July 14, 1959 C. F. HAUTAU 2,894,422

ROLLING MILL

Filed Nov. 22, 1954 4 Sheets-Sheet 1

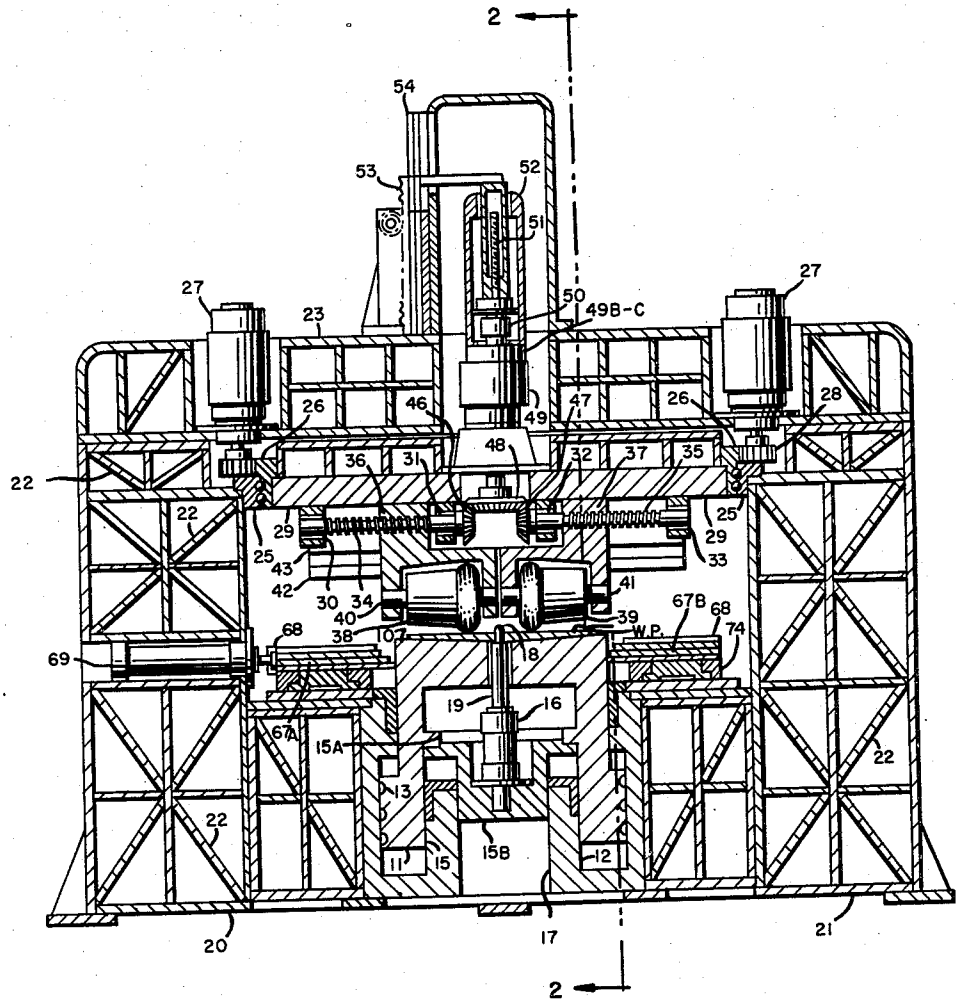


FIG 1

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ROLLING MILL

