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Bullard

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[54] **MANIPULATOR**

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[73] Assignee: **United States Steel Corporation,** Pittsburgh, Pa.

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[21] Appl. No.: **233,241**

[52] **U.S. Cl.**..... **72/250,** 214/147 R, 214/1 BB, 294/103

[51] **Int. Cl.**..... **B21j 13/12**

[58] **Field of Search**..... 214/148, 146.5, 1.1, 214/1.2, 1.3, 1.4, 1.5, 1 Q, 1 QE, 147 R, 147 T, 27, 28, 142; 72/250, 251, 252, 419, 421; 29/34 R, 561, 563, 33 P; 294/103

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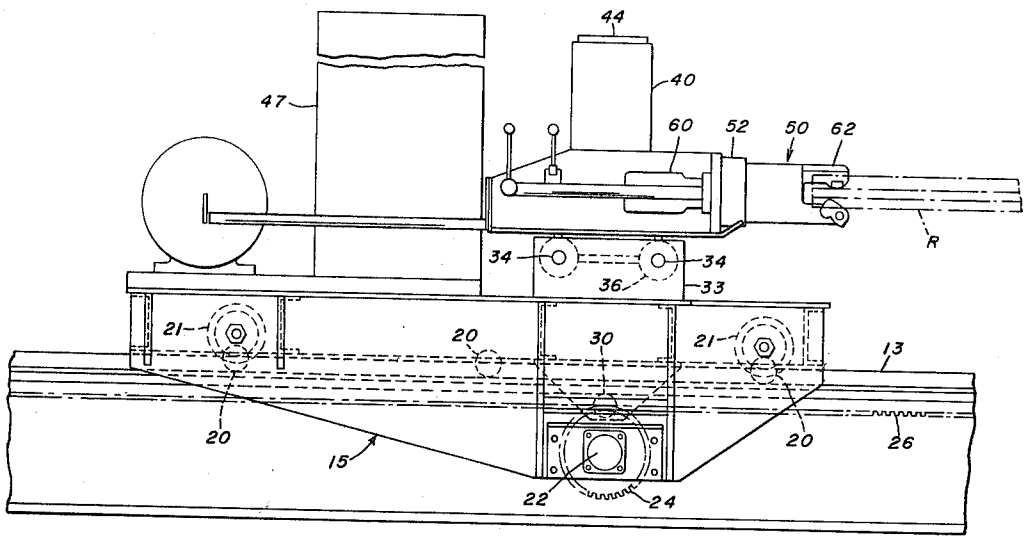
Primary Examiner—Gerald M. Forlenza
Assistant Examiner—Frank E. Werner
Attorney—Ralph H. Dougherty

[57] **ABSTRACT**

Manipulator apparatus for rotating an elongated article such as a rail about its longitudinal axis and propelling such rail longitudinally. The apparatus includes a carriage, a drive mechanism for the carriage, a rail gripping mechanism, and a rail rotating mechanism. The apparatus is characterized by instant response to fingertip control. Retractable rollers are disclosed for supporting the body of the article.

11 Claims, 9 Drawing Figures



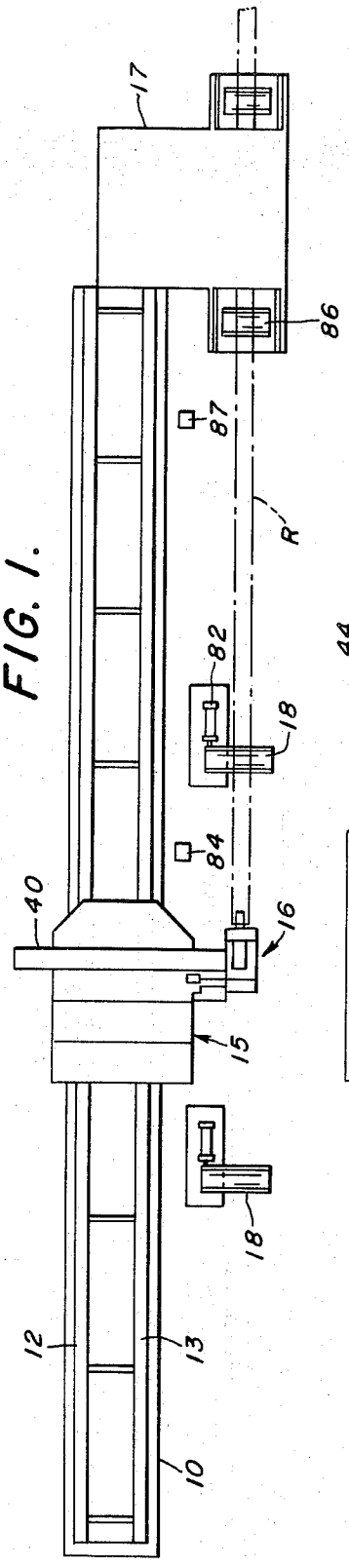

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FIG. 1.

