

March 21, 1967

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**3,309,992**

## BLADE ADJUSTING AND CLAMPING METHOD AND APPARATUS

Filed March 9, 1964

8 Sheets-Sheet 1

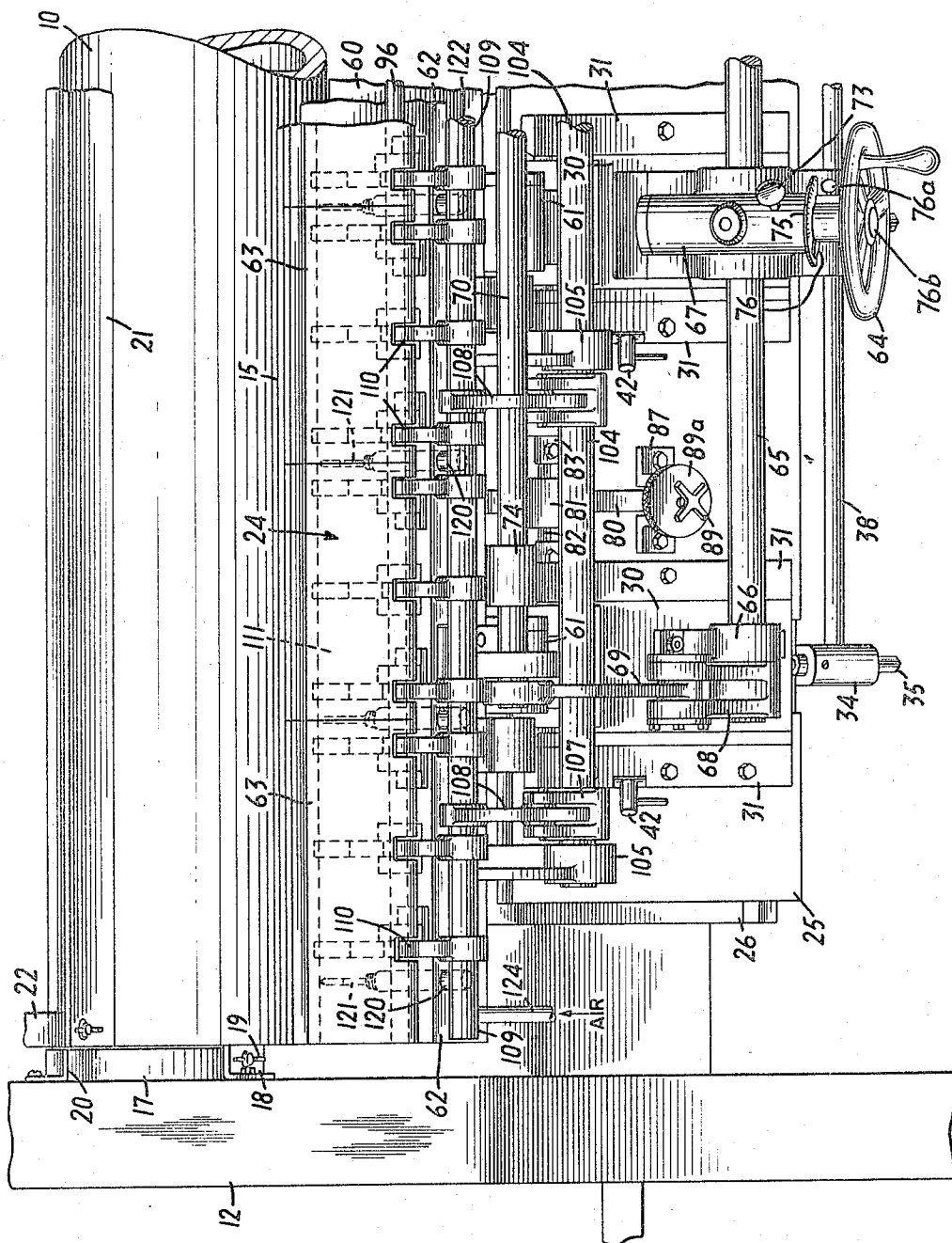


FIG. 1A

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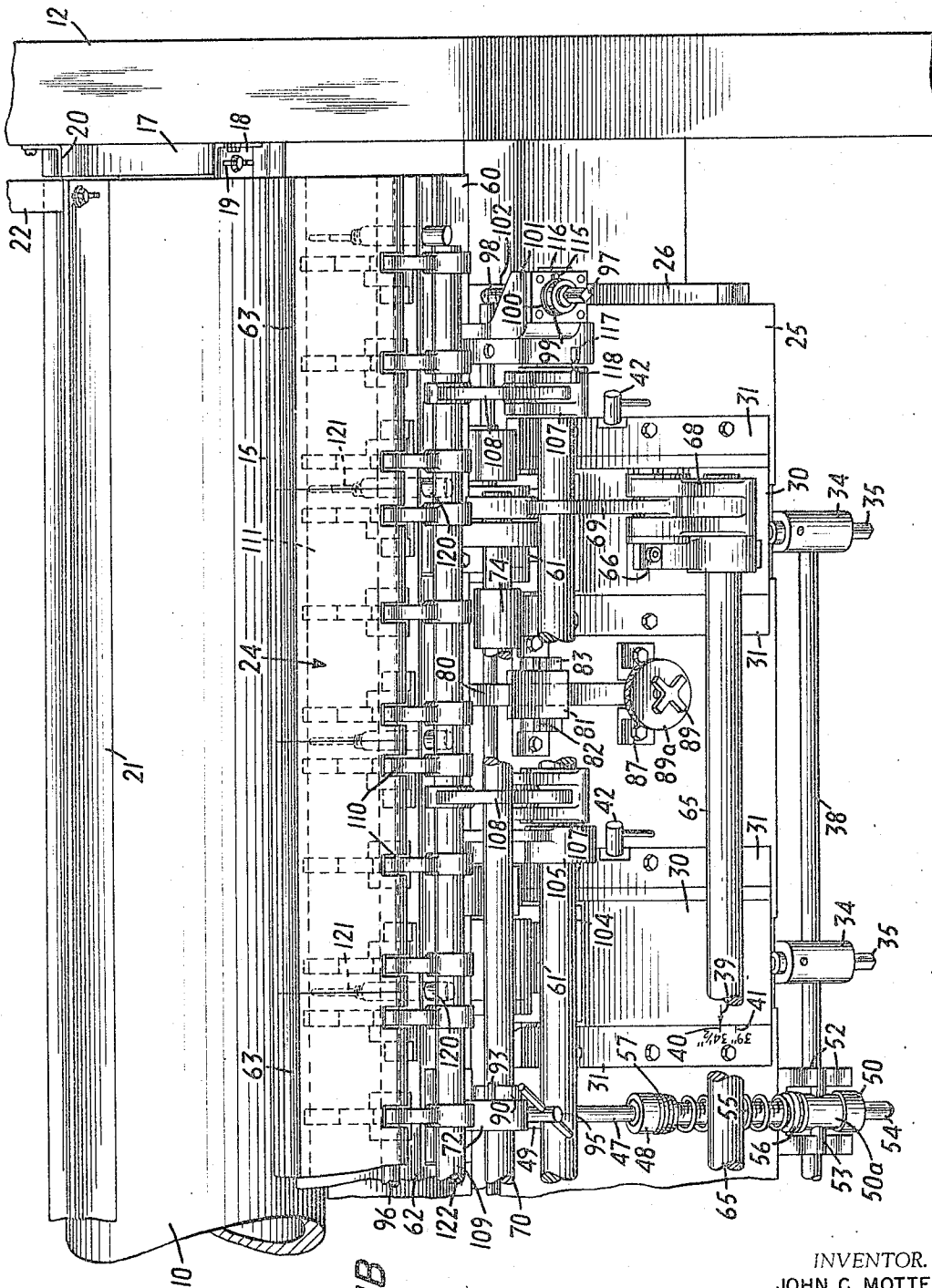
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## BLADE ADJUSTING AND CLAMPING METHOD AND APPARATUS

