United States Patent

Halling et al.

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[54] METAL SPINNING MACHINE

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[52] **U.S. Cl.** .....**113/1 E**, 113/23 E, 113/30

[51] **Int. Cl.**.....**B21d 51/32**

[58] **Field of Search** .....113/1 E, 30, 31, 23 R, 23 A, 113/23 B, 23 C, 23 D, 23 E, 23 F, 19, 20, 21, 22; 29/243, 52

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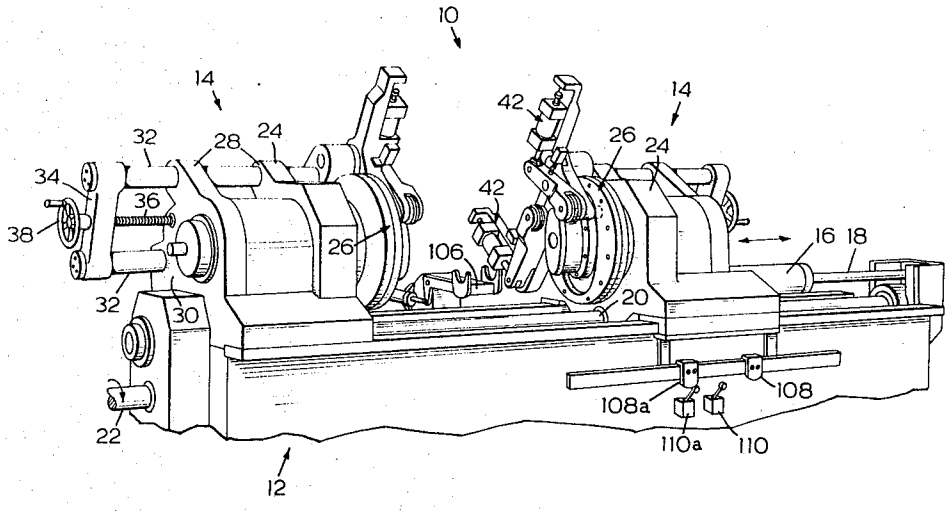
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[57] **ABSTRACT**

A metal spinning mechanism mountable on the bed of a spinning machine and operable for securing end caps to muffler cans and the like. The machine consists of a frame which forms a bed and a pair of rotatably driven head assemblies mounted on the bed. One of the head assemblies is slidably mounted on the bed so as to be moved towards and away from the other assembly. Each of the head assemblies includes a cam track extending in a predetermined path about the longitudinal axis of the head assembly and a pair of cam follower arms pivotally mounted on the housing. A first forming arm is pivotally mounted on one of the follower arms and a second follower arms is pivotally mounted on the second follower arm. Hydraulic drive means is provided for driving each of the forming arms towards the longitudinal axis of the spinning head so as to sequentially form the spinning metal to the required contour in use.

