Feb. 27, 1973 E. WERNER 3,718,025

MACHINE FOR STRETCHING MATERIAL PRIOR TO ROLLING OR FORGING

Filed March 12, 1971 2 Sheets-Sheet 1

FIG. 1

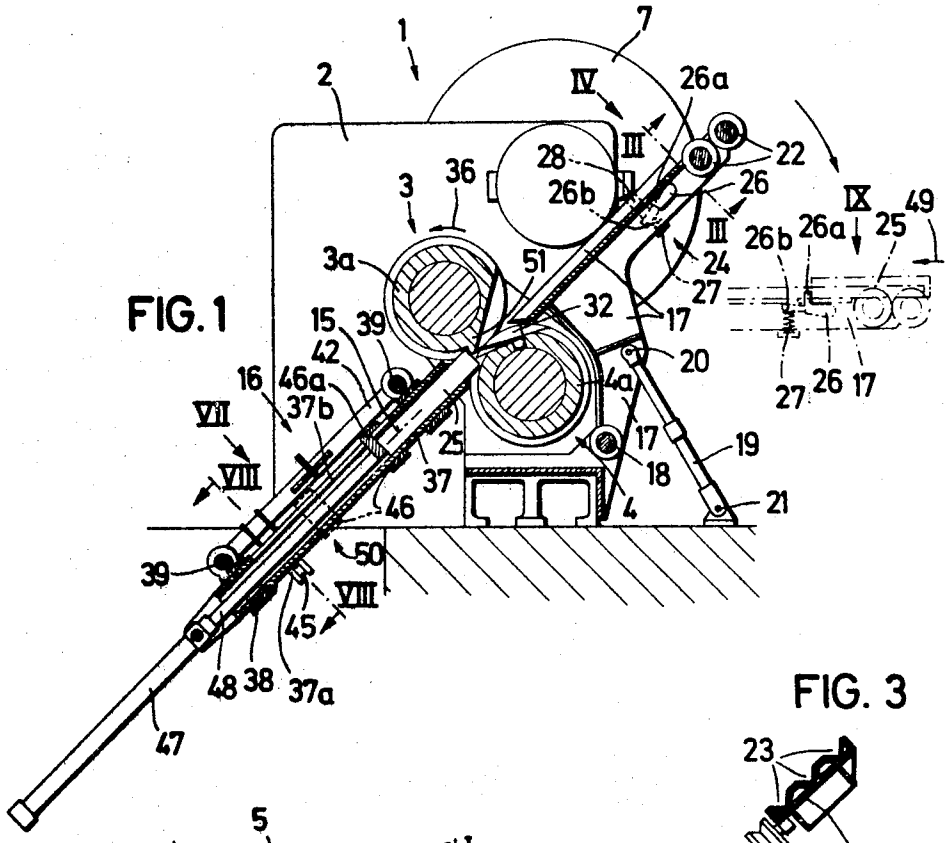

FIG. 3

FIG. 2

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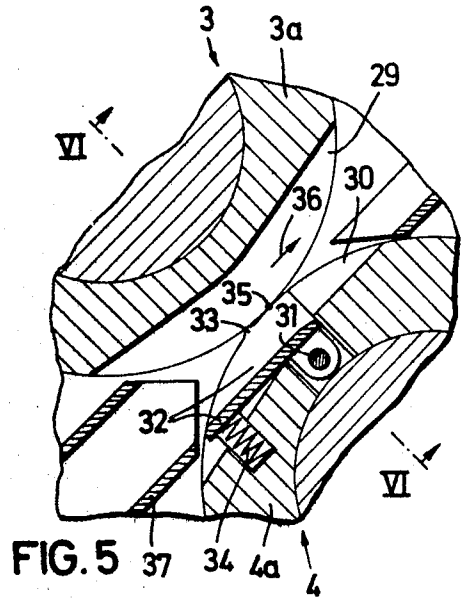