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8 Sheets-Sheet 2



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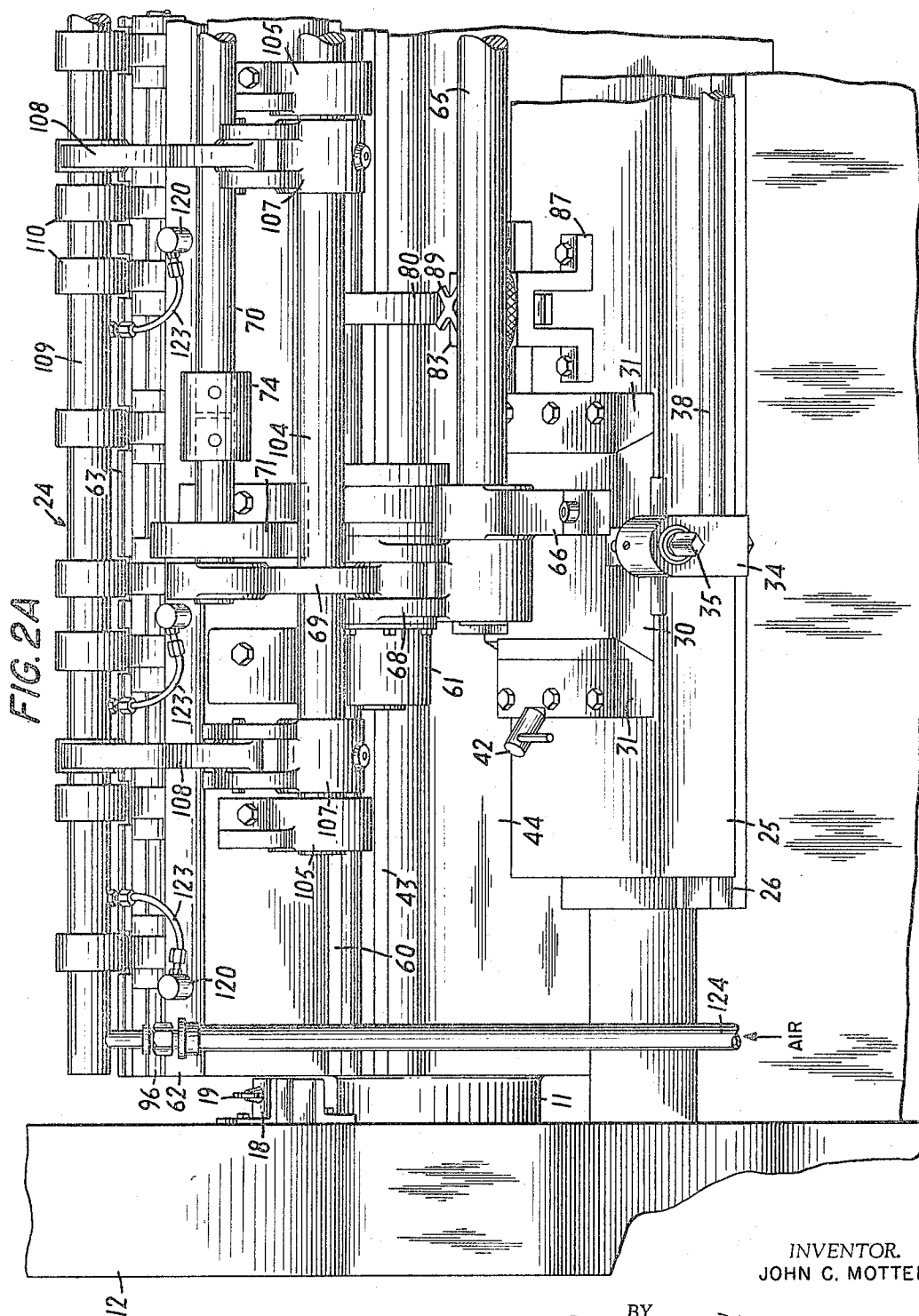
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## BLADE ADJUSTING AND CLAMPING METHOD AND APPARATUS

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8 Sheets-Sheet 3



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BLADE ADJUSTING AND CLAMPING METHOD AND APPARATUS

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8 Sheets-Sheet 4

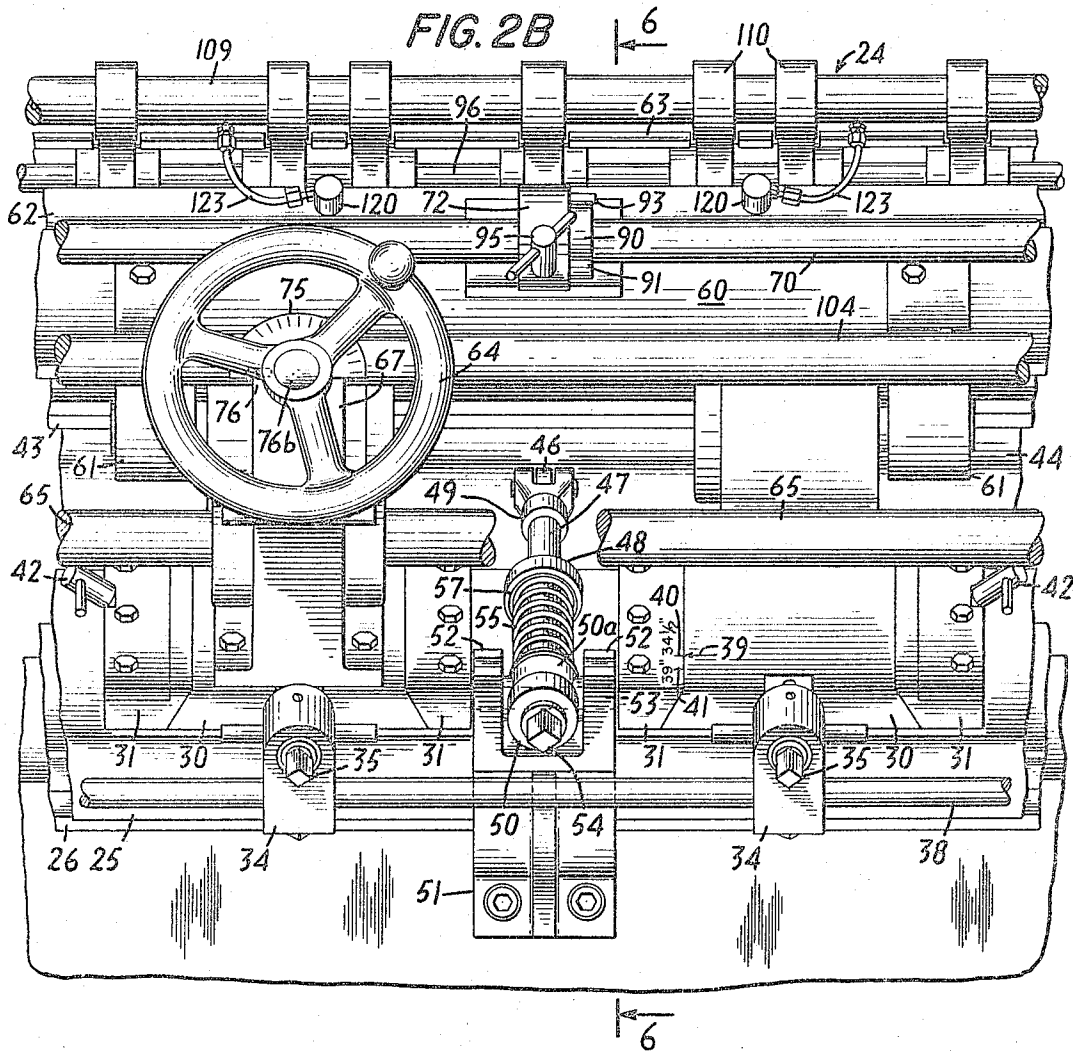
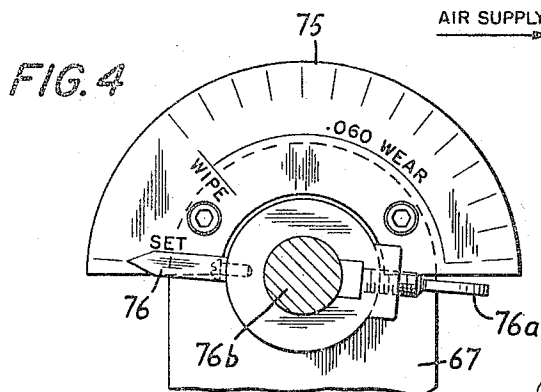
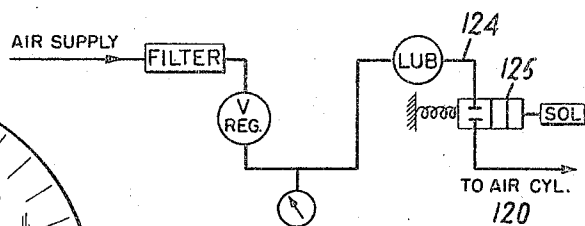


