Jan. 3, 1961 J. L. CHANEY 2,967,120

METHOD AND APPARATUS FOR CLEANING THERMOMETERS

Filed Nov. 7, 1956

FIG-1

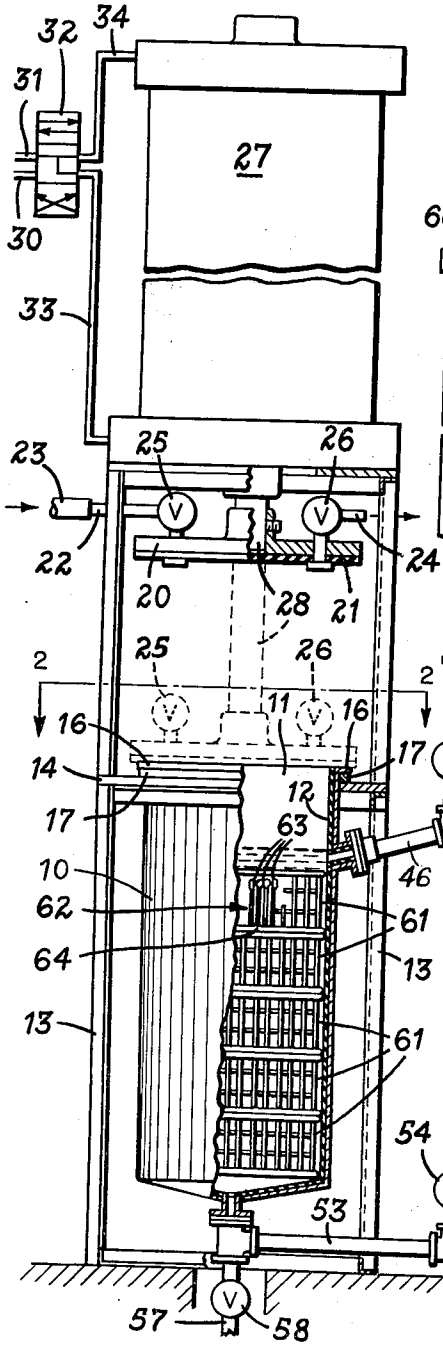


FIG-2

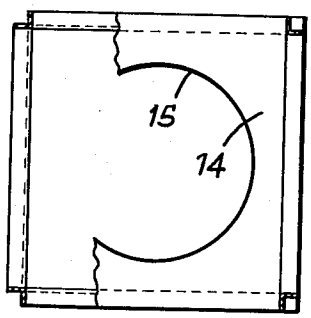
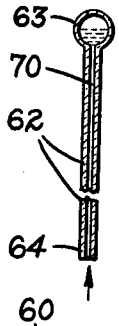
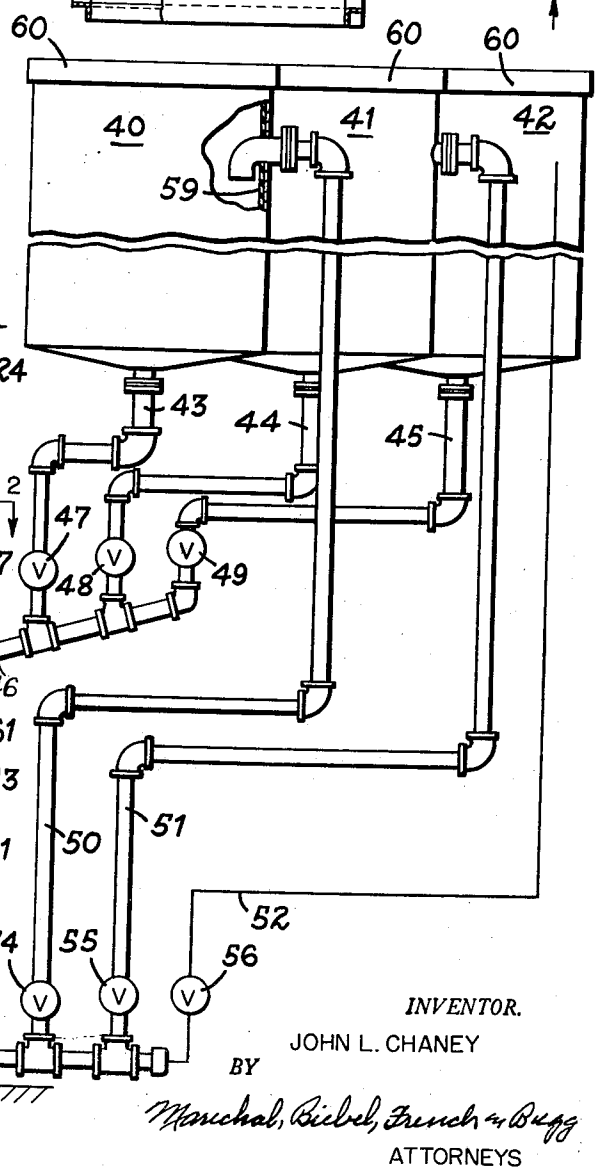


