HAND TOOL FOR CRIMPING CONNECTORS

This invention relates to hand tools for crimping electrical connectors of the type used for joining the ends of electrical conductors to provide an electrically conductive joint therebetween. Hand tools embodying the present invention can be used in a variety of different ways to crimp many different types of connectors. However, the utility of the present hand tool can be most conveniently pointed out by selecting a specific illustrative application for which it is especially useful and describing this application in some detail. Accordingly, the tool will be initially described in relation to its use for effecting electrical connections between the blasting wires and fusing wires of a demolition circuit.

In many electrical wiring operations, it is necessary to make a large number of electrical connections between wire ends. It is thus desirable to have for such work a relatively simple and certain method of tools for making electrical connections between wires in the field. Moreover, it is desirable that the method of connection used be operative to effect a good electrical connection between the wires under extreme environmental conditions, such as, for example, at sub-zero temperatures, or in moist ground, or even under water. Also the modes of connection used should be such as to provide the desired electrically conductive joint between wires of different sizes.

A sleeve-type connector, suitable for use in effecting such wire-resistant, electrically conductive joint is described in the copending application of George T. Ritter, Serial No. 242,850, filed August 21, 1951, and is illustrated in Fig. 21 of the drawings of the present application. To effect a joint between two conductors with this type of connector the insulation is stripped from the ends of the conductors to predetermined distances that are proportioned to the wire sizes of the conductors, and the stripped ends are then inserted into the sleeve connector until they are in substantially abutting relation within the connector. Thereafter the connector is crimped with a suitable tool at four points to provide the joint illustrated in Fig. 21. Referring to Fig. 21, the two center crimps 10 engage the stripped ends of the wire to provide an electrical connection therebetween and the crimp 12 engage the insulation of the conductors to provide a water-tight joint.

In cases where telephone, telegraph or demolition wiring is to be installed or repaired at low temperatures, as for example such as occur in Arctic and subarctic regions, it is necessary for the operator to wear heavy gloves or mittens, and it is desirable that the tool or tools provided for effecting the electrical connection between the conductors be so constructed that the operator can carry out all of the necessary steps without removing his gloves. These steps include measuring the length of insulation to be removed from the end of each conductor, which length, as previously indicated depends upon the wire size of the conductor; stripping this predetermined length of insulation from the conductor; selecting an uncrimped connector from a supply of connectors and moving it to crimping position; inserting the stripped ends of the conductors into the connector; holding the conductor ends in proper position within the connector until crimping is completed; and crimping the connector to effect the desired electrically conductive, water-tight joint between the conductors.

It is an object of the invention to provide a hand tool adapted to be used in performing the foregoing operations. It is another object of the invention to provide a hand tool so constructed that an operator can perform all of these operations therewith without removing his gloves. It is another object of the invention to provide a hand tool of this type that includes a supply of connectors to be crimped and provides for positioning of the connectors to receive the wires to be joined. It is a still further object of the invention to provide a hand tool of this type that is light in weight and can be readily used in relatively inaccessible locations. Other objects of the invention will be in part obvious and in part pointed out hereafter.

The many objects and advantages of the present invention can best be understood and appreciated by reference to the accompanying drawings which illustrate a hand tool incorporating a preferred embodiment of the present invention and a modification thereof.

In the drawings:

Fig. 1 is a side elevation of the hand tool showing its general organization;

Fig. 2 is an enlarged top plan view of the crimping head of the connector with a portion of the connector supply magazine broken away to show the connection of the handle to the crimping head;

Fig. 3 is a fragmentary perspective view of the crimping head with the top portion thereof removed to reveal the reciprocable plunger and the four crimping dies formed on the leading end of the plunger;

Fig. 4 is a vertical section taken on the line 4--4 of Fig. 3 and showing in side elevation the reciprocable plunger, one of the crimping dies associated therewith and one of the ejector arms for ejecting a crimped connector from the tool;

Fig. 5 is a perspective view taken approximately along the line 5--5 of Fig. 3 and particularly showing the four crimping molds of the crimping head and the relation of the ejector arms thereto;

Fig. 6 is a perspective view of the magazine or clip for containing the supply of connectors to be crimped;

Fig. 7 is a perspective view of the connector-retaining spring of the connector magazine;

Fig. 8 is a plan view of the magazine showing the actuating spring that urges the connectors toward the discharge end of the magazine;

Fig. 9 is a side view of the magazine partially broken away to show further the relationship between the actuating spring and the connectors;