8 Claims, 8 Drawing Figures



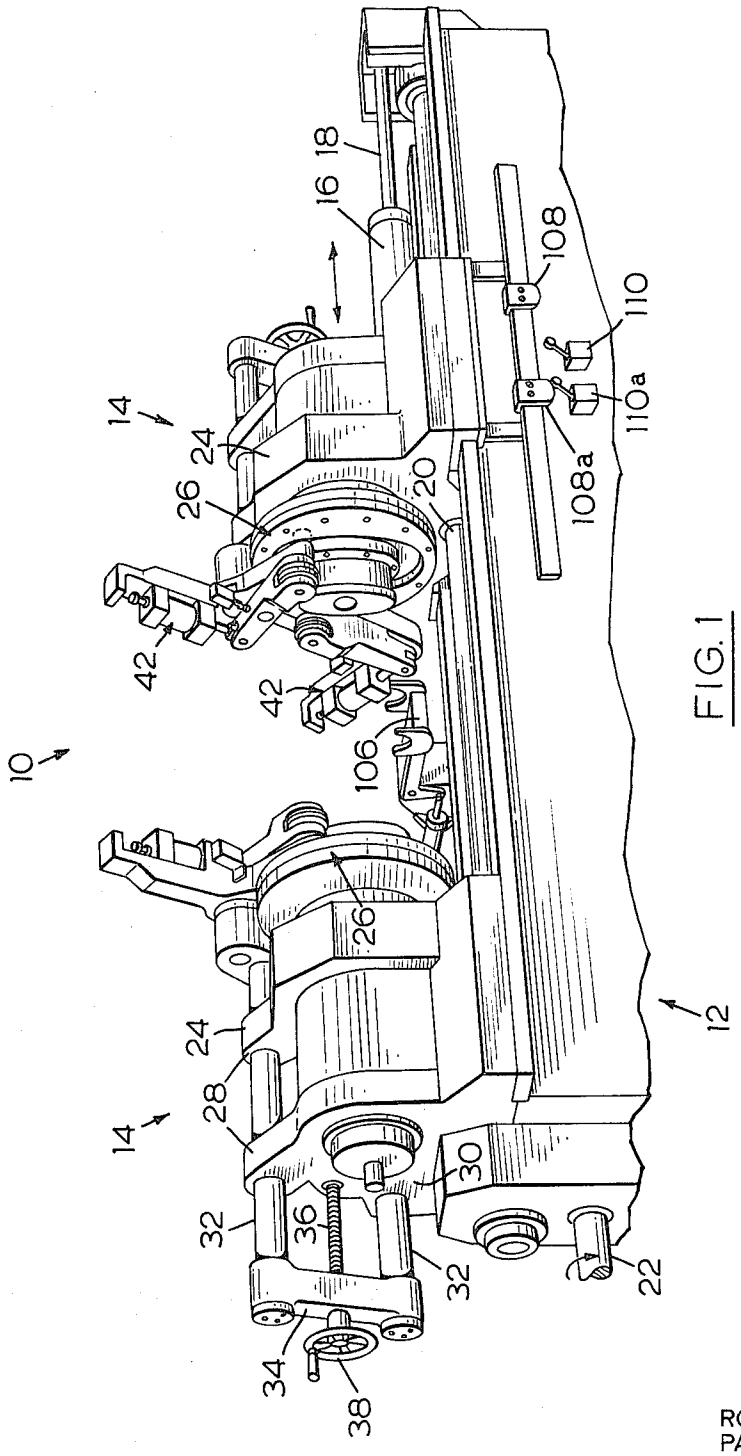


FIG. 1

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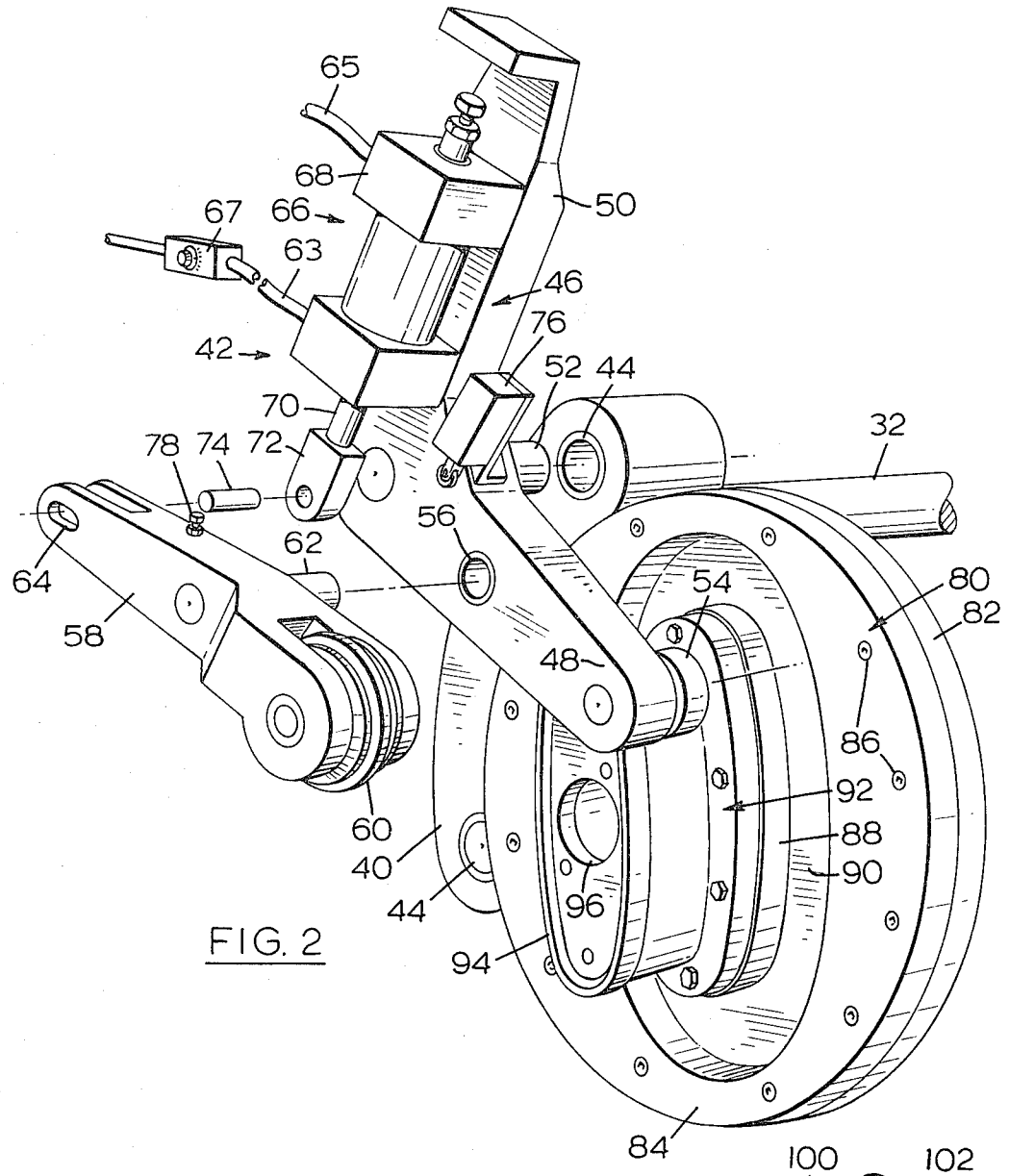