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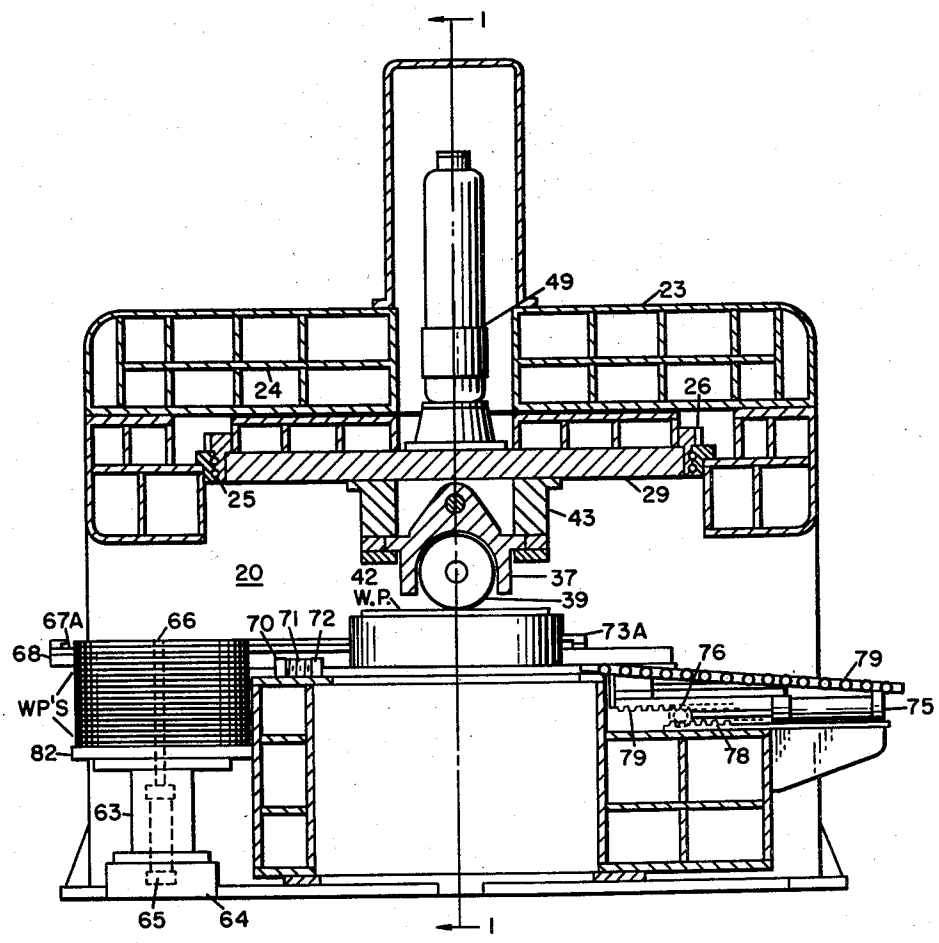


FIG- 2

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ROLLING MILL

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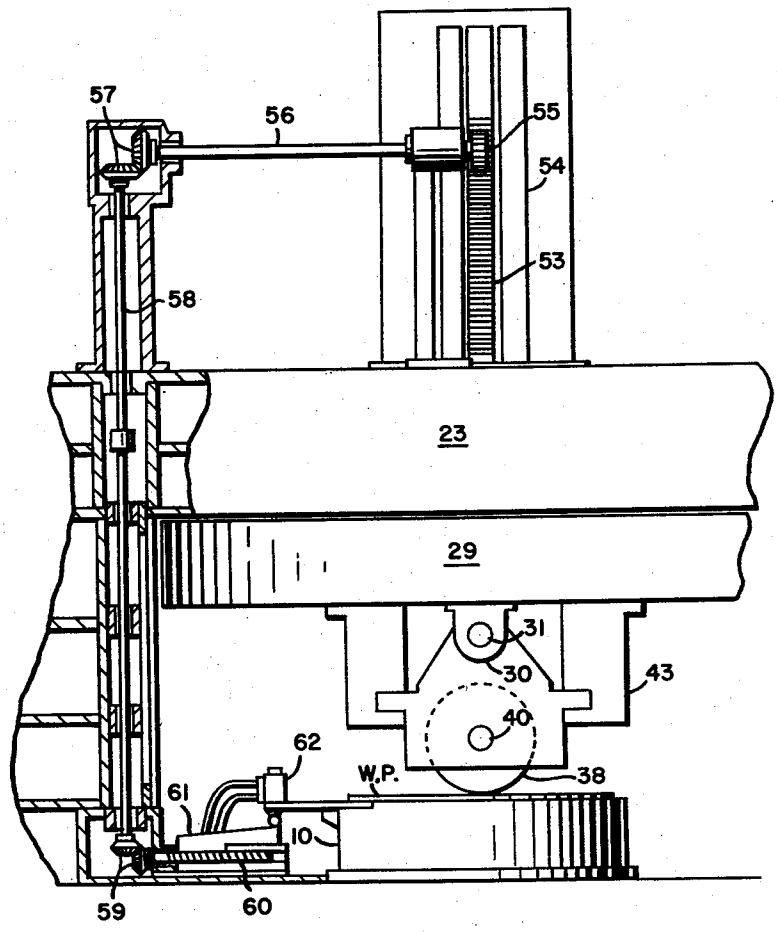