FIG. 5

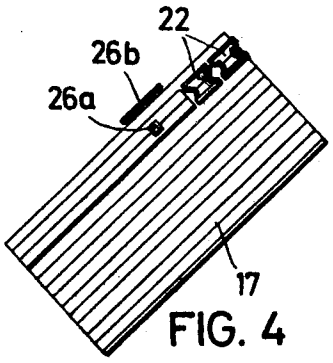

FIG. 4

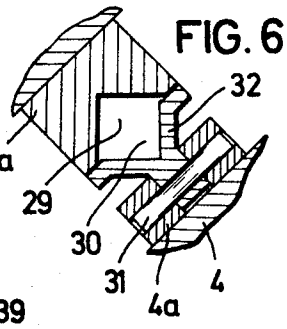

FIG. 6

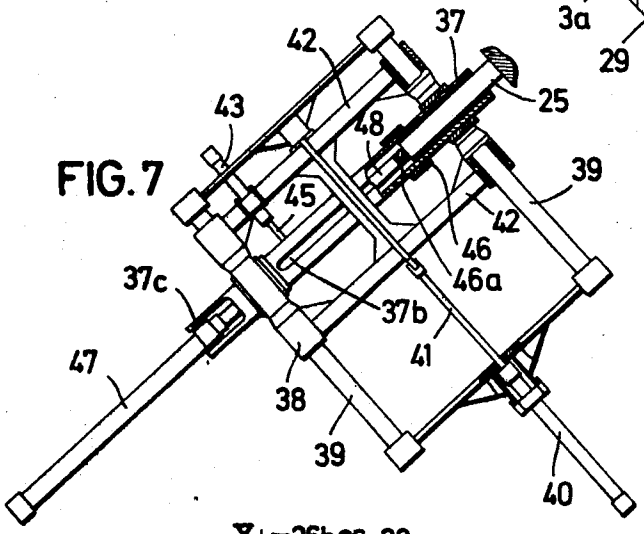

FIG. 7

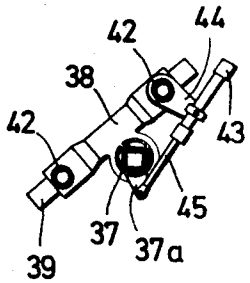

FIG. 8

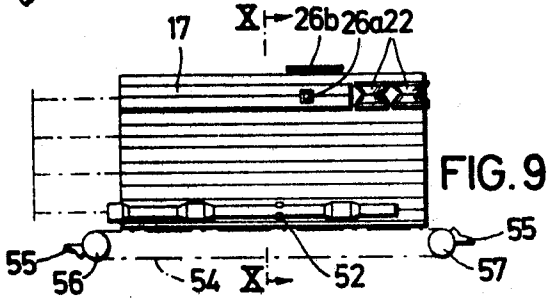

FIG. 9

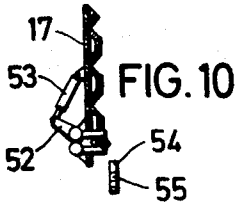

FIG. 10

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MACHINE FOR STRETCHING MATERIAL PRIOR TO ROLLING OR FORGING

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Claims priority, application Germany, Mar. 14, 1970, P 20 12 249.0
Int. Cl. B21b 39/14
U.S. Cl. 72—222 19 Claims

ABSTRACT OF THE DISCLOSURE

A machine for stretching workpieces comprises a pair of rolling tools, each rolling tool having a plurality of parallel annular segments on the cylindrical surface thereof such that workpieces are rolled between successive pairs of segments as they pass between the rolling tools. The rolling tools are positioned such that the rolling plane therebetween is located in a path inclined at an acute angle relative to the horizontal. Conveyor means is provided for successively feeding workpieces upwardly along the inclined path to successive segments of the pair of rolling tools and a pivotally mounted supporting table is provided at the opposite side of the pair of rolling tools, the surface of the table being along the inclined path for receiving workpieces from the rolling tools. Recesses are provided at one point in the surface of each of the rolling tools, rotation of the rolling tools being controlled such that they stop with the recesses facing each other forming a passage therebetween so that workpieces may slide downwardly from the supporting table through the passage to the conveyor means and then be conveyed upwardly as the pair of rolling tools begin to rotate again, whereby the workpiece may be rolled and carried upwardly onto the supporting table again and the cycle repeated a predetermined number of times.

