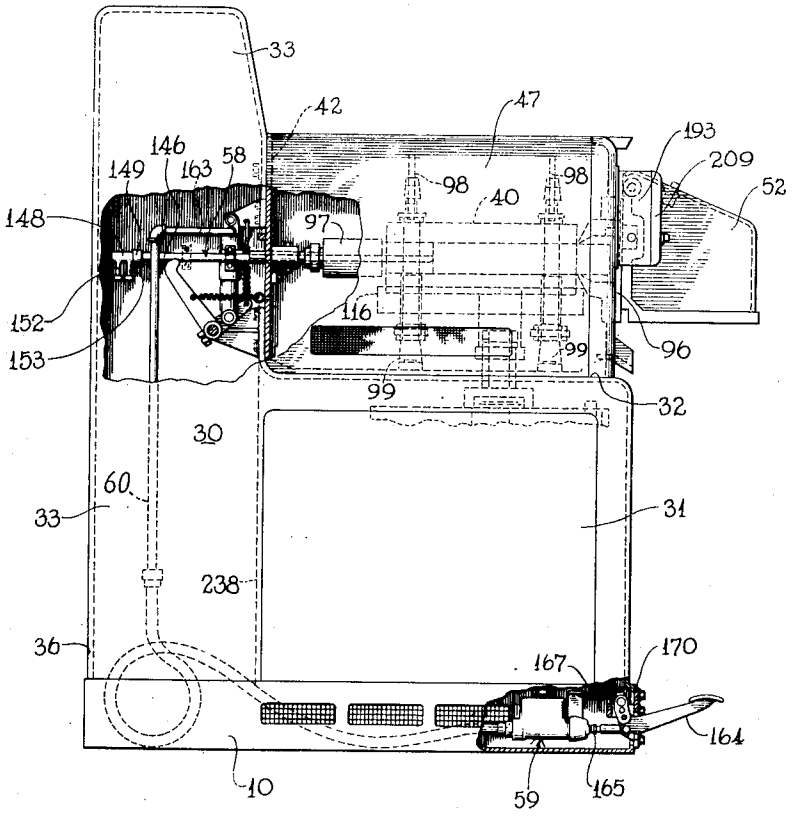
June 12, 1951 H. A. STRICKLAND, JR 2,556,234