Fig. 10 is an enlarged discharge end view of the magazine of Fig. 9;

Fig. 11 is a vertical section through the crimping head, showing particularly the manner in which connectors are fed from the magazine to the crimping elements of the tool;

Fig. 12 is an enlarged side elevation of the insulation cutter of the tool;

Fig. 13 is a vertical section taken on the line 13--13 of Fig. 12 and showing the manner in which the knife elements of the insulation cutter cooperate to cut the insulation of a conductor and also the manner in which the conductor is positioned to cause a predetermined length of insulation to be cut;

Fig. 14 is a vertical section taken on the line 14--14 of Fig. 12 and showing the manner in which the upper knife element of the insulation cutter engages the lower
knife element to provide proper relative positioning of these parts;

Fig. 15 is a perspective view of the wire-positioning abutment of the insulation cutter showing a pair of guide surfaces for positioning the ends of conductors of different sizes to insure cutting of the proper length of insulation;

Fig. 16 is a perspective view of the crimping head showing, in the foreground, one of the wire holders;

Fig. 17 is a horizontal section taken on the line 17—17 of Fig. 1, that is, substantially at the center of one of the wire holders and showing the wire-holding plunger together with its actuating spring and latch mechanism;

Fig. 18 is a fragmentary side elevation of the crimping head broken away to provide a side view of the wire-holding plunger;

Fig. 19 is a perspective view of the latch spring of the wire holder;

Fig. 20 is a perspective view of the manual operating member of the wire holder;

Fig. 21, as previously pointed out, is a perspective view of a connector crimped with the tool of Figs. 1 to 20;

Fig. 22 is a top plan view of a modified form of crimping head;

Fig. 23 is a side elevation of the crimping head of Fig. 2 with the magazine shown in section;

Fig. 24 is a view similar to Fig. 23, but with the plunger withdrawn to show the manner in which connectors are fed to the crimping elements of the head.

Referring to the drawings and particularly to Figs. 1, 2, and 3, the hand tool there shown comprises a crimping head generally designated 14, within which a plunger 16 is mounted for reciprocatation in the direction indicated by the arrows in Fig. 3. Reciprocatation of plunger 16 within head 14 is effected by means of a pair of handles 18 and 20 that are pivotally connected to the head 14 by the links 22 and 24 respectively and pivotally connected to each other and to the plunger 16 by a pin 26. The mode of connection of handles 18 and 20 to head 14 and plunger 16 is further shown in Figs. 11 and 16 of the drawings.

The construction is such that as the handles 18 and 20 are brought together, the plunger 16 is advanced by a toggle action toward the right (assuming that the parts are viewed as shown in Figs. 1 to 3) and as the handles are separated the plunger is withdrawn to the left. The handles 18 and 20 are provided with a ratchet and ratchet-release mechanism 28 of the type shown in Carlson Patent No. 2,618,993. The mechanism 28 operates to maintain the handles, as they are brought together, in any position to which they have been pressed and prevents separation of the handles until the mechanism has been fully actuated.

Referring particularly to Figs. 3 and 5, the plunger 16 is provided at its leading end with four crimping dies 30, 32, 34 and 36 that cooperate, when the plunger is advanced by bringing together handles 18 and 20, with four crimping molds 38, 40, 42 and 44 respectively formed in the crimping head 14 to crimp a connector that is positioned between the dies and molds. As shown in Figs. 3, 4 and 5, the plunger is also provided with a pair of ejectors 46 and 48. The ejector 46 is arranged to slide between the molds 38 and 40 as the plunger reciprocates and is provided at its free end with an upwardly extending arm 50. The ejector 48 is positioned for downward movement between the molds 42 and 44 and is provided at its free end with an upwardly extending arm 52. The construction is such that as the plunger 16 is retracted after crimping a connector, the arms 50 and 52 of the ejectors 46 and 48 disengage the crimped connector from molds 38 to 44.

Referring now particularly to Fig. 11, mounted on the side of each table 54 is a magazine or clip 56 containing a supply of connectors to be crimped. The receiver 54 can be secured to head 14 in any suitable manner such as by means of the screw 58. At its lower end receiver 54 is provided with a downwardly extending lip 60 that serves to guide uncrimped connectors from the discharge end of the magazine downwardly to a position in front of the plunger 16 when the plunger is in its retracted position.

