

[54] **METHOD OF MANUFACTURING TYPE FINGERS**

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[21] Appl. No.: **244,918**

Related U.S. Application Data

[63] Continuation of Ser. No. 92,676, Nov. 25, 1970,
abandoned.

[52] U.S. Cl. 29/407, 29/418, 29/464,
76/107, 101/401.4, 101/401.6, 29/411

[51] Int. Cl. **B23q 17/00**

[58] Field of Search 29/407, 411, 417,
29/418, 464, 493; 76/107; 101/401.4, 401.6

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Primary Examiner—Charlie T. Moon

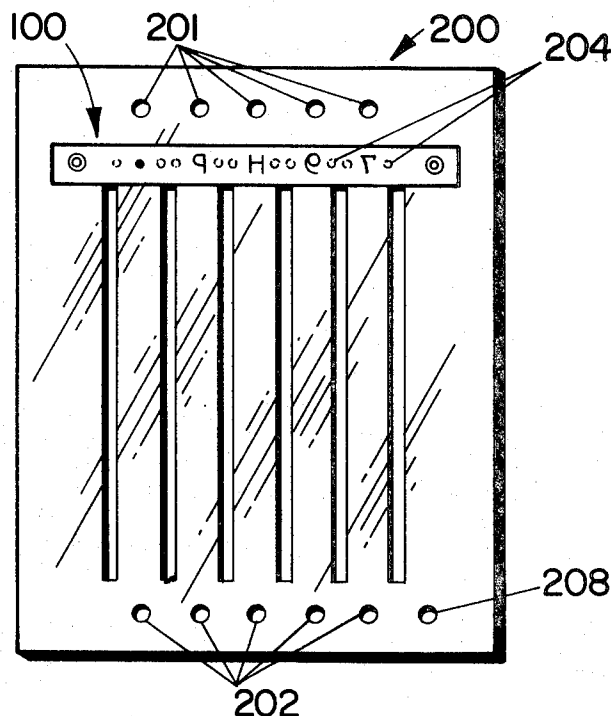
Attorney—Michael Masnik et al.

[57]

ABSTRACT

High precision type fingers are produced from a character bar containing raised type faces for a plurality of characters, and a precision punched sheet metal coupon blank. The method comprises forging of the character bar, punching of the coupon blank, welding and brazing the two elements together, and then punching out a plurality of type fingers from each assembly.

