Nov. 3, 1953 J. W. GARRETT 2,657,698

QUENCHING APPARATUS

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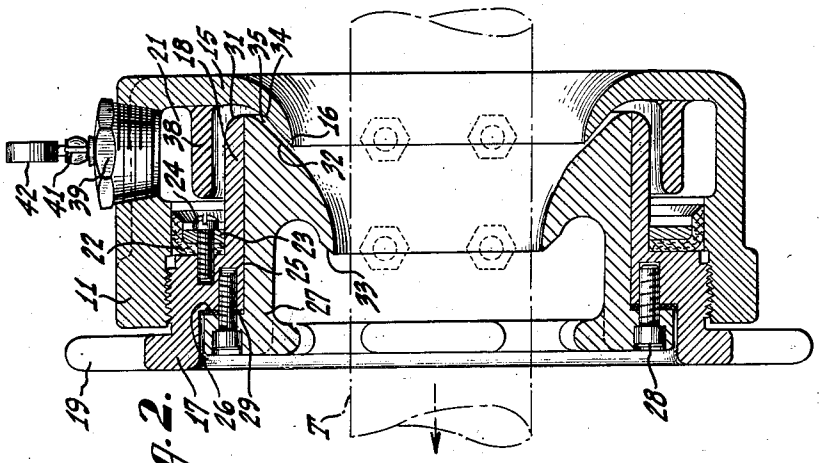


Fig. 2.

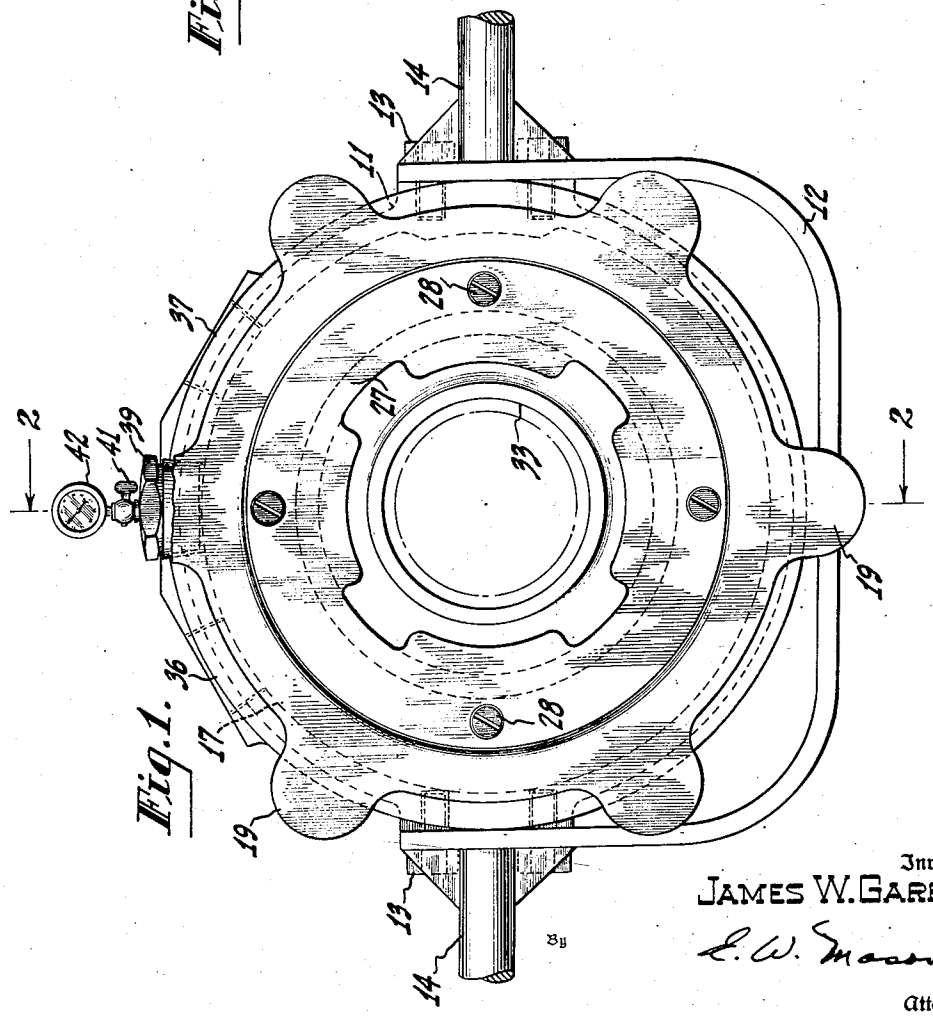


Fig. 1.

