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(19)

(54) PLATE SLOTTING MEANS

(71) We, AMPLIFORM PTY. LIMITED an Australian Company of Wilson Street, Royal Park, State of South Australia, Commonwealth of Australia, 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 means for the slotting of plates, plate-like aluminium extrusions or other workpieces preparatory to forming expanded metal products.

In the specification accompanying Jury & Spiers Australian Patent 434,936 there is described, with respect to Figs. 6 and 7, a method of slotting plates having flanges separated by ribs wherein the flanges were of sufficient strength to support the plate or member while it is being slotted. This arrangement enabled circular slotting tools to be used without the need to support the workpiece with a female die.

In a later British Patent 1,431,456, based on a former Australian application PA 9721, and standing in the name of predecessors in business of the present Applicant, there is shown in Figs. 2, 4, 5 and 6 an arrangement wherein a stripper plate is utilised to reduce the tendency of the workpiece to distort during and after slotting.

This invention is generally connected with further developments of the abovementioned features, but has as its main object the provision of improvements which will be effective to reduce the tearing of metal at the slot ends when the metal is slotted between slotting and back-up rollers usually termed "anvil" rollers.

When a product is formed by producing a series of slots in a plate and subsequently expanding the slotted plate by transversely moving its edge members away from one another, those portions of the plate which are adjacent the slot ends are the portions which are subject to the greatest stress and for this reason it is important that the ends of the slots be relatively smooth and rounded in shape. However if the workpiece is passed between a slotting roller and a back-up anvil roller having a peripheral speed which is, for example, the same as the pitch speed of the slotting rollers (that is, the linear speed of that portion of the slotting roller knife half way through the metal at a point on a line joining axes of rotation of the rollers) then there exists an initial interference between the end of the slotting roller projection and the slot which it forms as the projection enters the metal to form the slot, while the other end of the projection has a corresponding clearance. Clearly this is undesirable, and to overcome this problem proposals have been made to undercut one end of the projection. However this results in an overhung end which is fragile and liable to damage and generally unsuited for use in a production line.

An object of this invention is to provide improvements whereby the interference can be at least partly relieved, and this invention is characterised in that drive means are arranged to drive said anvil roller with a peripheral speed which exceeds the pitch cutting speed of the slotting roller knives.

This invention consists of plate slotting means for the cutting of slots having parallel side walls and curved end walls in a workpiece which is thereby made suitable for expansion into an expanded metal product, comprising a slotting roller having slotting knives thereon, each slotting knife being a plate-like member having at least one circumferential projection extending part way around its periphery and terminating in faces which are curved convexly about respective axes which are parallel to but spaced from a diametral plane of the roller, an anvil roller having a periphery which bears against and supports the workpiece as the slotting roller knives penetrate the workpiece, drive means coupled to the slotting roller and drive means coupled to the anvil roller, characterised in that said drive means are arranged to drive said anvil roller with a peripheral speed which exceeds the pitch cutting speed of the slotting roller knives.

We have found that if the back-up or anvil roller is driven faster than the slotting roller pitch speed, the workpiece is urged away from the entry end of the projection as a slot is

formed and thus the interference which would otherwise occur does not occur, while by careful adjustment (best found by trial and error) of the relative speeds, interference with the trailing end of the circumferential projection can still be avoided, thus achieving rounded slot ends which are smooth and which do not have excessive burrs.

We have further found that the relative speeds of the slotting roller and back-up roller are capable of varying slot length, and if a consistent product is to be produced it is desirable that the speed relationship remains the same for different rates of production, and in some instances the drive means is a fixed ratio drive means which cannot be varied other than by replacement of parts (for example anvil roller diameter).

While the invention may be utilised with a workpiece of such configuration that the slotting knives of the slotting roller can pass between workpiece flanges, and underlying workpiece flanges can serve as back-up means for the formation of slots in the workpiece, such conditions are not always convenient in a product design. In some instances the anvil roller comprises an assembly of plates of circular shape in the form of radially outstanding flanges interposed between the circumferential projections of the slotting roller knives.