WORK EXPULSION MECHANISM FOR FURNACES

Original Filed March 21, 1941 3 Sheets-Sheet 1

FIG. 1



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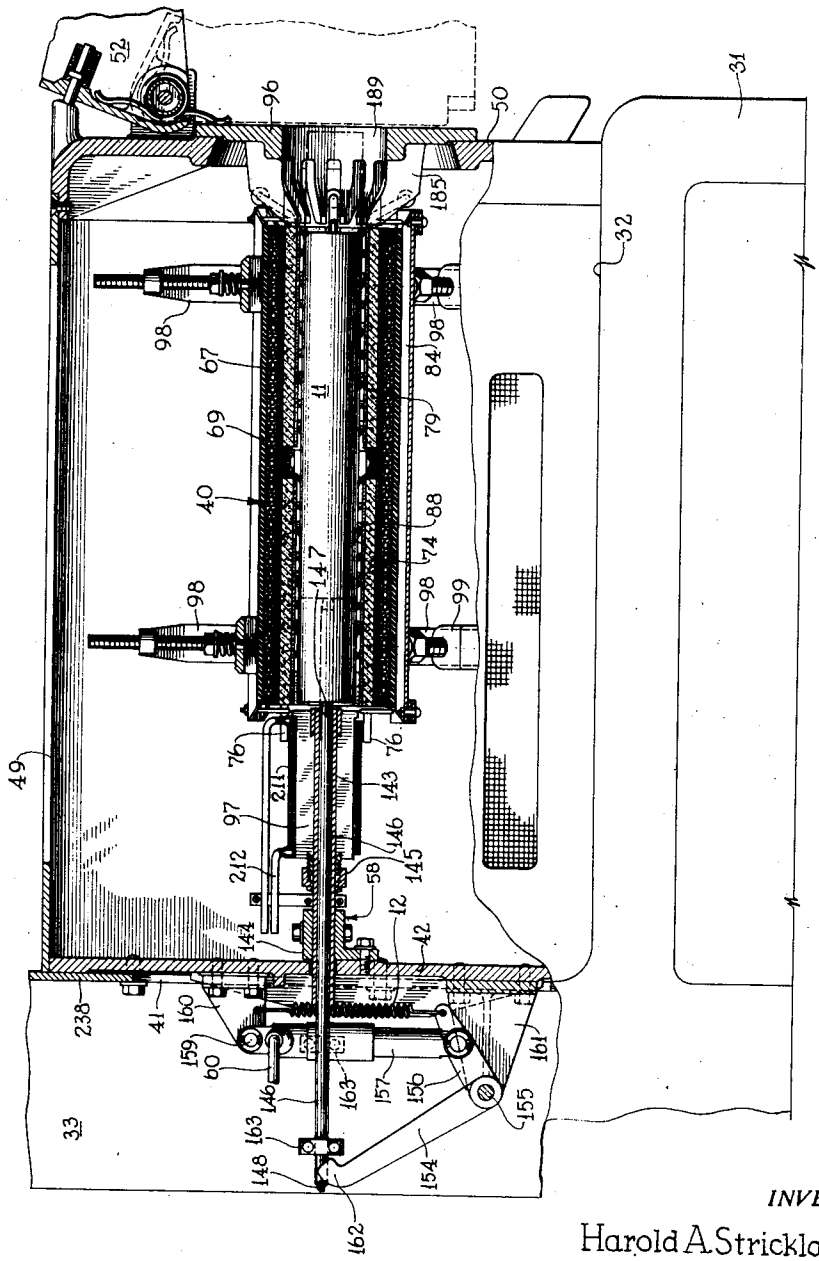
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WORK EXPULSION MECHANISM FOR FURNACES

Original Filed March 21, 1941 3 Sheets-Sheet 2

FIG. 2



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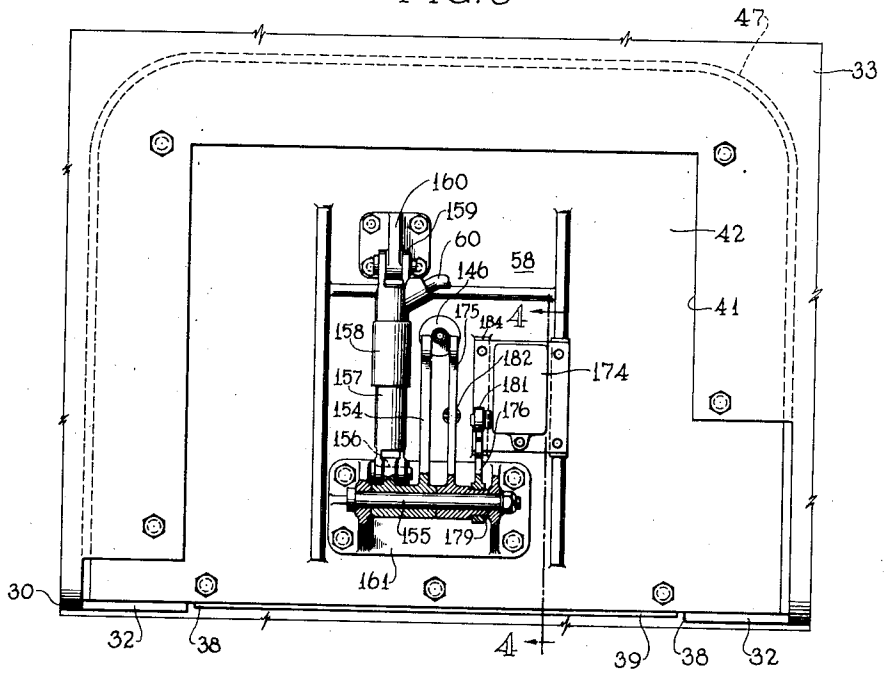
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WORK EXPULSION MECHANISM FOR FURNACES

