ABSTRACT OF THE DISCLOSURE

The disclosure of this invention relates to a straightener machine for use in straightening I-beams and wide flange beams. The machine disclosed has a number of driven shafts, to the overhanging ends of which are mounted pairs of cooperative straightening tools, such as rollers. The innermost tool of each pair is rigidly mounted on the shaft and the outer one is slidable mounted to move toward and away from the inner tool. The outer tool is urged by a piston cylinder assembly into engagement with the beam which causes the beam to engage the inner tool in a manner that equal forces are imposed upon different portions of the beam by the pair of tools. The reaction forces of the tools and the piston cylinder assemblies are self-contained within their respective shafts. The disclosure also includes a potentiometer for measuring the displacement of at least one of the pistons of the piston cylinder assembly, which measurement reflects the distance between the pair of tools.

BACKGROUND OF INVENTION

Beam straighteners, in the past, have possessed two very serious limitations which have, of late, become very acute in view of recent changes in the design of the beams themselves and the increased need of productivity. At this point reference is made to an article appearing in the Journal of The Iron And Steel Institute (November, 1955 pp. 263-272, entitled “Roller-Straightening of Sections and Rails” by W. A. J. Dinwoodie, and U.S. Pat. No. 2,501,087 which issued to J. B. Picton et al. on Mar. 21, 1950 on Straightening Machine, both of which point out these limitations.

Prior art straightening machines involved considerable difficulty and lost production time in changing the tools or inserting or removing filler rings in order to accommodate the various size beams handled by the machine. In this connection it will be noted that this is the problem to which the above patent is addressed. An equally serious limitation of prior straightening machines, and particularly, when such machines were called upon to straighten beams with a large ratio in the thickness of the flange and web, was that in the straightening process cracks, and in many instances, total ruptures occurred in the portion of the beam joining the webs and flanges. This problem became so acute that some beams, although they fell within the load range of the machine, could not be straightened. In these beams the web sections were not strong enough to bend the flanges beyond their elastic limits which resulted in the webs being torn from the flanges. This result occurred in previous straighteners because of the fact that the tools of the straightener were held in a fixed relationship on their supporting arbors in which it was necessary to set the width of the tools so that their beam engaging surfaces were less than the inside dimension between the flanges of the beam. This was done in order to establish a clearance between the flanges and the tools to facilitate easy entrance of the beam into the straightener. Depending upon the initial straightness of the beam entering the straightener, this clearance created a situation where only one side of the beam would be engaged by the bending tools of the straightener. Such a condition, in addition to setting up shearing stresses in the web of the beam, also created substantial bending stresses, both of which acted together to cause fracture or tearing of the web from the flanges. In this connection reference is made to the above article which points out this serious problem.

SUMMARY OF THE INVENTION

The present invention, as noted above, is addressed to an improved straightening machine for beam, structural members and the like which, in a very simple, trouble-free arrangement overcomes both of the aforementioned limitations of prior straightening machines.

In one form of the present invention there is provided a machine for straightening structural members comprising a housing for rotatably supporting a plurality of parallelly arranged driven shafts, each carrying straightening tools, at least one tool carried by one of said shafts having a surface adapted to engage a distinct portion of the member relative to one of the other tools and applying a force sufficient to contribute to the straightening thereof, said one tool being axially adjustable relative to its shaft, power means associated with said one tool for adjusting said tool to vary the effective distance between the beam engaging surface of said tool and said member.

In another form of the present invention there is provided a machine for straightening elongated metallic structural workpieces, such as, beams, comprising a housing for rotatably supporting a plurality of parallelly arranged driven shafts, each of said shafts carrying a pair of cooperative tools, each tool of a cooperative pair having a surface adapted to engage discrete portions of a beam and applying a force to the beam sufficient to contribute to the straightening thereof; one of said cooperative pair of tools for each shaft being rigidly connected to their shafts, the other tools of the cooperative pairs of tools being shiftable carried by their shafts and displaceable relative to said other cooperative tools, means connected to each of said displaceable tools, each said cooperative pair of tools and its pressure means being constructed and arranged to exert substantially equal and opposite forces on said beam, and wherein the lateral force imposed upon said cooperative pair of tools are self-contained in said shaft.

In a still further embodiment of the present invention there is provided in connection with said pressure means, which may take the form of a piston cylinder assembly, means for determining the relative displacement of the piston relative to the cylinder thereof, whereby the distance between said cooperative pair of tools can be ascertained.

DRAWINGS

These features and advantages of this invention, as well as others, will be more correctly understood when the following description is read in the light of the accompanying drawings of which:

FIG. 1 is a partial elevational view of a structural straightening machine incorporating the features of the present invention;
FIG. 2 is a sectional view taken on FIG. 1; FIG. 3 is a fragmentary plan view of the tool position indicator illustrated in FIG. 2; and FIG. 4 is an enlarged view of a certain pressure means shown in FIG. 2.