13 Claims, 8 Drawing Figures



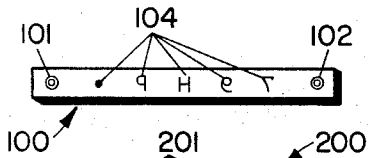


FIG. 2

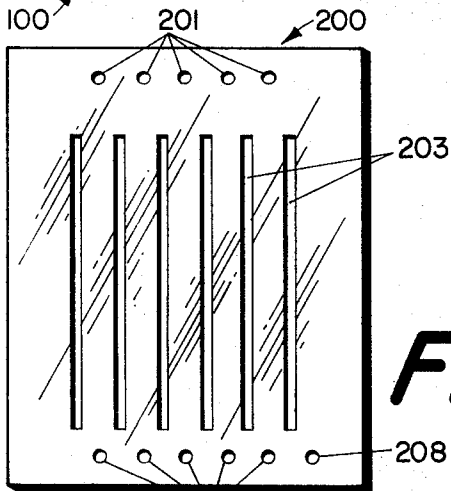


FIG. 3

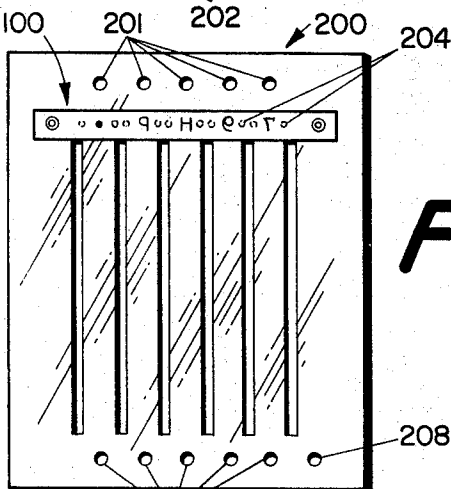


FIG. 5

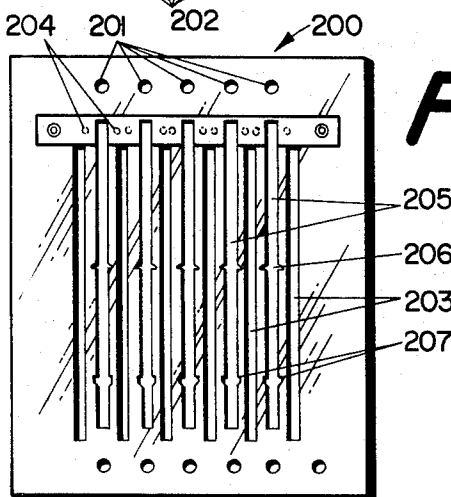
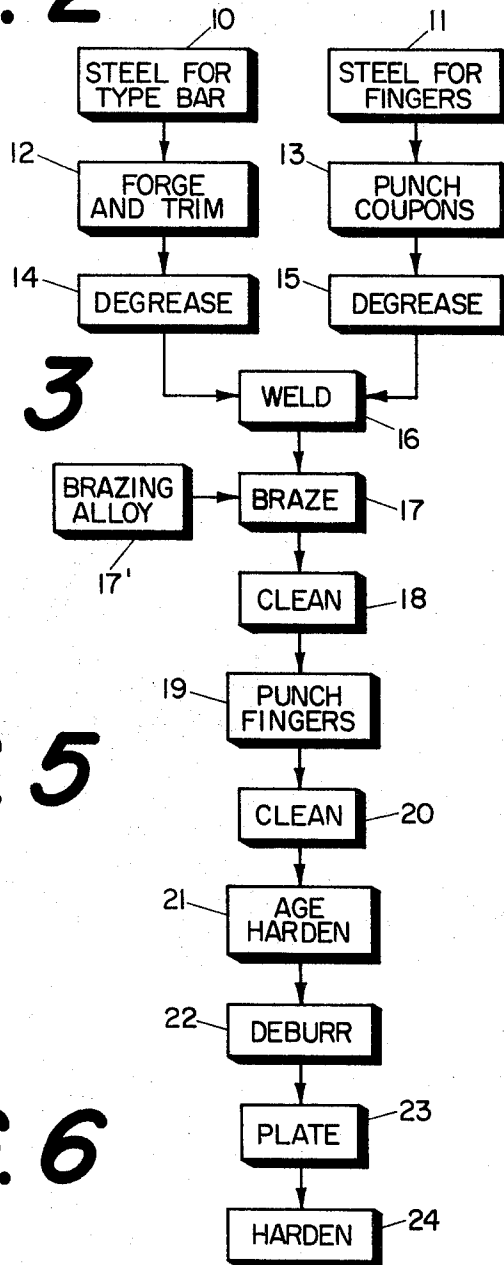


FIG. 6

FIG. 1



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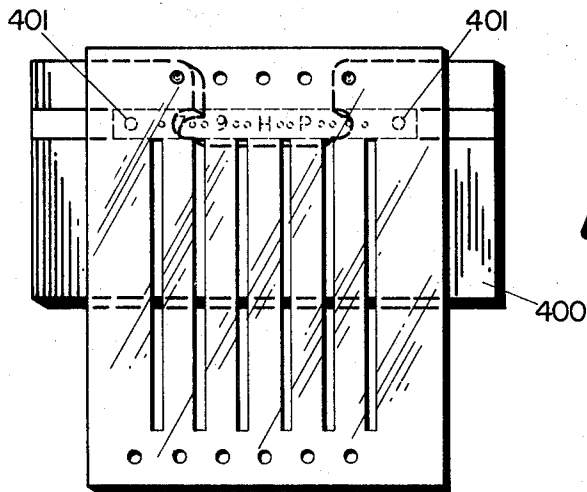


