

Aug. 31, 1948.

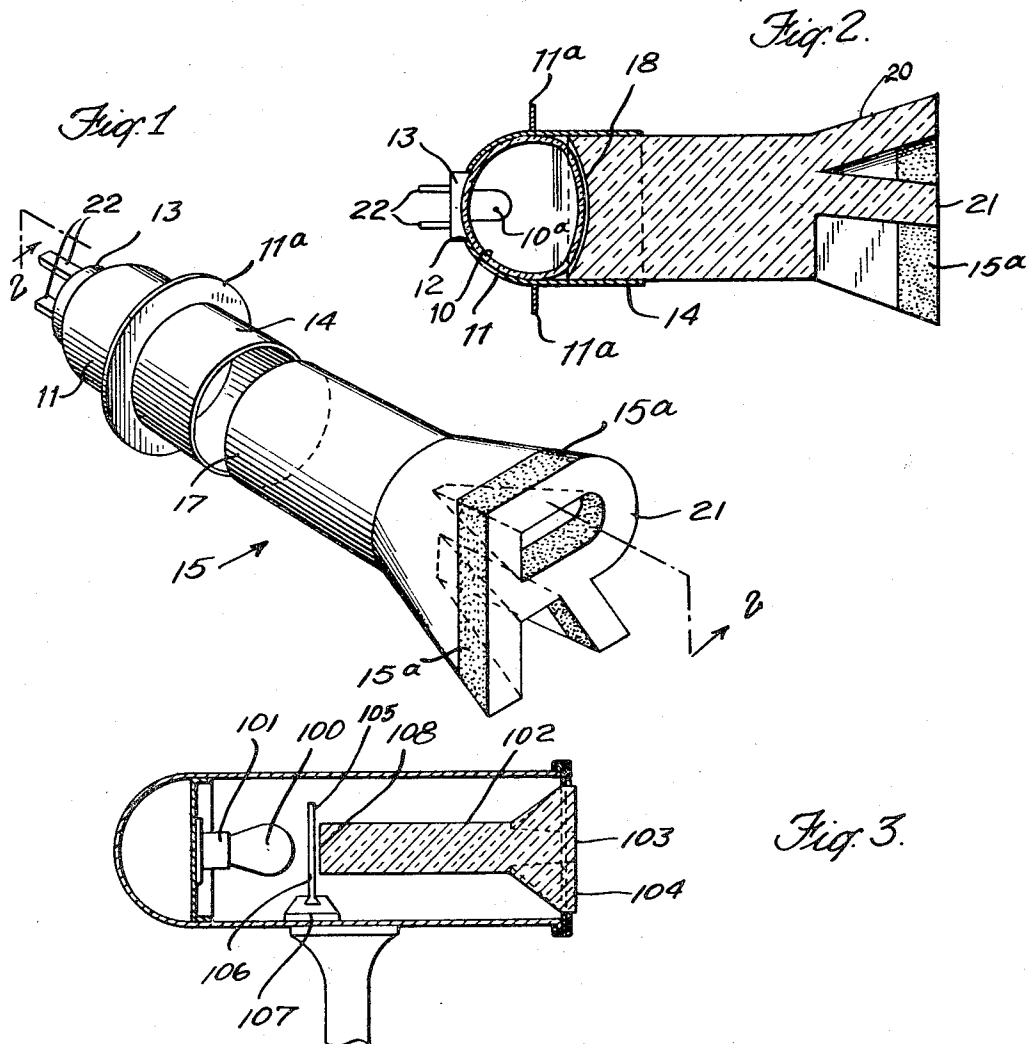
O. M. ARNOLD

2,448,244

ILLUMINATED DISPLAY DEVICE

Filed Sept. 22, 1942

2 Sheets-Sheet 1



INVENTOR
ORLAN M. ARNOLD
BY *[Signature]*
ATTORNEY

Aug. 31, 1948.