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FIG. 3



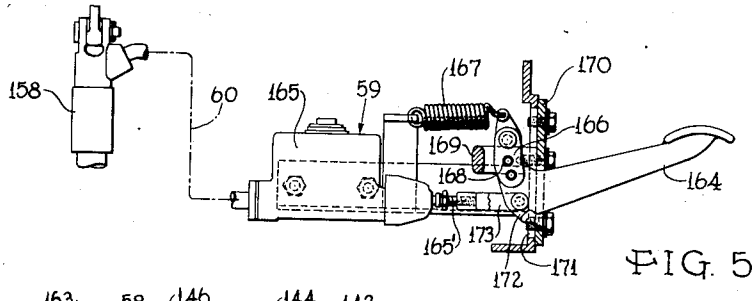


FIG. 5

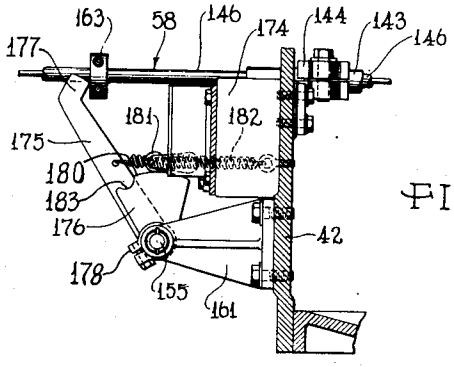


FIG. 4

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Patented June 12, 1951

2,556,234

UNITED STATES PATENT OFFICE

2,556,234

WORK EXPULSION MECHANISM FOR FURNACES

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Original application March 21, 1941, Serial No. 384,503, now Patent No. 2,408,350, dated September 24, 1946. Divided and this application January 10, 1946, Serial No. 640,228

6 Claims. (Cl. 219—47)

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This invention relates to furnaces for heating by electromagnetic induction, and particularly to such furnaces as are used or intended for use in the heating of bar or billet stock for forging purposes. This application is a division of my copending application Serial No. 384,503, filed March 21, 1941, entitled "Electric Furnace Machine," now Patent No. 2,408,350, dated September 24, 1946.

In the application above referred to there is disclosed a furnace construction including a heating chamber and means generally referred to as push-out mechanism for removing the workpiece after the heating cycle has been completed in the furnace. This push-out mechanism includes a rod operable from the rear side of the furnace and having a contacting tip engageable with the rear end of the workpiece so that when the mechanism is energized the rod moves axially to push out the workpiece to a point where it can be grasped by tongs or the like for complete removal.

A primary object of the present invention is to provide mechanical, readily actuated means for moving a furnace workpiece to a point where it is accessible to the attendant. Another object of the invention is to provide push-out mechanism which may be adjusted to workpieces of different linear length.

An object also is to provide a push-out mechanism which is simple and positive in action and easily accessible for repair and adjustment. Another object of the invention is to provide in association with and supported by the push-out adjustment means, a device for centering the furnace flux at the end of the heating chamber.

Other objects will appear on consideration of the specific structure hereinafter described.

Referring to the figures:

Figure 1 is a side elevation of a furnace to which my invention is applicable, with parts broken away to show the operating mechanism for the push-out rod;

Figure 2 is a side elevation in section of the furnace coil and associated parts, with enlarged detail of the push-out mechanism;

Figure 3 is a detailed view showing the rear end of the push-out rod and operating parts;

Figure 4 is a side view of the mechanism as shown in Figure 3; and

Figure 5 is a detail illustrating the pedal device used for operating the push-out means.

In Figure 1 of the drawings there is illustrated a furnace in side elevation to which my invention is applicable. On the base 10 an L-shaped

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structure 30 constituting the furnace as a whole is mounted, this furnace having an L-shaped section with a horizontal branch 31 and a vertical branch 33 forming an angular recess in which the furnace proper is placed. This furnace is designated by the numeral 40 applied to the induction coil and the numeral 47 applied to the casing which completely encloses the coil and associated appurtenances. In the L-shaped structure 31—33 are mounted the operating mechanism for a push-out rod assembly 58 and in the casing 47 are included the induction coil unit 40, the C-brackets 98 with their supporting bases 99, a flux drum 97, and a section of the push-out rod extending from the section 33 of the L-unit. The casing 47 is provided at the front end thereof opposite to the casing section 33 with a door opening for insertion of a workpiece, the hinged door 52 overlying this opening to protect it from flame blast gases in removal of the workpiece prior to completion of the heat treatment.