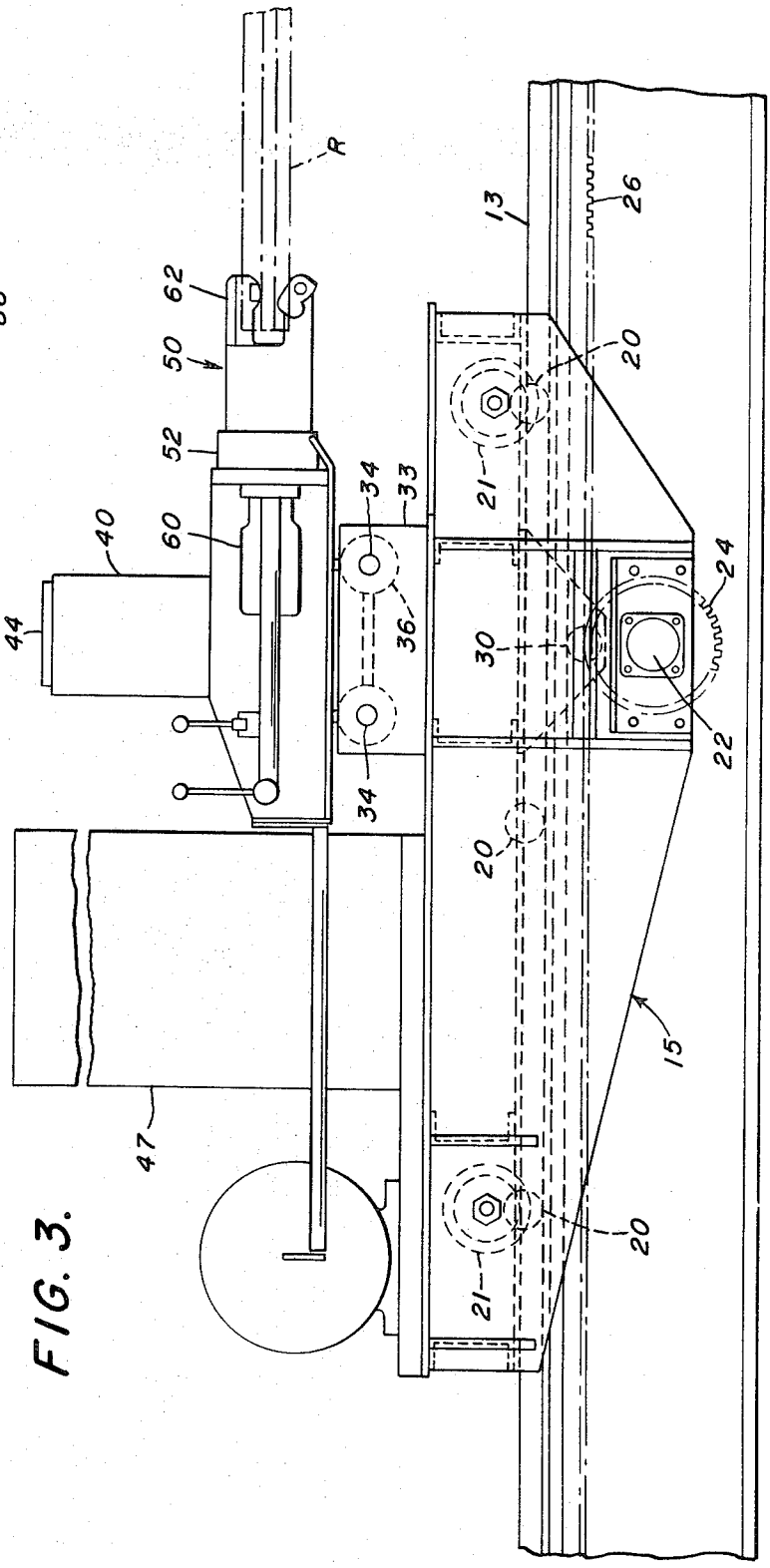
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FIG. 3.

