March 31, 1953 L. R. BERKEBIL 2,633,233

DRAWING MACHINE

Filed Sept. 9, 1947 2 SHEETS—SHEET 1

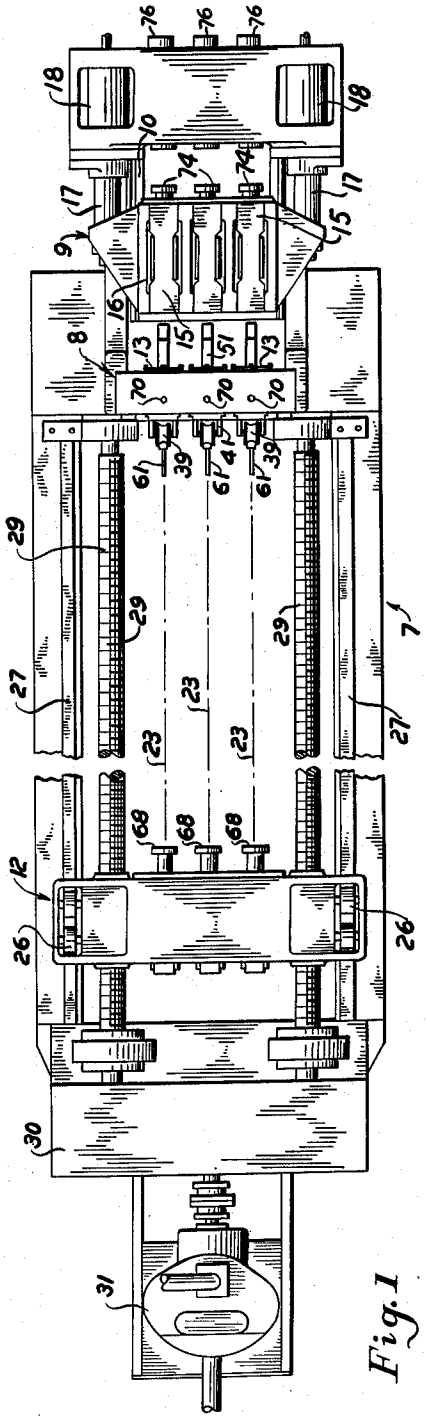


Fig. 1

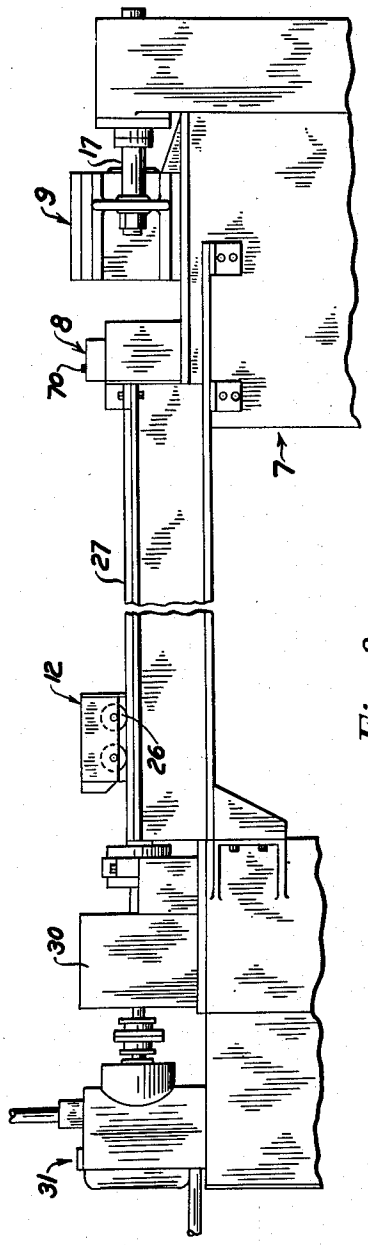


Fig. 2

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DRAWING MACHINE

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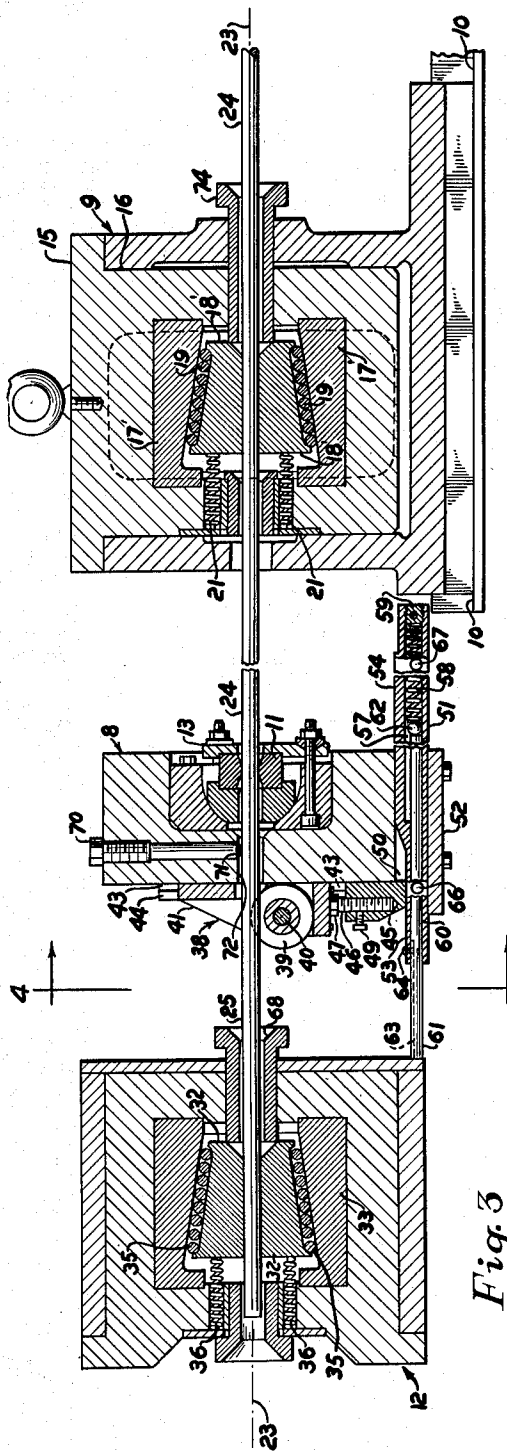


Fig. 3

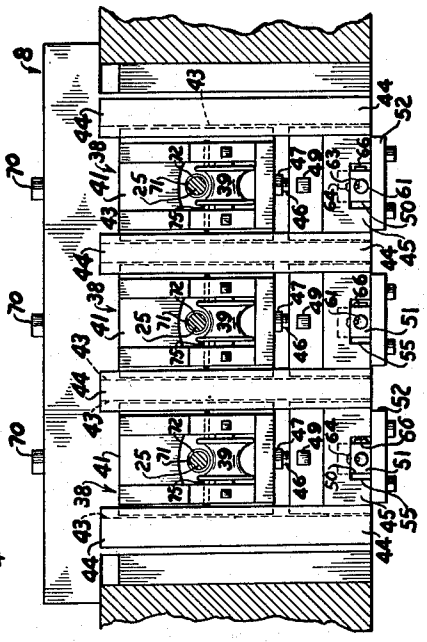


Fig. 4

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UNITED STATES PATENT OFFICE

2,633,233

DRAWING MACHINE

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5 Claims. (Cl. 205—6)

1

The present invention relates to a method of and apparatus for drawing rods in which lengths of wires, rods, bars, or the like, hereinafter collectively referred to as "rods," are drawn through a die to reduce or form the rods to the desired size or shape.

As used herein, the terms "drawn," "drawing" and the like are used to indicate that as the rod is moved through the die the rod is reduced in size or formed to the desired shape. These terms are not limited to where the rod is pulled through the die and include those methods and machines where the rod is pushed through the die while being drawn.