FIG-3





INVENTOR.
JOHN L. CHANEY
BY
Marshall, Bibel, French & Bugg
ATTORNEYS

United States Patent Office 2,967,120
Patented Jan. 3, 1961

2,967,120

METHOD AND APPARATUS FOR CLEANING THERMOMETERS

John L. Chaney, Lake Geneva, Wis.

Filed Nov. 7, 1956, Ser. No. 620,827

10 Claims. (Cl. 134—22)

This invention relates to the manufacture of thermometers, and is particularly directed to the cleaning of unfilled thermometer tubes, or the like, after the bulbs have been formed at one end of the tubes and while the other ends of the tube remain open.

In previous methods, thermometer tubes have been partially cleaned by the use of weak cleaning liquids, such as alcohol, or the like. These methods have been unsatisfactory because of the lack of cleaning power of such liquids. The present invention permits the use of much stronger cleaning liquids, such as muriatic, nitric or similar acid liquids, without danger of harming the operator.

Hence, an object of this invention is to provide a method and apparatus for cleaning thermometer tubes with an acid liquid in a safe and thorough manner.

Another object of this invention is to provide a method of cleaning unfilled thermometer tubes or the like with an acid liquid by drainably supporting a plurality of the tubes in inverted position with their bulb ends at the top and with their open ends at the bottom in a pool forming zone, gravitationally draining an acid liquid from an acid liquid supply zone into said pool forming zone and subjecting the surface of said acid liquid to a gaseous pressure sufficient to drive the acid liquid into the bulb ends of the tubes, returning the acid liquid from the pool forming zone to the acid liquid supply zone under gaseous pressure, and thereafter subjecting the tubes to an acid neutralizing and rinsing procedure.

Another object of this invention is to provide a method of cleaning unfilled thermometer tubes or the like in which a plurality of the tubes are supported in inverted position with their bulb ends at the top and with their open ends at the bottom in a pool forming zone, and into which zone a cleaning liquid is gravitationally drained from a cleaning liquid supply zone, and then subjecting the surface of the cleaning liquid to a gaseous pressure sufficient to drive the cleaning liquid into the bulb ends, and then returning the cleaning liquid from the pool to the cleaning liquid supply zone under gaseous pressure.

Another object of this invention is to provide an apparatus for cleaning unfilled thermometer tubes or the like which comprises a rigid receptacle, preferably cylindrical, and having a large vertical opening at its upper edge and having an acid-proof inner surface, a rigid cover substantially horizontal when in use for sealing the opening and having an acid-proof lower surface and having a valved inlet for gas under pressure and a valved gas outlet, means for moving said cover into and out of sealing engagement with the vertical opening, for example, by a fluid pressure piston above the cover, one or more liquid tanks in drainable position into the receptacle with individual valved conduit draining means for the liquid from the tank or tanks into the receptacle and with a valved drain conduit from adjacent the bottom of the receptacle for returning liquid to the tank or tanks under gaseous pressure in the receptacle.

Further objects will become apparent as the description of the invention proceeds in connection with the accompanying drawings in which:

Fig. 1 is a vertical elevation, partly in cross-section, showing an apparatus embodying this invention.

Fig. 2 is a partial cross-section taken along the line 2—2 of Fig. 1.

Fig. 3 is a cross-section of a thermometer tube in the process of being cleaned.

Referring to the drawings which illustrate a preferred embodiment of the invention, a rigid acid-proof receptacle 10 is preferably vertical and cylindrical, as shown in Fig. 1. It has a large vertical opening 11 at its top or upper edge and has an acid-proof inner surface or lining 12, and the outside of the tank may be painted with any acid-proof paint. For example, the lining 12 may be a 3/32 inch layer of Vyflex L–10 or any other well known material and the acid-proof paint may be Nukemite No. 24, or any other well known material.