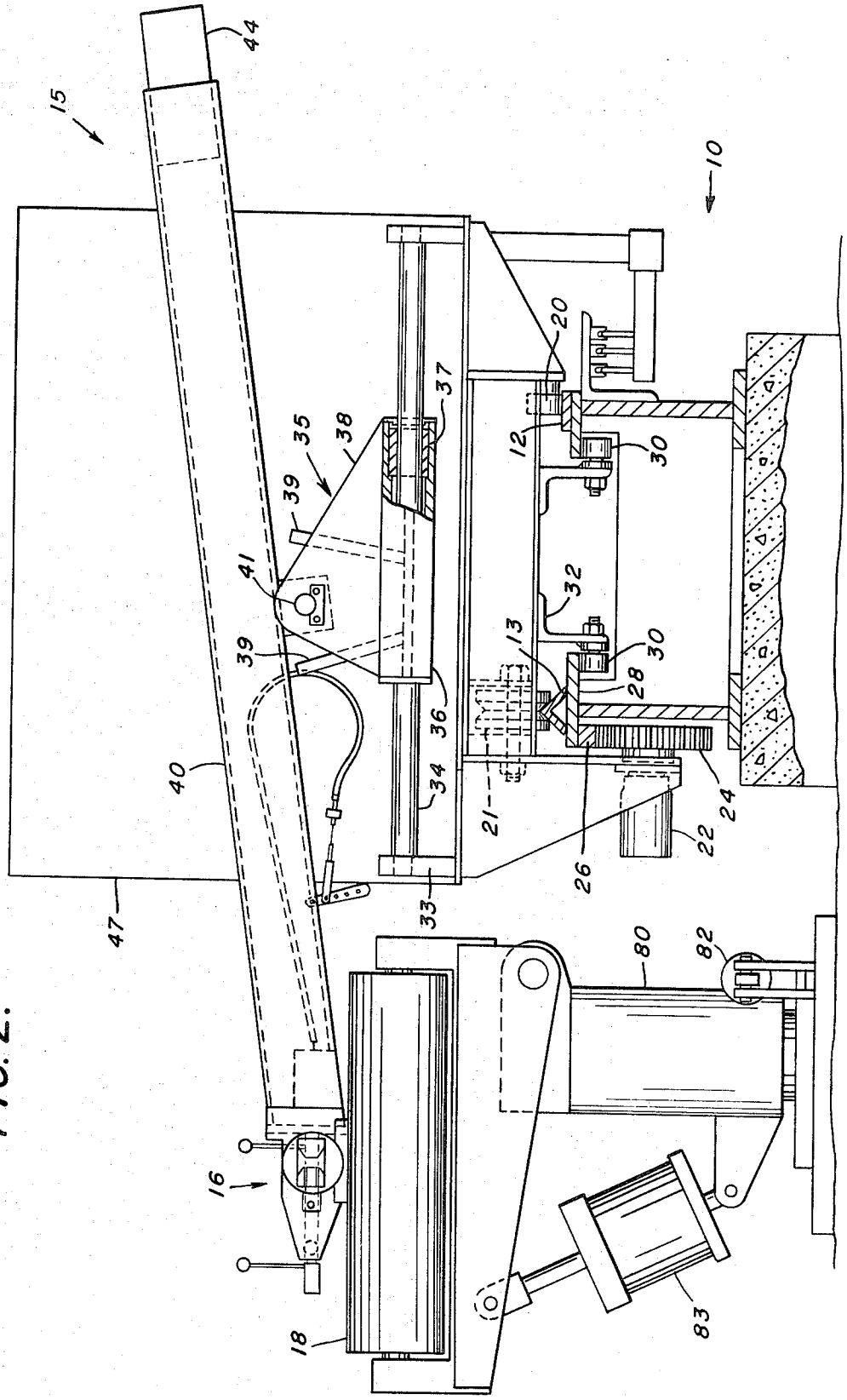
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FIG. 2.

FIG. 4.

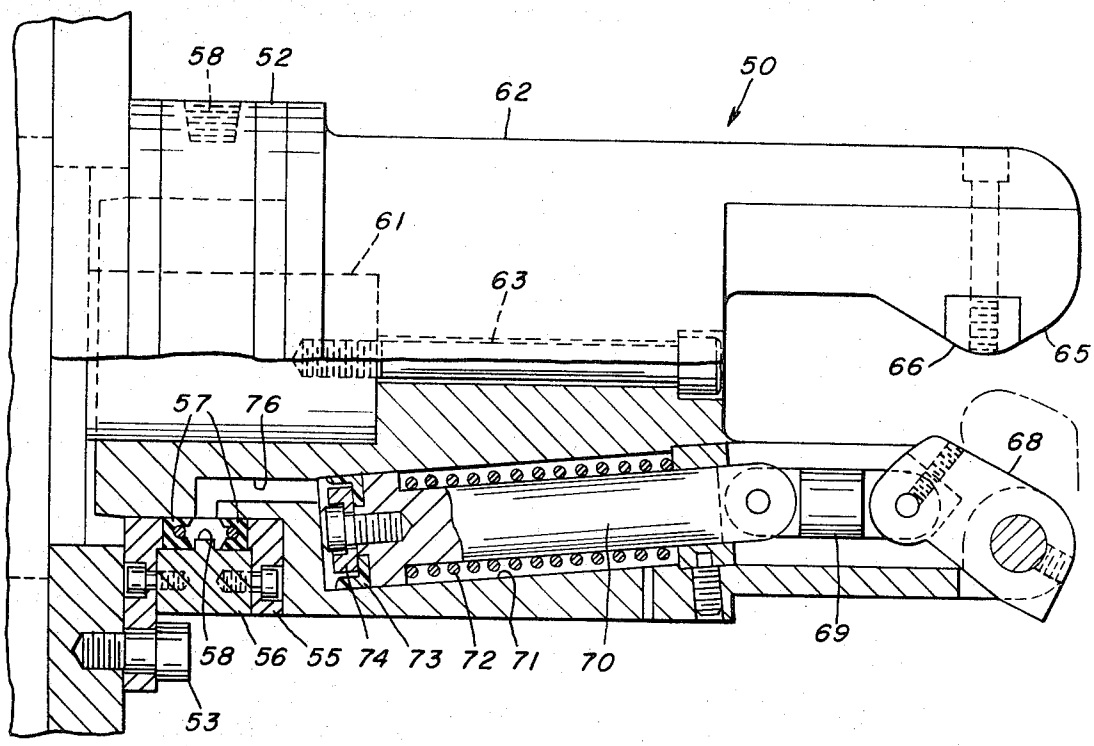
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FIG. 5.