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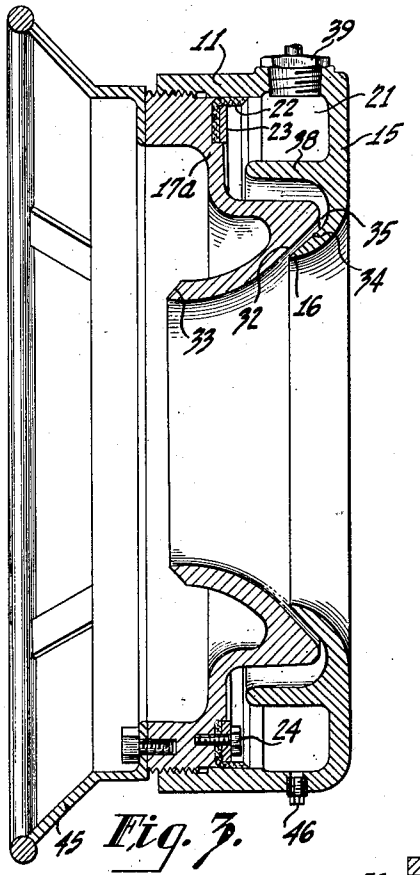


Fig. 3.

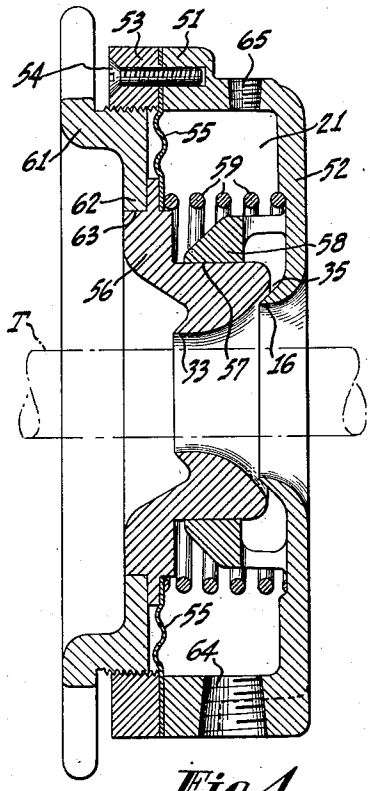


Fig. 4.

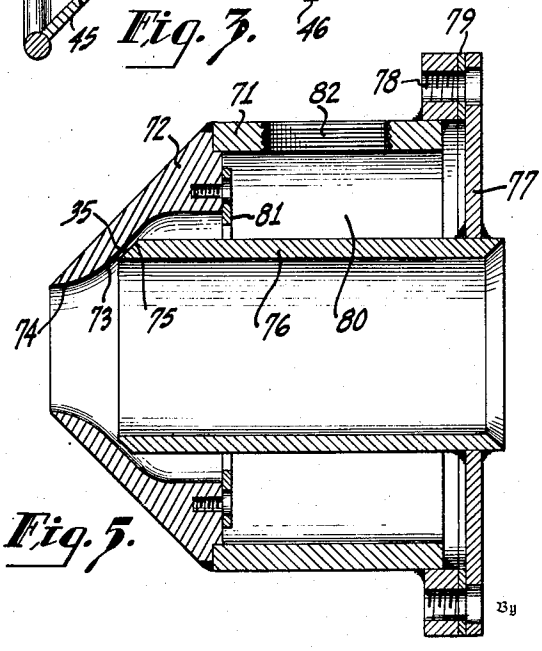


Fig. 5.

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QUENCHING APPARATUS

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6 Claims. (Cl. 134—122)

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The present invention relates to apparatus for use in the heat treating of metals, and more particularly to apparatus that is used for quenching bar or tube stock as it emerges from a furnace in which it has been heated.