FIG. 2

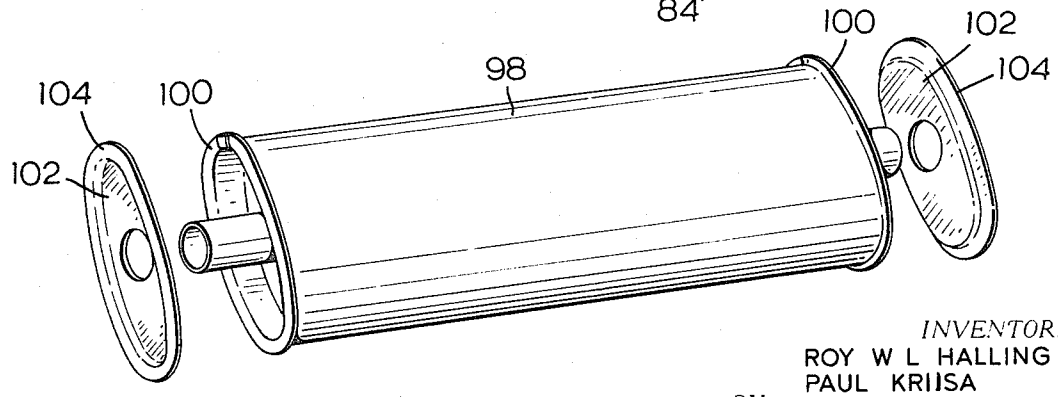


FIG. 3

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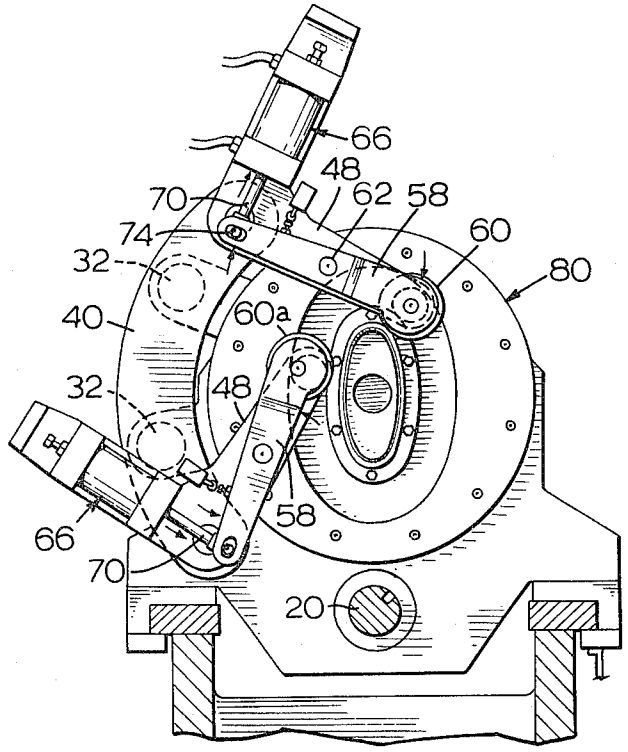


