

Feb. 17, 1959

B. G. WINSTROM

2,873,515

COIL INSERTER

Filed Jan. 3, 1955

2 Sheets-Sheet 1

FIG. 1.

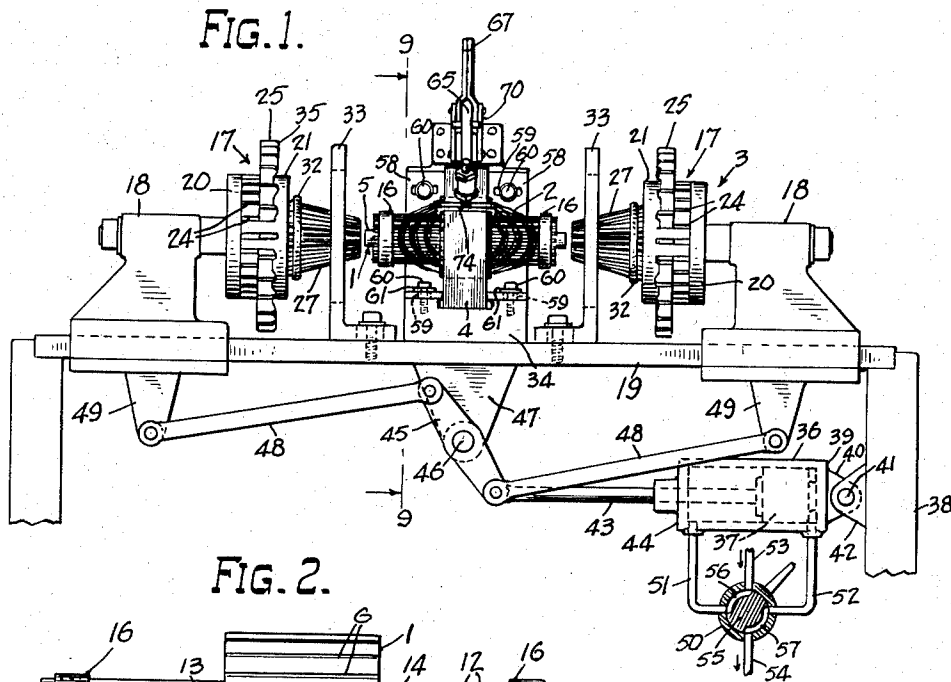


FIG. 2.

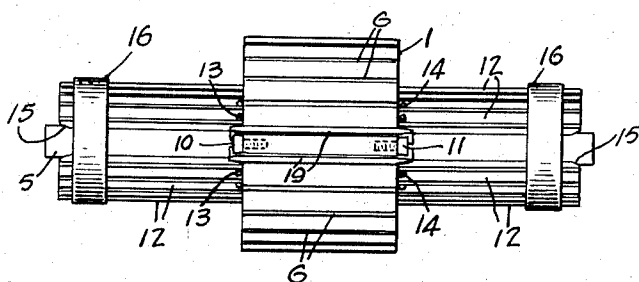


FIG. 3.

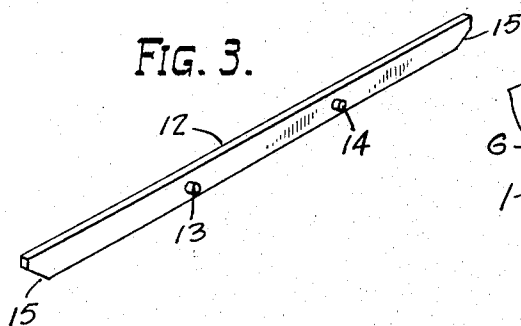
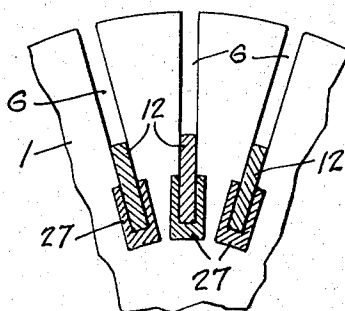


FIG. 4.



INVENTOR.
Bertil G. Winstrom
BY *Andrus & Seales*
ATTORNEYS.