FIG. 9

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BLADE ADJUSTING AND CLAMPING METHOD AND APPARATUS

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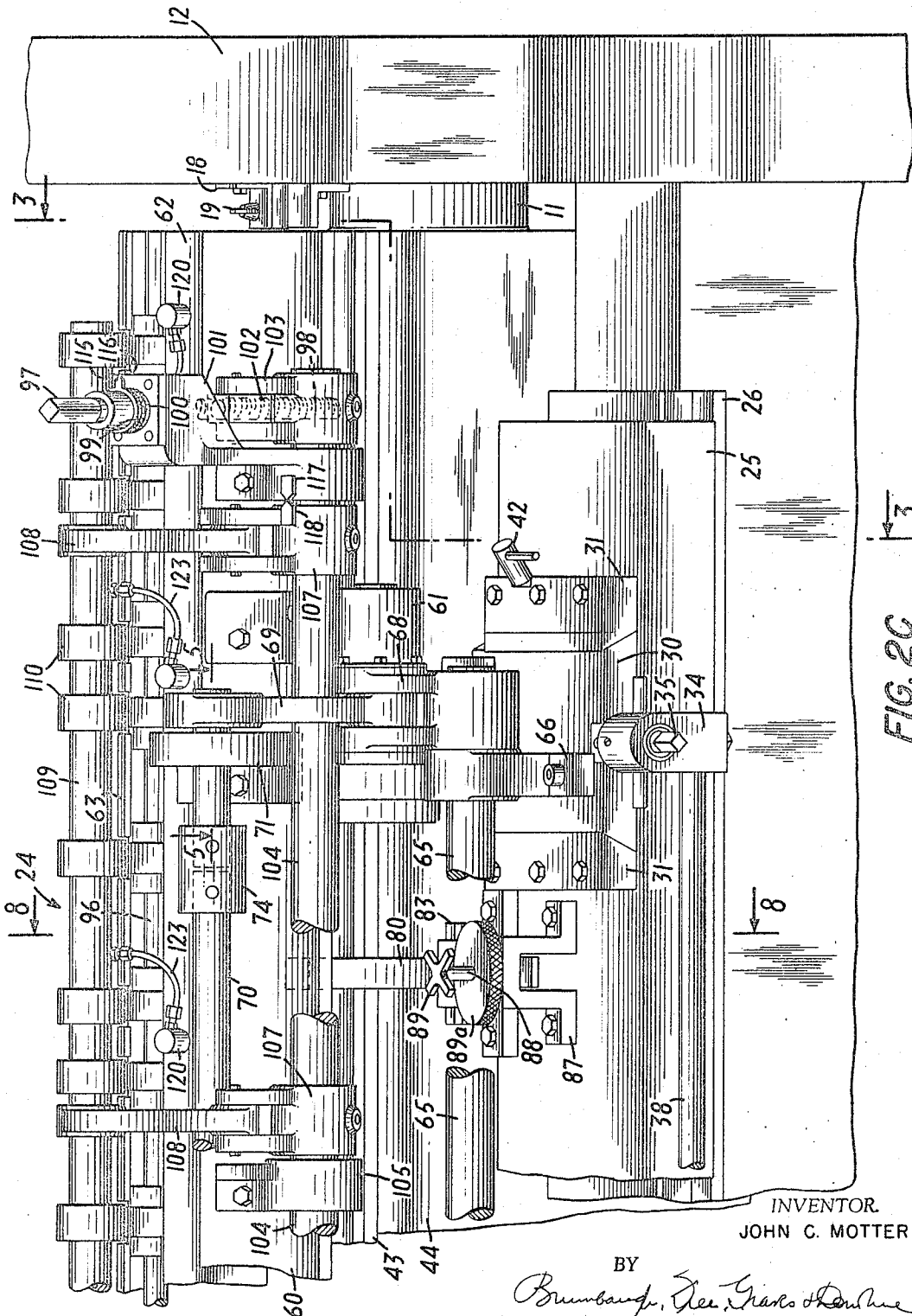


FIG. 2C

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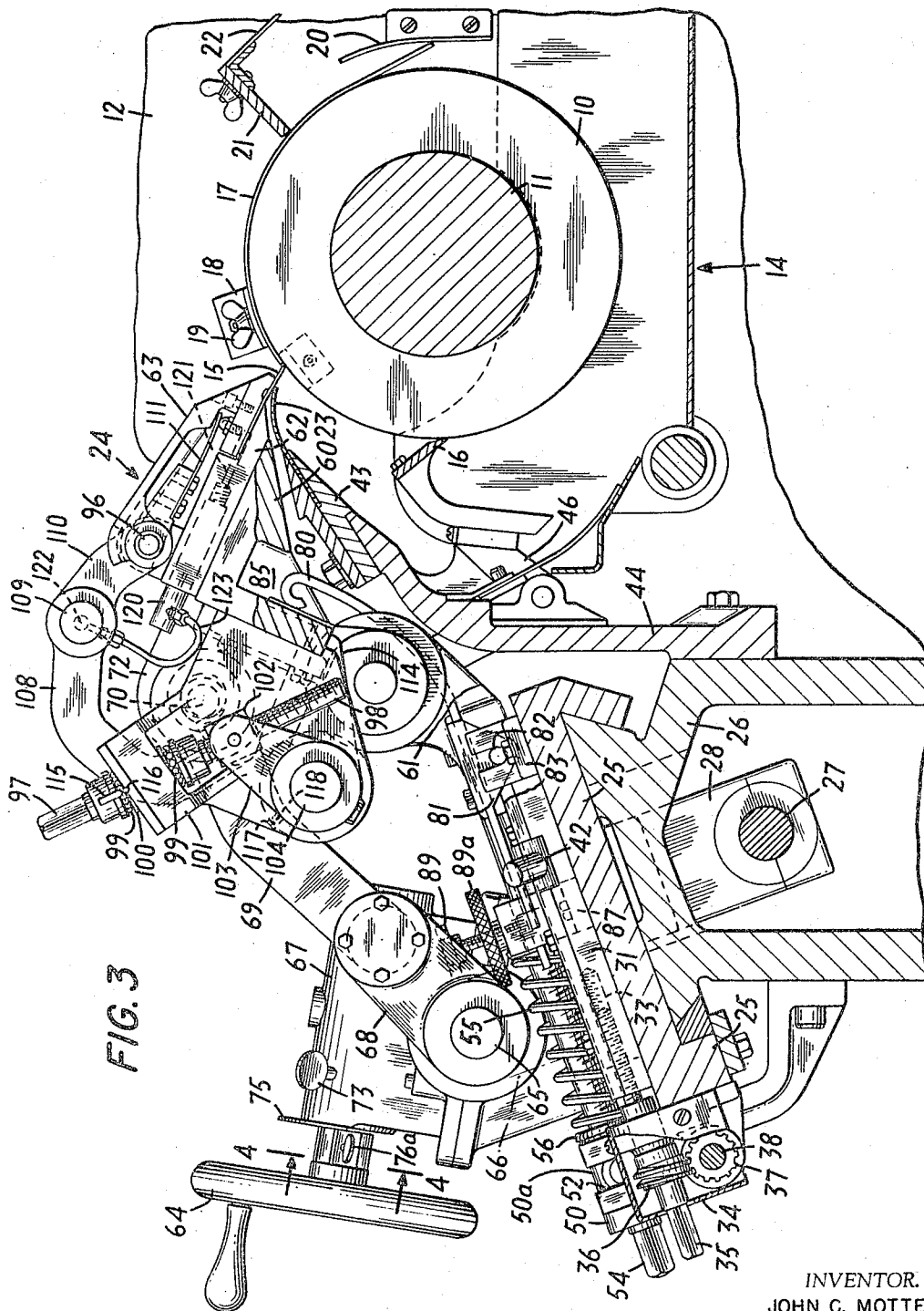
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BLADE ADJUSTING AND CLAMPING METHOD AND APPARATUS