In some rod drawing machines, the leading end is pointed or is formed in a reduced size so that it can be freely pushed through the die. The present invention is only concerned with where the rod is drawn, that is, reduced in size or formed to the desired size or shape, upon being pushed through the die. For various reasons, the forward or leading end portion of a rod upon being pushed through the die will at times bend laterally away from the wire line of the machine. The bending of the rods may be caused by imperfections in the die or may be caused by variations or imperfections in the different rods, or the bending may result from the combination of these factors. Where imperfections in the die cause the rods to bend when pushed through the die, the rods will bend in the same direction. Bent rods may not be properly drawn and may cause damage to the machine and it usually is necessary to discard or reprocess these bent rods which is uneconomical. As a practical matter, it is very difficult, if not impossible, to construct dies so perfectly that the rods do not bend a slight amount and a slight amount of bending which is not sufficient to interfere with subsequent operations usually requires that the rods be straightened.

It is an object of the present invention to provide a method of and apparatus for drawing rods that will reduce or prevent the rods from bending out of shape.

Another object of the present invention is to provide a method of and apparatus for drawing rods in which the end portions of those rods which bend or tend to bend upon being pushed through the die as a result of imperfections in the die will be straightened, either substantially or perfectly, as the rods are pushed through the die.

A further object of the present invention is to provide a method of and apparatus for drawing rods that will straighten out those rods which

2

tend to bend and that will not deform those rods which do not tend to bend.

It is also an object of the present invention to provide a rod drawing machine including rod straightening means that is automatically properly positioned.

In accordance with the present invention, a rod is pushed through the die and if the rod bends as a result of imperfections in the die, it is straightened as the rod is advanced through the die. In a rod drawing machine embodying the principles of the present invention, a die is positioned so that those rods tending to bend as a result of die imperfections, which may be all or part of the rods being drawn, will tend to bend in the same predetermined direction. A rod straightening device is provided on the exit side of the die and this device includes a guide which engages the rod and bends it substantially straight as the end portion is being pushed through the die by the push carriage. Preferably, the rod straightening guide is so positioned as to bend the end portion of the rod a slight amount beyond the straight condition so that the stresses set up in the rod by the die will be entirely overcome. It is necessary to bend the rod only slightly beyond the straight condition as the stresses and strains caused by the die are readily overcome and the rod at this time has only a relatively small amount of "springback." If the rod were not straightened until later when the metal has age hardened, it would be very difficult to straighten the rod and it would be necessary to use relatively quite heavy equipment. With the guide positioned either to bend and maintain the rod substantially or perfectly straight as it leaves the die or positioned to bend the end portion laterally and slightly beyond the straight condition, the end portion of the rod is bent by the guide in a direction opposite to the direction the die bends the rod to straighten the rod. Cam means may be provided to automatically move the guide into and out of the rod straightening position. By means of the present invention, the production of the bent rods as a result of imperfect dies is substantially or completely eliminated. The rod straightening guide does not bend straight rods sufficiently to deform them.

These and other objects and advantages of the present invention will become more readily apparent from the following detailed description, taken in connection with the accompanying drawings, in which:

Figure 1 is a plan view of a rod drawing ma-

chine embodying the principles of the present invention;

Figure 2 is a side elevational view of the machine of Figure 1 with portions of the supporting structure removed;

Figure 3 is an enlarged, fragmentary longitudinal sectional view of part of the machine of Figure 2; and,

Figure 4 is an enlarged, fragmentary view taken substantially along line 4—4 of Figure 3.

Referring to the drawings, the rod drawing machine includes a draw bench 7 on which is mounted in a fixed position a die holder 8. A power-actuated push carriage 9 is slidably mounted in ways 10 for movement forwardly and rearwardly along bench 7 toward and away from the die holder. Carriage 9 advances the leading end portion of a rod 24 through a die 11 removably retained in holder 8 by plate 13 upon each forward stroke toward the die 11. A power-actuated pull carriage 12 is supported on bench 7 for forward and rearward movement away from and toward the die holder 8 to pull a rod through die 11 upon each forward stroke away from die holder 8. Thus, as will be more fully hereinafter described in detail, the push carriage 9 pushes the leading end of a rod 24 through die 11 and then pull carriage 12 engages the leading end of the rod and pulls it the rest of the way through the die. The rod is drawn by the die both when it is being pushed and when it is being pulled through the die.