It is an object of the invention to provide apparatus which will spray a solid sheet of water, or other quenching medium, over the entire surface of a piece of work as it leaves a furnace in which it has been heated. It is a further object of the invention to provide a quenching apparatus that is shaped to conform to the surface of a piece of work so that a sheet of quenching medium may be sprayed evenly over the entire surface of the work as it is passing from a furnace.

It is also an object of the invention to provide a quenching apparatus for use in progressively and evenly quenching cylindrical workpieces as they emerge from a furnace in which they have been heated. It is a further object of the invention to provide a quenching apparatus of the type mentioned above in which the volume of quenching medium discharged therefrom may be varied easily as occasion demands.

In modern metal heating practice it is customary to heat continuously bars, tubes and sheets in a furnace and to quench them as they issue therefrom. The quenching apparatus ordinarily used for this type of work is supplied with a plurality of small openings through which the quenching medium, usually water, is forced. From time to time these openings become clogged so that the spray pattern lacks uniformity. This results in non-uniform quenching and consequent warping of the workpieces.

The quenching apparatus of the present invention is designed to supply a solid sheet of the quenching material around the workpieces, the volume of which may easily be varied as desired depending upon the dimensions and temperature of the work. The apparatus is disclosed as being designed for use with a cylindrical piece of work which will be referred to herein as a tube, although it will be obvious that it could be so shaped that sheets or other forms of metal could be quenched equally as well. Also, for sake of convenience, the quenching medium will be referred to as water, since this is most commonly used.

The various features of novelty which characterize my invention are pointed out with particularity in the claims annexed to and forming a part of this specification. For a better understanding of the invention, however, its advantages, and specific objects attained with its use, reference should be had to the accompanying

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drawings and descriptive matter in which I have illustrated and described a preferred embodiment of the invention.

In the drawings:

Figure 1 is a front view of the quenching apparatus and a portion of its supporting mechanism.

Figure 2 is a section taken on line 2—2 of Figure 1; and

Figures 3, 4 and 5 are views similar to Figure 2 showing different forms that the quenching apparatus may take.

The apparatus of the present invention takes the form of a hollow ring which is mounted closely adjacent the exit of a furnace. As the work, in this case a tube or rod, emerges from the furnace it passes directly through the ring and while so passing is sprayed on its entire surface with a sheet of water. Thus the tube is quenched immediately and entirely before the surface can become oxidized. The apparatus, in one form, consists of a body portion 11, which is mounted in a suitable frame 12 by means of bolts 13 that extend through the frame and through openings formed in suitable surfaces on the body. This support is provided with outwardly extending shafts 14 that are mounted in any suitable type of apparatus by means of which the body can be adjustably mounted so that it may be positioned with its opening exactly concentric with the exit of the furnace. Body 11 is preferably a casting of brass or some other non-corrosive material and is formed with a radial flange 15 which terminates in a sharp edge 16 that extends in a generally axial direction corresponding to the direction of tube travel. The annular body portion is formed with internal threads into which is threaded an insert 17 which has a flange projecting rearwardly toward the flange 15 of the body. The insert is preferably a casting and is provided with lugs 19 that form handles, whereby the insert may be rotated with respect to the body.

As shown best in Figure 2 of the drawings, the body and the insert are so formed that an annular chamber 21 is made between the two parts. In order that this chamber is pressure tight, a circular washer 22 of leather, or other suitable material, is fastened to the insert and is held in position by a retaining ring 23 and bolts 24.

The insert has machined surfaces 25 and 26 that mate with complementary surfaces of an annular casting 27. This casting is fastened to the insert 17 by bolts 28 extending through the two parts and a gasket 29 that is provided so that a pressure tight joint is formed. The inner end

of flange 18 is curved as shown at 31, and this curve merges into a generally conical surface forming a continuation thereof on the casting 27, as is shown at 32 in the drawing. The surface 32 continues until it terminates at a sharp edge 33, the inner surface of which is substantially axial. Surfaces 31 and 32 cooperate with a complementary surface 34 on the inside of flange 15 to form a throat or passage 35 through which the water is forced against a tube passing through the device. The inner edge of the throat adjacent chamber 21 is slightly wider than the outer end thereof so that water passing through this throat increases in pressure and velocity as it travels toward the work.