The present invention relates to machines used for rolling workpieces or preforms to stretch the workpieces before they are subjected to forging hammers and die forging presses. These machines are known as stretching roll machines and comprise a pair of driven rolling tools, each of the rolling tools having a plurality of annular parallel segments in the cylindrical surface thereof whereby a workpiece may be rolled by passing it a number of times between the rolling tools, each time passing it between a different pair of opposed segments.

Different types of conveying means are provided in known machines for feeding the workpiece to the pair of rolling tools. These include a collet chuck which must be controlled by an operator durnig the entire rolling operation. In the case of heavy workpieces the collet chuck is manipulated by mechanical means. Workpiece conveying arrangements are also known which provide fully automated operation and are mechanically driven synchronously with the driven rolling tools during the rolling operation.

A common feature of all of these conveying arrangements for rolling machines is that the workpiece is rolled along a plane which is substantially horizontal. Thus, with conveying arrangements which operate in a partial or fully automatic manner, it is necessary to provide an appropriate drive and guide arrangement for the collet chuck over the entire rolling length. Also, there is a tendency with known rolling apparatus for a workpiece, when it has exceeded a certain length to bend downwardly because of its own weight after it has passed between the rolling tools. When rolling out such workpieces by hand,

the tendency to bend can be counteracted by appropriate supporting tables, but in the case of mechanized or automatic rolling machines which roll the workpiece in a horizontal plane, devices to support the elongated workpiece and prevent bending become costly. It is possible to construct a fully automatic workpiece conveying arrangement to operate along a vertical path in order to counteract the bending tendency of the workpiece, but with this arrangement it is necessary for the workpiece to be held and driven during the entire rolling operation requiring a complex machine which again is costly, particularly in the case of workpieces of substantial length.

It is an object of the present invention to provide a machine for stretching workpieces by rolling which includes a conveying arrangement for handling long workpieces which is simply designed and not costly and yet avoids the possibility of the workpiece bending.

The machine for stretching workpieces according to the invention is constructed in such a manner that the pair of driven rolling tools is arranged with the rolling plane inclined at an acute angle relative to the horizontal, and the conveying and support means are arranged to convey and receive workpieces in the same inclined plane. The driven rolling tools rotate such that the rolling operation is carried out in only one direction with the workpiece being carried upwardly along the inclined plane. The conveying means for conveying the workpieces to the driven rolling tools is arranged below the driven rolling tools to convey the workpieces along a path which is also inclined with respect to the horizontal and the receiving means on the opposite side of the rolling tools is arranged to receive the rolled workpiece along the same plane. By constructing the stretching machine in this way, substantially longer workpieces can be rolled without the workpieces bending, and the machine can be designed to operate automatically without the need for a full-time attendant.

Furthermore, by utilizing an inclined rolling plane a substantial saving can be achieved in the complexity of the conveying means for the workpiece. The rolling operation proceeds with the workpiece being moved upwardly from below along the inclined path, and after the rolling operation has been carried out on the workpiece, the rolled workpiece slips back automatically along the path into the starting position for the rolling operation. The conveying arrangement is in general simpler in construction and more easily controlled. No special conveying system is required for the workpiece both during rolling and after rolling for returning the rolled workpiece. This is particularly; advantageous when rolling exceptionally long workpieces. It is not necessary to use collet chucks and there is the further advantage that it is possible to roll workpieces without the so-called chuck end, i.e. without the workpiece end required for gripping in the chuck. Thus, the workpiece can be rolled over its entire length.