Feb. 17, 1959

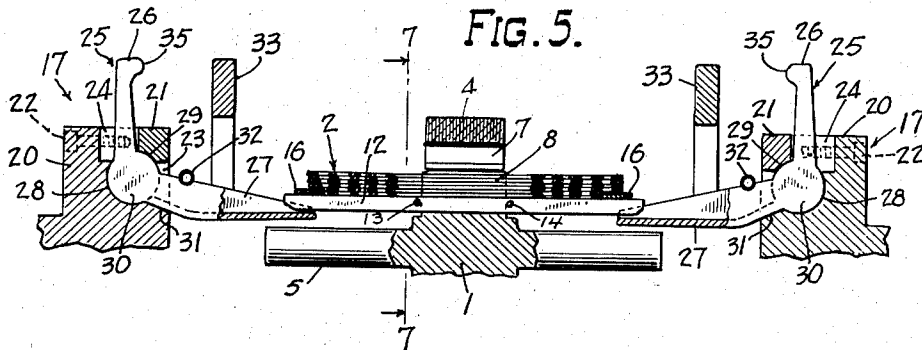
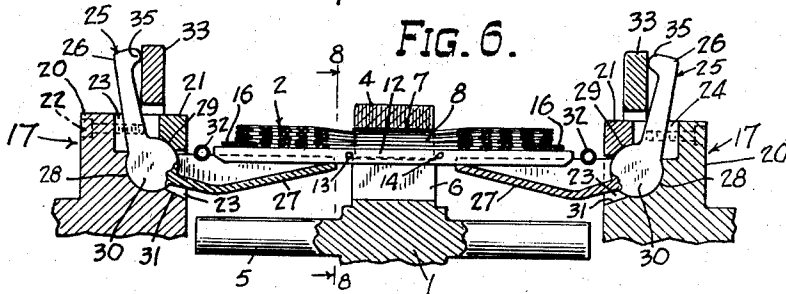
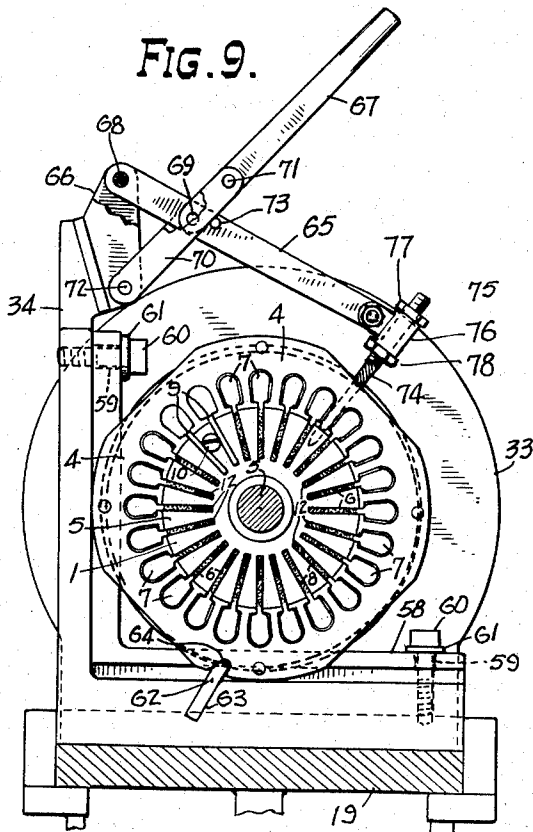
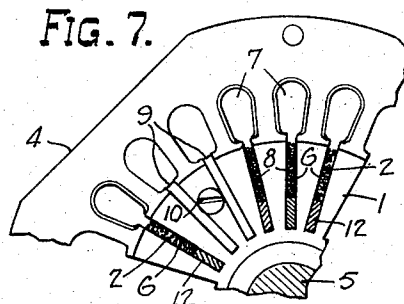
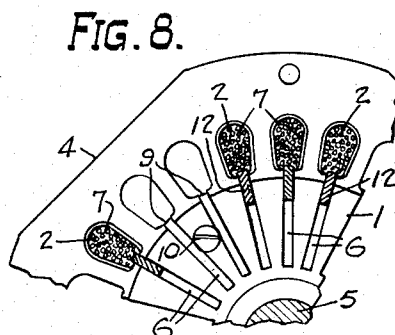
B. G. WINSTROM

2,873,515

COIL INSERTER

Filed Jan. 3, 1955

2 Sheets-Sheet 2



INVENTOR.
Bertil G. Winstrom
BY *Andrus & Seales*
ATTORNEYS.

