

Feb. 24, 1953

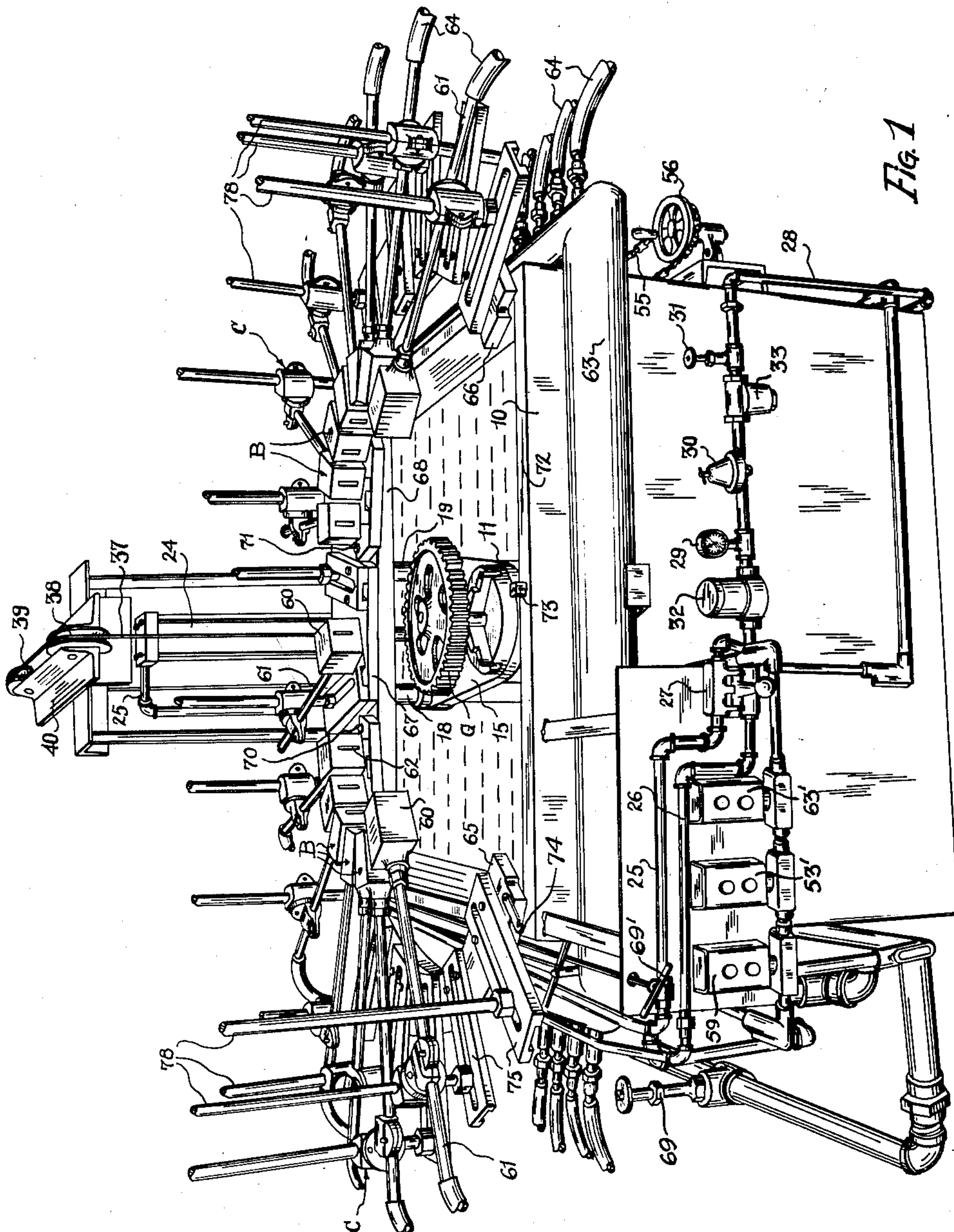
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2,629,589