Means are provided for rigidly supporting the receptacle 10, preferably at its upper edge. For example, an angle iron steel framework 13 may support a platform 14 having an opening 15 to receive the receptacle 10. The platform 14 supports the flange 16 of the receptacle 10 through the medium of a metal ring 17. If the receptacle 10 is 12 inches inside diameter and 26 inches long, for example, then the framework may be made of 2-inch by 2-inch angle iron bars welded together. The platform 14 may be one-half inch thick steel plate, and the receptacle 10 may be made of 10-gauge steel.

A rigid, substantially horizontal, cover 20 has an acid-proof lower surface or lining 21 made of the same material as lining 12 and the main part of the cover 20 may be a three-quarter-inch thick steel plate. It has a valved inlet 22 connected to a supply of gas under pressure 23, such as compressed air. The cover 20 also has a valved gas outlet 24 for permitting the escape of gas under pressure from the receptacle 10. The valves 25 and 26 may be manually operated or may be provided with solenoids which may be energized by electrical buttons or by an electrical timer, not shown, which may also similarly control all of the other valves herein described, to produce the sequences of operation herein described.

A fluid pressure piston in the cylinder 27 above the cover 20 is connected thereto by the plunger 28 to move the cover into and out of sealing engagement with the vertical opening 11 and may press the cover 20 down on the opening 11 with a force of between 2500 and 3000 lbs. The cylinder 27 may be connected to a source of liquid under pressure through the pipe 30 and this liquid may be returned to the source through the pipe 31. The manually operated or solenoid operated valve 32 selectively introduces the liquid from pipe 30 into the pipe 33 at the same time that liquid is being returned from the pipe 34 into the pipe 31, or vice versa. The valve 32 in another position can also close all connections between the pipes 30, 31, 33 and 34. The pipe 34 feeds liquid above the piston while the pipe 33 feeds the liquid below the piston to move the cover 20 down and up to seal or uncover the opening 11.

A plurality of cleaning fluid tanks 40, 41 and 42 are supported in position to discharge liquid by gravity into the receptacle 10. Conduits 43, 44, and 45 drain from the respective tanks 40, 41 and 42 into the receptacle 10 through the medium of the common pipe 46. These conduits have individual valves 47, 48, and 49 for controlling the flow of liquid from each of the tanks into the receptacle 10. These valves may be manually opened and closed or they may be automatically closed by solenoids controlled by the timer or push-button construction previously described. Individual return conduits 50, 51 and 52 return liquid from adjacent the bottom of receptacle

10 through the common return pipe 53, under the control of individual return valves 54, 55 and 56 into return positions, preferably at the upper parts of the respective tanks 40, 41 and 42. A drain conduit 57 may be controlled by valve 58, manual or solenoid operated, for draining any liquid, as desired, into any waste pipe or any other place of disposal. The tank 40, and the tanks 41 and 42, if desired, may be protected by an acid-proof lining 59 similar in construction and material to lining 12. Removable covers 60 are provided for the tanks 40, 41 and 42. Muriatic, nitric, or other suitable acid liquid, of 20% strength or the like, is placed in tank 40. An acid neutralizing liquid, such as soda water or other alkaline material, is placed in tank 41, and a rinsing liquid, such as distilled water, is placed in tank 42.

An acid-proof pervious container, adapted to permit the flow of liquid into and out of such container includes one or more baskets 61 made of plastic material, for example, and are adapted to receive unfilled thermometer tubes in inverted positions, the tubes 62 having their bulbs 63 at the top and their open ends 64 downward. The basket or baskets 61 are insertable and removable from the container 10 through the large vertical opening 11 when the cover 20 is in its upper position.