FIG- 3

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ROLLING MILL

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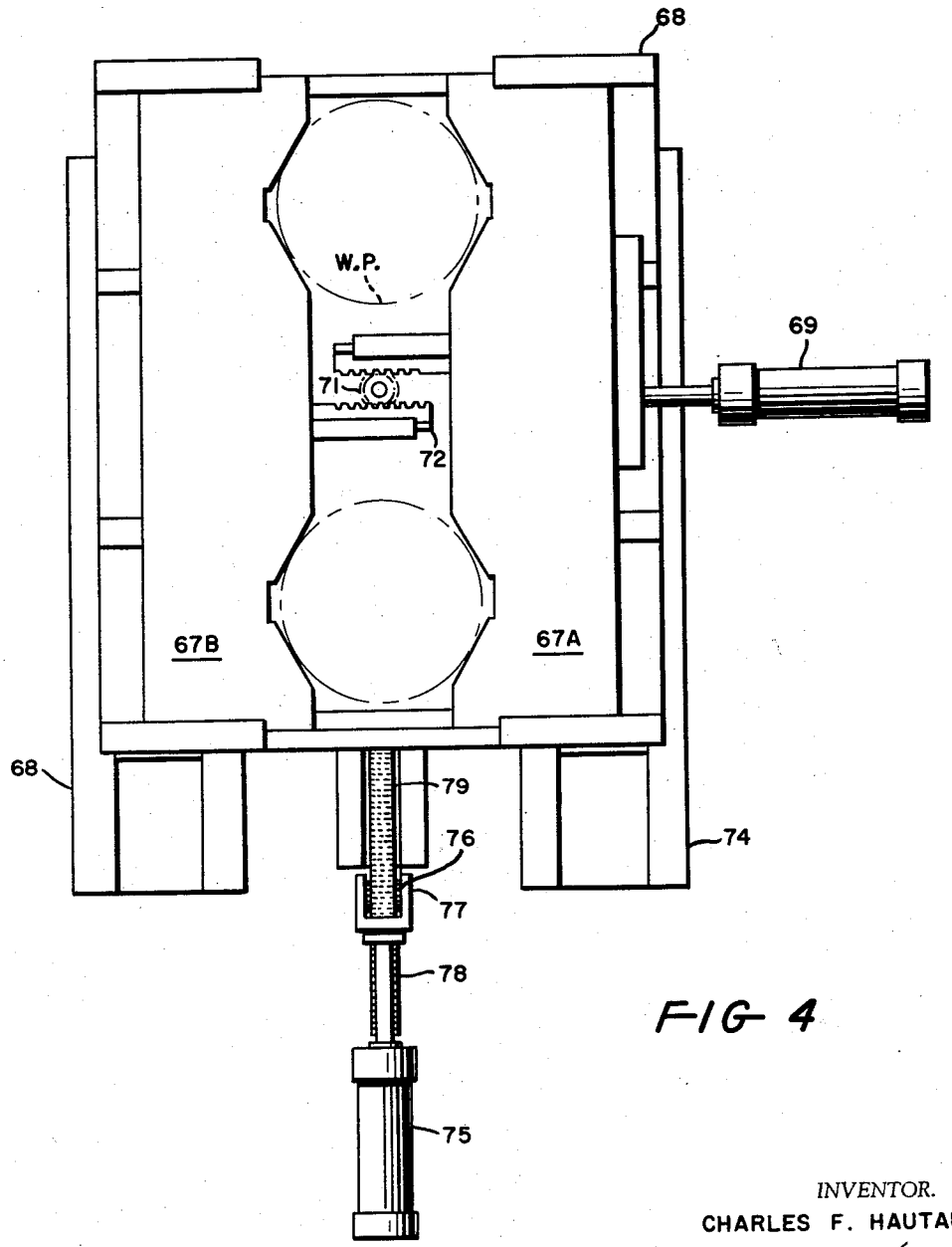


