

May 5, 1953

A. P. BAMFORD

2,637,270

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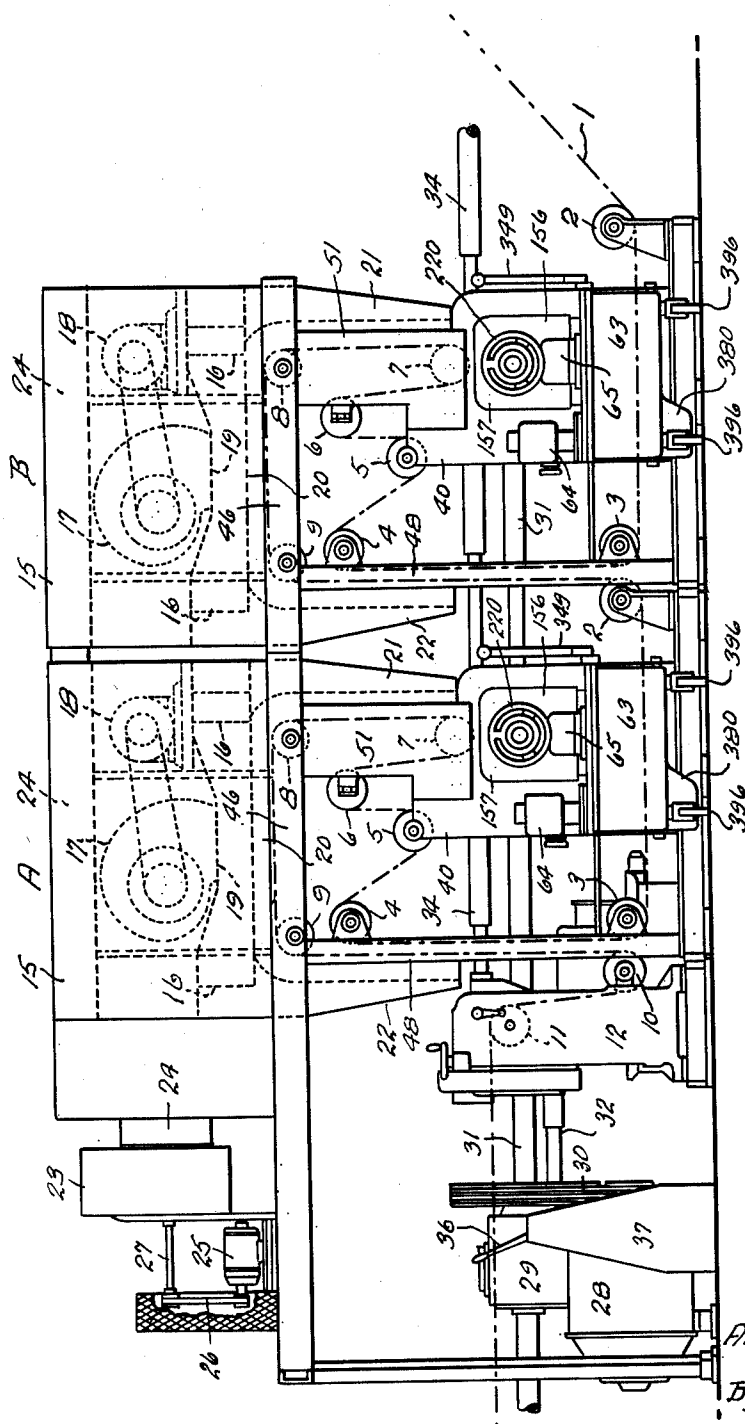


Fig. 1

INVENTOR.

Arthur P. Bamford

By Victor A. Borst

Atty.

May 5, 1953

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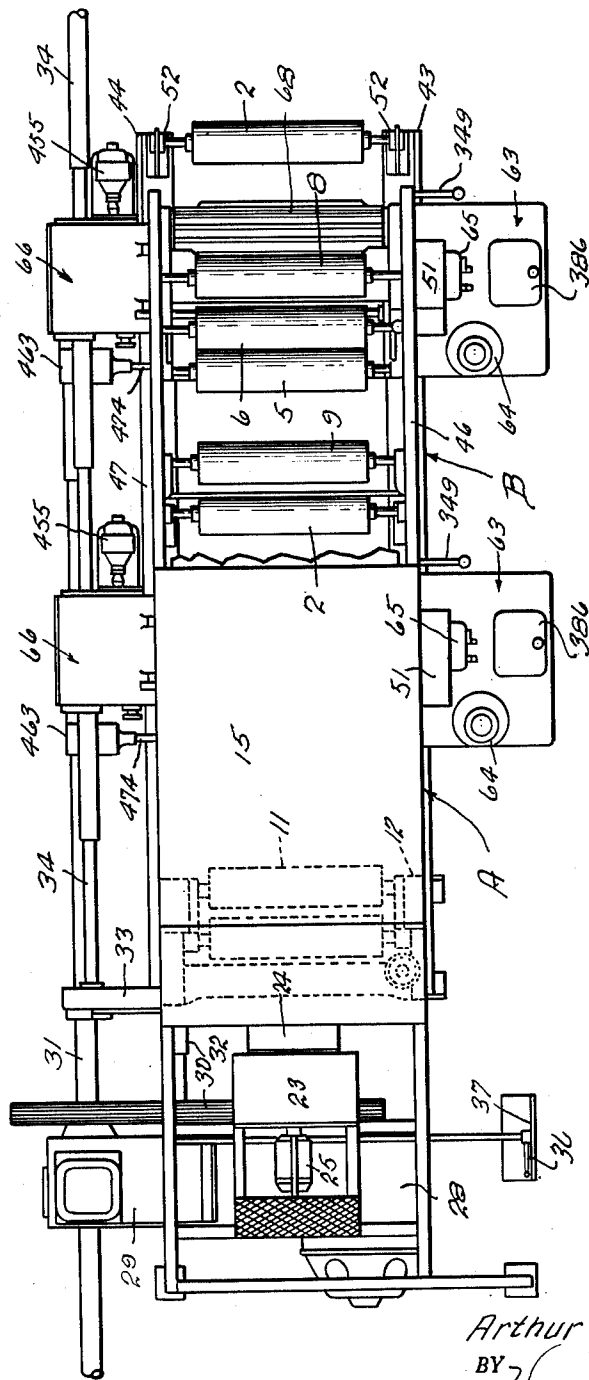


Fig. 2

INVENTOR.
Arthur P. Bamford
BY Victor N. Borst
Atty.

May 5, 1953

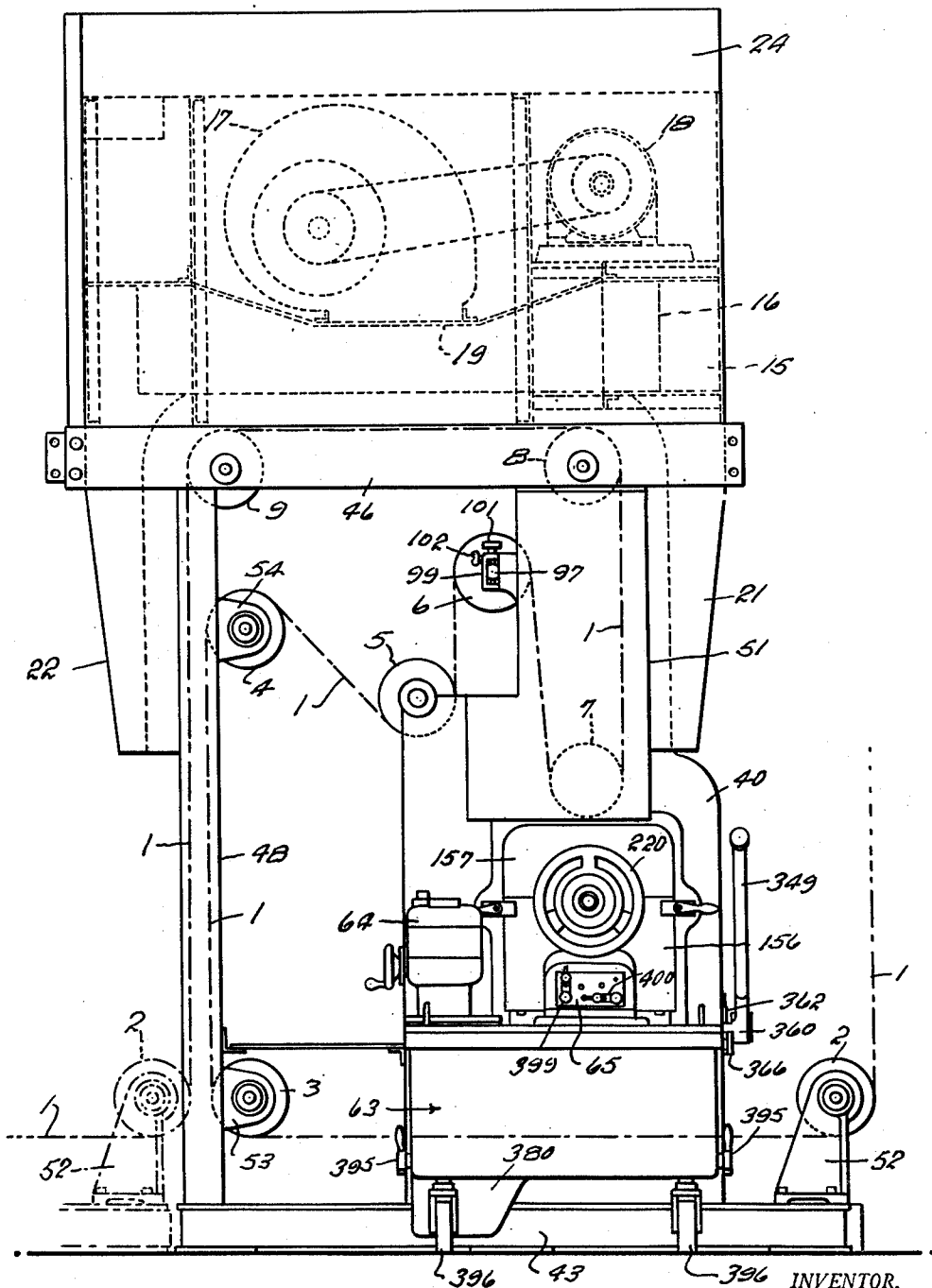
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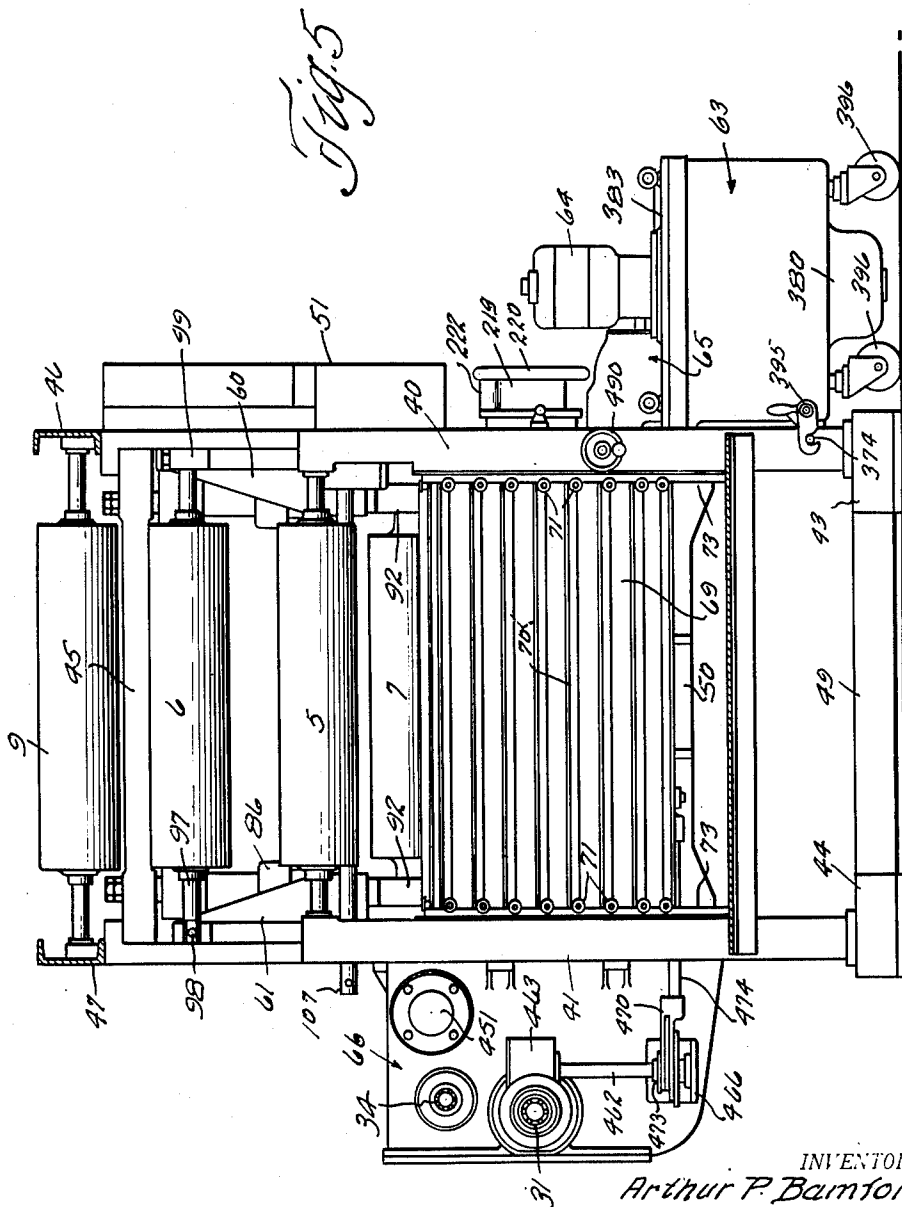
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INVENTOR.
Arthur P. Bamford
BY *Victor W. Bonet*
Atty.

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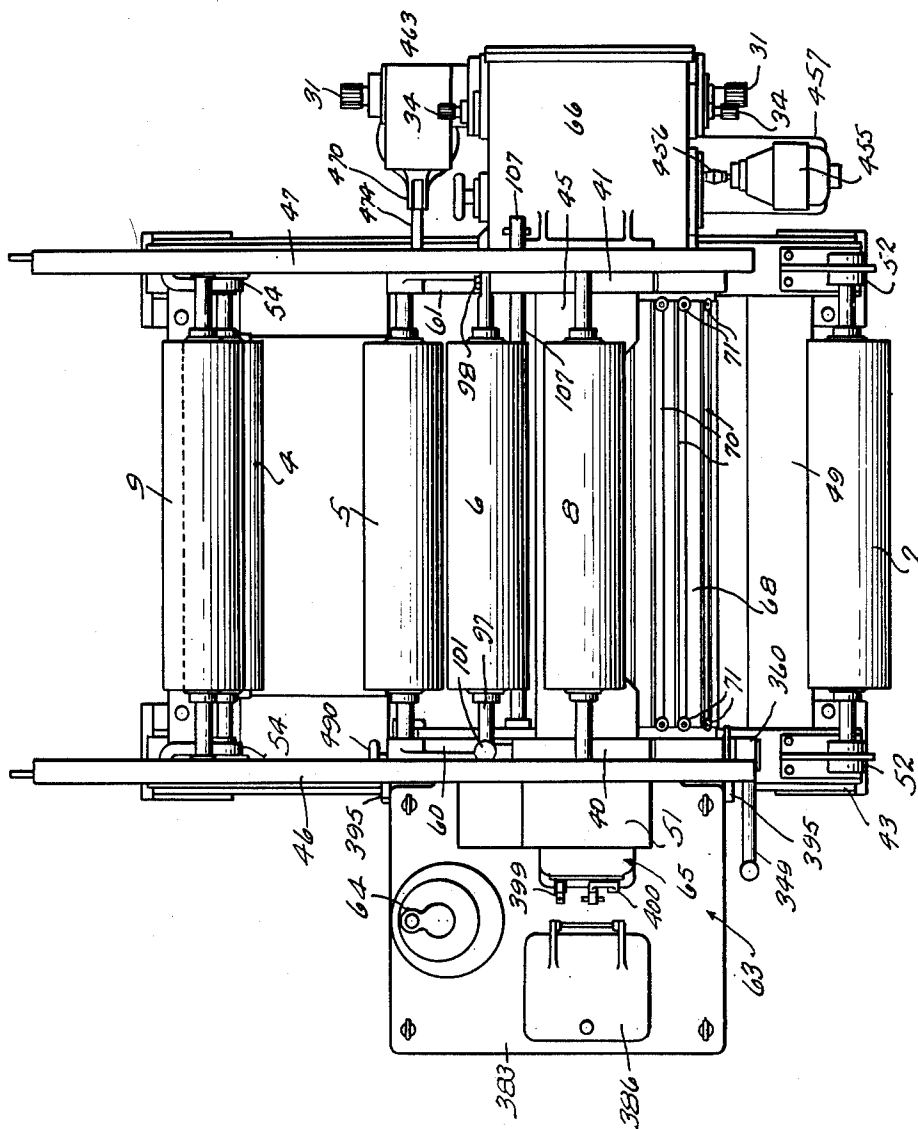


Fig. 6

INVENTOR.
Arthur P. Bamford
BY
Victor W. Boret
Atty.

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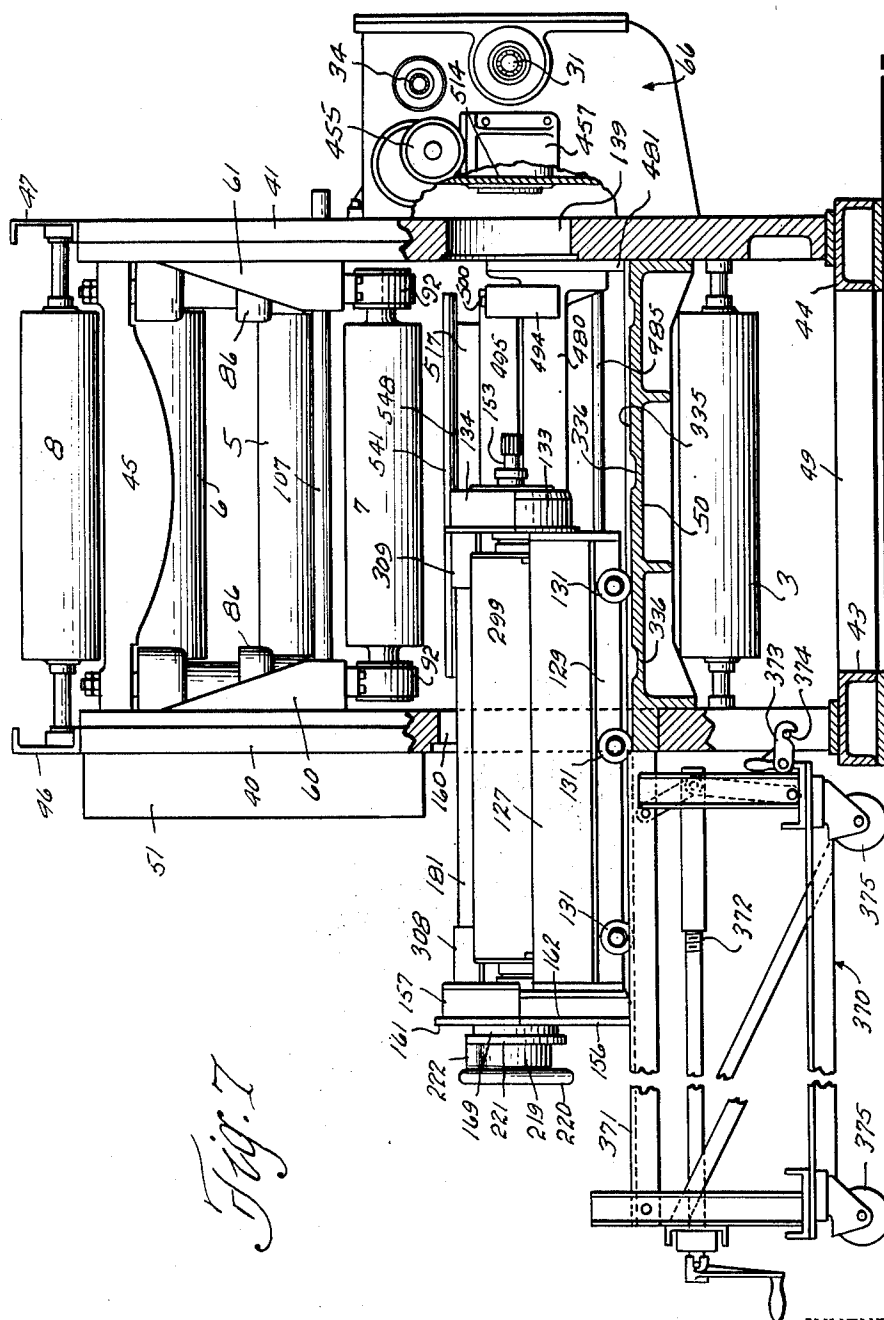


Fig. 7

INVENTOR.
Arthur P. Bamford
BY Victor W. Bonet
Atty.

May 5, 1953

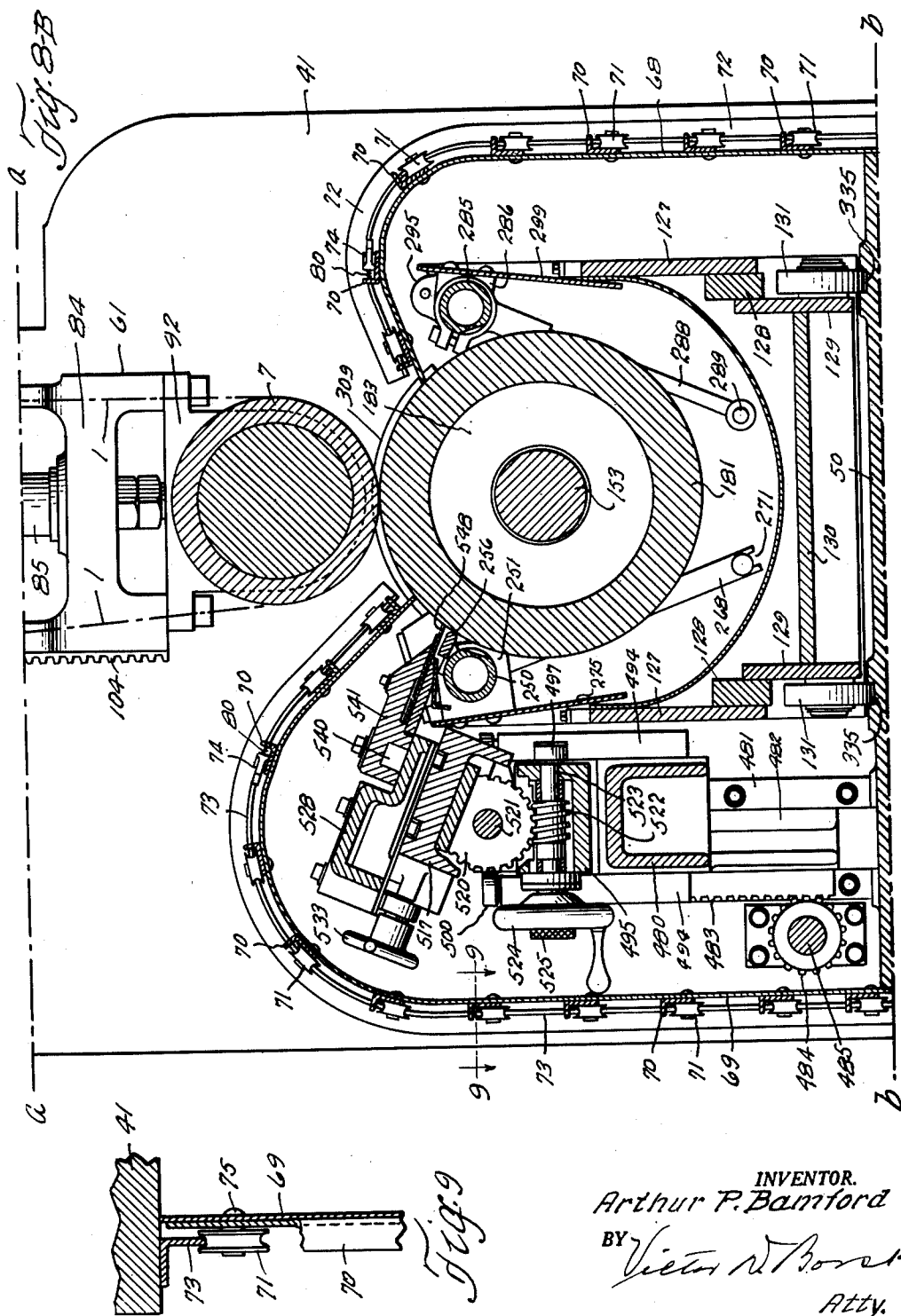
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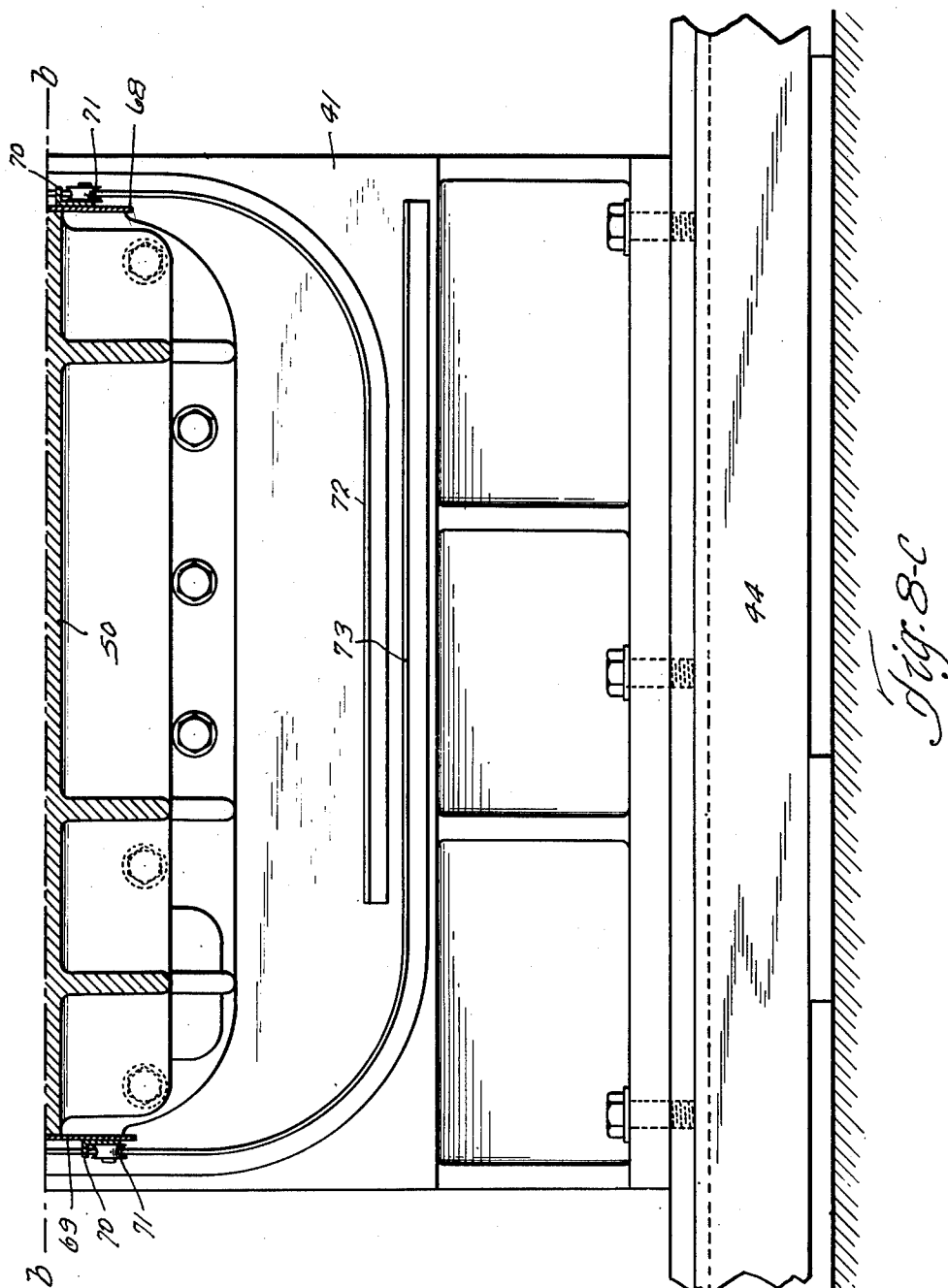


Fig. 8-c

INVENTOR.
Arthur P. Bamford

BY *Victor W. Bont*

Atty.