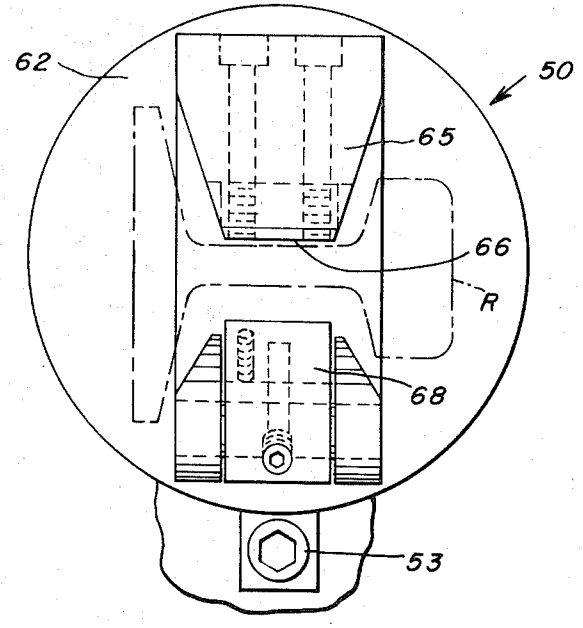
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FIG. 6.

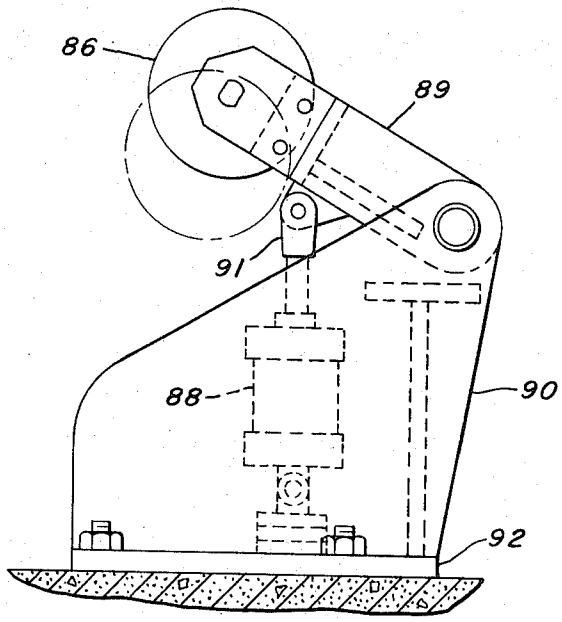
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FIG. 8.

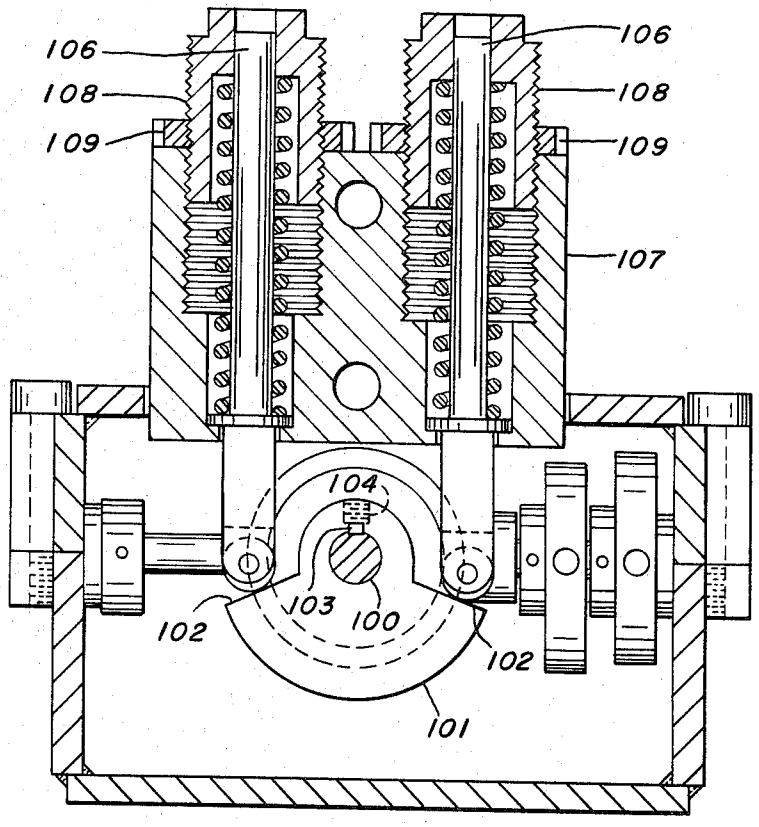
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FIG. 7.

