June 16, 1953 J. E. ERHARDT, JR., ET AL 2,641,937

ADJUSTABLE TORSION SHAFT IN FLYING SHEARS

Filed July 15, 1949 3 Sheets-Sheet 1

Fig. 3.

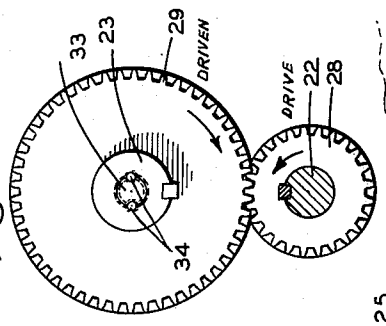


Fig. 1.

INVENTORS:
John E. Erhardt, Jr.,
Joseph S. Druffy,
BY Cushman, Darby & Cushman
ATTORNEYS.

June 16, 1953 J. E. ERHARDT, JR., ET AL 2,641,937

ADJUSTABLE TORSION SHAFT IN FLYING SHEARS

Filed July 15, 1949 3 Sheets-Sheet 2

Fig. 2.

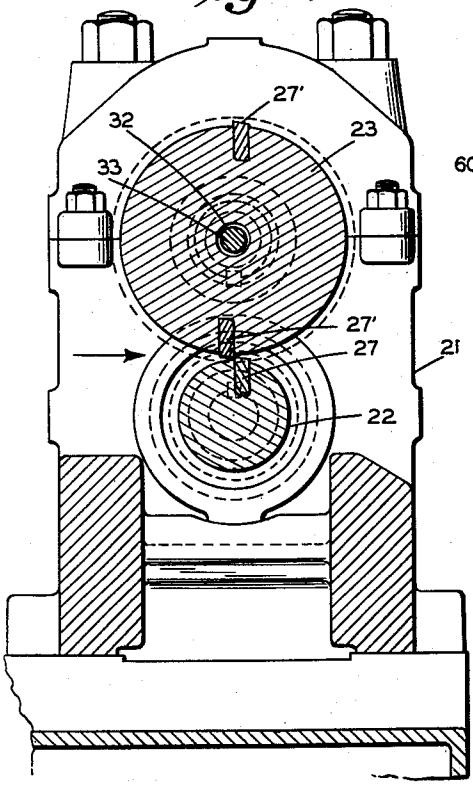


Fig. 9.

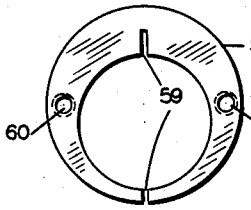


Fig. 10.

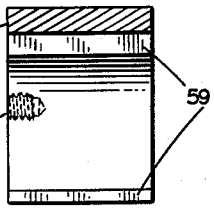


Fig. 11

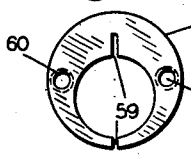


Fig. 12.

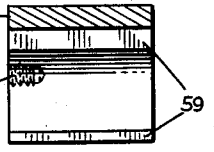


Fig. 13

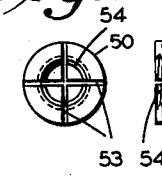


Fig. 14.

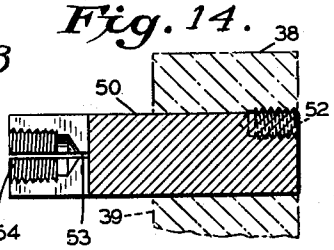
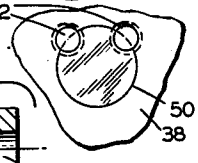


Fig. 15.