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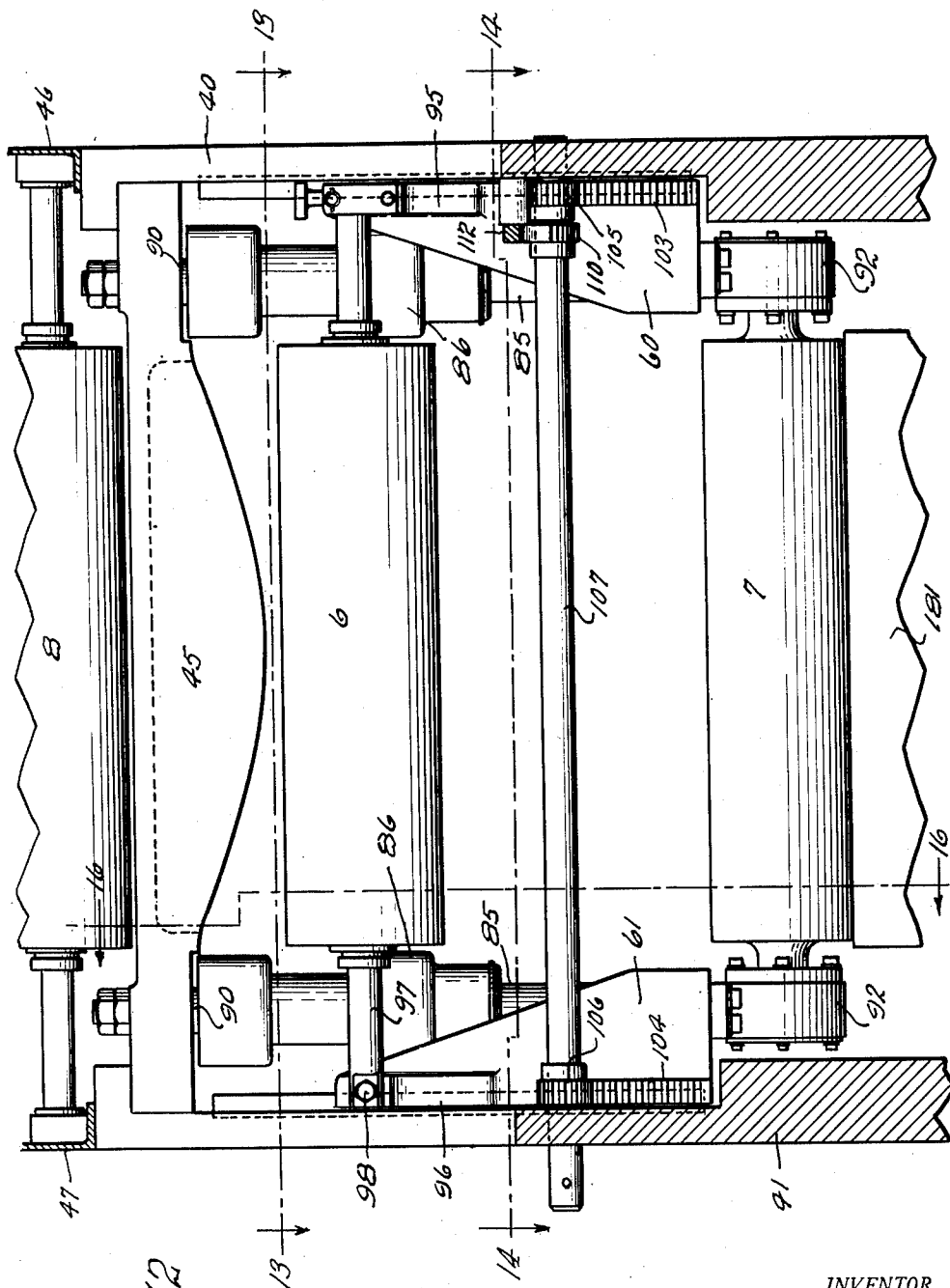


Fig. 12

INVENTOR.
Arthur P. Bamford
BY *Victor W. Bont*
Atty.

May 5, 1953

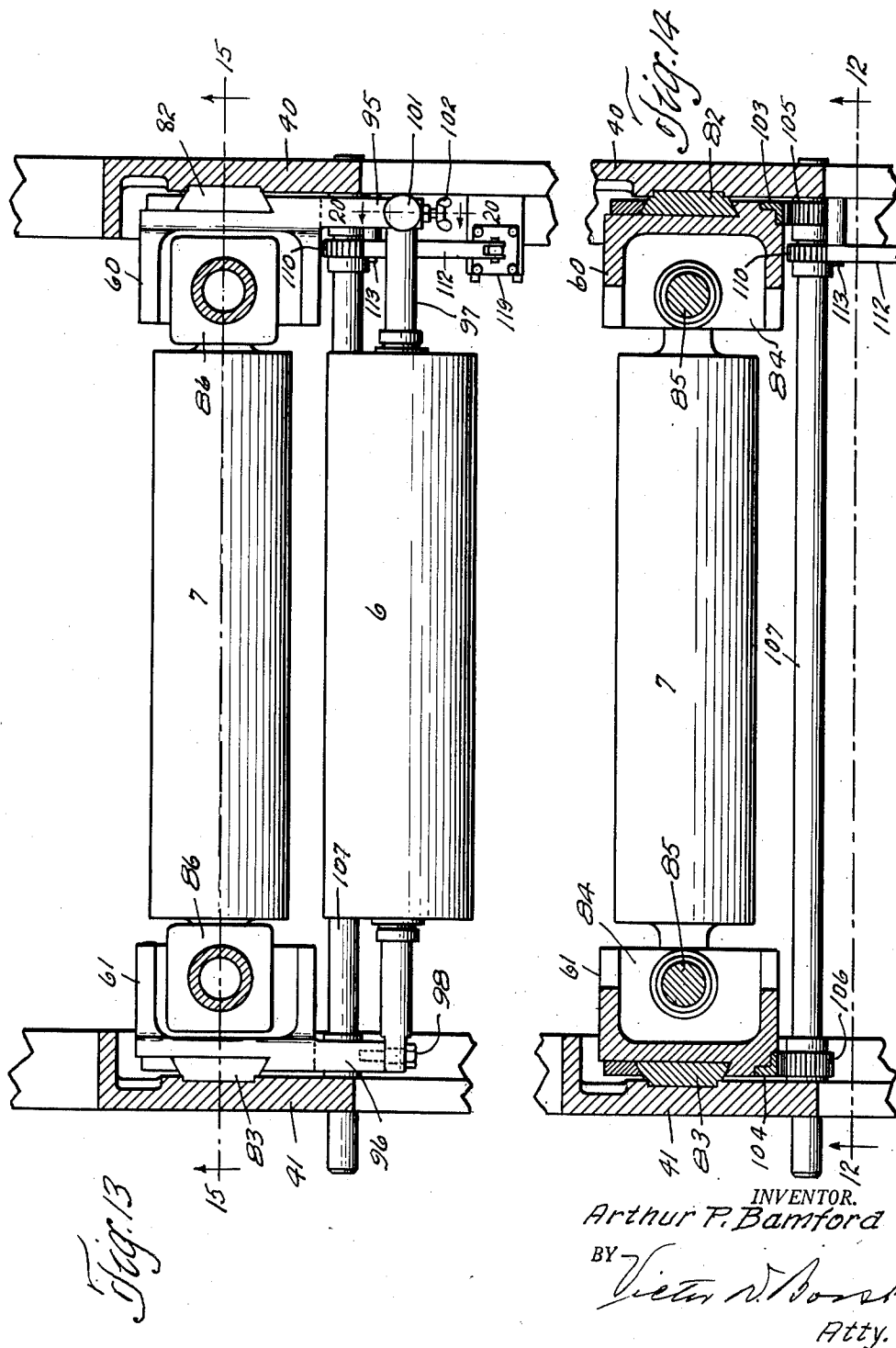
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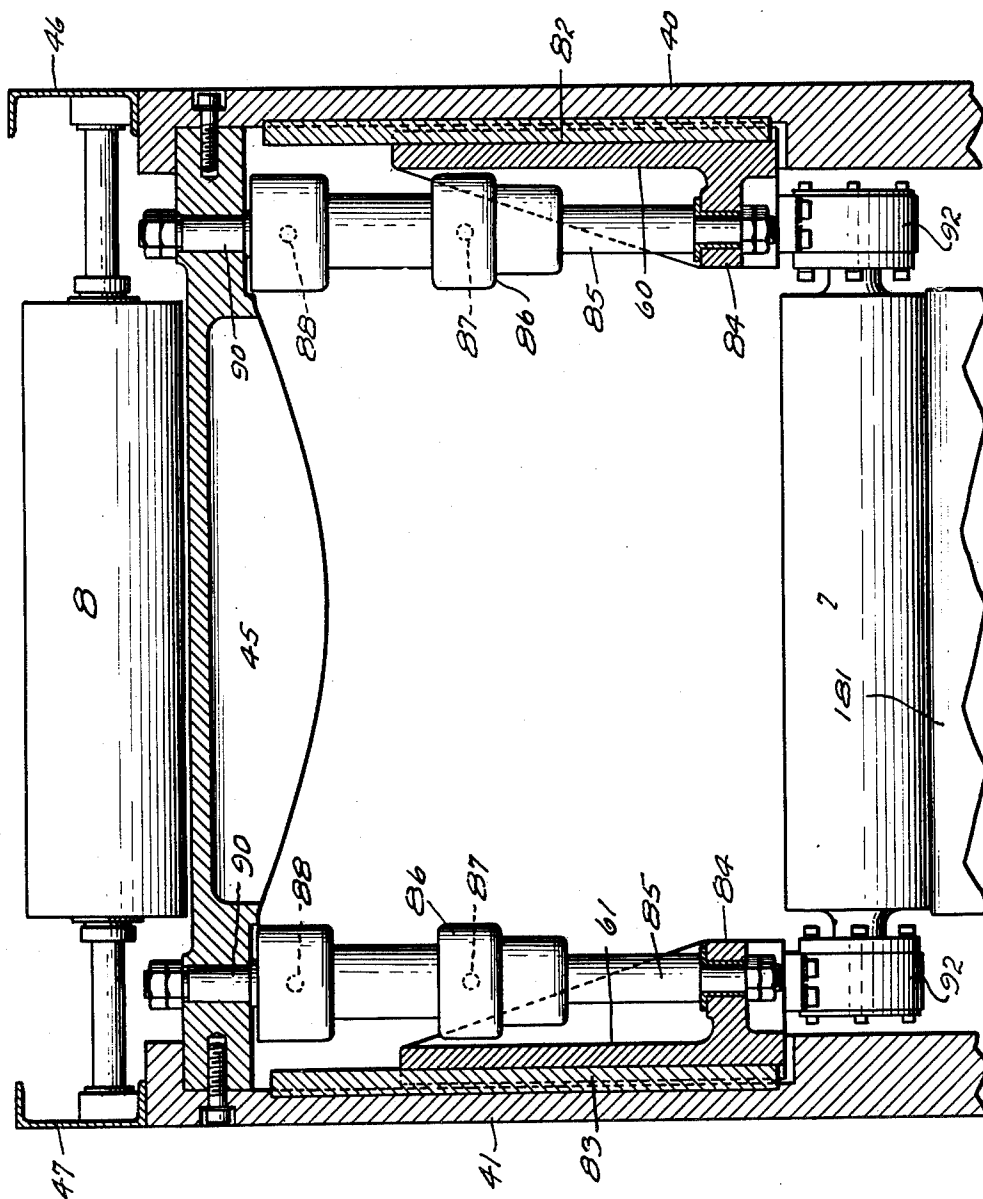


Fig. 15

INVENTOR.
Arthur P. Bamford
BY *Victor W. Bont*
Atty.

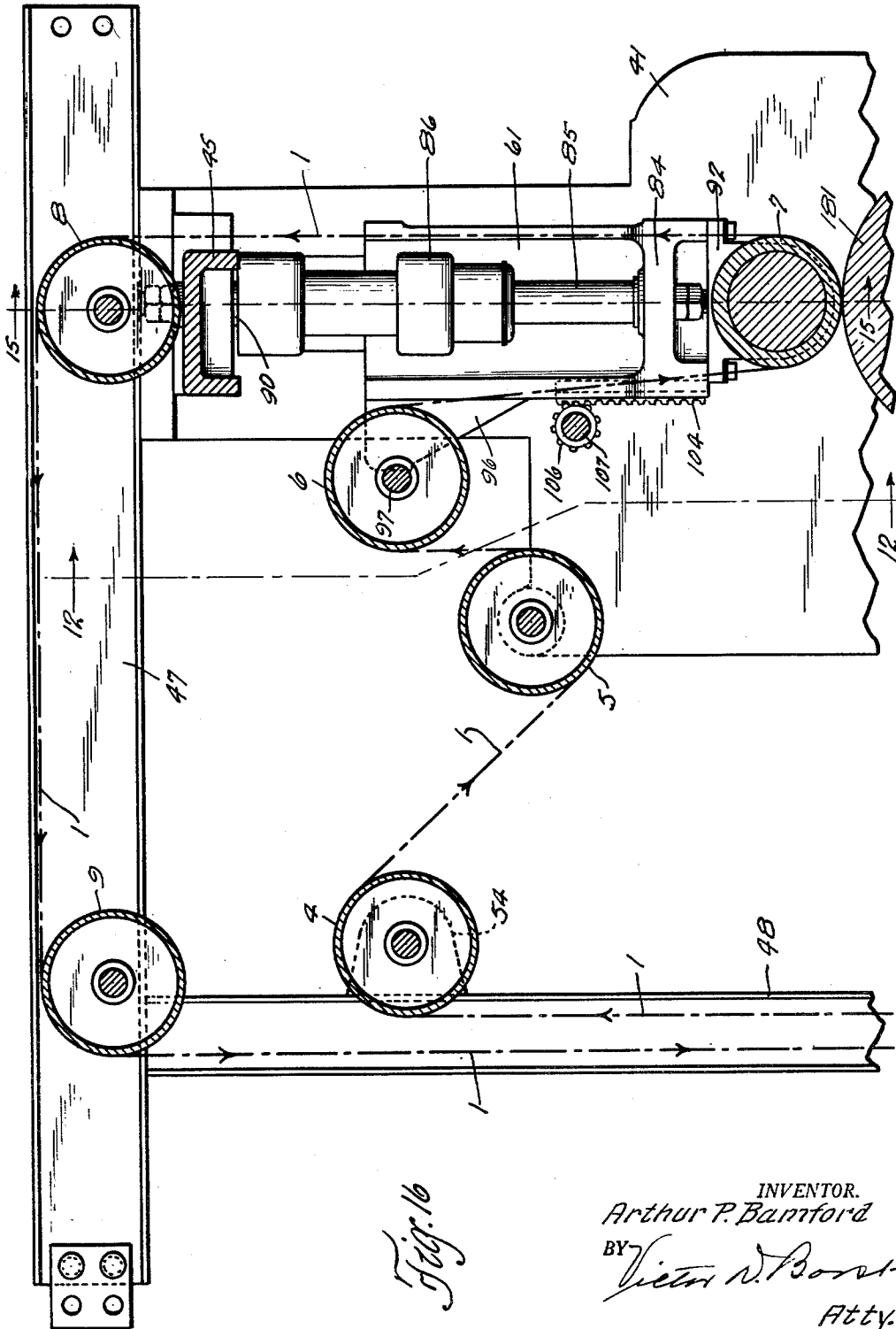
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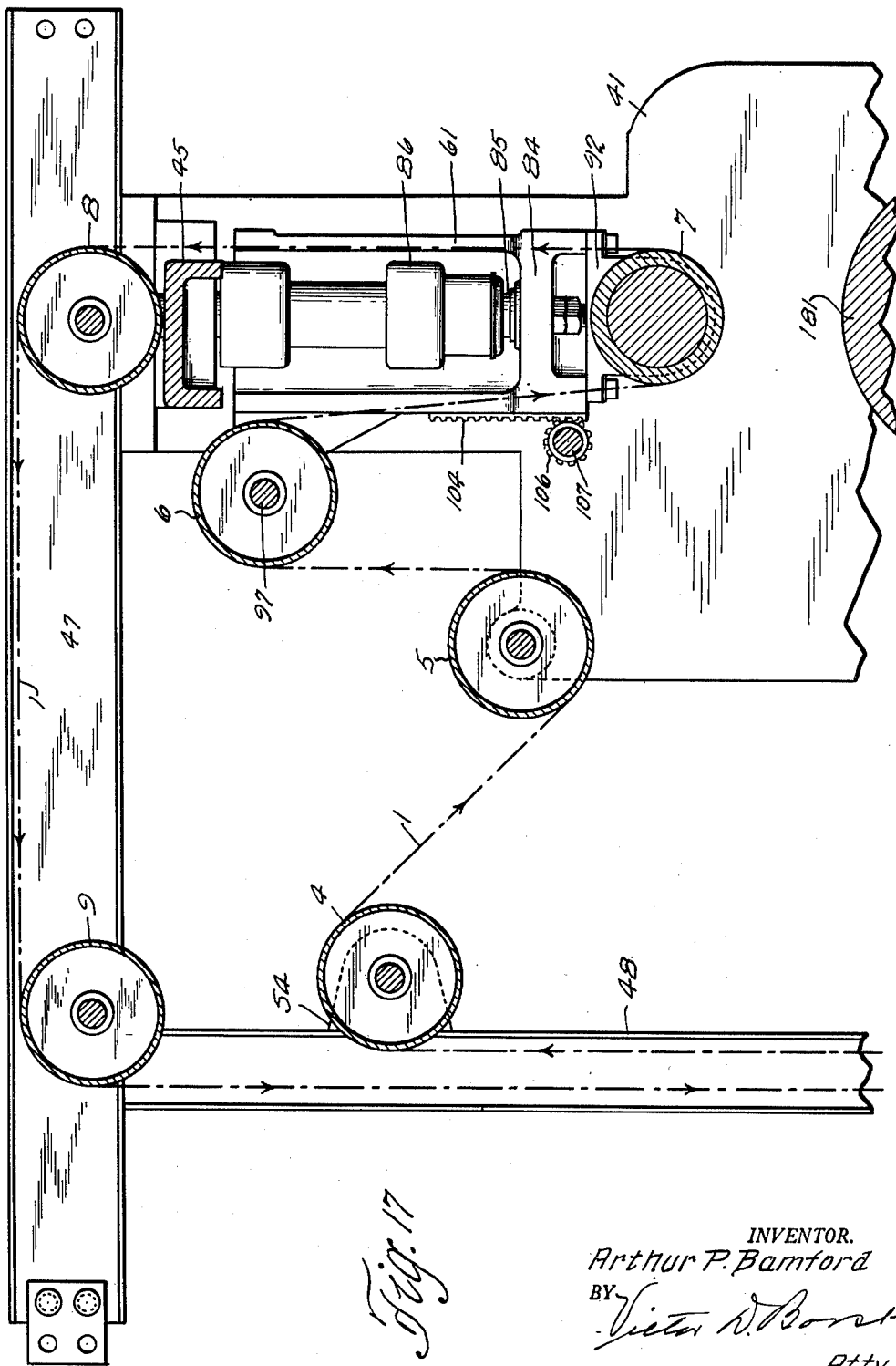
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INVENTOR.
Arthur P. Bamford
BY Victor W. Bonst
Atty.

May 5, 1953

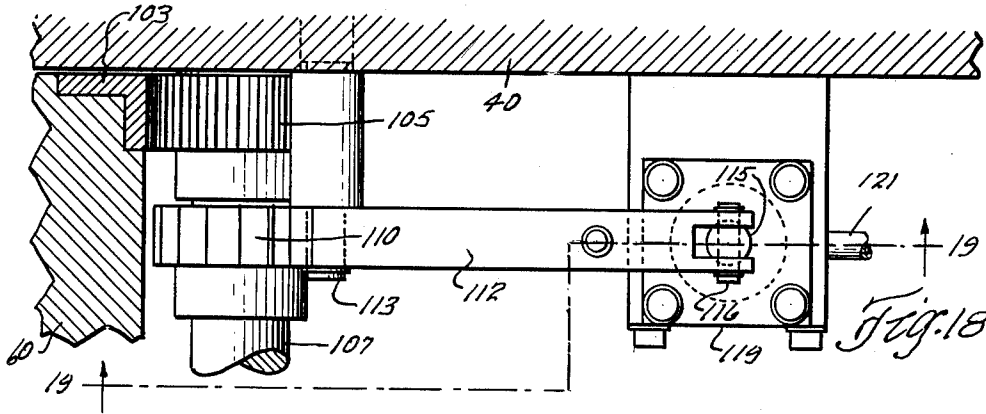
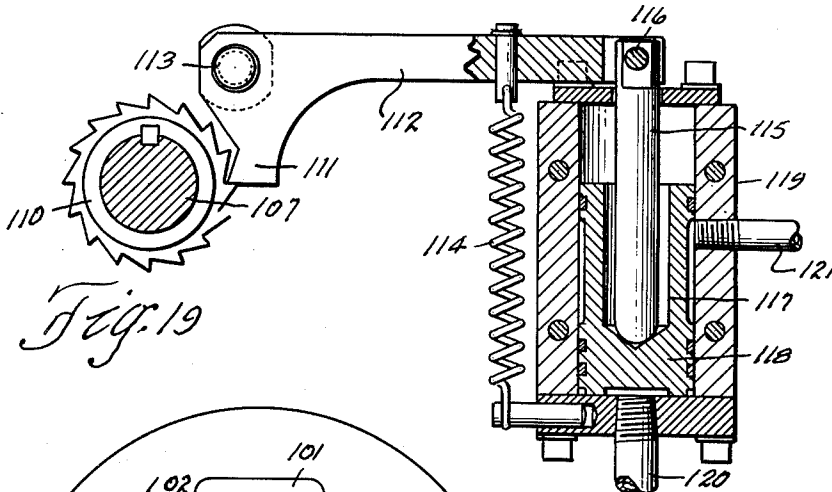
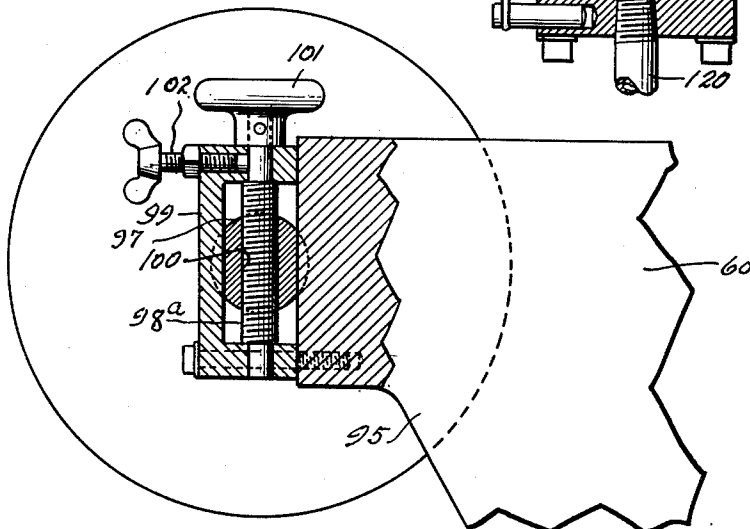
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INVENTOR.

Arthur P. Bamford

BY

Vietm N. Borst

Atty.