When slugs are removed from a workpiece in the formation of slots, there is a tendency for the workpiece to become distorted in shape. As said, the specification which accompanied British Patent 1,431,456 described a stripper plate, the plate being carried between the slotting rollers. The effect of the ejector plate is to support the workpiece during and immediately after removal of the slugs, but contrary to expectation we have found that the configuration of the stripper or ejector plate is of importance in the efficient functioning of the invention. A great deal of friction develops between that portion of the surface of the stripper or ejector plate engaged by the workpiece and the workpiece itself, and in some instances the radius of the curvature of the stripper or ejector plate diminshes in an upstream direction so that there is a self "relief" effect should there be slight rotation of the stripper plate.

Two embodiments of the invention are described hereunder in some detail with reference to and are illustrated in the accompanying drawings, in which:

Fig. 1 is a partly sectioned end elevation of a plate slotting machine,

Fig. 2 is a part elevation drawn to a larger scale showing the rollers,

Fig. 3 is a cross-section through an anvil roller and its drive shaft,

Fig. 4 is a fragmentary perspective view of a slotting roller,

Fig. 5 is a section through the slotting roller of Fig. 4,

Fig. 6 is a part-section through an anvil roller according to a second embodiment, and

Fig. 7 is an elevation of a stripper plate according to each embodiment.

In the first embodiment a machine 10 for the slotting of plates (which term includes extruded or rolled members having flanges with webs therebetween) comprises a roll case (not shown) for feeding a workpiece from an input end to a slotting station and a chute 12 extending beyond the output end of the slotting station 11.

At the slotting station there are provided two sets of bearings, the lower set of bearings designated 14 supporting a lower shaft 15 for rotation and the upper set of bearings 16 supporting an upper shaft 17 for rotation. The upper set of bearings 16 is shown as vertically above, but may be set slightly rearwardly of the lower set of bearings 14, and is adjustable for height by means of packers 19 between upper and lower frames 20 and 21. Its longitudinal position is adjustable, the clamping bolts 22 being in slots in the upper frame 20.

As shown in detail in Fig. 3, the upper shaft 17 is both slidable and rotational in its bearings 16. Its axial position can be accurately adjusted by adjusting sleeves 26 with adjusting screws 27 which bear against flange members 28, themselves constrained against axial movement by thrust bearings 29. The sleeves 26 abut shoulders at respective ends of a boss 30 which is intermediate the ends of shaft 17. A driven sprocket 31 is keyed to shaft 17 at one end.

The upper shaft 17 carries on it a cylindrical back-up, or anvil, roller 24, while the lower shaft 15 carries on it a series of circular slotting knives 35. The slotting knives 35 form portions of the slotting roller 36, each slotting knife 35 being a plate-like member having at least one circumferential projection 37 (Fig. 5), terminating in faces 38 which are curved about respective axes which are parallel to but spaced from a diametral plane of the roller (in such a way that any two adjacent faces are parallel to one another). The knives are assembled onto the lower shaft 15, and are separated by circular spacers 39. The peripheries of projections 37 are serrated.

A plurailty of stripper plates 44 (Fig. 7) are interposed between the adjacent knives 35, each stripper plate having an aperture 45 of diameter which is greater than but only slightly greater than the spacer ring 39 about which it is positioned. A maximum of 0.030" clearance is considered desirable, but the rings must be freely running within the stripper plates, and therefore a minimum clearance of 0.005" is provided between the aperture 45 of each stripper plate 44 and the ring 39

around which it is disposed.

The forward or input end 46 of each ejector plate 44 is curved, the radius of curvature R2 exceeding radius R1, that is, being greatest at the tangential point where the ejector plate is engaged by the oncoming workpiece. The radius diminshes towards the input end from R2 so that there is a self freeing effect between the ejector plate and the workpiece as the workpiece passes between the rollers. The upper edge of each plate 44 (except one end plate) is thicker than the remainder of the plate as shown in Fig. 4, at its output end. Rotation of the ejector plate however is restricted by means of a block 47 (Fig. 2) carried in a sump 48 on the machine lower frame 21, the block 47 being for example a block of hard wood and being beneath the ejector plate such that rotation of the ejector plate due to frictional engagement with the workpiece is inhibited by the block. The sump 48 contains lubricant.