In the practice of the method and operation of the apparatus, a plurality of thermometer tubes 62 are supported in inverted position by the baskets 61 with their bulb ends at the top and open ends at the bottom. After the baskets have been inserted in the receptacle 10, the acid liquid from the tank or acid liquid supply 40 is drained by gravity through the pipes 43 and 46 by the opening of valve 47 into the pool forming zone, or lower part of the recceptacle 10. The pipes 43 and 46, as well as any other pipes so desired, may be lined with acid-proof material of a character similar to lining 12. The cover 20 is moved to the lower position by the action of the piston in cylinder 27 either before or after the introduction of the acid into the receptacle 10. A gaseous medium under pressure, such as air under 15 lbs. gauge, is then introduced from the supply hose 23 through the pipe 22 by the opening of valve 25 while all other valves are closed. This subjects the surface of the acid liquid in the pool forming zone to a gaseous pressure sufficient to drive the acid liquid through the open ends into the bulb ends, as illustrated in Figure 3. This is sufficient to dissolve and clean any impurities which are likely to be in the tubes. Thereafter the acid liquid is returned to the tank or acid liquid supply zone 40 through the pipes 53 and 50 by the opening of valve 54. Much of the acid liquid in tubes 62 is forced out by the air under pressure trapped in the bulbs 63. At this time the valve 25 may remain open, or may have been closed, if the amount of air within the receptacle 20 is sufficient to lift the acid liquid into the tank 40. Thereafter the valves 25 and 54 are closed, and any slight amount of acid liquid remaining in the tubes 62 and tank 40 may be allowed to drain or blow through the pipe 57 by the opening of valve 58 for a sufficient length of time to permit such drainage, after which the valve 58 is reclosed. Thereafter the gas outlet valve 26 is opened to relieve all gaseous pressure within the receptacle 10.

The acid neutralizing liquid is then drained from the neutralizing liquid supply zone or tank 41 through the pipes 44 and 46 by the opening of valve 48 into the pool forming zone of the receptacle 10. Thereafter the valve 48 is closed along with valve 26 and the valve 25 is opened to subject the surface of the acid neutralizing liquid to the gaseous pressure from the pipe 22 such as air under 15 lbs. gauge pressure, as before. This drives the acid neutralizing liquid into the bulbs 63 of the tubes 62 to neutralize the acid in the tubes and bulbs after which the liquid is drained from the tubes and receptacle 10 and returned to the tank 41 under gaseous pressure in a manner similar to that previously described with respect to the tank 40. Any excess liquid remaining in the tubes or receptacle may also be blown or drained through the valve 58 as previously described.

Thereafter the valve 58 is closed and valve 26 is opened, and the rinsing liquid may be introduced into the pool forming zone of receptacle 10 from the tank or liquid supply zone 42 and may be returned thereto after pressurizing in a manner similar to that previously described with respect to the acid liquid and acid neutralizing liquid operations. On the other hand, if it is desired not to return the distilled water from the receptacle 10 to the tank 42, the valve 56 need not be opened and the valve 58 may be opened to allow the entire contents of distilled water to be blown or drained from the receptacle 10 and tubes 62 to the waste drain 57.

It is to be noted that whenever there is a cleaning liquid in the cleaning liquid supply zone or lower part of receptacle 10, and when the gaseous pressure is applied to the surface of such liquid, then such liquid rises through the temperature indicating passageway 70 of the tube 62 into the bulb 63. The 15 lb. pressure indicated is sufficient to cause compression of the air within the tube 62 to such an extent that the liquid rises approximately to fill half the bulb 63 which is sufficient to cause a full cleaning of the tube. Naturally a higher air pressure causes a higher rise of liquid in the bulb 63. When the pressure is relieved by the opening of any of the valves 54, 55, 56 and/or 26 or 58, the air trapped at the top of the bulb 63 forces the liquid out of the tube 62, so that the tube is substantially empty when such pressure is relieved. The volume content of the bulb 63 ordinarily is about 10 times the volume content of the passageway 70, and this high ratio of volume content permits the rise of the liquid within the bulb 63 under the pressure conditions previously described.

Occasionally, when liquid is expressed from tube 62 by the action of the compressed air contained within bulb 63, the expression is incomplete, a small quantity of liquid being left near the small end of tube 62. Since the possibility of contamination, as well as useless loss of rinse liquids, occurs when tubes 62 contain small quantities of acid, it is often advantageous to include an additional liquid expressing step between successive rinses to insure that tubes 62 are effectively stripped of liquid remaining therein. The additional step comprises subjecting tubes 62 to an atmosphere of clean, compressed air intermediate each, or following any one of the rinsing steps to compress the air contained within the tubes The increase in pressure within the tubes is accomplished by filling the rinsing zone, chamber 10, with compressed air. Upon release of the gas pressure from container 10 any remaining liquid will be exhausted from the tube.

