

PATENT SPECIFICATION

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(54) A METHOD FOR FORMING COUNTER-SUNK HOLE IN A BASE MATERIAL AND AN APPARATUS FOR CARRYING OUT THE SAME

(71) I, YOSHITAKA NAKANISHI of
12-9, Yawata 5-chome, Ichikawa-shi,
Chiba-ken, Japan a citizen of Japan, do
hereby declare the invention, for which I
pray that a patent may be granted to me, and
the method by which it is to be performed, to
be particularly described in and by the fol-
lowing statement:-

The present invention relates to a method
and apparatus for forming counter-sunk
holes.

It is well known to form a counter-sunk
seat on the top of a hole in a base material
by means of a metal machining process or a
press-working process, and it has also been
noticed that the latter press-working process
is more efficient than the former machining
process. The press-working process has such
defects in the forming of a counter-sunk seat
that the base material tends to expand in the
radial direction or to swell at the outer
periphery of the counter-sunk seat as a re-
sult of the compression by the conical sur-
face of a work tool against the base mate-
rial. The swelling phenomenon around the
counter-sunk seat results in the reduced
value of a finished product as merchandise
in view of utility and strength, while the de-
fect of expansion along the radial direction
results in that, when forming a counter-sunk
hole in a long base material which is fed con-
secutively to a working spot, the dimension
of elongation caused by expansion of the
material along the feeding direction is added
to the original length of the material so as to
cause difficulties in forming the counter-
sunk holes at a correct position in the mate-
rial.

An object of the present invention is to
provide a method for forming precisely a
counter-sunk hole by means of a press-
working process at a predetermined spot,
which has the advantage of reducing to the
minimum dimensions of the swelling around
the counter-sunk hole and the elongation in

the radial direction caused on a base mate-
rial worked in the course of the counter-
sinking stage, as well as of obtaining such a
product of strong and good quality to be
valuable as merchandise.

Another object of the present invention is
to provide a method capable of simply form-
ing a counter-sunk hole in a very hard base
material such as a stainless steel sheet and
the like.

According to the present invention, there
is provided a method of forming a counter-
sunk hole in a plate-like base material, com-
prising the steps of punching a preliminary
hole in the base material; forming a counter-
sunk seat around the preliminary hole by
compressing the preliminary hole to force
out the edge portion thereof into the pre-
liminary hole by means of a conical working
surface, and punching a finished hole
around the inner edge portion of the pre-
liminary hole to remove the material forced
out into the preliminary hole by the com-
pressing step.

There is also provided a method of pro-
ducing a unitary base material having at
least one counter-sunk hole therein from a
strip-like base material, comprising the
steps of feeding the strip-like base material
to a press working position by a feeding
pitch corresponding to the length of the uni-
tary base material, punching lateral slits
into the strip-like base material spaced rela-
tive to each other by the length of the uni-
tary base material, forming at least one pre-
liminary hole in the unitary base material
between the slits, forming a counter-sunk
seat around the or each preliminary hole by
compressing the preliminary hole to force
out the edge portion thereof into the pre-
liminary hole by means of a conical working
surface, and punching a finished hole
around the inner edge of the or each pre-
liminary hole to remove the fraction forced
out into the preliminary hole by the com-

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pressing step.

According to the invention there is further an apparatus as claimed in Claim 6, wherein said conical working surface has a continuous spiral-shaped shoulder.

There is also provided a press working apparatus for forming at least one counter-sunk hole in an elongated base material, comprising a punch for perforating a slit in the elongated base material to prevent the extension of the material in the feeding direction thereof, at least one punch for forming a preliminary hole in the base material, at least one bevelling punch having a conical working surface at one end thereof for forcing the edge portion of the preliminary hole into the preliminary hole, and at least one punch for forming a finished hole around the preliminary hole to remove the material forced thereinto by the bevelling punch, the at least one bevelling punch being disposed at a subsequent stage to that of both punches for perforating slits and preliminary holes in order to form a counter-sunk seat around each preliminary hole, and the at least one finishing punch being disposed at a subsequent stage to the bevelling punch.

A counter-sunk hole of better quality and stronger formation can be obtained by making a finished hole around the preliminary hole by punching out the portion of the worked material which flows into the preliminary hole during formation of the counter-sunk seat.