The present rod drawing machine is constructed and arranged for drawing three rods simultaneously. There are three identical dies in holder 8 and three identical rod gripping mechanisms in each carriage. Those mechanisms cooperating to draw one rod will be described in detail, it being understood that these mechanisms are duplicated for each rod simultaneously drawn and that it is immaterial whether one or a plurality of rods are drawn.

Carriage 9 is connected to the outer ends of pistons 17 of a pair of hydraulic cylinders 18 connected through suitable valves (not shown) to a source of fluid under pressure. A jaw holder 15 is removably mounted in a pocket 16 of carriage 9. As shown more clearly in Figure 3, in the holder 15, there are a pair of blocks 17' having tapered, opposed inner surfaces. A pair of rod-gripping jaws 18' are movably mounted in blocks 17' with ball bearings 19 disposed therebetween. Springs 21 urge the jaws 18' toward the right and inwardly toward the wire line 23 of the rod drawing machine. The springs 21 permit limited, spreading movement of jaws 18' toward the left so that a rod can be pushed manually between the jaws and toward the die 11. When the carriage 9 moves toward the left and toward the die 11, the jaws 18' are wedged against and tightly grip the rod 24 and force its leading end portion 25 through the die. When the carriage 9 is withdrawn toward the right away from die 11 and along the ways 10, or when the rod 24 is pulled through the die 11 by pull carriage 12, the grip of jaws 18' on rod 24 is loosened sufficiently to allow the rod 24 to slide through the jaws.

The pull carriage 12 is mounted on two pairs of rollers 26 for movement along rails 27 toward and away from the die 11. The carriage 12 is in engagement with a pair of lead screws 29, each of which is connected through a gear train in box 30 to the hydraulic motor 31. When the hydraulic motor 31 rotates, the lead screws 29 rotate to move the carriage 12 toward or away from the die 11 depending upon the direction of rotation of the lead screws.

A pair of rod gripping jaws 32 are mounted in a pair of blocks 33 with ball bearings 35 disposed between their tapering surfaces. Springs 36 resiliently urge jaws 32 inwardly toward the right into engagement with the rod end portion 25. As the carriage 12 is moved toward the right and approaches the position shown in Figure 3, the jaws 32 can spread sufficiently to slip over the end of rod 24. When the carriage 12 is then moved toward the left to the position shown in Figures 1 and 2, the jaws 32 are wedged into engagement with the rod and pull it through the die 11. The greater the resistance of movement of the rod through the die, the more securely jaws 32 and jaws 18' grip the rod.

The above described combination of die and push and pull carriages containing releasable rod gripping jaws forms no part of the present invention and other types of push and pull carriages and other arrangements of rod gripping means and dies may be used. The present invention is not limited to the rod drawing machine shown herein and is applicable to other types of rod drawing machines, such as headers, in which the rod is advanced through the die solely by being pushed.

Referring more particularly to Figures 3 and 4, the rod gripping jaws 18' and 32 and the die 11 are all disposed along and symmetrically arranged about the wire line 23 of the rod drawing machine. When the rod 24 is drawn properly without distortion, it is moved through the machine with its longitudinal axis coinciding with the wire line 23. The movement of both carriages is parallel with this wire line. As the push carriage 9 advances, the leading end portion 25 of rod 24 through die 11, portion 25 is unsupported as it emerges from the die. At least at times, the leading end portion 25 will bend laterally away from the wire line. At times it may be possible to construct and arrange the die so that none or substantially none of the rods bend, but if a different die is substituted, the rods may bend. With any particular die, it has been found that those rods which are caused to bend by the die will all bend in the same direction.

