

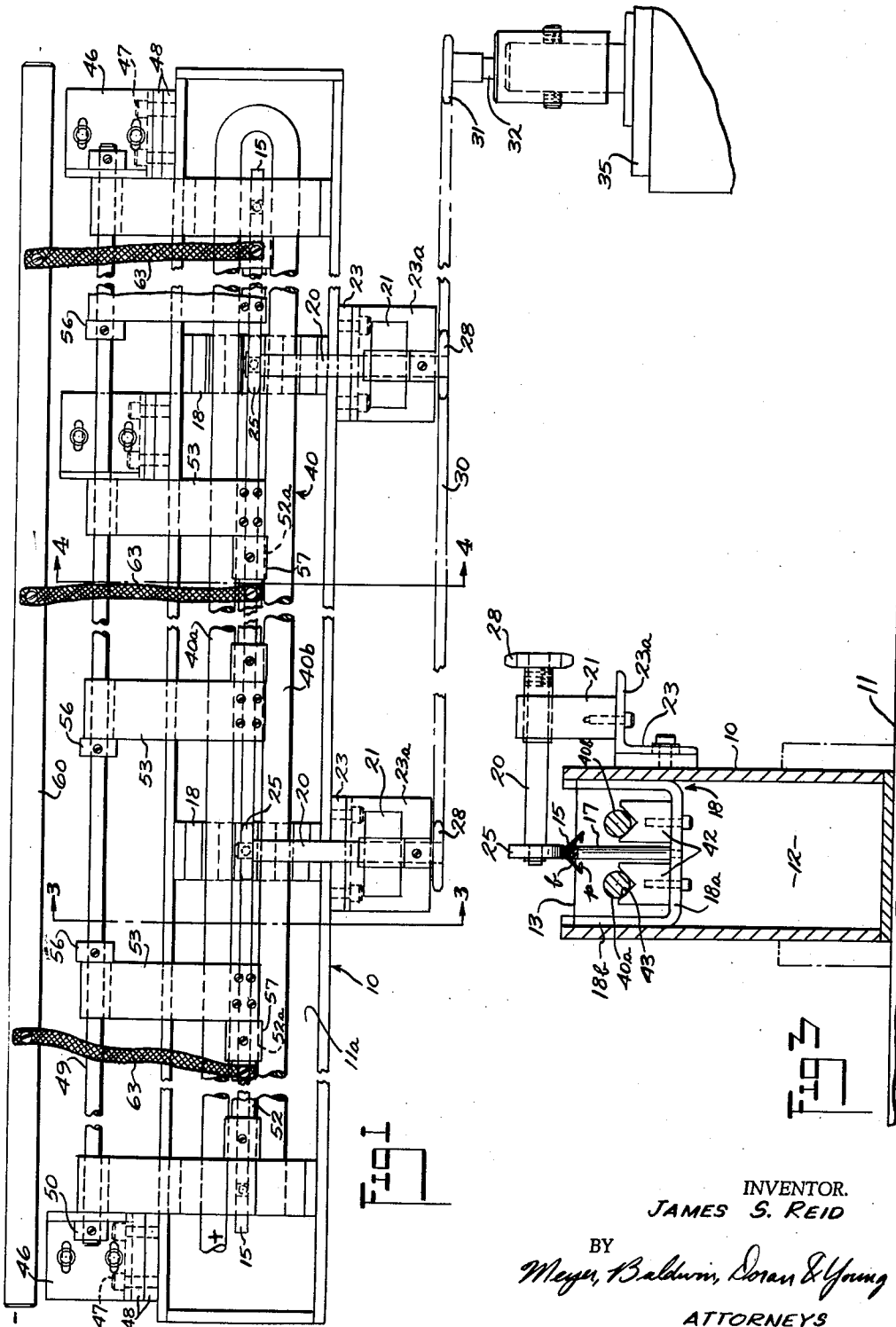
Nov. 27, 1962

J. S. REID  
APPARATUS FOR SELECTIVELY ELECTROPLATING  
METALLIC STRIP STRUCTURES

3,066,091

Filed April 27, 1960

3 Sheets-Sheet 1