Chamber 21 is provided with inlets 36 and 37 through either or both of which a quenching medium, which in this case is water, may be forced under pressure. The water in the chamber leaves the same at high velocity through throat 35. In order to prevent turbulence and to insure an even flow around the circumference of the throat there is provided an annular flange 38 in the chamber so that water coming in through a passage that leads directly to the throat. It will be noted that the passage is wider than and forms an entrance for the throat so that there is no turbulence in the flow and so that the water pressure and velocity are continually increased between the inlet and the exit. The upper part of the body 11 is provided with an opening in which there is placed a bushing 39 that has a test cock 41 threaded into its upper surface. Mounted above the test cock is a pressure gauge 42.

In the operation of the device, a tube T leaving a furnace as shown in the dash lines in Figure 2 of the drawing will be moving toward the left. As the tube passes through the annular opening in the device water will be sprayed upon it in a solid conical sheet through throat 35. The pressure of this water is maintained so that there will be an even flow around the entire circumference of the throat and therefore, there will be an even quenching action throughout the entire surface of the tube to prevent possible warping thereof due to uneven cooling. The angle with which surface 32 is formed from edge 16 at the exit of the throat until it is substantially parallel to the tube at its outer end 33 is such that the water will tend to cling to this surface as it is forced through the throat. Edge 16 is formed as a sharp edge so that the water will not tend to be drawn around it and drip vertically against the tube. Therefore water under high velocity and pressure will converge toward the surface of the tube and the latter will be received in a substantially cylindrical body of water that meets the tube along a line perpendicular to its axis. Cooling of the tube will take place on a substantial line contact that moves along the length of the tube as it is travelling from the furnace.

The amount of water that is necessary to quench properly the tube is dependent upon the temperature to which the tube has been heated and upon its dimensions. For example, a solid rod will have more heat energy in it than will a tubular body of equal diameter, therefore, the rod will require a larger volume of water for proper quenching than will the tube. This variation in volume that is necessary due to dimensional and temperature differences in the type of work that is being quenched may easily be adjusted by rotating the insert 18 and casting 27 with respect to the body portion 11. As the

insert is rotated in a counter-clockwise direction in Figure 1 of the drawing, the thickness of the throat 35 will be increased without changing its shape, and the increase in thickness will permit a larger volume of water to be forced against the surface of the tube.

Another advantage obtained by making parts 11 and 17 axially adjustable is the ease with which the throat or passage 35 may be cleared of obstruction. From time to time during the use of the device, particularly if unfiltered water is used, small particles of dirt may become lodged in passage 35. This will cause the spray pattern to become uneven with consequent uneven quenching of the work. In order to dislodge the particles from the passage it is only necessary to move part 17 axially relative to part 11 to increase the passage thickness. When the dirt has been flushed out of the pasasge, it can be reduced to its proper size.

In order for the apparatus to work at peak efficiency the inner diameter of the opening in casting 27 must be such that there is only a small annular space between edge 33 and the surface of the tube. Therefore, for work of different diameters, a different size opening should be used. It is for this reason that the casting 27 is made separate from the insert 17. When work of a different diameter is to be quenched, it is merely necessary to remove the casting 27 by removing bolts 28 and another casting of the proper diameter can be inserted in the device. When in operation, however, parts 17 and 27 can be considered a single structural element. Thus, it will be seen that there is provided apparatus for forcing against a tube at high velocity the proper amount of quenching water for the type and size of tube that is to be quenched and for the temperature of the tube.

The embodiment in Figure 3 of the drawing is similar to that of Figures 1 and 2 and like reference numerals will be used for like parts in the description thereof. This embodiment differs from that of Figures 1 and 2 principally in the use of a single part to form the insert and the casting having surface 32, as is shown at 17*a* in the drawing. Such a construction is lighter than that disclosed in Figure 1 and for this reason may be desirable. Also with a construction of this type a larger chamber 21 may be obtained. It is noted that an opening is made in the bottom of chamber 21 that is closed with a plug 46. This opening can be used for draining the chamber of sediment which will accumulate from time to time if the water is not filtered. An increase in the size of this chamber has a tendency to help decrease the turbulence in the flow of water through the chamber and throat 35 onto the work. Adjustment of insert 17*a* relative to the body 11 to change the size of the throat is obtained in this embodiment by means of a hand wheel 45 that is suitably fastened to the front of the insert.