In the accompanying drawings:-

Figure 1 is a perspective view of a metal sheet for a hinge having a plurality of counter-sunk holes formed therein by a method according to the present invention;

Figure 2 to Figure 4 are schematic sectional side views showing the steps of punching and counter-sinking according to the method of the present invention;

Figure 5 is a fractional front view of a punch for counter-sinking in the method of the present invention;

Figure 6 is a schematic plan view of consecutive steps for forming a hinge wing having perforated counter-sunk holes from an elongated base material according to the method of the present invention; and

Figure 7 is a sectional view taken along the line VII-VII of Figure 6.

There are many kinds of materials in which it may be desired to provide counter-sunk holes, and in Figure 1, a unitary base material 1 is shown as an example to be used for making a wing of a hinge. The base material 1 is a rectangular stainless steel sheet having a plurality of counter-sunk holes 2 in one side portion, while the other side portion thereof has no counter-sunk holes therein and may be subsequently bent by a conventional process to form tubular

portions receiving the axis of a hinge therein. When the counter-sunk holes 2 are perforated by the press-working process, the distance between adjacent countersunk holes is increased, as mentioned hereinbefore, so that the distance between the correlative holes is disarranged, and also the length of the unitary base material from its one edge 3 to the other edge 4 in the feeding direction of the material is elongated, when making a unitary base material out of a long strip-like material, whereby it is very difficult to precisely supply the unitary base material to a correct working spot. Hence, Figure 2 to Figure 4 show the steps of a process according to the invention which is able to solve this problem. The steps of process for forming counter-sunk holes are as follows:-

Firstly, a preliminary hole 6 is formed in the base material 1 by use of a die 7 for punching the perforation as shown in Figure 2.

In the next place, by pressing the punched preliminary hole 6 at its top edge portion downward with a bevelling punch die 8 at its conical working surface 9, a conical seat (counter-sunk seat) 10 is formed on the top end of the preliminary hole 6, as shown in Figure 3. A fraction 11 of the worked material which is of the edge portion of the preliminary hole and pressed by the bevelling die at the conical working surface 9 thereof is pushed downwards into the preliminary hole 6, and a part 12a of the pushed-down fraction 12 is forced out of the lower surface 13 of the preliminary hole. As a result of the foregoing working process, even a very hard base material such as a stainless steel sheet can simply have a counter-sunk hole 2 formed therein. At the same time, the swelling phenomenon occurring at the edge portion around the counter-sunk seat 10 in the worked base material can be strictly controlled to the minimum dimension which are caused in case of making counter-sunk holes by a press-working process, and also elongation of the worked base material in the direction of the surface plane thereof is controlled in the same. Therefore, a counter-sunk hole 2 can be precisely formed at a predetermined spot. The conical working surface 9 of the bevelling punch die 8 may be formed in a serrated or an annular stepped shoulder 14 as shown in Figure 5, and the preliminary hole 6 is pressed downward at the top edge portion 11 thereof by means of the shoulder 14 in a serrated shape. The pressed edge portion 11 is displaced much more smoothly toward the inner part of the preliminary hole 6 as compared with the process of compressing with a conical smooth working surface of a bevelling punch die. The shoulder 14 may be formed in a spiral or non-spiral shape, however the spiral-shaped shoulder 14 can readily be

made by a lathe. The width W as well as the height H of the shoulder 14 is defined due to the angle of the circular cone, but the width and the height are equal with a cone angle of 45°. The dimension of the shoulder 14 may be varied due to the quality of the base material to be worked and, as an example, when a stainless steel sheet is employed the dimension is determined properly within the range from about 0.05 mm to about 0.3 mm.