In Figure 2 is given greater detail of the furnace construction wherein it is seen that the coil unit 40 is comprised of an outer insulating casing 69 of any suitable material overlying the furnace coil which is in tubular form. The workpiece chamber, in which a workpiece 11 is indicated, is spaced from the coil by fire brick 74 and a framework of tubular guides 76 embedded in the fire brick on which internally thereof are mounted retaining lugs 79 and load bearing lugs 88. At the inlet opening of the front casing 50 a casting 96 is placed having a central opening 189 and inwardly directed guide fingers 185 which bend inwardly at their tips to form a constricted opening adjacent the open outer end of the furnace chamber of the coil unit 40. By this means the workpiece is guided into the furnace chamber on to the bearing lugs 88 of the guide tubes and is consequently positioned for heat treatment. When so positioned and the door 52 closed the heating cycle is commenced which brings the workpiece to the desired temperature. The heat is then automatically turned off and the door 52 opened, at which time the workpiece may be removed. The mechanism for accomplishing the removal is incorporated in the push-out mechanism 58 comprising a push-out rod 146 movable in a supporting tube 143, which tube is frequently referred to as a stock-gauge.

The push-out mechanism 58, and the flux drum or magnetic core 97 of the coil 40 associated therewith, all coact with the axially inner end of the workpiece at or near the axially inner end of the coil 40. While they are located

generally in Figures 1 and 2, their detail is depicted generally in Figures 3, 4 and 5. Referring particularly to Figures 2 and 4 for the moment, it will be seen that the stock-gauge per se comprises a tubular member 143 lying on the axis of the coil 40, and supported from the plate 42 of the coil casing for relative axial adjustment by a clamping bracket 144 bolted to the plate 42. The tubular member 143 projects rearwardly through the plate 42 a considerable distance allowing it to be axially adjusted back and forth through the clamp 144, to adjust its forward end with respect to the axially inner end of the coil 40, thereby to engage an inserted workpiece in different axial positions within the coil 40. Once adjusted for the proper gauging of the stock, for the proper heating thereof through the proper length, the gauge member 143 may be firmly clamped in its supported position.

The flux drum or magnetic core is mounted on this adjustable member 143, shown in Figure 2 as being fixed although it may be adjustable. The magnetic core 97 is comprised of an annular series of radially extending, radially tapering laminations, the details of which are no part of the present invention and are, therefore, not shown. Sufficeth to say, they are bound in place upon the support 143 or equivalent support by any suitable means such, for example, as the commonly known interlocking tongue and groove device 145. This magnetic core is of considerable diameter and axial extent. Therefore, a considerable magnetic mass is shown as of approximately the diameter of the workpiece accommodatable by coil 40. As projected in juxtaposition to the end of a workpiece, it receives the flux flowing external to the coil 40, collects and concentrates it, and conducts it more or less directly axially inwardly of the inner end of the workpiece. Its utilization and relative adjustment with respect to the end of the workpiece very considerably improves the reluctance of the magnetic circuit and affords a very flexible control of the distribution of heat in the heating of the axially inner ends of the workpiece. Thus with the proper gauge of the stock in position within the coil 40, plus adjustment of the flux through its axially inner end, irregular or imperfect heating or excessive heating in any portion in the inner end of the bar may be avoided. Thus it combines with such portion of the stock as may project from the outer end of the furnace to achieve a general reduction in the reluctance of the circuit.

The push-out mechanism comprises a preferably though not necessarily water-cooled push-out rod 146 working axially back and forth within the tubular support 143. The engaging tip 147 of the push-out rod 146 is made of heat-resisting metal or other such material, and is preferably removably secured to the end in a manner not shown, but well known in connection with welding electrode tips and the like.