FIG. 4

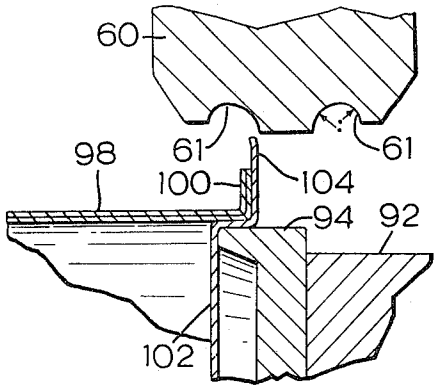


FIG. 5

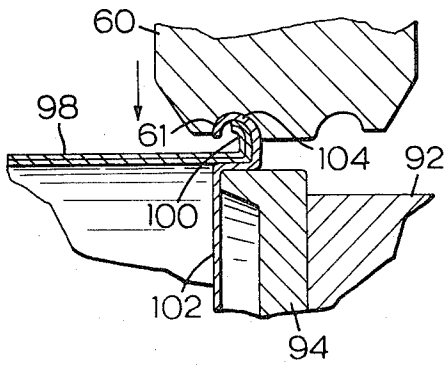


FIG. 6

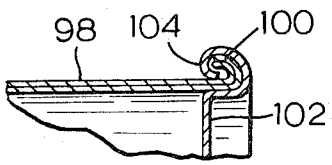


FIG. 7

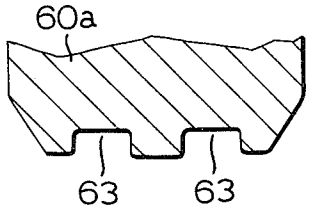
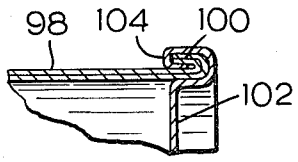


FIG. 8



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METAL SPINNING MACHINE

1. Field of Invention

This invention relates to metal spinning machines. In particular, this invention relates to metal spinning machines of the type which are used to secure end caps to muffler cans and the like.

2. Prior Art

Metal spinning machines of the type used for securing end caps to muffler cans and the like have previously employed complicated cam guided mechanisms for moving the forming roller relative to the muffler can as it is rotated so as to form the joint required between the muffler can and its end caps. The machines which are commonly used employ one forming roller at each rotating head. Each machine includes two rotating heads and, in use, the muffler can and the ends which are to be secured are mounted between the heads, the heads are rotated and the forming roller is moved towards the heads so as to form the joint between the end caps and muffler cap. The heads are in the form of face plates which are rotatably driven at the inner end of each housing. In the known mechanisms, the movement of the forming roller relative to the follower arm is achieved by a complex cam actuated mechanism which includes a cam track located at the outer end of each housing. This mechanism requires the drive to be transmitted from the outer end of the housing to the inner end of the housing so as to move the forming roller to and fro as required in use.

SUMMARY

The present invention provides a much simpler mechanism for guiding the movement of the forming roller and it provides two forming rollers so as to achieve a more satisfactory seal between the components which are connected by the spinning operation. The total number of moving parts has been considerably reduced in the structure of the present invention with the result that the maintenance costs have been reduced and the reliability of the mechanism has been improved.

According to an embodiment of the present invention, a metal spinning mechanism which is adapted to be mounted on a frame and operable for securing end caps to muffler cans and the like comprises, a housing which is adapted to be mounted on said frame and a rotatably driven head assembly mounted in said housing for rotation about a longitudinal axis. The head assembly includes cam track means extending in a predetermined path about the longitudinal axis and at least one follower arm pivotably mounted at one end on the housing and having a cam follower at the other end mounted in the cam track such that when the cam track is rotated, the follower arm may be caused to pivot relative to the housing. The head assembly also includes a forming arm pivotably mounted intermediate the ends thereof on the follower arm. The follower arm has a forming roller rotatably mounted at the inner end thereof to cooperate with the forming head in use. The head assembly further includes hydraulic drive means having one end secured to the follower arm and the other end secured to the other end of the forming arm. The hydraulic drive means is operable to move the forming arm relative to the follower arm so as to move the forming roller in a direction towards or away from the longitudinal axis in use.

According to a further embodiment of the present invention, the spinning mechanism includes a second follower arm pivotally mounted relative to the housing and a second forming arm pivotally mounted intermediate the ends thereof on the follower arm. A second hydraulic drive means is also provided for moving the said forming arm relative to the follower arm to move a second forming roller which is secured to the forming arm towards or away from the longitudinal axis as required in use.

According to a still further embodiment of this invention, the metal spinning machine includes a frame and a pair of spinning mechanisms described above.

PREFERRED EMBODIMENT

The invention will be more clearly understood after reference to the following detailed specification read in conjunction with the drawings, wherein

FIG. 1 is a pictorial front view of a spinning machine according to an embodiment of the present invention;

FIG. 2 is an exploded detailed view of a forming head showing one forming roller assembly;

FIG. 3 is a pictorial view of a muffler can and end caps of the type which are mounted by means of the spinning machine of the present invention;

FIG. 4 is an end view of the spinning head according to the present invention;

FIG. 5 is a partially cross-sectional view illustrating the first step in the spinning operation;

FIG. 6 is a cross-sectional view similar to FIG. 5 illustrating a second step in the forming operation;

FIG. 7 is a cross-sectional view illustrating the form of the joint on completion of the first forming operation; and

FIG. 8 is a cross-sectional view of a portion of the final forming roller and a portion of the joint made thereby in the final forming operation.