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8 Sheets-Sheet 6



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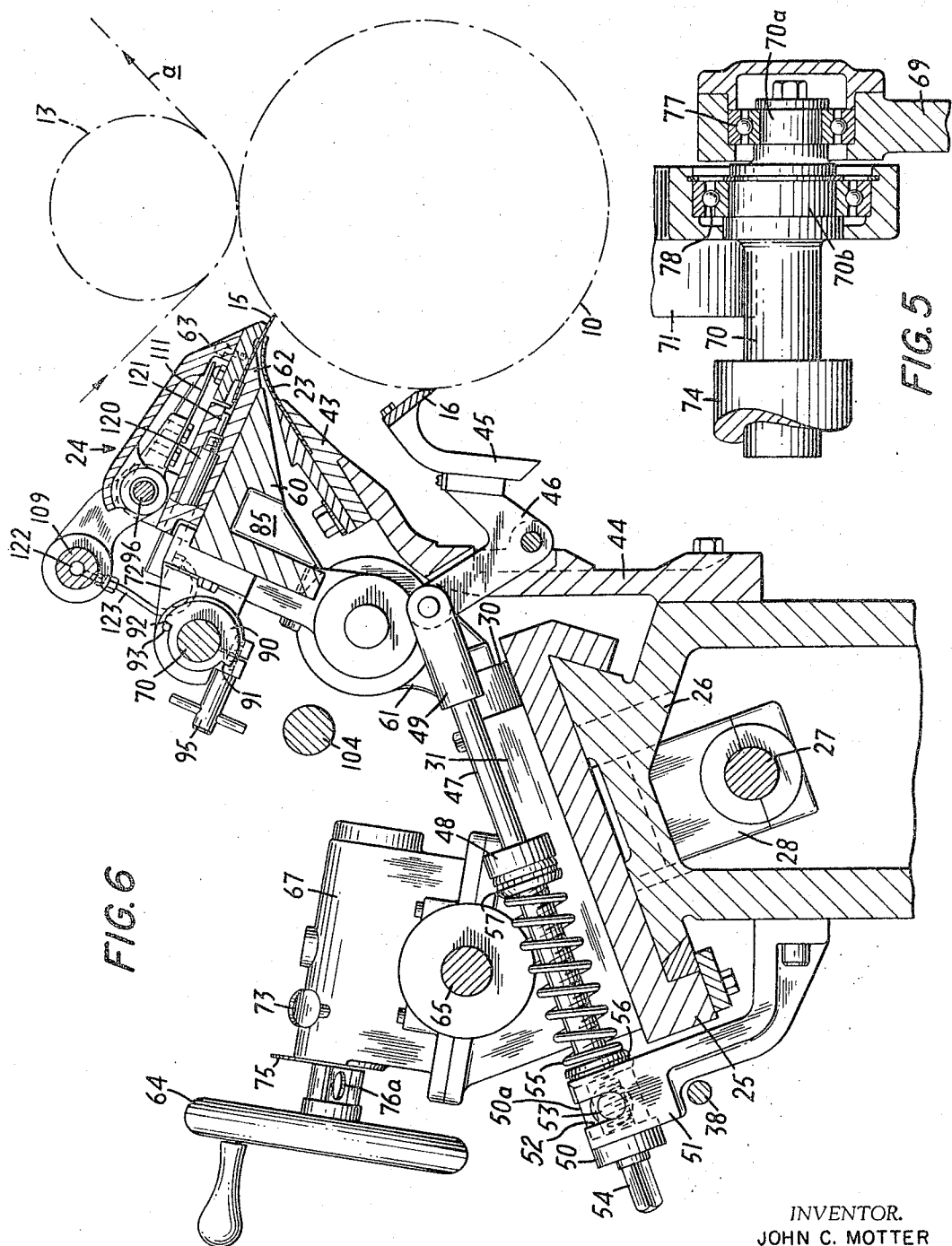
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BLADE ADJUSTING AND CLAMPING METHOD AND APPARATUS

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8 Sheets-Sheet 7



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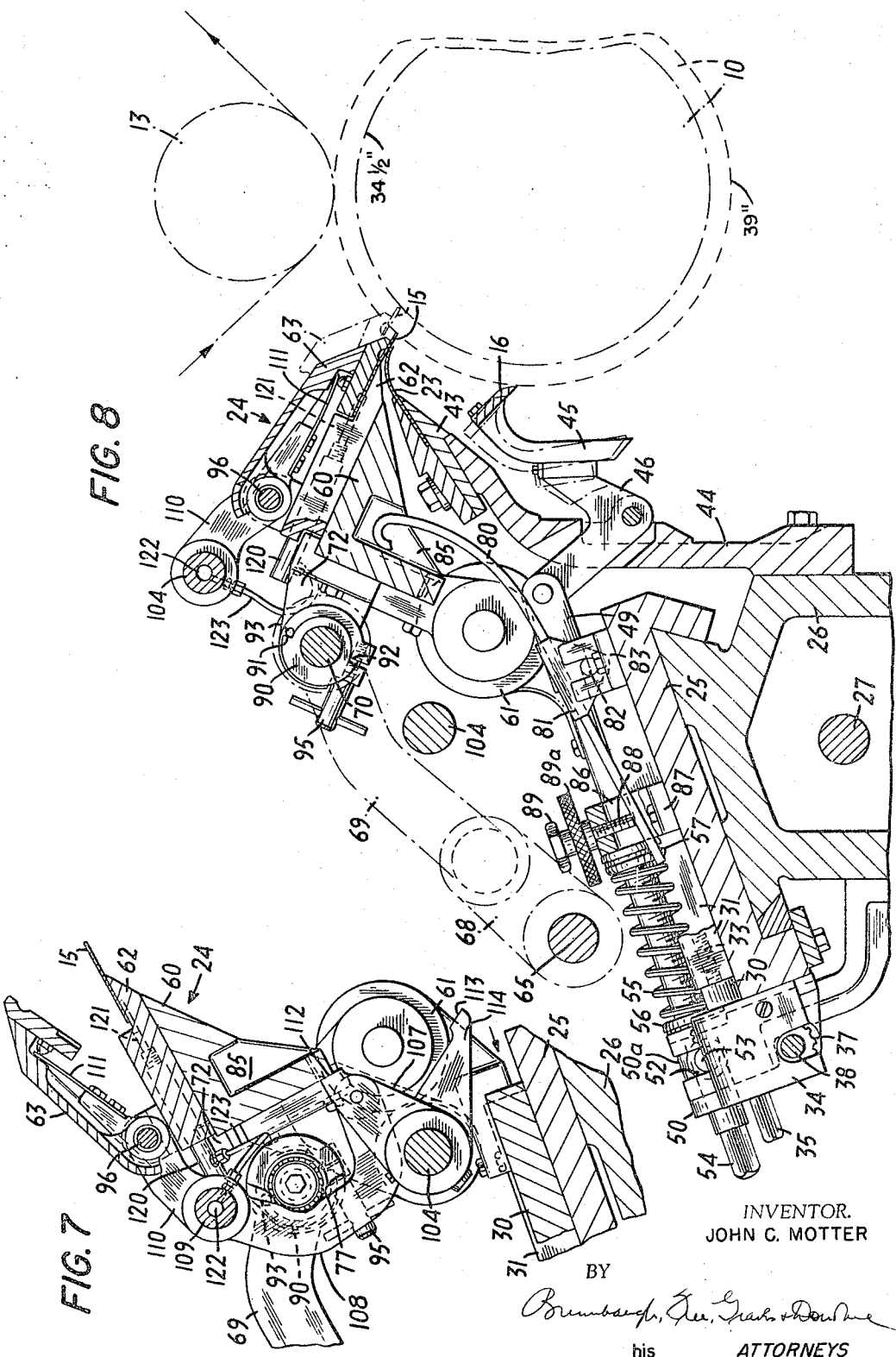
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BLADE ADJUSTING AND CLAMPING METHOD AND APPARATUS

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8 Sheets-Sheet 8



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## BLADE ADJUSTING AND CLAMPING METHOD AND APPARATUS

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Filed Mar. 9, 1964, Ser. No. 350,384  
16 Claims. (Cl. 101-169)

This invention relates to a novel blade clamping and adjusting apparatus and to a novel method for bringing a blade into the desired operative relationship with a rotatable cylinder. The present invention is particularly applicable to rotogravure printing presses, but it may also be applicable to other types of machines, such as web coating machines and other types of printing presses.