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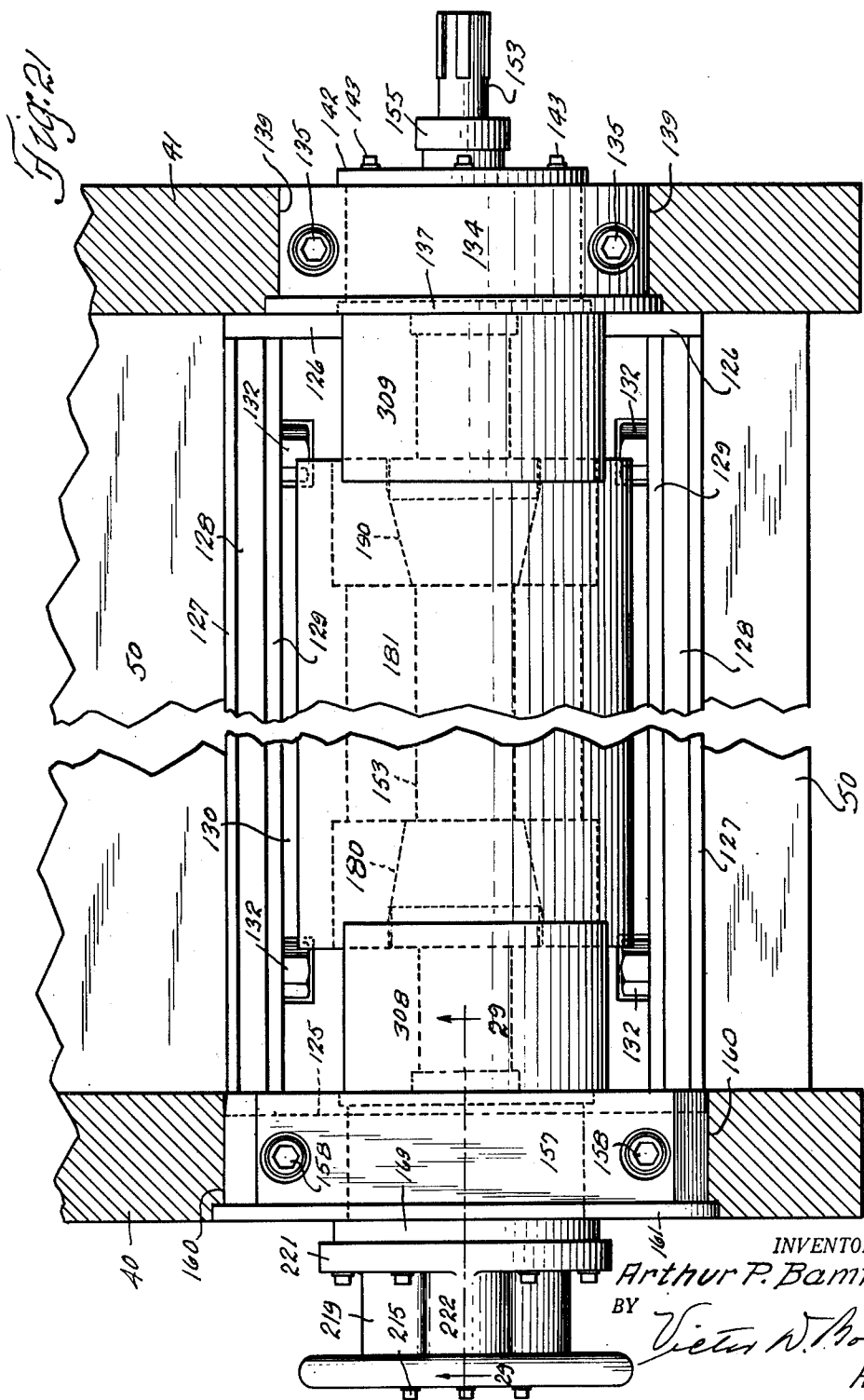
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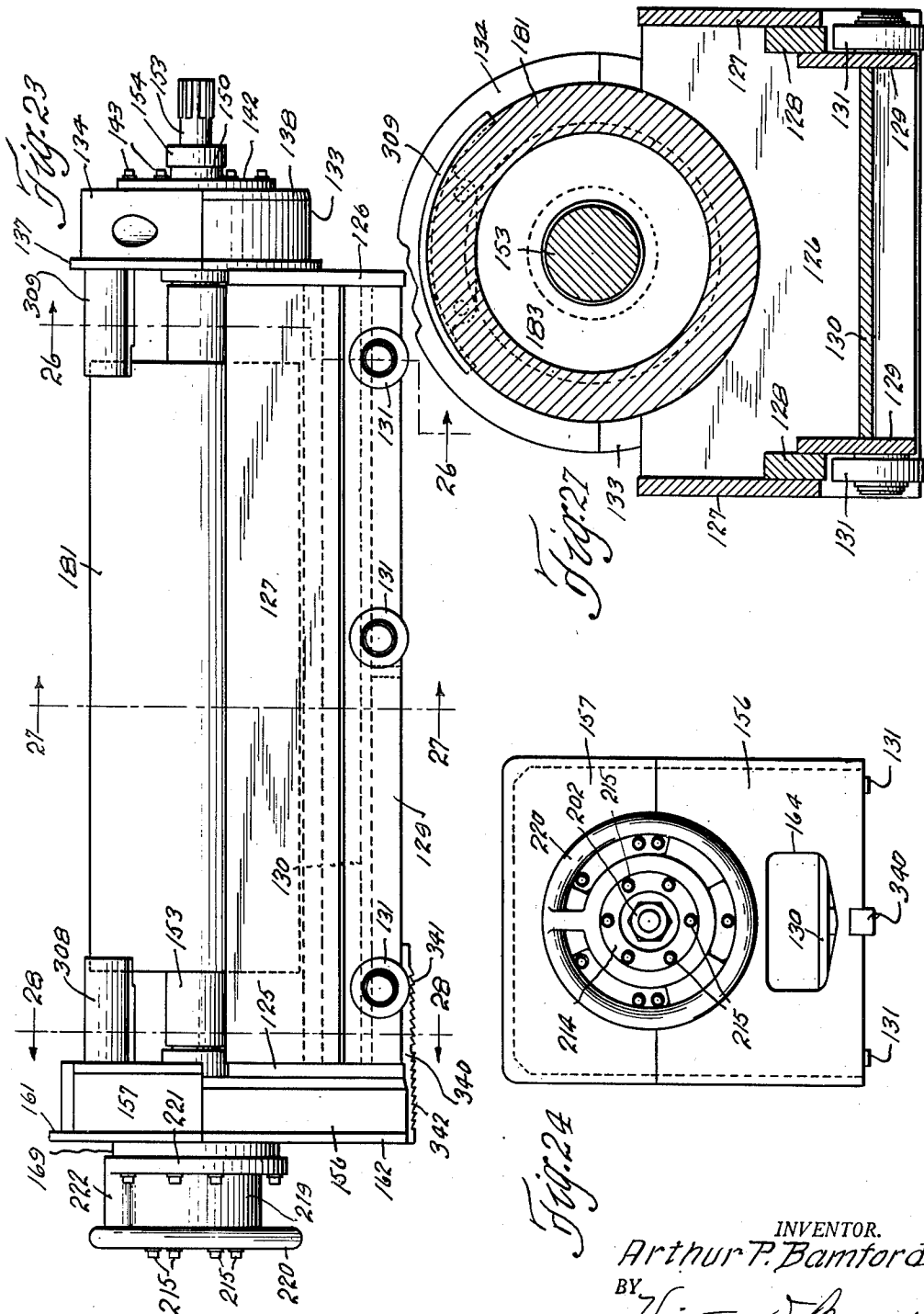
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INVENTOR.
Arthur P. Bamford
BY
Victor W. Bont
Atty.

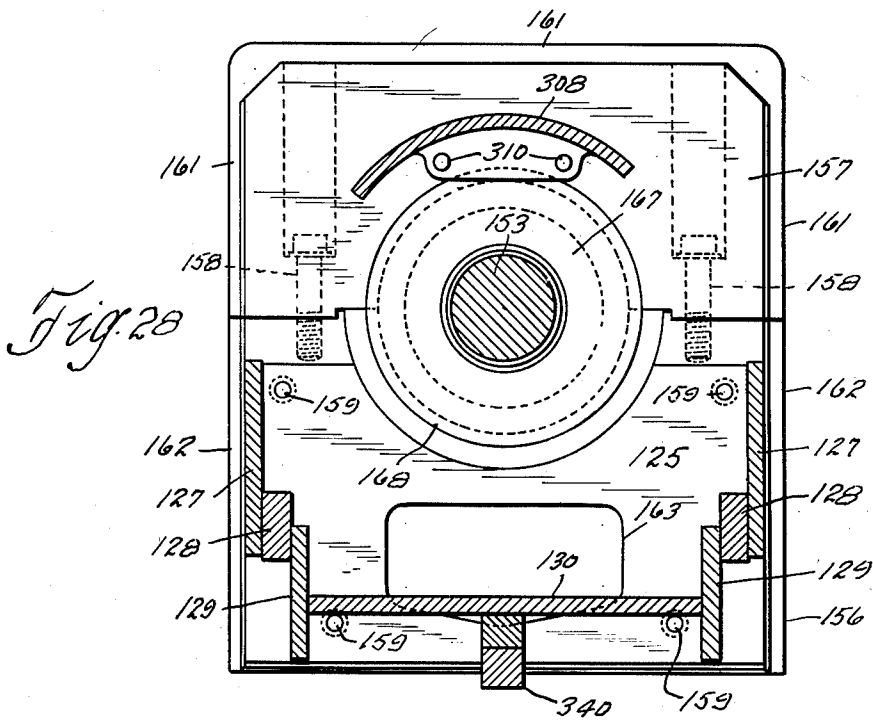
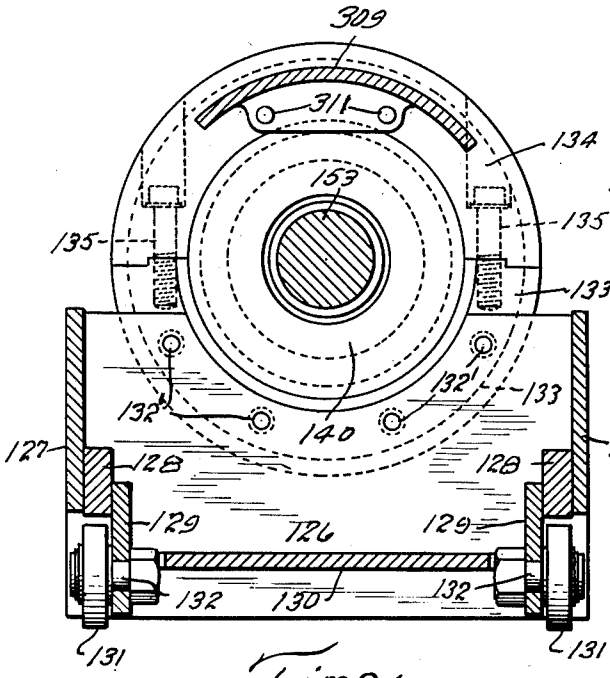
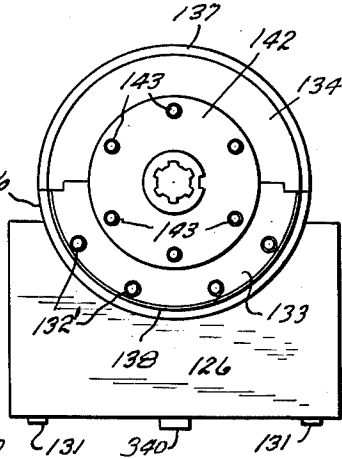
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INVENTOR.
Arthur P. Bamford
BY Victor W. Bonst
Atty.

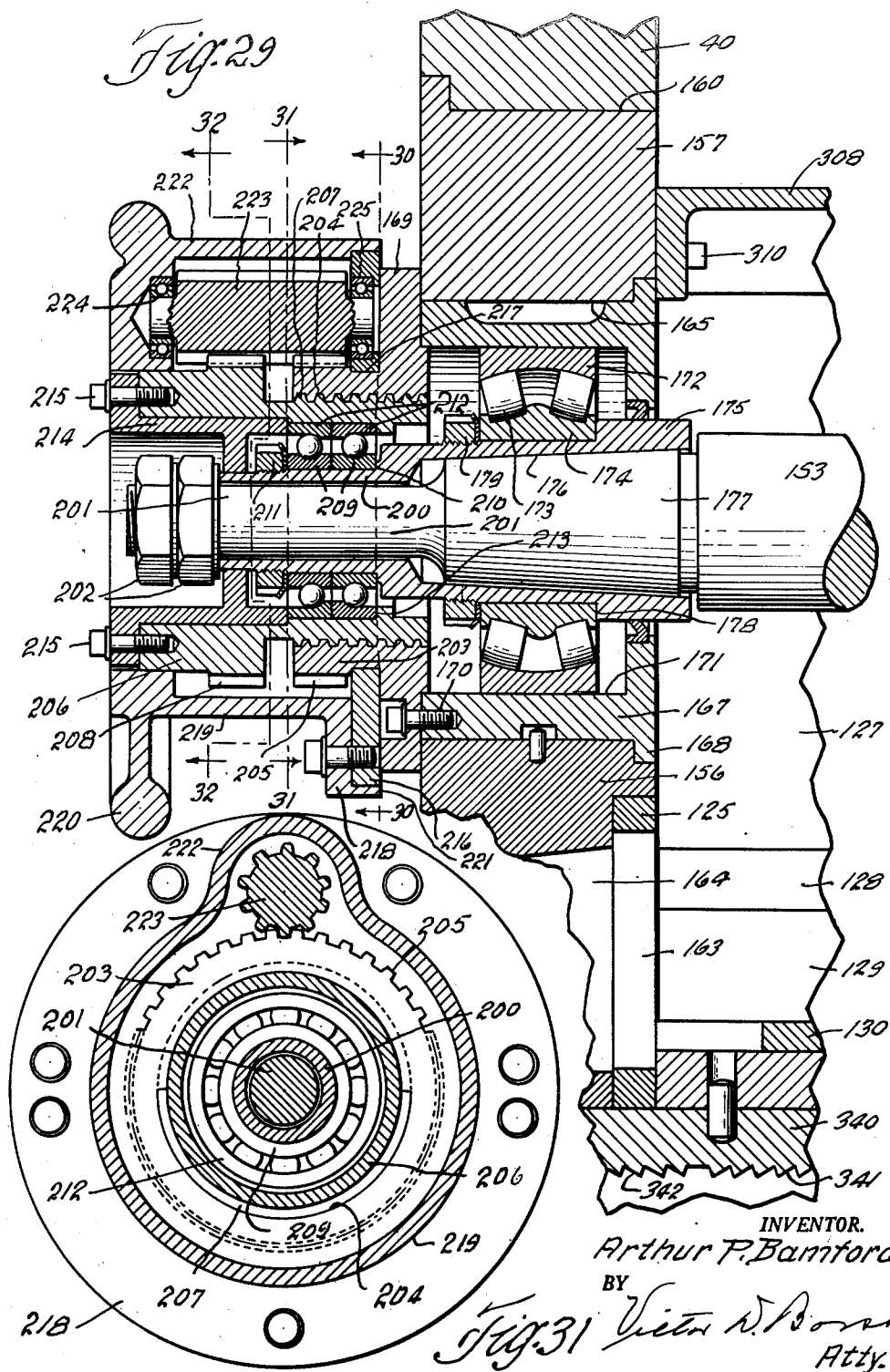
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Fig. 30

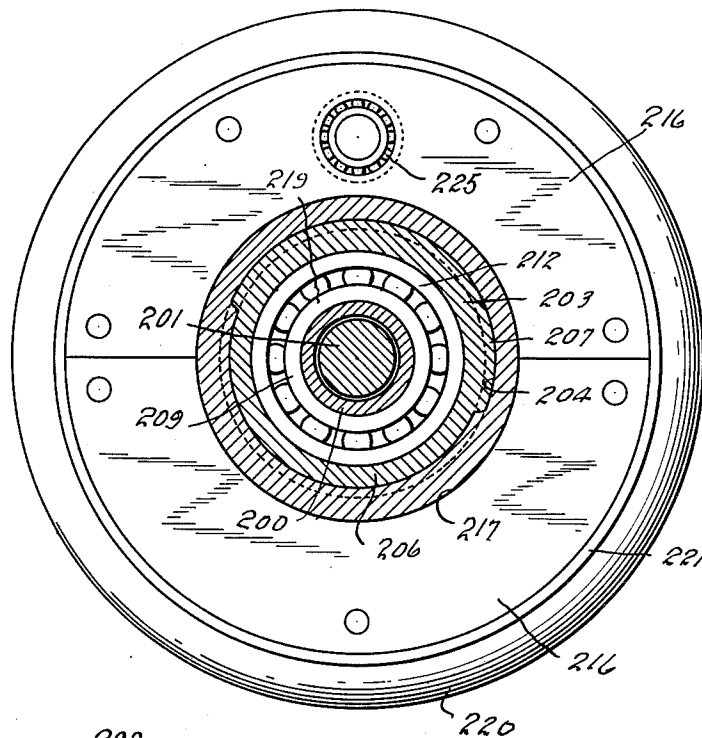
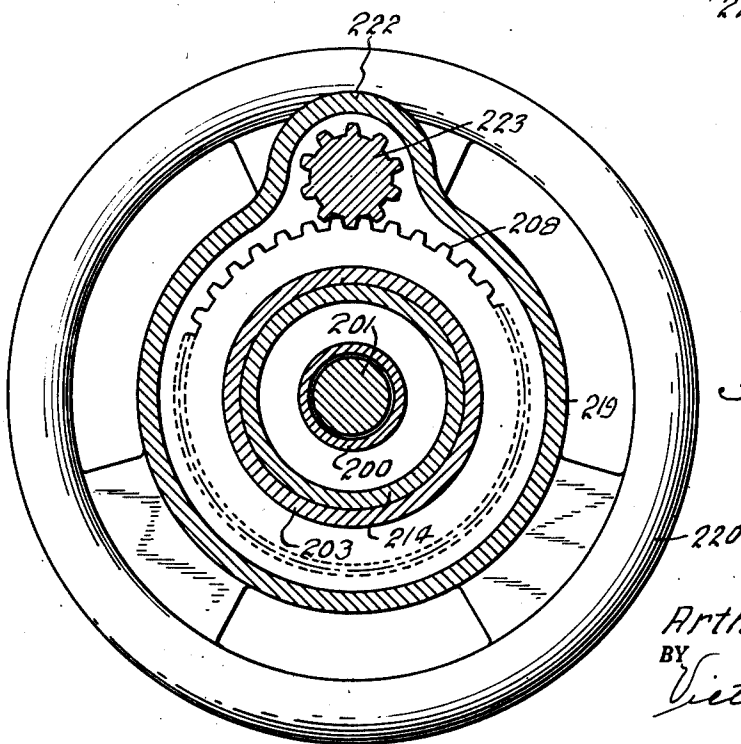


Fig. 32

INVENTOR.
Arthur P. Bamford
BY *Victor W. Bost*
Atty.

May 5, 1953

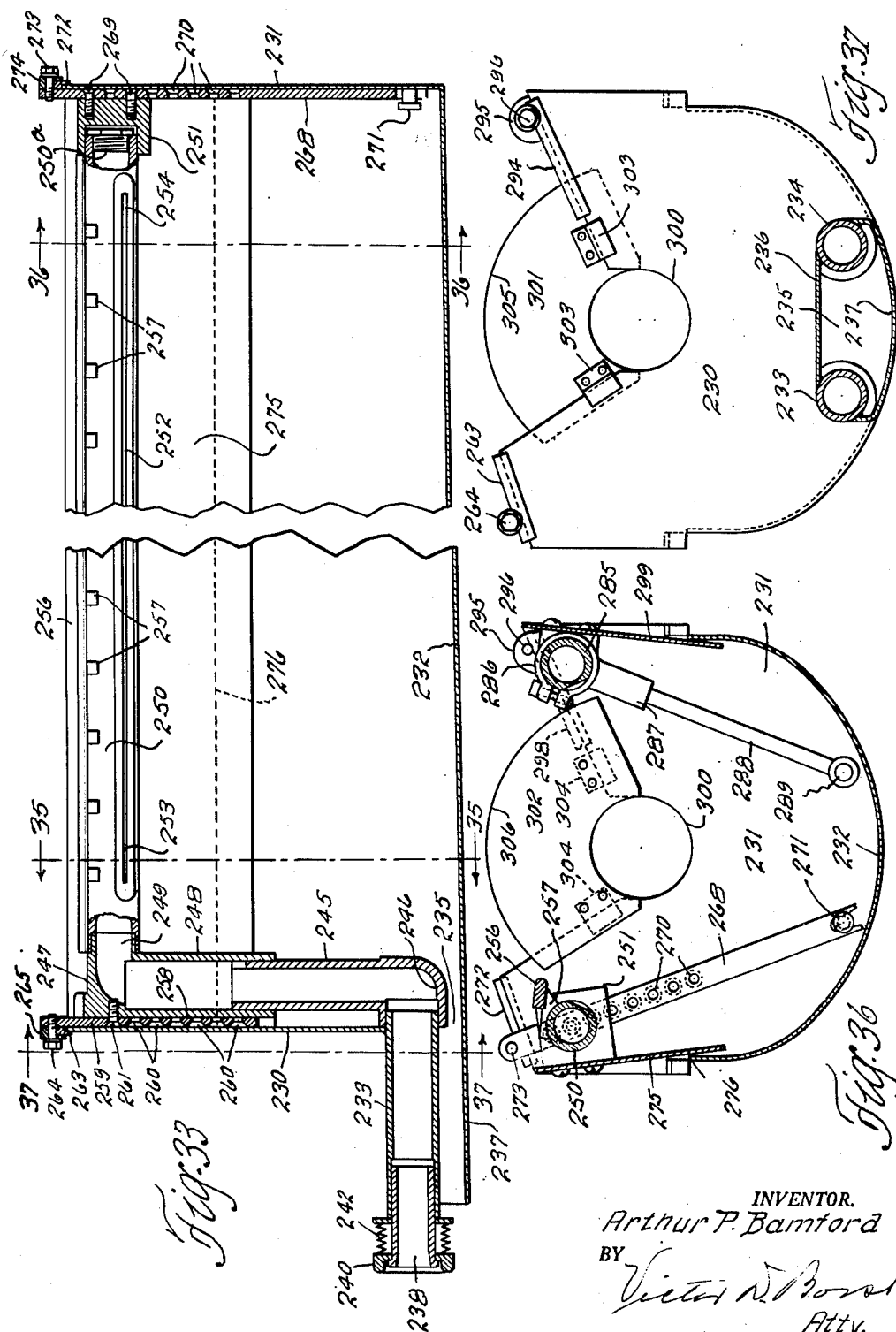
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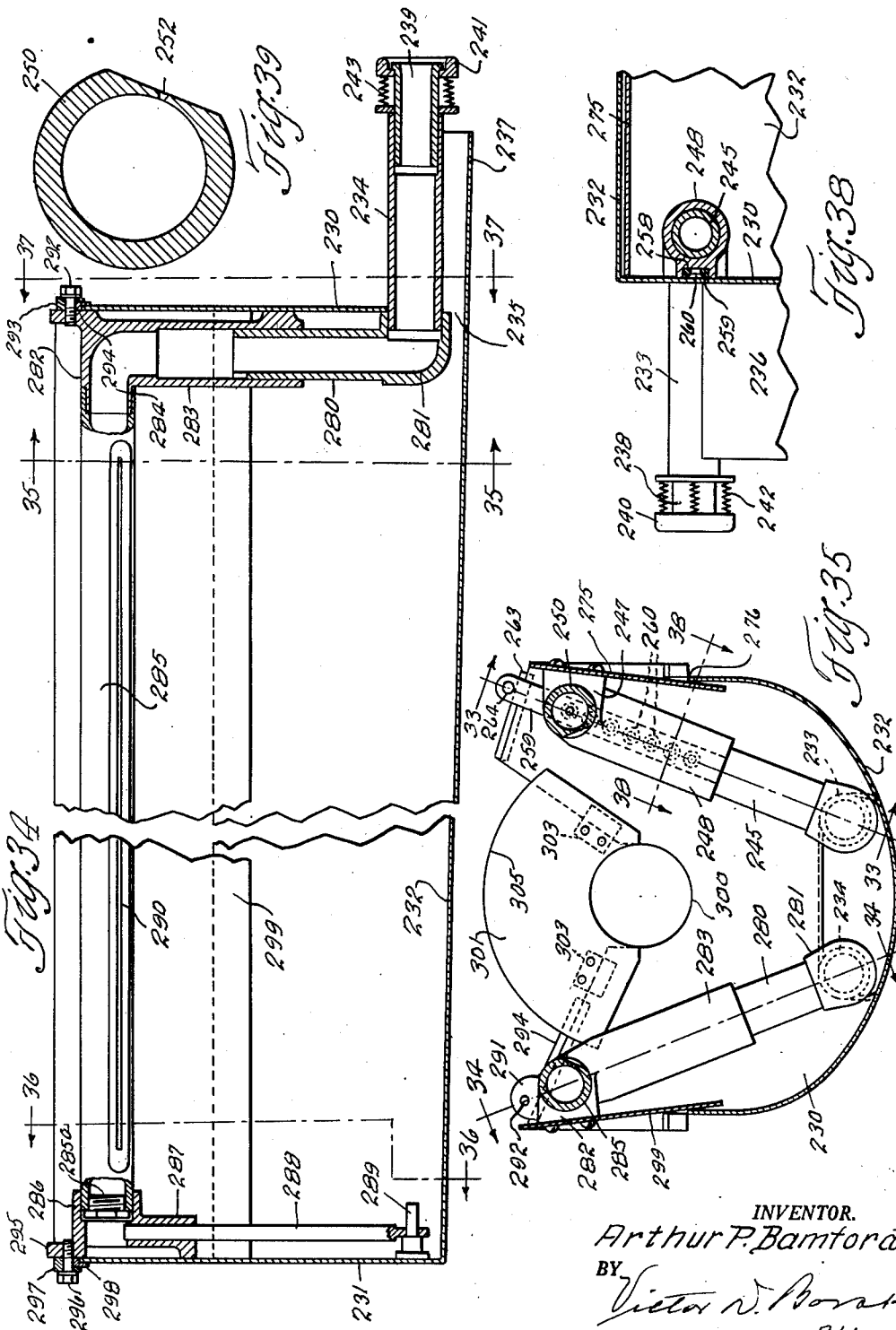
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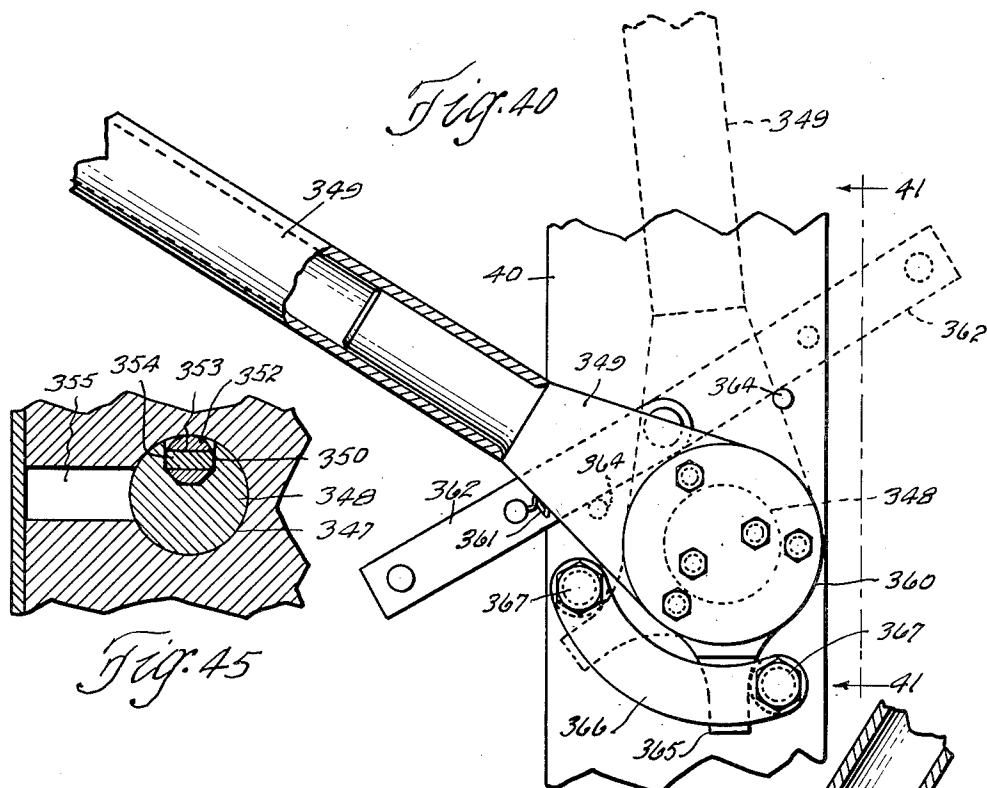
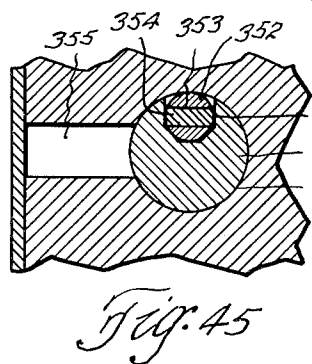
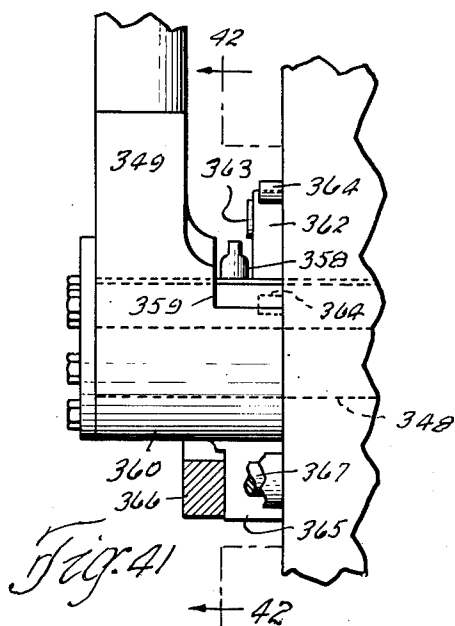
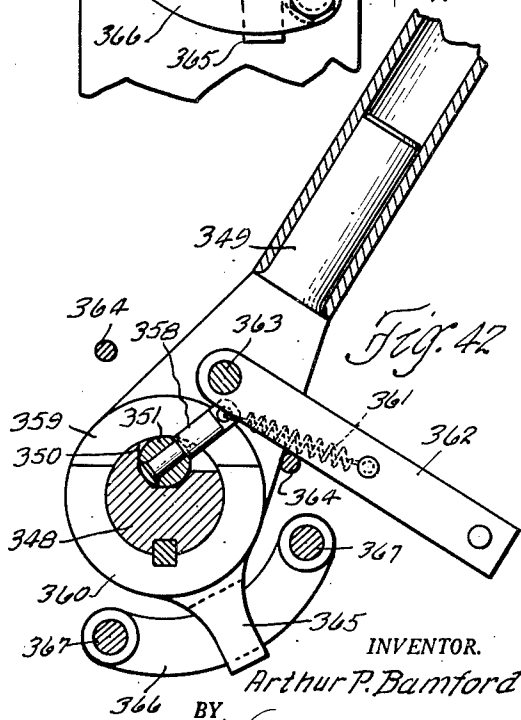
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INVENTOR.
Arthur P. Bamford
BY
Victor W. Borst
Att.