Separate drive means are coupled to the upper and lower shafts 17 and 15, each being a chain drive respectively designated 50 and 51 from respective motors 52 and 53. It might be noted that the motor 52 for the anvil roller 24 is larger than the motor 53 for the slotting roller 36, but more power is not required for the former. Between chain 51 and motor 53 there is interposed an infinitely variable transmission (a "Reeves Drive") 54 so that the pitch speed of the slotting roller 36 can be accurately fixed, to be slightly greater than the peripheral speed of anvil roller 24. Alternatively, the required speeds can be ascertained by trial and error, and then fixed by anvil diameter. Clearly, a single motor with two drives to respective rollers can be used. Speed differential of the rollers achieves a relief on the inward cut of the projecting end of a slotting roller knife, but the relief need not be so much as to cause the trailing end to interfere with the other slot end.

The workpiece for use with the embodiment described in Figs. 1 to 5 and Fig. 7, is of such configuration that back-up plates on the anvil roller are not necessary. This will be the case where the workpiece is an extended workpiece formed with flanges which are relatively strong and are capable of withstanding the shearing loads applied to the workpiece. However in certain cases the workpiece flanges must be supported separately, and this is achieved by having spaced circular plates designated 58 in Fig. 6, which illustrates a second embodiment. The peripheries of the plates 58 are spaced apart, and annular spaces designated 59 accommodate the circumferential projections 37 on the slotting roller 36. The plates 58 also have a secondary set of annular spaces designated 60 which accommodate fins 61 of a workpiece 62, which are not in themselves strong enough to withstand the pressure of slotting roller 36.

A brief consideration of the above embodiments will indicate that the invention provides considerable improvements over the prior art. By use of this invention it is possible to have a satisfactory machine which is very much lower in cost than that contemplated in our previous British Patent Specification 1,431,456. High production rates are also readily achievable, and as can be seen from the two embodiments, in this invention it is possible to slot plate-like members having a wide range of cross-sectional configurations.

The peripheral speed of the anvil roller in most instances should be about 5% to 10% greater than the pitch cutting speed of the slotting roller knives. It is desirable that the pitch diameter of the cutting knives should not exceed 250 mm, and that the workpiece should be supported as shown in Fig. 2 before it enters slotting station 11, to limit bending stresses on, and wave formation in the workpiece.

WHAT WE CLAIM IS:—

1. A plate slotting means for the cutting of slots having parallel side walls and curved end walls in a workpiece which is thereby made suitable for expansion into an expanded metal product, comprising

a slotting roller having slotting knives thereon, each slotting knife being a plate-like member having at least one circumferential projection extending part way around its periphery and terminating in faces which are curved convexly about respective axes which are parallel to but spaced from a diametral plane of the roller.

an anvil roller having a periphery which bears against and supports the workpiece as the slotting roller knives penetrate the workpiece,

drive means coupled to the slotting roller and drive means coupled to the anvil roller,

characterised in that said drive means are arranged to drive said anvil roller with a peripheral speed which exceeds the pitch cutting speed of the slotting roller knives.

2. Plate slotting means according to claim 1, further characterised in that said drive means comprises an infinitely variable transmission interposed between an electric motor and one of the rollers.

3. Plate slotting means according to either claim 1 or claim 2 further characterised in that said slotting roller comprises a plurality of circular spacers interposed between respective adjacent pairs of slotting knives, and a series of stripper plates each positioned about a respective said spacer, each stripper plate having an aperture within which its said spacer is rotatable, and having a leading edge which is curved with respect to its aperture centre to have a radius of curvature which diminishes towards the input end of the stripper plate.

4. Plate slotting means according to claim

around which it is disposed.