Referring now to Figs. 6 to 10, the magazine 56 comprises a casing 62 having a longitudinal slot 64 formed therein. The upper surface of casing 62 is provided with a pair of small bosses 66 that are adapted to engage corresponding recesses formed in the inner surface of receiver 54 to insure proper positioning of the magazine in the receiver. Within the casing 62 there is an actuating spring 68 which, as particularly shown in Fig. 9, engages an adapter 70 and causes it to bear against a row of connectors 72 to urge them toward the discharge end of the casing.

In order to prevent connectors from being discharged from magazine 56 before the magazine has been inserted in receiver 54, a retaining spring 74 is provided, the configuration of which is best shown in Fig. 7. The spring 74 comprises a pair of arms 76 that embrace the casing 62 and a pair of arms 78 that extend upwardly in front of the discharge end of the casing and prevent connectors from being discharged therefrom until the magazine has been inserted in receiver 54. Spring 74 also includes an arm 80 having a downwardly extending lip 82. When the magazine is inserted in the receiver, lip 82 engages the upper edge of the receiver and as the magazine is forced into the receiver the casing 62 slides with respect to spring 74, thereby causing arms 78 to be retracted from in front of the discharge end of the casing.

Reverting to Fig. 11, if the plunger is in its retracted position when the magazine is inserted in the receiver, the first connector from the magazine will drop down in front of the plunger in position to be moved forwardly by the advancing movement of the plunger and crimped. If, on the other hand, the plunger is in its advanced position when the magazine is inserted, the first connector of the series will drop down on top of the plunger and when the plunger is retracted, will move further downward to a position in front of the plunger. It will be noted that the magazine 56 and receiver 54 are arranged at a relatively sharp angle with respect to the horizontal in order to make sure that only one connector at a time is positioned in the lower knife element 16.

Referring now to Figs. 12 to 15 of the drawings, the head 14 is provided with an insulation cutter generally designated 90, and comprising a wire-positioning block or abutment 92, secured to the head 14 in any suitable manner such as by the screws 94 (only one of which is shown); a lower knife element 96 secured to block 92 by the screws 98; and an upper knife element 100 pivotally secured to the lower knife element by means of a rivet 102. As best shown in Fig. 1, the upper knife element 106 is provided with a finger piece 104, by means of which the upper element can be manually forced downwardly against the lower knife element.

As particularly shown in Fig. 12, the upper element 106 has at its lower edge a semi-circular knife edge 106 formed therein and a second semi-circular knife edge 108 that is somewhat smaller than the knife edge 106. The knife edges 106 and 108 cooperate with corresponding semi-circular knife edges 110 and 112 respectively formed in the lower knife element 96 to define circular openings having substantially the diameters of the connectors from which the insulation is to be cut. The position of the knife elements and knife edges when cutting the insulation of a conductor is particularly illustrated in Fig. 13.

As disclosed in the co-pending Ritter application Serial No. 2,423,856, a series of adapters 114 and 116 for connectors of different sizes are to be joined that a relatively shorter length of insulation be stripped from the
smaller conductor so that when the conductors are inserted in the connector a satisfactory water-tight seal can be achieved between the connector and the insulation of the conductor. Automatic determination of the proper length of insulation to be severed is achieved in the present structure by means of the wire-positioning block 92. As best shown in Fig. 15, the block 92 is provided with spaced wire-positioning surfaces 114 and 116. The positioning surface 116 is located closer to the knife element than is surface 114 and is also positioned in registry with the opening defined by knife edges 108 and 112. The positioning surface 114 is located in registry with the opening defined by knife edges 106 and 110. Thus block 92 cooperates with knife elements 96 and 100 to ensure that the proper length of insulation will be cut from the conductor, based on the size of the conductor from which the insulation is to be stripped.

In order to ensure proper relative positioning of the knife edges of the upper and lower knife elements respectively the upper element as shown in Fig. 14 is forked to provide arms 118 that embrace the lower element as the knife edges are brought together. In this way proper alignment of the knife edges to produce the desired cutting action is ensured. In operation the upper knife element 100 is raised by means of finger piece 104, the conductor to be stripped is inserted until its end abuts one of the surfaces 114 and 116 and the upper element 100 is then pressed downwardly to sever the insulation. Thereafter, with the upper knife element depressed, the conductor is manually withdrawn from the wire cutter whereupon the severed length of insulation is detached from the conductor.

In using the present hand tool it is usually desirable to strip the wires and insert them in the connector in sequence and accordingly means are provided for holding one wire in crimping position within the connector while a second wire is being stripped. Referring particularly to Figs. 16 to 20 of the present movement 14 is provided with a wire holder generally designated 120 and comprising a block 122 secured to the head 14 by means of the screws 124. A second wire holder 126 (see Fig. 2) is provided on the other side of head 14. Since the wires and holders are of similar construction, only one need be described in detail.