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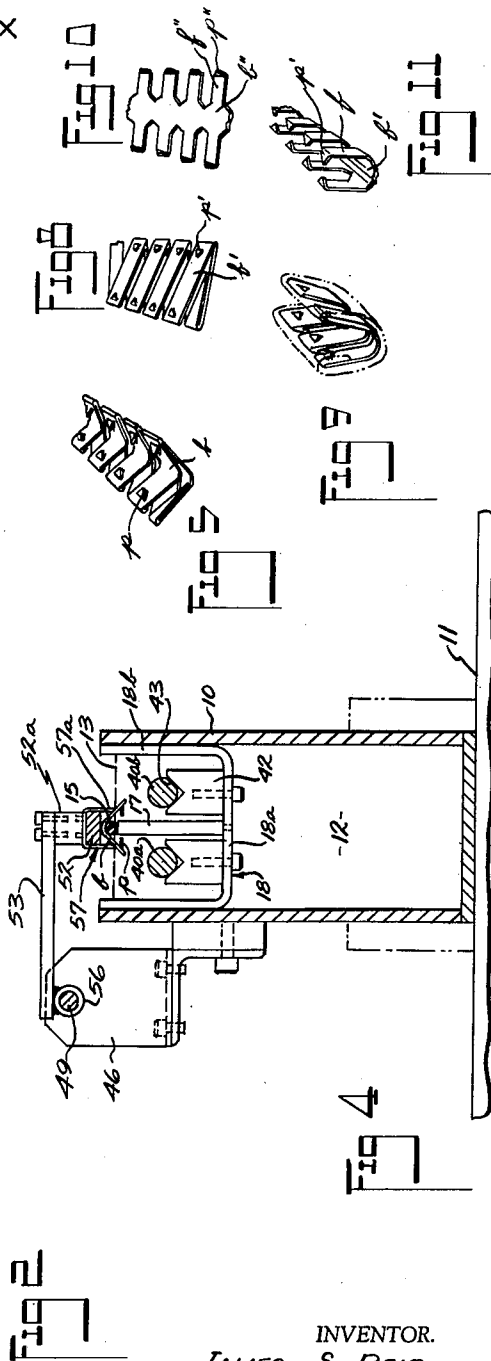
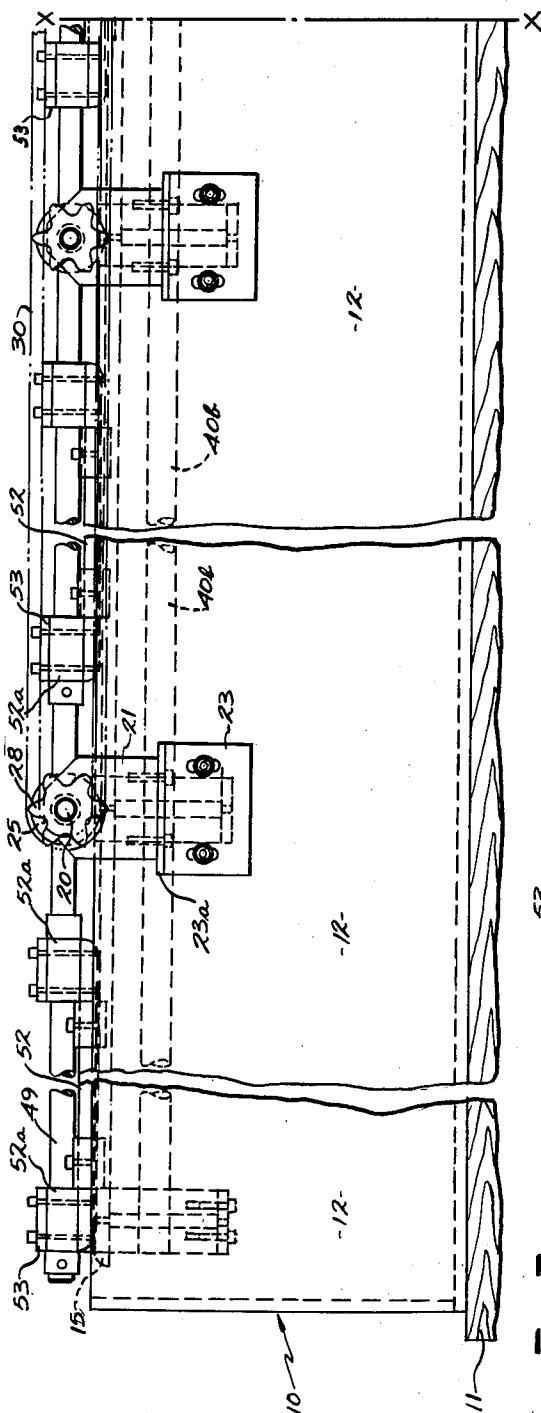
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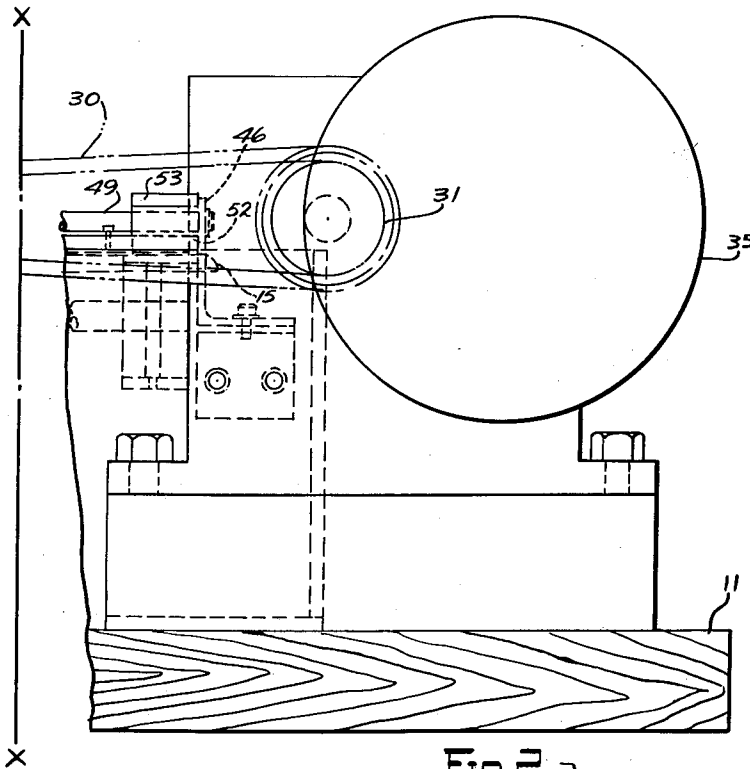


