Feb. 24, 1948. H. V. DETTMAN 2,436,383

METHOD AND APPARATUS FOR BENDING SHEET MATERIAL

Filed May 27, 1946 2 Sheets-Sheet 1

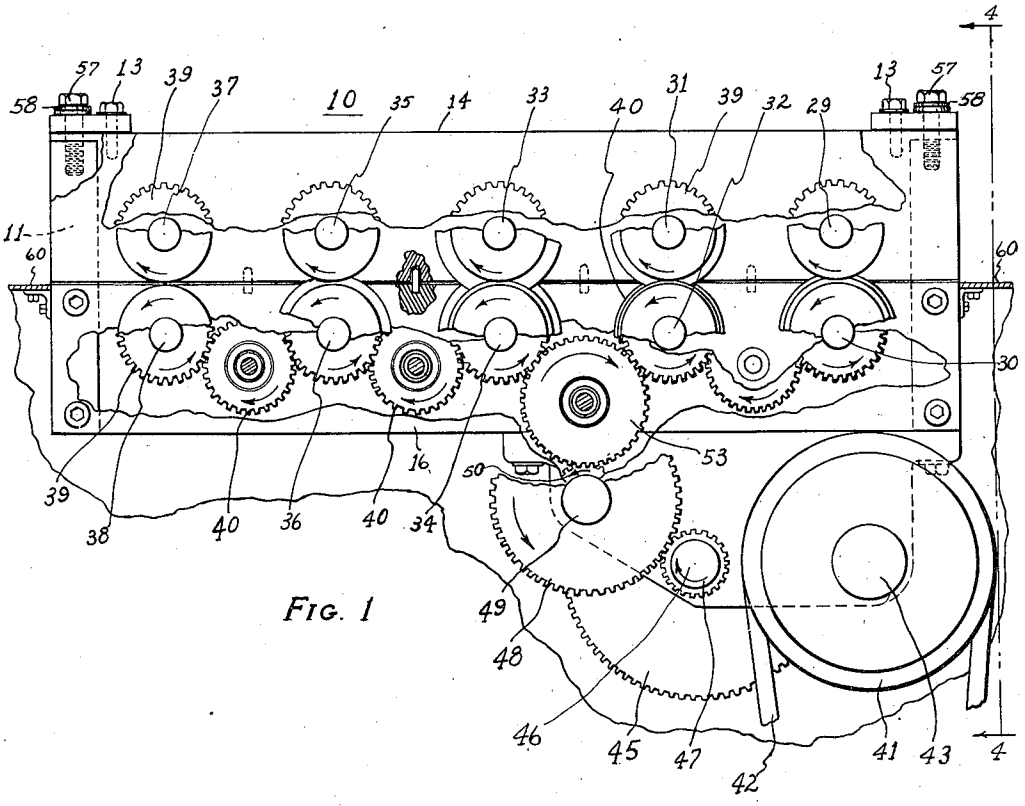

FIG. 1

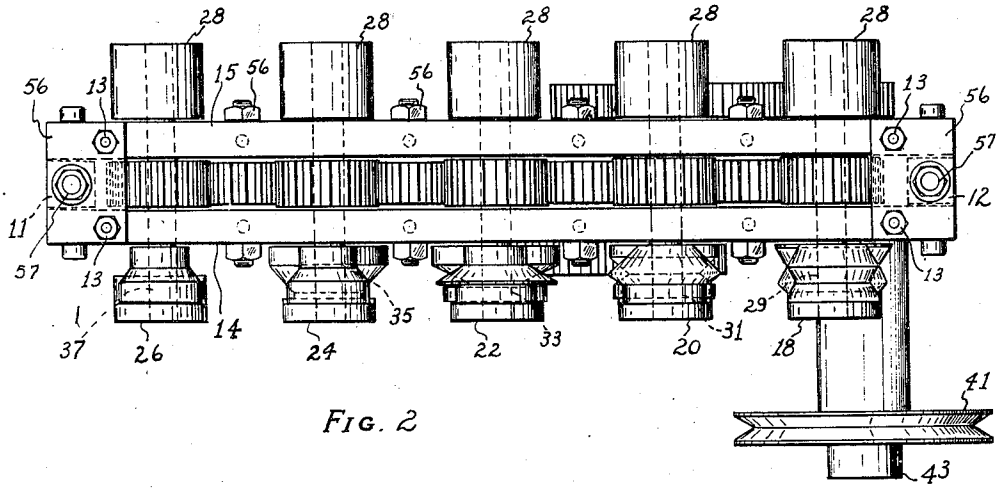

FIG. 2

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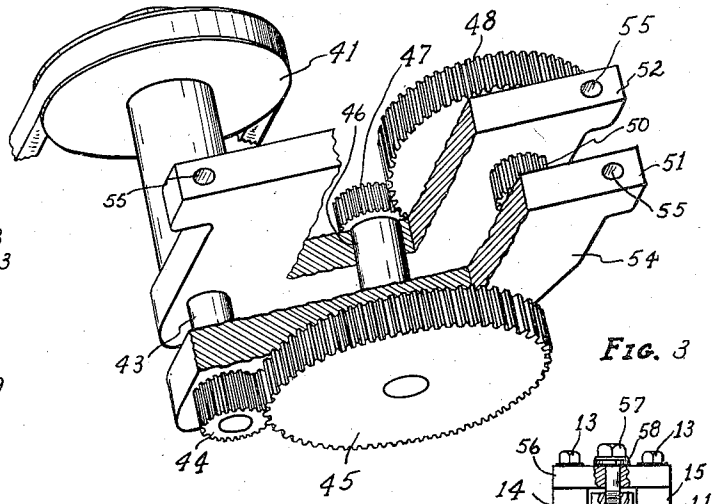