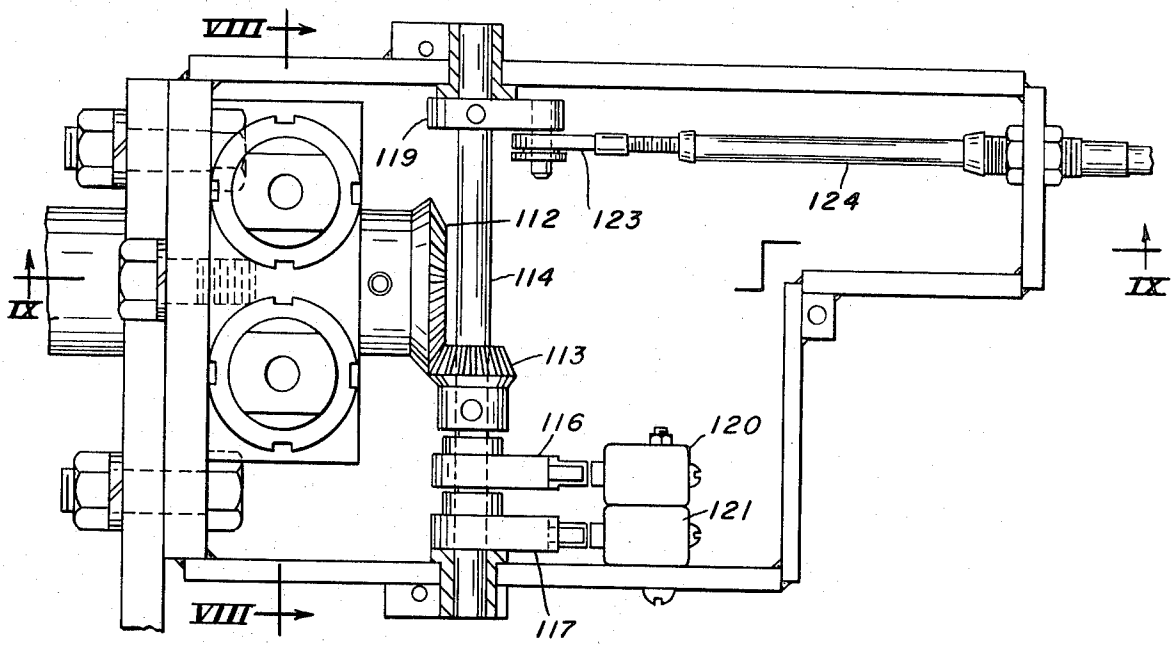
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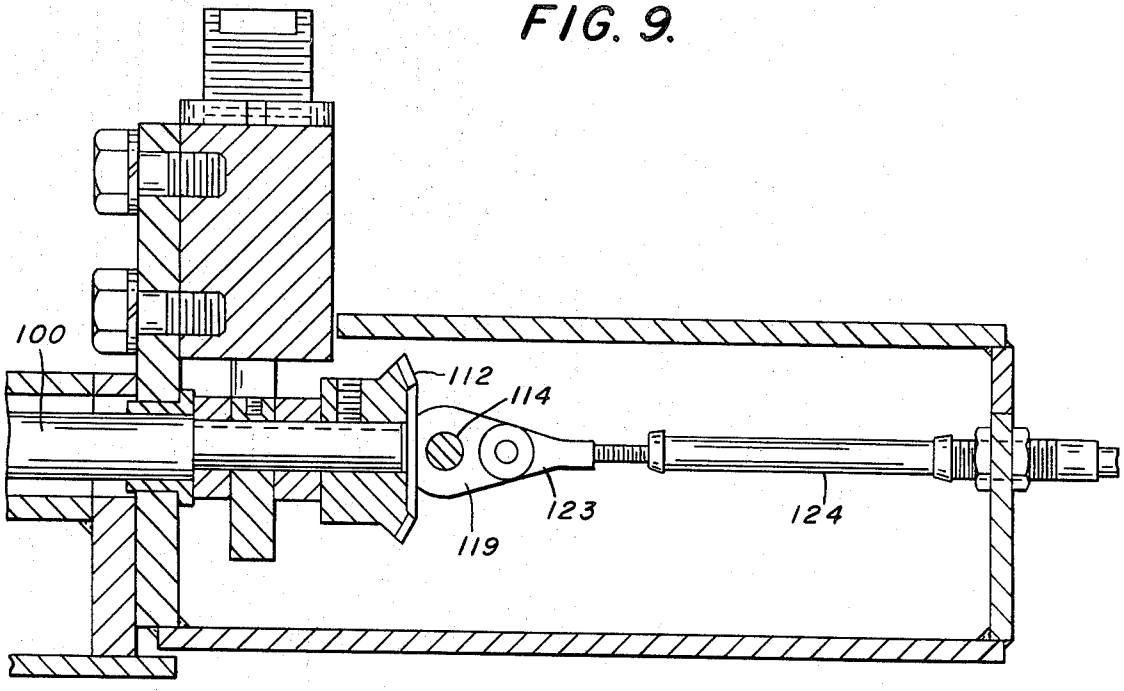
FIG. 9.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MANIPULATOR

This invention relates to apparatus that will manipulate an elongated article rotatably and longitudinally, and more particularly to apparatus for manipulating a railroad rail during the straightening operation.

In the manufacture of rails, the rail straightening operation subsequent to the hot rolling of rails has been performed through the years by manual labor and is considered an art. The operation involves two men—a straightener and a gagger—who acquire their skills through on-the-job experience. The straightener grasps the end of a rail and sights along it as he maneuvers the rail through a gag press, and, by head and eye motions, he signals the gagger when and where to place an anvil between the rail and the gag hammer. The gag hammer continually reciprocates vertically, but does not strike the rail. The anvil is a steel block which is struck by the hammer to straighten the rail. A clear line of vision between the straightener and the full length of rail section as well as between the straightener and the gagger is essential to the operation.