Fig. 2a

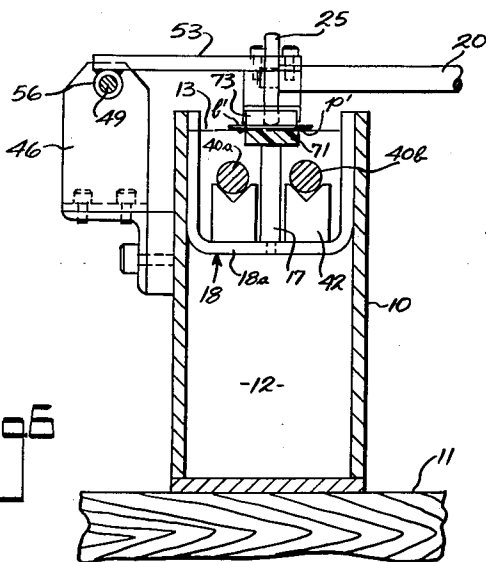


Fig. 6

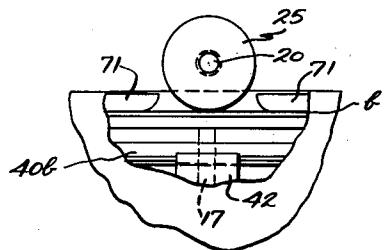


Fig. 7

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3,066,091

## APPARATUS FOR SELECTIVELY ELECTROPLATING METALLIC STRIP STRUCTURES

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Filed Apr. 27, 1969, Ser. No. 25,044