1

2,873,515

COIL INSERTER

Bertil G. Winstrom, Thiensville, Wis., assignor to A. O. Smith Corporation, Milwaukee, Wis., a corporation of New York

Application January 3, 1955, Serial No. 479,263

7 Claims. (Cl. 29—205)

This invention relates to a fixture for mechanically inserting a prewound winding within the slots on the inner periphery of an annular core and constitutes an improvement on the inserter shown in the copending application of S. Dwight Mills, Serial No. 479,197, filed December 31, 1954, and entitled, "Cam-Actuated Coil Inserter." As shown and claimed in that application, prewound windings are transferred from a cylindrical core member to the slots of the annular core member that is to be provided with the coils or winding. To accomplish the transfer, radially moving blades are forced outwardly by simultaneously applying a radial force to the opposite ends of the blades by means of tapered cams.

In accordance with the present invention, the blades are moved radially outwardly by pivotal arms. To accomplish the coil insertion operation, the winding is prewound on a mandrel like slotted cylindrical core member or bobbin with radially moving blades disposed in the base of the slots of the winding mandrel and extending to both sides of the winding mandrel. Arms or cams of a generally L and channel-shape are simultaneously moved toward the winding mandrel and receive the radially movable blades with the sides of the winding in the slots of the winding mandrel and the ends of the winding overlying the outer portions of the pivotal arms and the blades. After a predetermined longitudinal movement of the arms, they are simultaneously pivoted to move the inner ends of the arms radially outwardly and force the blades radially outwardly and thereby transfer the windings from the slots of the winding mandrel to the slots of a dynamo-electric core which has been assembled around the winding mandrel.

The drawings furnished herewith illustrate the best mode presently contemplated for carrying out the invention.

In the drawings:

Figure 1 is an elevational view of a winding mandrel, a stator core, and windings disposed in a transferring machine;

Fig. 2 is an elevational view of the winding mandrel;

Fig. 3 is a perspective view of a radially moving transfer blade;

Fig. 4 is a fragmentary end view of the winding mandrel showing, in cross section, several blades resting within their respective channel-shaped arms;

Fig. 5 is a longitudinal sectional view showing the mandrel and the channel-shaped arms in assembled position prior to transfer of the winding to the core;

Fig. 6 is a view similar to Fig. 5 showing the arms after transferring the winding to the core;

Fig. 7 is a view taken on line 7—7 of Fig. 5;

Fig. 8 is a view taken on line 8—8 of Fig. 6; and

Fig. 9 is a view taken on line 9—9 of Fig. 1.

Referring to Figure 1 in the drawings, the invention comprises, in general, a winding mandrel or bobbin 1 which carries a prewound winding 2 and is securely supported within a press unit 3 which is adapted to transfer

2

the winding to an annular or stator core 4 surrounding the mandrel 1.

As more clearly shown in Figs. 5 and 6 the mandrel 1 is formed integrally with a shaft 5 axially protruding to both sides thereof and is provided with a series of radially extending, circumferentially spaced slots 6 to receive the winding 2. The slots 6 are equal in number and circumferentially spaced with relation to the slots 7 in the stator core 4 such that the slots in each can be aligned to permit the transfer of the winding 2 from the mandrel slots 6 to the stator slots 7 as more fully described hereinafter.

The windings 2 are formed of series connected coils having each coil side 8 being initially disposed within a single mandrel slot 6 and spaced in accordance with the final distribution within the stator core slots 7.

For purpose of aligning the mandrel slots with those of the stator, a key 9 is secured to each of two adjacent mandrel slots 6 and extends radially outwardly for a short distance. The keys 9 are secured in place by two set screws 10 and 11 which are threaded into each end of the mandrel between the keys 9. The stator core 4 is pressed about the mandrel 1 and the protruding ends of alignment keys 9 engage two adjacent stator core slots 7 to radially align the stator slots and the mandrel slots as seen in Figs. 7, 8 and 9. The described alignment structure requires that certain of the stator slots do not receive any of the coil sides being transferred from the mandrel 1 to the stator core 4 which is true of most stator cores. In the event all the slots of the stator core receive a coil side other suitable aligning structures are employed.