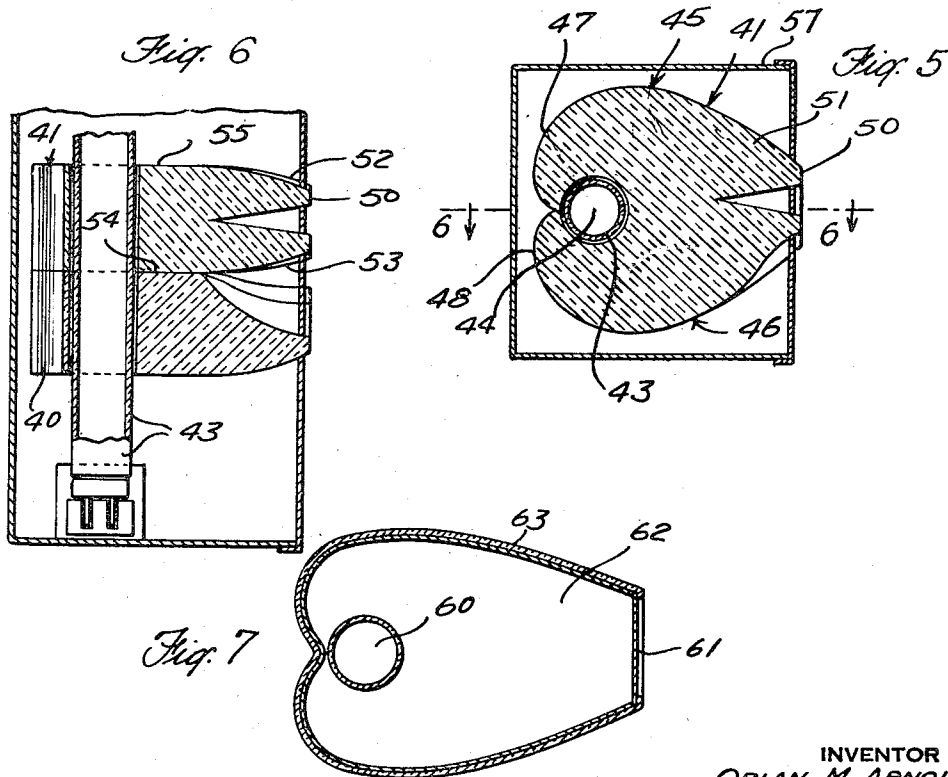
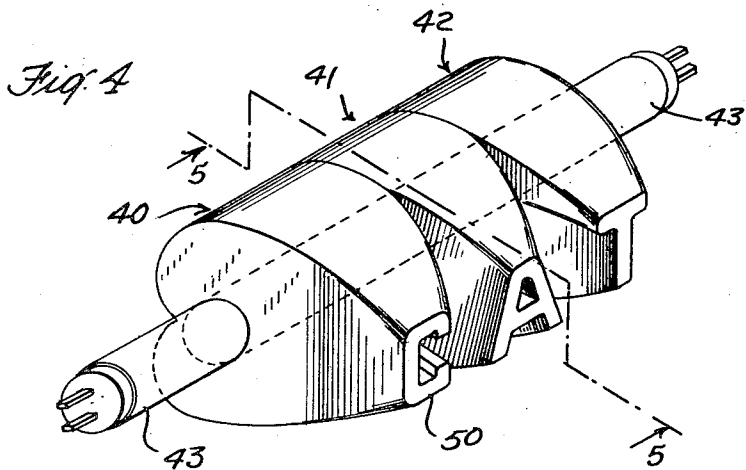
O. M. ARNOLD

2,448,244

ILLUMINATED DISPLAY DEVICE

Filed Sept. 22, 1942

2 Sheets-Sheet 2



INVENTOR
ORLAY M. ARNOLD.
BY *Thomas J. Arnold*
ATTORNEY

UNITED STATES PATENT OFFICE

2,448,244

ILLUMINATED DISPLAY DEVICE

Orlan M. Arnold, Troy, N. Y.

Application September 22, 1942, Serial No. 459,263

13 Claims. (Cl. 40—130)

1

This invention relates to display devices, including sign and signal constructions.

One of the objects of this invention is to provide an illuminated display device which will be simple, efficient, and thoroughly practical in use. A further object is to provide a construction of the above character which will be inexpensive to operate, giving a commanding or spectacular appearance with a saving of energy consumed. Another object is to provide a construction of the above character which will be neat and attractive in appearance. Another object is to provide a construction of the above character which has a minimum of individual parts, thus greatly facilitating the assembly thereof. Another object is to provide a construction of the above character the manufacture of which will be economical, both from the standpoint of labor and materials used. A still further object is to provide a construction of the above character wherein the individual parts, as well as their particular construction, are designed to permit the letters or characters of a sign to be readily and quickly changed. Other objects will be in part obvious and in part pointed out hereinafter.

The invention accordingly consists in the features of construction, combinations of elements, and arrangements of parts as will be exemplified in the structure to be hereinafter described, and the scope of the application of which will be indicated in the following claims.