In accordance with the present invention, a rod straightening device shown generally at 38 is provided for straightening the end portions 25 of those rods which normally bend laterally away from the wire line 23 as a result of stresses set up in the rod by the die without distorting or deforming those rods which do not tend to so bend. A rod straightening device 38 is provided for each die 11. As these devices are all similar, only one will be described in detail. The die 11 is turned so that those rods which do bend, bend downwardly. A rod straightening guide or roller 39 is rotatably mounted on a pin 40 supported in a bracket 41 vertically, slidably mounted in ways 43 of retainer members 44. A lower member 45 is also vertically slidably mounted in ways 43 below bracket 41. A screw 46 is adjustably mounted in lower member 45 with its head 47 engaging bracket 41 for adjusting the vertical position of roller 39. A set screw 49 is provided in member 45 for locking screw 46 in the proper position. The lower side of die holder 8 is slotted at 50 to receive a horizontally movable cam 51. Cam 51 is held in place by plate 52 bolted to the bottom of die holder 8. Cam 51 includes a

lower cam surface 53 and an upper cam surface 54 and extends through a slot 55 in lower member 45 so that member 45 and bracket 44 are supported on either cam surface 53 or cam surface 54. The cam 51 includes an elongated recess 57 containing a spring 58 and closed by a threaded plug 59. The opposite end 60 of recess 57 is of reduced size and has slidably mounted therein an elongated pin 61. A ball 62 is interposed between the rear end of pin 61 and spring 58. A slot 63 is formed in the outer end portion of pin 61 for receiving the end of a stop pin 64. Pin 64 limits movement of pin 61 toward the left. Stop pins 66 and 67 are mounted in cam 51 and serve to limit the movement of the cam relative to holder 8.

Cam 51 projects beyond the die holder 8 toward push carriage 9 so that when the push carriage 9 is moved toward the die holder to push the leading end 25 of the rod 24 through die 11, the carriage 9 pushes the cam toward the left. This movement of the cam 51 brings surface 54 beneath member 45 and raises roller 39 into position to engage the bottom surface of the rod to straighten and prevent the leading end portion 25 from bending downwardly and laterally away from wire line 23 as it is pushed through the die. The straightening device, and especially screw 46 and roller 39, are preferably so arranged that when the cam raises the roller 39 to the operating position, the roller 39 bends the leading end portion of the rod upwardly and slightly beyond the wire line 23 so as to overcome the stresses and strains set up in the rod by the die. The amount that rod portion 25 should be bent upwardly beyond the wire line will depend on a number of factors including the magnitude of the stresses caused by the die. At times, it may be desirable to have cam 51 and screw 46 so proportioned and arranged that the roller 39 only is raised far enough to bend the leading end portion of the rod upwardly sufficiently to maintain the end portion straight as it emerges from the die and prevent it from bending downwardly away from the wire line without bending the rod portion 25 upwardly beyond the wire line. With the roller 39 in either position and if the die tends to bend the rod downwardly as it is pushed through the die, the roller tends to bend the rod upwardly and straighten the rod.

When the pull carriage 12 is moved toward the die 11 to the position shown in Figure 3, it engages the end of pin 61 and pushes cam 51 toward the right to the positions shown. As carriage 12 approaches the leading end portion 25 of rod 24, portion 25 normally will be at least close enough to being in alignment with the wire line 23 so that the end of the rod will enter between jaws 32. If the straightening device 38 including cam 51 is so constructed that the rod straightening guide or roller 39 bends the end of the rod upwardly and beyond the wire line sufficiently so that the rod end will not enter the guide passage 68, then cam 51 must be moved toward the right sufficiently to lower roller 39 to the inoperative position before the end of rod 24 starts to enter the passage 68 leading to jaws 32. When the rod straightening deivce 38 and cam 51 are so constructed and arranged that the roller 39 maintains the forward end portion of the rod in a substantially straight horizontal line or only bends the rod end upwardly beyond the wire line such a slight amount that the rod end can enter passage 68 and between the jaws 32, then the roller 39 need not be and preferably is not moved downwardly away from the rod until the end of the rod has entered passage 68 and between jaws 32. Normally, it will not be necessary or desirable to bend the rod end up far enough so it cannot enter passage 68.

A long bolt 70 is mounted in holder 8 with its lower end 71 extending into rod passage 72 on the exit side of die 11. The end 71 of bolt 70 is positioned above the wire line 23 a distance substantially equal to the radius of rod 24. When the rod straightening roller bends the end portion 25 upwardly to straighten this portion, the rod engages the end 71 of bolt 70 to provide a three point support for bending the end portion straight. When bending an elongated member, a three point support is better than a two point suport. The bolt end 71 prevents all bending of the rod taking place adjacent the die 11. The bolt end 71 preferably is slightly spaced above rod 24 so that it does not deface the rod as the pull carriage pulls the rod through the die. Although bolt end 71 may touch rod 24 at all times, it should not exert enough pressure on the rod to deface the rod. When cam surface 54 raises roller 39 only far enough to bend the rod end upwardly sufficiently to maintain the end portion 25 straight and prevent the rod end from bending downwardly, the end of bolt 70 aids in bending and maintaining portion 25 straight.