1 Claim. (Cl. 204—206)

This invention relates to improvements in hardening of metallic material, and more particularly to novel and improved apparatus for and methods of hardening predetermined parts of metallic strip structures.

A primary object of the present invention is the provision of a novel and improved method and to apparatus for practicing the said method for use in hardening of predetermined parts of metallic strip structures, and wherein said method teaches the concept of supporting a metallic strip structure in such manner that only the parts to be hardened are immersed within a hardening medium, and thence advancing said structure so as to successively present said parts to said medium.

Another object of the present invention is the provision of a novel and improved method and to apparatus for practicing the said method for use in hardening predetermined parts of metallic strip structure, and wherein said apparatus includes a receptacle containing a hardening medium, and means for supporting said strip structure with the aforementioned predetermined parts thereof intended to be continuously presented to said hardening medium, said strip structure being moved to thereby cause said predetermined parts of said structure to successively lie within said medium.

Another object of the present invention is the provision of a novel and improved method especially designed for use in hardening predetermined parts of strip structures which parts project outwardly from the body portion thereof, and wherein the instant method teaches the concepts of supporting said strip structure above a hardening medium in such manner that said projecting parts extend into said medium, said structure being thereafter advanced so as to cause said projecting parts to successively lie within said medium.

Another object of the present invention is the provision of novel and improved apparatus especially designed to practice the method of the present invention for use in hardening predetermined projecting parts of metallic strip structures, and wherein said apparatus includes a reservoir into which is disposed a suitable hardening medium, said strip structure being supported above said reservoir to thereby permit the projections thereof to extend generally downwardly and into said medium, and means for advancing said strip structure so as to carry the same over said reservoir to thereby cause the projecting parts thereof to successively lie within said medium.

Still another object of the present invention is the provision of a novel and improved method and apparatus for practicing the said method for use in hardening predetermined parts of metallic strip structures, and wherein said method teaches the concepts of providing a coating of metallic material to said parts by means of a suitable method of plating whereby said parts partake of a composite construction having an outer shell or skin of substantially hardened material.

Another object of the present invention is the provision of a novel and improved method as is above referred to in the last preceding object, and wherein, in addition, said method preferably utilizes an electrolysis type of plating for said predetermined strip parts.

Other objects and advantages of the present invention will be realized by one skilled in the art to which it

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pertains and upon reference to the following description of several preferred apparatus embodiments thereof and the novel hardening methods incorporated thereby and which are illustrated in the accompanying drawings wherein;

FIG. 1 is a plan view of apparatus incorporating an electrolysis plating process and embodying the concepts of the present invention;

FIGS. 2 and 2A are longitudinal elevational views of the apparatus of FIG. 1;

FIG. 3 is a transverse sectional view taken approximately on the line 3—3 as indicated in FIG. 1;

FIG. 4 is also a transverse sectional view taken approximately on the line 4—4 as indicated in FIG. 1;

FIG. 5 is a fragmentary perspective view of a form of strip structure somewhat channel-shaped in lateral configuration and which is to be accommodated by the apparatus of FIGS. 1—4 inclusive;

FIG. 6 is a transverse sectional view of a second or modified embodiment of apparatus embodying the present invention;

FIG. 7 is a fragmentary longitudinal elevational view of said modified embodiment looking generally in the direction as is indicated by the arrow 7 in FIG. 6;

FIG. 8 is a fragmentary perspective view of another form of strip structure, substantially flat in lateral configuration and particularly accommodated by the apparatus of FIGS. 6 and 7;

FIG. 9 is a fragmentary perspective view of an automotive type of weatherstripping which utilizes the aforementioned strip structure as a flexible core material;

FIG. 10 is a fragmentary perspective view of yet another embodiment of strip structure particularly accommodated by the apparatus of FIGS. 6 and 7; and,

FIG. 11 is a fragmentary perspective view of the strip structure of FIG. 10 subsequent to its being fabricated by the instant apparatus and bent into substantially U-shaped configuration.

