Oct. 27, 1953 C. W. RIVA 2,656,683

METHOD OF INSTALLING UNDERGROUND PIPES OR DUCTS

Filed Feb. 7, 1950 2 Sheets-Sheet 1

Fig. 1.

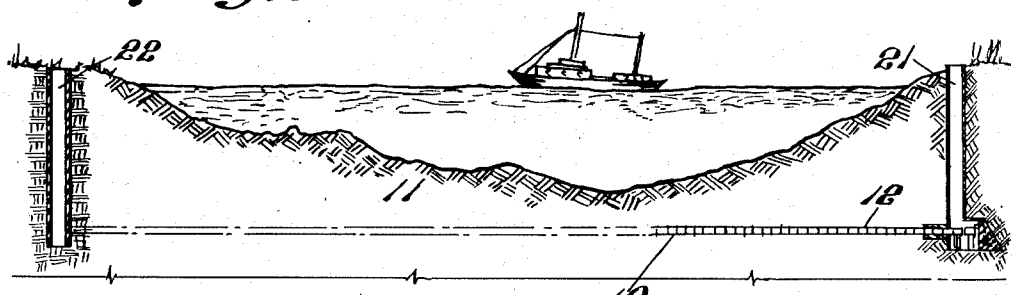


Fig. 2.

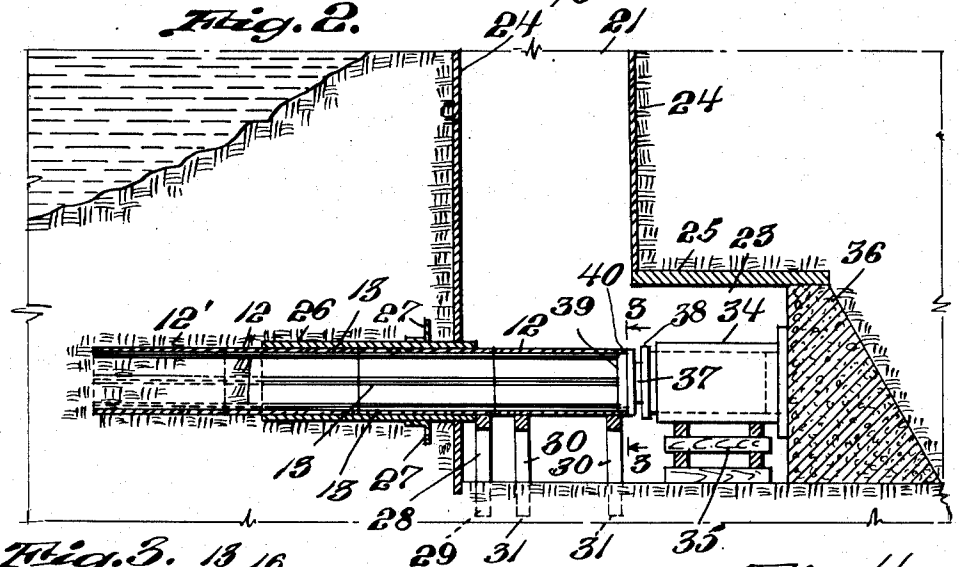


Fig. 3.

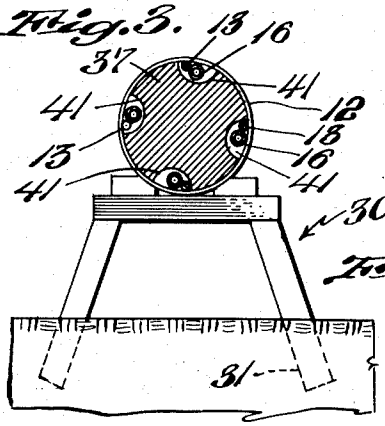


Fig. 4.

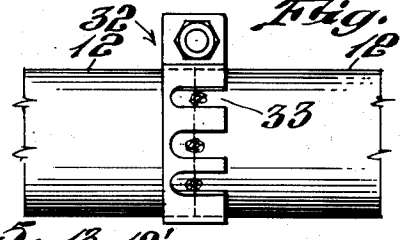


Fig. 5.