In current rail mill practice, the straightener uses a bar about three feet long with an "F" shaped jaw at one end to manipulate the rail. He hooks the end of the web section of the rail with the F-shaped jaw and, using the full length of the bar for leverage, he "flips" the rail either clockwise or counterclockwise as he pushes the rail or pulls it through the gag press to the position desired for straightening. On light rail sections the straightener can manipulate the rail alone; however, on the heavier rails he must have assistance to turn the rail.

In the above described method of rail manipulation, the bar has been known to slip loose from the rail and be propelled through the air dangerously. The rail has been known to slip loose and continue to roll off its supports endangering the operators. The physical effort required to manipulate the rail has had an adverse effect on the health and well being of most straighteners.

The physical effort and manpower requirements involved in the rail straightening operation have long been the motivation for invention of machinery to improve this operation. However, the devices developed heretofore do not provide the durability, responsiveness, mobility and unobstructed line of vision necessary for the described method of straightening rails.

It is the primary object of the subject invention to provide an apparatus for manipulating an elongated article that will give instant response to an operator, have finger-tip control, and will manipulate such article rotatably, longitudinally and transversely.

It is another object to provide an apparatus with sufficient grip to pull a rail through a gag press and with sufficient force to rotate the rail continuously either clockwise or counterclockwise.

It is also an object to provide an apparatus with sufficient mobility to move the rail through the gag press.

It is still another object to provide an apparatus that is safe to operate and does not obstruct the line of vision of the operator.

I have invented a manipulator which grasps the web of a rail, or other elongated structural section, upon its exit from a gag press or straightening machine, propels the rail longitudinally in either direction, and rotates the rail about its longitudinal axis to any desired orientation. Provision is also made for support of the rail on

retractable rollers which are extended and retracted automatically.

In the appended drawings:

FIG. 1 is a plan view of my rail manipulator mounted adjacent a gag press.

FIG. 2 is a partially sectioned elevational view of the rail manipulator showing the travelway, the carriage, and a pivotal rail-support roller mechanism.

FIG. 3 is a side elevational view of the rail manipulator.

FIG. 4 is a partially sectioned plan view of the rail clamping mechanism.

FIG. 5 is an end view of the rail clamping mechanism showing the location of a rail in phantom.

FIG. 6 is a side elevational view of the exit roll of a gag press.

FIG. 7 is a plan view of the carriage drive control system.

FIG. 8 is a sectional view of the carriage drive control system taken along line VIII—VIII of FIG. 7.

FIG. 9 is a sectional view of the carriage drive control system taken along line IX—IX of FIG. 7.

The invented rail manipulator apparatus comprises a base **10**, a pair of rails **12** and **13** mounted on the base, and a carriage **15** movable along said rails and having a manipulator head or clamp **16** extending to one side. The base is located at the exit end of a gag press **17**, as are one or more rollers **18**, which are in a line along which the rail travels during the straightening operation. As shown in FIG. **2**, rail **12** is flat. Rail **13** is angled with the apex up. The carriage **15** has a regular wheel **20** which rides on rail **12** and a matching grooved wheel **21** which rides on angle rail **13** and aligns the carriage with respect to the center line of the gag press. The aligning rail and wheel surfaces can have any matching male and female configuration. The carriage is propelled along the track by a reversible hydraulic motor **22**, which drives a pinion **24**, which in turn engages a rack **26** mounted on the underside of the rail base plate **28**, which is mounted on base **10**. The carriage is prevented from lifting off the rails by a pair of hold-down devices which comprise two wheels **30** journaled in brackets **32** depending from the underside of the carriage, which wheels **30** engage the underside of the rail base plates **28**.

Slide brackets **33** are mounted on carriage **15**. Attached to these slide brackets are a pair of slides **34** on which boom carriage **35** is mounted. Slides **34** are polished alloy steel bars which flex to take the shock imparted to the rail by the gag press. The boom carriage includes a pair of tubular members **36**, each of which has internal bushings **37** to allow sliding movement of the boom carriage along the slides **34**. Each tubular member **36** has an upstanding support bracket **38**. These brackets are connected by a pair of heavy connecting members **39** which also act as boom stops. The boom **40** is connected to the boom carriage by a pivot pin **41**. One end of the boom carries the manipulator head **16**, the other end of the boom is provided with a counterweight **44** which offsets the weight of the manipulator head. Also mounted on carriage **15** are a hydraulic tank or reservoir **47** and all of the necessary hydraulic equipment to provide power for drive motor **22** and manipulator head **16**.

Manipulator head **16** A pair a rail clamping and rotating assembly as shown in FIGS. **4** and **5**. The clamping and rotating assembly **50** includes a collector ring

52 which is fastened to boom 40 by a single screw 53. The collector ring comprises a pair of seal retainers 55 spaced apart by a separator 56. A PAIR of seals 57, such as Molythane-Polypak Seals manufactured by the Parker Seal Company, are also spaced apart by a protruding lip or flange 58 of separator 56. A motor 60 for rotating the assembly 50 is mounted on the boom and has a drive shaft 61 which protrudes through the boom. Clamp body 62 is inserted in collector ring 52 and is fastened to the end of shaft 61 by a pin or bolt 63 as well as being keyed onto shaft 61 by a key and keyway, not shown. The clamping assembly includes a fixed jaw 65 which has a replaceable wear plate 66, and opposite the fixed jaw, a movable jaw 68 one end of which is connected through a link 69 to a piston rod 70, the other end of which is pivotally connected to the extremity of the clamp body. The rod is movable in a cylindrical chamber 71 formed in the clamp body. As shown, the piston rod 70 has a return spring 72. The head of piston 70 includes a Molythane cup 73 held in position by a cup retainer 74. Cylindrical chamber 71 communicates with the chamber formed by seals 57 by means of an orifice 76 in clamp body 62.