After the tubes have been subjected to the action of the acid liquid, the acid neutralizing liquid, and the rinse liquid, and all of the liquids have been drained out of the tubes 62 and receptacle 10, the pressure is relieved by the opening of valve 26, if necessary, and then the cover 20 is moved to its upper position by the action of the piston in cylinder 27 and the trays 61 and tubes 62 in them are removed from the receptacle 10 through the opening 11. Thereafter the tubes are filled with temperature indicating liquid and the open ends 64 are sealed in any well-known manner.

The method and apparatus as herein disclosed is particularly effective in cleaning thermometer tubes in large quantities. The use of strong cleaning liquids is rendered harmless to the operator by the foregoing features of the invention.

While the embodiment of the invention herein disclosed is that which is now preferred, and while certain materials have been mentioned and certain pressures have been suggested, it is to be understood that these are illustrative in nature, and may be varied within the scope of the claims which follow.

I claim:

1. An apparatus for cleaning unfilled thermometer tubes comprising, a receptacle having a large vertical opening at its upper end, means for supporting said receptacle in an upright position, a cover for said opening movable in and out of sealing engagement therewith, said receptacle having a valved inlet for gas under pressure and a valved gas outlet, an acid liquid tank and an acid neutralizing liquid tank each being in position to discharge liquid into said receptacle by gravity, individually valved conduits discharging by gravity from each of said tanks into said receptacle, a valved conduit connecting the bottom of said receptacle to each of said tanks for returning liquid from said receptacle to its respective tank under the influence of gaseous pressure within said receptacle, and a pervious container insertable and removable through said large vertical opening adapted to support unfilled thermometer tubes in inverted positions with their bulbs at the top and their open ends at the bottom and submerged in the liquid in said receptacle.

2. The method of cleaning unfilled thermometer tubes which comprises, drainably supporting a plurality of said tubes in inverted posithion with their bulb ends at the top and with their open ends downward in a pool forming zone, flowing an acid liquid from an acid liquid supply zone into said pool forming zone and covering the open ends of said tubes with said acid liquid subjecting the surface of said acid liquid to a gaseous pressure sufficient to drive said acid liquid through said open ends into said bulb ends with resultant compression of the gas entrapped in said bulb ends, withdrawing said acid liquid from said pool forming zone and relieving the pressure thereon to effect removal of said liquid from said tubes by expansion of said entrapped gas, introducing an acid neutralizing liquid into said pool forming zone and subjecting the surface of said acid neutralizing liquid to a gaseous pressure sufficient to drive said acid neutralizing liquid into said bulb ends, and relieving said pressure and withdrawing said acid neutralizing liquid from said tubes and pool forming zone.

3. The method of cleaning unfilled thermometer tubes which comprises, drainably supporting a plurality of said tubes in inverted position with their bulb ends at the top and with their open ends downward in a pool forming zone, supplying a cleaning liquid from a cleaning liquid supply zone into said pool forming zone and covering the open ends of said tubes with said cleaning liquid, subjecting the surface of said cleaning liquid to a gaseous pressure sufficient to drive said cleaning liquid through said open ends into said bulb ends against the pressure of the gas entrapped therein, releasing said pressure on said liquid, and withdrawing said liquid from said pool forming zone to cause the liquid in said tubes to drain under the pressure of the gas trapped in said bulbs.

4. The method of cleaning unfilled thermometer tubes which comprises, drainably supporting a plurality of said tubes in inverted position with their bulb ends at the top and with their open ends at the bottom in a pool forming zone, gravitationally and sequentially draining a plurality of cleaning liquids from a plurality of cleaning liquid supply zones into said pool forming zone and covering the open ends of said tubes with said cleaning liquids, sequentially subjecting the surface of each of said liquids to gaseous pressure sufficient to drive each of said cleaning liquids through said open ends into said bulb ends, and sequentially relieving said pressure and returning each of said cleaning liquids from said pool forming zone to the respective cleaning liquid supply zones.

5. The method of cleaning unfilled thermometer tubes which comprises, drainably supporting a plurality of said tubes in inverted position with their bulb ends at the top and with their open ends downward in a pool forming zone, gravitationally draining an acid liquid from an acid liquid supply zone into said pool forming zone to cover the open ends of said tubes with said acid liquid, subjecting the surface of said acid liquid to a gaseous pressure sufficient to drive said acid liquid through said open ends into said bulb ends, returning said acid liquid from said pool forming zone to said acid liquid supply zone, filling the pool forming zone with an atmosphere of compressed gas, and thereafter releasing said compressed atmosphere so that the pool forming zone returns to substantially atmospheric pressure with resultant stripping of remaining liquid from the tubes.