FIG. 3

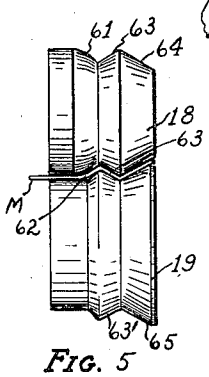

FIG. 5

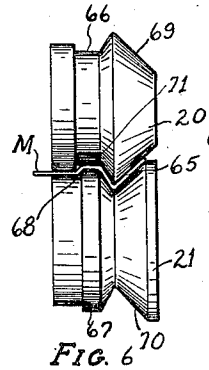

FIG. 6

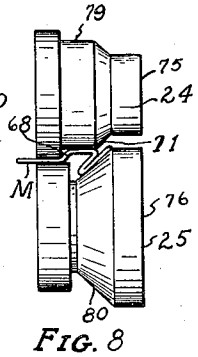

FIG. 8

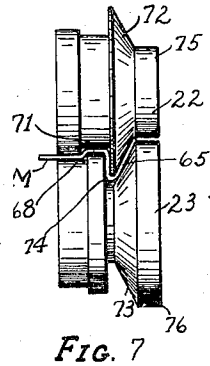

FIG. 7

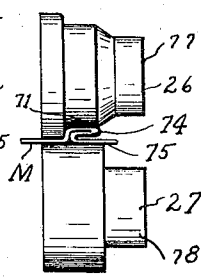

FIG. 9

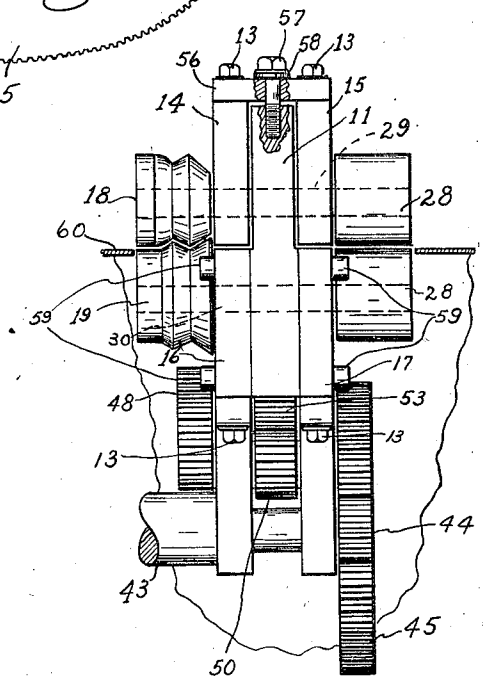

FIG. 4

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UNITED STATES PATENT OFFICE

2,436,383

METHOD AND APPARATUS FOR BENDING SHEET MATERIAL

Harold V. Dettman, Chicago, Ill.

Application May 27, 1946, Serial No. 672,366

2 Claims. (Cl. 153—28)

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This invention relates to a method and apparatus for bending sheet metal to form a seam or fold therein and particularly relates to a method and machine for forming a fold which is known in the trade as a "Pittsburgh lock."

It is an object of this invention to provide an improved sequence of steps in the making of the fold which is more economical and results in a better fold or "Pittsburgh lock."

It is a further object of my invention to provide an improved machine for operating the forming rolls in which there is no tilting action in the frame holding the rolls when a sheet of metal is inserted between the forming rolls. By my construction the shaft about which the opposing forming rolls rotate are always maintained in parallel alignment which eliminates the pinching of the metal sheet during forming as commonly occurs in machines of this general character now on the market.

It is also an object of this invention to provide a novel arrangement of the driving gears which operate the forming rolls in the support or frame.

Other objects, advantages and uses of my method and machine will become more apparent by referring to the drawings in which

Figure 1 is a side elevation of the machine with a portion cut away in order to illustrate the gearing mechanism.

Figure 2 is a plane view of my apparatus.

Figure 3 is a perspective view partially in section of the end view of my machine which is shown in Figure 4.

Figure 4 is the end view of the machine along the lines 4—4 of Figure 1.

Figures 5, 6, 7, 8 and 9 illustrate the forming rolls in the sequence of steps used for forming a fold from sheet metal and these forming rolls are also shown in Figure 2.