Roller 18, in the line of sight of the straightener operator, is shown in FIG. 2 and is pivotal around column 80. Cylinder 82 pivots the roller through a 90° arc. Cylinder 83 lifts the end of the roller as it moves into the path of the rail and retracts the roller, that is, pulls it downward, as it moves out of the path of the rail. These cylinders are actuated by a limit switch 84 shown in FIG. 1. As many rollers 18 as are necessary to support the rail are provided. A retractable roller 86 located on the delivery side of the gag press is controlled by limit switch 87. The roller is positioned by air cylinders 88. The roller is journaled in pivotal arms 89, which attached to a support frame 90 and to the piston rod 91 of cylinder 88. The cylinder is attached to the base 92 of frame 90. The retracted position of roller 86 is shown in phantom in FIG. 6.

The speed and direction controller for carriage 15 is shown in FIGS. 7, 8, and 9. A handle 100 has a deadman control or centering cam 101 with symmetrical shoulders 102 fixed to the handle by a key 103 and a set screw 104. A pair of spring loaded plungers 106 extending through housing 107 bear against shoulders 102. Spring retainers 108, which are exteriorly threaded, are screwed into the threaded portions of housing 107 to the proper depth to create equal compressive force on the plungers. When the proper compression has been achieved on the springs, locking nuts 109 are tightened against the end of housings 107.

Bevel gear 112, fixed to the end of handle 100, engages bevel gear 113 which is fixed to shaft 114. Shaft 114 also carries cams 116 and 117, and a lever 119 at the opposite end of the shaft from the cams. Cams 116 and 117 control microswitches 120 and 121, respectively. Each microswitch controls one direction of movement of the carriage. Lever 119, through a knuckle or clevice 123, is connected to a cable 124 which operates a servo valve, not shown, on a hydraulic pump mounted on the outside of hydraulic tank 47. The servo valve controls the speed at which carriage 15 moves along the track.

In operation, a straightener (operator) sights along a rail as it is emerging from the gag press. The straightener then causes the clamping jaw to clamp on the web of the rail R at the leading end. The movable clamping jaw 68 is open when in its normal position. When a valve (not shown) is opened on the hydraulic line leading to the hydraulic fluid inlet 58 of collector ring 52, fluid enters the annular space between seals 57, then flows through orifice 76 and enters the portion of cylinder 71 beneath cup 73 forcing piston rod 70 out of the cylinder, which in turn forces movable jaw 68 toward the position shown in phantom in FIG. 4 and against the web of the rail. As long as the fluid pressure is on, the rail will be tightly clamped between jaws 65 and 68. When the fluid pressure is released, the piston rod 70 is returned to the position shown in FIG. 4 by the action of its associated return spring 72.

The clamping jaws are horizontally aligned with the web of the rail by a manual movement of the manipulator head 16. The clamping assembly, boom 40, and boom carriage 35 are horizontally slidable as a unit along slides 34 shown in FIG. 2. Reversible hydraulic motor 60 controls the rotational movement of the clamping head. The straightener operates a three-position control lever on motor 60 to impart clockwise rotation, countercloskwise rotation or no rotation to the rail.

Carriage 15 is movable along rails 12 and 13 which are substantially parallel to the path of the rail being straightened as it moves through the gag press. The operation of the gag press imparts tremendous forces to the rail which transfers these forces to the clamping head and carriage. Grooved wheel 21 riding on angle rail 13 prevents lateral movement of the carriage. Rolls 30, bearing against the underside of rail base plates 28, prevent the carriage from lifting off the tracks. Movement of the carriage along tracks 12 and 13 is controlled by the speed and direction controller mechanism shown in FIGS. 7, 8 and 9. When the straightener moves the handle 100 toward the gag press, carriage 15 moves in that direction. The rotation of handle 100 rotates bevel gear 112 which causes rotation of bevel gear 113 and with it shaft 114. Cams 116 and 117, fixed to shaft 114, control microswitches 120 and 121 which are connected to motor 22, and thus they control the direction of the movement of the carriage. The cams are eccentrically arranged in such manner that only one cam can contact a microswitch at any one time. The amount of rotation of shaft 114 controls the opening of the servo valve, not shown, connected to cable 124. Thus the farther handle 100 is moved from the center position, the higher the speed at which the carriage will move.

When the straightener releases handle 100, the springs in housing 107 cause the plungers 106 to return to their equilibrium position as shown in FIG. 8. This action causes the rotation of shaft 114 to a neutral position stopping the movement of the carriage.