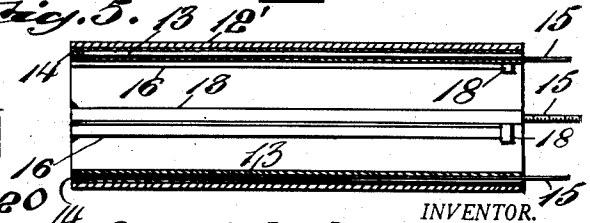
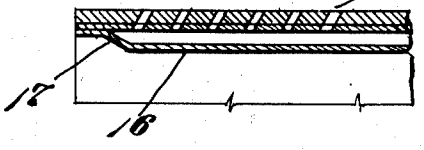


Fig. 6.



INVENTOR.
CHARLES W. RIVA, DECEASED
LOUISE E. RIVA, ADMINISTRATRIX
BY
Barlow & Barlow
ATTORNEYS.

Oct. 27, 1953 C. W. RIVA 2,656,683

METHOD OF INSTALLING UNDERGROUND PIPES OR DUCTS

Filed Feb. 7, 1950 2 Sheets-Sheet 2

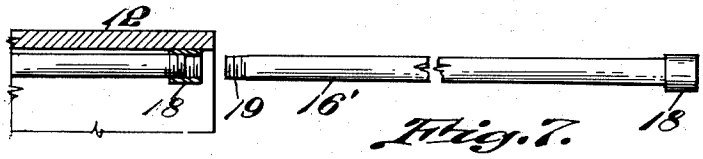


Fig. 7.

Fig. 8.

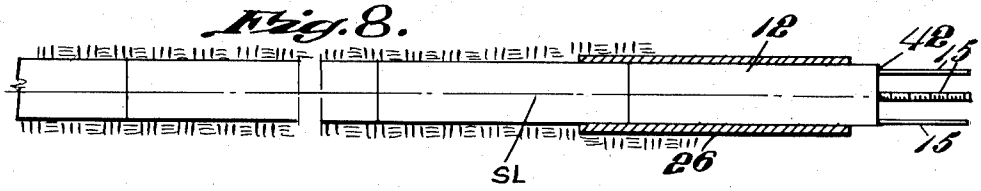


Fig. 9.

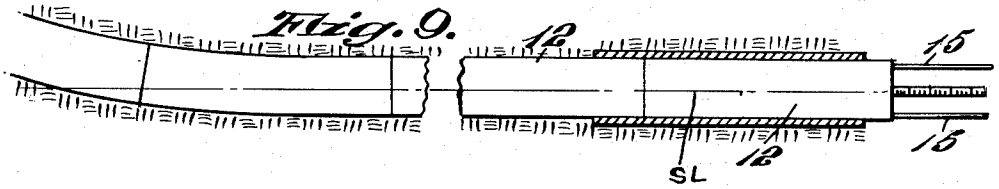
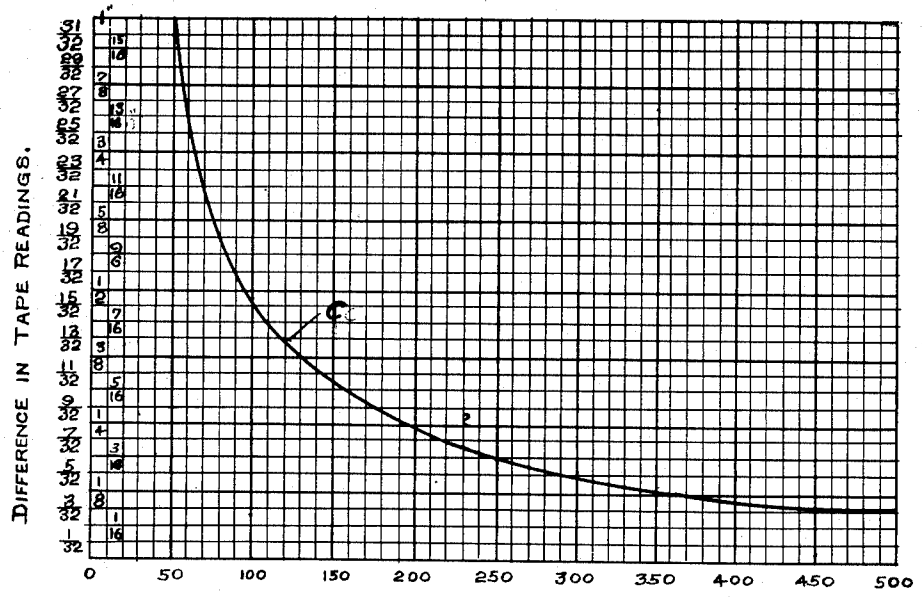


Fig. 10.