Referring to the drawings, a frame 10 is provided having a pair of central plate sections 11 and 12 to which are bolted by means of bolts 13 outer upper plates 14 and 15 and lower outer plates 16 and 17. The first pair of opposing forming rolls 18 and 19 are keyed to shafts 29 and 30 respectively. The shafts 37 and 38 are journalled in the outer plates 14 and 16. In a similar manner the remaining pairs of forming rolls are arranged as follows: rolls 21 and 22 are keyed to shafts 31 and 32 respectively, rolls 22 and 23 are keyed to shafts 33 and 34 respectively, rolls 24 and 25 are keyed to shafts 35 and 36 respectively, rolls 26 and 27 are keyed to shafts 37 and 38 respectively, all of said shafts being journalled in the outer plates 14 and 16.

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On the opposite side of frame 10 from the forming rolls shown in Figures 5 to 9 inclusive, are provided additional forming rolls 28 which may be of the same design and character as those shown in Figures 5 to 9, or may be a different shape and character in order to form bending operations different than those which are made by the forming rolls shown in Figures 5 to 9.

Opposing gears 39 are keyed to each of the shafts 29 to 38 inclusive. Idler gears 40 are provided which mesh with the lower gears 39 as shown. This train of gears are driven as follows: A pulley 41 keyed to shaft 43 is provided and by means of the pulley belt 42 attached to a suitable motor or other means, the driving power is furnished for my apparatus. The chain of gears between the pulley 41 and gears 39 are best shown in Figures 3 and 4. A small pinion gear 44 is keyed to the shaft 43 on the opposite end from the pulley wheel 41. The gear 44 meshes with the larger gear 45 which is keyed to the shaft 46 and on the end of the shaft 46 opposite the gear 45 is provided another small pinion gear 47. The gear 47 meshes with the gear 48 which is keyed to the shaft 49. The large gear 48 and the small gear 50 in between the plates 51 and 52 are both keyed to the common shaft 49. The small pinion gear 50 meshes with the large idler gear 53 which meshes with the pair of the gears 39 which are keyed to the shafts 32 and 34. Thus gears 44, 45, 47, 48, 50 and 53 provide a speed reducing unit which in effect steps up the power required for driving the forming rolls. These latter gears are all in the gear box 54 which is bolted onto the lower pair of plates 16 and 17 by means of the bolts 13 as shown in Figure 4. The bolt holes 55 for the bolts 13 are best shown in Figure 3.