Further, as shown in Figure 4 the edge portion of the preliminary hole 6 is perforated by use of a die 15 for punching a finished hole so as to form a finished hole 16 concentric with the preliminary hole 6. By means of punching work for forming the finished hole 16, the fraction 12 forced out into the preliminary hole 6 is removed. The diameter of the finished hole 16 may be equivalent in dimension to that of the preliminary hole 6 for shearing only the fraction 12 forced out into the preliminary hole 6 or the diameter of the finished hole 16 may be made larger than that of the preliminary hole 6 to punch the edge portion of the preliminary hole 6 together with the forced-out fraction 12. Since the counter-sunk seat 10 is formed on the top end of the preliminary hole 6 under the process for perforating the preliminary hole 6 and then forcing out the fraction staying around the preliminary hole 6 to be displaced into the preliminary hole, the distance between the centres of adjacently disposed counter-sinks 2 is kept constant as set forth hereinbefore, and as the finished hole 16 is punched after forming the counter-sunk hole, the centre of the finished hole 16 can easily be aligned with the centre of the counter-sunk hole 2, so that the centre of the finished hole 16 can be precisely positioned at just the same spot as the specifications or a plan.

In Figure 6 and Figure 7, there is shown a method for forming consecutively a unitary base material 1 having a plurality of counter-sunk holes therein out of a strip-like base plate.

By starting a press-work for an elongated base material 17 which is fed to a press-working device comprising a punch holder 30 and dies 40, the elongated base material 17 is fed in sequence by a feeding pitch corresponding to the length of a unitary base material 1 with respect to one stroke of a press ram.

Firstly, the base material 17 is perforated to form concurrently a slit 18 and preliminary holes 6 therein at a working position A by means of respectively relative punching dies 19 and 7. On the other hand, the process for punching the slit 18 and for punching preliminary holes 6 may be carried out subsequently instead of the aforementioned process for punching concurrently both the slit 18 and preliminary holes 6 or the process

with steps reverse to the foregoing may be carried out.

Secondly, when the slit 18 and preliminary holes 6 reach a working position B after the elongated base material 17 having been fed by one pitch of distance according to the punching work, the elongated base material 17 is held at a correct position by inserting a pilot pin 23 into the slit 18. At the same time, counter-sunk holes 10 are formed on the top ends of preliminary holes 6 respectively by use of a punching die 8 for bevelling to a conical-shape. In this instance, the fraction 11 at the bevelled portion of the base material compressed by the punching die 8 flows out into the preliminary hole 6. As the counter-sunk seat 10 is formed on the top edge of the preliminary hole 6 after the slit 18 has been punched, even though the base material 17 is elongated in the longitudinal direction in the course of forming the counter-sunk seat by pressing the preliminary hole 6 at the top edge thereof with a conical working surface of the punching die 8, the elongation is absorbed into the slit 18. Accordingly, the distance between the slits 18 corresponding to a feeding pitch is maintained constant as well as the feeding pitch for the base material 17 is kept correctly. As a result, each centre of the preliminary hole 6 and of the counter-sunk seat 10 as well as of the finished hole 16 which is formed later is aligned with one another without any disalignment, whereby the counter-sunk hole can be punched just at the same position as indicated by the specifications and the plan.

Next, the elongated base material 17 is fed by one feeding pitch, and the counter-sunk seat 10 reaches a position C where no press operation is performed.

In a subsequent step, the elongated base material 17 is fed by a feeding pitch and the counter-sunk seat 10 reaches a working position D where the top edge portion of the preliminary hole 6 is perforated by a punch 15 so as to form a finished hole around the preliminary hole 6. At the same time, the base material 17 is cut off at both sides 5 thereof by an edging punch 20 for bringing to completion. However, such process of punching the finished hole 16 and then cutting off both sides 5 of a unitary base material may be carried out in place of the process for punching the finished hole 16 and cutting off both sides 5 of a unitary base material simultaneously.

In a further step, the base plate 17 is fed by one pitch and the finished hole 16 comes to a working position E, then the pilot pin 24 is inserted into the finished hole 16 to fix the base material securely at a correct position as well as the base material 17 locating within the working spot E and is cut off at the right end thereof by a shearing punch 21 to separate the preceding unitary base mate-

rial 1 from the base material 17.

When the elongated base material 17 is fed further by one pitch, the end surface of the cut-out unitary base material 1 runs against a gauge plate 22 and the finished hole 16 comes to a working position F where the base material is cut off at the left end thereof by a shearing punch 21.

Each of punching dies employed in the foregoing steps of process is fixed to a punch holder 30 to be actuated integrally with one another in a vertical movement. All the steps of the above-mentioned process including a step of punching a first slit 18 to a step of shearing the last unitary base material 1 by one stroke of a press ram are carried out simultaneously whereby a single unitary base material 1 provided with counter-sunk holes 2 is produced efficiently in the course of one stroke of a press ram.