FIG 4

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2,894,422

ROLLING MILL

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Application November 22, 1954, Serial No. 470,425

1 Claim. (Cl. 80—16)

This invention relates to rolling mills and more particularly to a mill for rolling radially symmetrical sections.

The mass production rates common to the metal working industries today necessitate the development of processing equipment which is completely automatic. The present invention contemplates a rolling mill which is electrically and hydraulically controlled so as to constitute a completely automatic unit. An automatic feed picks up work blanks from the preceding operation and delivers the finished pieces to a subsequent operation.

An object of the invention is to provide a mill having a stationary workholder and rotating rollers so that the rotation need not be stopped when a new workpiece is fed into the mill, as is done on prior devices of this nature. This novel feature allows the loading time to be substantially reduced, conserves the power used to start and stop the rotating member, and results in few machine breakdowns.

Another object of the invention is to provide means with which the workpiece may be moved into contact with the rotating rollers, in contrast to the method of the prior art in which the rollers were moved into contact with the workpiece. This feature allows the vertical position of the workpiece to be varied in timed relation with the radial movement of the rollers, so that a radially nonlinear section may be rolled.

A further object of the invention is to provide servo means for controlling the position of the workpiece with respect to the rolls.

A further object is to provide means whereby the rollers may be moved radially with precision at a controlled variable rate.

Another object is to provide magnetic means for securing the workpiece to the workholder.

A further object is to provide a mill of such construction as will allow continuous automatic operation with a minimum of downtime, and will produce a workpiece of superior dimensions.

Other objects and advantages will be made apparent by the detailed description of a preferred embodiment of the invention which refers to drawings to which:

Fig. 1 is an elevation section of the machine taken along lines 1—1 of Figure 2.

Figure 2 is an elevation section of the machine taken along lines 2—2 of Figure 1.

Figure 3 is a detail of the workbed control mechanism.

Figure 4 is a detail of the loading mechanism.

A workpiece designated W.P., when in a working position, is supported on a cylindrical support **10** which is an extension of a piston **11**. The piston **11**, moves in a hydraulic cylinder **12**. Annular seals **13** are set in grooves in the periphery of the piston and act as oil seals. The piston **11** has a hollow center **15** which is partially enclosed at its lower end by a mounting flange **15A**. A mounting bracket **15B** is fixed to the flange **15A** and serves to support a hydraulic cylinder **16**. The cylinder **12** has an internal cylindrical pilot **17** which serves as a means of servicing the cylinder **16**. Cylinder **16** is a

double extended hollow rod cylinder. An internal pilot rod **18** extends through the center to cylinder **16** and is fixed at its lower end to the bracket **15B**. The rod **18** acts as a centering pin for the purpose of aligning the work blank W.P. on the support **10**. The outer piston rod **19** serves to disengage the workpiece from the support **10** when the rolling is completed.