Referring particularly to Fig. 17, mounted for reciprocating movement in a channel formed in block 122 there is a wire-holding finger 128 having at its left end a rod-like extension 130 and at its right end a curved head 132 adapted to bear against a wire that has been inserted in the connector and hold it against a portion of head 14 as best shown in Fig. 16. The rod-like extension 130 of finger 128 extends into a spring 134 located in channel 127 and normally biased to urge finger 128 to the right. Threaded into the side of finger 128 there is a screw 136, the inner end 138 of which is of reduced diameter and extends into a recess 140 formed in the side of plunger 16. The construction is such that as the plunger 16 is withdrawn, an end wall of recess 140 engages inner end 138 of screw 136, thus causing the wire-holding finger 128 to be retracted with the plunger 16. As the finger 128 completes its retractive movement it is latched in retracted position by a manually releasable latch that will now be described.

Referring particularly to Figs. 17 and 19, a leaf spring 142 is secured at its left end to the block 122 by a screw 144. The spring 142, near its right end, is provided with a slot 146 through which the screw 136 passes, and the spring is normally biased in such manner as to bear against the head of screw 136. Approximately midway between the ends of slot 146, and at the sides of the slot there are a pair of projections 148. As the plunger 16 is retracted, wire-holding finger 128 is also retracted and the head of screw 136 passes over projections 148, after which the spring and projections move outwardly in such manner as to latch the screw and associated wire-holding finger in retracted position. The spring 142 can be pressed inward manually to release the wire-holding finger for advancing movement under the influence of spring 134, provided that the plunger 16 has been sufficiently advanced to permit advancing movement of the inner end 138 of screw 136.

It is sometimes desirable to readjust one of the wires after it has been inserted in the conductor and before the connectors are to be latched. To facilitate such adjustment, the wire-holding finger 128 is provided with manually operable means whereby it can be retracted. Referring to Figs. 17 and 20, this manual means consists of a plate 150 secured to the finger 128 at the inner side thereof and having a hole 152 through which the inner end 138 of screw 136 extends. Plate 150 is also provided with an outwardly extending tab 154 that can be manually pressed to retract the wire-holding finger.

The operation of the present hand tool should be largely apparent from the foregoing description. In using the tool a magazine 56 is inserted in the receiver 54. The handles 18 and 20 are then separated to retract the plunger and permit a connector from the magazine to be dropped down in front of the plunger. Thereafter handles 18 and 20 are pressed together with a relatively light pressure to move the uncrimped connector against the molds 38 to 44, the pressure being insufficient to crimp the connector. Thereafter the conductors are inserted in the insulation cutter as previously described, the upper knife element 100 pressed downwardly to sever the insulation and the conductors pulled outwardly to detach the severed insulation from the end of the conductor. The stripped ends of the conductors are then inserted in the connector until their ends substantially butt one another within the connector. Thereupon the wire-holding fingers are released to hold the wires in proper position within the connector and the handles 18 and 20 are pressed together with a force sufficient to effect desired crimping of the connector between the dies 30 to 36 and molds 38 to 44. The resulting crimped joint is illustrated in Fig. 21 as previously described.

Figs. 22 to 24 illustrate a simplified form of the crimping tool previously described wherein the wire holder and insulation cutter are omitted and a different type of magazine is provided for storage of the uncrimped connectors. Referring to Figs. 23 and 24, the magazine 56 and receiver 54 previously described are replaced by a single storage chamber 160, which is secured to the crimping plunger 166 and provided internally with an actuating spring 168 that urges an end section 172 of chamber 160 into a line of uncrimped connectors. Secured to the top of chamber 160 there is a feedspring 168 that has a curved lower end 170 adapted to bear against the top of the crimping plunger when it is in its advanced position. Feed spring 168 is also provided with a connector-retain ing finger 172 that extends through a slot 174 in the upper wall of chamber 160 and is adapted to be moved into the path of the connectors discharged from the chamber. As shown particularly in Fig. 24, when the crimping plunger is withdrawn, curved end 176 of feed spring 168 drops down into the path of the plunger thus causing retaining finger 172 to move between the first two uncrimped connectors in the storage chamber 160. As the crimping plunger continues to be retracted, the leading connector drops down in front of the plunger as shown in Fig. 24 and the remaining connectors are held back by finger 172.