In the drawings in which are shown several of the various embodiments of my invention,

Figure 1 is an exploded perspective view of an element illustrating the invention;

Figure 2 is a vertical sectional view taken on the line 2—2 of Figure 1, but with the parts assembled;

Figure 3 is a vertical sectional view of a modification of the construction shown in Figure 1;

Figure 4 is a perspective view of a sign formed from elements which are modifications of the element shown in Figure 1;

Figure 5 is a vertical sectional view taken on the line 5—5 of Figure 4;

Figure 6 is a horizontal sectional view taken on the line 6—6 of Figure 5; and,

Figure 7 is a vertical sectional view of another modification of the construction shown in Figures 4, 5, and 6.

Similar reference characters refer to similar parts throughout the several views of the drawings.

This application is a continuation-in-part of my copending application, Serial No. 291,668, filed

2

August 24, 1939, entitled "Signal device," now Patent 2,301,185.

As conducive to a clearer understanding of certain features of this invention, it might here be pointed out that in illuminated display devices it is desirable to make the device both attractive and eye-arresting in appearance, while at the same time it should be inexpensive to operate. This combination is difficult to achieve because the power of such a device to attract attention is in a degree proportional to the intensity of the illumination in the letters or characters or other display elements of the device. Thus, in electric signs in use today, their effectiveness may be considered in a degree proportional to their cost of operation. This cost is high because light is scattered by radiation or reflection in all directions. According to my present invention I provide a display device, e. g. an illuminated sign having low operational cost through the use of a low intensity light source and the concentration of substantially all its light into illuminated display elements, e. g. the intelligible form of the sign or signal. In this way I provide a sign having a high degree of eye-arresting quality through efficient utilization of the light subtending from the light source.

Referring now to the drawings, the display device e. g. the sign or signal is constructed from an element or a series of elements in each of which the light radiated from the light source is "piped" to a surface or surfaces forming a letter or other display element. A water white methyl methacrylate resin or a material having similar characteristics, especially a relatively high index of refraction and a low critical angle and low absorption of visible light, is used as a conductor to "pipe" the light from the light source to the letters or characters. Because of these characteristics, the light entering the methyl-methacrylate resin material from the light source is conveyed around corners and through substantial distances to the surface forming the letter or character of the sign with relatively little loss of light through the sides of the conductor or by absorption.

Referring now to Figure 2, a bulb 10, which forms the light source of the element shown in Figures 1 and 2, has a reflector 11 mounted thereon. Reflector 11, which is concavely shaped to fit bulb 10, has its inner surface silvered or otherwise suitably treated to form a reflecting surface and has a hole 12 therein through which the base 13 of bulb 10 passes. The right-hand portion of the reflector, as viewed in Figure 2, extends out-

3

wardly from the bulb to form an annular flange 14 having a slightly greater diameter than the diameter of bulb 10. The reflector has a fin or fins 11a extending therearound to dissipate the heat given off by the filament in bulb 10. Thus, the bulb and reflector may be readily assembled, and a majority of the light radiated rearwardly and toward the sides from the filament 10a of the bulb is reflected to the right, as viewed in Figure 2. Advantageously, the reflector approximates a parabolic form with focus at the filament.

The light conductor, generally indicated at 15 (Figures 1 and 2), as shown, is broadly cylindrical in shape and has a portion 17 thereon adapted to fit within annular flange 14 with a force fit. The end surface 18 of the conductor preferably is concave and shape-fitted to the end of the lamp 10 so that, when the end of the conductor 15 is fitted into the reflector 11, its end surface 18 fits the surface of bulb 10. The right-hand portion 20 of the conductor is formed and tapered so that the end surface 21 of the conductor is in the shape of a letter or character suitable for the particular signal or sign. This tapered end portion is made as short as is consistent with good light distribution in its end 21, the slope of the tapered sides relative to adjacent surface farther from the end advantageously approximating an angle complementary to the critical angle. For greatest efficiency I have found it important that opposed surfaces of the conductor should not converge very much longitudinally. The tapered end portion 20 is therefore flared so that the area of the end surface 21 is as great or greater than the cross-sectional area of the cylindrical portion.