The operation of the quenching apparatus of this embodiment is exactly the same as that of the embodiment previously described. It is noted, however, that this particular embodiment would be designed for a given size tube and in order to change the apparatus from one size tube to another it will be necessary to supply another insert assembly.

A further embodiment of the invention is shown in Figure 4 of the drawing. This embodiment however, is exactly the same as those previously described with respect to the manner in which

throat 35 through which the quenching fluid flows is shaped. The embodiment differs from the previously described embodiments in the manner in which the parts are assembled. As shown in Figure 4 there is provided a body 51 that has formed as a part thereof a radially extending flange 52, the inward end of which is formed with edge 16 as was the case in the previously described embodiments. Fastened to the body 51 by screws 54 is a ring 53 which ring serves to hold in place the outer edge of a flexible diaphragm 55, the inner end of which is fastened in any suitable manner, such as by soldering, to a casting 56. This casting is formed with a cylindrical surface 57 that is slidably received in guides 58 which extend forwardly from the flange 52. Thus, when the parts are assembled, throat 35 is formed between surfaces on the end of casting 56 and on flange 52. These surfaces are curved so that there will be a smooth flow of water between them. Normally casting 56 is biased by means of spring 59 away from the body 51 in a direction to enlarge the throat. One end of the spring is supported by a shoulder formed on the inside of the casting 56 and bears against the diaphragm 55. The other end of this spring bears against a shoulder formed in flange 52 just outside of the projection from that flange upon which the supports 58 are formed.

In order to adjust the size of the throat, there is provided a hand wheel 61 that has threads on its outer surface which are received by threads on the interior of ring 53. This hand wheel has a flange 62 that engages a shoulder 63 of the insert. Therefore, as the hand wheel is rotated relative to the insert, the latter will be forced to the right by the action of the hand wheel or will be moved to the left by the action of spring 59. Because of the action of spring 59 there will be no lost motion between the parts so that the throat 35 will stay at the dimension to which it is adjusted. It is noted that the pressure of the water in chamber 21 acts in the same direction as the spring so that when the device is in operation this force also tends to keep the parts rigidly in their adjusted position. In this case an inlet 64 for the water is shown in the bottom of the chamber 21 instead of the top thereof as in the previously described embodiments and there is an opening 65 provided in the top to which the test cock and pressure gauge may be attached. Whether the supply opening is in the top or in the bottom of chamber 21 is a matter of choice and convenience. This will be determined mainly by the easiest way of leading supply pipes thereto. In any event, chamber 21 is kept full of water due to the fact that this water is supplied in such volume under such a pressure that the volume leaving the chamber through the throat 35 will never be sufficient to permit the chamber to become partially empty.

The embodiment of the invention disclosed in Figure 5 differs from the others in that the size of the throat is not adjustable after the device has been assembled. In this case there is provided a tubular body 71 that has as a part thereof or attached thereto a conical member 72 which comprises the outer portion of the throat. This member is provided with a surface 73 that merges into a tubular portion 74 forming the outer part of the throat. The inner part of the throat consists of a bevelled surface 75 on the end of a tubular member 76. The tubular member is supported in proper spaced relation to cone 72 by means of a disc 77 that is attached by bolts 78

to a flange formed on the body. In this case the width of the throat 35 is determined by the thickness of a gasket 79 which is placed between a flange on body 71 and the disc 77. Therefore, after the proper thickness of the throat has been determined a gasket of the right thickness will be inserted and the parts bolted together. In order to disassemble the device the bolts and the gasket must be removed.

Chamber 80, which is supplied with water through an inlet 82, has in it, adjacent the end thereof toward the throat, a ring 81 which restricts the path of flow of the water. This ring is fastened to a shoulder on the conical member 72 and serves to reduce turbulence of the water and also to increase its pressure as it flows from the inlet through the outlet.

This embodiment of the invention operates in exactly the same fashion as those previously described. Water is supplied under pressure through the inlet 82 and passes through chamber 80, to the throat between surfaces 73 and 75. The water passes to the outer surface of the work which is going through the tubular member 76 and serves to quench the work.