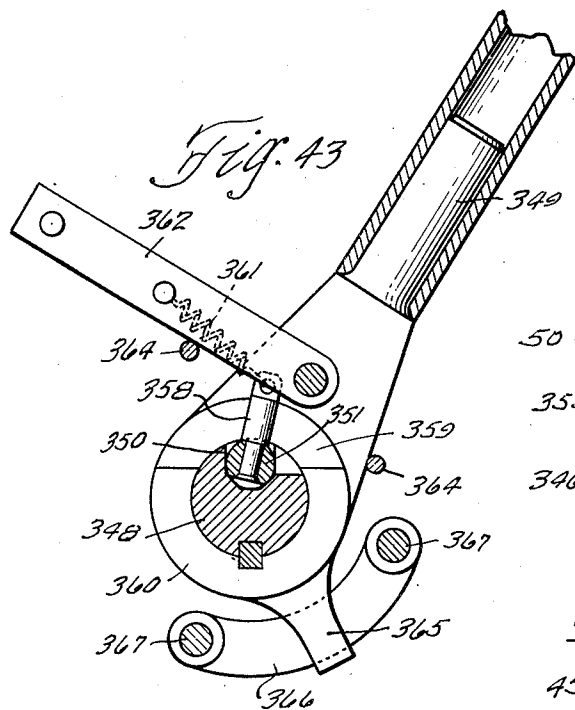
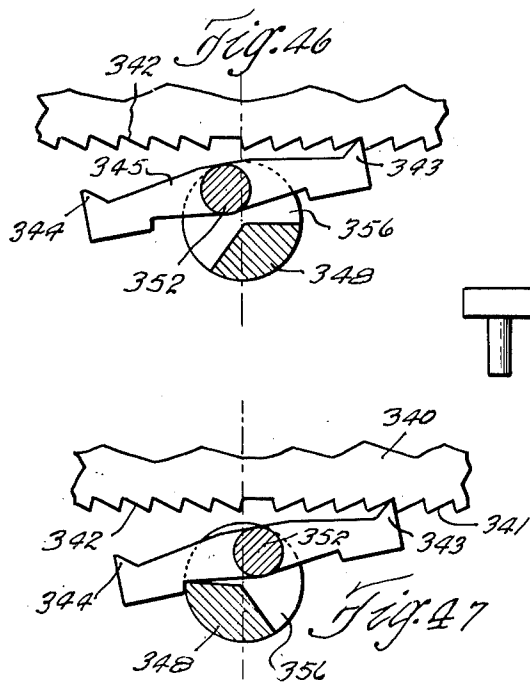
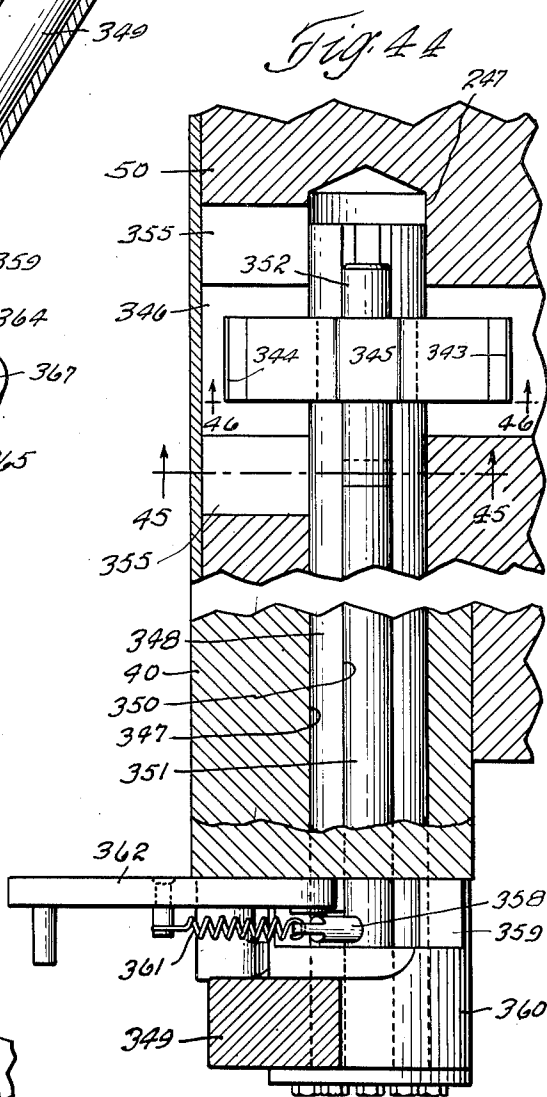
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INVENTOR.
Arthur P. Bamford
BY *Victor D. Bond*
Atty.

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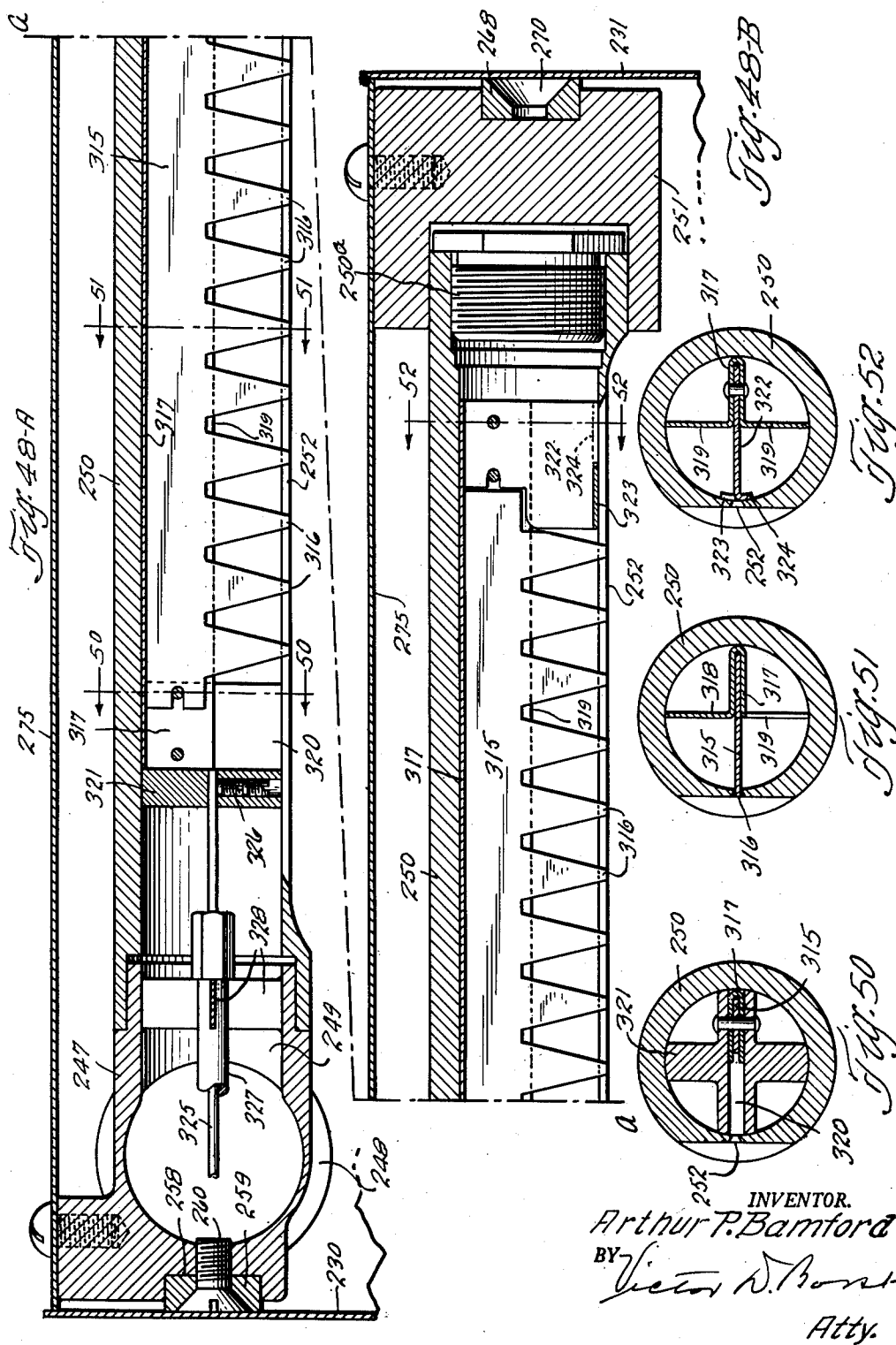
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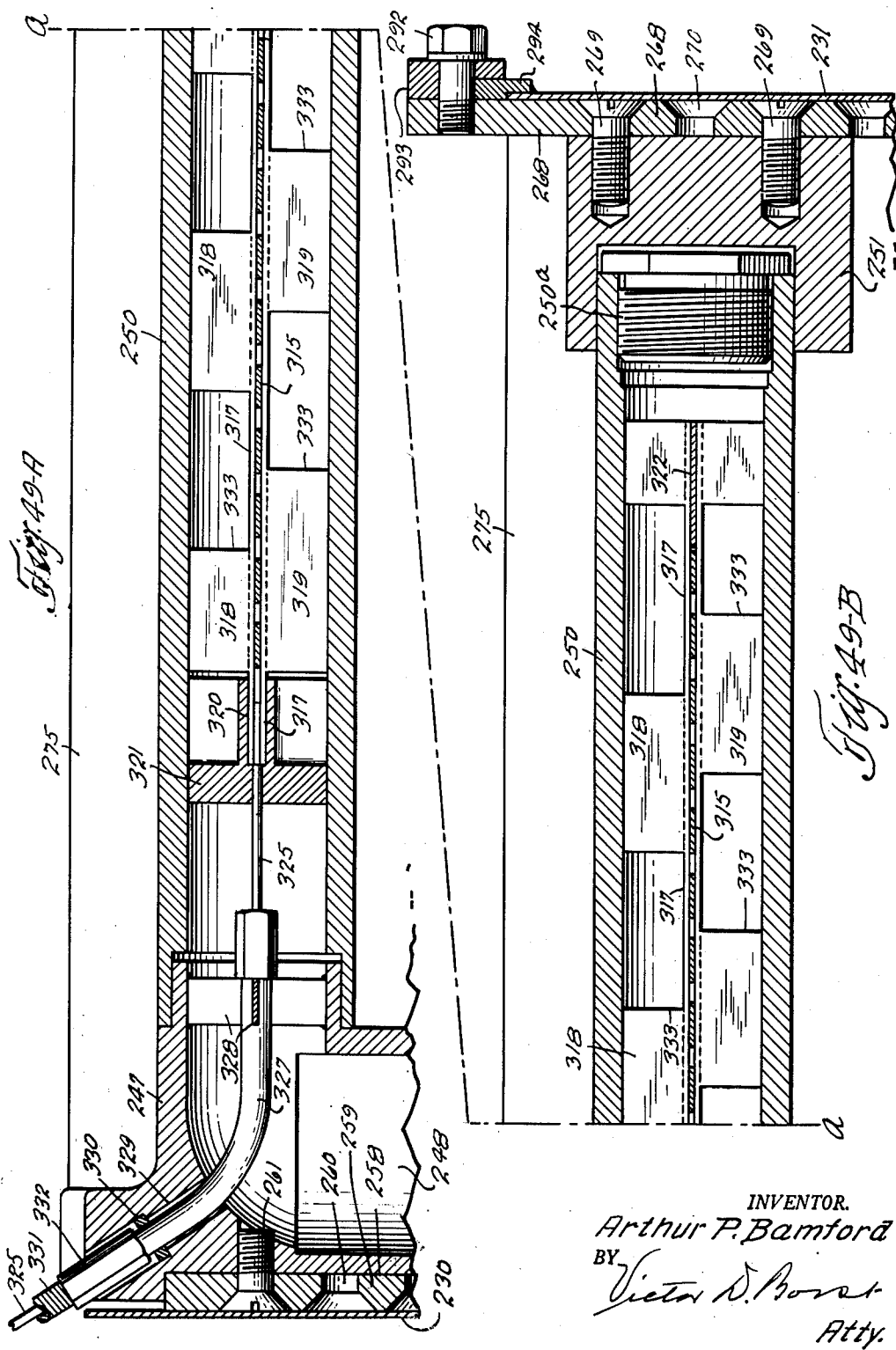
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INVENTOR.
Arthur P. Bamford
BY Victor D. Bovee
Atty.

May 5, 1953

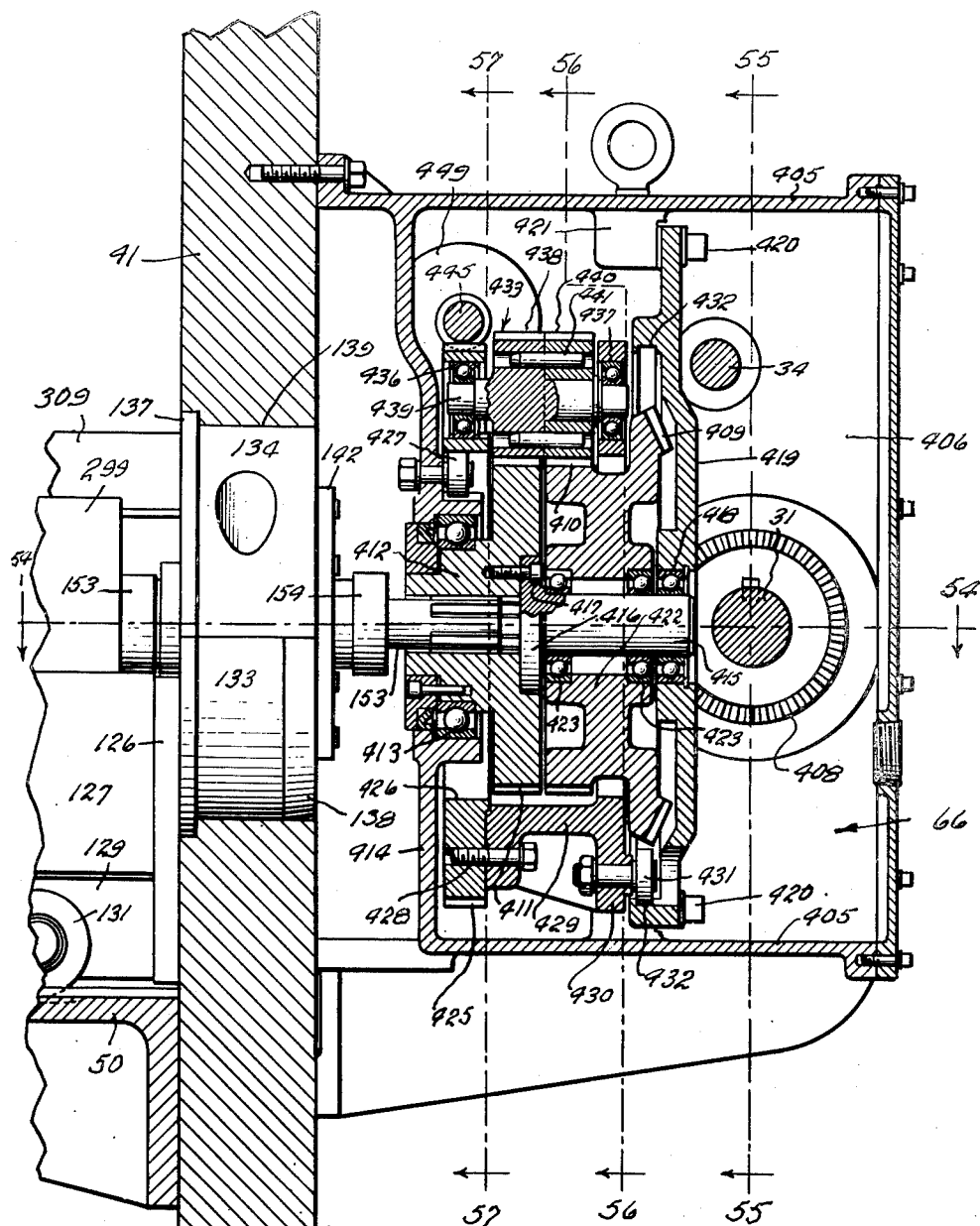
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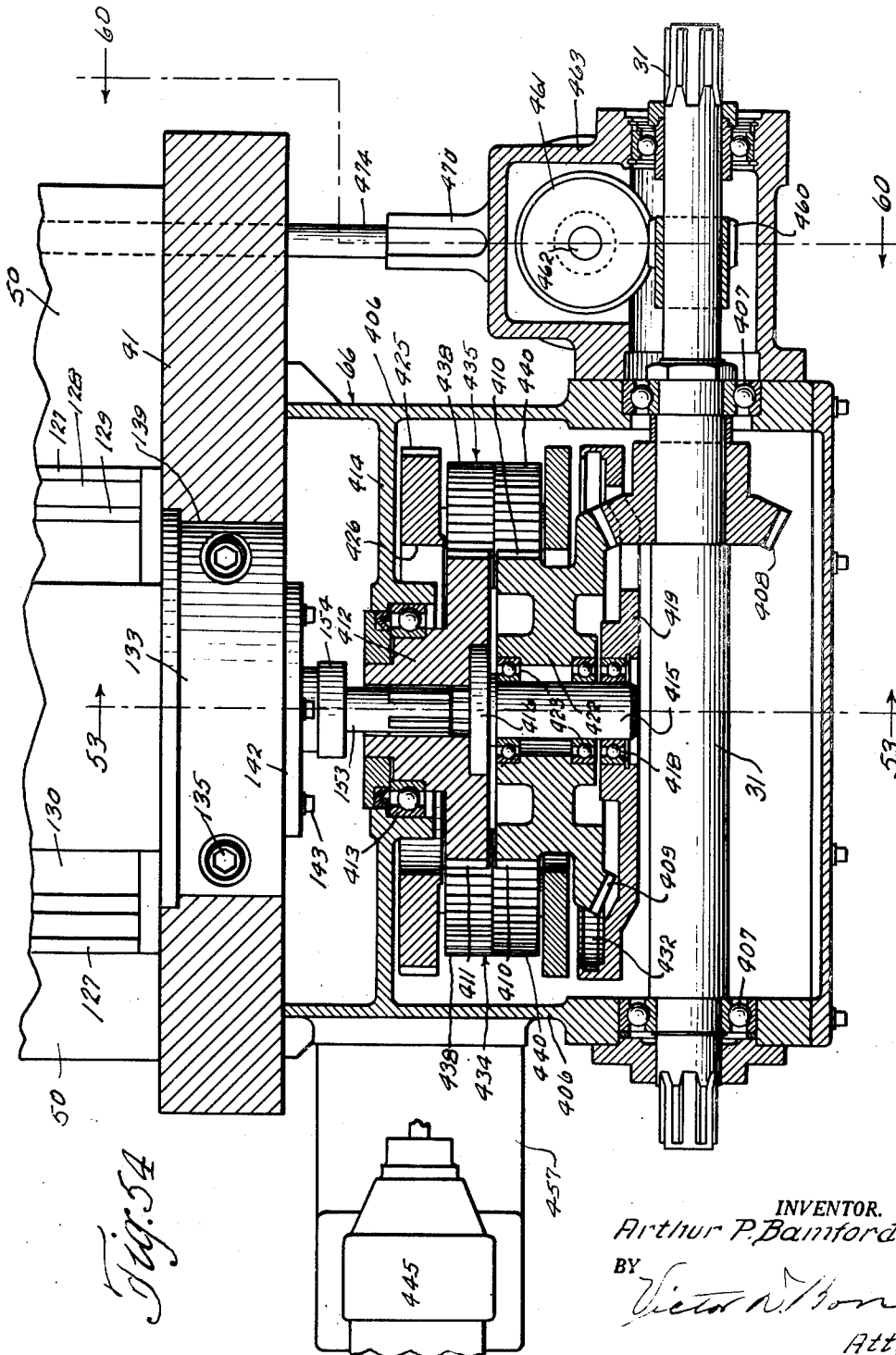
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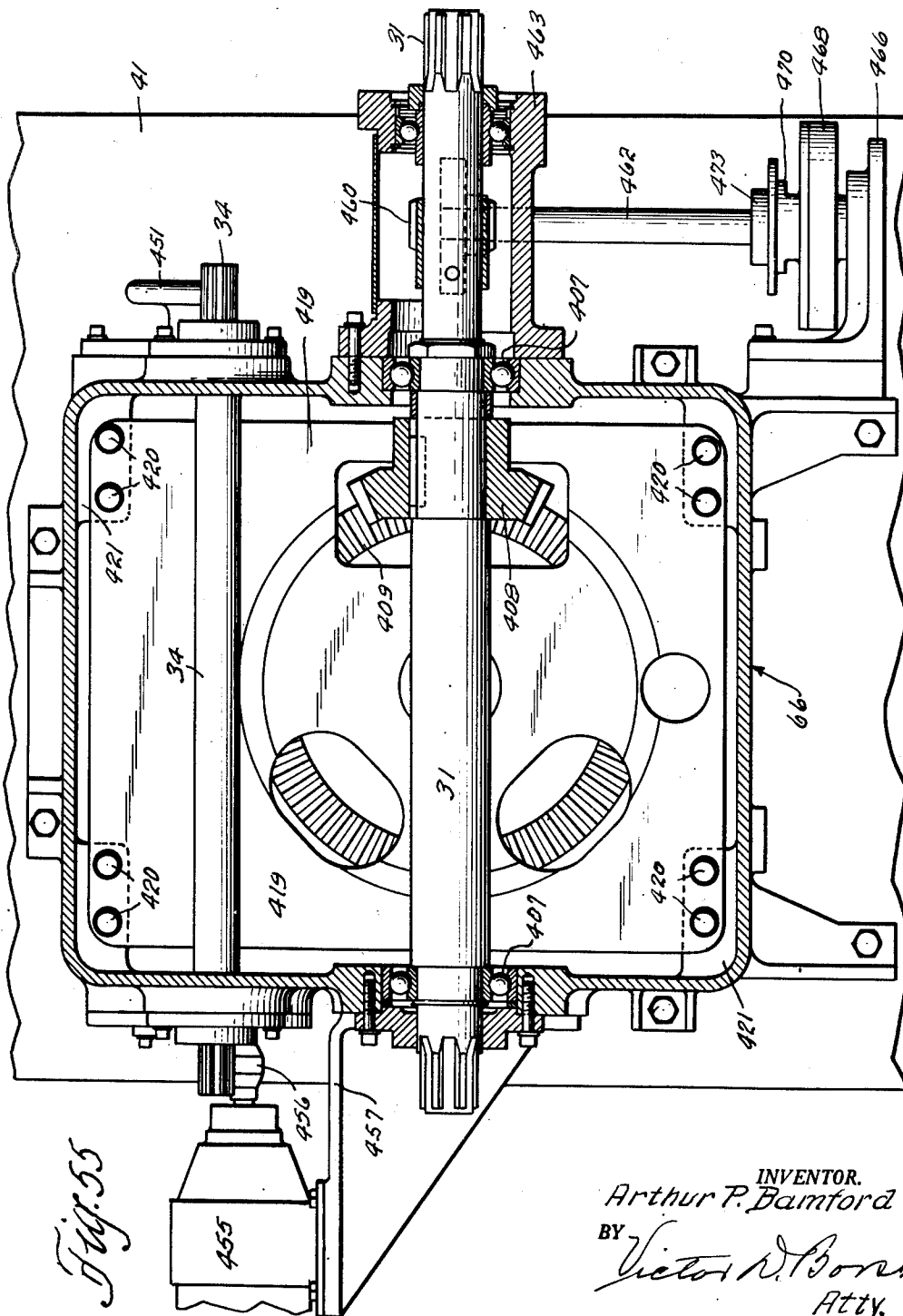
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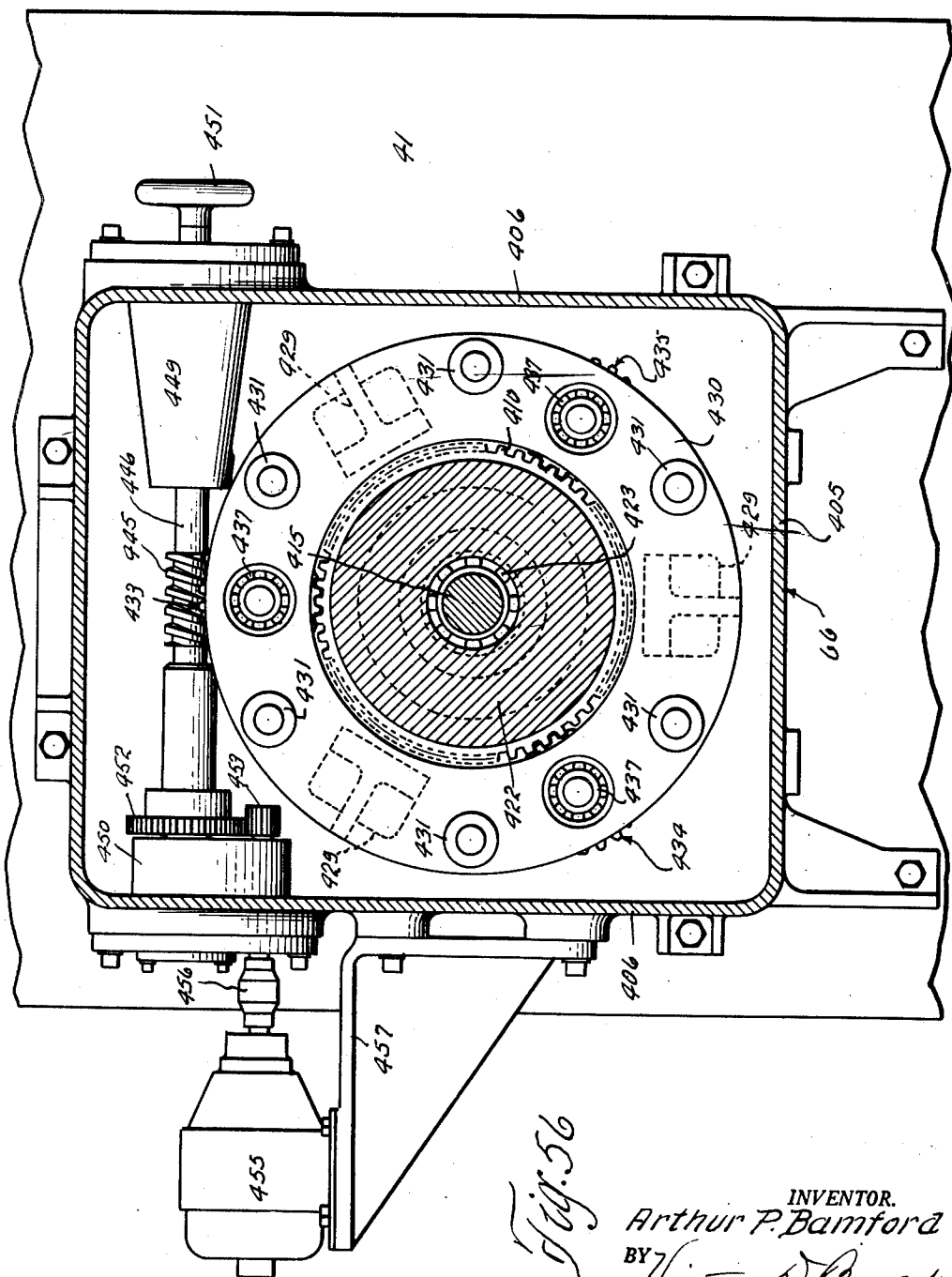
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INVENTOR.
Arthur P. Bamford
BY *Victor D. Bont*
Atty.