With reference to the drawings, the reference numeral **10** refers generally to a metal spinning machine according to an embodiment of the present invention. The machine includes a bed or frame **12** upon which a pair of spinning mechanisms **14** are mounted. One of the mechanisms **14** is securely mounted at one end of the bed and the other mechanism is slidably mounted on the bed **12** so as to reciprocate back and forth thereon. A reciprocating movement of the second spinning mechanism is achieved by means of a hydraulic cylinder **16** which is connected to the second spinning mechanism and includes a connecting rod **18** which is connected to one end of the bed **12**. The primary drive mechanism for the spinning mechanism includes a drive shaft **20** which extends over the length of the frame and is mounted in suitable bearings at either end. The drive shaft **20** is rotatably driven by an input drive **22** from a drive motor (not shown) in a conventional manner.

The metal spinning mechanisms **14** are substantially identical to one another with the exception that they are of opposite ends and one is secured relative to the bed while the other is slidably mounted. In view of the similarity between these mechanisms, only one mechanism will be described hereinafter.

As shown in FIG. 1 of the drawings, each of the mechanisms **14** includes a housing **24** and a rotatably driven head assembly **26** which is rotatably mounted in the housings **24**. Each of the head assemblies **26** is rotatably driven from the drive shaft **20** by suitable gearing mounted in the housing (not shown) in a conventional manner such that the heads rotate about a common longitudinal axis so as to rotate a muffler can mounted therein in use. The body of each housing is formed with two pairs of outwardly projecting lugs **28** and **30** which have axially aligned passages formed therein for receiving a pair of spaced parallel support bars **32**. The rear ends of the support bars **32** are connected by a bridge member **34** and a threaded jacking screw **36** extends from the housing **14** through the bridge member **34** to an actuator handle **38**. By rotating the handle **38**, it is possible to move the bridge member **34** and associated support bars **32** relative to the housing **14**. As shown in FIGS. 2 and 4 of the drawings, an arcuate shaped member **40** connects the inner ends of the support bars **32**.

As shown in FIG. 1 of the drawings, each of the head assemblies **26** includes two forming roller assemblies generally identified by the reference numeral **42**. Each of these assemblies are substantially identical to one another and only one of these assemblies is shown in detail in FIG. 2 of the drawings. In FIG. 2 of the drawings it will be seen that the arcuate shaped bridge member **40** has a pair of passages **44** located at either end thereof. The forming assemblies **42** are adapted to be mounted one in each of the passages **44** so as to be circum-

ferentially spaced relative to one another about the axis of rotation of the head assembly. Each of the forming assemblies **42** consists of an L-shaped member **46** which includes a follower arm **48** and a hydraulic drive supporting arm **50**. The L-shaped member is mounted to pivot about the axis of one or other of the passages **48** by means of a stub shaft **52**. A cam follower **54** is mounted at the outer end of the follower arm **48** for rotation thereon in the cam track as will be described below. A passageway **56** is formed intermediate the ends of the follower arm. The inner end of the forming arm **58** is bifurcated and a forming roller **60** rotatably mounted between the arms thereof. The roller **60** has a pair of circumferential grooves formed thereon. Only one of the grooves is used at a time, the other groove may be used by adjusting the roller when the first groove becomes worn in use. As shown in FIG. **5** the radius of curvature of the forming grooves **61** decreases in a direction away from the point at which first contact is to be made by the roller on the flanges which are to be formed. This configuration ensures that the forming action will be gradual. The forming arm **58** has a stub axle **62** located intermediate the ends thereof and adapted to be pivotally mounted in the passageway **56** of the follower arm **48**. The other end of the forming arm **58** is bifurcated and formed with elongated slots **64** in each of the bifurcated arms.