INVENTOR.
CHARLES W. RIVA, DECEASED BY
LOUISE E. RIVA, ADMINISTRATRIX
BY
Barlow & Barlow
ATTORNEYS.

Patented Oct. 27, 1953

2,656,683

UNITED STATES PATENT OFFICE

2,656,683

METHOD OF INSTALLING UNDERGROUND PIPES OR DUCTS

Charles W. Riva, Cranston, R. I.; Louise E. Riva, administratrix of said Charles W. Riva, deceased

Application February 7, 1950, Serial No. 142,852

6 Claims. (Cl. 61—42)

1

This invention relates to a method for the installation of underground pipes or ducts.

Heretofore it has been proposed in certain cases to install underground pipes by jacking or otherwise forcing the same through the earth at such location where it is objectionable or is not economical to employ the usual trenching or tunneling methods of laying pipes. In such proposed schemes, which are familiar to those skilled in the art, the earth or soil at the forward edge of the pipe being jacked was excavated by workmen entering the pipe or by means of some earth boring tool, the pipe often being directed by a guide attached to the pipe. In instances where the pipe is not of a diameter sufficient to permit workmen to enter and check the forward movement of the end of the pipe with respect to a selected line or grade, the above schemes are impractical because the pipe may move out of the selected line and even emerge at some point removed from that desired.

The general object of the invention is the provision of an improved method and apparatus for jacking a pipe or duct through solid compact earth in a manner to avoid the difficulties of the prior art.

A more specific object of the invention is the provision of an improved method and apparatus for jacking a pipe wherein the forward movement of the pipe may be properly ascertained as the work progresses.

Another object of this invention is the provision of an improved method for guiding and progressively effecting or changing the direction of movement of the forward end of the pipe should the same move away from the selected line.

With these and other objects in view, the invention consists of certain novel features of construction, as will be more fully described and particularly pointed out in the appended claims.

In the accompanying drawings:

Figure 1 illustrates a method of jacking an underground pipe or conduit beneath a river bed embodying my invention;

Figure 2 is a sectional view on an enlarged scale of the right-hand portion of the view shown in Figure 1;

Figure 3 is a sectional view taken substantially along line 3—3 of Figure 2;

Figure 4 is a fragmental view of two pipe sections held together by means of a clamp to align the same for further operation thereon;

Figure 5 is a sectional view of the first section of the pipe shown in Figure 1;

Figure 6 is a detail of construction on enlarged scale;

2

Figure 7 is a fragmental portion of a section of pipe showing a water conduit attached thereto;

Figure 8 is an elevational view of a plurality of sections of pipe extending through the earth from a guide;

Figure 9 is a similar view but showing the forward end of pipe extending through the earth from a guide out of a straight line;

Figure 10 is a view of a chart showing an approximate curve plotted thereon for a twelve-inch rise of a particular diameter pipe along a distance of approximately five hundred feet.

In carrying out the invention, which, by way of example, is shown in the drawing as applied to the installation of a pipe or conduit 10 to extend beneath a river or canal bed 11, soundings are first made in order to ascertain the nature of the earth or soil along or adjacent to the selected line SL along which line it is desired that the pipe 10 is to be jacked.

It may here be pointed out that the pipe 10 is made of a plurality of sections 12, each of a similar general construction. Each section has four equally spaced channels 13 which may be provided by means of small diameter pipes. These channels 13 extend along the inner wall of the said section from end to end thereof and are welded or otherwise attached in position along the said inner wall of the section. In welding or otherwise attaching the pipe sections 12 to each other end to end, the channels 13 are positioned to be in register with, and may be attached to, each other end to end in any convenient manner so as to provide a length of pipe section 12 having four channels 13 extending lengthwise thereof and diametrically opposite each other (see Fig. 3). In the first of the pipe sections 12 designated 12', the forward end of each channel 13 is closed (see Fig. 5) by means of a plug 14 in order effectively to seal the same against the entrance of earth therein as the pipe section 12' is being moved into the earth. A steel tape 15 is fastened at the forward edge of each channel in the pipe section 12' and extends within the channels, the tapes being successively threaded through the channels of the added pipe sections 12. There are four of these tapes and each is graduated similarly, preferably in increments of inches.