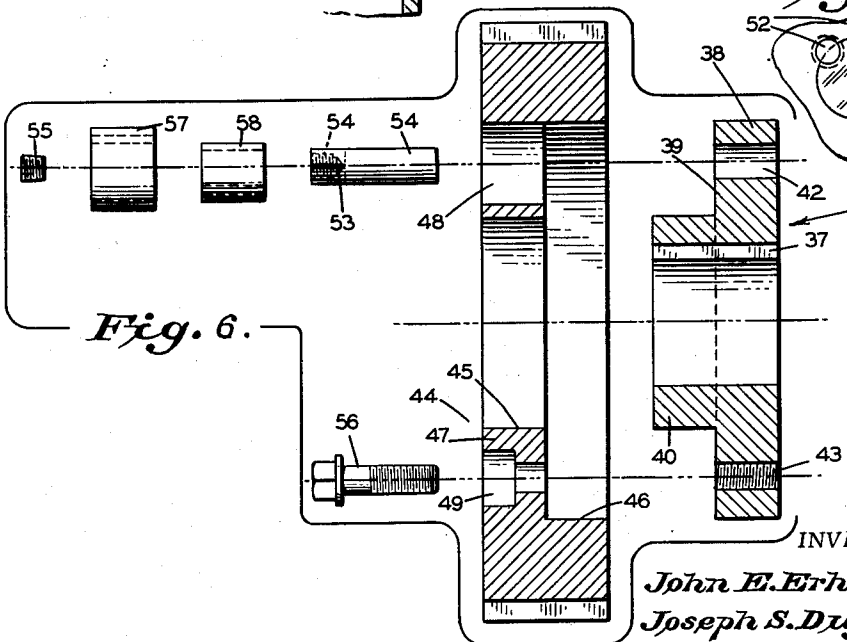


Fig. 6.

INVENTORS:
John E. Erhardt, Jr.,
Joseph S. Duffy,
BY Cushman, Darby & Cushman
ATTORNEYS.

June 16, 1953 J. E. ERHARDT, JR., ET AL 2,641,937

ADJUSTABLE TORSION SHAFT IN FLYING SHEARS

Filed July 15, 1949 3 Sheets-Sheet 3

Fig. 4.

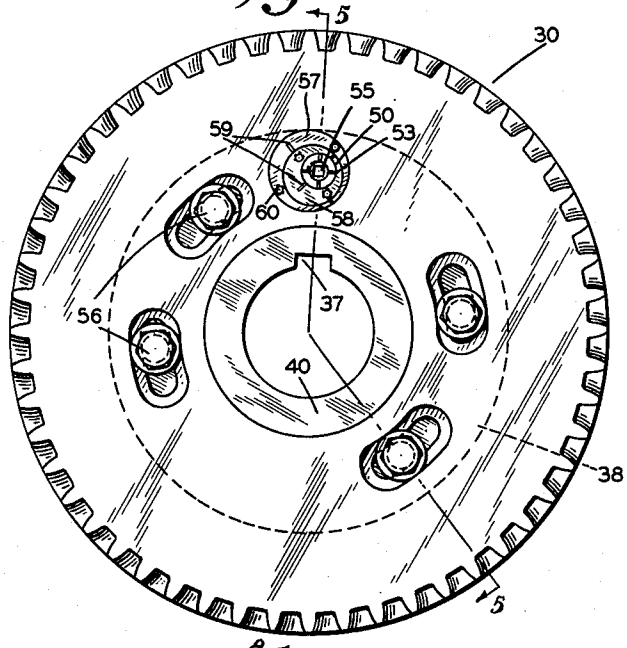


Fig. 5.

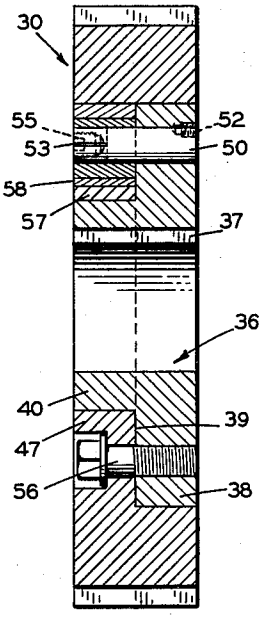


Fig. 7.