May 5, 1953

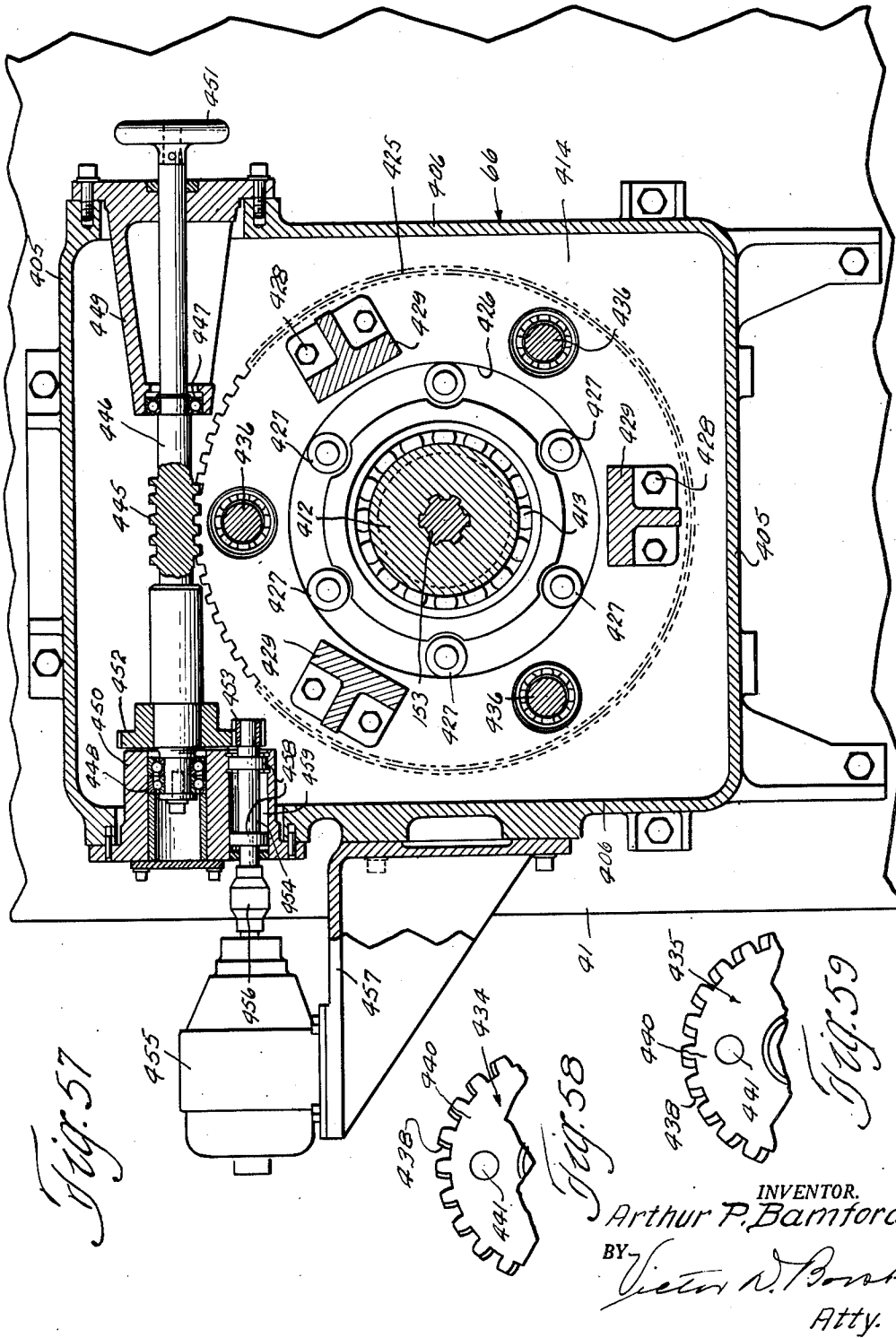
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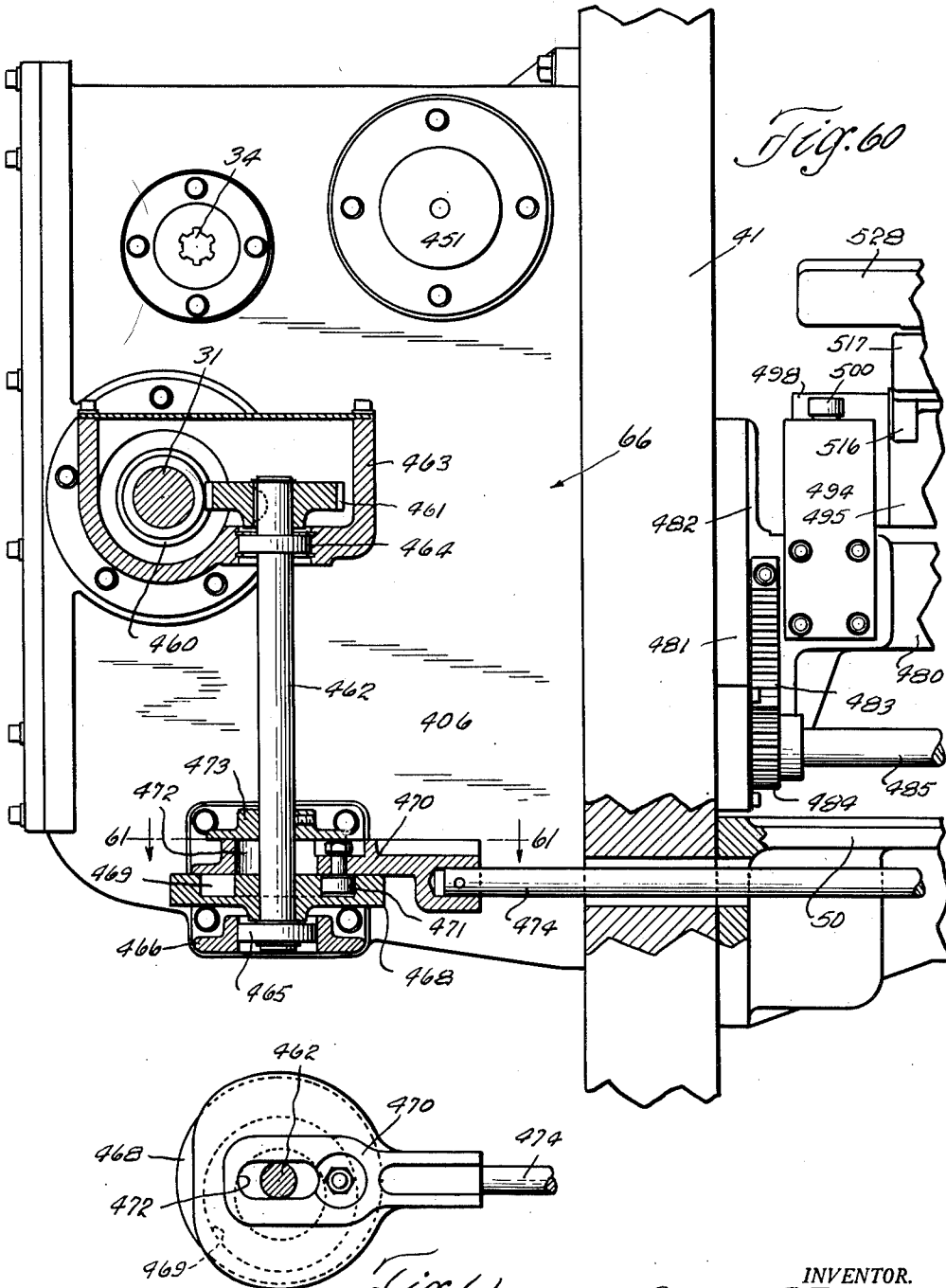
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INVENTOR.
Arthur P. Bamford
BY Victor W. Bonst
Atty.

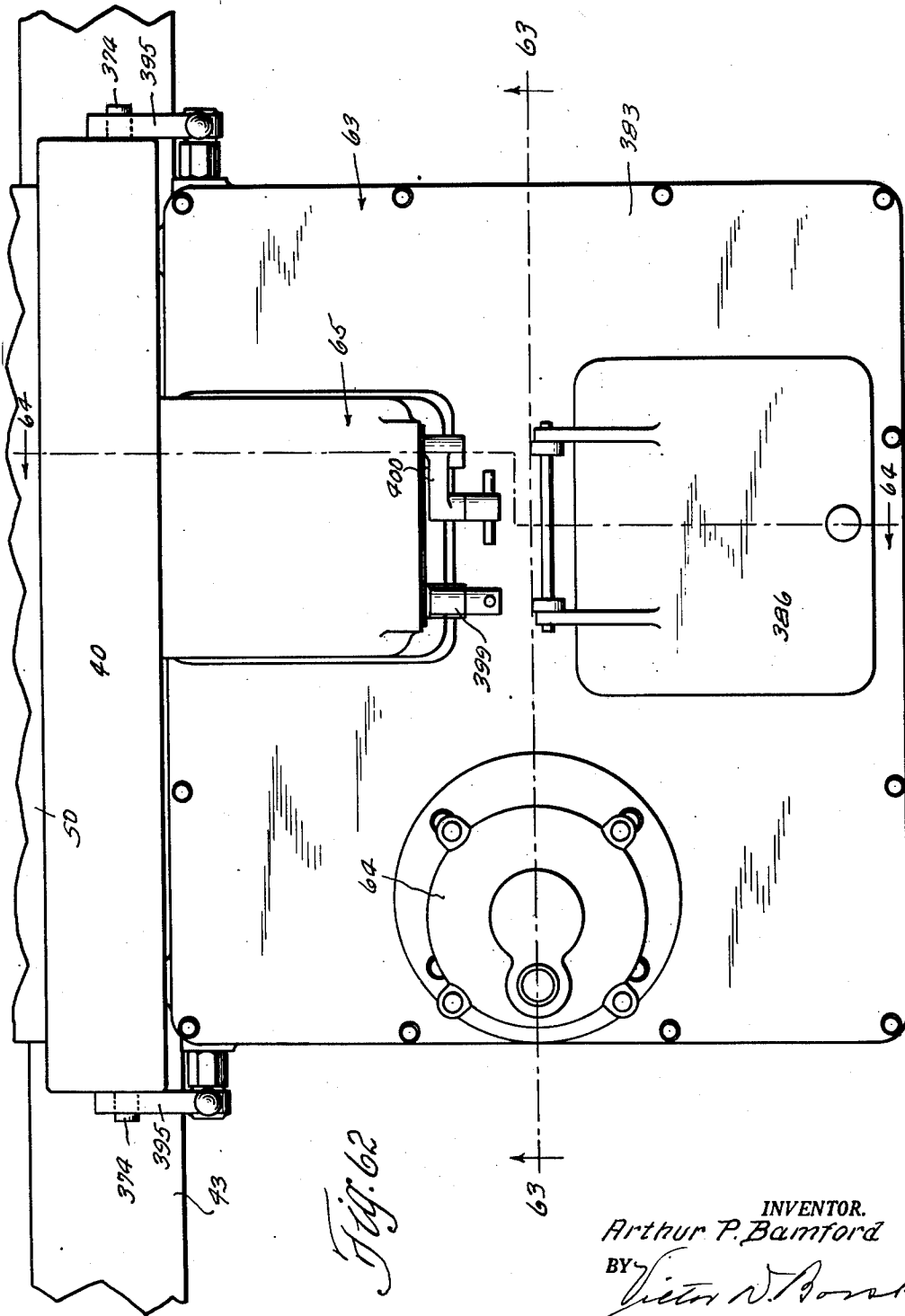
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INVENTOR.
Arthur P. Bamford
BY Victor W. Bond.
Atty.

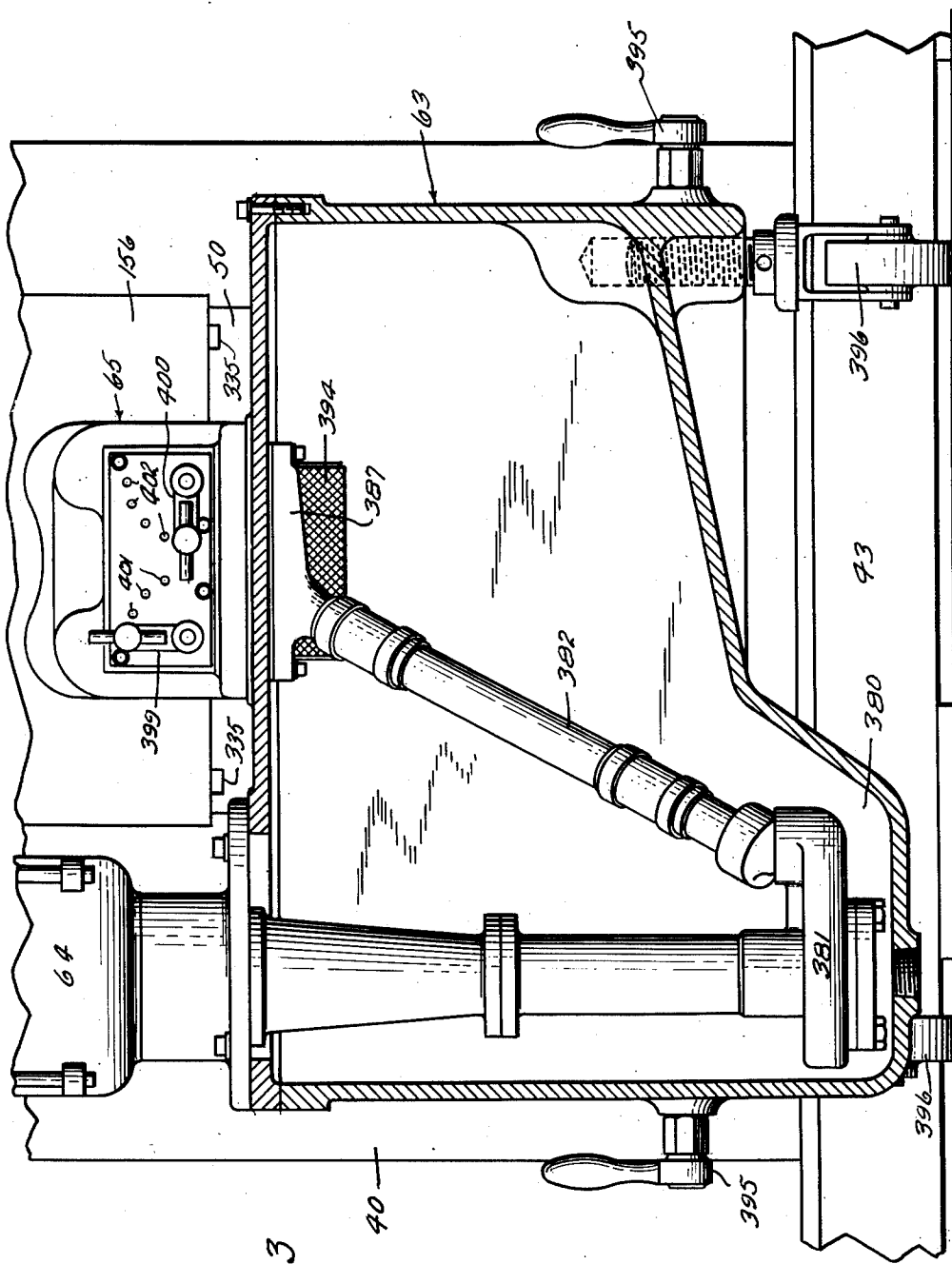
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45 Sheets-Sheet 36



INVENTOR.
Arthur P. Bamford
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Atty.

May 5, 1953

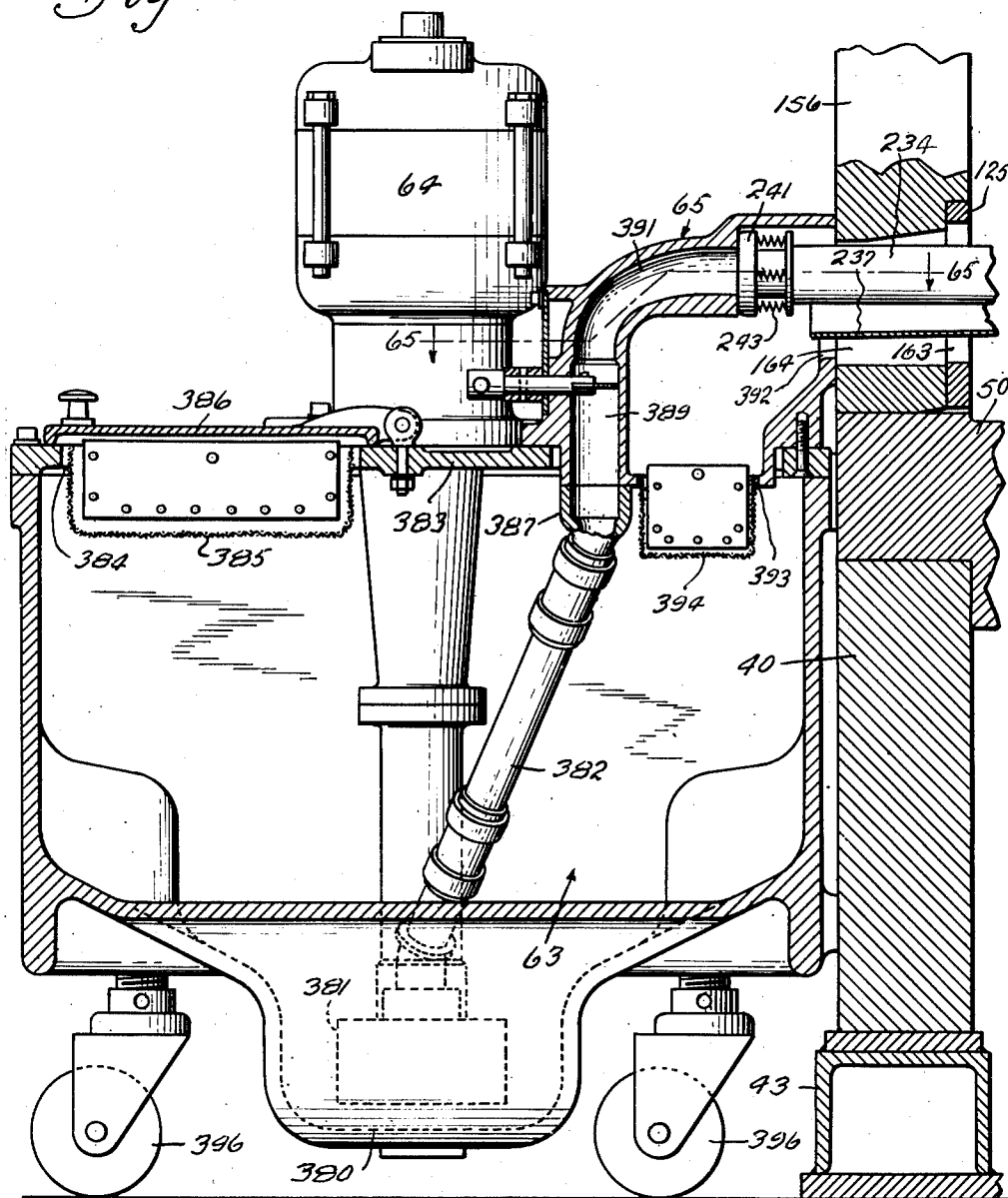
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Fig. 64



INVENTOR.
Arthur P. Bamford
BY *Victor D. Bone*
Atty.

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2,637,270

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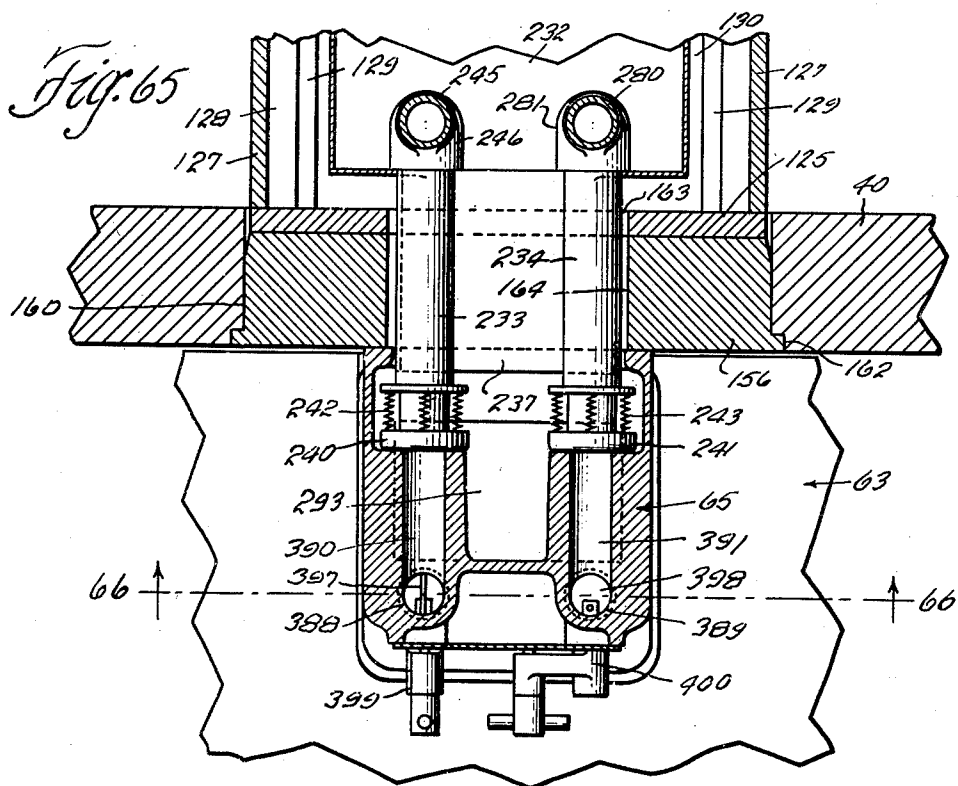
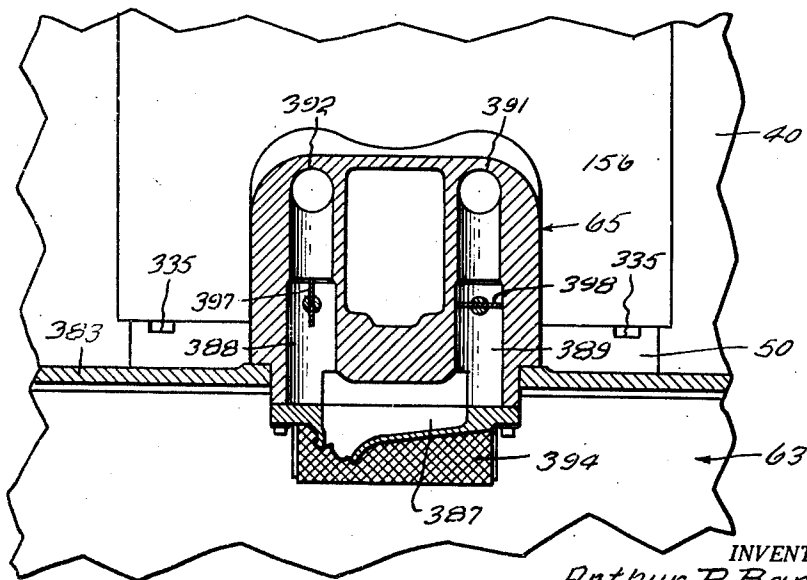


Fig. 66

INVENTOR.
Arthur P. Bamford
BY
Victor D. Bona
Atty.

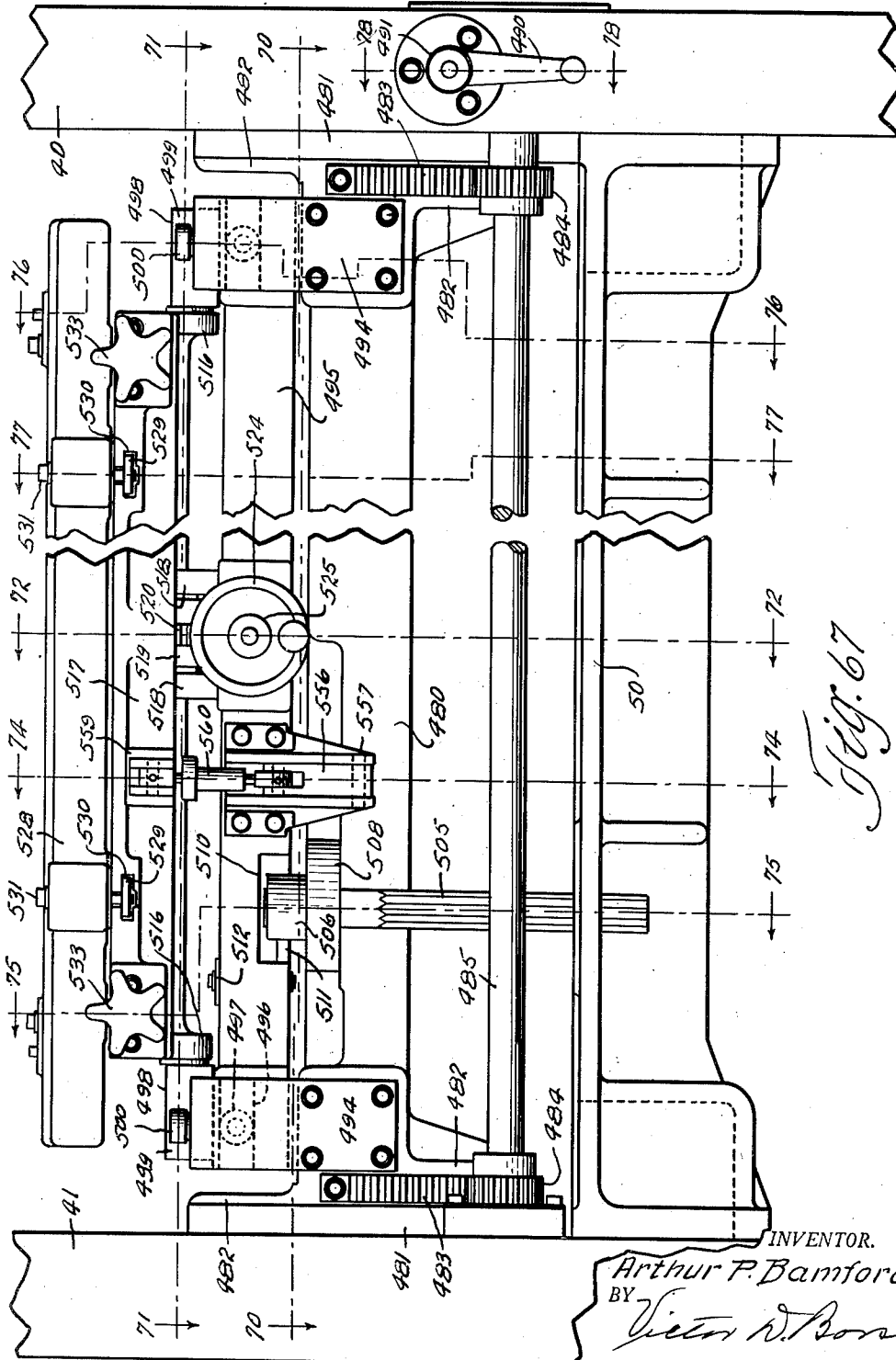
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INVENTOR.

Arthur P. Bamford

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Victor W. Bost

Atty.