The supporting table provided above the rolls for the workpieces is advantageously made to be capable of pivoting between a horizontal position and an inclined plane position of the conveying arrangement. As a result, the feeding of the workpiece to the conveying arrangement and the removal or conveying-away of the finished rolled workpiece is facilitated.

Other objects and advantages of the invention will become apparent in the following description of an embodiment therein wherein:

FIG. 1 is a cross-sectional side view of the machine for stretching workpieces;

FIG. 2 is a front view of the machine shown in FIG. 1, the cross-section shown in FIG. 1 being taken along the line I—I of FIG. 2;

FIG. 3 is a cross-sectional view of the supporting table and taken along the line III—III of FIG. 1;

FIG. 4 is a plan view of the supporting table in the direction of the arrow IV of FIG. 1;

FIG. 5 is a cross-sectional view showing the rolling tools in greater detail;

FIG. 6 is a cross-sectional view taken along the line VI—VI of FIG. 5;

FIG. 7 is a plan view of the conveying means in the direction of the arrow VII in FIG. 1;

FIG. 8 is a cross-sectional view taken along the line VIII—VIII of FIG. 1;

FIG. 9 is a plan view of the supporting table in the horizontal position in the direction of the arrow IX of FIG. 1; and

FIG. 10 is a cross-sectional view of the supporting table taken along the line X—X of FIG. 9.

The machine for stretching workpieces shown generally at **1** comprises a pair of rotatably mounted rolling tools **3** and **4** arranged adjacent each other. The rolls **3** and **4** are driven by a motor **5** and pulley **6** which is connected by a V-belt to a flywheel **7**. A coupling **8** is driven by the flywheel **7** and drives a transmission in housing **2** which includes a pair of gear wheels **13** and **14** of equal size. The rolling tools **3** and **4** are rotatably mounted between the housing **2** on the one side and the housing **9** on the opposite side and are driven through the gear wheels **13** and **14** of the transmission. The housing **9** is horizontally displaceable along guide **10** in order that the rolling tools **3** and **4** may be changed. A rotatably mounted screw in the guide **10** is connected to reversible motor **12** through spindle **11** whereby the housing **9** can be moved in both directions along the guide **10**.

The pair of rolling tools **3** and **4** are so arranged that their rolling plane **15** is inclined at an acute angle relative to the horizontal. Advantageously, the inclination should be about 45°.

Above the pair of rolling tools **3** and **4** is a supporting table **17** which is pivotably mounted on shaft **18**. Movement of the supporting table **17** about the shaft **18** is controlled by a hydraulic cylinder **19** pivotably mounted at one end on the table **17** at **20** and at the other end at **21**. The supporting table **17** may be moved by the hydraulic cylinder **19** between an inclined position as shown in solid lines in FIG. 1 and a horizontal position shown in dotted lines also in FIG. 1. In the inclined position the surface of the supporting table **17** is in line with the rolling plane between the rolling tools **3** and **4**.

Each of the rolling tools **3** and **4** are divided into a plurality of parallel annular segments in the cylindrical surface thereof, the annular segments of the rolls being in line with each other. The surface of the supporting table **17** includes a plurality of longitudinal guides or recesses **23** each of which is in line with a pair of segments on rolling tools **3** and **4**. The first guide **23** of the supporting table **17** which is on the left as seen in FIG. 2 is the entry guide for receiving new workpieces to be rolled. The entry guide includes a pair of rollers **22** and a stop **24** for retaining the workpiece **25** after it has been pushed or laid on the supporting table. The stop comprises a lever **26** having a retaining element **26***a* extending into the entry guide. The lever **26** is further provided with an extension **26***b* which is biased by spring **27**. A pin **28** is provided on the machine for depressing the lever **26** causing withdrawal of the retaining element **26***a* automatically when the supporting table **17** is moved from its horizontal position to its inclined position. This automatically releases the workpiece **25** permitting it to slide downwardly towards the rolling tools **3** and **4**.

