effecting the reciprocal movement of said brush, and control mechanism for synchronizing the operation of the aforesaid means.

18. A laminae-assembling machine comprising, a supporting frame, a laminae-receiving element mounted thereon, a narrow vertically-disposed open-top chute for supporting individual laminae vertically on edge and positioned so as to have laminae vertically-disposed in said chute and discharged therefrom horizontally into said laminae-receiving element, a magazine located at one side of said chute to support laminae in superimposed relationship transversely of the plane of

said chute with the uppermost lamina adjacent the open top of said chute, reciprocating selector means adapted to successively engage the uppermost lamina in said magazine and convey said lamina to a position above the open top of said chute with the plane of said lamina disposed substantially vertical, stripper means for disengaging said lamina from said selector means to permit said lamina to gravitate into a vertically-disposed position in said chute, means other than and operating independently of said selector means for injecting said lamina from said chute into said laminae-receiving element, and control mechanism for synchronizing the operation of the aforesaid means.

19. A laminae-assembling machine comprising, a supporting frame, a grooved jig mounted on said frame to receive and support laminae in a predetermined assembly, a carriage, a main power unit for moving said carriage along said jig, a laminae magazine mounted on said carriage, a chute associated with said magazine and having its delivery end positioned to direct laminae into said jig between the advances of said carriage along said jig, connections between said main power unit and said carriage for intermittently advancing said carriage along said jig to bring said chute into registration with the laminae-receiving grooves in said jig, reciprocating selector means mounted on said carriage for transferring laminae from said magazine to said chute, means for injecting laminae from said chute into said jig grooves, a motor for advancing said laminae in said magazine into the path of said selector means, a motor on said carriage for operating said selector means, cam-actuated means associated with said main power unit and synchronized with said connections for effecting the operation of said selector-means motor intermediate the intermittent movements of said carriage.

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