FIG. 4A

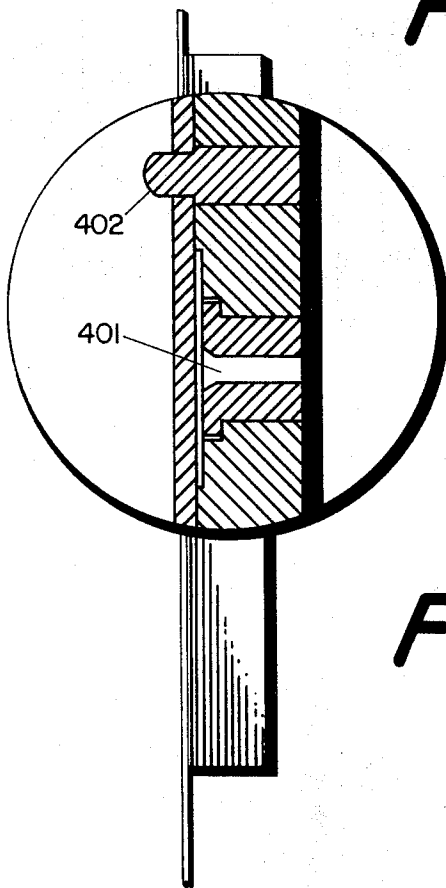


FIG. 7

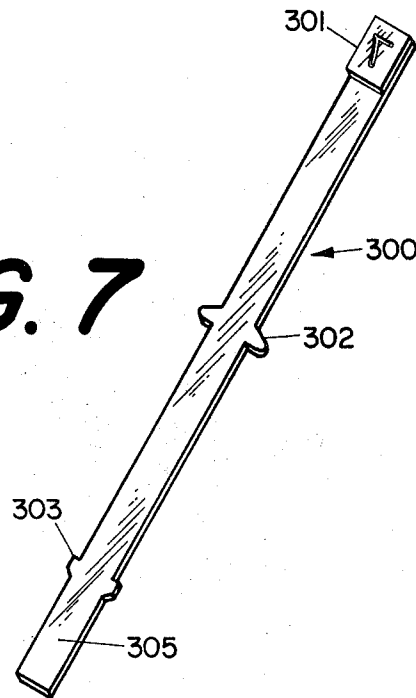


FIG. 4B

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METHOD OF MANUFACTURING TYPE FINGERS

The present invention in a continuation of my co-pending application Ser. No. 92,676, filed Nov. 25, 1970 now abandoned, and assigned to the same assignee as the present invention.

BACKGROUND OF THE INVENTION

This invention relates to a method for producing secured multi-elements metallic parts; more particularly, it relates to a method for producing type fingers having a raised type-face at one end of an elongated member.

DESCRIPTION OF THE PRIOR ART

There is a need for producing type fingers for printer applications requiring excellent spring quality for rebound after impact printing, the endurance limits to survive countless flexings, the hardness to resist wear from impact and abrasion by hammer action and contact with the printing ribbon and record medium. Where the fingers are carried by a flexible belt exposure to damage and wear is increased due to the ballistic nature of the printing. While type fingers have been developed heretofore, they have been costly, unreliable and have suffered from varying deficiencies in operation. Accordingly there exists a need for a method to provide improved type fingers having the desired, mentioned characteristics. A need also exists to provide a method which is capable of providing such improved type fingers in larger quantities and low cost.

United States patent application Ser. No. 734,501 filed June 4, 1968, by Earle B McDowell and Clifford M. Jones, discloses a printing apparatus utilizing a type carrying belt that carries a number of flexible arms, each of which has the type-face for a particular character on one end thereof. United States patent application Ser. No. 734,499 filed June 4, 1968, now U.S. Pat. No. 3,605,613, by Seymour Merritt DePuy and Donald George Herbert discloses such a type carrying belt and the general design of the flexible arms, or type fingers. These type fingers are preferably made of metallic material and have a shank provided with upper and lower shoulder portions. The shank is adapted to fit within a slot on the belt and it is vertically positioned by the shoulder portions.

It will be appreciated that such type fingers must be designed with certain criteria in mind. For instance, the shank portion must exhibit a degree of resilience and it must be rather accurately dimensioned. On the other hand, the type-face portion must be suitable for continuous impacting without damage and must be suitable to methods for the precise forming of the various characters thereon. In general, the usual method of rolling, forging, trimming, heat treating, and plating create material stresses and dimensional defects which prevents production of optimum type finger elements. In particular cases where single elements were used to form the type fingers, excessive waste resulted.