In conventional rotogravure printing presses the locking of the doctor blade in the blade clamping assembly to insure that it will be brought into the desired pressure engagement with the surface of the printing cylinder throughout the entire length of the blade is a critical, difficult and time consuming operation. Also, in conventional rotogravure printing presses it is a difficult and time consuming task to adjust the blade clamping assembly to insure that the doctor blade will be brought into proper engagement at the desired angle when a printing cylinder of one circumference is removed and replaced by a printing cylinder of a different circumference. Nevertheless, it is frequently desirable, and sometimes necessary, to install a printing cylinder of different circumference in the printing press.

The present invention provides a blade clamping and adjusting apparatus and a method of adjusting a blade with respect to a rotatable cylinder which, in their application to a rotogravure printing press, greatly facilitates the proper adjustment of the doctor blade within the blade clamping assembly to insure that the doctor blade will be in a predetermined uniform engagement with the printing cylinder and in the desired angular relationship to the printing cylinder, even though a printing cylinder of one circumference is substituted for a printing cylinder of a different circumference. Toward this end, in the blade clamping apparatus of the present invention the blade clamping assembly and the means for adjusting the blade clamping assembly between an operative position and a retracted position are both mounted on an adjustable support which is positioned and locked in a predetermined position corresponding to the particular circumference of the printing cylinder installed in the printing press. The blade clamping assembly also embodies means which makes it possible to orient the doctor blade in a predetermined angular position corresponding to the circumference of the printing cylinder installed in the press. When both the movable support and the doctor blade angle are adjusted for a printing cylinder of a certain circumference, the doctor blade assembly can be moved from a retracted position to the operative position by reference to the same dial or indicating means used to adjust the blade clamping assembly in operative position relative to a printing cylinder of different circumference.

In a preferred embodiment of the blade clamping apparatus, the blade clamping assembly is pivotally mounted on support means which is movable toward and away from the printing cylinder and adjustable to a

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predetermined position for a cylinder of a particular circumference. The pivotal motion is imparted to the blade clamping assembly to move the doctor blade clamped therein between operative and retracted positions by an adjustable means, also carried on the movable support means, which acts through a mechanical linkage incorporating means to adjust the effective length thereof. When both the support means and the effective length of the linkage are adjusted to positions specified for the particular circumference of the printing cylinder, the setting of the adjustable means to its usual operative position, irrespective of the particular circumference of the cylinder, will insure that the doctor blade will be brought into the desired engagement and oriented in the desired angular relationship with respect to the particular printing cylinder installed in the press.

Another feature of the blade clamping apparatus of the present invention is that the blade clamping assembly embodies therein means for applying a predetermined force to the edge of the doctor blade opposite the cylinder engaging edge thereof to assist in initially adjusting the doctor blade in the blade clamping assembly relative to the surface of the printing cylinder. This permits the doctor blade to be adjusted within the clamping jaws and relative to the printing cylinder by a novel method which includes the steps of loosely gripping the blade in the blade clamping assembly, moving the blade clamping assembly to a predetermined position with respect to the printing cylinder intermediate the operative and retracted positions of the blade clamping assembly, applying a predetermined force against the edge of the doctor blade opposite the operative edge thereof, thereby pushing the operative edge of the doctor blade into engagement along its entire length with the surface of the printing cylinder, and then, after releasing the force applied against the doctor blade and retracting the blade clamping assembly from the printing cylinder, tightly clamping the doctor blade in the blade clamping assembly. With the blade thus properly locked up, the blade clamping assembly can be moved into its operative position with assurance that the blade will be in proper adjustment with respect to the printing cylinder.

For a complete understanding of the present invention, reference should be made to the detailed description which follows and to the accompanying drawings in which:

FIGS. 1A and 1B, when taken together, present a composite plan view of the doctor blade adjusting and clamping apparatus of the present invention;

FIGS. 2A, 2B and 2C, when taken together, present a composite front elevational view of the blade adjusting and clamping apparatus of the present invention;

FIG. 3 is a view taken along the line 3-3 of FIG. 2C, looking in the direction of the arrows;

FIG. 4 is a view taken along the line 4-4 of FIG. 3, looking in the direction of the arrows;

FIG. 5 is a view taken along the line 5-5 of FIG. 2C, looking in the direction of the arrows;

FIG. 6 is a view taken along the line 6-6 of FIG. 2B, looking in the direction of the arrows;

FIG. 7 is a cross-sectional side elevation of part of the blade clamping apparatus showing the clamping jaws in a retracted, open position;

FIG. 8 is a sectional view taken generally along the line 8—8 of FIG. 2C, looking in the direction of the arrows; and

FIG. 9 is a schematic illustration of the fluid system which facilitates the adjustment of the doctor blade in a desired engagement with the printing cylinder.

Referring to the drawings, and particularly to FIG. 3, the doctor blade adjusting and clamping apparatus of the present invention is shown applied to a rotogravure printing press in which a rotatable printing cylinder 10 is supported by shaft 11 which extends between a pair of side frames 12 of the press. As illustrated in FIG. 8, printing cylinders of different sizes can be mounted in the printing press. In the particular embodiment shown in the drawings, the printing press is adapted to have mounted therein printing cylinders of either 34½" or 39" circumference. As in conventional rotogravure printing presses, an impression roll 13 is supported above the printing cylinder between a pair of movable supports (not shown) which can be adjusted to bring the impression roll into predetermined pressure engagement with the printing cylinder. The printing cylinder and the impression roll in operative position form a printing couple between which a paper web *a* is fed.

The printing cylinder of the printing press rotates partly submerged in an ink fountain 14, and the excess ink is wiped from the etched surface of the printing cylinder by a doctor blade 15 before the surface comes into printing engagement with the paper web *a*. Even before the surface of the printing cylinder encounters the doctor blade 15, some of the excess ink is removed from the printing cylinder by a pre-wipe blade 16. Both the doctor blade 15 and the pre-wipe blade 16 can be adjusted into desired operative position for either size printing cylinder.

As best shown in FIG. 3, curved end splash guard strips 17 are mounted to the inner surfaces of both side frames 12 by mounting fixtures 18 to which the leading ends of the splash guard strips are fixed by wing nuts 19. The trailing end of the splash guard strip engages the front face of a bracket 20 affixed to the side frame. These end splash guard strips 17 are adjusted to different positions for different size printing cylinders.

In order that the ink fountain 14 may be effectively sealed, a sealing strip 21 is provided adjacent the discharge side of the printing couple and is fastened at opposite ends to brackets 22, as best shown in FIG. 3.

Another sealing blade 23 is provided to protect the doctor blade apparatus and other parts of the doctor blade mechanism from contamination by ink. The sealing blade 23 is a resilient strip clamped in position so that the free end thereof is in pressure engagement with the underside of the doctor blade 15.

