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(54) Apparatus and method for the automatic discharge and restart of a cross-winding machine.

(57) The apparatus comprises a spindle (V) on which the bobbin (RC) is formed, and which is axially shiftable from a retracted discharge position to an expanded working position, so as to cooperate with a fixed extractor (E) whereby when the spindle carrying the formed bobbin is retracted, the bobbin abuts against the extractor and is discharged. The spindle is provided on its free end with a frontally toothed portion (D). The spindle can be moved from a bobbin forming station (K) to a tie-in and discharge station (K') , while the yarn (F) is maintained under tension. On the side surface of the formed bobbin at the tie-in and discharge station, at one end of the bobbin, there is positioned a needle (50) having a hook (150). A winding rotation is imparted to said bobbin and to said needle so that the body of the needle will be enfolded by a suitable number of turns (FX) of yarn. The yarn is then displaced to form one turn (FX') engaging the hook of the needle, which is then stopped together with the bobbin. The needle is retracted so that it will cause the tail end of the yarn to be bent into a U-shape and to be passed beneath the turns. Means (54) are provided for cutting the yarn and for retaining the leading end of said yarn. At this point, the bobbin is discharged by retracting the spindle and subsequently the spindle is moved again to the bobbin forming station where it is extended to its working position so that its tooted end will engage the leading end of the yarn retained by the cutting and retaining means and a new cycle of the winding machine can be resumed upon re-starting the rotary motion of the spindle.

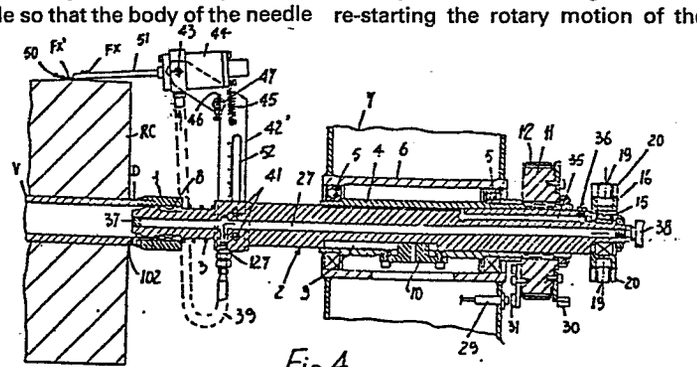

Fig.4

EP 0 200 121 A2

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"Apparatus and method for the automatic discharge and restart of a cross-winding machine"

Conventional cross-winding machines, as shown diagrammatically and in plan view in Figure 1 of the accompanying drawings, comprise a spindle V for the formation of a bobbin RC thereon, arranged horizontally and mounted cantilevered on the end portion of a powered spindle shaft M which, in turn, is supported on the end portion of an arm B which is pivotable about a stationary axis A which is parallel to said spindle. A cylinder-and-piston unit (not shown) can swing the arm B so as to move and maintain the spindle shaft M either to the station K where a bobbin is formed, or to the station K' (suitably spaced from the station K) where said bobbin is tied-in, is severed from the yarn coming from the winding machine, and, finally, is discharged. When the spindle shaft M is at the station K, said spindle V substantially engages with, and is parallel to, a roller T which is comprised in the traversing device which reciprocatingly moves the yarn over the spindle to effect the so-called traversing or helical cross-wound formation that characterizes usually the winding of a bobbin. P indicates the guiding, adjusting and feeding pulleys for

the yarn F coming from the cops S which are mounted on a suitable supporting, indexing and automatic feeding structure Q. The spindle V is provided, at the free end thereof, with teeth D parallel to its axis, to quickly engage with the leading end of the yarn F and disengage therefrom when desired.

In the known cross-winding machines, when the bobbin RC has been formed and the spindle shaft has been stopped, said arm B is moved from the station K to the station K' where an operator, by means of a suitable hook-shaped tool ties-in the tail end of the yarn forming said bobbin. Thereafter, the operator severs the length of yarn between the bobbin and the winding machine and effects the discharging or doffing operation comprising the sliding movement of a collar E over the spindle V by the action of a cylinder-and-piston unit. The tied-in bobbin is thus removed from the spindle V and falls onto collecting means to be brought away, and thereafter said collar E moves back to its rest position. The arm B carries the spindle shaft M back to the station K and, then, the operator engages the leading end of the yarn with the toothed end of the spindle V and finally he activates said spindle shaft M and the cross-winding machine to form a new bobbin.

The object of this invention is the complete automation of the step of tying-in the bobbin, the step od discharging and severing the bobbin from the yarn coming from the winding machine, and of the step of engaging the new leading end of the yarn with the toothed end of the

spindle V.

