

PATENT SPECIFICATION

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(54) SELF-PIERCING BLIND FASTENERS

(71) We, ILLINOIS TOOL WORKS INC., a corporation organised under the laws of the State of Delaware, United States of America, of 8501 West Higgins Road, Chicago, Illinois 60631, United States of America, do hereby declare the invention for which we pray that a patent may be granted to us and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to fasteners of the type that can be installed from only one side of a work-piece. The invention more particularly relates to such a fastener that is capable of piercing its own hole and expanding behind the workpiece as the result of a single operating stroke.

Blind fasteners are currently utilised to attach a plurality of plates together by first drilling or punching aligned holes in the plates and then inserting a rivet body having a bore and a drive pin situated in the bore. After the rivet body has been positioned through the aligned holes in the plates, a driving blow is imparted to the drive pin causing the entering end of the rivet body to expand behind the plates. This practice is obviously time-consuming in that it requires a separate operation to prepare the necessary holes into which the rivet body may be inserted.

Previous efforts to provide a blind fastener which is capable of piercing a hole in a workpiece, and expanding therebehind in one operating stroke, have not met with success. One of the reasons for this lack of success is the fact that the single impact blow imparted to the drive pin tends to cause the fastener body to expand prematurely, thus reducing the amount of energy available to pierce the workpiece and increasing the piercing area of the entering end of the rivet body.

Existing blind rivet assemblies are not adaptable for use with production line techniques. Present blind rivets cannot be utilised with a power driver in which a

plurality of such rivets are fed in succession to a nosepiece chamber for subsequent driving through a workpiece. The prior art fasteners conventionally have a circular head and a concentric shank extending beneath the head. This configuration will not allow the rivet shank to be guided effectively as it travels through the nosepiece chamber.

According to the present invention, a blind rivet assembly comprises a rivet body and a drive pin, the rivet body including a shank having a leading and a trailing end, the trailing end being formed with opposed laterally projecting wings, the shank being further formed with a recess extending axially from its trailing end to a point intermediate its length, the drive pin having an entering and a trailing end, and being received into the recess, the length of the pin being greater than the depth of the recess, the drive pin and rivet body including co-operating surfaces to transmit a driving force through the pin to the rivet body, and the pin and shank further including means by which a part of the assembly may be radially expanded on penetration of a workpiece by a continuation of the driving force.

An important aspect of the invention is the capability of the rivet assembly to expand or enlarge laterally from a plane extending axially of the assembly. The rivet body will have a substantially constant cross-sectional dimension transverse this plane, so that the shank is confined and restrained from expanding by the walls of the nosepiece as the assembly is driven therethrough.

The structure outlined in the preferred embodiments of the invention also contributes to total guidance of the fastener as it is driven through the nosepiece chamber of the power driver. The shank of the present invention is in sliding contact with the walls of the nosepiece to prevent the fastener shank from cocking or otherwise becoming inclined to the intended axis of penetration.

It is, therefore, an object of the invention to provide a blind rivet assembly which is capable of piercing the workpiece and expanding behind the workpiece as a result of a single continuous blow.

Another object of the invention is the provision of a rivet assembly that can be guided and confined within the nosepiece of a power driving apparatus.

Still a further object of the invention is the provision of a blind rivet assembly which will pierce the hole in a workpiece and expand behind it utilizing a minimum of driving energy.

These and other objects and advantages of the present invention will become more apparent by reference to the following description of the invention, as illustrated in the accompanying drawings:—

Figure 1 is a perspective view of a preferred embodiment of the blind rivet assembly;

Figure 2 is a front view of the rivet body, shown in Figure 1.

Figure 3 is a longitudinal sectional view of the rivet body taken along the lines 3—3 of Figure 2;

Figure 4 is a point end view of the rivet body of Figure 2;

Figure 5 is a side view of a drive pin used with the rivet body shown in Figures 2 and 4;

Figures 6 and 7 are cross-sectional views of two rivet bodies showing alternative configurations for the side walls of the rivet body;

Figure 8 is a partial cross-sectional view showing the rivet assembly situated in the nosepiece chamber of a driving tool, about to be driven into associated workpieces.

Figure 9 is a view similar to Figure 8 showing the rivet assembly being driven through the workpieces.