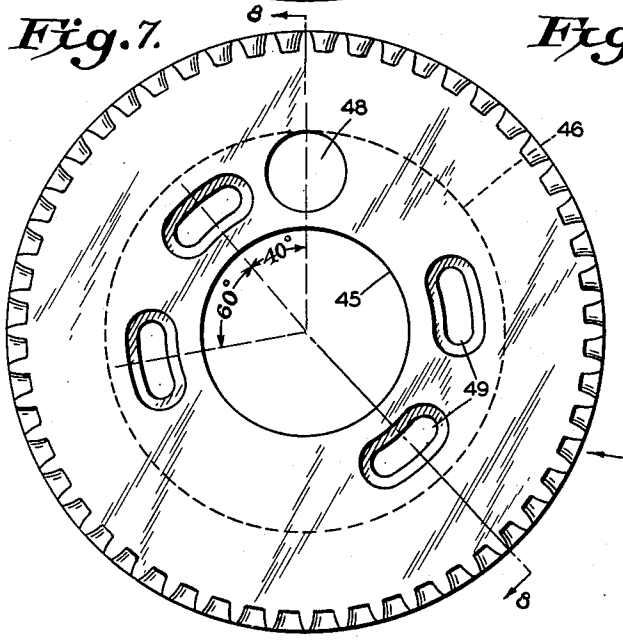
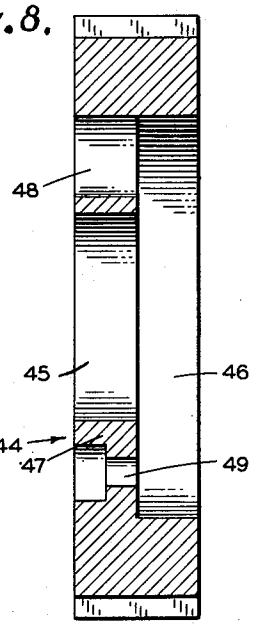


Fig. 8.



INVENTORS:

John E. Erhardt, Jr.,
Joseph S. Duffy,

BY Cushman, Darby & Cushman

ATTORNEYS.

Patented June 16, 1953 2,641,937

UNITED STATES PATENT OFFICE

2,641,937

ADJUSTABLE TORSION SHAFT IN FLYING SHEARS

John Edward Erhardt, Jr., and Joseph Silbey Duffy, Baltimore, Md., assignors to Crown Cork & Seal Company, Inc., Baltimore, Md., a corporation of New York

Application July 15, 1949, Serial No. 104,842

5 Claims. (Cl. 74—409)

1

This invention relates to adjustable gear structure, and particularly to adjustable gear structure associated with the torsion shaft of a pair of flying shears.

In flying shears employing cooperative rotating knife heads, it is common practice to gear the knife heads together at both ends thereof, for the principal purpose of assuring proper knife alignment. It is also known to provide a central torsion shaft within one of the heads, one end of the shaft being fixed to the head and the other end of the shaft fitting freely therein and protruding therefrom. The head so provided with the torsion shaft carries one fixed gear at the end whereat the shaft is fixed, and the other gear is fixed to the opposite end of the torsion shaft. The two gears so mounted may be slightly offset relative to each other, so that when meshed with the gears of the cooperative head the torsion shaft is deflected due to torsional stress, whereby backlash, vibration and other undesirable operating factors are substantially reduced.

The above-described arrangement, however, is inflexible, and does not permit variance of the stress in the torsion shaft to suit changing conditions, such as shear speed, gage, width and type of material being sheared, knife and gear wear, and the like.

It is an object of the present invention, therefore, to provide flying shears of the torsion shaft type including means for varying and adjustably fixing the shaft torsion, whereby the operation of the shears may be adjusted with varying conditions, and the life of the shear knives greatly extended.

It is a further object of this invention to provide geared flying shears wherein backlash is eliminated, and smooth, efficient operation may be maintained for long periods of time through widely varying conditions.

A further object is to provide a novel and efficient gear adjusting structure.

Yet another object is to provide a multiple part gear structure in which a gear portion may be angularly adjusted relative to a hub portion with an exceeding degree of fineness, and the several portions readily and positively fixed in the desired relationship.

Further objects will be in part obvious and in part pointed out hereinafter.

The invention and the novel features thereof may best be made clear from the following description, and the accompanying drawings, in which:

Figure 1 is an elevational view in section, showing an exemplary pair of flying shears incorporating the features of the present invention;

2

Figure 2 is a sectional view of the shears, taken on the line 2—2 of Figure 1;

Figure 3 is an elevational view taken on the line 3—3 of Figure 1, showing the relationship of the driving gears of the shears;

Figure 4 is an end elevational view of the adjustable gear assembly employed in the shears, and Figure 5 is a section therethrough, taken along the line 5—5;

Figure 6 is an exploded view corresponding to Figure 5, showing the component elements of the adjustable gear assembly, and their relative relationship;

Figure 7 is an end elevational view of the gear member of the gear assembly, and Figure 8 is a section through the gear member, taken along the line 8—8 thereof;

Figure 9 is an end elevational view of the outer eccentric of the gear assembly, and Figure 10 is a vertical section therethrough;

Figure 11 is an end elevational view of the inner eccentric of the gear assembly, and Figure 12 is a vertical section therethrough;

Figure 13 is an end elevational view of the anchor pin associated with the gear hub member, and Figure 14 is a vertical section through the anchor pin, and

Figure 15 is an elevational view of the other end of the anchor pin, illustrating the manner of its attachment to the hub member.