The hydraulic drive mechanism is generally identified by the reference numeral **66** and it is rigidly secured to the support arm **50** of the follower assembly. The hydraulic drive mechanism includes double-acting hydraulic cylinder unit **68** which has a reciprocally driven drive shaft **70** extending from the one end thereof. Fluid is supplied to the hydraulic cylinder **68** through tubes **63** and **65**. A flow control device **67** is located in the tube **63** so that the volume of fluid supplied to the cylinder through tube **63** is regulated. A suitable flow control device is available from Racine Hydraulics Canada Ltd., and is identified as flow control No. OF2–AHSH–02K. The drive shaft **70** has an end portion **72** adapted to fit within the bifurcated end of the forming arm and to be secured therein by means of a pivot pin **74**. It will be seen that when the forming mechanism is assembled, the hydraulic drive mechanism may be operated to cause the forming arm to pivot about the axis of the axle **62** so as to move in an arc relative to the forming arm. The elongated slots **64** provide a clearance sufficient to permit the reciprocating action of the connecting rod to activate the pivoting action of the forming arm. The extent of movement of the arm towards the axis of rotation of the forming head is limited by means of a micro-switch **76** which, when assembled, is aligned with an adjustable striker **78** carried by the forming arm. The adjustable striker **78** may be a simple set-screw and locking nut assembly which is threadably mounted in the follower arm. The micro-switch **76** is preferably electrically connected in a circuit which is operable to control the flow of hydraulic fluid to either end of the double-acting hydraulic cylinder so that the flow of fluid can be re-directed when the switch is activated.

A rotatably driven head assembly **80** consists of a generally planar face plate **82** which has an outer cam track forming plate **84** releasably secured thereto by a plurality of cap screws **86**. An inner cam track forming plate **88** is also secured to the face plate **82** by a plurality of cap screws (not shown) so as to define a cam track **90** between the inner plate **88** and the outer plate **84**.

A forming head **92** is secured to the inner cam plate **88** and projects outwardly therefrom. The forming head **92** has a forming lip **94** formed at the outer end thereof and arranged in alignment with the forming roller **60**. The forming lip **94** has a contour adapted to receive an end cap of a muffler can or the like as shown in FIG. **5** of the drawings. The former **92** is also preferably formed with a passageway **96** formed therein. The passageway **96** provides clearance for the muffler input and output pipes and it will be understood that this passage may be disposed off center in order to provide clearance for off-set pipes.

As shown in FIG. **3** of the drawings, a conventional muffler can generally includes a casing **98** which is formed with a pair of end flanges **100**. Each of the end caps **102** has a recess formed therein and an outwardly projecting rim **104** is formed at the outer edge thereof.

When the mechanism of the present invention is in use, an end cap **102** is located on the forming lip on each of the head assemblies **92** with the annular rim portion thereof projecting outwardly therefrom. A muffler casing is then mounted in the saddle assembly generally identified by the reference numeral **106**, such that the muffler casing is in axial alignment with the axis of the forming head **92**. The machine is then activated and the reciprocally mounted mechanism **14** is then moved towards the stationary mechanism **14** by the hydraulic cylinder as previously described. The movement of the reciprocating mechanism continues until the striker plate **108** activates a micro-switch **110**. The striker plate **108** is carried by the slidably mounted housing **24** and the micro-switch **110** is mounted on the bed **12**. The location of the striker plate **108** is adjusted according to the length of the muffler can which is to be mounted in the machine. When the slidably mounted assembly **14** is in its innermost position, both of the end caps **102** of the muffler can will be located within the body of the muffler casing, as shown in FIG. **5** of the drawings, with the flange **100** of the casing abutting the flange **104** of the end cap. When the muffler is assembled in this condition, both of the forming rollers are spaced a substantial distance from the flanges which are to be formed in the spinning operation. The operation of the machine proceeds and the saddle **106** is lowered out of contact with the casing of the muffler. During this preliminary setting up operation, both of the head assemblies **26** are stationary. After the setting up has been completed, the forming head assemblies **26** are rotatably driven and hydraulic fluid is supplied to one of the hydraulic drive units **42**. Referring to FIGS. **2** and **4** of the drawings, it will be seen that as the head assembly **80** is rotatably driven, the form of the cam track will cause the follower arm to pivot to and fro about its pivoted mounting on the arcuate shaped support **40**. The pivoting movement of the follower arm will cause the forming arm to pivot so as to move the forming roller relative to the axis of rotation. The first hydraulic cylinder unit **66** is activated so as to gradually pivot the forming arm about the axis of the shaft **62** so that it is moved from the spaced position shown in FIG. **5** towards the flanges **104** and **100** of the end plate and muffler can. As the roller **60** engages the flange **104**, the flange follows the curvature of the forming groove **61** and moves through the intermediate curved position shown in FIG. **6** to the locking position shown in FIG. **7**. It will be noted in FIG. **7** of the drawings that the flange **104** curls around the flange **100** so that the end cap is locked in position with respect to the casing.