The longitudinal polished surfaces of conductor 15 are polished to give efficient internal reflection without diffusion, but in the embodiment shown in Figures 1 and 2, borders 15a thereon immediately adjoining the end surface 21 of the conductor are roughened so as to disperse the light which otherwise would be reflected internally from these portions. Thus, these border portions are visible when the letter or character is viewed at an angle to the plane in which the letter or character lies, and they present a strikingly different texture. This feature may be used to give an "offset" appearance to the letter or character. This border may also be bevelled somewhat so as to be visible from the front of the letter or character.

When the conductor and reflector are fitted together to form a unit, the bulb is gripped between them, thus insuring that the conductor will maintain a set position with respect to the bulb. The base 13 of the bulb is preferably provided with prongs 22 suitable for plugging into a female electrical socket. Thus, if the prongs are definitely related to the axial position of the letter or character on the end of conductor 15 in the assembled unit, the correct position of the letter or character in the sign is assured when the prongs 22 are plugged into the socket. Thus, one may provide a standard alphabet of interchangeable letter units; and, as may be seen, any letter or character in a sign may be readily and quickly interchanged by unplugging one element and replacing it with another.

In operation, rays of light radiated rearwardly and from the sides of filament 10a are directed by reflector 11 into the left-hand end of conductor 15 together with the rays of light radiated forwardly from the filament. Because of the low critical angle and low light absorption

4

of the conductor, the light is piped from the filament 10a to the letter or character at the outer end of the conductor with a relatively small loss of light, and the great part of the light originating in the filament is concentrated to give high intensity at the letter. Thus, because the light rays of the filament are conducted to the end surface 21 with a minimum of loss, a low intensity light source may be used, while at the same time the letter or character shows brilliantly and effectively.

In Figures 1 and 2, the conductor is shown as being substantially straight. However, if desired, the conductor may be curved, and the same effect is achieved because of the characteristics of the material used to form conductor 15.

Referring now to Figure 3, in which the top portion of a traffic signal pole is shown, a bulb 100 is mounted on a socket 101. A light conductor 102 made of methyl-methacrylate resin, or from a material having similar characteristics, has its outer end surface formed in the shape of a "+," and this portion of the conductor is fitted through an opening in an end wall 104 which may be an opaque, colored or translucent screen to provide a desired background for the signal character. Between bulb 100 and the inner end surface of conductor 102, a color filter 105 is mounted on arm 106. This filter has green and red sections and is mounted on arm 106 which is moved by suitable mechanism in box 107, e. g. a solenoid motor (not shown) actuated by usual electric signal impulses, so that the green and red sections of the filter alternately are positioned between the light source and the receptor surface 108 of conductor 102.

Thus, in operation, screen 104 forms an effective background to offset the illuminated character formed by the outer end 103 of conductor 102. This construction is particularly suitable for use as a "blackout" traffic signal which, because of its efficient utilization of light in a distinctive signal, operates with very low candle power lamps and with extraordinary efficiency; and because of its simple construction, may be quickly and economically installed in existing traffic poles.

Referring now to Figures 4, 5 and 6, in which another modification of the construction is shown, a plurality of light conductors, generally indicated at 40, 41, and 42, are mounted upon a standard tube lamp 43. Conductors 40, 41, and 42 are substantially similar in construction, and may be represented for purpose of description by the conductor 41. This conductor may be molded from clear plastic, glass or fused quartz or cut from a suitable block of material having the desired properties of high transparency, high index of refraction, and low critical angle. The end surface 50 of conductor 41 is formed in the shape of a letter or other character, e. g., by tapering outer portion 51 of the conductor. Conductor 41 has a hole 44 extending transversely there-through. This hole is preferably of slightly greater diameter than the diameter of tube lamp 43, thus permitting the tube to be passed through the hole in the conductor so that, when in position, the conductor covers a portion of the light-emitting surface of the tube.

The upper and lower surfaces 45 and 46 with their respective rear surfaces 47 and 48 of the conductor are formed to approximate a spiral the normal to which at each point makes an angle with the radius from tube lamp 43 which approximates or is greater than the critical angle.

5

Thus, rays radiated upwardly, downwardly, or rearwardly from tube lamp 43 are reflected to the right, as viewed in Figure 5, through the end surface 50 of conductor 41.

Some stray light will usually strike the side and rear surfaces at angles such as to permit its escape; if the entire unit is enclosed in a box 57 having reflector sides, such light will be largely redirected into the conductor, thus taking advantage of the fact that light will pass from air into a transparent solid at an angle which would result in total reflection of light passing in the solid toward the air.