To transfer the winding 2 from the mandrel to the stator core 4, a radially movable winding transfer means or blade 12, a perspective view of which is shown in Fig. 3, is inserted into each slot 6 of mandrel 1 prior to the placing of the winding onto mandrel 1. To prevent axial movement of the blades 12, longitudinally spaced pins 13 and 14 extend from the side of each blade 12, and engage the opposed axial end surfaces of mandrel 1. The ends of the blades 12 are tapered as at 15 to provide a blunt point at the blade ends and thereby expedite the alignment of the blades as hereinafter described. The blades 12 are movably secured within the mandrel slots 6 by rubber tubes or the like 16 which encircle the blades, one to each side of the mandrel 1.

The mandrel 1, with windings 2 assembled therein and stator 4 disposed around it, is supported between two spaced identical heads 17 which are secured to carriages 18 of the press unit 3. The carriages 18 are slidably mounted on the press bed 19 and are interlinked to effect a simultaneous movement of the heads 17 toward or away from each other and the mandrel.

As shown in Figs. 1, 5 and 6, each of the two heads 17 consists of an annular body 20 and a cap 21 secured to the body 20 by a plurality of set screws 22. A series of aligned circumferentially spaced grooves 23 and 24 in the body 20 and the cap 21 respectively, accommodate a series of generally L-shaped blade-moving arms or cams 25 having a radial leg 26 extending through the groove 24 and an axial leg 27 extending axially in the groove 23 toward the mandrel 1 beneath the cap 21.

The radial inner base edge of the groove 23 is arcuate as at 28 and the inner edge of cap 21 is correspondingly arcuate as at 29 to provide a bearing surface for an integral circular junction 30 of the two legs of the L-shaped cam 25 pivoting therebetween. The inner end of groove 23 is inclined as at 31 to provide a pivoting space for the axial leg 27. The axial leg 27 in its retracted position extends downwardly along the inclined surface 31 and then parallel to the axis of the mandrel.

The axial leg 27 is channeled so that as the heads 17 travel toward the mandrel 1 each blade 12 engages the

3

channels of opposed aligned axial legs 27. When the axial leg ends are still slightly removed from the mandrel 1, the cam pivots with the axial leg 27 traveling radially outwardly to force blades 12 and the winding outwardly from each slot of mandrel 1 and into an aligned slot in the stator core 4 as seen most clearly in Figs. 7 and 8. The axial legs 27 are biased to an initial radially inward position by a garter spring 32 encircling the legs 27 of each set of cams 25. The garter springs may be located and confined within heads 17 if desired to eliminate the necessity for notching the arms 27 to retain the spring. The pivotal movement is transmitted to the cams 25 by two preset stationary vertical rings 33 which are adjustably secured to the press bed 19, one to each side of the stator holder 34. The rings 33 are preset such that the ends of the radial legs 26 upon axial mandrelwise travel engage the rings 33 when the pivotal movement is desired. Further axial movement causes the cams to pivot and move the legs 27 radially outwardly against the bias of garter spring 32. The ends of the radial legs 26 have a curved bearing surface 35 disposed to engage rings 33.

Referring to Figure 1, movement of the carriages 18 and consequently the heads 17 is hydraulically controlled by a hydraulic cylinder 36 which has a movable piston 37 connected to a linkage joining the carriages, as described below.

The hydraulic cylinder 36 is pivotally secured to a leg 38 of the press 3 with the longitudinal axis of the cylinder substantially parallel to the longitudinal axis of the press heads 17. To provide this mounting, one head 39 of the cylinder has a lug 40 which is bolted at 41 to a mating lug 42 extending from the press leg 38.

A piston rod 43, connected to the piston 37, extends outwardly through the opposite cylinder head 44 and is bolted to the lower end of a bell crank 45 and acts to rotate the bell crank about a central stationary pin 46 supported by a bracket 47 depending from the bed 19. To transmit the rotary motion of the bell crank 45 to the carriages, a link 48 is bolted to each end of the bell crank 45 and to a lug 49 depending from each carriage 18. As the bell crank 45 rotates, the carriages and press heads 17 simultaneously travel toward or away from each other. With the links 48 connected to the ends of the bell crank 45, as shown in Figure 1, a clockwise rotation of the bell crank moves the press heads toward each other and conversely a counter-clockwise rotation of the bell crank moves the press heads further apart.

