April 26, 1938. B. H. URSCHEL 2,115,474

STRAIGHTENING MACHINE

Filed Feb. 28, 1936 3 Sheets-Sheet 1

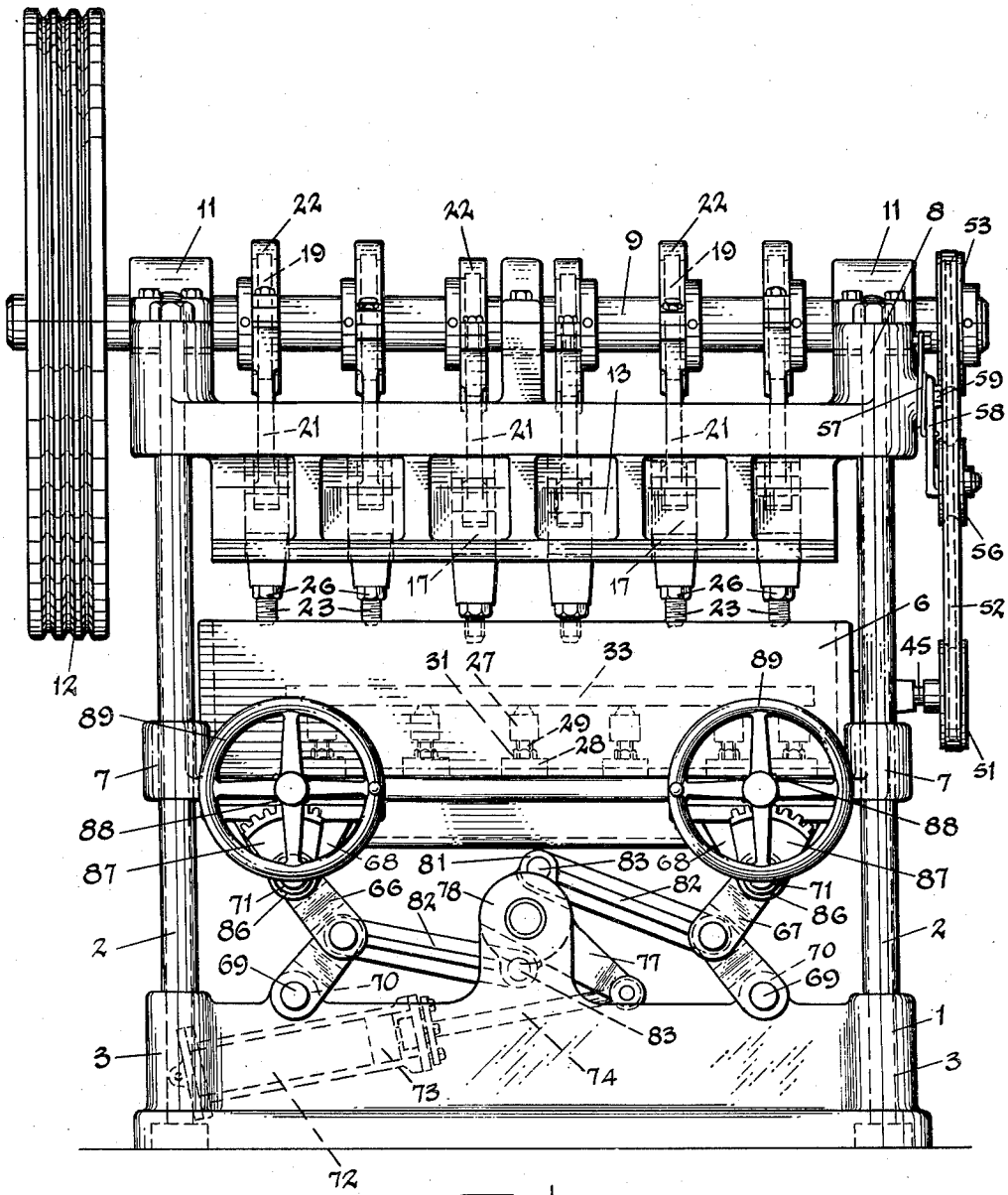


Fig 1

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STRAIGHTENING MACHINE

Filed Feb. 28, 1936 3 Sheets-Sheet 2

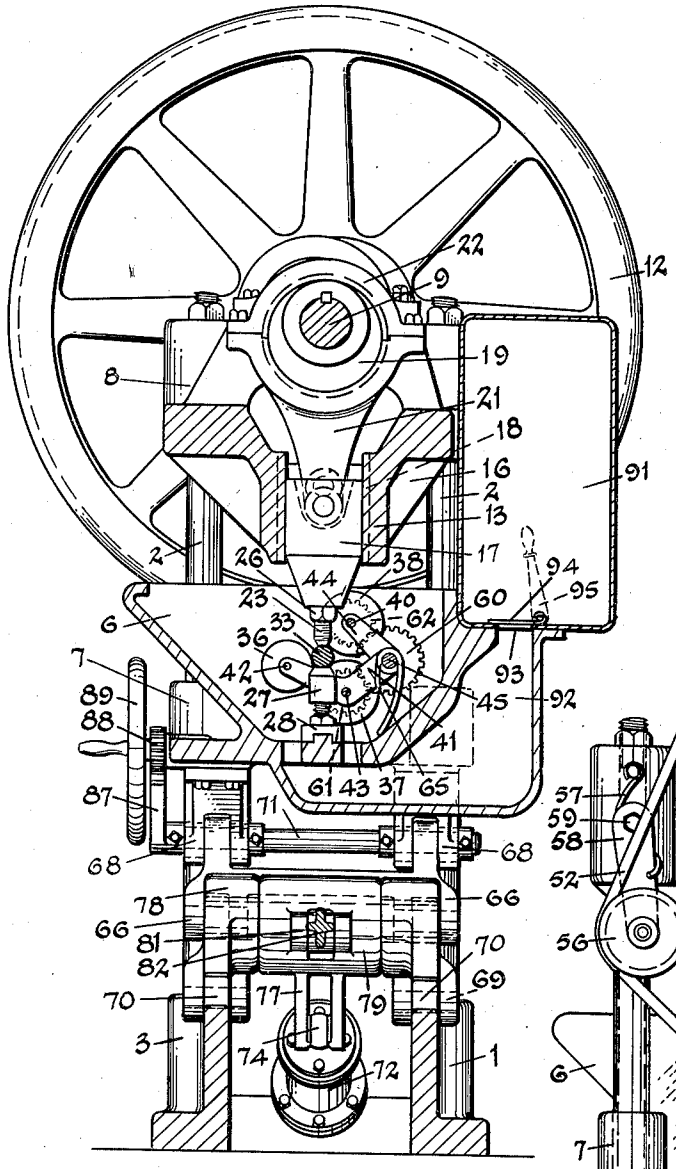


Fig 2

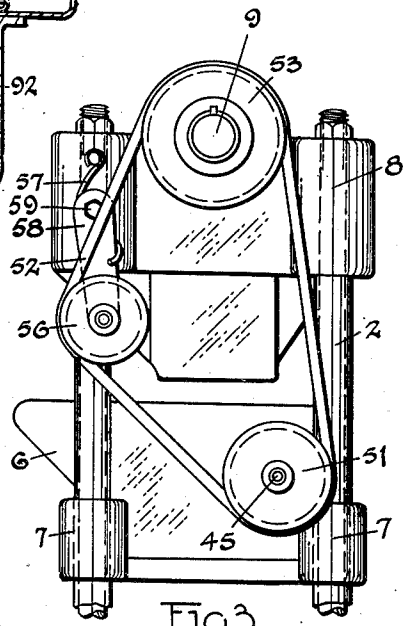


Fig 3

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STRAIGHTENING MACHINE

Filed Feb. 28, 1936 3 Sheets-Sheet 3

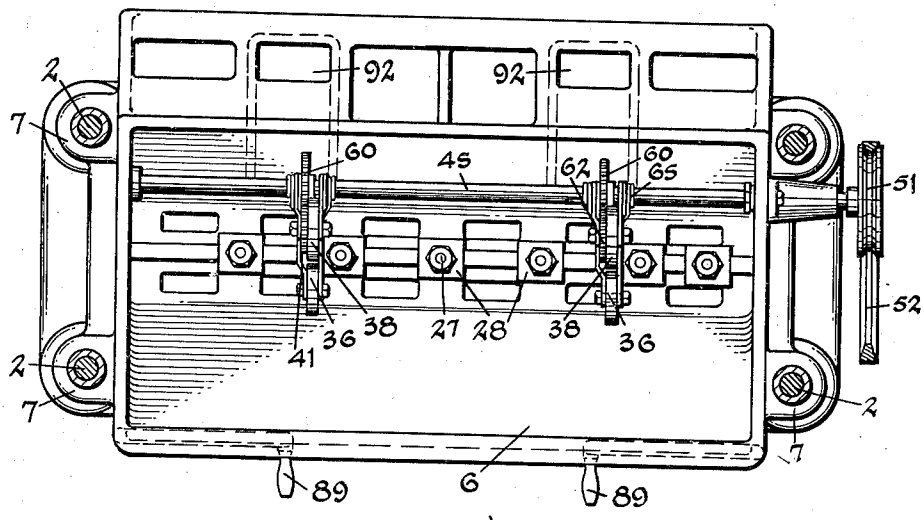


Fig 4

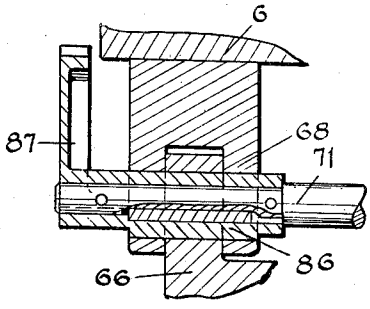


Fig 6

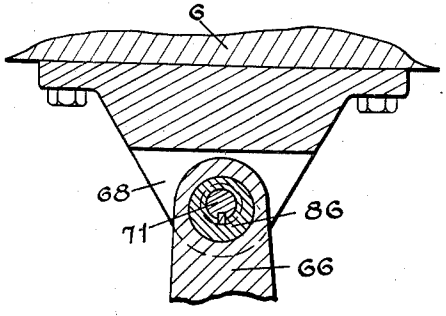


Fig 5

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UNITED STATES PATENT OFFICE

2,115,474

STRAIGHTENING MACHINE

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Application February 28, 1936, Serial No. 66,314

12 Claims. (Cl. 153—48)

My invention has for its object to provide means for progressively shaping or straightening articles while hot, and when shaped or straightened, the articles may be immediately submerged in a chilling or tempering material to produce a desired hardness. The invention also provides a machine wherein rapidly reciprocating plungers are caused to operate relative to simultaneously adjustable anvils located in a receptacle containing a cooling liquid for cooling the work as it is shaped by the plungers.

The invention also provides means for raising the work from the anvils and also, if desired, from the cooling liquid when the plungers release the work in their reciprocatory movements. Thus, the cooling of the work may be prolonged or controlled and the work may be shaped as it is cooled by adjustment relative to the working stroke of the plungers.