Upon advancing movement of the crimping plunger, the discharged connector is moved forward toward the crimping molds and as an incident of this advancing movement of the plunger the curved end 170 of feed spring 168 is moved upwardly by the plunger, thus withdrawing finger 172 from in front of the remaining connector and permitting another connector to drop down on top of the crimping plunger as shown in Fig. 23.
other respects the operation of the hand tool of Figs. 22 to 24 is essentially similar to that of the hand tool of Figs. 1 to 20.

From the foregoing description it should be apparent that the present invention provides a hand tool capable of achieving the objects outlined at the beginning of the specification. Thus the hand tool can be made relatively light in weight and readily portable. Additional clips of connectors can be inserted as desired to provide connectors for making a large number of conductive joints. The insulation cutter, wire holders, plunger actuating means, and operator storage are all so constructed as to permit an operator wearing heavy gloves or mittens to operate them without removing his gloves. The toggle connection between the handles 18 and 20 and the crimping plunger provides heavy crimping pressure with a relatively light force exerted on the handle.

1. In a manually operable tool for crimping electrical connectors in combination, a crimping head having a plurality of spaced crimping molds formed therein including an inner pair of molds and an outer pair of molds; a plunger movably mounted in said head and having a plurality of crimping dies, each of which is aligned with one of said molds whereby it moves with said plunger toward and away from the mold with which it is aligned to crimp a connector placed between said dies and molds; a pair of handles pivotally connected to each other and to said plunger and a pair of links connected to said head and to said two handles respectively at points spaced from the pivotal connection of said handle to said plunger, whereby said handles are manually operable to move said plunger in said head; and a pair of ejectors secured to said plunger, each of said ejectors being located between each of said inner molds and its adjacent outer mold, said ejectors being retractable with said plunger to eject a cramped connector from said mold upon retraction of said plunger from said molds.

2. In a manually operable tool for crimping electrical connectors in combination, a crimping head having a plurality of crimping molds therein including an inner pair of molds and an outer pair of molds; a plunger mounted for reciprocating movement in said head and having a plurality of crimping dies, each of which is aligned with one of said molds whereby it moves with said plunger toward and away from the mold with which it is aligned to crimp a connector placed between said dies and molds; a pair of handles pivotally connected to each other and to said plunger and a pair of links connected to said head and to said two handles respectively at points spaced from the pivotal connection of said handle to said plunger, whereby said handles are manually operable to reciprocate said plunger in said head; a pair of ejectors secured to said plunger, each of said ejectors being slidably positioned between one of said inner molds and its adjacent outer mold and being retractable with said plunger to eject a cramped connector from said mold, and a magazine for holding a supply of connectors for crimping, said magazine being mounted on said head and having a discharge end positioned adjacent to the path of said plunger, whereby as said plunger is retracted a connector is fed from said magazine into the path of said plunger.

3. In a manually operable tool for crimping electrical connectors in combination, a crimping head having a plurality of spaced crimping molds formed therein, a plunger movably mounted in said head and having a plurality of crimping dies, each of which is aligned with one of said molds whereby it moves with said plunger toward and away from the mold with which it is aligned to crimp a connector placed between said dies and molds; a pair of handles pivotally connected to each other and to said plunger and a pair of links connected to said head and to said two handles respectively at points spaced from the pivotal connection of said handles to said plunger, whereby said handles are manually operable to move said plunger in said head; at least one ejector secured to said plunger and positioned between adjacent crimping molds to eject a cramped connector from said mold upon retraction of said plunger from said molds, and a tubular magazine housing mounted on said head having a plurality of spaced crimping molds formed therein, a plunger mounted for reciprocable movement in said head and having a plurality of crimping dies, each of which is aligned with one of said molds whereby it moves with said plunger toward and away from the mold with which it is aligned to crimp a connector placed between said dies and molds; means for moving said plunger and associated dies toward and away from said molds, at least one ejector secured to said plunger and positioned between adjacent crimping molds to eject a cramped connector from said mold upon retraction of said plunger from said molds, a tubular magazine containing a supply of connectors to be cramped slidably positioned in said housing, said magazine having a discharge end adjacent to the path of said plunger whereby as said plunger is retracted a connector is fed from said magazine to said plunger, and latch means for holding said magazine in operative position within said housing.