This push-out or ejector rod 146 is axially projectable through the tubular support 143 by means of the long arm 154 of a bell crank pivoted at 155 and whose short arm 156 is connected with piston 157 of a floating fluid pressure cylinder 158 linked at 159 to a bracket 160 secured to the rear face of plate 42. The spring 12 moves the arm 156 against the action of the piston and cylinder. Bell crank 154, 156 is itself supported along with other parts of the mechanism from a larger bracket 161 also secured to the plate 42. Engagement of arm 154 with the

ejector rod 146 is a one-way engagement toward the coil through contact of its forwardly bent upper end 162 with an adjustable collar 163 about the rod, whereby the length of the rod may be made sufficiently great to enable it to be used in connection with workpiece stock of various lengths as associated with coils 40 of various lengths, the relation between the tip 147 and the collar 163 being appropriately adjusted to the ejection requirements of stock and coil sizes and positions and stroke of the push-out mechanism at large.

The stroke of the push-out mechanism is achieved by fluid pressure applied through conduit 60 from a master cylinder 59 of the automobile brake type operated by foot pedal 164. The system is kept filled from the usual reservoir 165 as in the automobile practice. The stroke of cylinder 59 and hence of the ejector rod 146 is regulatable by an adjustment of the leverages through which foot pedal 164 is connected to the piston rod of cylinder 59. Pedal 164 is a bell-crank whose short arm 166, to which retracting spring 167 is connected, is adjustably fulcrumed at 168 upon a fulcrumed bearing bracket 169. Bracket 169, together with pedal 164 and cylinder 59 and appurtenant parts, are all borne from a removable mounting plate 170 bolted to the face of the housing section 31, whereby the ensemble of this foot-pedal-operated actuating mechanism is removable as a unit from the housing 31 through the opening 171, without disconnecting from hose 60, and to the extent permitted by the provided length of flexible hose 60, merely by disconnecting the plate 170. A heel 172 on lever 164 abuts the inner face of the mounting plate 170 at the outer extreme of the stroke. Further stroke adjustment can be had through the screw-threaded adjustment of piston rod 165' with respect to link 173 by means of which it is connected to pedal 164.

Workpiece stock-limiting switch 174 (see Figures 3 and 4) is also operated in connection with the push-out rod 146. This is achieved through the long arm of bell-crank lever 175, 176, which long arm through a forwardly projected end 177 also has a one-way forward engagement with the adjustable collar 163. Like the bell-crank 154, 156, the bell-crank 175, 176 is freely journalled on the pivotal shaft 155. Unlike the bell-crank 154, 156, the arms of which are integral, the bell-crank 175, 176 has its arms relatively adjustable, the short arm 176 being adjustably clamped by a split collar 178 surrounding a lateral extension 179 of the hub of the long arm 175. Arm 176 forms a segment about the axis 155, and on an outer arc-shaped periphery 180 of this segment rides the switch-actuating roller arm 181 of the limit switch 174. Bell-crank 175, 176 is biased toward a forward position by a spring 182 extending to back plate 42, and the roller of roller arm 181, when the bell-crank is in its extreme forward position and the workpiece has been pushed out, engages in an arc-shaped depression 183 in this segment. By angularly relatively adjusting the arm 176 with respect to arm 175, the action of limit switch 174 may be adjusted effectively for each adjustment of collar 163. Switch 174 is mounted upon a bracket 184 also borne by back plate 42. The switch 174 may be connected to suitable control circuits such that when the switch is actuated, energization of the heating coil of the induction coil unit 40 may take place. The particular circuits other than the initiation function of the switch 174 form no part of the present invention

and will not be described or shown in detail. A preferred embodiment of a circuit into which the switch 174 may be connected is shown in Figure 19 of the parent application referred to above out of which this application has been divided.

Thereupon the heated workpiece may be removed simply by pushing downwardly on foot pedal 164. This actuates cylinder 158 to rock crank 154 about its axis 155 to engage the upper end of the crank with collar 163 on push-out rod 146, therethrough to push the workpiece axially outwardly. Simultaneously, it may be grasped in suitable tongs and removed for placement in the forging machine or other instrumentality used to treat or form it.