DESCRIPTION OF THE INVENTION

With reference to the above figures and, particularly, to FIGS. 1 and 2, there is illustrated a housing made up from a base II to which is secured a series of lower front
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frames 12, an upright 13, an upper front frame 14, similar lower and upper frames are employed at the back of the machine, the upper back frame being identified as 15 on FIG. 2. It should be appreciated that the straightener is generally symmetrical so that only one-half has been shown.

The structure of the straightener itself is quite well known, as seen from the above article and patent, so that it need not be specifically described in every detail. The frames, 12, 14 and 15 are adapted to receive a plurality of cantilever supported straightener rollers 16 which are arranged in a staggered relationship and between which a beam to be straightened is fed. The rollers are adjustable, both horizontally and vertically, according to usual practice.

FIG. 2 better illustrates the construction of one of the rollers 16 and the interior construction of one of the supporting shafts. The other upper and lower rollers 16 are similarly mounted. The straightener rollers themselves each comprise two cooperative tools or collars 21 and 22 which engage the inner opposed flange sections, as well as a common side of the beam fed between the two cooperative pairs of rollers, which relationship is illustrated in FIG. 2. FIG. 2 also indicates, in phantom, an adjacent position of the outer tool 21 with respect to a similar pair of tools 21 and 22 carried by an arbor 23 which is rotatably received in a cartridge 24 in which connection, at the front, roller bearings 25 are provided and at the rear, a series of roller bearings 26. The cartridge 24 itself, which rotatably supports the arbor, is carried by the front and rear frames 14 and 15.

The arbor 23 is driven by a motor 27 which supplies torque to a gear 28 meshing with a gear 29, which, in turn, meshes with and rotates a gear 31. Gear 31 is in mesh with a second pinion 32 that drives a gear 33 secured to the arbor. The gearing 28, 29, 31 and 32 are received in a gear case 34. It will be noted that the second pinion 32 is rotatably carried by the cartridge 24.

Returning again to the front of the arbor, as noted previously, the tool 22 is rigidly secured to the arbor 23 in a manner that any lateral force imposed thereon is transferred to the arbor; whereas, the outer tool 21 is slidable received in a slot 36 formed in the arbor. The outer tool is adjustable relative to the inner tool and for which purpose there is provided a movable sleeve 37 which telescopes with the end of the arbor and is attached to the movable tool 21 at one end and at another end to a rod 38 by means of a nut 39. The rod 38 passes through a hole 41 provided through the arbor 23 to which it is connected at its opposite end a piston 42 of a piston cylinder assembly 43 mounted to the rear of the arbor. The cylinder 44 of the piston cylinder assembly is rigidly connected to the end of the arbor and rotates therewith, as best shown in FIG. 4.

The piston cylinder assembly 43 is double acting and for which reason, as illustrated in FIG. 4, there is provided a fluid pressure inlet pipe 45 which feeds fluid to a rotating joint 46 and, more particularly, to the inside of a sleeve 47, whereby fluid is introduced to the right side of the piston 42. Fluid from the other side of the piston 42 is received from a fluid pressure inlet pipe 48 which feeds fluid to the rotating joint 46 but to the other side of the sleeve 47 and conveyed by passageway 49 to the left side of the piston 42. In this manner the movable tool 21 is adjustable axially of the arbor so as to accommodate a wide range of different beams and, as noted before, eliminating entirely the need of removing and replacing the tools or requiring insertion or removal of filler rings. Of equal importance is the fact that the arrangement described allows the control of the pressure necessary to effect straightening of the beam.

It will be noted that tool 22 is rigidly carried by the arbor while the other tool of the piston 43 and that the lateral pressure against both tools in self-contained within the arbor, thereby eliminating axial forces. Moreover, the pressure of the piston cylinder assembly 43 is equally transmitted to each of the tools of a pair and which pressure can be controlled to meet the particular requirements for effecting straightening and obtaining the optimum straightening effect.

The adjustment of the tools also affords the ability of the straightener to control the dimension between the tools and the flanges of the beam so that, initially, a clearance can be allowed until entrance of the beam into the straightener, after which the operative relationship of the tools to the beam can be established. Also for certain beams a clearance can be established for the operational period so that, if desired, the machine can be operated in the same fashion as machines now in operation, but with a smaller clearance for optimum results.

It is important to note that in straightening beams, where care must be taken to avoid the development of detrimental shearing stresses, and bending stresses being developed, as previously noted, in employing the present invention full contact can be established and maintained between the two working surfaces of each tool and the beam. This is illustrated in FIG. 2 where it is seen that the tools are continually urged against the flanges of the beam in addition to engaging the webs simultaneously.