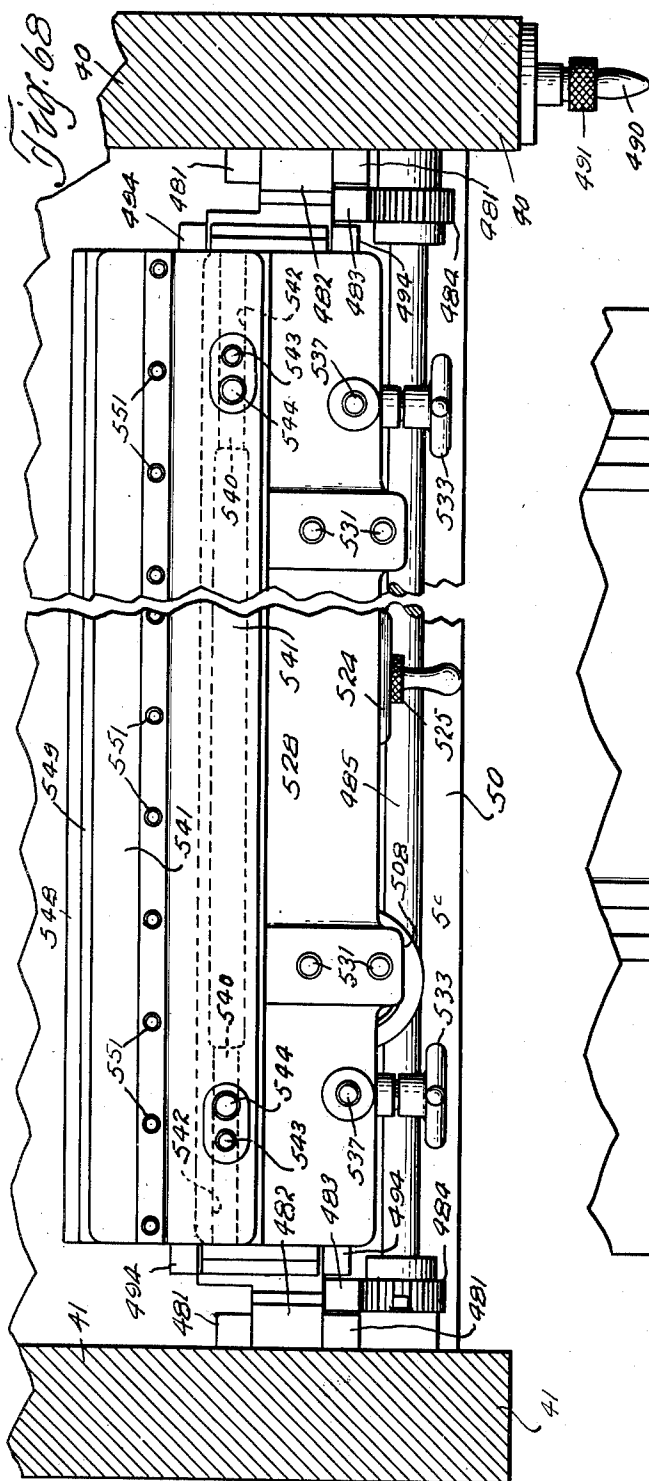
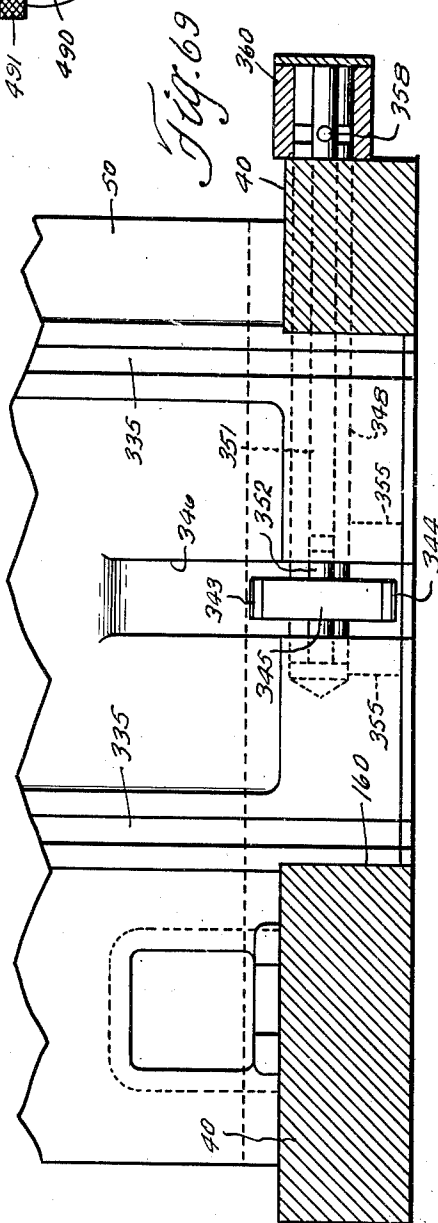
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INVENTOR.
Arthur P. Bamford
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Atty.

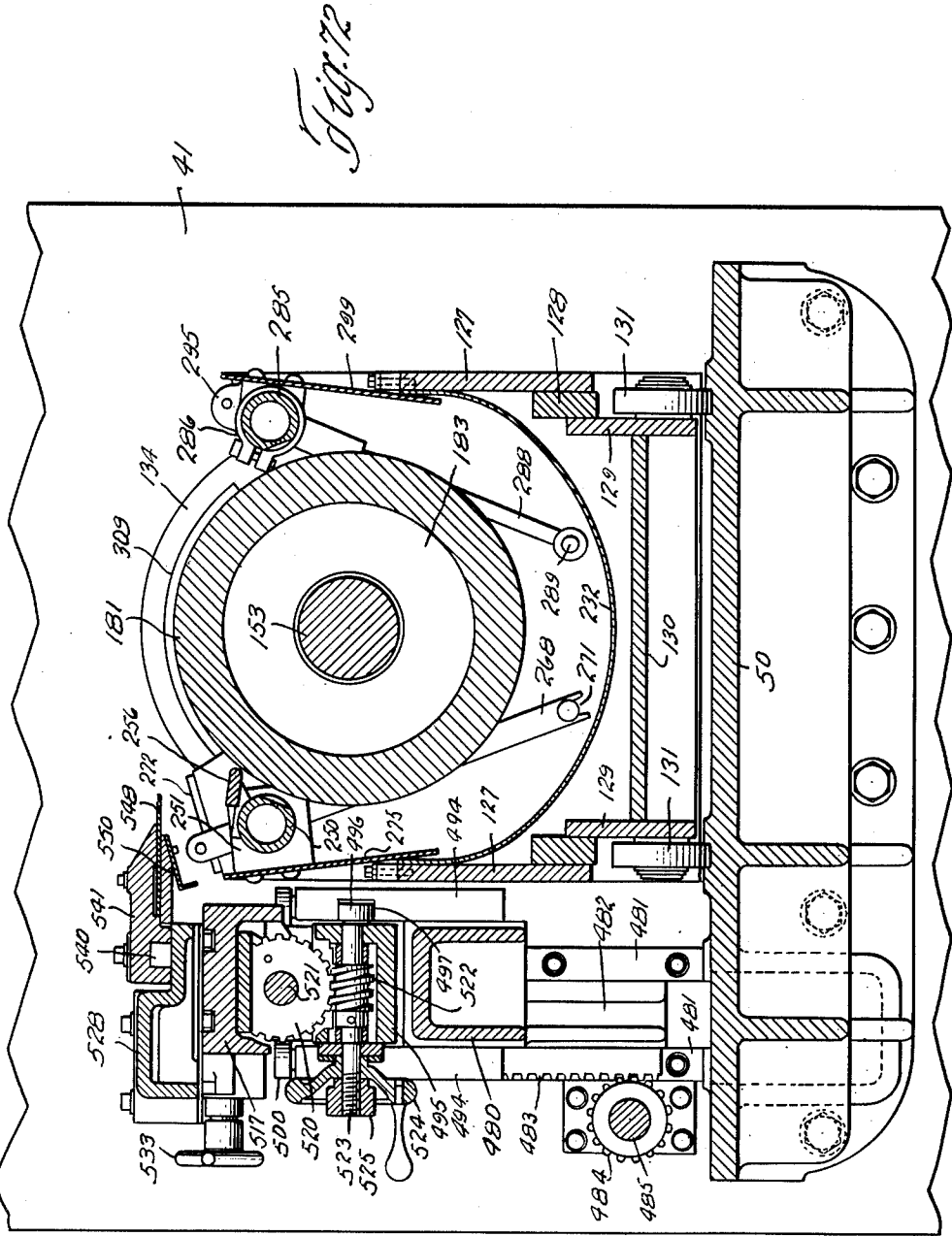
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INVENTOR.
Arthur P. Bamford

BY
Victor W. Borst
Atty.

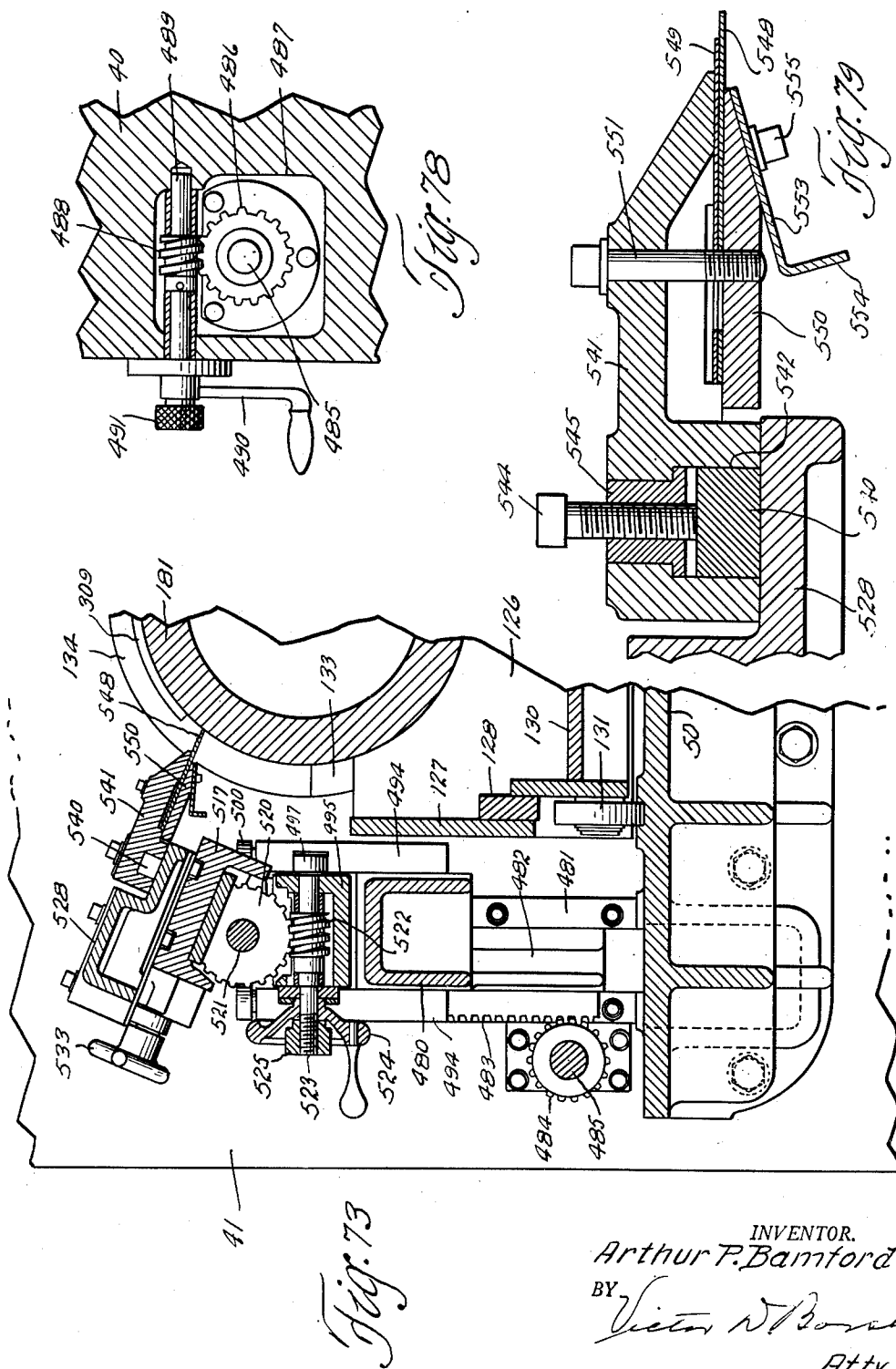
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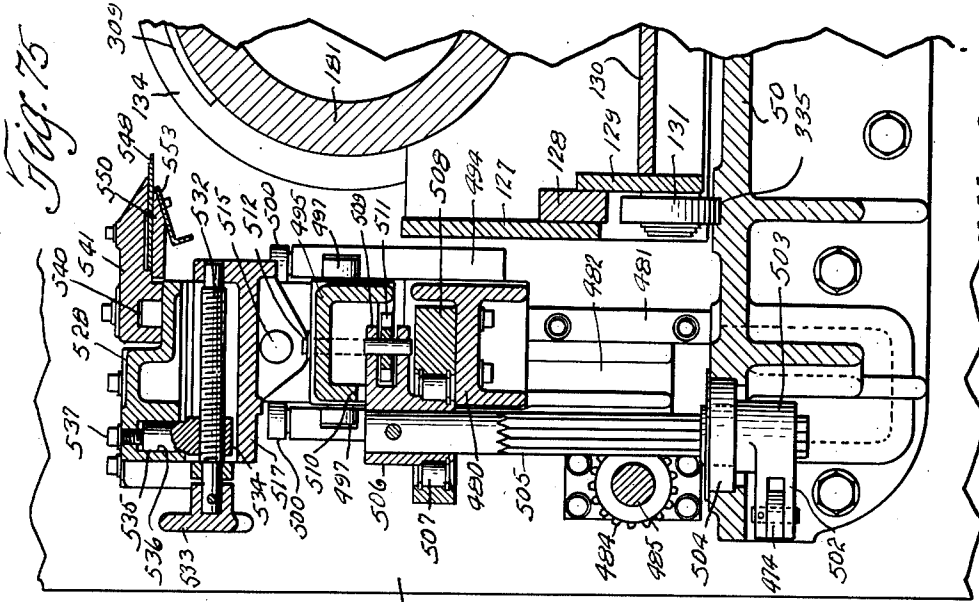
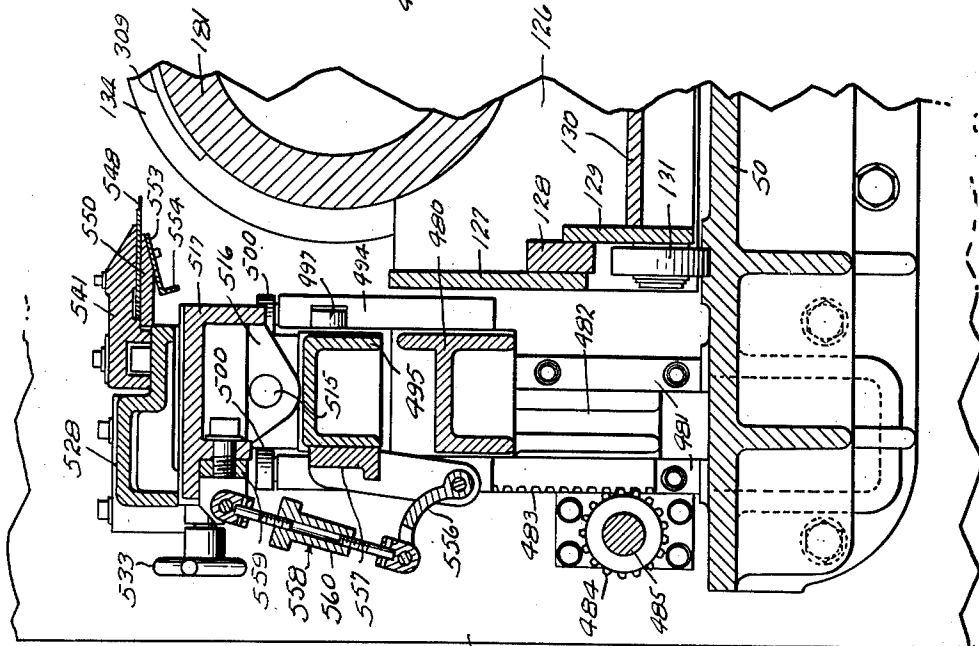
A. P. BAMFORD

2,637,270

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INVENTOR.
Arthur P. Bamford
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Atty.

May 5, 1953

A. P. BAMFORD

2,637,270

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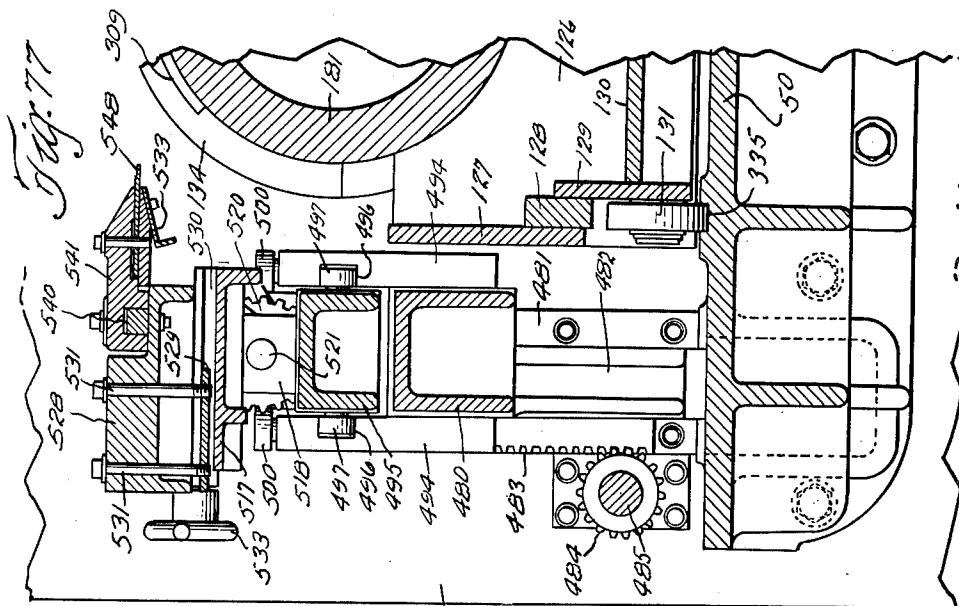
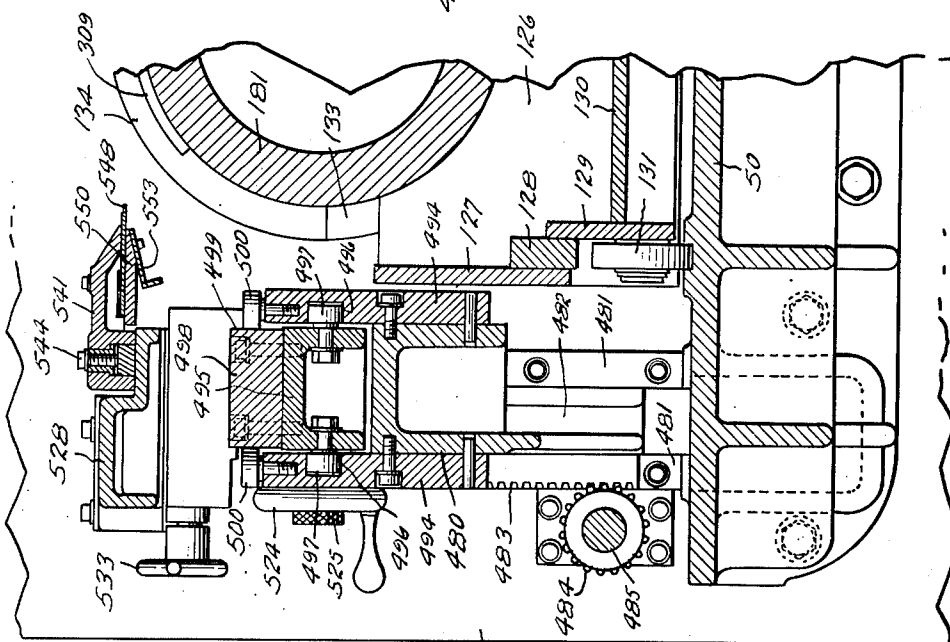


Fig. 76

INVENTOR.
Arthur P. Bamford
BY
Victor W. Borer
Atty.

UNITED STATES PATENT OFFICE

2,637,270

INTAGLIO PRINTING PRESS

Arthur P. Bamford, East Orange, N. J., assignor
to The Sperry Corporation, Long Island City,
N. Y., a corporation of Delaware

Application June 23, 1949, Serial No. 100,890

12 Claims. (Cl. 101--157)

1

This invention relates to intaglio printing presses and has for an object to provide a press of the above type having novel and improved characteristics.

Another object is to provide a multi-color intaglio press composed of a plurality of units each of which is provided with improved actuating and control mechanism.

Another object is to provide an intaglio press in which the web to be printed is held against the printing cylinder by a pressure roll and in which means is provided for advancing or retracting the pressure roll to or from printing position while maintaining a constant web tension.

Another object is to provide a multi-unit intaglio press of the above type in which the pressure roll in each of the units may be controlled independently without altering the web feed in the remaining units.

Another object is to provide an intaglio press having novel and improved means for controlling the position of the pressure roll.

Another object is to provide in an intaglio press novel and improved means for supporting and removing the printing cylinder.

Another object is to provide an intaglio press in which the printing cylinder is mounted on a carriage which is carried on rollers to facilitate removal thereof from the press.

Another object is to provide in a press of the above type improved end register control mechanism for adjusting the axial position of the printing cylinder in accordance with registry requirements.

Another object is to provide a multi-unit intaglio press of the above type with common driving means for the various printing cylinders and with improved running register control mechanism for providing an accurate adjustment and control of the running registry positions of the various cylinders.

Another object is to provide, in an intaglio press, improved means for enclosing the inking mechanism.

Another object is to provide, in an intaglio press, ink applicator tubes of novel and improved construction.

Another object is to provide novel and improved means for supporting and adjusting the positions of the ink applicator tubes.

Another object is to provide a removable ink reservoir and improved coupling means to facilitate positioning or removal thereof.

Another object is to provide novel and im-

2

proved supporting and adjusting mechanism for the doctor blade.

Various other objects and advantages will be apparent as the nature of the invention is more fully disclosed.

The invention comprises generally a plurality of press units each of which contains a printing cylinder, web guide rolls, an adjustable pressure roll and drying and exhaust mechanism. The pressure roll is designed to hold the web in engagement with the printing cylinder during the printing operation and is mounted to be advanced or retracted as desired without altering the web tension and without changing the web feed to or from the unit.

The drying mechanism includes a drying chamber through which the printed web passes and which is mounted on the top of the press frame with downwardly extending portions at the two sides of the frame forming a hood. The drying chamber includes suitable heating elements and a blower for blowing air against the printed web. A suction fan is also provided for removing the vapor laden air from the web and discharging the same in a suitable location.

The printing cylinder is mounted on a carriage which is supported by wheels riding on a track which facilitate the removal thereof from the machine. The carriage includes bearing blocks which are insertable in the frame of the machine and support the weight of the printing cylinder when the carriage is in printing position. A hand ratchet mechanism is provided which may be used to ratchet the carriage into or withdraw the carriage from its printing position. When the carriage is withdrawn sufficiently to remove the bearing blocks from the frame it rests on its rollers and may readily be moved away.

The carriage also carries ink applicator tubes which are disposed on opposite sides of the printing cylinder and are independently adjustable to accommodate cylinders of different diameters. An ink reservoir is mounted on separate casters and is positionable to supply ink to the applicator tubes through the coupling members which are automatically separated when the reservoir is removed. The reservoir carries the ink feed pump and adjusting valves for controlling the supply of ink to the respective tubes.

The carriage also carries an end register control mechanism which provides for accurate adjustment of the axial position of the printing cylinder and is controlled by a manually operable hand wheel which is accessible from the front of the machine. The printing cylinder is driven from a main drive shaft which runs along the

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back of the machine and drives all of the units. The connection to the main drive shaft is made through suitable running register control mechanism in the form of planetary gearing which provides an accurate control of the running register of the cylinder.

The doctor blade is slidably supported on and extends between the front and rear frames of the machine and is provided with manual means for vertically adjusting the same, with automatic reciprocating means driven by the main drive shaft for reciprocating the doctor blade, with a tilting control for varying the angular position of the doctor blade on the carriage, with adjusting means for shifting the doctor blade to or from the printing cylinder so as to position the same accurately in contact with the surface of said cylinder, and with means for adjusting the position of the blade in the holder. Means is also provided for allowing the blade to be retracted from the cylinder and to be again brought into operative position without disturbing the previous adjustments.

All of the above features which are characteristic of this invention will be better understood by referring to the following description, taken in connection with the accompanying drawings in which a specific embodiment thereof has been set forth for purposes of illustration.

In the drawings:

Fig. 1 is a front elevation of a multi-color intaglio press embodying the present invention, showing two of the color units and the drive mechanism;

Fig. 2 is a top plan view of the units shown in Fig. 1 with the heating and drying mechanism of one of the units broken away;

Fig. 3 is a front elevation of a single unit taken on a larger scale;

Fig. 4 is a side elevation of a unit taken from the right side of Fig. 3;

Fig. 5 is a side elevation of a unit taken from the left side of Fig. 3;

Fig. 6 is a top plan view of the unit of Fig. 3 with the heating and drying unit removed;

Fig. 7 is a side elevation, similar to Fig. 4, partially in section and showing the printing cylinder carriage partially removed from the press onto the dolly by which it is transported to and from the press;

Figs. 8a, 8b and 8c, when joined along the lines a-a and b-b, respectively, constitute a central vertical section through the machine taken on the line 8-8 of Fig. 4 but on a larger scale;

Fig. 9 is a detail section taken on the line 9-9 of Fig. 8b;

Fig. 10 is a detail view partly in section showing the latching mechanism for the slidable side closures by which the inking mechanism is closed when in operation;

Fig. 11 is a horizontal section taken on the line 11-11 of Fig. 10;

Fig. 12 is a vertical section showing the web tensioning mechanism taken along the line 12-12 of Figs. 14 and 16;

Fig. 13 is a horizontal section taken on the line 13-13 of Fig. 12;

Fig. 14 is a horizontal section taken on the line 14-14 of Fig. 12;

Fig. 15 is a central vertical section taken on the line 15-15 of Figs. 13 and 16;

Fig. 16 is a transverse section taken on the line 16-16 of Fig. 12, showing the parts in

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printing position with the pressure roll holding the web against the printing cylinder.