As is clearly described in the above referred to patent, upon removal of the workpiece the load switch 174 is opened, thereby opening the operating circuits of the furnace. In the event that the workpiece is not removed after the heating cycle, the circuits and switch mechanism are maintained in open position so that the power may not be reapplied to the same load as long as it remains in the furnace. This is simply because as long as a workpiece is in the machine, the push-out rod 146 through collar 163 retains rock arm 175 in its rearward position against the tension of spring 182, in which cam 180 retains switch arm 181 raised and switch 174 closed. Thus an operator is compelled to notice that a workpiece has been partially heated and refrains from replacing it in the machine until after it has been cooled. Overheating of a workpiece through subjection to one whole heating cycle and after exposure to a fraction of a prior heating cycle is thus prevented.

The mechanism as above described is direct in its actuation and may be manipulated readily by the operator to bring about movement of the workpiece to a point where it may be easily removed from the furnace chamber.

Modifications of the precise operating mechanism obviously may be made within the scope of the appended claims.

What is claimed is:

1. An apparatus for heating a workpiece by electromagnetic induction comprising an induction heating coil, a track for supporting the workpiece during heating, a laminated magnetic core adjacent the end of a workpiece when in heating position and in general prolongation of the workpiece, a stock gauge by which the core is supported, said stock gauge extending through the core, and a workpiece push-out device slidable through said core and guided within and by said stock gauge.

2. A machine for heating workpieces comprising in combination, a tubular heating coil having at least one end open for the insertion and removal of a workpiece and workpiece removing mechanism positioned adjacent the other end of the coil for moving the workpiece toward the open end, said mechanism including a rear index stop for the workpiece, said stop being adjustably supported to fixed positions along the axis of said coil.

3. A machine for heating workpieces comprising in combination, a tubular heating chamber having at least one end open for the insertion and removal of a workpiece, an indexing stop for the workpiece adjacent the other end of the chamber, said stop comprising an adjustably mounted tube and a plunger rod in said tube for pushing the workpiece toward the open end.

4. A machine for heating workpieces comprising in combination, a tubular heating chamber having at least one end open for the insertion and removal of a workpiece, an indexing stop for the workpiece adjacent the other end of the chamber, said stop comprising an adjustably mounted tube and a movable plunger rod in said tube for moving the workpiece towards the open end, said plunger also having adjustable stops to vary its stroke and its action on the workpiece.

5. A machine for heating workpieces, comprising in combination, a frame, means on said frame for supporting tubular heating coils of different length, an induction heating coil supported on said supporting means, an adjustably supported magnetic core positioned at one end of the coil so as to be adjustable to new positions to accommodate different lengths of coils, a tubular support for said core adjustably mounted so as to provide a variable index stop for a workpiece in said coil, a workpiece push-out plunger operably mounted in said tubular support and having an adjustable stroke to push a workpiece a determinable amount toward an open charging end of said coil, mechanism for positively actuating said plunger in the push-out direction, the plunger being returned by the insertion of a workpiece, and a control switch for energizing said heating coil operated by said plunger on its return movement by the workpiece.

6. In induction heating apparatus including an electric induction heating coil having a passage in which workpieces are adapted to be positioned for the purposes of heating same, the improvement which comprises: means for moving workpieces toward one end of said coil for removal from said passage, said means including a member positioned generally at the end of said coil remote from said removal end and movable in the direction of said removal end, said member having a portion adapted to engage a workpiece, movement of said member in said direction pushing a workpiece along a path extending through the passage of the coil and elements operatively associated with said member for controlling movement of said member in the opposite direction for controlling the position of a workpiece in said passage as a workpiece is inserted.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
716,680	Daniels et al.	Dec. 23, 1902
756,946	Edwards	Apr. 12, 1904
1,516,970	Kiger	Nov. 25, 1924
1,646,498	Seede	Oct. 25, 1927
1,749,700	Fourment	Mar. 4, 1930
1,815,666	Cook et al.	July 21, 1931
1,838,015	Forster et al.	Dec. 22, 1931
1,870,619	Flanzer	Aug. 9, 1932
1,980,875	Northrup	Nov. 13, 1934
1,981,631	Northrup	Nov. 20, 1934
1,989,376	Northrup	Jan. 29, 1935
2,108,355	Swift	Feb. 15, 1938
2,277,564	Somes	Mar. 24, 1942
2,379,463	Strickland	July 3, 1945
2,402,852	Strickland	July 25, 1946