SUMMARY OF THE INVENTION

The present invention lies in a method of producing type fingers from two distinct components. Each of these components may be selected for optimum properties relative to the particular function performed thereby.

An object of the present invention is to provide a method for producing superior type fingers.

Another object of the present invention is to provide a method of efficiently and reliably producing type fingers.

Another object of the present invention is to provide a method for producing type fingers having dimensional precision.

Another object is to provide improved type fingers in larger quantities and reduced cost.

Another object of the present invention is to provide a method for increasing the rate of production of type fingers.

In accordance with a preferred embodiment of the invention, there is provided a method for producing type fingers from a character bar having a plurality of raised characters disposed along the length thereof, and a coupon blank. The character bar is welded to the coupon blank and then brazed thereto. Finally, the type fingers are punched out of the assembled elements in such a way as to provide a single character disposed at one end of each finger.

The manner in which the cited objects are achieved and the numerous features of this invention, will be clearly understood and appreciated from the following detailed description, made in conjunction with the attached drawing.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a flow chart showing each step in connection with carrying out the method of this invention in accordance with a detailed embodiment;

FIG. 2 is a view of a character bar developed in carrying out the method of the invention;

FIG. 3 is a view of a coupon blank developed in carrying out the method of the invention;

FIG. 4 A and B are of a fixture bar and coupon prepared for welding.

FIG. 5 is a view of a character bar and coupon blank assembly developed in carrying out the method of the invention;

FIG. 6 is a view of the residue of the assembly shown in FIG. 5, after the type fingers have been punched out; and

FIG. 7 is a typical type finger produced in accordance with the method of the invention.

DESCRIPTION TO THE PREFERRED EMBODIMENTS

In order to fully appreciate the significance of the various steps carried out in producing type fingers by this invention, the structures shown in FIGS. 2-6 will be referred to during analysis of these steps. The invention comprises five basic steps.

First, one forms a character bar such as illustrated in FIG. 2. This bar 100, contains plurality of type faces 104 such as for example, representing the five characters "7, e, H, p, .". If desired, the characters could all be the same. In addition, it includes projections 101, 102, used to precisely locate the bar. Each of the five characters is raised above the surface 103 and each character is precisely spaced with equal distances between the center lines thereof. In a particular example, the character bars were precision forged from type C-1008 steel with five raised printing characters 104 and two raised truncated cones 101, 102 all along the same longitudinal axis and centered 0.310 inch apart. The flattened section 103 was reduced to less than 0.010 inch thickness.

Second, one selects an appropriate steel and forms a coupon blank such as illustrated in FIG. 3. This coupon blank 200, is designed to provide the shank portion of five type fingers. It includes an array of precisely located positioning apertures 201 along one edge, and a second array of precisely located apertures 202 along the opposing edge. These apertures are precisely oriented along the horizontal and vertical axes for use in subsequent processing operations. In addition, a number of elongated slots 203 are located transverse the coupon blank between these apertures. The longitudinal slots are employed because the flat coupon may warp during the subsequent brazing cycle. By positioning these slots between proposed finger shanks, there is a tendency to align the thermal stress distortion in one direction with a slight transverse crowning effect due to the difference of thermal expansion between the subsequently bonded portions. In a preferred embodiment, the apertures 201, 202 and the slots 203 were formed in one punching operation.

In a particular example, the coupon blanks were formed of maraging steel, a super-strength alloy with relatively good hardness, slight corrosion resistance, favorable fatigue limits, and good spring properties. This steel can be obtained in an annealed and 20 percent cold rolled condition, satisfying the necessary considerations of flatness and tendencies toward galling encountered during punch and dye operations. The coupons 200 were designed so that the subsequently punched fingers would occur on horizontal centers of 0.310 inch. The positioning apertures 201 and 202 were located at precisely 0.310 inch centers in alignment with the material to form the fingers.