A hydraulic fluid valve 50 governs the flow of fluid to and from the cylinder 36 to control movement of the piston 37 and consequently rotation of the bell crank 45. A fluid line 51 communicates with the valve 50 and one end of the hydraulic cylinder 36 and a second fluid line 52 communicates with the opposite end of the hydraulic cylinder and the valve diametrically opposite the connection of the fluid line 51 and the valve. The valve 50 has a fluid inlet 53 and a fluid exhaust 54 disposed diametrically opposite each other and removed 90° from connection of lines 51 and 52. A drum gate 55 is rotatably mounted in valve 50 and has diametrically opposite 90° arcuate recesses 56 and 57 which connect the fluid inlet 53 to either line 51 or 52 and at the same time connect the fluid exhaust 54 to either line 51 or 52. The connections are reversed by turning the drum gate 55 one-quarter turn; that is through 90°. As shown in Figure 1, when fluid inlet 53 is connected to the line 51 the hydraulic pressure acts on the piston 37 to hold the carriages 18 and press heads 17 in a separated or retracted position. Turning the drum gate 55 through 90° changes the connections and the fluid inlet 53 is then connected to the line 52 and the hydraulic pressure acts on the opposite side of piston 37 to move the carriages 18 and heads 17 toward each and holds

4

them in such position until the drum gate 55 is reversed. To lock the carriages in any desired intermediate position, the drum gate is turned slightly to cover the lines 51 and 52 with the recesses communicating only with the inlet and exhaust and thereby trapping the fluid in the cylinder 36 and lines 51 and 52.

To center the winding mandrel 1 between the press heads 17, the stator core and mandrel support 34 is secured to the press bed 19 midway between the press heads 17. The stator core and mandrel support 34 is L-shaped and secured to the face thereof is a pair of adjustable, spaced alignment brackets 58. The brackets are slotted as at 59 and the shank of a bolt 60 passes through each slot and threads into the mandrel support with the bolt head and a washer 61 clamping the brackets 58 in position. Thus, by suitable adjustment of the brackets 58, a recess equal in width to the stator core 4 is disposed midway between the press heads.

As shown in Fig. 9, to radially align the cams 25 with the movable blades 12, locating key 62 is secured in a recess 63 in the bottom surface of stator holder 34. The key 62 mates with an axial groove 64 in the outer surface of the stator core to effect the required alignment. As shown, the stator is constructed of a plurality of stacked laminations and is generally octagonal in shape with alternate straight and curved sides. In stacking the laminations, an index groove in each lamination is aligned with an index pin, not shown, and it is the resultant groove 64 which is employed to radially align the cams with the movable blades, as described above.

To securely hold the mandrel within the support 34 a clamp is provided which is described and claimed in the copending application of S. Dwight Mills previously referred to herein. The clamp comprises a lever 65 which pivotally depends from a bracket 66 bolted or otherwise secured to the upper portion of the mandrel support and is interlinked with a control handle 67. The bracket 66 is channeled with the lever 65 having its one end pinned within the upper end of the channel as at 68. The handle 67 is disposed above the lever 65 and has spaced legs which straddle the lever 65 and connect to the lever by a pin 69 passing through aligned openings in the handle and lever. The handle 67 is also movably linked to the bracket 66 by a link 70 which is pinned to the handle 67 above the lever 65 as at 71 and is also pinned to the lower end of bracket 66 as at 72. A stop pin 73 which extends through the lever 65 limits the downward movement of the handle 67 to the point where the handle 67 and link 70 are aligned. With the handle 67 in its forward dead center position, as shown in Fig. 9, it locks the lever 65 in clamping position. The lever 65 is released and raised by moving the handle 67 away from the operator.

An adjustable clamp 74 is secured to the free end of the lever 65 and with the handle 67 in a forward position bears against the outer periphery of the stator core and extends downwardly to the mandrel or bobbin 1 to securely hold the core in position within the support 34. The clamp 74 has a threaded shank 75 which passes through a tubular support 76 and is locked in adjusted position by nuts 77 and 78 threaded on the shank 75 and bearing against opposite ends of support 76. To increase the range of adjustment for various size stator cores, the tubular support 76 is bolted to the free end of lever 65 to permit pivotal adjustment of the support 76 and clamp 74.

In carrying out the invention, the winding mandrel 1 is assembled with the locating keys 9 and the blades 12 disposed in the appropriate mandrel slots 6. The prewound winding 2 is disposed within the slots 6 in the same relative position the winding is to have on the stator core 4. A prewound winding 2 includes a winding formed on a separate mandrel from the winding mandrel 1 and which is then placed in the slots 6 or a winding which is mechanically wound on the winding mandrel 1.