6. The method of cleaning unfilled thermometer tubes which comprises, drainably supporting a plurality of said tubes in inverted position with their bulb ends at the top and with their open ends at the bottom in a pool forming zone, gravitationally and sequentially draining a plurality of cleaning liquids from a plurality of cleaning liquid supply zones into said pool forming zone to cover the open ends of said tubes with said cleaning liquids, sequentially subjecting the surface of each of said liquids to gaseous pressure sufficient to drive each of said cleaning liquids through said open ends into said bulb ends, sequentially returning each of said cleaning liquids from said pool forming zone to the respective cleaning liquid supply zones, and filling and exhausting the pool forming zone with an atmosphere of compressed gas intermediate each of said sequentially performed liquid cleaning steps to strip the remaining liquid from the tubes.

7. The method of cleaning unfilled thermometer tubes which comprises, drainably supporting a plurality of said tubes in inverted position with their bulb ends at the top and with their open ends at the bottom in a pool forming zone, gravitationally and sequentially draining a plurality of cleaning liquids from a plurality of cleaning liquid supply zones into said pool forming zone and covering the open ends of said tubes with said cleaning liquids, sequentially subjecting the surface of each of said liquids to gaseous pressure sufficient to drive each of said cleaning liquids through said open ends into said bulb ends, sequentially returning each of said cleaning liquids from said pool forming zone to the respective cleaning liquid supply zones, and filling and exhausting the pool forming zone with an atmosphere of compressed gas after the compression of the last liquid cleaning to strip the remaining liquid from the tubes.

8. The method of cleaning unfilled thermometer tubes which comprises, drainably supporting a plurality of said tubes in inverted position with their bulbs at the top and with their open ends downward in a pool forming zone, admitting a cleaning liquid into said zone to cover said open ends with said cleaning liquid, subjecting the surface of said liquid to a gaseous pressure sufficient to drive said liquid through said open ends into said bulbs with the resultant compression of the gas trapped in said bulbs, removing said liquid and said pressure from said zone to effect the substantial removal of said liquid from said tubes by the expansion of said entrapped gas, and subjecting said tubes to a gaseous pressure and releasing said pressure to effect the purging of any remaining liquid from said tubes.

9. The method of cleaning unfilled thermometer tubes which comprises, drainably supporting a plurality of said tubes in inverted position with their bulbs at the top and with their open ends downward in a pool forming zone, admitting a cleaning liquid into said zone to cover said open ends with said cleaning liquid, subjecting the surface of said liquid to a gaseous pressure sufficient to drive said liquid through said open ends into said bulbs with the resultant compression of the gas trapped in said bulbs, removing said liquid from said zone under the influence of said pressure, removing said pressure to effect the substantial removal of said liquid from said tubes by the expansion of said entrapped gas, and subjecting said

tubes to a gaseous pressure and releasing said pressure to effect the purging of any remaining liquid from said tubes.

10. The method of cleaning unfilled thermometer tubes which comprises, drainably supporting a plurality of said tubes in inverted position with their bulbs at the top and with their open ends downward in a pool forming zone, admitting a cleaning liquid into said zone to cover said open ends with said cleaning liquid, subjecting the surface of said liquid to a gaseous pressure sufficient to drive said liquid through said open ends into said bulbs with the resultant compression of the gas trapped in said bulbs, removing said liquid from said zone under the influence of said pressure, and removing said pressure to effect the removal of said liquid from said tubes by the expansion of said entrapped gas.

References Cited in the file of this patent

UNITED STATES PATENTS

1,174,662	Brandwood	Mar. 7, 1916
1,194,542	Raymond	Aug. 15, 1916
1,328,657	Fish	Jan. 20, 1920
1,492,957	Bots	May 6, 1924
1,865,289	Trowbridge	June 28, 1932
1,978,721	Perkins	Oct. 30, 1934
2,558,628	Redin	June 26, 1951
2,619,974	Daley	Dec. 2, 1952
2,774,362	Nordling	Dec. 18, 1956
2,849,944	Prickett	Sept. 2, 1958