The cylinder **12** is supported by supports **20** and **21**. Both are internally braced by cross members **22**. The supports **20** and **21** are of welded construction. A cylindrical top **23** of similar welded construction, braced by cross-members **24** is supported on the members **20** and **21**. The side members **20** and **21** support the outer race of an annular high speed ball bearing **25**. An outwardly oriented ring gear **26** is integral with the inner race of the bearing **25**. Two electric motors **27** are supported in the top **23** with their output shafts downward. Their shafts carry gears **28** which mesh with the ring gear **26**. The motors **27** are located at diametrically opposite points in the top **23**, and thus cancel out any unbalanced thrust against the ring gear **26**.

A disk shaped plate **29** is carried on the inner race of the ring bearing **25**. Two pairs of roller bearings **30** and **31**, **32** and **33** are fixed to the lower side of plate **29** so that a line through each pair is radially directed. A screw shaft **34** and **35** is carried by each pair of bearings **30** and **31**, **32** and **33**.

A threaded roll carrier **36** and **37** is mounted on each of the screw shafts **34** and **35**. Rolls **38** and **39**, being of basically cylindrical shape and having bulges in their surfaces at their radially inward ends, are carried on shafts **40** and **41**, which are mounted in the carriers **36** and **37**. The weight of the carriers **36** and **37** are carried on hardened ways **42** which are supported off of the disk **29** by a member **43**.

At their radially inward ends the screw shafts **34** and **35** extend through the bearings **31** and **32** and carry bevel gears **46** and **47**. Both of the bevel gears **46** and **47** are in mesh with and driven by a third bevel gear **48** which is driven by the output shaft of a direct current electric motor **49**. The motor **49** is supported in the center of disk **29** and its shaft extends through the disk. The motor **49** therefore rotates with the disk **29** and it must be fed current through the slip rings **50**.

The rotational rate of the screw shafts is therefore equal to the difference between the rotational velocity of the disk **29** and the shaft of the motor **49**. The speed of the motor **49** is accurately controlled by a positively variable voltage control.

The motor **49** has a double ended shaft. The upper end of the shaft is screw-cut **51** and a lead nut **52** rides the screw. An electric clutch-brake **49B** and **49C** is connected on the shaft below the screw **51**. The brake is arranged so as to rigidly connect the motor frame with the shaft and the clutch is arranged to disengage the screw **51** from the shaft. A gear rack **53** is integrally connected to the lead nut **52** and moves with it. The rack **53** moves on hardened ways **54**. As is seen in Figure 3 a gear **55** is supported so as to be rotated by the translation of the rack **53**. The gear **55** drives a shaft **56** which communicates, through bevel gears **57**, shaft **58**, and bevel gears **59** with a screw shaft **60**. Thus the screw **60** turns in timed relation with the shaft of the motor **49** and therefore of the radial motion of the rolls **38** and **39**. A cam **61** rides on the screw **60** and guides the follower of a hydraulic tracer valve **62**. The valve **62** is mechanically connected to the work support **10**, and the valve's hydraulic output is fed to the cylinder **12** which moves the piston **11**. Therefore the workpiece W.P. is moved vertically in a timed pattern which is determined by the position of the rolls **39** and **40** and the shape of the cam **61**.

The complete cycle, including the loading operation, is carried on automatically, through the use of limit switch initiated electric and hydraulic circuits. These circuits, which are of the type normally used with such machines, do not constitute part of the invention and are not shown in the drawings.

The blank workpieces W.P. 1 are stacked on a plate 82 which is supported by a hollow shaft 63 of a hydraulic cylinder 64, which is set in the floor. A second hydraulic cylinder 65 is carried internally of the hollow shaft 63 and its rod 66 serves as a locating pin for the work blanks W.P. 1.

Each time a work blank is removed from the stack the cylinder 64 raises its rod a sufficient distance to place the top blank in position for pickup by the transfer jaws 67A and 67B. The cylinder 65 then lowers its rod 66 a sufficient distance to free the top blank. The jaw 67A moves in on a free work blank along hardened ways 68 under the power of a hydraulic cylinder 69. A rack 70, connected to the jaw 67A rotates a pinion gear 71 which in turn moves a second rack 72 which is connected to the second jaw 67B. Thus the two jaws close in on a free work blank. Two additional jaws 73A and 73B are integral with the jaws 67A and 67B. While the jaws 67A and 67B are picking up a blank workpiece the jaws 73A and 73B are picking a completed workpiece off of the work support 10.