The invention may be contained in structures of different forms that may be varied in their details and still embody the invention. To illustrate a practical application of the invention, I have selected a straightening machine as an example of the various structures that contain the invention and shall describe the selected structure hereinafter, it being understood that certain features of my invention may be used to advantage without corresponding use of other features of the invention and without departing from the spirit of the invention as presented in the claims. The particular structure selected is shown in the accompanying drawings.

Fig. 1 is a side view of the machine selected as an example of my invention. Fig. 2 is a view of a cross section of the machine. Fig. 3 is an end view of the upper part of the machine and particularly illustrates a means for connecting the rotative drive elements of the machine. Fig. 4 is a top view of the tempering trough. Fig. 5 illustrates a broken view of an elevating means for raising a work supporting part. Fig. 6 illustrates a section of the part shown in Fig. 5.

In the particular form of construction shown in the drawings, the machine is provided with a base 1 in which are located the four uprights or tie rods 2. The tie rods 2 are suitably secured in bosses 3, formed in the corners of the base 1 and slidably support a suitable receptacle or trough 6 having sleeves 7 located in each of its lower corners. The upper ends of the tie rods 2 are secured to the head 8 of the machine on which is mounted a shaft 9 located in suitable bearings 11. The shaft 9 is driven by a suitable motor or other source of power that rotates the wheel 12 which is keyed to the shaft.

The head 8 is provided with depending walls 13 suitably reinforced with reference to the body of the head by means of webs 16 formed integral with the walls 13 and the body of the head. A plurality of plungers 17 are located between the walls 13. The plungers 17 and the side walls 13 are provided with suitable slots in which are located the keys 18 for guiding the plungers 17 in their reciprocatory movements. The plungers 17 are actuated by a plurality of eccentrics 19, keyed to the shaft 9 and connected to the plungers 17 by suitable links 21. The links are connected by the straps or yokes 22 to the eccentrics 19. For the purpose of description, the eccentrics 19 may be divided into three pairs of eccentrics consisting, respectively, of the two centrally disposed eccentrics, the two outer eccentrics, and the two intermediate eccentrics. The eccentrics of each pair are mounted to have the same angular relation to the shaft 9, while the different pairs are progressively spaced about the shaft 9 from the center outwardly in equal angular intervals of 120 degrees. This arrangement results in progressive straightening of the work by sequential operations of the plungers associated with the different pairs of eccentrics.