Referring to the drawings in detail, in Figures 1 and 2 is shown a base casting 21, in which knife heads 22 and 23 are suitably supported in parallel, cooperative relationship, as by anti-friction bearings 24 adjacent the ends thereof. In the embodiment shown, the lower knife head 22 is driven through coupling 25 by a suitable source of power, such as the drive-reducer unit 26. The lower knife head 22 is provided with a knife 27 mounted therein in the usual manner, and the larger diameter upper knife head 23 is provided with an oppositely disposed pair of coacting knives 27'.

The knife heads are suitably driven and coordinated by gearing, lower head 22 being provided with a gear 28 keyed to each end thereof. A gear 29 is fixed to one end of the upper head 23, in meshing engagement with the corresponding gear 28, and associated with the other end of the upper head is the adjustable gear assembly indicated generally as 30, similarly in meshing engagement with the corresponding gear 28 of the lower head. The upper head 23 is provided with

an axial passage 32, through which extends the torsion shaft 33. Torsion shaft 33 is fixed, as by set screws 34, to the end of head 23 bearing the gear 29, and adjacent its other end is formed into a boss 35, machined to a turning fit with the corresponding portion of passage 32. The adjustable gear assembly 30 is keyed to the protruding free end of torsion shaft 33.

The gears 28, 29 and 30 may be of the spur or any other common type, but are preferably helical, a helix angle of 7½° being entirely suitable. The gears 29 and 30, in the exemplary embodiment, are of twice the effective diameter of the gears 28, whereby the upper head 23 is driven at half the rotational speed of lower head 22, as may be readily seen in Figure 3, the effective peripheral speed of the heads being identical. By this arrangement, and the proper positioning of knives 27 and 27', it will be understood, the knife 27 is successively brought into shearing engagement with first one of the knives 27' and then the other. Suitable means, not shown, are provided for feeding stock to be sheared between the heads at a speed properly coordinated with the peripheral speed of the knife heads.

Assuming the gears 28 of the lower head to be fixed in alignment, and the gears 29 and 30 of the upper head to be somewhat out of alignment, for example offset angularly a distance corresponding to one-half tooth, it will be recognized that the mechanism can be assembled only by torsionally deflecting the shaft 33. The torsion of shaft 33 so effected has been found to take up the backlash between the gears of the two heads, and thereby reduce vibration and contribute substantially to prolonged knife life. By such an arrangement, however, the torsion of shaft 33 remains substantially constant under all operating conditions.

To most effectively employ the torsion shaft arrangement described, it has been found necessary to provide a feature of adjustment, whereby the twist of the torsion shaft may be varied to a value found to be most efficient with each change of operating conditions, such as the speed of the shears, the gage, width or type of material being worked upon and the like. In the instant invention, this feature of adjustability is attained by the provision of the novel adjustable gear assembly 30.

The adjustable gear 30, as best seen in Figure 6, comprises a hub member 36, adapted to be fixed to the end of the torsion shaft by means of keyway 37. The hub member includes an annular flange portion 38, bounded by a face surface 39 normal to the hub axis, and a guide portion 40 of relatively small diameter extending laterally from face 39. The flange portion of the hub member is provided with an anchor pin receiving aperture 42, and a plurality of circumferentially spaced threaded openings 43. Gear member 44 is adapted to fit about and enclose the hub member 36, the gear member having a central bore 45 adapted to receive the hub guide portion, and a counterbore 46 adapted to enclose the hub flange portion 38. Circumferential of the bore 45, the gear member comprises the inwardly extending rib 47, positioned and adapted to abut hub face portion 39, and provided with a locking aperture 48 and a plurality of circumferentially spaced slots 49. The locking aperture 48 and slots 49 are positioned for general alignment with, respectively, the aperture 42 and threaded openings 43 of the hub member. Gear member 44 is best shown in Figures 7 and 8.