Briefly, the novel and improved method of the present invention and the apparatus for practicing the said method as is hereinafter disclosed, is intended to harden predetermined parts of metallic strip structures, which parts project outwardly from the body portion of said structure to thus form a hardened exterior surface on said projections.

The concepts of the present invention are particularly applicable for use in the fabrication of strip structures made from relatively soft metallic material utilized for example as core material for automotive weatherstripping, and the like, which structures have projections formed therein and which extend outwardly of the body portion thereof, and further wherein it is desirable that said projections are substantially harder than said body portion and thereby adapted to anchor weatherstripping material thereto while permitting said relatively soft body portion to readily accommodate the various configurations of window and/or other similar body openings commonly found in modern automobiles.

In the preferred instance the hardening of the aforesaid projections of said strip structure is accomplished by electroplating a coating or layer of chromium upon the relatively soft material of said strip projections to thus form a substantially hard exterior surface thereon.

Referring now to the drawings wherein like elements are designated by the same reference numerals, several configurations of strip structures are herein shown in FIGS. 8 and 10, at various stages in the process of fabrication thereof; said strip in its completed form, being especially designed for use as a metallic core material in flexible weatherstripping, or the like, for use in automobiles, one embodiment of said weatherstripping being shown in FIG. 9 wherein a suitable fabric is placed over

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the aforesaid strip structure and anchored thereto by the projections of said strip.

As seen in FIG. 5, one form of strip structure that is accommodated by the apparatus shown in FIGS. 1-4 inclusive, has a body portion *b* that is somewhat curved or channel-shaped in lateral configuration, and which, in turn, has a plurality of nail-like projections or barbs *p* struck therefrom adjacent the longitudinal edges thereof and extending outwardly from one face of said body portion, and generally toward one another.

The other preferred forms of strip structures, as seen in FIGS. 8 and 10 preferably have a substantially flat body portion *b''*, which, in turn, has a plurality of projections *p''*, struck from the same and extending outwardly from one face thereof. As seen in FIG. 8, the projections are struck from the body portion adjacent the free longitudinal edges thereof as in the embodiment of FIG. 5; whereas, in the strip embodiment of FIG. 10 the projections are formed on the ends of transversely extending and aligned fingers *f''*.

Subsequent to hardening the projections of the aforesaid strip structures, the fabrication of the same is thence completed wherein the body portion is bent into substantially U-shaped configuration, such as is shown in FIGS. 9 and 11 to thus accommodate the aforementioned weatherstripping fabric.

With reference now directed particularly to FIGS. 1-4, inclusive, a preferred embodiment of apparatus especially designed for practicing the hardening method of the present invention is herein disclosed, being likewise particularly applicable to accommodate the configuration of strip structure as shown in FIG. 5, and is seen to include a rectangular tank 10 mounted upon a suitable base 11, thus defining an open reservoir 12 into which is deposited a suitable hardening medium to a level therein as is indicated by the reference numeral 13.

As is above mentioned, the instant method of hardening the predetermined projecting parts of the aforesaid strip structure incorporates the concept of electroplating a suitable coating over said projections, said coating being preferably of a metallic composition and having a surface hardness substantially greater than the remaining body portion of said strip structure. For this purpose, the aforementioned hardening medium is preferably a sulphuric, chromic-card solution which is capable of permitting a hydrolysis type of plating wherein a coating or shell of chromium is applied over each of the aforementioned strip projections.