Referring particularly to Figures 2 and 4, the bolts bolt the side plates 14 and 15 and also the side plates 16 and 17.

The preventing of tilting of the shafts on which the opposing forming rolls are attached is accomplished in the following manner. The side plates 14 and 15 are bolted to a pair of top plates 56, one at each end of the frame 10, by means of the bolts 13. The top plates 56 are also bolted to the central plate 11 by means of the bolts 57. A leather washer 58 is provided which provides sufficient resiliency that when the metal from which a bend or fold is to be made is inserted between the forming rolls 18 and 19 for example, that only an upward thrust by the shafts 29 occurs and the plates 14 and 15 raise somewhat, permitting the metal to pass through the form-

ing rolls 18 and 19 while still maintaining the shafts 29 and 30 as well as the other shafts to which the forming rolls are keyed in parallel alignment. The bolt 57 also provides a means for taking care of variations in the thickness of the material to be bent or folded.

It should be noted that the upper plates 14 and 15 are not tightly drawn against the central plate 11 but are free to move in a vertical direction in order to permit the shafts to which the forming rolls are attached to stay in parallel alignment. The lower plates 16 and 17 are firmly drawn up against the central plate 11 by means of bolts 59.

Referring to Figure 4, a portion of the table top 60 is shown which provides the support for guiding the sheet of metal between the forming rolls. It is also shown in Figure 1.

The "Pittsburgh lock" is shown formed in Figure 9. The forming of the "Pittsburgh lock" by my device, is accomplished in the following manner. Referring to Figures 5 to 9 inclusive, a sheet of metal M is guided through the first pair of forming rolls 18 and 19. It should be noted that the section 61 of the forming roll 18 assisted by the corresponding portion of the lower roll 19 is curved inwardly and upwardly at an angle of about 45° which bends the metal M upwardly in a gradual curve equivalent to an angle of about 45°. This gradual curve is shown by the numeral 62. Simultaneously section 63 and section 64 of roll 18 together with the corresponding opposing sections 64 and 65 of roll 19 form a V 63 in the metal adjacent the curved portion 62. The purpose of forming the gradual curve 62 in the first step of the operation is to remove some of the stretch in the metal which is encountered either in the forming operation occurring in the first roll or in subsequent forming operations when the offset 68 (shown in Fig. 6) is formed as hereinafter described. It is not desirable to form the offset 68 in the first operation. If the offset is formed in the first operation and a V-bend formed simultaneously, it tends to buckle the metal and stretch it along the edge of the sheet. If no provision is made in the first forming operation to take care of the stretching of the metal when the offset 68 is formed, buckling may occur and frequently such a procedure in the forming of the offset stretches the metal to the point that it tears in one of the folds. Therefore by providing the rounded upward curve 62 in the first operation, I have insured a uniform forming of the offset by the second pair of rolls without endangering the tearing of the metal sheet and also the offset is formed in each operation at a uniform height.

Furthermore I have found that an edge of a sheet of metal when curved upward to about an angle of 45°, as is the curve 62 with a sharp V-bend adjacent thereto, that the upward curve 62 together with the V-bend 63 will act as a guide in guiding the metal through subsequent forming operation in a much straighter line which insures the formation of a uniform fold and also insures that all the "Pittsburgh locks" so formed by my device are uniform in size and shape. Furthermore the upward curve 62 and the V 63 climinates the tendency for the sheet to "crawl" or run out from the rolls during the formation operations and results in the formation of a much truer fold.