The operator (straightener) walks behind the controls in the path of movement of the rail being straightened. Since a rail is a heavy structural section and will bend under its own weight, additional rollers are needed to provide support for the rail as it emerges from the gag press. Roller 18 as shown in FIGS. 1 and 2 is such a roller. As can readily be seen in FIG. 1, the straightener cannot move along the path of the rail through roller 18. Therefore, it has been necessary to provide apparatus for removing roller 18 from the straightener's path when the roller is not needed to support the rail. As the carriage 15 passes limit switch 84, cylinders 82 and 83 are actuated to rotate the roller

into position normal to the path of the rail. When limit switch **84** is tripped by movement of carriage **15** in the opposite direction, that is, toward the gag press, cylinders **82** and **83** are actuated in the opposite direction retracting the roller and pulling the free end of it downwardly. The roller is lifted by cylinder **83** as it moves into its rail-supporting position because the rail sags of its own weight and would prevent a completely level roller from rotating into the proper position.

Additional roller support for the rail is provided by an exit roller **86** located at the delivery side of the gag press. Roller **86** is supported by a pivotal arm to which a pair of air cylinders **88** are connected. As the carriage **15** moves away from the gag press, it trips limit switch **87** which causes air cylinders **88** to lift exit roller **86** into position. As the carriage moves toward the gag press, it trips limit switch **87** in the opposite direction causing roller **86** to be retracted.

It is readily apparent from the foregoing that I have invented a safe, easily operated manipulator that gives instant response, has fingertip control, yet has sufficient force to grip a rail and both propel it longitudinally and rotate it about its longitudinal axis.

I claim:

1. An apparatus for rotating an elongated article about its longitudinal axis and propelling said article longitudinally, said apparatus comprising;
- a base;
- a pair of parallel rails attached to said base;
- a carriage movably supported by said rails;
- means connected to said carriage for driving said carriage along said rails;
- means connected to said carriage for rotating said article about said longitudinal axis,
- a boom mount;
- a boom carriage horizontally slidable on said mount normal to the direction of movement of said carriage;
- a boom pivotally attached to said boom carriage and extending transverse to the movement of said carriage, one end of which boom carries a manipulator head, the other end of which carries a counterweight; and
- means connected to said carriage for gripping one end of said article.

2. Apparatus according to claim **1** in which said first named means comprises;
- a drive motor fixed to said carriage,
- a pinion rotatable by said motor, and
- a rack fixed to said base for engagement by said pinion.

3. Apparatus according to claim **2** further comprising means for controlling the speed and direction of movement of said carriage.

4. Apparatus according to claim **1** in which said carriage includes hold-down devices comprising wheels depending from said carriage and adapted to engage the underside of said base.

5. Apparatus according to claim **1** in which a reversible drive motor is mounted on said boom, and a clamp is fixed to the drive shaft of said motor.

6. Apparatus according to claim **1** in which said last named means comprises:
- a clamp mounted on said boom, said clamp including a fixed jaw and a movable jaw;
- a piston housed in the body of said clamp said movable jaw being connected to said piston and the body of said clamp; and
- means for actuating said piston in each direction.

7. Apparatus according to claim **6** in which said fixed jaw has a replaceable wear plate.

8. Apparatus according to claim **1** in which said first named carriage has wheels which are mounted on said rails and at least one of said rails and said wheel mounted thereon have matching male and female surfaces.

9. An apparatus for rotating an elongated article about its longitudinal axis and propelling said article longitudinally, said apparatus comprising;
- a base,
- a pair of parallel rails attached to said base,
- a carriage movably supported by said rails,
- means connected to said carriage for driving said carriage along said rails,
- means connected to said carriage for rotating said article about said longitudinal axis,
- a boom mounted on said carriage;
- a clamp mounted on said boom, said clamp including a fixed jaw and a movable jaw;
- a piston housed in the body of said clamp said movable jaw being connected to said piston and the body of said clamp;
- an annular fluid dispensing member connected to said boom;
- a rotatable clamp journaled in said annular fluid dispensing member, said clamp having a hydraulically actuatable movable jaw therewith, and a fluid orifice communicating with said movable jaw and said fluid dispensing member, whereby introducing hydraulic fluid under pressure to said fluid dispensing member will cause actuation of said hydraulically actuatable jaw regardless of its relative axial position; and
- biasing means for returning said jaw to its unactuated position.

10. In combination, apparatus for guiding, rotating, supporting and propelling a rail through a straightening machine comprising:
- apparatus for rotating said rail about its longitudinal axis and propelling said rail longitudinally comprising:
- a base,
- a pair of parallel rails attached to said base,
- a carriage movably supported by said rails,
- means connected to said carriage for driving said carriage along said rails,
- means connected to said carriage for rotating said article about said longitudinal axis, and
- means connected to said carriage for gripping one end of said article,
- at least one retractable deflectable support roller apparatus in the path of travel of said rail, comprising:
- a base;
- a column pivotal on said base;
- a roller having an axle on which it is journaled, one end of said axle being pivotally attached to the top of said column;
- a hydraulic cylinder connected to the other end of said axle and to the bottom of said column for deflecting one end of said roller; and

a hydraulic cylinder connected to said base and to the bottom of said column for pivoting said column about its vertical axis; and

a limit switch on each side of said column in the path of said carriage, actuated by said carriage to extend said roller when said carriage is moving away from said straightening machine, and to retract said roller when said carriage is moving toward said machine.

11. A combination as defined in claim **10** further comprising a retractable support roll apparatus at the exit end of said straightening machine.

* * * * *