The plungers 17 may be formed square in cross section and their lower ends may be tapered. Hammers 23 of hardened steel may be secured in the lower ends of the plungers 17. The shanks of the hammers 23 may be threaded and the lower ends of the plungers may be tapped for adjustably connecting the hammers. They may be securely held in their adjusted positions by means of the lock-nuts 26.

A plurality of anvils 27 are located in the trough 6 for supporting the work. The trough may be provided with a ridge or a plurality of bosses or blocks 28 that may be integrally formed or suitably secured to the bottom of the trough. The blocks may be tapped and the shanks 29 of the anvils may be threaded for connecting the anvils to the blocks 28 located in the trough. The anvils may be adjustably secured in position with reference to the bottom of the trough by means of the lock-nuts 31.

If desired, the work engaging surfaces or anvils and the hammers may be suitably shaped to produce the desired shape of the article to be formed. Thus, the contacting surfaces of the anvils and the hammers may be formed concave where cylindrical articles are to be shaped or straightened.

The hammers and the anvils may be located in

any desired arrangement in order to efficiently shape the article. Consequently, certain of the anvils may be adjusted as to height, or certain of the hammers may be lowered to locate the engaging surfaces of the anvils and hammers in desired relations to the surface of the article, according to the results that are to be produced. The anvils and hammers may be located in axial alignment, or the hammers may be located in positions intermediate the anvils, or the hammers and anvils may be located at any desired relative spaced points. In the particular form of construction shown, the hammers engage the work at points intermediate the points at which the work is engaged by the anvils. The hammers are rapidly reciprocated and are caused to produce short strokes. The work may be gradually raised and is shifted with respect to the hammers to produce a progressive and gradual shaping of the article. The progressive shaping of the articles enables the molecules or parts of the steel of which the article is formed to adjust themselves with reference to the other molecules or parts of the articles as the shaping of the article is produced and eliminates reverse bending.

In the form of construction shown, the work is shifted or progressively or intermittently moved relative to the hammers when the hammers are withdrawn from the work. The work, in the particular illustration, is in the form of a bar **33** that may be provided with suitable flange or protruding parts or enlargements for coupling purposes, etc., and the anvils and the hammers may be correspondingly located or adjusted to straighten the bar.

In the form of construction shown, one or more sets of rollers **36**, **37**, and **38** may be located in the trough to frictionally contact the work **33** to cause its intermittent rotation. The rollers **36** and **37** of each set are supported on arms **41** to which they are pivotally connected by the pins **42** and **43**. The arms **41** are pivotally supported on a shaft **45** that extends the length of the trough **6** and is rotatably supported in suitable bearings located on the ends of the trough. The rollers **38** are located intermediate the arms **44** which are connected together by the pins **40** that also rotatably support the rollers **38**. The arms **44** may be located intermediate the arms **41** to secure the friction rollers in their opposed relation with respect to the work **33**.

The shaft **45** is connected to and driven by a pulley wheel **51**. The wheel **51** is rotated by a belt **52** that moves over the pulley **53** connected to the drive shaft **9** of the machine. To provide for the raising and lowering of the trough **6** along the tie rods **2**, the belt **52** moves over an idler **56** rotatably supported on an arm **58**, pivotally supported on the head **8** by a stud **59**. The arm **58** is spring pressed by means of the spring **57** connected to the head **8** of the machine and to the arm **58**.

The shaft **45** is provided with the gear wheels **60** that are located intermediate the arms **41** and **44** and suitably keyed or secured to the shaft **45**. The rollers **37** are connected to the gear wheels **61**, and the rollers **38** are connected to the gear wheels **62**. The gear wheels **61** and **62** mesh with the gear wheels **60** and on rotation of the shaft **45**, the rollers **37** and **38** are rotated. The roller **36** is an idler and rotates with the work. It coacts with the roller **37** to support the work when the work is raised from the anvils.