In order to quickly and, if desired, automatically adjust the position of the movable tools, this movement can be related to the displacement of the piston 41 which displacement can be measured as a representation of the position of the movable tool 21. This measurement may be made by any number of well-known devices, such as a potentiometer. The signal from the potentiometer is fed back to an electro-servo hydraulic valve. By this arrangement, the valve can be automatically operated to anticipate moving the tools into the operative position from an open position where the workpiece enters the zone of the rolls but is not contacted as yet by the tools. FIGS. 2 and 3 illustrate a potentiometer arrangement wherein a rod 51 is connected to the rod 38 of the piston and passes through the rotating joint 46. To the joint 46 is connected a lever 52, the lower end of which is associated with a potentiometer 53 or selsyn. On displacement of the piston 42 and hence the rod 51, the lever 52 is displaced accurately to operate the potentiometer 53. The signal of the potentiometer can be related to a gauge, not shown, which will be calibrated in terms of the maximum distance between the two tools.

While the present invention has been described in conjunction with a specific embodiment thereof, it will be appreciated by those skilled in the art that within the scope of the invention its features and advantages can be employed in other forms.

In accordance with the provisions of the patent statutes, I have explained the principle and operation of my invention and have illustrated and described what I consider to represent the best embodiment thereof. However, I desire to have it understood that within the scope of the appended claims, the invention may be practiced otherwise than as specifically illustrated and described.

I claim:

1. In a machine for straightening elongated metallic structural workpieces of varying widths, such as flanged beams, comprising: a housing for rotatably supporting a number of shafts, each of said shafts carrying a cooperative pair of tools, said pairs of tools being arranged to successively engage workpieces along a undulating path as they pass through the machine, each tool of said cooperative pairs having a working surface engageable with a different portion of the workpieces with respect to the other tool of the pair and being arranged to apply a straightening force to the workpieces, at least one of the tools of one of the cooperative pairs being nonshiftable by its shaft while the other tool of said one pair is shiftable carried by its shaft.
and displaceable axially of its shaft towards and away from the other cooperative tool of said one pair of tools,
pressure means connected to said shiftably carried tool for continuously urging its working surface in a manner to bring both of the working surfaces of said one pair of tools into engagement with different portions of varying width workpieces and cause them to exert substantially constant forces on said different portions of the workpieces.
2. In a machine according to claim 1, wherein said pressure means is controllable to cause said tools of said one pair to exert a predetermined straightening force on said workpieces.
3. In a machine to claim 1, wherein said pressure means includes means for placing said shiftable tool of said one pair so that the distance between the tools of said one pair is greater than the width of the workpieces, and means after the workpieces have entered between the tools of said one pair for bringing the tools thereof into engagement with the workpieces.
4. In a machine according to claim 1 wherein for the other pairs of cooperative tools, one tool of each said other pair is nonshiftably carried on its shaft and the other tool thereof is shiftably carried by its shaft and displaceable axially thereof towards and away from the other cooperative tool,
a pressure means connected to each of said other shiftable tools for urging their working surfaces in a manner to bring both of the working surfaces of each pair of said other tools into engagement with the workpieces and cause them to exert substantially constant forces on said workpieces.
5. In a machine according to claim 1 including means for driving the shaft of said one pair of cooperative tools.
6. In a machine according to claim 1 wherein said workpieces have opposed flange portions joined by a web portion, the working surfaces of the tools of said one pair comprise for each tool angularly disposed surfaces which engage one of the flanges and the web of the workpieces, said tools of said one pair arranged to engage the inside portions of said flanges and said shiftable tool being displaced towards and away from one of said flanges.
7. In a machine according to claim 1 wherein said shaft of said one pair of tools includes means for driving said shiftable tool in a manner to allow the tool to move axially of the shaft, said shaft having a central opening through which is arranged a rod,
means for connecting one end of said rod to said shiftable tool,
said pressure means comprising a piston cylinder assembly carried by the end of the shaft opposite the tools,
means for connecting said piston cylinder assembly to said shaft in a manner that the reaction force of the piston cylinder assembly and said one pair of tools are self-contained within the shaft.
8. In a machine according to claim 7 including means for rigidly connecting said nonshiftable tool to its shaft in a manner that the axial forces of the tool are transferred directly to said shaft,
means for securing said piston cylinder assembly to said shaft in a manner that its reaction force is transferred to the shaft but in a direction opposite to the direction of the axial force of said nonshiftable tool.
9. In a machine according to claim 1 wherein a displacement of a member of said pressure means from a reference point reflects the distance between the working surfaces of the tools of said one pair, and means for measuring the amount of displacement of said member of said pressure means.
10. In a machine according to claim 9 wherein said pressure means comprises a piston cylinder assembly and wherein said member comprises the piston thereof, said measuring means comprising a potentiometer adapted to measure the displacement of said piston.
11. In a machine according to claim 1 wherein said pressure means includes means for placing said shiftable tool of said one pair in a position so that the distance between the working surfaces of the tools of said one pair is less than the distance between said different portions of the workpiece while the workpiece is entering the zone of the tools but before actual engagement with the tools, after said entering has taken place, said last-mentioned means is adapted to increase the distance between the working surfaces of said tools of said one pair an amount greater than the distance between said different portions of the workpieces to bring the working surfaces into engagement with the workpiece.

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