FLAME HARDENING APPARATUS

Filed Dec. 17, 1949

4 Sheets-Sheet 1



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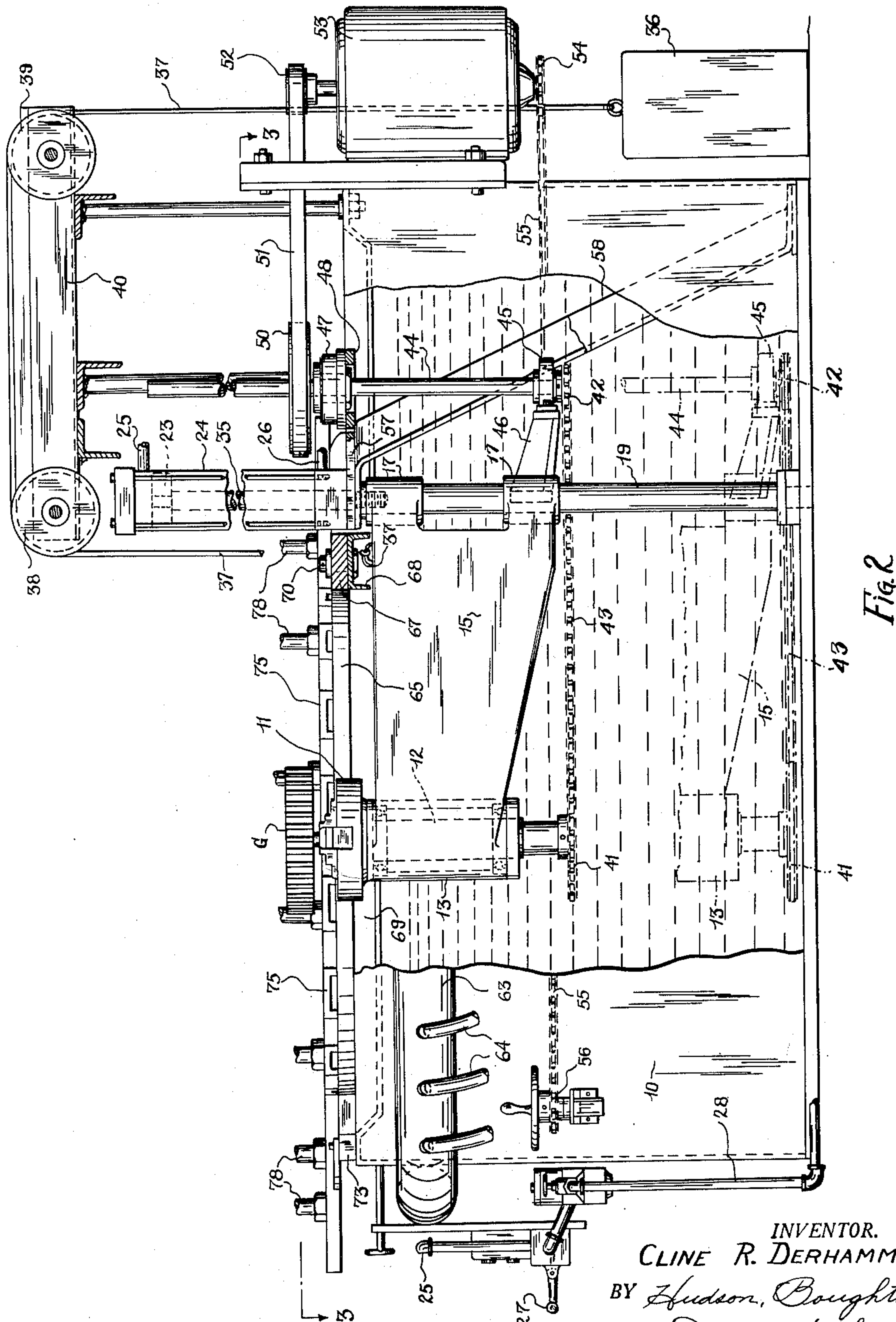


Fig. 2

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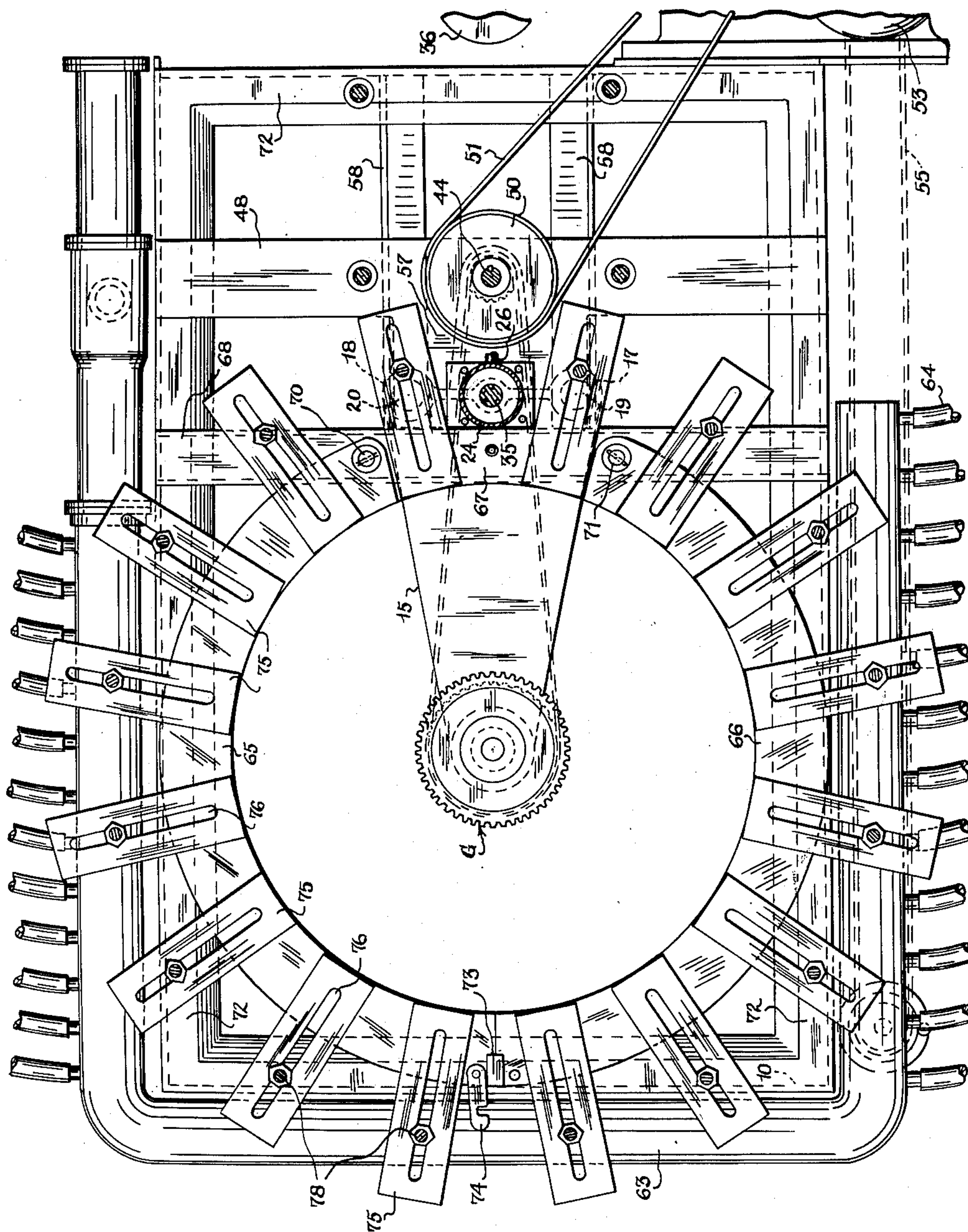