An anchor pin 50 is fixed in the hub aperture 42, as by set screws 52 (Figures 14 and 15), and extends from the hub flange in parallelism to the guide portion 40 thereof. The outer end of the pin is slit inwardly by crisscross slits 53, and is provided with a central threaded recess 54, adapted to receive a correspondingly threaded tapered plug 55. As shown in Figures 4 and 5, a plurality of bolts 56 extends through gear member slots 49 into threaded engagement with openings 43 of the hub. Desirably, the portions of the gear member slots adjacent the outer surface of the gear member are enlarged, as shown, to receive the bolt heads within the gear member.

With anchor pin 50 positioned centrally of the gear member locking aperture 48, the hub openings are aligned with the middles of the circumferential slots 49. Since the locking aperture 48 is of larger diameter than the pin, the gear member 44 may be rotatably adjusted relative to the hub member 36 within a small range, and partially fixed in adjusted position by means of bolts 56. To positively lock or fix the gear member in adjusted position relative to the hub member, a pair of cooperating eccentrics 57 and 58 are provided. The outer eccentric 57 (Figures 9 and 10) is adapted to fit closely within locking aperture 48 of the hub member, and the inner eccentric 58 (Figures 11 and 12) is adapted to fit closely within the outer eccentric and to enclose the outer end of pin 50. The assembled relationship of these elements is evident in Figure 6, and is clearly shown in Figures 4 and 5. The eccentrics 57 and 58 are preferably slit through the thinner sides thereof, the slits 59 extending into the inner portions of the thicker sides as shown in Figures 9 and 11, and are desirably provided with threaded holes 60 for the reception of wrenches or similar tools.

By proper positioning of the eccentrics 57 and 58 within the locking aperture 48, a small range of angular adjustment of gear member 44 relative to the pin 50 (and hub member 36) is effected. This range, for example, may correspond to one gear tooth, and the adjustable gear be so positioned on torsion shaft 33 as to permit adjustment of the gear member 44 relative to the fixed upper head gear 29 from a position corresponding to gear tooth alignment to a position a full tooth offset from the original position. In this manner, the above-described shears may be employed with a twist in the torsion shaft 33 varying from zero to that corresponding to the angular spacing of a full gear tooth, and adjustable to intermediate values within that range with infinite fineness. Obviously, the gear assembly may be designed to provide a greater or a lesser range of adjustment, if desired. Furthermore, by reason of the provision of slits 53 and 59 in the anchor pin and eccentrics, and the tapered plug 55, it has been found that the gear member may be positively fixed on the hub member at the desired angular relationship, the tapered plug functioning to spread the surrounding segments of pin 50, and they in turn functioning to spread the eccentrics 57 and 58. The particular slitted configuration of the members 50, 57 and 58 has been found to effect an outstandingly rigid locking of the hub member and gear member in desired relationship, permanently secure against vibration, twisting moments and other forces.

In employing the adjustable gear structure of our invention in the flying shears above de-

scribed, the gear assembly may be adjusted initially to effect a twist of torsion shaft 33 equal to, for example, half a tooth. Upon changing operation of the shears to a different speed or material, or in compensation of gear or knife wear or both, the torsion of the shaft 33 may be readily adjusted as necessary to maintain optimum operation. This is accomplished conveniently by removing cover plate 62 from the base, loosening the bolts 56, and removing tapered plug 55 and the eccentrics 57 and 58 from the gear assembly. The threaded holes 60 may be employed to remove the eccentrics. The adjustment of gear member 44 is then made, either manually or by means of a suitable tool, the proper adjustment being determined either by "feel," by measurement or by reference to suitable indicia. When the position of the gear member has been suitably adjusted, the eccentrics are replaced in the locking aperture 48 and about the pin 50. It will be recognized that for any position of pin 50 relative to aperture 48, only one corresponding position of the eccentrics is possible, and they must be rotatably adjusted relative to the gear member and hub member and to each other until the proper positioning for insertion is determined.

When the eccentrics have been replaced, the plug 55 may be inserted into recess 54, whereby the eccentrics will be spread slightly and effect a positive locking of the gear member and hub member in the angular direction. The bolts 56 are then tightened to prevent axial separation of the hub and gear members, the cover plate 62 replaced and operation resumed.

By judicious adjustment of the torsion in shaft 33 when required, it has been found that the life of knives 27 and 27' may be greatly extended, and quiet and smooth operation maintained for long periods of time, with excellent shearing results. For example, in shearing tin plate at speeds in excess of 600 feet per minute, using a lower knife head of 9 inches effective diameter, a single set of knives has been used for more than a hundred operating hours with excellent results, at the end of this time still giving perfect cuts, with no burrs on the cut edges.