The section 12' is, or may be, provided with four equally spaced water conduits 16 which are positioned adjacent to or in between the channels 13 and extend from end to end of said section 12' (see Figs. 3 and 5). These water conduits are also welded or otherwise attached to the inner walls of the section 12'. The forward

end of each water conduit 16 is sealed as at 17 (see Fig. 6) and the other end of the conduit is provided with an attachment to receive another section of water conduit, in the case shown being a usual pipe coupling 18 internally threaded. As each pipe section 12 is added, water conduits designated 16' are attached one to the other (see Fig. 7). Each water conduit 16' is similar to the other and each carries a threaded coupling 18 and is threaded at the other end as at 19 to engage with the coupling 18 of the previously attached water conduit 16' or 16.

The pipe section 12' is also provided with a plurality of openings 20 (see Fig. 6) and in line with each of the water conduits 16. These openings 20 extend rearwardly and through the adjacent wall of the water conduit 16. The four groups of openings provide a nozzle in the pipe section 12' with four equally spaced water outlets for directing a flow of water under pressure in any or all of four different directions or quarters from the said section 12'. It may be found advantageous in some instances to provide outlet openings 20 in a plurality of the pipe sections 12, and also in water conduit sections 16'.

With satisfactory soil conditions a shaft 21 is sunk or embedded or otherwise provided in one bank of the river to provide an accessible location for forcing the pipe 10 through the earth. A similar shaft 22 may be sunk or embedded or otherwise provided in the other bank of the river to provide another accessible location to receive the pipe 10. The lower portion of the shaft 21 may be enlarged as at 23 so as to provide ample space for storing the necessary paraphernalia required in projects of this sort and for workmen to work in. The walls of the shaft 21 may be lined as at 24 and 25 as is usual in constructions of this kind so as to prevent caving of the said walls.

At the proper lever a guide 26 is accurately positioned to extend from the wall of the shaft 21 to be sunk or embedded or otherwise provided in the earth adjacent to the shaft and in a position to extend axially along the selected line SL along which the pipe is to be jacked. The guide may also be positioned wholly within the shaft or may be positioned partly in the shaft and partly in the earth adjacent to the shaft as the choice or condition may dictate. The guide 26 is made in tubular form to accurate dimensions so as to slidably receive and accurately guide pipe sections 12' and 12 and is of a length sufficient to provide ample bearing for the pipe sections to assure accurate initial movement thereof through the soil. The guide may be reenforced in position against displacement by side or top fins or brackets such as angle irons 27, which are welded or otherwise attached to the outer side of the guide and which extend therefrom laterally to the longitudinal axis of the said guide and which are shown in the present instance as being embedded into the soil around the guide. However, the fins or brackets or angle irons may be properly supported and anchored into position in any other appropriate manner; even in the walls of the shaft or in supports set wholly within the shaft.

With the guide 26 in proper position the work of pushing the pipe sections through the soil may proceed. The first pipe section 12' is set or pushed or positioned into guide 26 so that the rearward end of pipe section 12' overhangs the rearward end of the guide 26 a distance sufficient to allow the next pipe section 12 to be properly set into position in shaft 21 or in shaft enlargement 23, in order to be attached to pipe section 12'. This same procedure is followed for succeeding pipe sections 12. This section 12' and succeeding sections 12 are, or may be, additionally supported and held in line by a suitable guide device or cradle 28 properly supported and anchored against displacement as at 29. The next of the pipe sections to be added to section 12' is positioned on guide devices or cradles 30 which may be similar to cradle 28 and may be similarly anchored as at 31. With the pipe sections properly aligned so that the channels and water conduits are in register with each other (the free end portion of the steel tapes first having been previously passed through the said channels of the added section), the said sections may now be temporarily clamped to each other such as by means of a clamp 32 shown in Figure 4, this clamp having a plurality of openings 33 through which the sections 12' and 12 may be initially attached together to hold them in line by various methods; in the case illustrated spot welding being used as describing the principle involved.

With the pipe sections properly welded or otherwise attached to each other and the tape channels and water conduits also properly secured in the pipe sections may be welded or otherwise firmly attached to each other in a manner so as to provide a seal at the joint of the sections flush with the outer surface of the pipe sections. The sections of channel 13 and of water conduit 16 may next be attached to each other in position and/or to the inner face of the added section 12; sections of channel 13 and of water conduit 16 may be attached to each other and/or to the inner face of the added section 12 prior to the welding or attachment of the pipe sections to each other, if found advantageous so to do.