Fig. 3

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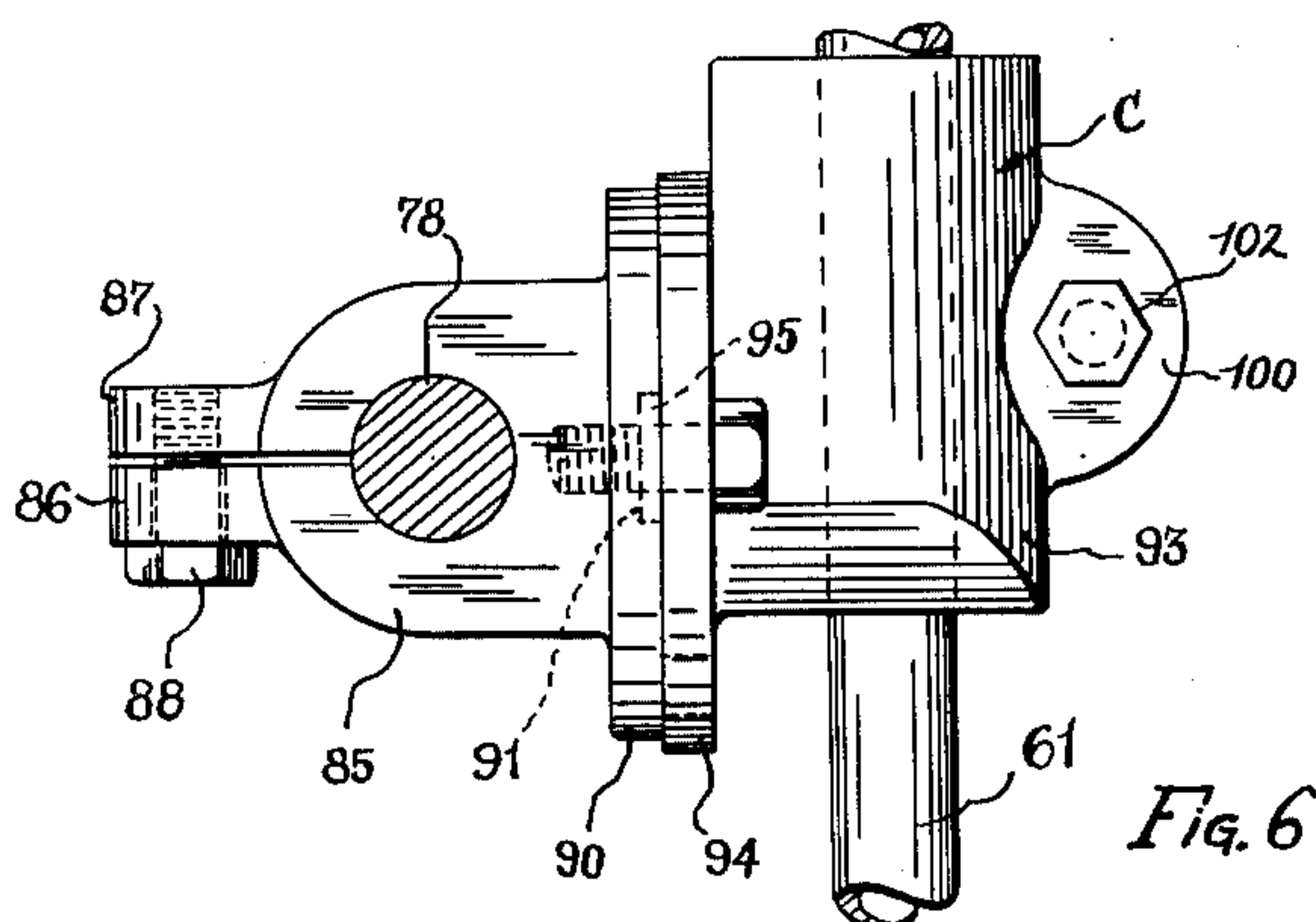