It will be obvious that the adjustable gear structure of our invention may be utilized for numerous purposes other than in association with flying shears.

It will thus be seen that there has been provided by this invention a structure in which the various objects hereinbefore set forth, together with many practical advantages, are successfully achieved. As various possible embodiments may be made of the mechanical features of the above invention, all without departing from the scope thereof, it is to be understood that all matter hereinbefore set forth or shown in the accompanying drawings is to be interpreted as illustrative, and not in a limiting sense.

For example, as indicated by the appended claims, it is not necessary that the drive coupling and the adjustable gear assembly be on different knife heads, or that the drive coupling and the adjustable gear assembly be at opposite ends of the flying shears.

We claim:

1. In combination, a first rotary head and a second rotary head fixedly disposed relative to each other in operative relationship, a gear fixed to each end of said first head, a gear fixed to one end of said second head and meshing with the corresponding gear of said first head, a torsion shaft concentrically enclosed by said second head, said shaft being fixed to the geared end of said second head and constituting a bearing for the other end thereof, a hub member fixed to said shaft adjacent the free end thereof, a gear concentrically mounted on said hub member and meshing with the corresponding gear of said first head, and means for adjustably fixing the angular relationship between said hub member and the gear mounted thereon.

2. In combination, a first rotary head and a second rotary head fixedly disposed relative to each other in operative relationship, a gear fixed to each end of said first head, a gear fixed to one end of said second head and meshing with the corresponding gear of said first head, a torsion shaft concentrically enclosed by said second head, said shaft being fixed to the geared end of said second head and constituting a bearing for the other end thereof, a hub member fixed to said shaft adjacent the free end thereof, a gear concentrically mounted on said hub member and meshing with the corresponding gear of said first head, said gear being apertured, a pin extending from said hub member into said aperture, and means operative on said pin and said aperture for positively fixing the angular relationship between said hub member and the gear mounted thereon.

3. In combination, a first rotary head and a second rotary head fixedly disposed relative to each other in operative relationship, a gear fixed to each end of said first head, a gear fixed to one end of said second head and meshing with the corresponding gear of said first head, a torsion shaft concentrically enclosed by said second head, said shaft being fixed to the geared end of said second head and constituting a bearing for the other end thereof, a hub member fixed to said shaft adjacent the free end thereof, a gear concentrically mounted on said hub member and meshing with the corresponding gear of said first head, said gear being apertured, a pin extending from said hub member into said aperture, a first eccentric mounted on said pin and a second eccentric mounted on said first eccentric, said second eccentric fitting closely within said aperture.

4. In combination, a first rotary head and a second rotary head fixedly disposed relative to each other in operative relationship, a gear fixed to each end of said first head, a gear fixed to one end of said second head and meshing with the corresponding gear of said first head, a torsion shaft concentrically enclosed by said second head, said shaft being fixed to the geared end of said second head and constituting a bearing for the other end thereof, a hub member fixed to said shaft adjacent the free end thereof, a gear concentrically mounted on said hub member and meshing with the corresponding gear of said first head, said gear being apertured, a pin of smaller diameter than said aperture extending from said hub member into said aperture, said pin being slit inwardly from the outer end thereof, a tapered plug threaded into the slit end of said pin, a first eccentric mounted on said pin and a second eccentric mounted on said first eccentric, said second eccentric fitting closely within said aperture, and said eccentrics being longitudinally slit.

5. Apparatus according to claim 4, including means for driving said first head.

JOHN EDWARD ERHARDT, JR.
JOSEPH SILBEY DUFFY.

(References on following page)

References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
105,605	Stratton	July 19, 1870
1,034,164	Swift	July 30, 1912
1,119,244	Coty	Dec. 1, 1914
1,240,212	Horvath	Sept. 18, 1917
1,318,892	Maier	Oct. 14, 1919
1,462,138	Langston	July 17, 1923
1,816,552	Trusler	July 28, 1931

Number	Name	Date
1,945,325	Lloyd	Jan. 30, 1934
1,988,215	Peterson	Jan. 15, 1935
2,213,919	Michon	Sept. 3, 1940
2,217,560	Michon	Oct. 8, 1940
2,242,363	Michon	May 20, 1941
2,374,344	Gillmore et al.	Apr. 24, 1945