The strip structure is intended to be supported above the hardening medium in the reservoir in such manner that the ends of the body portion *b*, thereof hang generally downwardly whereby said ends and the projections *p* formed thereon are immersed within said medium, said structure being thereafter passed or carried along and above said tank in such manner that said projections are successively presented to said medium and thus plated in a manner as will be presently described.

For this purpose, a suitable rod 15 is seen to be supported at points spaced longitudinally therealong centrally within the aforementioned tank 10 by means of upstanding rails or stations 17, each of the latter, in turn, being rigidly fastened to the base 18a of a substantially U-shaped bracket 18 and upstanding substantially vertically thereabove. Each of said brackets 18 is likewise seen to be of such dimension as to extend laterally across the tank 10 wherein the legs 18b thereof are suitably fastened to the opposed side walls of said tank by welding or the like. Said support rod 15 is preferably of such dimension and supported by the aforementioned pillars 17 so as to extend longitudinally centrally along the tank 10 with its upper surface spaced above the level 13 of the hardening medium. For reasons as will later appear, the rod 15 is likewise preferably formed of a non-conductive material such as a polyvinyl chloride.

As is above mentioned, the instant embodiment of ap-

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paratus is especially designed to provide for the plating of the configuration of strip structure as shown in FIG. 5 which has a somewhat channel-shaped body portion *b*. Consequently the support rod 15 is preferably provided with an upper surface which corresponds to the curvature of said body portion so that the strip projections *p* thereon are immersed to a sufficient depth within the aforementioned hardening medium.

Inasmuch as the instant method is intended to provide a substantially continuous fabrication and consequent hardening of the aforesaid strip projections *p*, the present embodiment of apparatus is preferably provided with means for continuously moving the strip structure over and along the rod 15 during which time the plating of said projections is accomplished.

For this purpose, a plurality of drivable shafts 20 are each seen to be rotatably supported within one of a plurality of bearing mountings 21, the latter being disposed in longitudinal spaced relation along said tank 10 and preferably supported upon one leg 23a of an angle bracket 23 in such manner as to project substantially vertically upwardly therefrom and adjacent one side wall of the aforementioned tank 10. With this mounting, each of the drivable shafts 20 extends substantially laterally across and over the aforesaid tank 10, its one end terminating substantially centrally of the latter and mounting a suitable roller or drive wheel 25. Said drive wheel is preferably formed of a rubber-like composition or other suitable friction material and carried on said shaft so as to be disposed substantially vertically upwardly from the aforementioned support rod 15, its periphery being spaced therefrom so as to permit the strip structure to be passed therebetween while being positively engaged by said wheel and adapted to be moved thereby along said support rod.

The opposite end of each of said shafts 20 is seen to mount a suitable sprocket 28 over which is passed an endless link chain 30, said chain likewise passing around a drive sprocket 31 mounted on drive shaft 32 of a suitable power source, such as an electric motor 35 located adjacent one end of the aforementioned tank 10.

With this construction, it will now be realized that upon energization of said power source 35 each of the drivable shafts 20 and drive wheels 25 thereon is thus rotatably actuated so as to propel the strip structure longitudinally along the aforementioned tank 10 to thereby successively present the projections *p* thereon to the hardening or plating medium.

To provide for plating said projections as the same are thus successively immersed in the aforementioned medium, the instant apparatus, as may be best seen in FIG. 1, also includes an anode element as is identified in its entirety by the reference numeral 40, and which, in its instant form, is seen to be substantially U-shaped in configuration to thus provide a pair of anode sections 40a and 40b, disposed in substantial parallel-spaced relation to each other.