Fig. 6

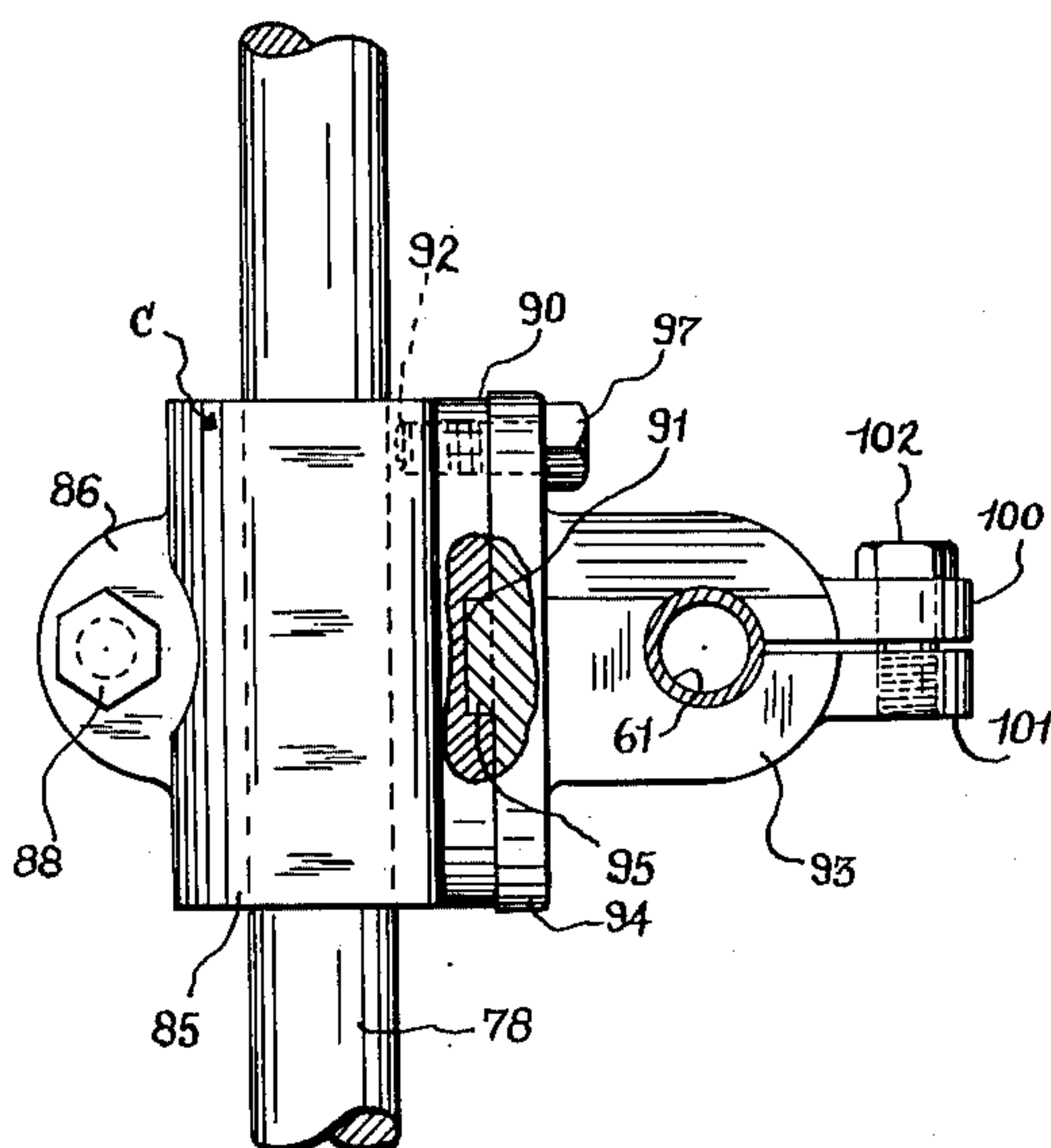


Fig. 4