Stator core 4 is then pressed about the winding mandrel 1 with the locating keys 9 protruding into the stator slots 7 and radially aligning the slots 6 in the mandrel with the slots 7 in the stator core.

The alignment brackets 58 and clamp 74 are adjusted to accommodate the stator core which is then clamped in place by moving the control handle 67 forward to lower the lever 65 and secure the clamp 74 against the stator core. The stator core 4 is clamped in position with the key 62 disposed in the axial stator groove 64 to radially align the cams 25 and the blades 12.

The drum gate 55 is turned to effectuate mandrelwise movement of the press heads 17 and therefore cams 25. The blades 12 enter the channeled axial leg 27 until the leg comes to within a short distance of the mandrel 1 at which time the radial legs 26 of cams 25 engage the annular rings 33. As the press heads 17 continue their mandrelwise movement, the cams 25 pivot about the circular leg junction 30. The axial legs 27 of cams 25 rotate radially outwardly with the ends of the axial legs bearing on the blades, adjacent the mandrel 1, and force the blades and winding from the mandrel 1 to the stator core.

Upon completion of the transfer of the winding from the mandrel 1 to the stator core 4, the drum gate 55 is turned 90° to effect retractory movement of the heads 17 and cams 25. The cams 25 return to the normal initial position under the action of garter springs 32 and the blades 12 return to the mandrel slots 6 under the action of the rubber bands 16. The handle 67 is rotated rearwardly to release the clamp 74 from the core 4 and the stator core and winding mandrel is removed from the press unit.

Thereafter the stator core 4 is removed from the winding mandrel and the ends of the windings shaped to the desired contour. Slot pegs may then be inserted to close the stator core slots.

In the copending application of S. Dwight Mills previously referred to there is a description and showing of the applicability of that invention to the insertion into a stator core of slot pegs simultaneously with the winding. Also there is described in that application the simultaneous insertion of running and starting windings and slot separators and slot pegs. It is also contemplated under the present invention that insertion of slot pegs, running and starting windings and slot separators can also be inserted separately or simultaneously.

The present invention provides a fixture for mechanically inserting the winding in a stator core which is positive and automatic in action and simple in operation and permits the use of unskilled labor in winding a stator core.

Various modes of carrying out the invention are contemplated as being within the scope of the following claims particularly pointing out and distinctly claiming the subject matter which is regarded as the invention. I claim:

1. In a fixture for mechanically inserting prewound windings into slots extending in the inner periphery of an annular core, a generally cylindrical member having longitudinal circumferentially spaced radial slots extending inwardly therein from the periphery of said member and disposed complementary to the slots of the annular core to receive prewound windings, a plurality of circumferentially spaced separate means adapted to engage the windings in the slots of the annular core to move the windings radially outwardly, a plurality of circumferentially spaced pivotal generally L-shaped arms adapted upon pivotal movement to simultaneously actuate said spaced separate means to move the windings radially outwardly and transfer the windings from the slots in the cylindrical member to the slots of the annular core, means for bodily shifting said pivotal arms toward and away from said cylindrical member and means to effect pivotal movement of said pivotal means.

2. In a fixture for mechanically moving prewound windings from a series of circumferentially spaced longitudinal slots in a cylindrical core into winding slots in the inner periphery of an annular core surrounding the cylindrical core, winding transfer means disposed in the slots in the cylindrical core radially inward of said windings, a series of circumferentially spaced pivotal cams provided on each axial end of the assembled cores and extending radially inward of and in alignment with the outer opposite ends of respective winding transfer means, means to bodily shift said cams toward and away from said core, and means engageable with said cams when the latter are shifted bodily into engagement therewith to pivot the cams into lifting engagement with said transfer means to transfer the windings from the slots of the cylindrical core to the slots of the annular core.

3. In a fixture for mechanically moving prewound windings from a series of circumferentially spaced longitudinal slots in a cylindrical core into winding slots in the inner periphery of an annular core surrounding the cylindrical core, winding transfer means disposed in the slots in the cylindrical core radially inward of said windings, a series of circumferentially spaced pivotal cams provided on each axial end of the assembled cores in alignment with the slots therein, means to move the cams toward the assembled cores and into lifting engagement with the winding transfer means, and means in the path of movement of the cams to pivot the cams and said transfer means outwardly to transfer the windings from the slots of the cylindrical core to the slots of the annular core.