Figure 10 is a view similar to Figures 8 and 9 but showing the rivet assembly being expanded by further axial force of the ram on the drive pin;

Figure 11 is a cross-sectional view of the nosepiece chamber taken along the lines 11—11 of Figure 9 showing the rivet assembly in place;

Figure 12 is a side view of an alternative embodiment of the rivet assembly;

Figure 13 is a partial longitudinal sectional view taken along the lines 13—13 of Figure 12;

Figure 14 is a partial cross-sectional view of the nosepiece chamber used with rivets of the type shown in Figure 12, showing a top plan view of the rivet;

Figure 15 is an exploded perspective view of another embodiment of the rivet assembly;

Figure 16 is an exploded front view of yet another embodiment of the rivet assembly; and

Figure 17 is a partial cross-sectional view of the embodiment shown in Figure 16 generally along lines 17—17 thereof as it is confined within the nosepiece of a driver and after it has pierced the workpieces.

The rivet assembly 10 shown in Figures 1 to 7, comprises a body part 20, with a generally cylindrical shank portion 22 and a sharp, tapered point 26 at one end, and laterally projecting wings 24 at the other end. An axial recess 28 is formed in the body part, terminating short of the point with the bottommost portion of the recess including substantially conical abutment surfaces 30.

A drive pin 12, formed with a point 16 at its leading end is positioned within the recess, and is of a cross-sectional configuration corresponding to the cross-sectional configuration of the recess. The point 16 of the pin is tapered to a conical configuration complementary to the abutment surfaces 30 in the recess. It will be noted that the overall length of the pin 12 is greater than the axial extent of the recess, so that the point of the pin may be driven past the abutment surfaces and cause the body to expand in a manner to be set forth later herein.

The entering end of the shank 22 and the point 26 is provided with a diametral slot 32 which extends generally in a plane including the axis of the fastener and parallel to the wings 24. The slot preferably extends upwards beyond the abutment surfaces 30 of the bore. Thus, when a predetermined driving force is exerted between the point 16 of the drive pin and the abutment surfaces 30 of the body, the body, if unrestrained, will be caused to spread or expand radially away from the plane of the slot 32.

It should be understood that the rivet body 22 may be merely weakened along an axial plane, rather than providing the shank with a fully formed diametral or substantially diametral slot. Examples of weakening the shank are shown in Figures 6 and 7. Figure 6 shows an embodiment wherein the outer peripheral extent of the body is uninterrupted but an indentation or partial slot portion 35 is provided by reducing the cross section in opposed portions lying on an axial plane. Figure 7 shows a structure wherein the shank is weakened by slotting the outer periphery of the shank, but not completely slotting the shank as in Figure 4. As in Figure 6, the weakened portion 36 is along an axial plane parallel to the plane of the wings 24.

The rivet assembly shown is capable of being driven, by impact force on the drive pin, with a force sufficient to pierce a workpiece and provide clamping engagement on either side of the workpiece as a result of a single, continuous axial force thereupon. This aspect of the invention is achieved

through the co-operation of the wings 24 and the plane of the slot or weakened portion 32. It will be noted, with reference to the drawings, that the wing portions 24

5 extend primarily in the plane of the slot and provide a maximum transverse dimension at the trailing extremity of the body.

10 In the preferred embodiment, the minimum dimension is the diameter of the shank 22 while the maximum dimension is the total lateral extent of the wings 24. In this embodiment, it should be apparent that opposing longitudinal segments of the shank, from the point 26 to the uppermost

15 extremity of the body, are capable of being confined and embraced by walls of a chamber such as the driving chamber of a nosepiece in a power driving device. The importance of this structural arrangement of

20 the invention will become apparent with reference to Figures 8 to 11. A plurality of fastener assemblies 10 may be fed consecutively to the nosepiece chamber of a driving tool. The nosepiece chamber, such

25 as the chamber 40, may be of a generally rectangular cross-section to conform to the substantially rectangular configuration of the wings 24. Since the minimum transverse dimension of the shank 22 is the diameter of the cylindrical shank, the side walls 41 of the chamber 40 will contact substantially the

30 entire longitudinal extent of the shank and prohibit the shank from expanding until the fastener has moved out of the nosepiece by piercing the workpiece. At that point, the wings 24 will abut the upper surface of the workpiece 44. Continued axial force on the

35 drive pin by a ram 42 will cause the point 16 of the pin to be driven past the abutment surfaces 30, expanding the shank away from the plane of the slot 32. Thus, the rivet assembly will engage the upper surface of a plate 44 as well as the under surface of a plate 45 by the wings 24 and expanded shank

40 20, respectively.