With the pipe sections welded or otherwise attached to each other and the tape channels and water conduits also properly secured in place, the attached pipe sections 12' and 12 may be pushed or forced into the soil and for this purpose there is provided a hydraulic jack 34 or some other suitable device which is properly supported such as by means of blocks 35 so as to be at the proper level axially with the pipe sections. The jack rests against an abutment 36 which may be of concrete or some other construction. Heavy timbers may be positioned between the end of the pipe section and the ram of the jack 34. It is of extreme importance to prevent any large movement of earth or water back through the pipe being installed, such as may occur when forcing the pipe through wet and soupy soil. To prevent such movement of earth there is provided a plug designated 37 which is positioned between the ram 38 of the jack and the edge of the last attached pipe section 12. The plug 37 is provided with a reduced portion 39 which is received within the pipe section 12 (and 12' if needed) and a shoulder 40 which abuts the end or edge of the said section 12 (and 12' if needed). The plug 37 also has recesses 41 at the outer peripheral edge thereof into which the water conduit 16 and channels 13 may extend and which will allow the free end of the tapes to pass out of said plug. After the pipe sections 12' and 12 are moved ahead into the ground through guide 26 to the proper position, this plug 37 is replaced by a smaller plug

while added pipe sections 12 and channels 13 and water conduits 16 are being attached to the pipe sections ahead of them. The purpose of the smaller plug is to prevent large movement of earth or water back through the pipe sections 12. When the pipe sections 12 and channels 13 and water conduits 16 are securely attached and ready to be moved ahead, the smaller plug is withdrawn out of pipe sections 12 and the plug 37 is positioned between the rearward end of pipe section 12 and the ram 38.

Other pipe sections 12 may be similarly attached and pushed through the soil. As work progresses a check is made at frequent intervals to ascertain the movement of the forward end of the pipe 10. This is accomplished by taking readings of the four tapes 15 at the edge 42 of the last attached pipe section 12 (see Fig. 8). Should the pipe be moving substantially along the selected line SL, then the readings on opposite tapes will be substantially similar to each other. Should the pipe, however, be moving too far out of the selected line SL, then the readings on the opposite tapes at the edge 42 of the last attached section 12 will be different and will indicate the direction and the amount of deviation from the said selected line SL, and this difference in tape measurement will then be known, and thus indicate the amount of rise, fall, or side movement of the pipe, as the case may be. For example, assuming in Figure 9 the difference in the readings between the upper and lower tapes to be three-sixteenths of an inch at a three hundred foot distance of inserted pipe; then by proper computation it will be seen that the end of this particular pipe is twelve inches above the selected line SL.

Should the pipe section be moving too far out of the selected line SL, then its direction of movement may be changed by the application of water under pressure at the forward end of the pipe 10 through one or more of the water conduits 16 and openings 20, thus readjusting the earth pressures which have been tending to move the pipe sections 12 out of the selected line SL. The use of water under pressure through water conduit 16 and openings 20 will also help in making the driving of pipe 10 easier, as the water will cut down the friction of the earth against the outside of the pipe 10. This principle holds whether the pipe 10 is substantially along the selected line SL or is too far out of the selected line SL. Further jacking will cause the end of the pipe to return to the desired direction. Upon the pipe having been jacked to the other accessible location, such as the shaft 22, then the earth or soil in the pipe may be removed by appropriate means such as by a boring tool, cleaning tool, by flushing, or otherwise as the condition of the soil may dictate.

In Figure 10, there is supplied a chart showing an approximate curve C, plotted for a twelve-inch rise at various distances of a particular diameter pipe. On the left of the chart are shown readings in increments of inches and at the lower edge the distance in feet. It will be seen in this particular instance that a difference in tape readings of one-eighth of an inch will be had at a distance of three hundred feet of pipe with a twelve-inch rise therein. At a one hundred foot distance of pipe a difference in tape readings of fifteen thirty-seconds of an inch will be had for a twelve inch rise of this particular pipe, it, of course, being obvious that

curves for various rises in pipe distances may also be plotted to provide a chart by which the out of line movement of the pipe may be had directly at the time of the readings of the tapes without further computation.