As best seen in FIG. 3, each of the anode sections 40a and 40b is intended to be supported within the aforementioned tank 10 so as to extend longitudinally throughout, being likewise immersed within the medium carried therein. For this purpose, the base 18a of each of said brackets 18 rigidly supports a pair of block elements 42, the latter being disposed in spaced relation to each other laterally of said tank. Each of said block elements, in turn, is preferably identical in configuration, being likewise constructed of a suitable insulative material, and extends substantially vertically upwardly from its supporting base 18a, terminating at a level below said support rod 15. A V-shaped groove 43 is formed on the top surface of each of said block elements. Said block elements are likewise preferably arranged in a pair of transversely spaced rows extending longitudinally along said tank to thus locate the grooves of each of said rows in substantial alignment. Each of the anode sections 40a and 40b is placed within the aligned grooves of one of said rows

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and in such manner as to be immersed within the medium carried within said tank, being supported therein below the medium level 13 and thus substantially equally spaced on either side of and below the aforementioned support rod 15.

As seen in FIG. 1, the said anode section 40a is preferably connected to a suitable source of electrical energy whereby a D.C. potential of positive plurality may be applied thereto.

As it is desirable to plate only the portions of the strip structure that is immersed within said medium, I prefer to utilize cathode means that are directly connected to the portion of the strip body overlying the aforesaid support rod 15 thus connecting said immersed strip portions into the electroplating circuit, as will be understood.

For this purpose, as may be best seen in FIG. 1, a bracket member as is identified in its entirety by the reference numeral 46, is seen to be rigidly fastened at 47 to suitable anchor plates 48 located on either end of the aforementioned tank 10. A rod member 49 is extended between the bracket members 46, being rigidly fastened at the ends thereto by means of fasteners 50, said rod member extending longitudinally of said tank and adjacent one side wall thereof.

As best seen in FIG. 2, a plurality of cathode electrodes 52 are placed directly upon the upper surface of the body portion of the strip structure overlying the support rod 15 being adapted to lie thereon as the same is carried through the tank 10, the instant embodiment of apparatus preferably having one of said cathode electrodes equally spaced on either side of each of the aforementioned drive wheels 25.

Each of said cathode electrodes, in turn, is seen to rigidly mount a block member 52a at each of its ends, said block member being preferably formed of a suitable insulative material, and rigidly attached to one end of a hinge arm 53. Each of said hinge arms, in addition, extends substantially laterally of its associated electrode and is mounted at its opposite end upon a suitable bushing 56, the latter being rotatably journaled upon the aforementioned rod 49. With this construction, said electrodes may be swung upwardly about rod member 49 and above the support rod 15 to thus facilitate the disposition of the strip structure upon the latter, said electrodes being thereafter returned to lie upon the body portion of said strip as above mentioned, the weight thereof being effective to maintain said electrode in positive engagement with said strip, being thus effective to connect the latter into the aforesaid plating circuit. If desired, a substantially U-shaped guide bracket 57 may be interposed between each of the aforesaid electrodes and block members 52a whereby the opposite legs 57a thereof extend downwardly on either side of said block member being thus positioned to engage the curved body portion b of said strip structure to thereby properly guide the same along said supported rod 15.

A connector or bus bar as identified by the reference numeral 60, is suitably supported adjacent the aforementioned tank 10, preferably extending substantially longitudinally along and in spaced relation to the aforementioned rod 49. Said bus bar is connected to a suitable source of negative potential relative to the positive potential applied to the anode sections 40a and 40b of the aforesaid anode 40, the instant embodiment of apparatus preferably connecting said bus bar to earth or ground. As best seen in FIG. 1, a plurality of flexible conductors as identified in each instance by the reference numeral 63, are each connected at one end to said bus bar preferably in spaced relation therealong and at the opposite end to one of the aforementioned cathode electrodes to thus connect each of said electrodes to said negative potential.

With this apparatus, it will now be seen that with the anode sections 40a and 40b and the cathode elements connected to the aforementioned sources of positive and

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negative potentials respectively, and with the strip structure being moved along the support rod 15 whereupon the projections of said strip are immersed within the chromic-sulphuric acid solution, as is above identified, a chromic plating of said projections of a preselected thickness will hence be accomplished whereby said projections partake of a composite construction having an inner core of relatively soft metal and an outer harder shell or layer of chromium, and which is substantially harder than the remaining non-plated portions of said strip structure.