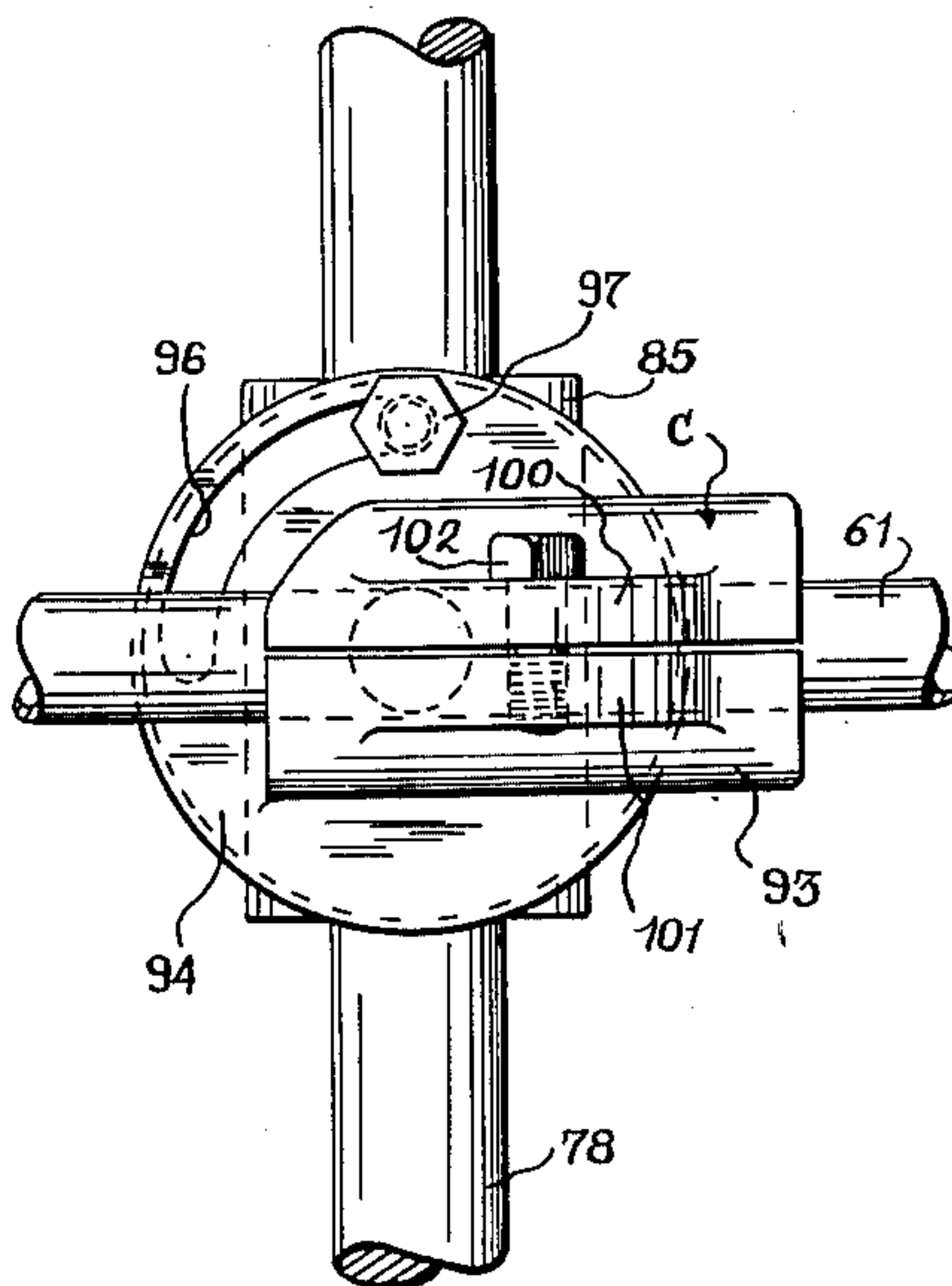
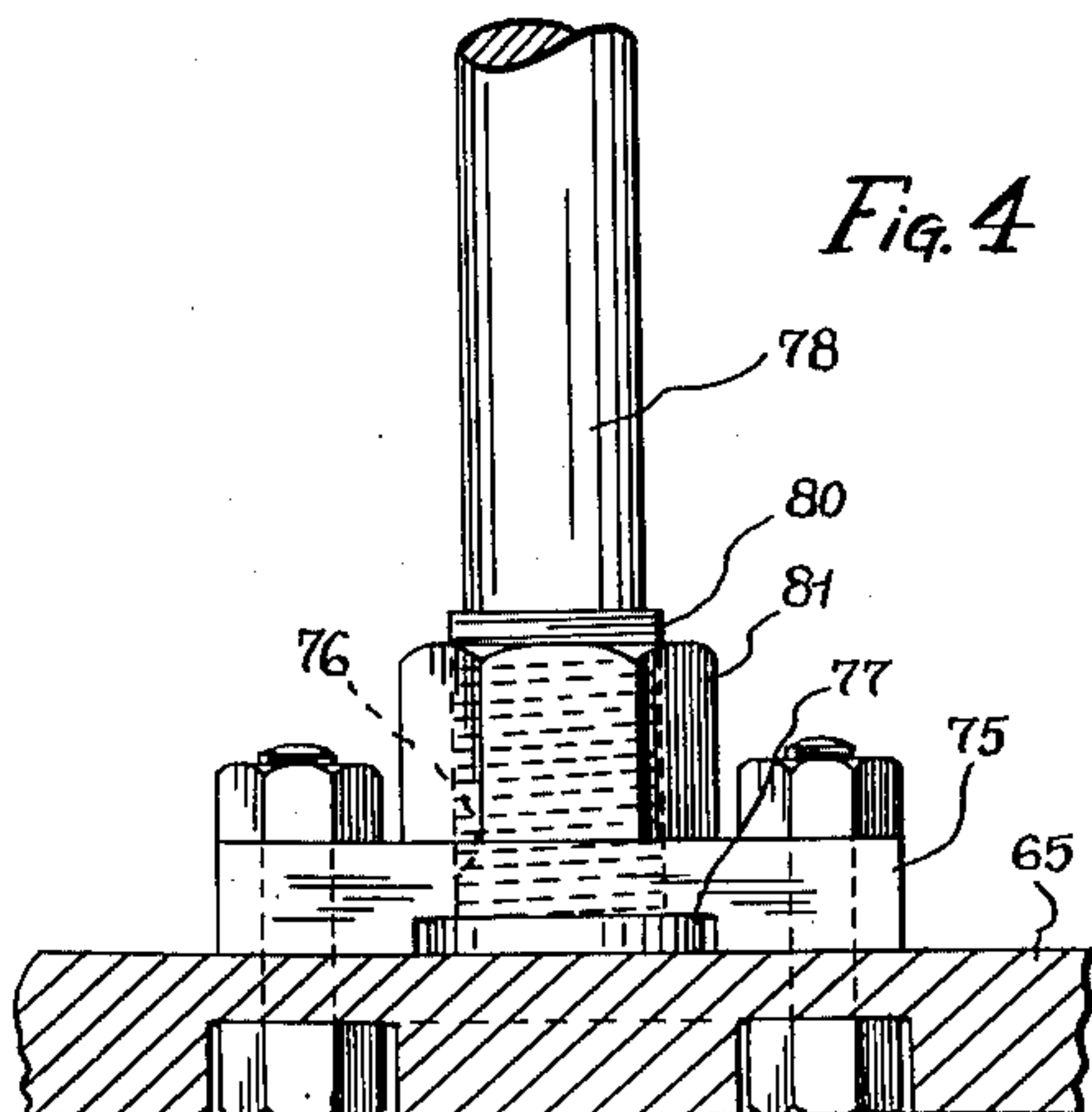