The doctor blade 15 is mounted in a blade clamping assembly, generally designated 24. The blade clamping assembly and the various adjusting means therefor are carried by a frame 25 which reciprocates laterally between the side walls 12 of the printing press. The reciprocating frame 25 is supported on a stationary frame 26. The stationary frame 26, the reciprocating frame 25 and the manner in which reciprocation is imparted to the frame 25 are conventional and form no part of the present invention. For present purposes it suffices to say that the reciprocating motion is imparted to the frame 25 by a crank-driven rod 27 which is connected to the frame 25 by brackets 28.

The blade clamping assembly 24 and the various adjusting means therefor, as will be more fully described below, are mounted on a plurality of slides 30 guided between ways 31 fixed to the top of the reciprocating frame 25. The slides are individually adjustable in a fore-and-aft direction on the reciprocating frame 25 (that is to say, in a direction perpendicular to the reciprocatory motion imparted to the frame 25), so that the blade clamping assembly 24 and the various adjusting means therefor can be adjusted to different positions depending on

the size of the printing cylinder mounted in the printing press. The adjustment of each of the slides 30 is accomplished by the rotation of a screw 33 threaded into the back edge of each of the slides. The screws 33 are each journaled for rotation in a housing 34 fixed to the reciprocating frame 25, and the head 35 of each screw extends forwardly of the housing 34 and is of polygonal shape to be engaged and rotated by a wrench. To insure that all of the slides 30 will be adjusted to the proper positions for the particular size printing cylinder mounted in the printing press, each of the screws carries a worm gear 36 within the housing 34 which meshes with a pinion 37 mounted on a transversely extending shaft 38. The transversely extending shaft 38 carries pinions 37 which mesh with the worm gears 36 mounted on each of the screws.

To facilitate the adjustment of each of the slides 30, they each have an index mark 39 (see FIGS. 1B and 2B) which in one adjusted position is in alignment with an index mark 40 on the adjacent way 31 to indicate the proper adjustment of the slide for a printing cylinder of 34½" circumference, and in another adjusted position is in alignment with an index mark 41 carried by the same way to indicate the proper adjustment of the slide for a printing cylinder of 39" circumference. For convenience these markings have been shown for only certain of the adjustable slides 30, but it is preferred that they be provided for each of the adjustable slides to facilitate the proper adjustment thereof. Locking clamps 42 are provided to lock each of the adjustable slides in its adjusted position.

The adjustable slides 30 make it possible to adjust the doctor blade 15 to one position for one size cylinder and in another position for a different size cylinder. As will be explained below, provision is also made to adjust the angle of the doctor blade so that the angle of wipe of the blade with the surface of the printing cylinder will remain constant irrespective of the size of the printing cylinder.

The sealing blade 23 is not carried by the reciprocating frame 25, but is held in a clamp 43, best shown in FIGS. 3, 6 and 8, affixed to an upstanding supporting bracket 44 which, in turn, is bolted to the stationary frame 26 of the printing press.

The pre-wipe blade 16 is spring-urged in operative position to permit the pre-wipe blade to yield in the event a break in the web produces a build-up of paper which tends to lift the pre-wipe blade. As best shown in FIGS. 6 and 8, the pre-wipe blade is affixed to a transversely extending support 45 which, in turn, is carried by one end of a bell crank lever 46 pivotally mounted in the upstanding supporting bracket 44. The other arm of the lever 46 is pivotally connected to a threaded rod 47 through a yoke 49 threaded onto the end of the rod. The rod 47 is movable longitudinally in a sleeve 50a which is mounted at the upper end of a bifurcated bracket 51 affixed at its lower end to the stationary frame 26. The bifurcated arms of the bracket 51 are provided with slots 52 which receive laterally projecting pivot shafts 53 of the sleeve 50a. The squared head 54 of the rod 47 projects outside the sleeve and carries a collar 50 which engages the sleeve. A compressed spring 55 is accommodated on the rod between a bearing 56 affixed to the sleeve and a bearing 57 affixed to the collar 48 threaded on the rod 47. If a build-up of paper wraps around the cylinder and tends to lift the pre-wipe blade 16, the spring 55 will be compressed.

The blade clamping assembly 24 includes a frame 60 pivotally mounted to supporting brackets 61 which are carried by the adjustable slides 30. The doctor blade 15 is locked in the blade clamping assembly between a lower jaw 62 and a plurality of pivotal upper clamping jaws 63 arranged side-by-side.

The pivotal frame 60 of the blade clamping assembly 24 can be moved toward and away from the printing

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cylinder by the operation of a rotatable handwheel 64. The handwheel 64 imparts rotation to a transverse shaft 65 mounted for rotation in bearings 66 carried by the outboard adjustable slides 30. The rotation is imparted to the shaft 65 from the handwheel by a gear transmission system accommodated within a housing 67 mounted on the centrally located adjustable slide 30. The shaft 65 is connected to the pivotal frame 60 through linkages which include arms 68 affixed to both ends of the shaft 65, links 69 pivotally connected at their lower ends to the arms 68, a transverse shaft 70 extending between the upper ends of the links 69 and having eccentric ends 70a (see FIG. 5) supported for rotation in the links 69, brackets 71 affixed to the pivotal frame 60 and supporting the intermediate portion of the transverse shaft 70 for rotation about an axis offset from the axis of rotation of the ends 70a of the shaft in the links 69, and a clamping bracket 72 mounted to the pivotal frame 60 intermediate the brackets 71 and incorporating means which will be more fully described below to limit the rotation of the shaft 70 to a half-turn, that is to say, an angle of 180°, and to lock the shaft 70 against rotation within the brackets 71 and 72. To facilitate assembly, the intermediate portion of the shaft 70 is made in several parts connected by couplings 74 (see FIGS. 2A and 2C).

As best shown in FIG. 4, a stationary dial 75 and a movable indicator 76 help the operator to set the doctor blade 15 to a "set" position to facilitate the lock-up of the doctor blade, or in a "wipe" position which is the initial operative position of the doctor blade, or in operative positions which compensate for the wear of the doctor blade. As the operator rotates the handwheel 64 to pivot the blade clamping assembly 24 toward the printing cylinder, the indicator moves in a clockwise direction as viewed in FIG. 4, the motion being imparted to the indicator by a gear reduction system within the housing 67. The handwheel can be locked in any position of adjustment by tightening the clamp 73. A set screw 76a (see FIGURE 4) locks the indicator on its supporting shaft 76b.

As has already been explained, the doctor blade clamping assembly can be translated toward and away from the printing cylinder to adjust it for printing cylinders of either 34½" or 39" circumference. The transverse shaft 70, described above as having eccentric ends, provides an adjustment for angularly orienting the doctor blade clamping assembly to insure that the angle of wipe of the doctor blade will be constant for either size printing cylinder. As shown in FIG. 5, the eccentric ends 70a of the shaft 70 are rotatably mounted in the bearings 77 of the upper ends of the links 69, and the portions 70b of the shaft are rotatably mounted in bearings 78 of the brackets 71 affixed to the pivotal frame 60. Since the axis of rotation of the shaft portion 70b is coaxial with the axis of rotation of the intermediate portion of the shaft 70 and offset in relation to the axis of rotation of the shaft portions 70a, the manual rotation of the shaft 70 through 180° will change the length of the linkage through which the handwheel 64 imparts pivotal motion to blade clamping assembly 24 and at the same time impart an angular adjustment to the blade clamping assembly 24 and the doctor blade 15 clamped therein without any corresponding adjustment of the handwheel 64. One adjusted position of the shaft 70 orients the blade clamping assembly and the doctor blade carried thereby so that in the "wipe" position of the blade clamping assembly the blade will be in the desired angular relation to the surface of a printing cylinder of one circumference, and the other adjusted position orients the blade clamping assembly so that the doctor blade will be in the same angular relation to the surface of a printing cylinder of another circumference.

The adjustment of the shaft 70 can be best accomplished when the doctor blade clamping assembly 24 is in the

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retracted position shown in FIG. 7. When the doctor blade clamping assembly is in the operative position, the center of gravity thereof is offset from the axis of rotation and it is more difficult to turn the shaft 70 by hand. However, when the doctor blade clamping assembly is in the retracted position, the center of gravity of the doctor blade assembly is substantially directly overhead the axis of rotation thereof and the adjustment can be easily made.