Third, the character bar 100 and the coupon blank 200 are bonded together by means of welding. The resulting assembly is illustrated in FIG. 5 wherein the location of each plurality of spot welds 204 is indicated by a small circle. By maintaining extreme accuracy of the punched coupons 200 and the forged character bars 100, it is relatively simple to hold these components in proper relation to one another for welding. Area is provided between the characters on the character bar, sufficient for reliable spot welding, yet away from the portion which will subsequently form the type face of the fingers. It is essential that the welds be of good quality because they become in essence the fixture which maintains dimensional accuracy of the assembly throughout the subsequent brazing and handling operations.

Bonding of the character bar and coupon blank is accomplished by use of the fixture 400. The fixture makes possible the accurate and secure location of the blank and bar with respect to use another for subsequent processing. The projections 101 and 102 are inserted into tapered holes 401 of fixture 400 with the type faces facing down on the fixture. The coupon is now placed on top of the located bar with the two outermost apertures 201 inserted over pins 402. With the bar on coupon now precisely and securely located, the arrangement is presented for spot welding. The coupon and bar are spot welded together into a rigid assembly which now serves as its own fixture for further processing.

The assembly shown in FIG. 5 illustrates the use of ten spot welds; with a pair bridging each character, spaced sufficiently far from the character to insure the discard of that portion when the fingers are punched out. In other embodiments of the invention, it has been

found that alternative spot welding arrangements may be employed. Thus, for example, one may utilize eight spot welds on each assembly; six at approximate centers between the seven raised portions of the character bar and one at each extreme end.

Fourth, the assembled elements are brazed. The selection of the brazing alloy depends upon the requirements of capillarity, strength, thermal limitations of base metals, furnace contamination limitations, ease of application, uniformity of results, and ease of removal of flux and binder residuals. The alloy may be applied in paste form, such as for example, as a bead along the length of the faying edge between the character bar 100 and the coupon blank 200 and the heating carried out in an adequately protective atmosphere, such as an inert gas. The alloy, when melted, flows between the faying surfaces of the bar and coupon uniting the interfaces.

Referring again to a particular example, a basic composition of 60% silver, 30% copper and 10% tin was employed. The brazing was carried out in a dry, protective atmosphere within a temperature range of 1325°F to 1550°F. Subsequently, the parts were cooled rapidly in a protective atmosphere to preclude overaging due to long cooling cycles and oxidation due to induced air cooling.

Fifth, and finally, the type fingers are punched out of the welded and brazed assembly, leaving a waste blank of the type illustrated in FIG. 6. The brazed assembly is now positioned in a punch and die having pins corresponding to the holes 201 and 202. The assembly is mounted so that holes 201 and 202 mate with the corresponding pins of the die. The hole 208 is used only as a reference or orientation mark. With this accurate positioning, each operation of the punch produces a punched finger of the proper configuration. As illustrated in this figure, the apertures 205 remain where the fingers have been removed. It is to be noted that these apertures include widened portions 206 and 207 which form the shoulders on the type fingers that assist in their subsequent positioning. The finger punching operation again requires precise dimensional accuracy and the punch and die are adapted to cooperate with the coupon blank to assure both horizontal and vertical centering of the character of the raised character face with the spring or shank portion of the type finger.

FIG. 7 illustrates a typical type finger 300 after it has been punched out. This type finger includes the raised character portion 301 adapted for printing the numeral "7" and upper and lower shoulder portions 302, 303 disposed on the shank portion 305.

Having described the essential steps in the method of this invention, it will be of value to consider ancillary steps that may advantageously be employed in order to achieve superior results.

The flow chart of FIG. 1 indicates that the first steps 10 and 11 comprise the selection of appropriate metal for the character bars and type fingers. Examples of specific materials and their characteristics have been discussed hereinabove. These materials are then forged and punched, respectively, as steps 12 and 13. Before the welding operation, both the character bars and the coupon blanks should be cleaned to remove surface elements that might otherwise inhibit the welding and brazing, tend to contaminate the furnace atmosphere, and possibly etch or blemish the metal surfaces.

The spot welding and brazing steps 16, 17 and the selection of a brazing alloy have also been discussed previously.

Following brazing, the cleaning operation 18 is carried out to remove the flux and binder surface residuals.

The finger punching operation 19, is the last step requiring precise positioning of the assembly. This is essential to insure proper location of each character relative to the center line of the finger.