Fig. 5



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## UNITED STATES PATENT OFFICE

2,629,589

## FLAME HARDENING APPARATUS

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Application December 17, 1949, Serial No. 133,574

## 1 Claim. (Cl. 266—4)

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The present invention relates to flame-type hardening apparatus for surface hardening generally circular articles, such as gears, cams, and the like and, more particularly, relatively heavy articles, such as gears employed in steel mill drives, etc.

One of the principal objects of the invention is the provision of a new and improved apparatus for hardening generally circular articles, such as track wheels, gears, including bevel gears, cams, etc., which apparatus will be simple in construction, economical in operation, will produce the desired heating of the article to be hardened in a minimum of time and is so arranged and constructed as to facilitate loading and unloading of the work and quenching of the work after it is heated.

Another object of the invention is the provision of a new and improved apparatus of the character referred to comprising a rotatable work support vertically reciprocable to submerge work carried thereby in a quenching bath and a plurality of burners arranged about the work support so as to direct flames against the work and including means whereby a plurality of the burners can be moved as a unit toward and from the work support, thereby facilitating access to the latter for the purposes of loading and unloading the work.

Another object of the invention is the provision of a new and improved heat treating apparatus of the character referred to comprising a plurality of burners mounted for universal adjustment with respect to the work support, thereby permitting the apparatus to be used with work of different size and configuration.

The invention resides in certain constructions and combinations and arrangements of parts and further objects and advantages will be apparent to those skilled in the art to which it relates from the following description of the preferred embodiment described with reference to the accompanying drawings forming a part of this specification; in which

Fig. 1 is a perspective view of a flame hardening apparatus for hardening gears and the like, certain parts thereof being broken away;

Fig. 2 is an elevational side view of the apparatus shown in Fig. 1, showing certain parts broken away and in section;

Fig. 3 is a plan view of the apparatus taken substantially along line 3—3 of Fig. 2;

Fig. 4 is a view in elevation of a burner bracket of the flame hardening apparatus, certain parts being broken away and others being shown in section;

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Fig. 5 is an elevational side view of a portion of the burner bracket shown in Fig. 4 and

Fig. 6 is a top view, partly in section, of a portion of the bracket shown in Fig. 4.

The invention contemplates the provision of heat treating apparatus comprising a work holding mechanism associated with a quenching tank and adapted to be operated to immerse the work into a quenching bath, in combination with a work heating apparatus, preferably in the form of fuel gas burners arranged to direct flames onto work in the work holding mechanism. The burners are supported on bracket means for universal adjustment relative to the work to be heated, and a portion of the bracket means is movable, as on a pivot, so that a plurality or bank of burners may be moved as a unit towards and from the work holding mechanism to provide access to the latter between heating operations for loading and unloading the work.