Each of the segments of the rolling tools **3** and **4** includes recesses **29** and **30** in the cylindrical surface thereof as seen in FIG. 5. The two recesses **29** and **30** together form a passage through which a workpiece may pass downwardly from the supporting table when the rolling tools **3** and **4** are stopped with the recesses **29** and **30** adjacent each other. Since the rotating rolling tools **3** and **4** are stopped by a friction brake after the machine has been turned off, variations will occur in the stopping positions of the rolling tools **3** and **4** which in some instances could prevent passage of a workpiece through the passage. To prevent this, a guide **32** is pivotably mounted on pin **31** in the recess **30** of the lower rolling tool **4**. The pivoted guide **32** is pressed outwardly by compression spring **34**. A cam surface **33** on at least one side of the pivoted guide **32** is designed to press against the cylindrical surface of the upper rolling tool **3** if the rolling tools **3** and **4** stop at a position beyond the predetermined stopping point **35**, the rolling tools **3** and **4** moving in the direction of the arrow **36** as they approach the stopping point **35**. The cam surface **33** is pressed downwardly if the rolling tools **3** and **4** stop beyond the stopping point **35** causing the pivoted guide **32** to move downwardly assuring the necessary space between the rolling tools **3** and **4** for the workpiece **25** to pass therethrough from the supporting table **17**.

On the lower side of the rolling tools **3** and **4** opposite the supporting table **17** is a conveying apparatus shown generally at **16** for receiving the workpiece after it has passed through the passage between the rolling tools **3** and **4** and for moving the workpiece laterally while rotating it about its longitudinal axis to position it in line with a different pair of segments in the rolling tools **3** and **4**. The conveying apparatus **16** comprises a carriage **38** which is slidable laterally along tubes **39**. Lateral movement is controlled by a hydraulic cylinder **40**, the rod of which is connected to cross-member **42**, a part of the carriage **38**. Mounted on the carriage **38** is a guide tube **37** designed to accommodate a workpiece **25**. The guide tube **37** is rotatably mounted, the rotational movement being controlled by a hydraulic cylinder **43** rotatably mounted on a holder **44** of the cross-member **42**, the rod **45** of the hydraulic cylinder being pivotally connected to an arm **37***a* fixed to the guide tube **37**. A single stroke of the hydraulic cylinder is designed to rotate the guide tube about its longitudinal axis through 90°. To support the workpiece **25** in the guide tube **37** a sleeve **46** is slidably mounted on the exterior surface of the guide tube **37** The sleeve **46** includes an inwardly projecting tongue **46***a* which passes through a longitudinally extending slot **37***b* into the interior of the guide tube **37**. The tongue **46***a* abuts the end of a rod **48** associated with a hydraulic cylinder **47** mounted at the rear end **37***c* of the guide tube **37** such that the hydraulic cylinder **47** is displaced laterally with the carriage **38**. It will be appreciated that the guide tube **37** for receiving the workpiece **25** is inclined and positioned in the same plane as the rolling plane of the rolling tools **3** and **4** so that movement of the workpiece both during the rolling step when the workpiece moves upwardly and during its downward movement through the passage between the rolling tools **3** and **4** is along a path which is inclined at an acute angle relative to the horizontal.

The operation of the machine for stretching workpieces will now be described. A workpiece **25** heated to rolling temperature in a furnace is fed in the direction of the arrow **49** to the supporting table **17** while it is in its horizontal position. The workpiece is fed into the first recess on rollers **22** and as far as the retaining element **26***a*. Sensing means (not shown) serves to actuate the hydraulic cylinder **19** causing the supporting table **17** to be swung upwardly to its inclined position where the pin **28** on the machine housing **2** presses the lever **26** moving the retaining element **26***a* downwardly thereby releasing the heated workpiece whereby it slides down by its own weight through the passage formed by recesses **29** and **30** in the rolling tools **3** and **4**, the pivoted guide **32** insuring that if the rolling tools have deviated from their predetermined stopping position the downwardly sliding workpiece **25** will be able to pass into the guide tube **37** of the conveying apparatus **16**. The tongue **46***a* held by the hydraulic cylinder **47** and the rod **48** is located in a position **50** indicated in dotted lines in FIG. **1**. The rolling tools **3** and