Although not herein shown, the strip structure as thus plated and exiting from the tank 10 may be wound upon a suitable coil, or the like, to thus facilitate its being removed from the instant plating apparatus and to provide for a continuous plating of said structure.

As a result of this particular fabrication it is intended that said projections will be of sufficient stiffness to adequately anchor the weatherstripping material to the strip structure whereas said structure may likewise be readily manipulated to accommodate the various configurations of automobile body openings for which the same is especially designed.

In FIGS. 5 and 6, a second embodiment of apparatus is herein shown for practicing the strip hardening method of the present invention, said apparatus being especially designed to provide for the chrome plating of strip structures that are substantially flat in transverse configuration.

With reference directed momentarily to FIGS. 8 and 10 several embodiments of a flat strip structure, as presently referred to, are herein shown, the form of strip shown in FIG. 8 having projections p' struck from a flat body portion b' likewise adjacent the free longitudinal edges of the latter and extending outwardly and toward the center of the same. In FIG. 10, the embodiment of strip structure is seen to include a flat body portion b' having spaced, transversely aligned fingers f, the latter having projections p' formed on the ends thereof and extending outwardly therefrom. Other embodiments of strip structures, as will be apparent may be readily accommodated by the instant form of apparatus.

With reference now directed particularly to FIGS. 6 and 7, the instant embodiment of apparatus is substantially similar to that of the previous form, differing therefrom in the supporting means utilized to support the strip structure as the same is moved along the plating tank 10 during the interval of plating thereof.

More specifically, in the instant apparatus a support plate 71 is preferably utilized in place of the aforementioned support rod 15, said plate being substantially rectangular in section and suitably fastened in a similar manner to the pillars 17 such that one side of greater dimension faces upwardly and in position to slidably support the flat body portion b' of said structure.

As best seen in FIG. 6, the plate 71 is intended to be of such dimension that said one side thereof is located above the level 13 of the plating medium, whereby, as the flat body portion b' of said strip structure is passed therealong, only the projections p' extend generally downwardly therefrom and are immersed within said medium.

The cathode electrodes as identified in the present instance by the reference numeral 73, are likewise preferably utilized in place of the electrodes 52 of the previous form, and as best seen in FIG. 6 each electrode 73 is substantially rectangular in section being of such configuration as to overlie and positively engage the flat body portion b' of the aforesaid strip structure.

With this particular apparatus assembly, the flat body portion b' of the strip structure is intended to be placed upon the support plate 71 in such manner that the projections p' hang downwardly therefrom so as to be immersed within the aforementioned medium. Thereafter,

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the drivable wheels 25 are actuated to move said strip along its support plate 71 as in the previous embodiment so as to successively present said projections to said medium. And, as is hereinabove mentioned, with the anode electrode 40 and cathode electrodes 73 likewise connected to the aforementioned positive and negative potentials respectively, an electroplating of said projections  $p'$  is thereby accomplished whereby a shell or layer of chromium is applied to the same.

Having thus described in detail the novel metallic hardening method of the present invention and several embodiments of apparatus for practicing the said method, it will be realized that the inventive concepts as are herein disclosed are susceptible to various modifications, combinations and arrangements of parts without departing from the scope of the appended claim.

What is claimed is:

Apparatus for electroplating the projections of strip structures, comprising a receptacle for containing a plating solution, nonconductive support means extending longitudinally along said receptacle and having a surface corresponding to the contour of the body portion

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of said structure for supporting said body portion with the projections thereof extending generally downwardly and into said receptacle, cathode means spaced along said receptacle and engaging the body portion of said strip structure on the side thereof opposite said support means, anode means disposed in said receptacle and extending longitudinally therethrough in spaced relation to said projections, means for applying a direct current potential to said cathode means and anode means, conveying means for moving said strip structure generally horizontally over said support means and including roller means spaced between said cathode means and engaging said body portion of said strip structure.

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