The present invention has been described with reference to the production of a hinge, however, the present invention is not restricted to the production of a hinge, but can be applied to the production of other articles provided with counter-sunk holes such as, for instance, fitting seats to serve as an attachment to door catches, handles, latches, door stops, side dump door stoppers and the like as well as flat-bars to be attached to furniture, fittings of a house and the like.

WHAT I CLAIM IS:-

1. A method of forming a counter-sunk hole in a plate-like base material, comprising the steps of punching a preliminary hole in the base material; forming a counter-sunk seat around the preliminary hole by compressing the preliminary hole to force out the edge portion thereof into the preliminary hole by means of a conical working surface, and punching a finished hole around the inner edge portion of the preliminary hole to remove the material forced out into the preliminary hole by the compressing step.

2. A method as claimed in Claim 1, wherein said conical working surface has a plurality of serrated shoulders.

3. A method of producing a unitary base material having at least one counter-sunk hole therein from a strip-like base material, comprising the steps of feeding the strip-like base material to a press working position by a feeding pitch corresponding to the length of the unitary base material, punching lateral slits into the strip-like base material spaced relative to each other by the length of the unitary base material, forming at least one preliminary hole in the unitary base material between the slits, forming a counter-sunk seat around the or each preliminary hole by compressing the preliminary hole to force out the edge portion thereof into the preliminary hole by means of a conical

working surface, and punching a finished hole around the inner edge of the or each preliminary hole to remove the fraction forced out into the preliminary hole by the compressing step.

4. A method as claimed in Claim 3, which further comprises the steps of shearing the unitary base material along the side plane thereof and shearing the edge portion of said slit subsequent to the step of forming the or each counter-sunk seat.

5. A method as claimed in any of Claim 3 or 4, wherein said conical working surface has serrated shoulders thereon.

6. An apparatus for forming a counter-sunk hole in a plate-like base material comprising a punch for forming a preliminary hole in the base material, a press tool having a conical working surface for forming a counter-sunk seat around the preliminary hole by compressing the preliminary hole to force out the edge portion thereof into the preliminary hole, and a further punch for punching a finished hole around the inner edge portion of the preliminary hole to remove the material forced out into the preliminary hole by the press tool.

7. An apparatus as claimed in Claim 6, wherein said conical working surface has a plurality of annular shoulders concentric with the centre of the conical working surface.

8. An apparatus as claimed in Claim 6, wherein said conical working surface has a continuous spiral-shaped shoulder.

9. A press working apparatus for forming at least one counter-sunk hole in an elongated base material, comprising a punch for perforating a slit in the elongated base material to prevent the extension of the material in the feeding direction thereof, at least one punch for forming a preliminary hole in the base material, at least one bevelling punch having a conical working surface at one end thereof for forcing the edge portion of the preliminary hole into the preliminary hole, and at least one punch for forming a finished hole around the preliminary hole to remove the material forced thereinto by the bevelling punch, the at least one bevelling punch being disposed at a subsequent stage to that of both punches for perforating slits and preliminary holes in order for form a counter-sunk seat around each preliminary hole, and the at least one finishing punch being disposed at a subsequent stage to the bevelling punch.

10. An apparatus as claimed in Claim 9, wherein the punch for perforating said slit is disposed at a preceding stage to the location of the bevelling punch or the punch for forming the preliminary hole.

11. An apparatus as claimed in Claim 9 or 10, further comprising a shearing punch

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rial 1 from the base material 17.

When the elongated base material 17 is fed further by one pitch, the end surface of the cut-out unitary base material 1 runs against a gauge plate 22 and the finished hole 16 comes to a working position F where the base material is cut off at the left end thereof by a shearing punch 21.

Each of punching dies employed in the foregoing steps of process is fixed to a punch holder 30 to be actuated integrally with one another in a vertical movement. All the steps of the above-mentioned process including a step of punching a first slit 18 to a step of shearing the last unitary base material 1 by one stroke of a press ram are carried out simultaneously whereby a single unitary base material 1 provided with counter-sunk holes 2 is produced efficiently in the course of one stroke of a press ram.