If maximum surface contact between the wings 24 and the upper workpiece, or a rivet body which somewhat resembles the conventional circular headed fastener is desired, the embodiment shown in Figures 12 to 14 may be utilised.

The assembly 10a shown in Figures 12 to 14, includes a generally cylindrical shank 20a, with a sharp tapered point 26a at the entering end, and laterally extending wings 24a in the trailing end. An axially extending slot 32a is provided in the shank, extending upwardly from the point 26a. A drive pin 12a is associated within a recess 28a in a manner similar to that of the embodiment shown in Figures 1 to 10. Attention is directed to the configuration of the wings 24a. As shown in Figure 14, the wings are essentially sectors of circles, substantially

65 semicircular when viewed in the axial

direction of the shank, radiating from the uppermost extremity of the cylindrical body, and are spaced circumferentially from one another by gaps 25. These gaps are opposing peripheral portions of the cylindrical shank, and lie generally along an axial plane which is perpendicular to the plane of the slot 32a. Thus, in accordance with the basic principles of the invention, the shank may be totally confined and embraced from the point 26a to the uppermost extremity as it is driven through the nosepiece of a power driving device.

Figure 14 shows how the nosepiece of such a device may be configured with a generally circular cross section and opposing longitudinal splines 41a adapted to be received in the gaps 25. The rivet 10a is thus confined from lateral expansion by the splines. The splines also accurately guide the rivet during its downward descent through the nosepiece.

It will be apparent that the tapered point may intersect the plane of the slot, as 26a shows, or it may be configured to taper toward the plane as shown in the dotted line configuration 26a, shown in Fig 13. A combination of tapers, or a conical point is also within the scope of the invention.

Figure 15 shows yet another embodiment of the invention wherein the rivet assembly 10b is constructed from flat sheet material, which is formed into blanks and then bent over upon itself along a line including the maximum transverse dimension. This procedure thus forms a rivet body 20b which has enlarged lateral wings 24b and a shank comprising two parallel portions, each having a sharp penetrating point 26b. The parallel portions are laterally separable from a plane containing the slot 32b. The portion of the axially extending recess 28b nearest the points 26b, will include inclined surfaces 30b, which co-operate with the pointed portion 16b of the drive pin 12b. The drive pin has a lateral dimension not exceeding twice the thickness of the material of the legs, plus the width of the slot, so as to permit confinement of the legs in a plane transverse to the plane of the slot.

In yet another embodiment, shown in Figures 16 and 17, it will be shown that the expandable element may be the drive pin rather than the rivet body. Assembly 10c shows such an embodiment, wherein the drive pin 12c is bifurcated by an axial slot 32c, to form two legs. The end of the slot 32c in the drive pin will be tapered outwardly to form surfaces 16c. The base of the recess 28c in the body part 20c of the rivet will be in the form of two surfaces 30c which form a knife edge to co-operate with the tapered end of the slot 32c in the drive pin in such a manner as to wedge the legs of the drive pin laterally away from the slot 32c after the

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drive pin and rivet body have proceeded through the workpieces. The rivet body will include laterally extending wings 24c forming the maximum dimension, while the thickness of the rivet body will form the minimum dimension and allow the laterally spreadable drive pin to be confined until the assembly has penetrated the workpiece and the wings 24c abut the top surface of the work-piece.

The ability of the fastener constructed in accordance with the invention to be confined by the side walls of a nosepiece chamber will allow the fastener to be driven with a minimum of driving force. It will be apparent that the impact force from a ram applied directly to a drive pin, in the present invention, will not be utilised to spread the rivet body until the final portion of the power stroke. The early stages of the power stroke may thus be sufficiently utilised to pierce the workpieces, since the rivet body is prevented from spreading until after the workpieces have been pierced.

Rivets of the type shown in Figures 1 to 14 may be made from plastics material, or may be of metal or metal alloys. Rivets of the types shown in Figures 15 to 17 are advantageously fabricated from metal or metal alloys. Metal fasteners of this type may be used to fasten metal sheets together, or to fasten plastics material.