After punching, the individual fingers are each subjected to cleaning, hardening, deburring, and plating. To provide the desired spring properties and wear resistance, the fingers are hardened. It has been found advantageous to harden the fingers 21, in a protective atmosphere of argon, and, in one example, heating at 900°F which is below the brazing temperature for three hours, followed by rapid cooling in the protective atmosphere, yielded satisfactory results. After hardening, the corners of the fingers may be smoothed by a vibratory and rotary, mildly abrasive deburring step 22. Plating is desirable for protection against possible corrosion. The subsequent plating operation 23, may comprise electroless nickel plating wherein a composition of nickel and phosphorous is deposited to a thickness of 70 to 130 micro-inch. To preclude hydrogen embrittlement from the plating solution and to harden the plating, a final hardening step 24 may be carried out. In one example, heating at 750°F in a protective atmosphere such as inert gas for 1 hour, proved effective.

Reviewing the method of this invention, it will be appreciated that high quality type fingers have been developed having spring finger shanks and raised type faces. The use of separate materials for the shank and face portions permits the selection of material having optimum characteristics for each part. The described method makes possible this reliable bonding of pre-formed parts to a flat spring material without damaging the dimensional, chemical, metallurgical, physical or mechanical properties of either part. Furthermore, it provides for the maintenance of very precise dimensions of the finished units.

Of course, modifications of some of the specific steps cited in describing embodiments of the invention, will occur to those skilled in the art. All such modifications which come within the spirit and teachings of this disclosure are intended to be covered by the following claims.

What I claim as new and desire to secure by Letters Patent of the United States, is:

1. The method of producing type fingers comprising: forming a character bar having a plurality of characters disposed along the length thereof, providing a coupon blank, welding said character bar to said coupon blank, subsequently brazing said character bar to said coupon blank, and punching out a plurality of type fingers each including a single character and a portion of said coupon blank.

2. The method of producing type fingers as defined in claim 1, including plating said type fingers.

3. The method of producing type fingers as defined in claim 1, wherein said welding comprises spot welding said character bar to said coupon blank in the space between each of said characters.

4. The method of producing type fingers as defined in claim 1, including initially punching said coupon blank with a plurality of slots extending parallel to the

location of the axis of the fingers to be subsequently punched out and intermediate each of the finger locations.

5. The method of producing type fingers as defined in claim 4, including initially punching positioning apertures in said coupon blank.

6. The method of producing type fingers as defined in claim 1, wherein said character bar is initially forged from a hard, corrosion-resistant steel and said coupon blank is initially punched from a sheet alloy having good resilience characteristics.

7. The method of producing type fingers as defined in claim 6, wherein said brazing is carried out with a brazing alloy in a protective atmosphere.

8. The method of producing type fingers as defined in claim 6 wherein said brazing is carried out with a brazing in which composition there is a flux and nickel additive, the flux inducing improved capillarity and the nickel inhibiting interface corrosion.

9. The method of producing type fingers comprising: forming a character bar having a plurality of characters spaced along the length thereof with location projections at the ends thereof and a relatively short length, forming a coupon blank having a length substantially equal to the length of said bar and having a plurality of slots extending lengthwise thereof, forming a first series of apertures along one end of the length dimension and a corresponding series of apertures along the other end of the length dimension, said apertures being positioned on the center lines between each pair of adjacent slots and having the same spacing as said characters on said bar, utilizing said projections and end apertures of said first and second series of apertures for accurately positioning said bar on said blank for a welding operation such that said characters lie on the center lines between opposing apertures of said first and second series of apertures spot welding said character bar to said blank in the space between each of said characters, to provide a composite assembly, brazing said bar to said blank at the faying surfaces of said bar and coupon, utilizing each of said first and second series of apertures for accurately positioning said composite assembly for a punching operation, punching out a plurality of type fingers in succession each including a single character and a portion of the coupon blank between opposing apertures of said first and second series of apertures and adjacent slots.