Prior to today's stringent controls on the leakage of exhaust from mufflers, the rolled joint described above was sufficient to provide a satisfactory connection between the end cap and the casing of the muffler. The new restrictions on exhaust have, however, made it essential to ensure that the assembled muffler can is gastight and in order to achieve this required result without using gas and electrical welding equipment, the apparatus of the present invention provides a second forming mechanism which is substantially the same as the first forming mechanism. The forming roller **60*a*** of the second forming mechanism is formed with a pair of annular grooves **63** which differ from the groove **61** of the first forming roller in that they are generally rectangular in cross-section. After the first roller **60** has formed the flange, the micro-switch **76** is activated to cause the first forming roller to be pivoted away from the flange. The second forming mechanism is then activated and the second roller **60*a*** is pivoted into engagement with the curved flange. The roller **60*a*** is moved towards the flange so that the curved flange is engaged by the groove **63** formed in the roller and the flange is flattened to the configuration shown in FIG. **8**. The inward movement of the roller **60*a*** is controlled by the setting of the adjustable screw **78** so that the

inward movement of the roller **60***a* will be terminated when the flange has been flattened to an extent sufficient to provide a gas-tight seal between the end cap and muffler casing.

When the forming operation has been completed, the rotary heads are stopped, the saddle **106** is elevated to engage the muffler can, and the reciprocally mounted mechanism **14** is moved away from the stationary mechanism **14**. The reciprocally mounted mechanism **14** moves away until the striker plate **108***a* engages the micro-switch **110***a*. As a result of the outward movement of the reciprocating assembly **14**, the muffler can is located on the saddle **20** and may be manually removed from the machine.

From the foregoing, it will be apparent that the forming mechanism of the present invention employs a very simple structure including relatively few moving parts. When the machine is to be adjusted for use with a different shape of muffler can, the cam plates **84** and **88** can be very easily removed. To achieve this result, the forming head assemblies **42** are moved away from the face plate **82** by rotating the adjustment handle **38** to cause the arch-shaped support which is mounted on the support arms **32** to move away from the face plate. This adjustment can be carried out without removing the forming assemblies **42**. This very simple form of adjustment considerably reduces the amount of time required in order to make the change-over from one forming assembly to another.

A significant advantage in using a hydraulic drive mechanism rather than a cam actuated mechanism for moving the forming arm is that the adjustment of the movement of the forming arm can be controlled by a simple micro-switch rather than by using a replacement cam for each different width of flange. In addition, it is no longer necessary to machine the cam track surfaces to the degree of accuracy required in the former mechanical driving mechanisms. In the former mechanisms, the accuracy of the movement of the forming roller was directly related to the accuracy of the cam track. Due to the fact that the rollers of the present invention will continue to move towards the cam track until their control valve is actuated, it is possible to ensure that complete sealing will be achieved despite minor inaccuracies in the shape of the cam track and variations in the dimensions of the flanges **104**. Previously minor inaccuracies in the dimensions of the cams of the known mechanisms could have resulted in the formation of a seal which was not gastight. The provision of an adjustment screw **78** has made it simple to adjust the final position of the forming roller relative to the arm **48** so that minor adjustment can be made to ensure that a gastight seal is formed.

The control valve **67** which are located in the input feed lines of each of the cylinders **66** are adjustable to control the rate of feeding of the forming rollers. The control valves **67** are also adjustable to ensure that each pair of forming rollers are advanced at the same speed when in use so that the operating cycle will not be delayed by one roller advancing slower than the other. The valves **67** may also be adjusted to increase or decrease the feeding speed according to the thickness of the metal being formed as required in use.

Various modifications of the apparatus described above will be apparent to those skilled in the art without departing from the scope of the invention. For example, there may be applications in which only one spinning head and one forming roller assembly is required.

What we claim as our invention is:

1. A metal spinning mechanism mountable on the bed of a spinning machine and operable for securing end caps to muffler cans and the like comprising,

a. a housing adapted to be mounted on said bed,

b. a rotatably driven head assembly mounted in said housing for rotation about a longitudinal axis,

c. said head assembly including cam track means extending in a predetermined path about said longitudinal axis,

d. at least one follower arm pivotably mounted at one end on said housing and having a cam follower at the other end thereof mounted in said cam track whereby said follower arm may be caused to pivot relative to said housing in response to movement of said cam follower as said head is rotatably driven,

e. a forming arm pivotably mounted intermediate the ends thereof on said follower arm and having a forming roller rotatably mounted at the inner end thereof, hydraulic drive means having one end connected to said follower arm and the other end connected to said forming arm, said drive means being operable to move said forming roller relative to said follower arm in a direction towards and away from said longitudinal axis to form the spinning metal to the required contour in use.