WHAT WE CLAIM IS:—

1. A blind rivet assembly comprising a rivet body and a drive pin, the rivet body including a shank having a leading and a trailing end, the trailing end being formed with opposed laterally projecting wings, the shank being further formed with a recess extending axially from its trailing end to a point intermediate its length, the drive pin having an entering and a trailing end, and being received into the recess, the length of the pin being greater than the depth of the recess, the drive pin and rivet body including co-operating surfaces to transmit a driving force through the pin to the rivet body, and the pin and shank further including means by which a part of the assembly may be radially expanded on penetration of a workpiece by a continuation of the driving force.

2. A blind rivet assembly according to claim 1 in which the shank of the rivet body has a weakened section extending in an axial

plane substantially parallel to the directions of the opposed wings.

3. A blind rivet assembly according to claim 2, in which the drive pin has a conical end surface to co-operate with a conical surface at the base of the axial recess in the rivet body, the conical surfaces constituting the means by which the assembly is radially expanded.

4. A blind rivet assembly according to claim 2 or claim 3, in which the weakened section is a substantially or completely diametral slot in the shank, extending from the leading end of the shank to a point intermediate its length.

5. A blind rivet assembly according to any preceding claim in which the wings on the trailing end of the shank are substantially semicircular when viewed in a direction parallel to the axis of the shank.

6. A blind rivet assembly according to claim 2, in which the rivet body is formed from sheet material, the shank comprising two sharp pointed portions defining a longitudinal axial slot, the laterally projecting wings extending in the plane of the slot, the base of the recess being constituted by surfaces inclined to the axis of the shank, and the drive pin being formed at its end with surfaces to co-operate with the inclined surfaces at the end of the recess in such a way as to expand the shank portions radially after penetration of a workpiece.

7. A blind rivet assembly according to claim 1 in which the drive pin is bifurcated to form two legs by an axial slot extending away from the entering end of the pin, the slot being aligned in use with the laterally extending wings on the rivet body, and the base of the recess in the shank being formed with inclined surfaces adapted to expand the legs of the drive pin radially, the entering end of the pin being formed with inclined surfaces to co-operate with the surfaces at the base of the recess.

8. A blind rivet assembly substantially as described with reference to Figures 1 to 11, Figures 12 to 14, Figure 15, or Figures 16 and 17 of the accompanying drawings.

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drive pin and rivet body have proceeded through the workpieces. The rivet body will include laterally extending wings 24c forming the maximum dimension, while the thickness of the rivet body will form the minimum dimension and allow the laterally spreadable drive pin to be confined until the assembly has penetrated the workpiece and the wings 24c abut the top surface of the work-piece.

The ability of the fastener constructed in accordance with the invention to be confined by the side walls of a nosepiece chamber will allow the fastener to be driven with a minimum of driving force. It will be apparent that the impact force from a ram applied directly to a drive pin, in the present invention, will not be utilised to spread the rivet body until the final portion of the power stroke. The early stages of the power stroke may thus be sufficiently utilised to pierce the workpieces, since the rivet body is prevented from spreading until after the workpieces have been pierced.

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2. A blind rivet assembly according to claim 1 in which the shank of the rivet body has a weakened section extending in an axial

plane substantially parallel to the directions of the opposed wings.

3. A blind rivet assembly according to claim 2, in which the drive pin has a conical end surface to co-operate with a conical surface at the base of the axial recess in the rivet body, the conical surfaces constituting the means by which the assembly is radially expanded.

4. A blind rivet assembly according to claim 2 or claim 3, in which the weakened section is a substantially or completely diametral slot in the shank, extending from the leading end of the shank to a point intermediate its length.

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6. A blind rivet assembly according to claim 2, in which the rivet body is formed from sheet material, the shank comprising two sharp pointed portions defining a longitudinal axial slot, the laterally projecting wings extending in the plane of the slot, the base of the recess being constituted by surfaces inclined to the axis of the shank, and the drive pin being formed at its end with surfaces to co-operate with the inclined surfaces at the end of the recess in such a way as to expand the shank portions radially after penetration of a workpiece.

7. A blind rivet assembly according to claim 1 in which the drive pin is bifurcated to form two legs by an axial slot extending away from the entering end of the pin, the slot being aligned in use with the laterally extending wings on the rivet body, and the base of the recess in the shank being formed with inclined surfaces adapted to expand the legs of the drive pin radially, the entering end of the pin being formed with inclined surfaces to co-operate with the surfaces at the base of the recess.

8. A blind rivet assembly substantially as described with reference to Figures 1 to 11, Figures 12 to 14, Figure 15, or Figures 16 and 17 of the accompanying drawings.

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