4 are then rotated to a starting position as shown in FIG. 1 whereupon the hydraulic cylinder **47** is actuated causing the tongue **46***a* supporting the workpiece **25** to move upwardly along the inclined plane until the leading end of the workpiece **25** presses against an abutment **51** in the upper rolling tool **3**. At this point, the rolling operation begins, the workpiece **25** being drawn upwardly through the rolling plane as the rolling tools **3** and **4** rotate. To insure that the workpiece is properly engaged by the rolling tools **3** and **4**, the hydraulic cylinder **47** continues to push the workpiece **25** upwardly for at least the initial part of the rolling operation. Then, when a predetermined angular position for the rolling tools **3** and **4** has been reached, the hydraulic cylinder **47** is reversed and the tongue **46***a* with the sleeve **46** is caused to move downwardly and to return to its original position **50**. In the meantime, the workpiece **25** is deformed and stretched between the first segments of the rolling tools **3** and **4** and is pushed onto the first guide or recess of the supporting table **17**. The rolling tools **3** and **4** continue to rotate until they reach their predetermined stopping position at point **35** whereupon the rolled workpiece automatically slides back off the supporting table **17** and through the passage formed by the recesses **29** and **30** into the guide tube **37** where the workpiece is stopped by the tongue **46***a* at position **50**. The guide tube **37** is then rotated about its longitudinal axis by actuation of the hydraulic cylinder **43** through an angle of 90°, and at the same time the carriage **38** is moved laterally by the hydraulic cylinder **40** by a distance equivalent to the distance between segments on the rolling tools **3** and **4** whereby the guide tube **37** is in line with the second segments of the rolling tools **3** and **4**. During this rotational and lateral movement of the guide tube **37**, the rolling tools **3** and **4** are rotated slightly so that when the hydraulic cylinder **47** is again actuated pushing the workpiece **25** upwardly the leading end of the workpiece is pressed against the abutment **51** of the next segment of the rolling tool **3**. Subsequently, the rolling tools **3** and **4** are again rotated and the rolling operation is repeated. The operating cycles described continue until each pair of segments of the rolling tools **3** and **4** has performed a rolling operation.

After the workpiece **25** has been rolled in the last pass the finished rolled workpiece is retained in the last recess **17** on the right as viewed in FIG. 2 by a clamping device **52** operated by a hydraulic cylinder **53**. Sensing means (not shown) detects the presence of the workpiece **25** in the last recess **17** and actuates the hydraulic cylinder **19** to pivot the supporting table **17** downwardly to its horizontal position. At this position, a conveyor belt **54** having dogs **55** and extending between pulleys **56** and **57** causes the finished workpiece **25** to be pushed from the lowered supporting table **17** onto the conveyor belt to be conveyed away after the clamping device **52** has been released. While the finished workpiece **25** is being conveyed away, a new workpiece is supplied to the supporting table **17** onto the rollers **22** in the manner described earlier.

Since the workpiece **25** is moved upwardly at an inclination by the rolling operation and can then slide downwardly by its own weight into its initial position in the guide tube **37**, the need for a separate drive mechanism to move the workpiece in either direction has been eliminated. The tongue **46***a* in the guide tube **37** serves a double function. It operates to brake the downward movement of the workpiece after it has passed through the passage between the rolling tubes **3** and **4**, and it further operates to drive the workpiece upwardly against the abutment **51** in the upper rolling tool **3** and into engagement between the rolling tools **3** and **4**. The rolling operation is carried out at sufficient speed pushing the workpiece upwardly along the inclined path at a sufficient rate onto the inclined supporting table that sufficient time remains for braking the rolling tools **3** and **4** in order that they may be stopped at the predetermined point **35** before the workpiece slides downwardly on the supporting table and through the passage between the rolling tools **3** and **4**. Optionally, the clamping device **52** for retaining a workpiece in the last recess of the supporting table **17** can be located along all of the recesses **23** in the supporting table to retain the workpiece in each recess for a longer period of time if this is necessary to stop rotation of the rolling tools **3** and **4**.