A complete cycle of operation will now be described, it being understood that control apparatus of any type can be used to automatically control the operation of the cylinders 18 and motor 31 or cylinders 18 and motor 31 may be manually controlled. At the start of the cycle, carriages 9 and 12 are in the position shown in Figures 1 and 2. Figure 3 also shows carriage 9 in position at the start of a cycle of operation. Three rods 24 are each inserted through a corresponding guide 76 at the right hand end of the machine and manually pushed through a guide 74 on carriage 9 toward the die 11. The forward end 25 of the rod is manually pushed between jaws 18' and pushed forward until the end is against die 11. Fluid under pressure is then admitted to the head ends of cylinders 18 to move carriage 9 along ways 10 from its position shown in the drawings toward the die 11. As carriage 9 moves toward the die, it first strikes cam 51 and then moves it toward the left to move cam surface 54 beneath member 45 and raise roller 39 to the operative position. This movement or first stroke of the carriage also moves the leading end portion of the rod through die 11 for a short distance. The flow of fluid to the cylinders 18 is then reversed and the cylinders move the carriage 9 toward the right and farther to the right than shown in the drawings. The cylinders 18 thereafter move the carriage 9 forwardly toward the left to the position shown in the drawings. This last forward stroke may be repeated a number of times as the carriage 9 pushes the rod through the die 11, the roller 39 bends the leading end portion upwardly to straighten the rod and preferably bends the leading end slightly beyond the horizontal or wire line. When the carriage 9 has pushed the end of the rod through die 11 so that the end can be engaged by jaws 32, carriage 9 is brought to rest in the position shown in the drawings.

After the end 25 of rod 24 has been pushed through the die 11, motor 31 is started to rotate lead screws 29 and move the carriage 12 from

its position shown in Figure 1 toward its position shown in Figure 3. As carriage 12 approaches die 11, the carriage strikes the end of pin 61 and moves cam 51 toward the right to its initial position shown in the drawings. When cam 51 has been moved as far as pin 66 will permit any continued movement of carriage 12 will cause pin 61 to compress spring 58 which also acts as a safety means in the event carriage 9 is not properly located. Before roller 39 is lowered, the straightened end portion 25 which is preferably bent upwardly and slightly beyond the horizontal is nearly enough aligned with the guide passage 68 so that upon movement of carriage 12 toward die 11, the rod enters passage 68. When carriage 12 reaches the position shown in Figure 3, the rod end is between jaws 32 and roller 39 has been lowered and the motor 31 is reversed to move the carriage 12 to the left to the position shown in Figure 1. As carriage 12 moves to the left, jaws 32 grip the rod and pull it through die 11. As the rod is being pulled by carriage 12 it is immaterial whether or not the rod tends to bend downwardly as it will be pulled straight. When the rod 24 has been completely drawn, it is removed from jaws 32 and the cycle repeated.

If cam surface 54 is of such a height or if screw 46 is so adjusted that roller 39 merely holds the rod end portion 25 horizontal or bends portion 25 slightly beyond the horizontal as it is pushed through the die 11, then the length of pin 61 preferably is such that the rod enters guide passage 68 and preferably between jaws 32 before the roller 39 is lowered. When roller 39 is positioned to bend the rod end upwardly past the wire line sufficiently so that the end portion cannot enter passage 68, then pin 61 is of such a length that roller 39 is lowered before the rod end enters passage 68.

I prefer to have the roller 39 bend the end portion slightly beyond the wire line so as to more nearly perfectly straighten the end portion by more nearly completely overcoming the stresses set up in the metal by the die. The degree to which the end portion is bent beyond the wire line will usually be very small but will depend at least in part on the properties of the metal and the characteristics of the die.