The metal leaves forming rolls 18 and 19 and next passes through the forming rolls 20 and 21 wherein section 66 of roll 20 and section 67 of roll 21 which forms an offset 68 which is an offset greater than 45° but less than 90°. Furthermore

the opposing sections 69 and 70 of the rolls 20 and 21 respectively deepen the V-section 65 and in addition the opposing sections 66 and 67 of the rolls flatten out the portion adjacent the offset 68 into a relative flat section 71 in between offset 68 and deepened V-section 65. In this second step the curvature is taken out of the 45° bend and in its place is formed an offset and at the same time the V-section 65 is deepened.

The formation of the offset is made by these rolls without any buckling or turning of the metal because of the formation of the curved section 62 in the first set of forming rolls. The formation of the offset made in the second step in passing through the forming rolls 20 and 21 tends to force the sheet being folded against the usual guide provided (but not shown) and eliminates all possibilities of the sheet "running out" of the rolls during the formation of the bend.

In a third set of rolls shown in Figure 7, the offset 68 is maintained as well as a flat section 71. Furthermore the V-section 65 of the Figure 6 is further deepened by the opposing sections 72 and 73 of the rolls 22 and 23 respectively and at the same time a right angle section 74 is formed adjacent the flat section 71. Sections 75 and 76 of the rolls 22 and 23 respectively merely are "filler sections" to line up the rolls 22 and 23 with the other forming rolls and have no function in the formation of the bend in the metal.

The same is true of "filler sections" 75 and 76 of rolls 24 and 25 respectively and sections 77 and 78 of rolls 26 and 27 respectively.

In the third step of the operation one leg of the V 65 is now in a vertical position and the other leg is at an angle of approximately 30° from the vertical end of the V and is now in position to be folded in under the offset which is accomplished in the forming rolls 24 and 25 as shown in Figure 8. The opposing sections 79 and 80 of the rolls 24 and 25 respectively compress the V section 65 and fold it back under the flat section 71 at an angle of about 45° relative to the flat section 71.

The fourth set of forming rolls 24 and 25 begins the folding under process and closes the V 65 so that the two legs of the V bend are flat and parallel to each other.

The fifth set of forming rolls 26 and 27 complete the operation. In this step the V-bend 65 is flattened and both sides of the V are now parallel with the horizontal section 71 and the section 74 urged tightly against each other and the leg 75 is spaced from 74 in the manner shown in Figure 2 thereby providing the "Pittsburgh lock." In this last operation the V-bend 65 is flattened into place inside the offset thereby completing the lock.

I claim as my invention:

1. In the formation of a sheet metal joint commonly called a "Pittsburgh lock," the method comprising the steps of first forming a slow bending curve bending inwardly toward said metal and at an angle of about 45° with said metal and simultaneously forming a V bend adjacent to said curve, secondly forming an offset from said curve in said metal, said offset being less than 90° but more than 45° while simultaneously forming a flat section adjacent the offset parallel to but in a different plane than the main body of the metal and simultaneously deepening the V bend formed in the first step and thereafter completing the joint by folding the V bend underneath said flat section into parallel alignment with the main body of the metal and said flat portion, the off-

set formed in the second step being maintained throughout the subsequent operations.

2. In a sheet metal forming machine for producing a sheet metal joint commonly called a "Pittsburgh lock," an initially contacted pair of forming rolls for producing in said metal a slow bending curve bending inwardly toward said metal at an angle of about 45° with said metal while simultaneously producing a V-bend adjacent to said curve, a second pair of forming rolls for producing an offset from said curve in said metal, said offset being produced at an angle less than 90° but more than 45° while simultaneously producing a flat section adjacent the offset parallel to but in a different plane than the main body of said metal, while simultaneously deepening the V-bend formed in the first step and a plurality of subsequent forming rolls providing means for thereafter completing the joint by folding the V-bend underneath said flat

section into parallel alignment with the main body of the metal and said flat section, the said offset formed in the second step being maintained by the subsequent forming rolls throughous the subsequent forming operations.

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