To achieve this object, some changes have been made to the cross-winding machine described above, and an apparatus has been devised to be associated with said cross-winding machine to operate automatically on the yarn and the bobbin when the latter is transferred from the station K to the station K'.

The characteristics of these changes and improvements will be apparent from the following description of a preferred embodoment of the invention, shown merely as a non-limiting example in the Figures of the accompanying four sheets of drawings, wherein:

Figure 1 is a diagrammatically top plan view of an improved cross-winding machine according to the invention;

Figure 2 is a diagrammatic side elevational view of the main components of the apparatus;

Figure 3 is a front elevational and partly sectional view of the apparatus, some components being omitted;

Figure 4 shows further constructional details of the apparatus, on the section line IV-IV of Fig. 3 and as seen in an intermediate working step;

Figure 5 shows further constructional details of the apparatus, as seen from one side in the direction of the arrow J in Fig. 3;

Figure 6 is a top plan view of the operative portion of the apparatus, at the beginning of a cycle;

Figure 7 shows some constructional details of the operative portion of Figure 6, as seen from the section VII-VII;

Figure 8 shows further constructional details of the operative portion of Figures 4 and 6, as seen from the section line VIII-VIII;

Figures 9 and 10 are front elevational and partly sectional views of the operative portion of the apparatus during two steps of the working cycle thereof;

Figure 11 is an elevational view of the apparatus as seen from the inner side, showing with particular evidence the control means for the length of yarn running between the cross-winding machine and the bobbin, when the latter is moved to the tying-in and discharging station;

Figure 12 is a front elevational and partly sectional view of the device guiding the length of yarn between the cross-winding machine and the bobbin when the latter is moved to the tying-in and discharging station;

Figures 13 and 14 are front elevational and top plan views, respectively, of the device for frictionally retaining and intermediately cutting the length of yarn running between the cross-winding machine and the bobbin, when the latter is moved to the tying-in and discharging station;

Figure 15 is a diagrammatic perspective view of a bobbin when tied-in by the apparatus of the invention.

In order to achieve the objects of the invention, a cross-winding machine has been modified as follows:

- the end toothing or castellation D of the winding spindle V is so constructed as to co-operate as a front clutch with a complementary portion to be described below;
- the assembly comprising the shaft M and spindle V is so constructed as to be movable axially with a stroke which is at least as long as said spindle V, while the extrator E keeps still. As explained hereinafter, the axial mobility of the assembly MV is used both to discharge the tied-in bobbin, and to effect the automatic anchoring of the new leading end of the yarn from the winding machine to the toothed end D of the spindle V.

With reference to Figures 1, 2, 3, 4 and 5, it is to be noted that when the spindle shaft M is moved to the station K', the toothed end D of the spindle V will be axially in line with and close to a complementary portion of an end-to-end clutch, formed on a bushing 1 which is

mounted on the end portion of a horizontal shaft 2, said end portion 102 being tapered and protruding from said bushing 1.. Said bushing 1 is mounted on the shaft 2 so as to be axially movable thereon to a sufficient extent, while being keyed thereto by means of keys 8 to prevent relative rotation. A spring 3 urges said bushing 1 to the end position of its stroke as seen in the Figures 3 and 4. The shaft 2 is partly mounted, so as to be axially slidable, within a bushing 4 which, in turn, is rotatably mounted by means of ball-bearings 5 within a body 6 which is fixed at the top of a supporting stand 7. The portion of the shaft 2 that is to be enclosed by the bushing 4 is provided with a longitudinal spline 9 engaged with a key 10 which is fixed to said bushing 4. The rear end of said bushing has keyed thereto a toothed pulley 11 which is connected, through a toothed pulley and belt system 12-13, to a motor-reducer unit 14 having an internal brake and secured to the base of said stand 7. The shaft 2 protrudes from the rear end of said bushing 4 and it mounts, with the intermediary of a bearing 15, a disc 16 provided with opposite flats 17 at right angles to said shaft 2 and slidably mounting therein sliding blocks 18 having pivoted thereto at 19 the ends of a fork-like member 20 which is fulcrumed at 21, normally to said shaft 2, to a support member 22 secured to said stand 7. The lower end of the fork-like member 20 is pivoted at 23 to the piston rod of a fluid-operated cylinder-and-piston unit 24 the body of which is pivoted at 25 to said stand 7. The numerals 26-26' indicate two sensors fixed to the support member 22 and detecting the inactive and active positions, respectively, of the fork-like member 20. The numerals 28

and 29 indicate two further proximity switches which are mounted: the former on the support member 22 and the latter on the stand 7 and which co-operate with respective members 30-31 which are fixed to the periphery of the pulley 11, so as to detect when the shaft 2 is in its active operative position as from Figures 3-4 and to detect two pre-established positions in the round angle of said pulley 11, and to detect as well the rotations imparted to said pulley and elements associated with the shaft 2. It is to be noted in Figure 3 that the stand 7 is mounted with its baseplate 107 on an additional baseplate 32, with the interposition of guiding and sliding means 33 parallel to the shaft 2 and provided with a control screw system 34 by means of which the stand 7 and associated elements may be moved to adjust the latter to the position of the toothed end D of the winding spindle V which is interchangeably mounted on the spindle shaft M, in order to form bobbins of different lengths.