The weight of the doctor blade clamping assembly 24 in its operative position is counterbalanced by a plurality of spring elements 80, best shown in FIGS. 3 and 8. The springs 80 carry saddles 81 intermediate the ends thereof having laterally projecting pivot shafts 82, and the pivot shafts are set into slots of upstanding U-shaped brackets 83 mounted on the reciprocating frame 25. The upper hooked ends of the springs are accommodated within a recess in the underside of the pivotal frame 60. The opposite ends of the springs pass through openings 86 (see FIG. 8) of brackets 87 mounted on the reciprocating frame 25. The counterbalancing force exerted by each of the springs 80 on the blade clamping assembly 24 can be regulated within limits by an adjustable screw 88 having a grippable head 89. The screw is threaded in the top of the respective bracket 87, and the lower end of the screw engages the upper surface of the respective spring 80. The screws 88 are adjusted to their maximum raised positions when operating with a 34½" circumference cylinder and to their lowermost positions when operating with a 39" circumference cylinder. The screws each carry a locking disc 89a thereon which when tightened against the top of the bracket 87 will lock the screw in its adjusted position.

The means for limiting the rotation of the shaft 70 to the two positions of adjustment and for locking the shaft in the desired position of adjustment can be best explained with reference to FIGS. 6 and 8. As shown in those figures, the shaft 70 carries a disc 90, half of which is of larger diameter than the other half, forming outwardly extending shoulders 91 and 92 approximately 180° apart. A stationary pin 93 on the bracket 72 serves as a stop. When the shoulder 91 is in engagement with the stop pin 93, as shown in FIG. 8, the linkage for imparting pivotal movement to the blade clamping assembly 24 is conditioned for a printing cylinder of 39" circumference, and when the shaft 70 is rotated to bring the shoulder 92 into engagement with the stop pin the linkage is conditioned for a printing cylinder of 34½" circumference.

The bracket 72 serves as a clamp for locking the shaft 70 in its adjusted position. More specifically, the bracket 72 (see FIG. 6) is in the form of a split collar which can be tightened or loosened by turning a clamping screw 95, and the shaft 70 can be rotated within the collar only when the collar is loosened.

The blade clamping assembly 24 includes means for opening and closing the pivotal clamping jaws 63 in unison. The clamping jaws are freely mounted on a transverse shaft 96. The jaws 63 are opened and closed by the rotation of the head 97 of an adjusting screw 98. The screw 98 is accommodated for rotation in bearings 99 of a sleeve 100 pivotally supported in the upstanding part of a bracket 101 mounted at one end of the pivotal frame 60, as best shown in FIGS. 2C and 3. The adjusting screw 98 has a rider 102 threaded thereon, and the rider is pivotally connected to a bifurcated arm 103 affixed to one end of a transverse shaft 104. The shaft 104 is rotatably mounted in the bracket 101, as shown in FIG. 2C, and also in bearings of a plurality of brackets 105 all mounted to the pivotal frame 60, as shown in FIGS. 2A and 2B. The shaft 104 is connected to all of the pivotal jaws 63 through linkages which include arms 107 affixed at spaced-apart intervals on the shaft 104, links 108 pivotally connected at their lower ends to the arms and supporting a transverse shaft 109 at their

upper ends, and arms 110 connecting the shafts 109 and 96. A plurality of resilient elements 111 are affixed to the arms 110, and the rotation of arms 110 on the shaft 96 imparts pivotal movement to the pivotal jaws 63 through these resilient elements. As the screw 98 is rotated to displace the rider 102 downwardly, as viewed in FIG. 3, the jaws 63 are opened, as shown in FIG. 7, and as the screw 98 is rotated to displace the rider 102 upwardly, the jaws 63 are closed to lock the doctor blade in the blade clamping assembly. The downward displacement of the rider 102 on the screw 98 is limited by the engagement of the stops 112 (see FIG. 7) of the arms 107 with the pivotal frame 60, and the upward displacement of the rider on the screw is limited by the engagement of stops 113, on arms 114 carried by the arms 107, with the pivotal frame.

The rotatable screw 98 carries a pointer 115 (see FIGS. 2C and 3) which when aligned with a line or notch 116 in the upper surface of the upstanding bracket 100 loosely clamps the doctor blade 15 between the jaws 62 and 63. Also, as shown in FIG. 2C, the bracket 101 has a pointer 117 which when aligned with a pointer 118 of the adjacent arm 107 indicates the same loosely clamped positions of the clamping jaws 63.

The pivotal frame 60 of the blade clamping assembly carries a plurality of fluid actuated cylinders 120 which help adjust the doctor blade 15 within the clamping jaws 62 and 63 and relative to the surface of the printing cylinder 10. The cylinders 120 each contain a movable spring-urged piston (not shown) connected to a plunger 121 which is movable into engagement with the edge of the doctor blade opposite the wiping edge. Air or other fluid pressure is supplied to the cylinders 120 through a manifold passage 122 in the transverse shaft 109 and flexible conduits 123 connect the passage 122 with each air cylinder. The manifold passage 122 communicates with the source of the air pressure through a conduit 124 (see FIGS. 1A and 2A) connected to one end of the shaft 109. As shown in FIG. 9, a solenoid actuated valve 125 is interposed in the line 124. The valve 125 is normally spring urged to closed position, but upon energization of the solenoid the valve is moved to open position, thereby actuating all of the air cylinders 120 to push the plungers 121 against the doctor blade.

The blade adjusting method of the present invention can be best understood by a description of the operation of the blade adjusting and clamping apparatus described above. Before the printing cylinder of the desired circumference is installed in the printing press, the splash guards 17 are mounted in their proper positions for the particular cylinder and the proper sealing blade 23 and holder 43 are installed. With the pre-wipe blade 16 in its retracted position, the printing cylinder 10 is installed in the printing press. The pre-wipe blade is then set in proper position with respect to the surface of the printing cylinder by rotating the head 54 of the threaded rod 47 until the pre-wipe blade is within about .010 inch to .015 inch from the surface of the printing cylinder.

The blade clamping assembly can then be bodily translated to the proper position with respect to the printing cylinder by adjusting the slides 30 within their respective guideways 31 to the position at which the index line 39 of the adjustable slide is in alignment with the appropriate index line 40 or 41 on the adjacent guide-way. As described above, each of the slides can be adjusted to the desired position by the rotation of the heads 35 of the rotatable screws 33, and each slide can be locked in its adjusted position by tightening the respective clamp 42. With the pivotal frame 60 of the blade clamping assembly in its retracted position and the clamping bracket 72 loosened, the eccentric shaft 70 is adjusted by manually rotating it to bring the shoulder 91 of the disc 90 into engagement with the stop pin 93 for a 39" circumference cylinder (the position shown in FIG. 8 of the drawings) or by rotating the eccentric shaft in the opposite direction

to bring the shoulder 92 into engagement with the stop pin for a 34½" circumference cylinder (the position shown in FIG. 6). The positions can be determined by appropriate markings on the eccentric shaft. When the eccentric shaft has been adjusted to the desired position, the clamping bracket 72 is tightened by the rotation of the clamping screw 95.

The counterbalancing leaf springs 80 should be adjusted for the particular size printing cylinder installed in the printing press. As explained above, the adjustable screws 88 are locked in their raised positions for a 34½" circumference cylinder and in their lower positions for a 39" circumference cylinder to obtain the proper counterbalancing action from the springs for the adjusted conditions of the pivotal frame 60 for each of the two cylinder sizes.

The doctor blade 15 is inserted in the blade clamping assembly when it is in retracted position with the upper jaws 63 in open relation with respect to the lower jaws 62. The doctor blade is coated with a thin film of grease before it is inserted into the open jaws with the rear edge in engagement with the lower jaw 62. The jaws are then closed by rotating the head 97 of the rotatable screw 98 until the pointer 115 is aligned with the notch 116 (and the pointer 117 of the bracket 101 is aligned with the pointer 118 of the adjacent arm 107), indicating that the doctor blade is gripped loosely between the jaws. The doctor blade assembly is then pivoted toward the printing cylinder by the rotation of the handwheel 64 to the "set" position indicated by the pointer 76 on the dial 75. The operation of the solenoid actuated valve 125 establishes communication between the predetermined air pressure and the air cylinders 120, thereby moving the plungers 121 into engagement with the rear edge of the doctor blade and pushing the doctor blade into engagement with the printing cylinder with a predetermined force. The air pressure can then be released by closing the solenoid actuated valve 125.