The frames, formed by the pin-connected arms **41**, are yieldingly held in their normal positions by means of the springs **65** that engage the arms **41**. The springs extend around the shaft **45** and form a central loop that engages a side wall of the trough to enable limited relative swinging movements of the arms about the shaft. The springs normally locate the rollers in position for supporting the work a short distance above the anvils and when thus supported, the work may be rotated by the rotation of the rollers that contact therewith. When the hammers **23** engage the work, the arms **41** are depressed against the yielding resistance of the springs **65**, and the work **33** is brought against the anvils **27** and rotation of the work ceases by reason of engagement of the work between the hammers and the anvils which causes the belt **52** to slip on the pulleys **51** and **53**. When the hammers are raised from the work, the work is raised a short distance from the anvils by the springs, and rotation of the work continues. The rate of rotation relative to the rate of reciprocation of the hammers may be varied. Ordinarily the rods are rotated about 100 revolutions per minute, while the hammers produce 300 double blows per minute.

The trough may be lowered to enable ready insertion of the work **33** in position between the rollers **36**, **37**, and **38** and may then be raised to a position for engagement of the hammers. The trough is raised and lowered by means of the toggles **66** and **67** connected to the base **1** and connected to the trough **6**. The trough is provided with bearing parts **68**, and the base is provided with the bearing parts **70**. The bearing parts are located near the corners of the base and the trough. The toggles are connected to the base by suitable pins **69** that extend through the bearings **70** and also to the bearings **68** by means of the pins **71**. The toggles are pneumatically operated by means of the cylinder **72** that may be connected at its end with a suitable source of supply of air under pressure to produce reciprocation of its piston **73**. One end of the cylinder is pivotally connected to the base **1** to enable oscillation of the cylinder and its piston rod. The piston is connected to an arm **77** by the piston rod **74**. The arm **77** is pivotally supported in bearing parts **78** that protrude upwardly from opposite side parts of the base **1**. The arm **77** may be provided with a suitable hub **79** having lugs **81** to which are connected links **82** by means of suitable pins **83**. The links **82** connect with the central joints of the toggles **66** and **67**, and rotation of the arm **77** operates the toggle joint to lower the trough **6** or to move the toggle joint towards the lines of centers of the toggles to raise the trough to the desired point according to the extent of the stroke of the piston **73**.

In the operation of the machine, the work may be readily pressed into position between the rollers, and the cylinder **72** may be then connected by means of suitable valves and pipe connections with a source of supply of air under pressure to raise the trough **6** and to locate the work in position to be operated upon by the hammers. In order that the work may be progressively shaped during the operation of the hammers, the trough may be progressively raised at either end or at both ends to regulate the effect of the reciprocatory movements of the hammers on the work or to produce the desired variable effects of the hammers on the work.

In order to thus accurately adjust the work as the bending operation progresses, the bearing pins or rods **71** are supported eccentrically in

bearing sleeves 86 that are connected to the sector gears 87. The sector gears mesh with pinions 88 located on suitable stub-axles to which the hand wheels 89 may be connected. Rotation of the sectors 87 by the hand wheels operates to shift the sleeves 86 relative to the bearing pins 71 and thus to graduate the elevation of the work relative to the hammers. The hand wheels 89 may thus be rotated to progressively move the work towards the hammers in order to produce accurate and progressive operation of the hammers on the work.

Thus, the work may be raised to a temperature above the critical temperature for tempering purposes and quickly and readily inserted in position in the trough and rapidly shaped by the operation of the hammers and anvils and, upon completion of the shaping operation, the work may be submerged in a tempering fluid or material to produce a desired degree of hardness. If desired, the work may be rotated by rotation of the shaft 45 through connections with the source of power that may be, if desired, independent of the connections with the shaft 9 to which the hammers are connected. Thus, the work may be rotated in advance of being flooded and also when submerged to produce a uniform chilling of the work and prevent distortion. In the form of construction shown, the hammers are operated and the work is rotated when the work is submerged to produce uniform chilling of the work and completion of the straightening operation during the chilling in the heat treatment of the work. A reservoir 91 is supported on the trough 6 and may be connected therewith by a suitable duct 92. The reservoir 91 may contain oil and may be provided with a suitable outlet 93 that is controlled by a clap valve 94 to flood the trough and cover the work with the oil to chill the work. The valve may be suitably operated as by an arm or handle 95. A suitable pump may be supported on the trough for pumping the oil from the trough to the reservoir when it is desired to withdraw the oil from the trough in advance of inserting the hot metal for shaping and preparatory to the subsequent tempering of the work.