From the above, it will be seen that I have devised a quenching apparatus which can be used to quench progressively heated work that is passing through the same. This apparatus is provided with a throat so formed that a cone shaped sheet of water will be forced against the periphery of the work at substantially a straight line around its periphery perpendicular to its axis. Therefore, quenching will take place immediately and evenly throughout the work. Because of the angle, with respect to the surface of the work, through which the water is forced, the water will tend to hug the surface of the work in the direction in which it is moving. Therefore there will be no splashing of the water backward toward the furnace with a consequent spotty quenching of the work and irregular cooling of the same. This apparatus performs the quenching operation rapidly and accurately as the work is moving from the furnace through the apparatus.

While in accordance with the provisions of the statutes, I have illustrated and described the best form of embodiment of my invention now known to me, it will be apparent to those skilled in the art that changes may be made in the form of the apparatus disclosed without departing from the spirit of my invention, as set forth in the appended claims, and that in some cases certain features of my invention may be used to advantage without a corresponding use of other features.

What is claimed is:

1. In a quenching device, the combination of a first annular member having an axially extending portion and a radially extending portion, said radial portion extending inwardly and curving toward an axial direction to form a substantially conical surface, a second annular member also having an axially extending portion smaller in diameter than the axially extending portion of said first member and a radially extending portion, the radially extending portion being received in the axially extending portion of the first member, said members cooperating to form an annular chamber, the axially extending portion of said second member being provided with means forming a substantially conical surface substantially parallel to said first-mentioned surface whereby a conical passage is formed between said surfaces, the surface on said means

continuing in a smooth curve radially inward of said first mentioned radial portion until it is substantially axial and terminating in a sharp edge, means through which liquid can be introduced into said chamber to flow through said passage and along said last mentioned surface into a cylinder or sleeve, and annular baffle means between the entrance for said liquid and the entrance of said passage.

2. The combination of claim 1 including means to adjust said annular members axially relative to each other and thereby vary the size of said passage.

3. In a quenching device, the combination of a plurality of annular cooperating parts operative to form an annular chamber, one of said parts including an inwardly and axially extending curved portion terminating in a sharp edge, said portion forming a substantially conical surface, means on the other of said parts having formed thereon a substantially conical surface inside and substantially parallel to and opposing said first-mentioned surface, said surfaces defining a conical passage extending inwardly of the annulus from said chamber, the portion of said means forming said second-mentioned surface continuing in a smooth curve radially inward of said first edge until it is cylindrical and coaxial with said annulus and terminating in a sharp edge, and means to adjust said parts axially with respect to each other to thereby vary the size of said passage.

4. The combination of claim 3 including inlet means in one of said parts through which a quench liquid may be introduced to said chamber, and an annular shield extending between said inlet and the inner end of said passage.

5. In a quenching device, structure including a pair of cooperating annular members forming an annular chamber having a circular outlet adjacent to one end and on the interior thereof, one of said members including means forming a conical surface extending inwardly toward the center of said members from one side of said outlet and terminating in a sharp edge, the other of said members including means forming a surface inside and parallel to said first-mentioned surface, adjacent to the other side of said outlet and continuing radially inward beyond said edge in a smooth curve until it is cylindrical to form with said first surface a conical passage communicating with said outlet, said last-mentioned means also terminating in a sharp edge, means forming an inlet in one of said members through which quenching fluid can be introduced into said chamber to flow through said outlet and passage and along said inside surface to form a cylinder of fluid, and means to adjust said members axially with respect to each other to vary the size of said passage.

6. The combination of claim 5 including an annular shield in said chamber between said inlet and said opening.

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References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
538,727	Byler	May 7, 1895
1,211,277	Bloom	Jan. 2, 1917
1,381,646	Kirgan	June 14, 1921
1,643,330	Barord	Sept. 27, 1927
1,672,061	George	June 5, 1928
1,688,705	Gray	Oct. 23, 1928
2,194,565	Moss	Mar. 26, 1940
2,287,825	Postlewaite	June 30, 1942
2,340,325	Horrigan	Feb. 1, 1944
2,376,515	Somes	May 2, 1945
2,542,237	Dewey	Feb. 20, 1951