In the preferred form of the invention, the burner bracket means includes two arcuately-shaped members, positioned opposite one another, and pivoted so that they may swing toward and from one another to move burners carried thereby towards and from work carried by the work holding mechanism. Preferably, the burner bracket means include mechanism for attaching the burners to the arcuately-shaped members which provide a universal and wide range of adjustment as to elevation, angularity, etc., of the burners proper relative to the burner support brackets.

The invention may be embodied in apparatus for heat treating various types of articles, but it is particularly suitable for hardening gears and is herein shown embodied in such type of apparatus. Referring to the drawings, the flame hardening apparatus shown comprises a tank 10 adapted to contain a bath of quenching oil or other suitable quenching medium. A work holding mechanism is provided in the tank, which mechanism comprises a chuck 11 attached to the upper end of a spindle 12 journaled in a sleeve 13. The sleeve 13 is attached at one end of a triangular frame 15 having pairs of sleeves 17, 18 at the opposite corners remote from the sleeve 13 and slidable upon vertical stationary rods 19, 20 for guiding the frame 15 vertically.

The frame 15 is adapted to be moved vertically by a piston 23 reciprocated in a cylinder 24 by pressure fluid, in present instance air, introduced into and expelled from opposite ends of the cylinder through tubes or conduits 25, 26, adapted to be selectively connected by a three-way valve 27 to exhaust and to a source of pres-



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sure fluid, not shown, by a conduit 28 including a pressure gauge 29, pressure regulator 30, shut off valve 31, oil filter 32 and moisture trap 33. Piston 23 is connected to the frame 15 by a piston rod 35.

Preferably, the weight of the work holding mechanism is counterbalanced by a counterweight 36 attached to the frame 15 by a cable 37 riding in sheaves 38, 39 supported on a frame 40 above the tank proper. The counterweight 36 reduces the effort required to raise the frame 15 and its associated mechanisms.

For the purpose of rotating the spindle 12 and in turn the chuck 11 and work during the heating operation, the lower end of the spindle 12 is provided with a sprocket 41 connected with a drive sprocket 42 by a sprocket chain 43. Drive sprocket 42 is attached to the lower end of a drive shaft 44 journaled adjacent to its lower end in a bearing 45 carried by a bracket 46 on the frame 15 and adjacent to its upper end in a bearing 47 attached to a plate 48 connected to the top of the tank 10. The shaft 44 is driven by a pulley 50 splined to the shaft so that the shaft may move vertically relative to the pulley as the frame 15 is raised and lowered. The pulley 50 is held against vertical movement and is driven by a belt 51 connected therewith to the driving pulley 52 of a motor driven variable speed power mechanism 53. The mechanism 53 may be of any suitable type and is here shown as an electric motor driven Reeves drive having a wide range of variable speeds which may be controlled by the rotation of a sprocket 54 connected by a chain 55 to a crank-operated sprocket 56 attached to the forward side of the tank 10. The operation of the motor for the drive is controlled by a switch 53'. The plate 48 extends across the top of the tanks 10 and has a centrally located, forwardly projecting portion 57 which supports the cylinder 24 and the upper ends of the rods 18, 19. The structure is further supported by braces 58 connected to opposite sides of the members 57 and to the bottom of the tank.

The work to be heat treated, such as a gear G, is attached to the chuck 11 and rotated thereby during the heating thereof above the surface of the quenching liquid. When the proper temperature has been attained, the frame 15 is lowered by operation of the valve 27 to the bottom of the tank, as shown in dotted lines in Fig. 2 to immerse the gear in the quenching oil. Preferably, the quenching oil is circulated in a tank by a suitable electric motor driven pump, not shown, and the operation of the motor is controlled by a switch 59.

The work is heated by a plurality of fuel gas burners B each comprising a box-like nozzle structure 60 connected to the end of a tubular stem 61. The outer walls of the nozzles each have a slit 62 through which fuel gas is emitted. The tubular stems 61 are connected with a fuel gas manifold 63 encircling three sides of the top of the tank 10 by flexible hoses 64. The manifold is connected with a suitable source of gas fuel and air through suitable control and mixing valves 69, 69', which maintain the proper pressure and mixture of the fuel. Air is supplied for the gas mixture by an electric motor driven blower, not shown, which is controlled by a switch 63'.

In the preferred form of the invention, the burners B are carried or supported by bracket means including oppositely positioned, arcuately

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shaped members or plates 65, 66 which together with a member or plate 67 normally form a circle having the axis of the chuck 11 or spindle 12 at the center thereof. The member or plate 67 is bolted to a channel member 68 extending across and attached to the top of the tank 10 immediately in front of the cylinder 24 and the rear ends of the members 65, 66, which members are slidable upon the top of the tank 10, are pivoted to the member 68 adjacent to the ends of the member 67 by pins 70, 71. The free ends of the members 65, 66 may be moved toward and away from one another to form a substantially closed circle as shown in Fig. 3 or to open the circular formation as shown in Fig. 1 and they provide or facilitate access to the chuck 11 for loading and unloading the work. Preferably, the top portions of the tank project inwardly as at 72 to form supports for the members 65, 66 and the front is provided with a stop 73 to facilitate positioning the members 65, 66 in their working position. A latch 74 on the member 65 cooperating with a pin on the member 66 may be employed if desired, to hold the members against accidental displacement during the heating operation.