The side walls 52 and 53 (Figure 6) of the outer portion 51 of the conductor are also preferably curved to aid in directing the light outwardly toward the outer end surfaces 50 of the conductor. The curvature of these surfaces 45, 46, 47, 48, 52, and 53, etc., is advantageously such that the angle of incidence thereon of the light emanating radially from the light source will be greater than the critical angle. When this is not convenient, either because of space limitations or because of properties of the material used, these surfaces, or parts of them, may be silvered or otherwise treated to increase their reflectivity.

The side walls 54 and 55 of the inner portion of the conductor preferably are flat and lie in planes normal to the longitudinal axis of tube lamp 43 when the conductor is in position thereon. Thus, a series of conductors 40, 41 and 42 may be placed on the tube lamp so that the letters or characters on their ends form a sign as illustrated. When the conductors are thus positioned on the tube lamp, the side walls at the inner ends of the conductors abut against each other, and any light which may leak through the side walls because of the contacting surfaces of the conductors passes into the adjoining conductor or conductors.

To obtain colored effects with the construction shown in Figures 4, 5 and 6, tube 43 may be made of a solid color or may be colored with a plurality of different colored strips. When the tube is colored in the latter manner, it may be mounted so that it can be rotated (not shown). This would cause the end surfaces of the letters or characters in the sign to be composed of a plurality of different moving colors, giving the sign a distinctive eye-arresting quality.

Although it is ordinarily most desirable to use a solid light conducting tube or body, it is also within the scope of my invention to use a hollow light conductor the walls of which are provided with mirror surfaces. Thus, a tube may have its inner or outer surfaces silvered and may be used in the same manner as a rod or methyl methacrylate or quartz, and if desired, such a conductor may be evacuated and sealed to avoid dust and oxidation; and such an evacuated conductor may be provided with a mirror surface by "sputtering" in the manner well understood in the manufacture of reflector incandescent lamps, or the mirror surface may be made by an electrolytic process. In Figure 7 I have shown such a hollow conductor, the wall 60 around the lamp and the end wall 61 in the character being transparent while the other walls 62 and 63 are silvered inside or out or otherwise made highly reflecting.

Thus, a practical and efficient display construction has been disclosed in which the light subtending from a low intensity light source is piped with a minimum of loss to, and concentrated in

6

the face of a letter or character of a sign. This sign is novel and eye-arresting in appearance and, because of its efficiency, has a low operational cost. Furthermore, the letters or characters of the sign may be readily and quickly changed. Although I have indicated these units as signs for display purposes and with letters formed in their ends, they may be used for other purposes, e. g., in traffic signals, direction indicators, warning signals, lighted numerals for call boards, elevator control boards, etc., and the ends may be formed into various characters such as arrows, crosses, numerals, etc., as well as letters.

As many possible embodiments may be made of the above invention, and as many changes might be made in the embodiment above set forth, 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.

I claim:

1. In an illuminated display device, in combination, a light source, a solid light conductor formed from a highly transparent material and having a polished external longitudinal surface, except for a narrow border adjacent the outer end thereof, adapted to reflect along the conductor light incident thereon, one end surface of said conductor being faced toward said light source and the other end surface of said conductor being faced in the direction of display at an angle to the light rays passing thereto along said conductor greater than the complement of the critical angle and having the form of an intelligible character, the external longitudinal surface of said conductor in said narrow border rearwardly adjacent said last-mentioned end surface being rough to disperse light reflected internally from the border, and means securing said light source in said relation to said conductor.

2. In an illuminated display device, in combination, a light source, a reflector positioned rearwardly of said light source, a light conductor having one end surface facing toward said light source, an integral outer end surface formed in the shape of an intelligible character, and a solid body of transparent material adapted to pipe light from said light source to said outer end surface, said reflector being adapted to reflect rays from said light source into the end surface of said light conductor facing toward said light source, and means connecting said reflector to said light conductor to enclose said light source between said reflector and said facing end surface of said light conductor.

3. In an illuminated display device, in combination, a light source and light conducting means formed from highly transparent material having the sides thereof arranged to conduct light therealong by internal reflection and an outer end of said means tapering differentially at different points to the borders of an area the shape of an intelligible character, said means surrounding said light source and extending outwardly therefrom to pipe the light from said light source to and through said area at the outer end.