2. A metal spinning mechanism mounted on the bed of a spinning machine and operable for securing end caps to muffler cans and the like comprising,

a. a housing adapted to be mounted on said frame,

b. a rotatably driven head assembly mounted in said housing for rotation about a longitudinal axis,

c. said head assembly including cam track means extending in a predetermined path about said longitudinal axis,

d. first follower arm means pivotably mounted at one end on said housing and having a cam follower at the other end thereof mounted in said cam track,

e. second follower arm means pivotably mounted at one end on said housing and having a cam follower at the other end thereof mounted in said cam track and circumferentially spaced from the cam follower of said first follower arm, said first and second follower arms being free to pivot relative to said housing in response to movement of said cam follower as said head is rotatably driven,

f. first forming arm means pivotably mounted intermediate the ends thereof on said first follower arm and having a first forming roller rotatably mounted at the inner end thereof,

g. second follower arm means pivotably mounted intermediate the ends thereof on said second follower arm and having a second forming roller rotatably mounted at the inner end thereof,

h. first hydraulic drive means having one end secured to said first follower arm and the other end secured to the other end of said first forming arm,

i. second hydraulic drive means having one end secured to said second follower arm and the other end secured to the other end of said second forming arm,

j. said first and second hydraulic drive means being operable to move said forming rollers relative to said follower arms in a direction towards and away from said longitudinal axis to form the spinning metal to the required contour in use.

3. A metal spinning machine for securing end caps to muffler cans and the like comprising,

a. a bed,

b. at least two housings adapted to be mounted on said bed, one of said housings being slidably mounted on said bed relative to the other,

c. means for moving said slidably mounted housing to and fro on said bed,

d. a rotatably driven head assembly mounted in each of said housings for rotation about a longitudinal axis,

e. said head assembly including, cam track means extending in a predetermined path about said longitudinal axis,

f. first follower arm means pivotably mounted at one end on said housing and having a cam follower at the other end thereof mounted in said cam track,

g. second follower arm means pivotably mounted at one end on said housing and having a cam follower at the other end thereof mounted in said cam track and circumferentially spaced from the cam follower of said first follower arm, said first and second follower arms being free to pivot relative to said housing in response to movement of said cam follower as said head is rotatably driven,

h. first forming arm means pivotably mounted intermediate the ends thereof on said first follower arm and having a

first forming roller rotatably mounted at the inner end thereof,

i. second follower arm means pivotably mounted intermediate the ends thereof on said second follower arm and having a second forming roller rotatably mounted at the inner end thereof,

j. first hydraulic drive means having one end secured to said first follower arm and the other end secured to the other end of said second forming arm,

K. second hydraulic drive means having one end secured to said second follower arm and the other end secured to the other end of said second forming arm,

l. said first and second hydraulic drive means being operable to move said forming rollers relative to said follower arms in a direction towards and away from said longitudinal axis to form the spinning metal to the required contour in use.

4. A metal spinning mechanism as claimed in claim 1, wherein said follower arm means includes a hydraulic drive mounting arm projecting outwardly from the pivotally mounted end of said follower arm substantially at right angles thereto and integrally connected thereto, said hydraulic drive means being mounted on said mounting arm substantially at right angles to the forming arm to which it is connected such that the forming arm may be pivoted by the reciprocating action of said drive means.

5. A metal spinning mechanism as claimed in claim 2, wherein said follower arm means includes a hydraulic drive mounting arm projecting outwardly from the pivotally mounted end of said follower arm substantially at right angles thereto and integrally connected thereto, said hydraulic drive means being mounted on said mounting arm substantially at right angles to the forming arm to which it is connected such that the forming arm may be pivoted by the reciprocating action of said drive means.

6. A metal spinning mechanism as claimed in claim 3, wherein said follower arm means includes a hydraulic drive mounting arm projecting outwardly from the pivotally mounted end of said follower arm substantially at right angles thereto and integrally connected thereto, said hydraulic drive means being mounted on said mounting arm substantially at right angles to the forming arm to which it is connected such that the forming arm may be pivoted by the reciprocating action of said drive means.

7. A metal spinning mechanism as claimed in claim 1, including control means operable in response to pivoting movement of said forming arm in a direction towards said forming head so as to control the operation of said drive means to limit the inward movement of said forming roller towards said forming head.

8. A metal spinning mechanism as claimed in claim 4, wherein said hydraulic drive means comprises a double-acting hydraulic cylinder mounted on said support arm and having a reciprocating drive shaft projecting outwardly therefrom, said drive shaft being pivotally mounted at the point at which it is secured to said forming arm such that reciprocation of said drive shaft causes said forming arm to pivot relative to said follower arm.

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