10. The method of producing type fingers comprising: forming a character bar having a plurality of type characters spaced along the length thereof from an impact resistant material, forming a coupon blank from a sheet alloy material having good resilience characteristics and a length substantially equal to the length of said bar, spot welding said character bar to said blank in the space between each of said characters at locations sufficiently far from the characters to permit the discard of the welded portion when the fingers are punched out in a subsequent operation, brazing said bar to said blank at the faying surfaces of said bar and coupon with a brazing alloy at the melting temperature of said alloy in a nonoxidizing atmosphere, punching out a plurality of type fingers each including a single character of said bar and a portion of the coupon blank brazed thereto, and subsequently hardening them in a nonoxidizing atmosphere for a sufficient period of time at a temperature below the temperature of brazing, followed by rapid

cooling in such atmosphere to provide the punched out type fingers with desirable spring properties.

11. A method according to claim 10 wherein said coupon blank material is maraging steel.

12. The method of producing type fingers comprising: forming a character bar having a plurality of characters spaced along the length thereof from a hard, impact resistant steel with location projections at the ends thereof, forming a coupon blank from maraging steel having a length substantially equal to the length of said bar and having a plurality of slots extending transversely of the length thereof, forming a first series of apertures along one end of the length dimension of said blank and a corresponding series of apertures along the other end of the length dimension of said blank, said apertures being positioned on the center lines between each pair of adjacent slots and having the same spacing as said characters on said bar, utilizing said projections and end apertures of said first and second series of apertures for accurately positioning said bar on said blank for a welding operation such that said characters lie on the center lines between opposing apertures of said first and second series of apertures, spot welding said character bar to said blank in the space between each of said characters at locations sufficiently far from the characters to insure the discard of the welded portion when the fingers are subsequently punched out, brazing said bar to said blank at the faying surfaces of said bar and coupon with a brazing alloy at the melting temperature of said alloy, utilizing each of said first and second series of apertures for accurately positioning said composite assembly for a punching operation, punching out a plurality of type fingers each including a single character of said bar and a portion of the coupon blank between opposing apertures of said first and second series of apertures and between adjacent slots, and subsequently hardening the punched out type fingers by heat treating them in a nonoxidizing atmosphere for a sufficient period of time at a temperature below the temperature of brazing, and then rapidly cooling in such atmosphere to provide the punched out fingers with desirable spring properties.

13. The method of producing type fingers comprising:

ing: forming a character bar having a plurality of characters raised above the surface of the bar and being equally spaced along the length thereof from hard, impact resistant material, said bar including projections used to precisely locate the bar in a fixture, forming a coupon blank from a super-strength alloy with relatively good hardness, slight corrosion resistance, favorable fatigue limits and good spring properties, said blank having a length substantially equal to the length of said bar and having a plurality of slots extending transversely of the length thereof, placing the bar with the type faces facing down on the fixture and the projections inserted into locating holes in the fixture, placing the coupon atop of the located bar with the two outermost apertures of the coupon inserted over corresponding locating pins in the fixture, punching said coupon blank with a plurality of slots extending parallel to the location of the axis of the fingers to be subsequently punched out and intermediate each of the finger locations, forming a first series of apertures along one end of the length dimension and a corresponding series of apertures along the other end of the length dimension, said apertures being positioned on the center lines between each pair of adjacent slots and having the same spacing as said characters on said bar, spot welding said character bar to said blank in the space between each of said characters at locations sufficiently far from the characters to insure the discard of the welded portion when the fingers are subsequently punched out, brazing said bar to said blank at the faying surfaces of said bar and coupon, utilizing each of said first and second series of apertures for accurately positioning said composite assembly for a punching operation, punching out a plurality of type fingers in succession each including a single character and a portion of the coupon blank between opposing apertures of said first and second series of apertures and between adjacent slots, subsequently hardening the punched out type fingers by heat treating them in nonoxidizing atmosphere, and then rapidly cooling said fingers in such atmosphere to provide the punched out fingers with desirable spring properties.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,763,544 Dated October 9, 1973

Inventor(s) Archibald M. Gibson, Jr.

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 1, line 3	cancel "in" and insert -- is --
Column 2, line 1	cancel "anogher" and insert -- another --
line 46	cancel "TO" and insert -- OF --

Signed and Sealed this

Twenty-first Day of September 1976

[SEAL]

Attest:

RUTH C. MASON
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents and Trademarks