When drawing rods other than rounds, such as, hexagons, it is desirable to have a flat surface on top to be engaged by bolt end 71. Consequently, it may not be possible or desirable to position die 11 so that the rods tend to bend vertically downward and it may be necessary to position the die 11 so that the rod end bends downwardly and slightly to one side of vertical. Pins 75 are provided in holder 41 for laterally positioning roller 39. Usually pins 75 are positioned to align roller 39 directly below the rod, but when the rod end tends to bend downwardly and laterally, then pins 75 can be shifted to shift the roller 39 laterally so that the roller will bend the rod end upwardly and laterally in the opposite direction.

When it is necessary to change the die, the new die first is fastened in place in the die holder. After one or more rods have been drawn, it will be apparent in which direction the new die causes the rods to bend and the new die can then be turned, if necessary, to cause subsequently drawn rods to bend downwardly. In those instances when the rods do not tend to bend even a slight amount as a result of die imperfections, the straightening device will not deform the rods.

Straightening the rod end portion 25 immediately after it passes through the die has been found to be much easier and better than straightening the end portion at a later period. When the rod is straightened immediately after being drawn through the die, age hardening of the metal which follows a cold drawing operation has not taken place and it is relatively easy to straighten the rod and overcome the stress and strains caused by the die. Age hardening of cold drawn rods is relatively rapid and apparently is accelerated by the heat generated when the rod is drawn. If such a rod is bent while being drawn, it will age harden so that by the next day relatively heavy straightening equipment will be required to straighten the rod.

I claim:

1. In a rod drawing apparatus having a straight draw line, the combination comprising, a bench, a die having an entrance side and an exit side disposed in a fixed position along the draw line on the bench, a push carriage movable along the bench toward and away from the entrance side of the die for advancing the leading end portion of a rod through the die upon movement toward the die, said die having a tendency to bend the leading end portion of the rod laterally in a direction away from the draw line, a pull carriage on the exit side of the die movable along the bench toward the die into an engaging position with the leading end portion of the rod which has been advanced through the die and movable away from the die to draw the remainder of the rod through the die, rod straightening means disposed adjacent the exit side of the die, support means for mounting the straightening means for movement into and out of an operable position in which the straightening means engages the leading end portion of the rod to straighten the end portion upon being bent when the rod is being advanced through the die, and actuating means for moving the straightening means into the operative position during movement of the push carriage and out of the operative position during movement of the pull carriage.

2. The combination of claim 1 in which the actuating means includes means operable responsively to movement of the push carriage toward the die to move the straightening means into operative position and means operable responsively to movement of the pull carriage to move the straightening means out of operative position.

3. The combination of claim 1 in which the actuating means includes cam means actuated by means responsive to movement of the push carriage toward the die to move the straightening means into operative position and by means operative responsively to movement of the pull carriage toward the die means to move the straightening means out of operative position.

4. The combination of claim 1 in which a member is disposed along the draw line between the rod straightening means and the die in position to engage the surface of the leading end portion only when the rod straightening means bends the leading end portion beyond the draw line, such member then consituting the sole point of contact of the leading end portion with the apparatus between the die and the rod straightening means.

5. In a rod drawing apparatus having a straight draw line, the combination comprising, a bench,

a die having an entrance side and an exit side disposed in a fixed position along the draw line on the bench, a push carriage movable along the bench toward and away from the entrance side of the die for advancing the leading end portion of a rod through the die upon movement toward the die, said die having a tendency to bend the leading end portion of the rod laterally in a direction away from the draw line, a pull carriage on the exit side of the die movable along the bench toward the die into an engaging position with the leading end portion of the rod which has been advanced through the die and movable away from the die to draw the remainder of the rod through the die, rod straightening means disposed adjacent the exit side of the die, the rod straightening means being operable to engage the leading end portion of the rod to prevent the end portion bending when the rod is being advanced through the die by the push carriage, and a member disposed along the draw line between the rod straightening means and the die in position to engage the surface of the leading end portion only when the rod straightening means bends the leading end portion beyond the draw line, the member then

constituting the sole point of contact of the leading end portion with the apparatus between the die and the rod straightening means.

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