4. In a manually operable tool for crimping electrical connectors in combination, a crimping head having a plurality of spaced crimping molds formed therein, a plunger mounted for reciprocable movement in said head and having a plurality of crimping dies, each of which is aligned with one of said molds whereby it moves with said plunger toward and away from the mold with which it is aligned to crimp a connector placed between said dies and molds; means for moving said plunger and associated dies toward and away from said molds, at least one ejector secured to said plunger and positioned between adjacent crimping molds to eject a cramped connector from said mold upon retraction of said plunger from said molds, a tubular magazine containing a supply of connectors to be cramped slidably positioned in said housing, said magazine having a discharge end adjacent to the path of said plunger whereby as said plunger is retracted a connector is fed from said magazine to said plunger, and latch means for holding said magazine in operative position within said housing.
8. In a manually operable tool for crimping electrical connectors in combination, a crimping head having a plurality of spaced crimping molds formed therein; a crimping plunger movably mounted in said head and having a plurality of crimping dies, each of which is aligned with one of said molds whereby it moves with said plunger toward and away from the mold with which it is aligned to crimp a connector placed between said dies and molds; means for moving said crimping plunger and associated dies toward and away from said molds; and a wire-holder for holding a wire that has been inserted into one of said connectors, said wire-holder comprising an abutment formed in said head and a wire-holding finger reciprocally mounted in said head and spring-urged toward said abutment, said wire-holding finger having a laterally extending manually operable means whereby it may be retracted from said abutment independently of retraction of said plunger.

9. In a manually operable tool for crimping electrical connectors in combination, a crimping head having a plurality of spaced crimping molds formed therein, a plunger mounted for reciprocating movement in said head and having a plurality of crimping dies, each of which is aligned with one of said molds whereby it moves with said plunger toward and away from the mold with which it is aligned to crimp a connector placed between said dies and molds; a pair of handles pivotally connected to each other and to said plunger and a pair of links connected to said head and to said two handles respectively at points spaced from the pivotal connection of said handles to said plunger, whereby said handles are manually operable to reciprocate said plunger in said head; and at least one ejector secured to said plunger and positioned between adjacent crimping molds to eject a crimped connector from said molds upon retraction of said plunger from said molds.

10. In a manually operable tool for crimping electrical connectors in combination, a crimping head having a crimping mold formed therein, a plunger mounted for reciprocating movement in said head and having a crimping die aligned with said crimping mold whereby it moves with said plunger toward and away from said mold to crimp a connector placed between said die and mold, a pair of handles pivotally connected to each other and to said plunger, a pair of links pivotally connected to said head and to said two handles respectively at points spaced from the pivotal connection of said handles to said plunger, whereby said handles are manually operable to reciprocate said plunger in said head, and ejector means secured to said plunger and spaced from said crimping die a distance greater than the diameter of the connector to eject a crimped connector from said mold upon retraction of said plunger from said mold.

References Cited in the file of this patent

UNITED STATES PATENTS

<table>
<thead>
<tr>
<th>Patent Number</th>
<th>Inventor</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>269,271</td>
<td>Duff</td>
<td>Dec. 19, 1882</td>
</tr>
<tr>
<td>273,448</td>
<td>Borchardt</td>
<td>Mar. 6, 1883</td>
</tr>
<tr>
<td>963,394</td>
<td>Richardson</td>
<td>July 5, 1910</td>
</tr>
<tr>
<td>1,399,303</td>
<td>Cowles</td>
<td>Apr. 1, 1919</td>
</tr>
<tr>
<td>1,451,717</td>
<td>Sommers</td>
<td>Apr. 17, 1923</td>
</tr>
<tr>
<td>1,613,715</td>
<td>Matson</td>
<td>Jan. 11, 1927</td>
</tr>
<tr>
<td>1,887,732</td>
<td>Pagel et al.</td>
<td>Nov. 15, 1932</td>
</tr>
<tr>
<td>2,018,996</td>
<td>Christians</td>
<td>Oct. 29, 1935</td>
</tr>
<tr>
<td>2,409,147</td>
<td>Neuhaus et al.</td>
<td>Oct. 8, 1946</td>
</tr>
<tr>
<td>2,453,872</td>
<td>Snauffer</td>
<td>Nov. 16, 1948</td>
</tr>
<tr>
<td>2,455,557</td>
<td>Burner</td>
<td>Dec. 7, 1948</td>
</tr>
<tr>
<td>2,565,983</td>
<td>Nelson</td>
<td>Aug. 28, 1951</td>
</tr>
<tr>
<td>2,574,811</td>
<td>Blumensaadt</td>
<td>Nov. 13, 1951</td>
</tr>
</tbody>
</table>