The doctor blade clamping assembly is then retracted by the rotation of the handwheel 64, and the doctor blade is locked securely between the clamping jaws by the rotation of the adjusting screw 98 as far as possible. The doctor blade clamping assembly is then ready to be moved by the rotation of the handwheel 64 to the "wipe" position indicated by the pointer 76 on the dial 75. The handwheel should be locked in this position by tightening the clamp 73.

As the doctor blade wears it will be necessary to periodically readjust the blade clamping assembly by releasing clamp 73 and rotating handwheel 64 to a position at which a good wipe is again obtained. As these adjustments are made, the pointer 76 will be displaced in a clockwise direction, as viewed in FIG. 4, indicating the extent of wear of the blade. When through periodic adjustments of the handwheel 64, the pointer is moved across the entire face of the dial, it is advisable that the operator reset the doctor blade or install a new blade by following the procedure described above. The blade which is being used can be reset by retracting the blade clamp to the "set" position on the dial 75 and opening the jaw 63 until the pointer 117 aligns with 118, indicating that the doctor blade is gripped loosely between the jaws. Air pressure is then applied to move the doctor blade into contact with the printing cylinder before tightly clamping the jaws.

The invention has been shown and described in a single preferred form and by way of example only, and obviously many variations and modifications are possible within the spirit of the invention. The invention, therefore, is not to be limited to any specific form or embodiment, except insofar as such limitations are expressly set forth in the claims.

I claim:

1. A blade clamping apparatus for use with cylinders of different circumference comprising a frame carrying clamping means for a blade which in operative position acts in cooperation with the surface of the cylinder, support means for the frame adjustable to bodily translate the frame toward and away from the cylinder so that the frame can be adjusted to desired position for a particular size cylinder, means carried by the support means for pivotally mounting the frame on the support means so that the frame can be pivotally moved between retracted and operative positions, means angularly orienting the frame to compensate for a cylinder of different size so that in the proper adjusted position of the support means with the frame pivoted into operative position with respect to the cylinder, a blade clamped in the clamping means will be in the desired angular relationship with the surface of the particular size cylinder, and a spring pivotally mounted intermediate its ends independently of said support means and of said pivotal frame, one end of the spring engaging and counterbalancing the pivotal frame and the other end resisting pivotal movement of the spring.

2. A blade clamping apparatus as set forth in claim 1 including means for varying the counterbalancing action of the spring.

3. A blade clamping apparatus as set forth in claim 2 in which said means for varying the counterbalancing action of the spring includes an adjustable screw which resists the pivotal movement of the spring at different positions of adjustment.

4. A blade clamping apparatus for use with cylinders of different circumference comprising a frame carrying blade clamping means, a rotatable shaft having one portion eccentric to another portion, means carried by the frame for rotatably mounting one portion of the shaft to the frame, and means for rotatably supporting the other portion of the shaft, the partial rotation of the shaft in the last-mentioned supporting means pivotally adjusting the frame relative to the supporting means so that a blade clamped in said clamping means can be adjusted to the desired angular position with respect to the particular size cylinder.

5. A blade clamping apparatus as set forth in claim 4 in which the ends of the shaft are rotatable on a common axis in said last-mentioned supporting means and the intermediate portion of the shaft is rotatable on an axis offset from the axis of rotation of the ends, said intermediate portion being rotatable in the means carried by the frame.

6. A blade clamping apparatus as set forth in claim 4 including means for clamping the shaft against rotation relative to the frame.

7. A blade clamping apparatus as set forth in claim 4 in which the means carried by the frame for rotatably mounting the shaft to the frame includes a clamp which can be tightened to lock the shaft against rotation relative to the frame.

8. A blade clamping apparatus as set forth in claim 4 including stop means to limit the rotation of the shaft.

9. A blade clamping apparatus as set forth in claim 4 in which said stop means includes a disc mounted on the shaft and having one portion of larger diameter than another portion to define two outwardly extending shoulders, and a fixed stop supported by the frame engageable with one shoulder in one adjusted position of the shaft and with the other shoulder in the other adjusted position of the shaft.

10. A blade clamping apparatus for use with cylinders of different circumference comprising a pivotal frame carrying blade clamping means, actuating means for imparting pivotal motion to said frame, a mechanical linkage connecting the actuating means and the pivotal frame and imparting pivotal motion to the frame, a rotatable adjusting shaft, said shaft having one portion eccentric to

another portion, means rotatably mounting one position of said shaft to said frame, and means rotatably mounting another portion of said shaft to an element of said linkage, whereby the actuating means can be operated to move the frame from a retracted to an operative position with respect to the cylinder and the rotatable adjusting shaft can be rotated to insure that the blade will be adjusted at the proper angle to the particular size cylinder.

11. A blade clamping apparatus as set forth in claim 10 including means for locking the rotatable adjusting shaft against rotation relative to the frame.

12. A blade clamping apparatus as set forth in claim 10 including stop means for limiting the rotatable adjustment of said shaft from one position to another.

13. A blade clamping apparatus for use with cylinders of different circumference comprising a frame carrying clamping means for a blade which in operative position acts in cooperation with the surface of the cylinder, the clamping means including at least one movable clamping jaw, support means for the frame adjustable to bodily translate the frame toward and away from the cylinder so that the frame can be adjusted to desired position for a particular size cylinder, means carried by the support means for pivotally mounting the frame on the support means so that the frame can be pivotally moved between retracted and operative positions, means angularly orienting the frame to compensate for a cylinder of different size so that in the proper adjusted position of the support means with the frame pivoted into operative position with respect to the cylinder, a blade clamped in the clamping means will be in the desired angular relationship with the surface of the particular size cylinder, actuating means for opening and closing the clamping means, linkage means carried by the frame connecting the actuating means and the movable clamping jaw, and resilient means for imparting motion through the linkage means to the movable clamping jaw to open and close the clamping means.

14. A method of adjusting a blade relative to a cylinder with which it cooperates comprising the steps of loosely clamping the blade between clamping jaws, moving the clamping jaws into a predetermined position relative to the cylinder, applying a predetermined force by a plurality of fluid pressure actuated elements against the edge of the blade opposite the edge which normally engages the cylinder, fluid under pressure being supplied simultaneously to all of said fluid pressure actuated elements, thereby moving the edge of the blade into engagement with the cylinder along its entire length and adjusting the position of the blade with respect to the surface of the cylinder and the clamping jaws, cutting off the fluid pressure to said fluid pressure actuated elements, locking the blade tightly between the clamping jaws, and retracting the clamping jaws away from the cylinder.

15. A blade clamping apparatus for use with cylinders of different circumference comprising a frame carrying clamping means for a blade which in operative position acts in cooperation with the surface of the cylinder, support means for the frame adjustable to bodily translate the frame toward and away from the cylinder so that the frame can be adjusted to desired position for a particular size cylinder, means carried by the support means for pivotally mounting the frame on the support means so that the frame can be pivotally moved between retracted and operative positions, means angularly orienting the frame to compensate for a cylinder of different size so that in the proper adjusted position of the support means with the frame pivoted into operative position with respect to the cylinder a blade clamped in the clamping means will be in the desired angular relationship with the surface of the particular size cylinder, and force-applying means carried by the pivotal frame for exerting a predetermined force on the edge opposite the cylinder engaging edge of a blade clamped loosely between the

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clamping jaws to move the cylinder engaging edge of the blade into engagement with the cylinder and thereby orient the blade relative to the surface of the cylinder and the clamping jaws, said force-applying means including a plurality of cylinders containing fluid actuated plungers and fluid passage means applying fluid under pressure to all of said cylinders.

16. A blade clamping apparatus as set forth in claim 15 including common actuating means for establishing communication between the source of the fluid under pressure and all of said cylinders.

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