4. In an illuminated display device, in combination, a solid light conductor made from a highly transparent material of high index of refraction, and a lamp positioned in a transverse opening in said light conductor, said light conductor extending outwardly from said lamp and having an outer end surface formed in the shape of a character, the upper, lower, and rear sur-

faces of said light conductor being angularly related to radii from said lamp so that the angle of incidence of the light from the lamp to these surfaces is greater than the critical angle, whereby said light conductor pipes light from said light source to and through said end surface.

5. In an illuminated device, in combination, a transparent light conductor having lateral surfaces opposed in volute spirals centered on the light source, the direction of the spiral at each point being at an angle to the radius from the light source not substantially greater than the complement of the critical angle, and the end of said conductor opposite to the light source being truncated to permit escape of light through said end.

6. In an illuminated display device, in combination, a tube lamp, and a series of light conductors each having a transverse opening for said lamp and being interchangeably mounted on said lamp, each of said light conductors extending outwardly from said lamp and having end surfaces adapted to form a portion of a sign, the external surfaces of said conductors being shaped to direct light by internal reflection within said light conductors from said lamp through said end surfaces.

7. An integral unitary light conductor for use in an illuminated display device, one surface of said conductor being adapted to face a light source whereby to receive into itself light from such source, an outer end of said conductor adapted to pass such light therefrom being formed to the shape of an intelligible character, and side surfaces between said receiving surface and said outer end being adapted and arranged to reflect along said conductor toward said outer end light incident on said side surfaces from said receiving surface.

8. A light conductor as defined in claim 7 in which the surface adapted to receive light is at an intermediate position within the conductor, and the sides adapted to reflect light extend therebehind whereby to concentrate light from all sides of a light source into said outer end which forms the character.

9. In an illuminated display device, in combination, a light source, a transparent light conductor having lateral surfaces making with respective radii from said light source angles not substantially greater than the complement of the critical angle and an end thereof opposite to said source formed gradually to an intelligible irregular projecting symbol, a reflector enclosing said source and said conductor except for said formed end and having an opening fitted thereto, through which said formed end projects, the inner surfaces of said reflector being adapted to reflect stray light back onto said transparent conductor.

10. An illuminated display device comprising a light source, light conductor means having a surface at one end adjacent to said source and approximately normal to light emanating from said source, formed at the opposite end into an intelligible character and having smooth reflect-

ing surfaces between said ends adapted to reflect substantially all light along the conductor means toward said intelligible end the interior of said conductor means being transparent to light thus reflected along the said conductor means and the entire end surface being pellucid to emit said transmitted light, and means securing said conductor means to the light source in said relation.

11. A light conductor for display devices and the like which comprises a transparent body substantially cylindrical throughout a portion of its length and its end portion verging gradually and smoothly, but sloping differentially at different points about its periphery, to an outer end having the form of an intelligible character.

12. A light conductor for display devices and the like which comprises a transparent body substantially cylindrical throughout a portion of its length and adjacent one end verging gradually and smoothly, but sloping differentially at different points about its periphery, to a face having the form of an intelligible character, the slope of various peripheral portions respectively being chosen so that opposed portions are at least as far apart at the face as at the points where they verge from the cylindrical body.

13. An illuminated display unit comprising, in combination, a lamp and a light conducting member, said light conducting member being formed of methyl-methacrylate resin and extending outwardly from said light source, one end surface of said light conducting member facing said light source, and the other end surface thereof, being sloped gradually and differentially at different points about its periphery to the form of an intelligible character, means mounted on said lamp adapted detachably to position said unit, and means securing said light conductor to said lamp.

ORLAN M. ARNOLD.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,139,723	Rich	May 18, 1915
1,284,016	Wise	Nov. 5, 1918
1,351,562	Foster	Aug. 31, 1920
1,542,183	Steinberg	June 16, 1925
1,663,308	Jenkins	Mar. 20, 1928
1,664,302	Leopold et al.	Mar. 27, 1928
1,762,383	Booraem	June 10, 1930
1,816,220	Hotchner	July 28, 1931
2,035,998	Thompson	May 31, 1936
2,051,288	Curtis	Aug. 18, 1936
2,071,284	Hyland	Feb. 16, 1937
2,080,259	Frei	May 11, 1937
2,173,371	Neugass	Sept. 19, 1939
2,186,143	Penayer	Jan. 9, 1940
2,227,861	Petrone	Jan. 7, 1941
2,247,258	Shepard	June 24, 1941
2,289,904	Curtis	July 14, 1942
2,316,589	Iwanonicz	Apr. 13, 1943
2,354,367	Ford	July 25, 1944