Fig. 17 is a central transverse section similar to Fig. 16 but showing the pressure roll raised from the printing roll;

Fig. 18 is a detail view of the latching mechanism for latching the pressure roll in the position shown in Fig. 17;

Fig. 19 is a vertical section taken on the line 19-19 of Fig. 18;

Fig. 20 is a detail section view taken on the line 20-20 of Fig. 13 but on an enlarged scale;

Fig. 21 is a broken plan view of the printing cylinder and carriage in position in the press, the frame of the press being in section with the inking mechanism removed;

Fig. 22 is a central vertical longitudinal section through the device shown in Fig. 21 with the end registry mechanism in elevation;

Fig. 23 is a side elevation of the carriage on a reduced scale;

Fig. 24 is an end elevation showing the left end of the mechanism of Fig. 23;

Fig. 25 is an end elevation showing the right end of the mechanism of Fig. 23;

Figs. 26, 27 and 28 are transverse sections taken on the lines 26-26, 27-27 and 28-28, respectively, of Figs. 22 and 23 and on the same scale as Fig. 22;

Fig. 29 is an enlarged vertical section taken on the line 29-29 of Fig. 21 showing the end register mechanism;

Figs. 30, 31 and 32 are transverse sections taken on the lines 30-30, 31-31 and 32-32, respectively, of Fig. 29;

Fig. 33 is a longitudinal section through one side of the inking mechanism taken on the line 33-33 of Fig. 35;

Fig. 34 is a longitudinal section through the other side of the inking mechanism taken on the line 34-34 of Fig. 35;

Figs. 35, 36 and 37 are transverse sections taken along the lines 35-35, 36-36 and 37-37, respectively, of Figs. 33 and 34;

Fig. 38 is a detail section taken on the line 38-38 of Fig. 35;

Fig. 39 is an enlarged transverse section through one of the ink applicator tubes shown in Figs. 33 to 37;

Fig. 40 is an end elevation with parts in section of the ratchet mechanism by which the carriage is forced into its final position for printing and is initially removed therefrom;

Fig. 41 is a side elevation of the mechanism shown in Fig. 40 as viewed from the line 41-41 of Fig. 40;

Fig. 42 is a vertical section taken on the line 42-42 of Fig. 41 showing the parts in position for inserting the carriage;

Fig. 43 is a view similar to Fig. 42 showing the parts in position for removing the carriage;

Fig. 44 is a detail horizontal section through a portion of the press showing the ratchet mechanism in plan;

Fig. 45 is a detail vertical section taken on the line 45-45 of Fig. 44;

Fig. 46 is a detail vertical section taken on the line 46-46 of Fig. 44 showing the parts in their initial position for feeding the carriage toward the right;

Fig. 47 is a view similar to view 46 showing the parts in their final position for feeding the carriage to the right;

Figs. 48a and 48b when joined on the line a-a constitute a horizontal section through an

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ink applicator tube showing the cleaning mechanism for cleaning the ink delivery slot;

Figs. 49a and 49b when joined on the line a—*a* constitute a vertical section through the ink applicator tube shown in Figs. 48a and 48b;

Figs. 50 and 51 are transverse sections taken on the lines 50—50 and 51—51, respectively of Fig. 48a;

Fig. 52 is a transverse section taken on the lines 52—52 of Fig. 48b;

Fig. 53 is a vertical section through the driving and running register mechanism taken on the line 53—53 of Fig. 54;

Fig. 54 is a horizontal section taken on the line 54—54 of Fig. 53;

Figs. 55, 56 and 57 are transverse vertical sections taken on the lines 55—55, 56—56 and 57—57, respectively, of Fig. 53;

Figs. 58 and 59 are detail views of certain of the planet gears shown in Figs. 53 to 57;

Fig. 60 is a vertical section taken on the line 60—60 of Fig. 54;

Fig. 61 is a detail horizontal section taken on the line 61—61 of Fig. 60;

Fig. 62 is a plan view of the ink reservoir showing a portion of the front frame;

Figs. 63 and 64 are vertical sections taken on the lines 63—63 and 64—64, respectively of Fig. 62;

Fig. 65 is a detail horizontal section taken substantially along the line 65—65 of Fig. 64;

Fig. 66 is a vertical section taken substantially on the line 66—66 of Fig. 65;

Fig. 67 is a broken detail side elevation of a doctor blade and operating mechanism therefor;

Fig. 68 is a plan view of the mechanism of Fig. 67 with the press frame in section;

Fig. 69 is a detail horizontal section through the front frame of the press showing the carriage platform, track and the ratchet mechanism in plan;

Figs. 70 and 71 are horizontal sections taken along the lines 70—70 and 71—71, respectively, of Fig. 67;

Fig. 72 is a transverse vertical section taken on the line 72—72 of Fig. 67 showing the doctor blade in retracted position;

Fig. 73 is a view similar to Fig. 72 showing the doctor blade in operative position;

Figs. 74, 75, 76 and 77 are transverse sections taken on the lines 74—74, 75—75, 76—76 and 77—77, respectively, of Fig. 67;

Fig. 78 is a detail vertical section taken along the line 78—78 of Fig. 67; and

Fig. 79 is an enlarged detail section showing the mechanism for clamping the doctor blade in place.

Referring to Figs. 1 and 2, the invention is shown as applied to an intaglio printing press composed of a plurality of units each of which is adapted to print one color onto a web. Two units A and B are shown in Figs. 1 and 2. It is to be understood, however, that any desired number of units may be added according to the number of colors desired. Each unit includes a printing cylinder together with inking and control mechanism, a web-guiding mechanism and a drying chamber. A single driving means is provided for all of the units which includes power means and drive shafts which extend in back of all of the units.

Referring to the figures more in detail, a web *1* is shown as fed to the unit B over guide rollers 2, 3, 4, 5 and 6 to a pressure roll 7, thence through a drying chamber and over guide rollers 8 and 9 and around the guide roll 2 of the unit A, thence

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over the correspondingly numbered rolls of the unit A from which it is discharged over a guide roll 10 similar to the roll 2, thence over a roll 11 in a pulling mechanism 12, whence it is discharged to suitable cutting or stacking mechanism or to a reeling mechanism as desired.

Each drying chamber 15 which is disposed over the top of the printing unit comprises a heating source 16 which may comprise a steam heating unit and blower mechanism comprising a fan 17 driven by a motor 18 and discharging air through a port 19 into a zone 20 in which the air is applied to the top of the web passing through the chamber 15. The zone 20 also communicates with chambers 21 and 22 which are disposed over the sides of the machine to apply air from the blower 17 to the webs as they advance toward and recede from the drying chamber 15. The air from the web 1, containing the vapors which are picked up thereby, is removed from the chambers 21 and 22 and from the zone 20 by means of a suction fan 23 communicating with a duct 24 which extends through and communicates with each of the drying chambers 15. The vapor-laden air from the exhaust fan 23 may be discharged to the outside or to a ventilator as desired. The exhaust fan 23 is driven by means of a motor 25 through a driving belt 26 which in turn drives a shaft 27 on which the exhaust fan is mounted.

The various units are driven by means shown as a main drive motor 28 driving a reduction gear train in a housing 29 through a multiple V-belt 30. The reduction gear in the housing 29 drives the main drive shaft 31 and a secondary drive shaft 32. The main drive shaft 31 extends along the rear of the various units and serves to drive the various printing rolls through means to be described. The secondary drive shaft 32 drives a reduction gearing mounted in a housing 33 which in turn drives a secondary drive shaft 34 which extends along the rear of the units and drives the paper feed mechanism not shown. The gear reduction mechanism in the housing 29 includes a clutch of any standard type which is actuated by a clutch lever 35 supported in suitable brackets on a pedestal 37. The lever 36 is adapted to control the operation of the main drive shaft 31 and the secondary drive shaft 34 and is mounted in a position readily accessible to the operator.

Figures 3 to 6

Figs. 3 to 6 illustrate the general arrangement of each unit. Referring to these figures, each unit comprises a front frame 40 and a rear frame 41 on which the various elements, including the printing cylinder, are mounted. The frames 40 and 41 are secured on longitudinal channel members 43 and 44, respectively, and are tied together at their tops by cross beams 45. A top frame comprising front and rear members 46 and 47 are secured at one end to the top of the front and rear frames 40 and 41 and are supported at their other ends by uprights 48 which are also secured to the longitudinal channel members 43 and 44. The channel members 43 and 44 are tied together by spaced cross members 49 to provide a rigid unit.

A platform 50 secured between the front and rear frames 40 and 41 supports the printing cylinder carriage to be described. The hydraulic control mechanism for the press is mounted in a casing 51 attached to the front frame piece 40.

The roll 2 is mounted on suitable brackets 52 carried by the channel members 43 and 44. The

rolls 3 and 4 are supported by the brackets 53 and 54 on the uprights 48. The rolls 8 and 9 are rotatably supported between the longitudinal members 46 and 47. The roll 5 is supported, in suitable bearings, between frames 40 and 41. Guide roll 6 and pressure roll 7 are mounted on suitable slides 60 and 61 which are supported on the front and back frames 40 and 41, respectively, for vertical sliding movement, so that the rolls 6 and 7 are raised or lowered in unison to bring the pressure roll 7 into printing position or to retract the same from the printing cylinder. An ink reservoir generally indicated by the numeral 63 is detachably connected to the front frame 40. The reservoir 63 carries a suitable pump mechanism which is driven by a motor 64. The reservoir also carries a valve housing and connecting means, generally indicated at 65, by which ink is supplied to and removed from the inking mechanism.

The driving gears and running register 66 which drive the printing cylinder and the doctor blade mechanism from the main drive shaft 31, are mounted in a suitable casing which is attached to the rear frame 41. The secondary drive shaft 34 extends through the casing 66 but is not connected to any of the mechanism therein. Flexible cover plates 68 and 69, shown in Figs. 4 and 5, respectively, are slidably mounted between the front and rear frames 40 and 41 and are adapted to form side closures for the printing cylinder and inking mechanism. These flexible plates are mounted for sliding movement for affording access to the printing cylinder and associated mechanism.

Sliding cover plates (Figs. 8b and 8c)

Referring to Figs. 8b and 8c, each of the flexible plates 68 and 69 is provided with a plurality of angle pieces 70 which extend thereacross at spaced points. Rollers 71 are carried at each end of each of the angle members 70. The rollers 71 which are carried with the plates 68 ride on tracks 72 which are attached to the front and back frames 40 and 41. The rollers 71 associated with the plate 69 ride on tracks 73 which are also carried by the front and back frames 40 and 41. The lower ends of the track 73 extend below the lower ends of the track 72 to provide sufficient space to receive the cover plates when they are in fully opened position.

One of the angle members 70 of each of the cover plates 68 and 69 carries at each end thereof a clamping means comprising an arm 74 pivoted to the angle member 70 at 75 and having a bifurcated end 76 which spans the track 72 or 73. Adjacent the bifurcated end 76 a hardened insert 77 is provided having a sharp edge 78 and secured by a set screw 79. The insert 77 is located in a position to grip the track 72 or 73 and is normally held in gripping position by means of a spring 80. The levers 74 are so positioned that they allow the cover plates 68 and 69 to be raised into closed position but automatically grip the tracks 72 and 73 to prevent the cover plates from sliding to open position. However, the cover plate is freely slidable to open position when the two levers are grasped and the free ends thereof rocked toward the supporting angle iron for retracting the sharp edges 78 of the inserts 77 from the track 72 or 73. The plates 68 and 69 have sufficient flexibility to follow the curvature of the track as the plates are raised or lowered.

Web-tensioning mechanism (Figs. 12 to 17)

Figs. 12 to 17 show the web-tensioning mechanism

by means of which the pressure roll 7 is raised or lowered without varying the tension on the web.

Referring now to these figures, the slides 60 and 61 are mounted for vertical sliding movement on gibs 82 and 83, respectively, which are bolted or otherwise secured to the front and rear frames 40 and 41, respectively.

The slides 60 and 61 are provided with transverse webs 84 which are secured to a piston rod 85 projecting from a cylinder 86 forming a part of a cylinder and piston assembly, the details of which may be of standard construction and are preferably arranged for the raising or lowering of the piston rod by the application of fluid pressure above or below the piston inlet and outlet ports 87 and 88, respectively. The cylinders 86 are attached by bolts 90 to the cross piece 45 of the frame.

At its lower end each of the slides 60 and 61 carries a bearing 92 which rotatably supports the pressure roll 7. The slides 60 and 61 also carry brackets 95 and 96, respectively, for supporting a shaft 97 on which the roll 8 is rotatably mounted. One end of the shaft 97 is pivotally supported on the bracket 96 by means of a pin 98. The other end of the shaft 97 is adjustably supported by the bracket 95 by means of a threaded shaft 98a journaled in a bracket 99 attached to the bracket 95 and extending through a threaded hole 100 near one end of the shaft 97. A handle 101 is provided for rotating the shaft 98a and a set screw 102 is provided for securing the threaded shaft 98a in adjusted position. The arrangement is such that actuation of the handle 101 varies the angularity of the shaft 97 and of the roll 6 for controlling the feed of the web.

In order to cause the slides 60 and 61 to operate in unison and thereby prevent any binding, the slides 60 and 61 are provided with racks 103 and 104, respectively, at their lower ends meshing with gears 105 and 106 which are carried on opposite ends of the shaft 107 journaled in the front and rear frames 40 and 41, respectively. The shaft 107 and the meshing gear teeth cause the slides 60 and 61 to operate in unison. However, in order to provide a certain clearance to permit the pressure roll 7 to adjust itself to the position of the printing cylinder when the pressure roll is in its lower position, the teeth at the upper portions of the respective racks 103 and 104 are made with more than normal clearance.

In order to provide a mechanical latch to prevent the slides 60 and 61 from drifting downwardly due to loss of hydraulic pressure when in their position, a ratchet 110 is secured to the shaft 107 adjacent the gear 105 and is engaged by a pawl 111 carried by an arm 112 pivoted to the frame 40 of the machine at 113 and normally held in engagement with the ratchet by a spring 114. The arm 112 may be raised by a pin 115 which is pivoted to the end of the arm 112 at 116 and rests in a cup 117 formed in a piston 118 which is slidably mounted in a cylinder 119. Hydraulic pressure is supplied to the lower end of the piston 118 by means of a duct 120 which is also connected to the line leading to the port 88 so that pressure is applied beneath the piston 118 whenever pressure is applied above the pistons in the cylinders 86 for lowering the slides 60 and 61. In the absence of pressure in the lines leading to the ports 88 and in the line 120 the spring 114 causes the pawl 111 to engage the ratchet 110 and thereby prevent rotation of the shaft 107 in the direction to lower the slides 60

and 61. Whenever pressure is applied to the cylinders 36 for lowering the slides, however, pressure is also applied to the cylinder 119 for releasing the pawl for 111. A vent 121 may be provided in the wall of the cylinder 119 to drain any fluid which may leak past the piston 118 from the pressure chamber therebelow.

Printing cylinder and carriage (Figs. 21-32)

The printing cylinder and carriage are shown in detail in Figs. 21 to 32. The carriage comprises a front plate 125 and a back plate 126 joined by side plates 127. Spacer bars 128 are attached on the inside of the side plates 127 with their lower ends extending slightly below the bottom of the side plates. The spacer bars 128 carry lower side plates 129 which extend nearly to the bottom of the end plates and are joined by a bottom plate 130. A plurality of wheels 131 are attached to the lower side plates 129 by means of studs 132. In the form shown three wheels 131 are spaced along each side of the carriage. The wheels, however, are unevenly spaced along the carriage as shown in Fig. 23.

Back plate 126 is bolted by means of bolts 132' to the lower half 133 of a split bearing block, the upper half 134 of which is bolted to the lower half 133 by bolts 135. The bearing blocks 133 and 134 are provided with positioning shoulders 136 and 137, respectively, and at its rear edge the bearing block 133 is tapered as indicated at 138 for positioning purposes. The outer peripheral surfaces of the bearing blocks 133 and 134 are cylindrical and seat in a cylindrical surface 139 in the rear frame 41. The bearing blocks 133 and 134 are slidable axially with the carriage in the rear frame 41.

Bearing blocks 133 and 134 carry a bearing housing 140 which is secured in the internal bore of said blocks and is held against axial movement by a shoulder 141 and a plate 142 which is attached thereto by screws 143. The bearing housing is provided with a cylindrical inner surface 145 in which the outer ball race 146 is mounted for axial sliding movement in response to axial adjustment of the printing cylinder. The outer race 146 carries roller bearings 147 engaging an inner race 148. The inner race is mounted on the cylindrical outer surface of a sleeve 150 having a tapered inner surface 151 which is seated on the tapered end 152 of a shaft 153 and is held in position by a nut 154 having a clamping screw 155.

The other end plate 125 of the carriage is bolted by bolts 159 to the lower half 156 of a rectangular bearing block, the upper half 157 of which is bolted to the lower half by means of bolts 158. The bearing blocks 156 and 157 are slidably mounted in a rectangular opening 160 in the front frame 40 and are provided with flanges 162 and 161, respectively, by which they are positioned in said frame. The front plate 125 is provided with a rectangular ink return opening 163 registering with an opening 164 in the lower bearing block 156. The sides and bottom of the bearing block 156 may be tapered slightly to facilitate the insertion in the rectangular opening in the front frame 40.

The blocks 156 and 157 have a cylindrical inner opening 165 in which a bearing housing 167 is mounted and is held in position by a flange 168 and a plate 169 which is attached thereto by bolts 170. The bearing housing 167 is provided with a cylindrical inner bore 171 in which an outer race 172 of a roller bearing is slidably

mounted. The outer race 172 carries rollers 173 which engage an inner race 174 mounted on a sleeve 175 having a tapered inner surface 176 which is seated on the tapered end 177 of the shaft 153. The inner race 174 is held in position by a shoulder 178 on the sleeve 175 and a nut 179 which is threaded onto said sleeve.

The shaft 153 has an enlarged frusto conical portion 180 formed integral therewith. The printing cylinder 181 is provided with end pieces 182 and 183 which are press fitted therein against shoulders 184 and 185, respectively. The end piece 182 is provided with a tapered inner bore registering with the conical section 180 of the shaft 153 and adapted to seat thereon. A key 186 engages a slot 187 in the end piece 182 to prevent relative rotation between the shaft 153 and the printing cylinder 181. The end piece 183 is provided with a tapered bore 190 in which a tapered split ring 191 seats. The ring 191 is provided with a cylindrical inner surface adapted to engage a corresponding surface on the shaft 153 and is forced into clamping position by means of a nut 192 which is threaded on the shaft 153. The arrangement is such that the printing cylinder is securely positioned on the shaft 153 by tightening the nut 192, but may be removed by first removing the nut 192 and then forcing the end plate 182 endwise from the conical surface 180. The shaft 153 is shown as provided with deflector rings 195 to prevent ink from flowing along the shaft into the respective bearings.

End register mechanism (Figs. 29-32)

The end register mechanism for adjusting the axial position of the shaft 153 and of the printing cylinder 181 is shown in detail in Figs. 29 to 32.

Referring first to Fig. 29, the sleeve 175 is formed with a reduced extension 200 which extends around a reduced extension 201 on the shaft 153. The sleeve is held in position on the shaft 153 by means of nuts 202 which are threaded onto the end of the shaft. The plate 169 is provided with a cylindrical extension 203 having an internal thread 204 and an external spur gear 205. A sleeve 206 is provided with external teeth 207 which are threaded into the teeth 204 of the extension 203 of the plate 169. The sleeve 206 also has formed on the periphery thereof an external gear 208 which has one less tooth than the gear 205. In the embodiment shown the gear 205 has 54 teeth and the gear 208 has 53 teeth. Between the sleeve 200 and the extension 203 is a thrust bearing comprising inner races 209 clamped between a shoulder 210 on the extension 200 and a clamping nut 211 which is threaded onto said extension; and an outer race 212 which is seated in the internal bore of extension 203 between a shoulder 213 and the end of the clamping sleeve 214 which extends within the bore of the sleeve 206 and is secured by bolts 215. The inner and outer races 209 and 212 carrying balls forming a thrust bearing which makes the sleeve 175 follow the axial movement of the sleeve 206 as the latter is threaded axially in the cylindrical extension 203 of the plate 169. A split plate 216 is rotatably mounted in an annular groove in the extension 203 and is bolted to an annular flange 218 above a cylindrical housing 219 carrying a hand wheel 220 at the free end thereof. The flange 218 is provided with a flange 221 which surrounds the split plate 216. The housing 219 has an offset portion 222 in which a spur gear 223 is rotatably mounted by means of bearings 224 carried in the hous-

ing 219 and bearings 225 carried in the split plate 216. The spur gear 223 meshes with both of the gears 205 and 208 and constitutes a planet gear which rotates around the stationary gear 295 when the housing 219 is rotated by means of the hand wheel 220.

Due to the planetary action of the gear 223 and the difference in the numbers of teeth in the gears 205 and 208 a complete rotation of the hand wheel 220 causes the sleeve 206 to rotate through a distance of only one tooth, which causes the sleeve 203 to be threaded in or out depending upon the direction of rotation with respect to the stationary thread 204 on the extension 203 of the plate 169. Hence the hand wheel 220 provides an extremely accurate control of the axial position of the printing cylinder and provides a convenient means for adjusting the same.

In the embodiment shown fifty-three complete revolutions of the hand wheel 220 cause a single revolution of the sleeve 206, which will advance the sleeve by the distance of one thread in the extension 203.

Inking mechanism (Figs. 33-39)

The inking mechanism is shown in detail in Figs. 33 to 39 and is mounted to be removable with the carriage as shown in Figs. 8b, 22 and 72. Referring to Figs. 33 to 39, the mechanism comprises a front plate 230 and a back plate 231 which are attached to the side plates 127 at the front and back of the carriage. A pan 232 is attached to the front and back plates 230 and 231 to provide an ink sump. Ink tubes 233 and 234 extend through the front plate 230 and are secured thereto. Between these tubes the front plate is provided with an ink discharge opening 235. A cover 236 is disposed between the tubes 233 and 234 in front of the front plate 230 to form with an extension 237 of the pan 232 an ink return spout. The tubes 233 and 234 are provided at their forward ends with extensions 238 and 239, respectively, on which sliding coupling members 240 and 241, respectively, are mounted. The members 240 and 241 are held forward by springs 242 and 243, respectively, and provide means for coupling the tubes 233 and 234 to an external ink supply mechanism.

A tube 245 is provided at its lower end with an elbow 246 which is mounted for rotation about the inner end of the tube 233. A fitting 247 is provided with a downward extension 248 which telescopes over the tube 245 for vertical adjustment and is provided at its upper end with an elbow 249 which carries one end of an ink applicator tube 250, the other end of which is carried in a block 251.

The ink applicator tube 250 is provided with a longitudinal slot 252 which extends the entire length of the printing cylinder 181 and gradually increases in width from its forward end 253 to its rear end 254 so as to compensate for the pressure differential in the ink as it flows along the tube and to provide a uniform stream or spray of ink along the entire length of the printing cylinder.

The ink applicator tube 250 also carries a wiper 256 which is attached thereto by series of lugs 257 and is adapted to remove excess ink from the cylinder as will be described.

In order to provide for vertical and radial adjustment of the ink applicator tube 250 to accommodate different sizes of printing cylinders, the fitting 247 is provided at its forward side

with a recess 258 in which an arm 259 slides. The arm 259 is provided with a plurality of holes 260 to receive a screw 261 by which the position of the arm with respect to the fitting 247 may be varied as desired.

The front plate 230 carries at its upper end a reinforcing angle piece 263 and the arm 259 is provided at its upper end with a bolt 264 carrying a clamping nut 265 which extends over the angle 263 and is adapted to clamp the upper end of the arm 259 in various positions along the surface of the angle member 263.

The block 251 is attached to an arm 268 by means of screws 269 which pass through a plurality of spaced openings 270 in the arm 268 for purposes of vertical adjustment. The lower end of the arm 268 is bifurcated and is guided by pin 271. The upper end of the arm 268 is clamped to an angle member 272 which is attached to the upper end of the back plate 231 by means of a bolt 273 and a clamping nut 274. The angle member 272 extends parallel to the angle 263 to provide for parallel adjustment of the two ends of the ink applicator tube 250.

An adjustable side plate 275 is attached to the fitting 247 and the block 251. The side plate 275 extends between the front and back plates 230 and 231 and its lower end projects within the pan 232 and slides over the upper edge 276 of said pan.

For adjusting the tube 250 to accommodate different size cylinders the clamping bolts 264 and 273 are loosened and the ink applicator tube 250 together with the fitting 247 and block 251 and arms 259 and 268 together with the adjustable side plate 275 are lifted out of the carriage. The screws 261 and 269 are then removed and the fitting 247 and block 251 are adjusted along the arms 259 and 268 to their desired position in which they are secured by reinserting the screws 261 and 269. The assembly is then reinserted in the carriage by telescoping the extension 248 of the fitting 247 over the tube 245 and inserting the bifurcated end 269 of the arm 268 over the pin 271. The assembly is then pivotally adjusted about the pin 271 and the tube 233 to bring the ink applicator tube 250 into its proper relationship with respect to the printing cylinder 181. The side plate 275 telescopes within the pan 232 during this adjustment. The clamping bolts 264 and 273 are then tightened to secure the parts in their adjusted position.

A tube 280 is provided at its lower end with an elbow 281 which is mounted for rotation about the end of the tube 234. A fitting 282 is provided with a downward extension 283 which telescopes over the tube 280 and with an elbow 284 to which one end of an ink applicator tube 285 is secured. The other end of the tube 285 is mounted in a fitting 286 having a downward extension 287 which telescopes on a rod 288. The rod 288 is pivoted at its lower end to a pin 289 which is attached to the back plate 231.

The ink applicator tube 285 is similar to the tube 250 and is provided with a similar elongated slot 290 through which ink is applied to the printing cylinder.

The fitting 282 is provided with an ear 291 carrying a bolt 292 having a clamping nut 293 for clamping the same to an angle piece 294 which extends along the upper end of the front plate 230 in a direction substantially radial of the printing cylinder.

The fitting 286 is also provided with an ear 295 carrying a bolt 296 having a clamping nut 297 which engages a reinforcing angle piece 298 carried by the upper end of the back plate 231 and

extending parallel to the reenforcing angle piece 294.

An adjustable side plate 299 is carried by the fittings 282 and 286. This plate is similar to the plate 275 and extends between the front plate 230 and back plate 231 and inside of the pan 232.

The ink applicator tube 285 is adjusted with respect to the printing cylinder by loosening the bolts 292 and 296 and shifting the same along the respective angle pieces 294 and 298 and then tightening the bolts to secure the tube in adjusted position.

The ends of the ink applicator tubes 250 and 265 are closed by plugs 250a and 265a, respectively.

The front and back plates 230 and 231 are cut out to receive the lower half of the shaft 153 as indicated at 300 and the space above the shaft 153 is closed by removable shields 301 and 302, respectively, which are held in place upon the front and back plates 230 and 231, respectively, by clips 303 and 304, respectively. The shields 301 and 302 are provided with arcuate top surfaces 305 and 306, respectively, which are substantially flush with the peripheral surface of the printing cylinder.

In order to close the space between the ends of the printing cylinder and the front and back frames 40 and 41, arcuate shields 308 and 309 are provided which are bolted, respectively, to end blocks 157 and 134 by bolts 310 and 311. The shields 308 and 309 are provided with arcuate lower surfaces which contact the arcuate tops 305 and 306 of the shields 301 and 302 and are formed with accurately machined forward extensions which overlie the ends of the printing cylinder 181 and engage the peripheral surface thereof with a runnig fit. Of course the shields 308 and 309 are changed when different sized cylinders are used. The shields 308 and 309 cooperate with the sliding cover plates 68 and 69 to completely enclose the printing cylinder and ink pan except for the limited area of the printing cylinder which is required to be exposed for contact with the web passing around the pressure roll 7. The upper edges of the cover plates 68 and 69 are shaped to engage the shields 308 and 309 which form a limiting stop and are spaced a minute distance from the peripheral surface of the printing roll.

Tube cleaning mechanism (Figs. 42a-52)

In order to clean the slots of the ink applicator tubes 250 and 265 a cleaning mechanism may be provided of the type shown in Figs. 42a to 52. Referring to these figures, the mechanism comprises a saw-toothed blade 315 which is slidably mounted in the tube with the tips of the teeth 316 extending into the slot 252. The blade 315 is supported in a U-shaped member 317 having upper and lower vertical flanges 318 and 319, respectively, with the blade 315 seated between the sides of the U-shaped portions 317. The U-shaped portions 317 and the flanges 318 and 319 are of a size to slide readily within the tube 250. At its forward end the U-shaped member 317 is clamped in a slot 320 of a cross block 321 having arms which are also adapted to slide within the tube 250. The opposite end of the U-shaped member 317 carries a retaining plate 322 which extends across the interior of the tube 250 and is provided with upturned and downturned flanges 323 and 324, respectively, which engage the inside of the tube to prevent displacement of the blade 315.

The blade 315 is reciprocated manually by

means of a wire 325 which is attached to the cross block 321 by means of a set screw 326 and extends through a rigid tube 327 one end of which is secured to the fitting 247 by means of a spider 328 and the other end of which extends through a bore 329 in said fitting and is secured by suitable means, such as solder 330. A flexible tube 331 is coupled to the end of the tube 327 by a nut 332 and leads to a position accessible to the operator. The wire 325 extends through the end of the tube 331 and may be provided with a suitable handle, not shown.