4. In a fixture for mechanically transferring a prewound winding from a series of circumferentially spaced longitudinal slots in a cylindrical core into winding slots in the inner periphery of an annular core surrounding the cylindrical core, which comprises means to secure the annular core around the cylindrical core during transfer of the windings from the latter to the annular core, winding transfer means disposed in the slots in the cylindrical core radially inward of said winding, a series of circumferentially spaced pivotal cams located on each end of the cylindrical core and disposed to move axially of the cylindrical core, means to move the cams to position the cams radially inward of the cylindrical core and beneath the winding transfer means, and means to pivot the cams into engagement with said transfer means to move the latter radially outwardly and transfer the winding from the slots of the cylindrical core to the slots of the annular core.

5. An assembling machine for mechanically transferring prewound windings from a series of circumferentially spaced slots in a cylindrical core to a series of correspondingly circumferentially spaced slots in the inner periphery of an annular core disposed in alignment with the cylindrical core slots, which comprises radially movable blade members disposed in the base of each cylindrical core slot radially inward of said windings, a plurality of circumferentially spaced pivotal cams located on opposite axial ends of the cylindrical core to dispose a pair of opposed cams in alignment with each slot of the cylindrical core, said cams being adapted to engage the opposite ends of a radially movable blade to move the respective blades outwardly, a press unit slidably mounted on said machine and on which said pivotal cams are pivoted whereby the cams simultaneously move toward and away from blade engaging positions, and means to pivot the cams into engagement with the blades at a predetermined time and thereby transfer the winding from the cylindrical core to the annular core.

6. An assembling machine for transferring a prewound winding from a cylinder having a series of radial slots to an aligned series of winding slots in the inner periphery of an annular core, which comprises a movable blade resting in and extending through each of the cylinder core slots, a pair of opposed heads disposed equidistant

one to each axial end of the core and cylinder, a series of circumferentially spaced cams pivotally secured to each head with each cam having an axially extending leg adapted to engage one of said movable blades and each cam also having a radially extending vertical leg, a press slidably mounted on said machine for each of said heads and on which are mounted to simultaneously move the heads toward the core and cylinder and subsequently to retract the heads to an initial position, and stop means disposed in the axial path of the vertical legs to prevent further axial movement of the vertical legs and thereby effect a pivotal movement of the cam in response to continued axial travel of the heads to engage the cams with said blades and move the blades radially outwardly and effect the transfer of the winding from the cylinder slots to the slots of the annular core.

7. An assembling machine for the mechanical embedding of annular stator windings by the mechanical transfer of prewound windings from a slotted cylinder to a surrounding stator core, which comprises a pair of opposed carriages slidably supported on a bed, linkage connecting the carriages together for simultaneous travel in opposed direction, fluid pressure means connected to the linkage to control the travel of the carriages, a head secured to each carriage, a series of circumferentially spaced L-shaped cams having an axial leg and a vertical leg joined by a circular junction, said cams being disposed within the heads with the legs extending out of L-shaped openings therein and having the circular junction secured between two opposed arcuate surfaces of the heads to allow pivotal movement of the cams, the axial leg of each cam being channel shaped to receive a wind-

ing moving blade resting in the slotted cylinder beneath said windings, a support secured to said bed midway between said carriages and being adapted to support the core and cylinder in axial alignment with the carriages and circumferentially aligned with the cams whereby upon core-wise travel of the carriages the channel-shaped axial legs receive the blades, and two annular rings secured one to each side of the support and interrupting the axial path of the ends of the radial legs of the cams as the heads are moved inwardly to effect a pivotal movement of the cams and thereby transfer the windings from the cylinder to the core, said rings being disposed to effect pivotal movement of the cams just prior to engagement of the axial cam legs with the cylinder whereby radial force is applied to the blades close to the cylinder to force the windings from the slots of the cylinder into the slots of the stator core.

References Cited in the file of this patent

UNITED STATES PATENTS

509,226	Kellogg	Nov. 21, 1893
1,164,704	Courembis	Dec. 21, 1915
1,538,187	Herrick	May 19, 1925
2,272,263	Cullin	Feb. 10, 1942
2,424,752	Heermans	July 29, 1947
2,443,824	Johnson	June 22, 1948
2,468,223	Mueller	Apr. 26, 1949
2,492,911	Williams et al.	Dec. 27, 1949
2,506,173	Polard	May 2, 1950
2,685,730	Probst	Aug. 10, 1954