When the jaws have closed they then move in a direction perpendicular to their line of action in closing, along the ways 74. The jaws are moved in this direction under the influence of a hydraulic cylinder 75. The cylinder 75 carries a pinion gear 76 in a yoke 77. The gear 76 rides against a fixed rack 78 and reacts against a rack 79 that is fixed to the jaws 67 and 73. Thus the rack 78 moves at twice the speed of the pinion gear 76.

The cylinder 75 moves the jaws 67 and 73 to a position where the jaws 67 are lined up with the work support 10 and the jaws 73 are over a roller conveyor 79. The cylinder 69 then retracts its rod, opening the jaws and depositing the workpieces on the support 10 and on the conveyor 79. The cylinder 75 then retracts its rod and the jaws 67 and 73 are returned to their original position, where they await the completion of the workpiece.

The work support 10 is in a lowered position in the cylinder 12 when it receives a blank workpiece, and the cylinder 16 has rectracted the knockout 19. As soon as the jaws 67 have deposited their workpiece which is aligned by the pin 18, oil under pressure is introduced into the cylinder 12, and its force is exerted against the piston 11, lifting the support 10 and its workpiece into contact with the rolls 38 and 39. At this point the rolls 38 and 39 are at their radially inward extremity of travel and they are being rotated about a central vertical axis by the motors 27.

The pressure of the workpiece against the rolls 38 and 39 is controlled by the hydraulic tracer valve 62 which follows the contour of the cam 61. Until the workpiece is brought into contact with the rolls 38 and 39 the motor 49 is receiving no power and its shaft is being held stationary by the brake 49B. When the workpiece is brought into contact with the rolls the brake 49B is

disengaged, a controlled voltage is sent to the motor 49 through the slip rings 50 and the motor's shaft begins rotating at a different speed than the motor stator. This causes the screws 34 and 35 to rotate and the carriers 36 and 37 move the rolls outward radially.

As the rolls 38 and 39 move outward the work support 10 moves toward and away from the rolls in accordance with the pattern of the cam 61.

At the end of the rolls' outward movement the work support 10 lowers and the motor 49 is reversed so as to bring the rolls 38 and 39 back to center and reset the cam 61.

Depending on the type of metal being rolled it may be desirable to have the workpiece brought into closer contact with the rolls on succeeding passes. This can be accomplished by either raising the template after each pass or introducing a new template after each pass. By introducing a new template it becomes possible to take a pass which is better adopted to the partly rolled shape.

When the cam has returned to a starting position a limit switch (not shown) actuates the brake 49B and the clutch 49C. The brake 49B causes the shaft of the motor 49 to move with the frame, thereby stopping the rotation of the screw shafts 34 and 35. The clutch 49C disengages the screw shaft 51 from the motor 49 so that the cam 61 does not move. When the next rolling operation begins the clutch and brake are de-actuated and the motor 49 is powered.

When the work support 10 is lowered following the final pass of the rolls 38 and 39 the cylinder 16 extends its hollow rod 18 which raises the workpiece off of the pin 19 so that the workpiece may be picked up by the loading jaws 73.

Having thus described the invention what is claimed as new and desired to be secured by Letters Patent is:

A rolling mill for rolling tapered discs comprising a platen; means for moving the platen vertically; a rotatable roll support; means for rotating said support; a pair of rolls on said support; roll moving means for moving said rolls radially of said platen; a cam; means operated by said roll moving means for moving said cam in a predetermined relation thereto; a cam follower; and means operated by said cam follower for actuating said platen moving means, whereby the distance between the rolls and platen can be varied in accordance with said cam as said rolls move radially.

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