As many embodiments may be made of the above invention, and as changes may be made in the embodiment set forth above, without departing from the scope of the invention, it is to be understood that all matter herein set forth or shown in the accompanying drawings is to be interpreted as illustrated only and not in a limiting sense.

I claim:

1. A machine tool for stretching workpieces to be forged comprising:

(a) at least one pair of cooperating driven rolling tools for stretching workpieces while being rolled between their cylindrical surfaces, said pair of rolling tools being positioned such that the rolling plane between said rolling tools extends along a path inclined at an acute angle relative to the horizontal and being synchronously rotatably driven to cause the workpieces to be carried only upwardly along said inclined path while being rolled.

(b) means for conveying workpieces to be rolled upwardly along said inclined path to the bite of said pair of rolling tools, and

(c) a support table positioned with the surface thereof extending along said inclined plane above said pair of rolling tools for receiving and supporting workpieces,

(d) whereby said pair of rolling tools will receive and stretch workpieces conveyed upwardly along said inclined path to the lower end of said rolling plane, said workpieces being fed upwardly along said inclined path as they pass between said rolling tools and being received and supported on said support table after passing between said rolling tools.

2. A machine as defined in claim **1** further comprising means for pivotally moving said supporting table between said inclined position in which the surface of said supporting table extends along said inclined path above said pair of rolling tools and a position in which the surface of said supporting table is substantially horizontal for unloading stretched workpieces and loading new workpieces to be stretched.

3. A machine according to claim **2** wherein each of said rolling tools comprises a plurality of parallel annular segments in the cylindrical surface thereof and the surface of said supporting table includes a plurality of longitudinal recesses, said annular segments and said recesses being in substantial alignment, movable stop means for retaining a workpiece loaded and positioned in one of said recesses in the surface of said supporting table and means for moving said stop means to release said workpiece when the surface of said supporting table is in said inclined position.

4. A machine according to claim **3** wherein said supporting table comprises clamping means for retaining a stretched workpiece received in another of said recesses from said rolling tools, and means for conveying stretched workpieces off and away from said supporting table after said supporting table has been pivoted to said horizontal position.

5. A machine according to claim **3** wherein the periphery of each of said rolling tools includes a recess in each segment thereof, said pair of rolling tools being synchronized such that the recesses face each other between rotational cycles to form a through passage therebetween whereby a workpiece on said supporting table may pass downwardly therethrough along said inclined path while said rolling tools are stationary.

6. A machine according to claim **5** wherein each recess

in one of said rolling tools comprises a guide device including a pivotally mounted supporting plate and means biasing said supporting plate towards the recess in the opposite rolling tool of said pair, said supporting plate including cam means for contact with said opposite rolling tool, whereby said pivoted supporting plate can be depressed against said biasing means to enlarge said through passage to insure said through passage being large enough to permit workpieces to pass therethrough irrespective of variations in the relative rotational positions of said pair of rolling tools between rotational cycles.

7. A machine according to claim **5** wherein said conveying means comprises guide means for receiving workpieces from said through passage between said rolling tools, abutment means for supporting the lower end of each workpiece while retained in said guide means, and means for moving said abutment means upwardly along said path to push the leading end of a workpiece in said guide means into engagement with and rolling between said pair of rolling tools.

8. A machine according to claim **7** wherein said conveying means further comprises means for transporting said guide means laterally with respect to said inclined path to positions in line with any one pair of opposed annular segments on said pair of rolling tools before a workpiece in said guide means is conveyed upwardly along said inclined path by said moving means to said rolling tools.