It will now be apparent that there is disclosed a method of installing underground pipe which provides for accurately determining the direction of movement of the pipe and for controlling the movement of the said pipe should the same be moved too far out of the said selected line SL.

What is claimed is:

1. Method of installing an underground pipe or duct which comprises erecting a tubular guide at one accessible location pushing through said guide into solidly compacted earth and along a selected line, successively, a series of end to end pipe sections until such series extends from said location to a second accessible location, and as the work progresses welding, each pipe section to the one ahead of it, said guide being arranged to engage at least the full length of one of said sections prior to a section being pushed beyond said guide, attaching at the leading edge of the first of said pipe sections prior to the pushing thereof through said guide a plurality of measuring tapes to extend along the inner wall of said joined pipe sections with pairs of said tapes positioned diametrically opposite each other to extend along the inner surface of said pipe sections, and measuring with said tapes at the free edge of the last joined section the length of said pipe sections at opposite diametrical sides thereof as the pushing progresses and without removing the earth from the pipe to determine the line of movement of said pipe sections as the work progresses.

2. A method of installing an underground pipe or duct as set forth in claim 1 wherein a plurality of water conduits are attached to the inner side of said pipe sections with pairs positioned diametrically opposite each other as the work progresses, said conduits having openings from said water conduits to extend through the sides of at least the first of the said pipe sections at positions rearwardly of the front edge of the leading section closing the forward ends of said water conduits and forcing water under pressure through said water conduits and out of said openings to loosen the earth on a selected side of the first pipe section for controlling the direction of the pipe as advanced, and temporarily sealing each section of pipe as added to prevent a backflow of earth through said sections as advanced.

3. Method of installing an underground pipe or duct which comprises pushing from one accessible location into solidly compact earth and along a selected line, successively, a series of end to end pipe sections and as the work progresses welding each pipe section to the other without removing earth from within the pipe, attaching to the inner side of said pipe sections pairs of water conduits with the conduits of each of said pairs positioned substantially diametrically opposite each other and to extend end to end through said pipe sections, said conduits having openings from said water conduits to extend through at least the side of the first of the said pipe sections at positions rearwardly of the front edge of the first of the said pipe sections closing the forward ends of said water conduits and forcing water under pressure through said water conduits and out of said openings to loosen the earth on a selected side of the first pipe sec-

tion for controlling the direction of the pipe as advanced.

4. The method of installing an underground pipe or duct through solidly compacted earth along a selected line from one accessible location to another which comprises attaching a plurality of smaller pipe sections to the inner surface of a main pipe section at diametrically opposite locations thereof with tapes in each of said smaller pipe sections attached adjacent to the leading edge thereof, forcing the assembled pipe sections into the earth in the direction of said selected line, adding to the first pipe section a second main pipe section with smaller pipe sections attached and in registry with those of the first pipe section and with the tapes extending through the second smaller pipe sections, welding the second main pipe section to the end of the first main pipe section, forcing both first and second assembled pipe sections into the earth, successively adding additional main and smaller pipe sections in repetition of the adding of the second main and smaller pipe sections with the tapes extending therealong and pushing the sections into the earth as assembled and measuring with said tapes the combined length of a series of the smaller pipe sections at diametrically opposite locations of the main pipe sections from their most distant to their nearest ends to determine by the difference in said length the line of movement of said pipe as the work progresses.

5. The method of claim 4 wherein a plurality of water conduits are also attached to the inner side of said main pipe sections as the work progresses with pairs positioned diametrically opposite each other, said conduits having openings at the forward portion of the first main pipe section coinciding with openings through the sides of the first main pipe section at a position rearwardly of the front edge thereof, and forcing water under pressure through said water conduits to loosen the earth on a selected side of the first pipe section to control the direction of movement of the main pipe section.

6. The method of claim 4 wherein the initial step is erecting a tubular guide in the accessible location where the duct is started and directing all main sections through said guide, said guide being arranged to engage approximately the full length of one of said sections prior to the section being pushed beyond said guide.

CHARLES W. RIVA.

References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
956,627	Conkling	May 3, 1910
1,796,752	Goodrich	Mar. 17, 1931
1,948,733	Robertson	Feb. 27, 1934
2,010,422	Townsend	Aug. 6, 1935
2,325,565	Williams	July 27, 1943