The bracket means for carrying the burners B also includes a series of plates 75 bolted to the tops of the members 65, 66, 67 which plates are rectangular in shape and extend radially outwardly with respect to the circle formed by the members 65, 66, 67. Each plate 75 has a central, longitudinally extending, inverted T-slot 76 therein terminating short of the ends of the plate, which slots are adapted to receive the head 77 of a rod 78, the shank of which extends upwardly through the slot 76 and is provided with a short threaded section 80 for the reception of a nut 81 by means of which the head may be drawn against the shoulders on the underside of the plate 77 to fix the rod 78 in any desired position along the slot 76. If desired, more than one rod 78 may be attached to each plate 75.

Each of the rods 78 carry one or more universal clamping brackets C, each comprising a split tubular member 85 adapted to receive the rod 78 therethrough and which has two complementary lugs 86, 87 provided with a clamp screw 88. The members C may be clamped to the rods 78 at any desired vertical position therealong by the clamp screws 88 which extend through an opening in lugs 86 and are threaded into lugs 87. Each of the tubular members 85 has an annular or disk like portion 90 having a circular face thereon provided with a central recess 91, and a tapped opening 92 offset therefrom. A second somewhat similar member comprising a split tubular member 93 formed integral with an annular or disk-like member 94 is pivotally connected with member 90. To this end the member 94 has a central circular boss 95 which engages in the recess 91 in the member 90 and an arcuate slot 96 there-through for the reception of the shank of a bolt 97 threaded into opening 92. The slot 96 extends through approximately 90° and permits the members 93, 94 to be rotated through 90° relative to member 90 and to be locked therewith in any adjusted position by tightening the bolt 97.

The split tubular members 93 are adapted to receive the burner stems 61 and have complementary lugs 100, 101 provided with clamp screws 102 the shanks of which pass through openings in the lugs 100 and are threaded into openings in the lugs 101. By this arrangement, the dis-



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tance of the burner nozzle from the upright support rods 78 can be adjusted, as desired.

It will be seen that the brackets C provide for adjustment of the burner nozzles with respect to elevation, angle of flame projection and distance from the work piece. If a large work piece is to be heat treated, a plurality of burners can be carried on each of the upright rods 78 by attaching additional brackets to the rods. In some cases all of the burners provided may not be required and in this event the burners not used may be positioned on the respective rods 78 out of the way of the active burners.

Work to be heat treated is placed in the chuck 11 by separating burner base or carrying members 65, 66, as seen in Fig. 1, to gain access to the chuck. Thereafter the members 65, 66 are swung together and the burners adjusted as to proper height and distance from the periphery of the work if necessary so that uniform heating of the proper intensity can be effected. During the heating of the work it is rotated and when the proper temperature is attained, the valve 27 is actuated and the frame 15 lowered to submerge the work in the quenching bath in the tank. The work is then elevated, the burners withdrawn or moved to inoperative position by separating the members 65, 66 and the work removed from the chuck.

It is apparent that all of the objects enumerated above as well as others have been attained and I have provided a flame hardening apparatus which provides easy access to the work holder and which has provisions for adjusting the position of the burners relative to the work and enables any number of burners to be readily removed from the operation and replaced according to the requirements of the particular work being heat treated.

While the preferred form of the invention has been described in considerable detail, it will be apparent that the invention is not limited to the constructions shown and it is my intention to cover hereby all adaptations, modifications and changes therein which come within the practice of those skilled in the art to which the invention relates and the scope of the appended claim.

Having thus described my invention, I claim:  
In a flame hardening apparatus, an open top

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quenching tank, a vertical spindle adapted to have a workpiece connected thereto adjacent to its upper end, means for supporting said spindle in the center of said tank for vertical movement, means for reciprocating said spindle to selectively position the upper end thereof above or below the surface of quenching fluid in said tank, means for rotating said spindle, means forming supporting surfaces adjacent to the upper edge of the tank and on opposite sides thereof, a pair of opposed semi-circular members slidably supported on said supporting surfaces adjacent to the top of said tank for movement in a horizontal plane toward and from the center of the tank, a plurality of fuel burners connected to said semi-circular members for universal adjustment relative thereto, means for connecting two of the adjacent ends of said semi-circular members for pivotal movement about a vertical axis adjacent to a side of said tank whereby the free ends of said semi-circular members may be moved toward and from each other to cause said burners carried thereby to be moved toward a workpiece connected to said spindle to direct flames onto the workpiece or away therefrom to leave the top of the tank open for loading and unloading said work spindle.

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