The forward or input end 46 of each ejector plate 44 is curved, the radius of curvature R2 exceeding radius R1, that is, being greatest at the tangential point where the ejector plate is engaged by the oncoming workpiece. The radius diminshes towards the input end from R2 so that there is a self freeing effect between the ejector plate and the workpiece as the workpiece passes between the rollers. The upper edge of each plate 44 (except one end plate) is thicker than the remainder of the plate as shown in Fig. 4, at its output end. Rotation of the ejector plate however is restricted by means of a block 47 (Fig. 2) carried in a sump 48 on the machine lower frame 21, the block 47 being for example a block of hard wood and being beneath the ejector plate such that rotation of the ejector plate due to frictional engagement with the workpiece is inhibited by the block. The sump 48 contains lubricant.

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The workpiece for use with the embodiment described in Figs. 1 to 5 and Fig. 7, is of such configuration that back-up plates on the anvil roller are not necessary. This will be the case where the workpiece is an extended workpiece formed with flanges which are relatively strong and are capable of withstanding the shearing loads applied to the workpiece. However in certain cases the workpiece flanges must be supported separately, and this is achieved by having spaced circular plates designated 58 in Fig. 6, which illustrates a second embodiment. The peripheries of the plates 58 are spaced apart, and annular spaces designated 59 accommodate the circumferential projections 37 on the slotting roller 36. The plates 58 also have a secondary set of annular spaces designated 60 which accommodate fins 61 of a workpiece 62, which are not in themselves strong enough to withstand the pressure of slotting roller 36.

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The peripheral speed of the anvil roller in most instances should be about 5% to 10% greater than the pitch cutting speed of the slotting roller knives. It is desirable that the pitch diameter of the cutting knives should not exceed 250 mm, and that the workpiece should be supported as shown in Fig. 2 before it enters slotting station 11, to limit bending stresses on, and wave formation in the workpiece.

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1. A plate slotting means for the cutting of slots having parallel side walls and curved end walls in a workpiece which is thereby made suitable for expansion into an expanded metal product, comprising

a slotting roller having slotting knives thereon, each slotting knife being a plate-like member having at least one circumferential projection extending part way around its periphery and terminating in faces which are curved convexly about respective axes which are parallel to but spaced from a diametral plane of the roller.

an anvil roller having a periphery which bears against and supports the workpiece as the slotting roller knives penetrate the workpiece,

drive means coupled to the slotting roller and drive means coupled to the anvil roller,

characterised in that said drive means are arranged to drive said anvil roller with a peripheral speed which exceeds the pitch cutting speed of the slotting roller knives.

2. Plate slotting means according to claim 1, further characterised in that said drive means comprises an infinitely variable transmission interposed between an electric motor and one of the rollers.

3. Plate slotting means according to either claim 1 or claim 2 further characterised in that said slotting roller comprises a plurality of circular spacers interposed between respective adjacent pairs of slotting knives, and a series of stripper plates each positioned about a respective said spacer, each stripper plate having an aperture within which its said spacer is rotatable, and having a leading edge which is curved with respect to its aperture centre to have a radius of curvature which diminishes towards the input end of the stripper plate.

4. Plate slotting means according to claim

3 further characterised in that some at least of the ejector plates have their upper edges at the output end thicker than the remainder of the plates.

5. Plate slotting means according to either claim 3 or claim 4 further characterised by a sump surrounding the lower portions of the ejector plates and slotting roller, and containing a block engaged by the lower edges of the ejector plates thereby limiting rotation of the ejector plates.

6. Plate slotting means according to any preceding claim further characterised in that said anvil roller is carried on a upper shaft journalled in bearings in an upper frame, said slotting roller is carried on a lower shaft journalled in bearings in a lower frame, and packers interposed between the frames comprise adjustment means therebetween.

7. Plate slotting means according to claim 6 further characterised by bolts extending between the frames securing them together, said bolts extending through slots in one of the frames thereby providing adjustment means for relative positions of the frames.

8. Plate slotting means according to either claim 6 or claim 7 further characterised by adjustment means between at least one of said shafts and the bearings in which it is journalled, said adjustment means being operable to adjust the axial position of that shaft.

9. Plate slotting means substantially according to the embodiment described in the specification with reference to and as illustrated in Figs. 1, 2, 3, 4, 5, and 7 of the accompanying drawings.

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