I claim:

1. In a shaping machine, a plurality of anvils for supporting the work at spaced points, a plurality of hammers, means for reciprocating the hammers to engage the work, and means controlled by the said hammers for moving the work relative to the anvils in advance of the engagement of the work by the hammers.

2. In a shaping machine, a plurality of anvils for supporting the work at spaced points, a plurality of hammers, means for reciprocating the hammers to engage the work sequentially, and means controlled by the sequentially engaging hammers for moving the work relative to the anvils in advance of the engagement of the work by the hammers.

3. In a straightening and tempering machine, a receptacle for containing a cooling fluid, means for submerging the work in the cooling fluid, a plurality of anvils located in the receptacle for supporting the work at spaced points, a plurality of hammers, and means for reciprocating the hammers to engage the work, means for shifting the work relative to the anvils during the intervals intermediate the engagement of the work by the hammers to progressively shape the work.

4. In a straightening and tempering machine, a receptacle for containing the cooling fluid, means for submerging the work in the cooling fluid, a plurality of hammers, means for moving the receptacle relative to the hammers, a plurality of anvils located in the receptacle for supporting the work at spaced points, means for shifting the work relative to the anvils, means for adjusting the anvils simultaneously relative to the hammers, means for reciprocating the hammers to engage the work at points intermediate the points of support by the anvils to progressively shape the work.

5. In a shaping machine, a plurality of anvils for supporting the work piece at spaced points, a plurality of plungers, means for reciprocating the plungers for sequentially engaging the work piece to progressively shape the work, and means for progressively moving the anvils simultaneously toward the work engaging parts of the plungers and in a direction parallel to the lines of reciprocation of the plungers as the work piece is shaped by reciprocation of the plungers.

6. In a straightening and tempering machine, a receptacle for containing a cooling liquid, a plurality of anvils located in the receptacle for supporting the work at spaced points, a plurality of plungers, means for raising the receptacle with respect to the hammers, and submerge the work in the liquid, means for reciprocating the plungers to sequentially engage the work, and means for shifting the work relative to the anvils intermediate the engagements of the work by the plungers.

7. In a straightening and tempering machine, a receptacle for containing a cooling liquid, a plurality of anvils located in the receptacle for supporting the work at spaced points, means for raising the work from the anvils, a plurality of plungers, means for reciprocating the plungers for submerging and depressing the work into the cooling liquid and against the anvils.

8. In a straightening and tempering machine, a receptacle for containing a cooling liquid, a plurality of anvils located in the receptacle for supporting the work at spaced points, means for raising the work from the anvils, a plurality of plungers, means for reciprocating the plungers for submerging and depressing the work into the cooling liquid, and against the anvils, and means for shifting the work relative to the anvils intermediate the engagement of the work by the plungers.

9. In a shaping machine, a plurality of anvils, means for yieldingly supporting the work at spaced points and in spaced relation with respect to the anvils, a plurality of hammers, means for reciprocating the hammers to move the work from the said spaced relation to the anvils and shape the work, and means for intermittently shifting the work relative to the anvils and the hammers during intervals intermediate the hammer engagements to progressively shape the work.

10. In a shaping machine, a plurality of anvils arranged in a line conforming to the configuration of the work piece and for supporting the work piece at spaced points along the work piece, a plurality of hammers for engaging the work piece at points between the anvils, and means for reciprocating the hammers to produce sequential engagement of the work piece by the hammers in pairs, and simultaneous engagement of the work piece by the hammers of each pair, the most central of the anvils located intermediate each of said pairs of hammers.

11. In a shaping machine, a plurality of an-

vils arranged in a line conforming to the configuration of the work and for supporting the work at spaced points along the work, a plurality of pairs of hammers, the hammers located to engage the work at points intermediate the anvils, the hammers of each pair disposed to engage the work on opposite sides of the central part of the portion of the work located in engaging relation to the anvils, and means for reciprocating the hammers to produce sequential engagement of the work in pairs and simultaneous engagement of the work by the hammers of each of the pairs.

12. In a shaping machine, a plurality of anvils for supporting the work at spaced points along the work, a plurality of pairs of hammers, the hammers operative to engage the work at points intermediate the points of engagement of the work by the anvils, the hammers of each pair located on opposite sides of a centrally disposed anvil and the hammers of different pairs located at different distances from the said centrally disposed anvil, and means for reciprocating the hammers to produce sequential engagement of the work in pairs.

BERTIS H. URSCHEL.