9. A machine according to claim **7** wherein said guide means comprises a guide tube extending along said inclined path, said guide tube including a longitudinal slot in one side thereof, said abutment means comprising a sleeve surrounding said guide tube and including an abutment member extending through said slot to support the lower end of a workpiece retained in said guide tube, and said moving means being adapted to displace said sleeve along said guide tube, whereby said abutment member extending through said slot and a workpiece support thereon may be moved along said inclined path.

10. A machine according to claim **9** wherein said conveying means further comprises means for rotating said guide tube with said sleeve and abutment member, whereby workpieces may be rotated before being conveyed upwardly along said path to said pair of rolling tools.

11. A machine according to claim **10** wherein said conveying means includes means for transporting said guide tube laterally with respect to said inclined path to positions in line with any one pair of opposed annular segments on said pair of rolling tools before a workpiece in said guide means is conveyed upwardly along said inclined path by moving means to said rolling tools.

12. A machine tool for stretching workpieces to be forged comprising:

(a) at least one pair of cooperating driven rolling tools, each of said rolling tools comprising a plurality of annular segments in the cylindrical surface thereof, said annular segments being in substantial alignment, and said pair of rolling tools being positioned such that the rolling plane between said tools extends along a path inclined at an acute angle relative to the horizontal, said path being inclined sufficiently for workpieces to freely slide downwardly along said path over a stationary surface,

(b) drive means for rotating said rolling tools such that workpieces are only rolled while being carried upwardly along said inclined path, and

(c) means for receiving and conveying workpieces both laterally with respect to said inclined path to positions in line with any one pair of opposed annular segments on said pair of rolling tools and at any one of said positions upwardly along said inclined path to push the leading end of a workpiece into engagement with a selected pair of said opposed annular segments for rolling between said pair of rolling tools.

13. A machine as defined in claim **12** wherein each of said rolling tools includes a recess in the cylindrical surface thereof parallel to the axis of said rolling tool and said drive means includes means for synchronizing the rotation of said rolling tools such that the recesses face each other between rotational cycles to form a through passage therebetween to permit workpieces to pass downwardly along said inclined plane to said receiving and conveying means.

14. A machine as defined in claim **13** wherein said inclined plane is at an angle of 45°.

15. A machine as defined in claim **12** wherein said receiving and conveying means comprises guide means for receiving workpieces, abutment means for supporting the lower end of each workpiece while retained in said guide means, and means for moving said abutment means, independently of said rolling tools, upwardly along said inclined path to push the leading end of each workpiece in said guide means into engagement with said rolling tools.

16. A machine according to claim **12** wherein said receiving and conveying means includes means for rotating a workpiece while supported thereon.

17. A machine according to claim **12** wherein said receiving and conveying means comprises means for conveying workpieces laterally with respect to said inclined path, means for conveying a workpiece upwardly along said inclined path, and means for rotating a workpiece, said means for conveying a workpiece upwardly along said path and said means for rotating a workpiece being supported on said means for moving workpieces laterally with respect to said inclined path.

18. A machine according to claim **15** wherein said guide means comprises a guide tube extending along said inclined path, said guide tube including a longitudinal slot in one side thereof, said abutment means comprises a sleeve surrounding said guide tube and including an abutment member extending through said slot to support the lower end of a workpiece retained in said guide tube, and said moving means is adapted to displace said sleeve along said guide tube whereby said abutment member extending through said slot and a workpiece supported thereon may be moved along said inclined path.

19. A machine according to claim **18** wherein said receiving and conveying means further comprises means for rotating said guide tube with said sleeve and abutment member, whereby workpieces may be rotated before being conveyed upwardly along said path to said pair of rolling tools.

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MILTON S. MEHR, Primary Examiner

U.S. Cl. X.R.

72—250, 252