The present invention has been described with reference to the production of a hinge, however, the present invention is not restricted to the production of a hinge, but can be applied to the production of other articles provided with counter-sunk holes such as, for instance, fitting seats to serve as an attachment to door catches, handles, latches, door stops, side dump door stoppers and the like as well as flat-bars to be attached to furniture, fittings of a house and the like.

WHAT I CLAIM IS:-

1. A method of forming a counter-sunk hole in a plate-like base material, comprising the steps of punching a preliminary hole in the base material; forming a counter-sunk seat around the preliminary hole by compressing the preliminary hole to force out the edge portion thereof into the preliminary hole by means of a conical working surface, and punching a finished hole around the inner edge portion of the preliminary hole to remove the material forced out into the preliminary hole by the compressing step.

2. A method as claimed in Claim 1, wherein said conical working surface has a plurality of serrated shoulders.

3. A method of producing a unitary base material having at least one counter-sunk hole therein from a strip-like base material, comprising the steps of feeding the strip-like base material to a press working position by a feeding pitch corresponding to the length of the unitary base material, punching lateral slits into the strip-like base material spaced relative to each other by the length of the unitary base material, forming at least one preliminary hole in the unitary base material between the slits, forming a counter-sunk seat around the or each preliminary hole by compressing the preliminary hole to force out the edge portion thereof into the preliminary hole by means of a conical

working surface, and punching a finished hole around the inner edge of the or each preliminary hole to remove the fraction forced out into the preliminary hole by the compressing step.

4. A method as claimed in Claim 3, which further comprises the steps of shearing the unitary base material along the side plane thereof and shearing the edge portion of said slit subsequent to the step of forming the or each counter-sunk seat.

5. A method as claimed in any of Claim 3 or 4, wherein said conical working surface has serrated shoulders thereon.

6. An apparatus for forming a counter-sunk hole in a plate-like base material comprising a punch for forming a preliminary hole in the base material, a press tool having a conical working surface for forming a counter-sunk seat around the preliminary hole by compressing the preliminary hole to force out the edge portion thereof into the preliminary hole, and a further punch for punching a finished hole around the inner edge portion of the preliminary hole to remove the material forced out into the preliminary hole by the press tool.

7. An apparatus as claimed in Claim 6, wherein said conical working surface has a plurality of annular shoulders concentric with the centre of the conical working surface.

8. An apparatus as claimed in Claim 6, wherein said conical working surface has a continuous spiral-shaped shoulder.

9. A press working apparatus for forming at least one counter-sunk hole in an elongated base material, comprising a punch for perforating a slit in the elongated base material to prevent the extension of the material in the feeding direction thereof, at least one punch for forming a preliminary hole in the base material, at least one bevelling punch having a conical working surface at one end thereof for forcing the edge portion of the preliminary hole into the preliminary hole, and at least one punch for forming a finished hole around the preliminary hole to remove the material forced thereinto by the bevelling punch, the at least one bevelling punch being disposed at a subsequent stage to that of both punches for perforating slits and preliminary holes in order for form a counter-sunk seat around each preliminary hole, and the at least one finishing punch being disposed at a subsequent stage to the bevelling punch.

10. An apparatus as claimed in Claim 9, wherein the punch for perforating said slit is disposed at a preceding stage to the location of the bevelling punch or the punch for forming the preliminary hole.

11. An apparatus as claimed in Claim 9 or 10, further comprising a shearing punch

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which is disposed at a subsequent stage to the location of the finishing punch in order to cut off a unitary base material from the elongated base material.

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12. An apparatus as claimed in any of Claims 9 to 11, further comprising an edging punch which is disposed at a subsequent stage to the location of the finishing punch in order to straighten up the edge on both sides of said base material.

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13. An apparatus as claimed in any of claims 9 to 12, wherein the working surface of the bevelling punch is provided with a plurality of concentric annular shoulders.

14. An apparatus as claimed in any of claims 9 to 12, wherein the working surface of the bevelling punch is provided with a continuous spiral-shaped shoulder.

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15. An apparatus for forming a counter-sunk hole, substantially as herein described with reference to the accompanying drawings.

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ELKINGTON AND FIFE,
Chartered Patent Agents,
High Holborn House,
52/54 High Holborn,
London WC1V 6SH.
Agents for the Applicants.

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