At periodic intervals the operator reciprocates the wire 325 and thereby reciprocating the blade 315 and causing the teeth 316 to reciprocate longitudinally of the slot 252 for cleaning the same.

The vertical flanges 318 and 319 of the U-shaped member 317 are provided with staggered openings 333 to provide for the free flow of ink around the blade and U-shaped member through the tube 250. The space between the teeth 316 also provides for the flow of ink around the blade and the supporting means.

Carriage track and ratchet mechanism (Figs. 7, 22, 40-47 and 69)

As shown in Figs. 7, 22 and 69, the platform 50 extends through the opening 160 in the front frame 40 and is provided with a pair of track grooves 335 in which the wheels 131 of the carriage ride. The track grooves 335 are provided with a plurality of recesses 336 which are positioned below the wheels 131 when the carriage is in fully inserted position at which time the carriage is supported by the front and rear bearing blocks.

For forcing the bearing blocks into seated position in their respective openings 160 and 139 in the front and rear frames 40 and 41, respectively, and also for initially retracting the bearing blocks from said opening when the carriage is to be removed, a ratchet mechanism is provided which is shown in detail in Figs. 40 to 47.

For this purpose a rack 340 is disposed on the bottom of the carriage at the central front portion thereof and is bolted to the bottom plate 130 of the carriage. The rack 340 is provided with oppositely directed ratchet teeth 341 and 342, respectively, which are selectively engaged by opposite ends 343 and 344 of a pawl 345 which is actuated for inserting or retracting the carriage.

The front part of the platform 50 is provided with a recess 346 beneath the rack 340 which is adapted to receive the pawl 345. The front frame 40 is provided with a bore 347 which extends from one side of the frame across the recess 346 and is adapted to receive a shaft 348. The shaft 348 extends beyond the front frame 40 and has a handle 349 keyed thereto. The shaft is also provided with a longitudinally extending eccentric slot 350 which is adapted to receive an actuating rod 351. The pawl 345 is mounted on a rod 352 which is also seated in the slot 350 and is provided at its end with a groove 353 which is adapted to receive a tongue 354 on the rod 351 for forming an operative connection. The short rod 352 and pawl 345 are adapted to be inserted into the slot 350 in the shaft 348 through a slot 355 at each side of the recess 346 in the platform 50. The shaft 348 is recessed as indicated at 356 below the pawl 345 to provide clearance for the actuation of the pawl.

At its projecting end the actuating rod 351 carries a pin 352 which projects through a cutout 359 in the hub 360 of the handle 349. The pin

358 is connected to a spring 361 which in turn is connected to a lever 362 pivoted by a pin 363 to the frame 40 and positioned to provide a toggle action so as to pull the pin 358 in one direction or the other when the lever 362 is shifted to the right or left. Stops 364 are provided to limit the movement of the lever 362. The lever 362 is shifted between the positions shown in Figs. 42 and 43 for shifting the pawl into engagement with the respective ends 341 and 342 of the rack 340 so as to cause the carriage to feed into or away from printing position.

In Fig. 42 the parts are shown in position to force the carriage into printing position and in Fig. 43 the parts are shown in the opposite position for retracting the carriage. The hub 360 of the handle 349 is provided with a tongue 365 which rides behind an arcuate plate 366 which is bolted to the frame 40 by bolts 367. The plates 366 serve to prevent axial movement of the shaft 348 and the bolts 367 serve as stops to limit the rocking movement of the shaft as the handle 349 is actuated.

The rack 340 is only provided at the point on the carriage corresponding to the extreme limit of its movement because as soon as the bearing blocks have been withdrawn from their supporting members the carriage rests on the wheels 131 on the track 335 and is readily rolled along said track. It is to be understood, of course, that before pulling the carriage from its seated position, a dolly 370 as shown in Fig. 7, having tracks 371 thereon, is positioned in front of the platform 50 in alinement with the tracks 335. The dolly may be provided with screw means 372 for raising or lowering the tracks 371 thereon for bringing them into alinement with the tracks 335 of the platform and is provided with latching means shown as latches 373 which engage pins 374 on the frame 40. The dolly is of course provided with wheels 375 to permit the same to be rolled to a desired location for servicing the printing cylinder and inking mechanism.

Ink reservoir (Figs. 62-66)

The reservoir 63 is formed with a sump 380 containing a pump 381 by which ink is pumped through a feed pipe 382. The pump 381 is actuated by a motor 64 mounted on the top 383 of the reservoir. The top 383 is also provided with a filler opening 384 below which is a screen 385. The opening 384 is closed by a cover 386.

The feed pipe 382 delivers ink to a header 387 which communicates with vertical passages 388 and 389 culminating in horizontal passages 390 and 391, respectively, to the housing 65. The passages 390 and 391 terminate in ports which are adapted to register with the coupling members 240 and 241 on the ends of the pipes 233 and 234. The housing 65 is also provided with a shield the front of which forms a tight fit with the lower bearing block 156 and which has a front opening 392 registering with the opening 164 in the bearing block and through which the end of the return ink spout projects. The interior of the housing 65 communicates with the reservoir 63 through an opening 393 having a screen 394 thereunder. The reservoir 63 is fastened to the front frame 40 by means of latches 395 which engage the pins 374 carried by the frame 40. The reservoir is provided with castors 396 which are mounted for vertical adjustment to permit the passages 390 and 391 to be brought into exact registration with the coupling members 240 and 241. It will be noted that the

reservoir may be removed by merely releasing the latches 395 and the dolly 370 may thus be rolled into place for the removal of the carriage.

The passages 388 and 389 are provided with butterfly valves 397 and 398, respectively, for controlling the amount of ink supplied therethrough. The valves 397 and 398 are provided with actuating handles 399 and 400, respectively, which may be secured in selected position by suitable spring pins (not shown) which register with holes 401 and 402, respectively, in the housing 65.

Driving and running register mechanism (Figs 53-61)

The driving and running register mechanism 66 for the printing cylinders for each of the units is shown in Figs. 53 to 61 as comprising a gear box 405 having side walls 406 carrying bearings 407 in which the shaft 31 is journaled. The shaft 31, as shown in Figs. 53 to 61, is formed in units which are coupled together for driving the various printing units in unison. The shaft 31 carries a beveled gear 408 meshing with the driving gear 409 which is spaced from and formed integral with a spur gear 410. Adjacent the gear 410 is another spur gear 411 having the same diameter as the gear 410 but provided with one less tooth than the gear 410. The spur gear 411 is provided with a hub 412 which is rotatably supported by a ball bearing 413 carried by a back plate 414 of the gear box. A shaft 415 is provided with a flange 416 which is bolted to a gear 411 by bolts 417. The rearward end of the shaft 415 is supported by a ball bearing 418 in a transverse plate 419 which is bolted by bolts 420 to lugs 421 formed integral with the gear casing 405.

The gears 409 and 410 are provided with a hub 422 which is supported by ball bearings 423 on the shaft 415. A ring gear 425 is provided with a cylindrical internal surface 426 which is rotatably supported by a plurality of rollers 427 which are carried by the back plate 414.

The ring gear 425 is bolted by bolts 428 to lugs 429 formed integral with and extending forwardly from a ring 430 which is disposed axially between the gears 409 and 410 about the hub 422. The ring 430 carries a plurality of rollers 431 which ride in a circular track 432 on the plate 419.

Three planet gears 433, 434 and 435 are spaced equi-distantly around the spur gears 410 and 411 and each of the planet gears is supported in a bearing 436 carried by the ring gear 425 and a bearing 437 carried by the ring 430. The planet gear 433, as shown in Fig. 53, comprises a gear 438 formed integral with a shaft 439 which is journaled in the bearing 436 and 437 and to which a gear 440 is pinned by pins 441. The gears 438 and 440 have the same number of teeth. The planet gears 434 and 435 are constructed similarly to the planet gear 433. In the case of the gear 433, the teeth of the gears 438 and 440 are in alinement. Since the planet gears 434 and 435 are displaced by 120° and 240°, respectively, from the gear 133 and the gear 411 has one tooth less than the gear 410, the corresponding teeth of the planet gear 434 are displaced by one-third of a tooth and the corresponding teeth of the planet gear 435 are displaced by two-thirds of a tooth as shown in Figs. 58 and 59, respectively.

A gear 445 on a shaft 446 meshes with the ring gear 425. The shaft 446 is mounted in bearings 447 and 448 in inwardly projecting brackets 449

and 450, respectively, bolted to the gear box 405. On one end the shaft 446 is provided with a hand wheel 451 for purposes of adjustment and on the other end the shaft 446 is provided with a gear 452 meshing with a gear 453 mounted on the shaft 454 which is driven by a motor 455 through a coupling 456. The motor 455 is shown as mounted on a bracket 457 bolted to the gear case 405. The shaft 454 is supported in bearings 458 in a bore 459 of the bracket 457.

The shaft 453 of the printing cylinder is removably splined into the hub 412 of the gear 411 and is pulled therefrom when the carriage is removed.

During the normal operation the drive shaft 31 through the beveled gears 408 and 409 drives the spur gear 410 which in turn drives the planet gears 433, 434 and 435. The planet gears drive the spur gear 411 at a constant rate and thereby drives the printing cylinder at a constant rate which is substantially the rate of the gear 410, but differs slightly therefrom due to the difference of one tooth in the gears 410 and 411. The ratio may, for example, be of the order 100:101.

When it is desired to adjust the running register the motor 455 is actuated in one direction or the other to drive the gear 445 which drives the ring gear 425 and causes the planet gears 433, 434 and 435 to change their orbital position.

Due to the one tooth difference between the gears 410 and 411, a complete rotation of the ring gear 425 will shift the position of the gear 411 by one tooth, either advancing or retarding the printing cylinder a similar amount. For initial adjustment purposes the hand wheel 451 may be used. The motor 455 is normally driven by an automatic registering device (not shown) which is responsive to any variation in the registration of the printing cylinder from its correct position.

The drive shaft 31 also carries a worm 460 meshing with a worm gear 461 on the upper end of a vertical shaft 462. The gears 463 and 461 are enclosed in a gear case 463 bolted to the gear box 405.

Referring now to Figs. 54, 60 and 61, the upper end of the shaft 462 is supported in a bearing 464 in the case 463 and the lower end of the shaft 462 is supported in a bearing 465 mounted in a bracket 466 bolted to the gear case 405. Above the bracket 466 the shaft 462 has keyed thereto a disc 468 having an eccentric cam slot 469 formed therein. A reciprocating slide 470 is provided with a roller 471 which engages the cam slot 469 and is also provided with an elongated slot 472 through which the shaft 462 extends. A cover plate 473 attached to the shaft 462 holds the slide 470 in place. The slide 470 is attached to a rod 474 which drives the doctor blade mechanism to be described.

Doctor blade mechanism (Figs. 67-79)

The doctor blade actuating mechanism is shown in detail in Figs. 67 to 79 and comprises in general a slide which is adjustable vertically and carries a platform which is reciprocable axially. The platform carries a tilting frame which is tiltable and in turn supports a doctor blade carrier which is adjustable transversely and carries a doctor blade. This combination provides for adjustment of the doctor blade in all directions so as to accommodate the same to different size cylinders.

Referring to Figs. 69-77 more in detail, the mechanism comprises a vertically slidable mem-

ber 480 which is slidable between gibs 481 attached to the front and back frames 40 and 41. The slide 480 is provided at each end with upwardly and downwardly extending projections 482 which provide sliding surfaces and serve to hold the slide against lateral movement.

The slide 480 carries a pair of racks 483 which are disposed at each end of the slide and are engaged by gears 484 carried on a shaft 485 which is journaled in the front and back frames 40 and 41 and at one end has a worm gear 486 which is disposed in a recess 487 in the frame 40. The gear 486 meshes with the worm gear 488 carried by a shaft 489 which extends to the side of the frame 40 and carries a handle 490 by which the rack and slide 480 are vertically adjusted. A set nut 491 is provided for clamping the shaft 489 in adjusted position.

The slide 480 carries a pair of side plates 494 at each end thereof which are bolted to the slide on each side thereof and between which a platform 495 is mounted for axial reciprocation. The side plates 494 are provided with grooves 496 in which ride rollers 497 which are carried by the platform 495. The rollers 497 guide and support the platform for its axial reciprocation. At each end of the platform 495 is mounted a block 498 having parallel side surfaces 499. Rollers 500 which are mounted on the top of the side plates 494 and rotate about vertical axes engage the side surfaces 499 of the block 498 for positioning the platform 495 laterally and preventing side play as the latter is reciprocated.

The connections for reciprocating the platform 495 are best shown in Figs. 67, 70 and 75. This mechanism comprises the link 474 which is pivoted to an arm 502 carried on a hub 503 which is journaled for rotating movement only in a bearing 504 mounted in a recess in the platform 50. The hub 503 has a splined opening in which the slidable end of a vertically splined shaft 505 is slidably mounted so that the shaft 505 is free to slide axially in the hub 503 but is constrained to rotate therewith. The upper end of the shaft 505 carries a hub 506 which is rotatably mounted in a bearing 507 carried by a block 508 which is bolted to the slide 480. The hub 506 carries an arm 509 which extends through a slot 510 in the side of the platform 495 and is pivoted to one end of a link 511, the other end of which is pivoted to the platform 495 by a vertical pin 512.

The arrangement is such that reciprocation of the rod 474 rocks the vertical shaft 505 and thereby reciprocates the platform 495.

The blocks 498 also carry pins 515 which rotatably support downwardly extending ears 516 on the ends of a tilting frame 517.

At its center the platform 495 carries a pair of upwardly extending brackets 518 between which are positioned a pair of spaced downwardly extending legs 519 which are secured to the tilting frame 517. A worm gear 520 is mounted between the legs 519 and is supported on a shaft 521 which is disposed in axial alignment with the pins 515.

The worm gear 520 meshes with a worm 522 carried by a shaft 523 which is journaled in suitable bearings in the platform 495 and carries at its outer end a hand wheel 524 by which the worm is rotated. A lock nut 525 is provided for locking the shaft 523 in adjusted position.

The worm wheel 520 is fixed to the legs 519 so that the tilting frame 517 is tilted about the axis

of the pins 515 and shaft 521 in response to actuation of the hand wheel 524.

A doctor blade carrier 528 slides transversely over the top surface of the tilting frame 517 and for clamping the carrier 528 in position a pair of plates 529 are slidably mounted in transversely extending T slots 530 in the tilting frame 517 and are secured to screws 531 which extend through the carrier 528. When the screws 531 are loosened the carrier 528 may be adjusted transversely. When it is properly adjusted it may be clamped by tightening the screws 531. For accurate lateral adjustment of the carrier 528 a pair of feed screws 532 are provided which are journaled in the tilting frame 517 and are provided with hand wheels 533 for manual adjustment. The screws 532 extend through feed nuts 534 having upwardly extending cylindrical legs 535 which are seated in recesses 536 formed on the upper side of carrier 528. Set screws 537 are mounted in the carrier 528 to engage the legs 535 of the feed nuts 534 for clamping the screws 532 and thereby preventing accidental turning thereof when the carrier 528 is properly adjusted. The plate 529 and screws 531 fit somewhat loosely in the T slots 530 to permit independent adjustment of the two ends of the carrier 528 so that the carrier may be adjusted accurately to conform to the peripheral surface of the printing cylinder.

A block 540 is mounted on the top of the carrier 528 at each end thereof. A doctor blade holder 541 is formed with a bottom channel 542 which fits tightly over the blocks 540. The holder 541 is secured to the blocks 540 by means of screws 543. In order to remove the holder 541 from the blocks 540 after the screws 543 have been removed, a pair of jack screws 544 are provided which are threaded in bushings 545 in the holder 541 and bear against the top of the blocks 540.

A doctor blade 548 and a thin backing plate 549 are adjustably clamped to the holder 541 by means of a clamping plate 550 which is secured by bolts 551 extending through elongated slots in the doctor blade 548 and the backing plate 549. Hence the doctor blade may be positioned as desired and clamped by tightening the various clamping bolts 551. This arrangement also permits the doctor blade to be moved outwardly to compensate for wear. The backing plate 549 is provided for strengthening purposes. An ink shield 553, having a rear depending flange 554, is secured to the underside of the clamping plate 550 by means of screws 555. The ink shield 553 is adapted to deflect downwardly into the ink pan ink which may pass over the top of the applicator tube 250 and thereby to prevent the ink from contacting the blade carrier and actuating mechanism.

In order to permit the tilting frame 517 and the doctor blade to be tilted away from the printing cylinder when desired without disturbing the accurate adjustment and thus necessitating readjustment thereof, an adjustable stop is provided in the form of a toggle comprising a link 556 which is pivoted to a bracket 557 carried by the platform 495 and an adjustable link 558 which is pivoted to a bracket 559 carried by the tilting frame 517. The free ends of the links 556 and 558 are connected together and the link 558 is provided with a threaded coupling 560 by which the length of said link may be adjusted. After the tilting frame has been properly adjusted to position the doctor blade against the printing cylinder the coupling 560 is adjusted to straighten

the toggle and bring the links 556 and 558 to their limiting position. Thereafter the tilting frame 517 may be retracted about its axis, causing the toggle to break into the position shown in Fig. 74, and in order to again position the doctor blade against the printing cylinder in its original adjusted position the tilting frame 517 is shifted about its axis until the movement thereof is stopped by the tightening of the toggle links 556 and 558.

Operation

Summarizing briefly the operation of the machine, the web 1 is fed through a number of units corresponding to the number of colors to be printed. All of the units are identical. Each is provided with a printing cylinder and a pressure roll for holding the web against the printing cylinder and is provided with blower and exhaust means for blowing air against the printed web and removing the vapor laden air therefrom for drying the webs before they reach the next unit. The units are all driven in synchronism from a common source of power shown as a sectional drive shaft 31 and each unit is provided with driving gears and running register mechanism 66, the running register being manually adjustable by the hand wheel 451 and automatically adjustable by means of the motor 455 which is individual to each unit, and which is adapted to be actuated by automatic registry control mechanism (not shown).

As shown in Figs. 16 and 17, the rolls 5 and 6 are so disposed that the web 1 extends vertically therebetween and the pressure roll 7 and roll 8 likewise are disposed so that the web 1 extends vertically therebetween and parallel to the line of movement of the pressure roll 7 as the latter is raised or lowered. By this means pressure roll 7 may be raised or lowered without changing the tension on the web 1 and without varying the position of the incoming or outgoing portions of the web 1. This feature is of particular importance in a multiple unit press inasmuch as it permits the pressure roll 7 in one of the units to be raised or lowered as desired without affecting the feed of the web to or the operation of the other units.

The pressure roll 7 is raised or lowered by hydraulic pressure supplied to the cylinders 86 which are designed for positive actuation in either direction. When the pressure roll is in its upper position it is latched mechanically by the pawl 111 engaging the ratchet 110. This prevents drifting of the pressure roll downwardly due to loss of hydraulic pressure or failure thereof. Pawls 111 are released automatically by the hydraulic pressure which is supplied to the cylinders 36 for lowering the pressure roll 7; hence the pawls automatically latch the pressure roll in its upper position and are also automatically released when pressure is supplied for lowering the same.

The slides 60 and 61 carrying the two ends of the pressure roll 7 are interconnected by an equalizer shaft 107 and racks 103 and 104 which cause the two slides to operate in unison regardless of any variation in the hydraulic pressure in the respective cylinders. The teeth at the upper portions of the racks 103 and 104 are made with additional clearance, however, in order to provide a limited amount of play which allows the pressure roll 7 to accommodate itself to the peripheral surface of the printing cylinder 181.

The printing cylinder 181 is journaled for rotation in end blocks 133 and 134 and end blocks 156 and 157 which are secured to the carriage and

which fit in corresponding recesses in the front frame 40 and rear frame 41. When the printing cylinder is in operative position the shaft 153 thereof is supported entirely by the bearings in the end blocks. For removing the cylinder and ink applicator tubes as a unit, however, the carriage is first ratcheted outwardly to pull the end blocks out of the recesses in the respective frames and thereby allow the wheels to rest upon the track 335 on the platform 50. Thereafter the carriage may be freely rolled along the tracks 335 and removed from the machine onto a dolly 370 as shown in Fig. 7. The carriage is ratcheted out of its seated position by means of a handle 349 which operates a pawl 345. The direction of feed of the ratcheting mechanism is controlled by the reversing handle 362. This handle is reversed when it is desired to force the bearing blocks back into their recesses in the front and rear frames 40 and 41.

The end register mechanism is carried by the bearing block 156-157 and is provided with a hand wheel 220 by which the axial position of the printing cylinder is accurately adjusted in accordance with registry requirements. The hand wheel 220 is connected through a planetary gearing to drive a feed screw 267 which is connected to the end of the printing cylinder shaft 153. Due to the planetary gearing, an extremely accurate control of the axial position of the printing cylinder is obtained.

The applicator tubes 250 and 255 are disposed to apply ink against the peripheral surface of the printing cylinder and are adjustable in position to accommodate various sizes of cylinders. The tube 255 is positioned to supply ink to the receding portion of the peripheral surface of the printing cylinder after it has passed the printing position so as to moisten the cylinder and thereby keep the ink from drying on the surface thereof.

The applicator tube 250 is positioned to supply ink to the advancing portion of the peripheral surface of the printing cylinder just before the surface reaches the doctor blade 548. The wiper 256 is positioned between the applicator tube 255 and the doctor blade 548 to remove excess ink from the surface of the cylinder before it reaches the doctor blade and also to force the ink into the engraved portions of the intaglio printing cylinder.

The excess ink from the applicator tubes 250 and 255 is received in the pan 232 which returns the ink to the reservoir 63 for recirculation.

The end shields 302 and 309 and the flexible side closure plates 68 and 69 form a substantially complete closure for the entire mechanism and prevent escape of ink vapors into the atmosphere.

The reservoir generally indicated at 63 is removably attached to the front frame 40 and supplies ink through passages 308-309 and 309-391 to the supply pipes 233 and 234, through the coupling members 240 and 241 which are spring-pressed against the delivery ends of the tubes 390 and 391 so that the ink reservoir may be removed without first disconnecting the coupling members. Any leakage which takes place at the couplings drains back into the reservoir. The arrangement is such that the reservoir 63 may be readily removed to permit the dolly 370 to be positioned for receiving the carriage.

The doctor blade 548 is carried by the front and rear frames 40 and 41 and is not removable with the carriage. The arrangement is such that the doctor blade may be adjusted vertically by manipulation of the crank 490. It is reciprocated from

the main drive shaft 31 by the rod 474 and the vertically splined shaft 505. The reciprocating platform 495 carries a tilting frame 517, the position of which may be adjusted by the hand wheel 524 and the tilting frame 517 carries the doctor blade carrier 523 which is adjusted toward or away from the printing cylinder by the hand wheels 533. It is to be understood, of course, that the doctor blade is tilted away from the printing cylinder before the cylinder and carriage are removed from the frame.

Although a specific embodiment of the invention has been described for purposes of illustration, it is to be understood that the invention is capable of various uses and that changes and adaptations may be made therein as will be apparent to a person skilled in the art.

What is claimed is:

1. A printing press comprising a pair of end frames, a platform extending between said frames, tracks on said platform, a printing cylinder carriage comprising bottom, side and end walls, bearing blocks on said carriage beyond said end walls, a shaft journaled in said bearing blocks and carrying a printing cylinder, bearing block supports carried by said end frames to support said bearing blocks when said carriage is in printing position and wheels on said carriage riding on said tracks for the withdrawal of said carriage from said press, said track having recesses beneath the wheels when in printing position whereby the cylinder and carriage are then supported solely by said bearing block supports, at least three wheels being spaced along said carriage to ride on each track, said wheels and recesses being unequally spaced whereby said carriage is supported by at least two of said wheels at all times when a third wheel is over one of said recesses during the travel of said carriage.

2. An intaglio printing press comprising a frame, a removable carriage slidable into and out of said frame, a shaft carrying an intaglio printing cylinder mounted thereon, a pan having bottom and side walls mounted on said carriage and forming an ink sump, end walls forming end closures for said sump, and a pair of ink applicator tubes disposed on opposite sides of said cylinder beyond the printing area thereof, a pair of ink supply pipes extending axially of said cylinder at the bottom of said sump for coupling to an external source of ink supply, vertical pipes adjacent one of said end walls pivotally connected to said first pipes for angular adjustment about the axes of said first pipes, vertical pipes attached to one end of each of said tubes telescoping with said first vertical pipes for vertical adjustment, brackets pivoted to the other end wall for angular adjustment about the axes of said first tubes and carrying the other end of each of said tubes, coupling means to provide vertical adjustment of said tubes on said brackets, and clamping means to clamp said tubes in adjusted positions to accommodate printing cylinders of different diameters.

3. A printing press as set forth in claim 2 in which said clamping means comprises guiding members attached to said end walls and clamps on said tubes to engage said guiding members.

4. A printing press as set forth in claim 2 in which side plates are attached to said tubes and extend downwardly within the side walls of said carriage to form side closures for said sump.

5. A printing press as set forth in claim 2 in which said end walls are recessed to receive the

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cylinder shaft and are open above said shaft to permit lifting of the shaft for the removal of said cylinder, and arcuate end plates are removably secured above said shafts to complete the end closures.

6. A printing press as set forth in claim 2 in which an adjustable end bracket is attached to one of said tubes adjacent its vertical pipe and clamping means is carried by said bracket to clamp the same in adjusted position on said end wall.

7. A printing press as set forth in claim 2 in which spring coupling means are carried by said first pipes for coupling to an external source of ink supply.

8. A printing press as set forth in claim 2 in which the end wall adjacent said vertical pipes is provided with an ink return opening, a spout communicating with said opening extends outwardly therefrom and said first pipes extend through said opening on opposite sides of said spout.

9. A printing press as set forth in claim 2 in which said end brackets are provided with bifurcated ends engaging pins on said end wall to permit removal of said brackets therefrom.

10. An intaglio printing press comprising a frame, a carriage slidable into and out of said frame, an intaglio printing cylinder mounted on said carriage, ink applicator tubes adjustably mounted on said carriage, an ink sump on said carriage, and releasable coupling means for connecting said tubes to an external source of ink supply whereby said cylinder and inking mechanism may be removed from said frame on said carriage.

11. A printing press comprising a pair of end frames, a platform extending between said frames, tracks on said platform, a printing cylinder carriage comprising bottom, side and end walls, a shaft journaled in said bearing blocks and carrying a printing cylinder, bearing block supports carried by said end frames to support said bearing blocks when said carriage is in printing position, wheels on said carriage riding on said tracks for the withdrawal of said carriage from said press, and ratchet mechanism connected to advance or retract said carriage between printing position with its weight carried by said supports and rolling position with the wheels riding on said tracks, said ratchet mechanism comprises a shaft extending across said platform, a pawl mounted eccentrically on said shaft and having oppositely directed pawl teeth, a cooperating rack on the underside of said carriage, manual means to rock said shaft, and manual means to shift said pawl for feeding movement in opposite directions.

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12. A printing press comprising a pair of end frames, a platform extending between said frames, tracks on said platform, a printing cylinder carriage comprising bottom, side and end walls, bearing blocks on said carriage beyond said end walls, a shaft journaled in said bearing blocks and carrying a printing cylinder, bearing block supports carried by said end frames to support said bearing blocks when said carriage is in printing position, wheels on said carriage riding on said tracks for the withdrawal of said carriage from said press, and ratchet mechanism connected to advance or retract said carriage between printing position with its weight carried by said supports and rolling position with the wheels riding on said tracks, said ratchet mechanism comprises a shaft extending across said platform, a rod eccentrically mounted in said shaft for rocking movement, a pawl secured to said rod having oppositely directed pawl teeth, a cooperating rack on the underside of said carriage, a manual lever to rock said shaft, a lever to shift said rod to bring selected pawl teeth in operative position to feed said carriage, and spring means connecting said last lever to said rod.

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