In Figure 4, the numeral 35 indicates a circuit which is fed through a lubricating nipple 36, by means of which the sliding surfaces of the elements 2 and 4 may be lubricated. The numeral 27 indicates an axial conduit in the shaft 2, which is plugged at the front end as shown at 37 and is connected at the rear end with a rotation joint 38 by means of which said conduit 27 can communicate with a source of pressurized fluid or can communicate with a discharge means. The conduit 27 comprises a branch 127 having connected thereto a flexible hose 39 for a purpose to be explained hereinafter. At the branch 127, the shaft 2

is formed with a pair of flats 40 which are parallel to each other and at right angles to the longitudinal axis of said shaft; secured to said flats by a pair of bolts 41 (see also Figure 7) are two parallel identical plates 42-42' having substantially the shape of a square and having pivoted at an end thereof, on a shaft 43 normal to said shaft 2 and suitably spaced therefrom, the body of a fluid-operated cylinder-and-piston unit 44 of the single-acting type, which is connected to the feeding hose 39 mentioned above. With reference also to Figure 6, it will be noted that the body of the unit 44 is urged by a spring 45 which is anchored to the plates 42-42', so as to engage normally against an adjusting screw 46 mounted on a lug 47 secured to said plates. When the apparatus is at rest, the axis of the unit 44 is substantially parallel to the longitudinal axis of the shaft 2 or is slightly diverging as shown in Figure 6. In the detail of Figure 8, it will be seen that the piston 144 of the unit 44 is urged to its rest position by a spring 48 arranged in a rear chamber of said unit, said chamber being freely communicating with the atmosphere. The front chamber 244 of the unit 44 communicates with the hose 39. Secured to the piston 144 and axially in line therewith is a needle 50 having a sufficiently rounded beard or hook 150 so shaped as to hook the yarn coming from the cross-winding machine. The needle 50 is axially slidably mounted in a sleeve 51 which is secured to the body of said unit 44 and is of such a length whereby when said unit is at rest, the hook of the needle 50 protrudes to an appropriate extent from the end 151 of said sleeve. The end 151 of said sleeve is shaped substantially as the mouthpiece

of a flute and is so directed whereby when the unit 44 is activated for retraction, as shown in Figure 9, said hook 150 of the needle 50 will contact the foremost edge of the end 151 of said sleeve 51 so as to form therewith a closed slit wherein the yarn F will be slidably anchored.

The assembly 50-51 described above is suitably projecting away from the shaft 2, as seen in Figure 6.

The plates 42-42', at the portions designed for connection with the shaft 2, are formed with longitudinal slots 52 (see Figures 4-7) whereby the distance of the assembly 50-51 from the axis of the shaft 2 may be adjusted, so that said distance may be suitably larger than the radius of the bobbin just formed on the spindle V.

When the apparatus is at rest, the assembly 50-51 is in the position shown in Figure 2, is arranged on the side of the shaft 2 that is facing toward the station K, and lies on an imaginary horizontal plane containing the axis of the shaft 2. This positioning is controlled by the group of sensors 31-29 (or 28-30).

It will be noted in Figure 1, 2 and 11 that a plate 53 carrying two devices 54 and 55 in cantilever fashion is secured on a side of the stand 7 so as to be adjusted to conform with the different diameters of the bobbins. The device 54 comprises pressure-clamping means and cutting means facing, respectively, toward the station K and the station K', while the device 55 comprises a fork-shaped yarn

guiding means best shown in Figure 12, which is mounted on a slide 56 which is slidably mounted within a stationary guide 57 parallel to the spindle shaft M, said slide being connected to a fluid-operated cylinder-and-piston unit 58 which may be controlled to move the yarn guiding device 55 from the position shown with solid lines to the position shown with dash lines, and vice versa. The movement of the slide 56 is detected by suitable sensors 49-49'. The devices 54 and 55 are arranged so that when a bobbin is transferred from the station K to the station K', the yarn connecting the bobbin to the cross-winding machine will suitably get inserted into said devices.

The apparatus described above operates as follows. Upon completion of the bobbin RC, the spindle shaft M is stopped together with the traversing device T, so that the last turns of yarn which have been wound on the bobbin are adjacent the right-hand end of said bobbin (looking at Figure 4). The yarn F is suitably tensioned by means of an appropriate control of the assembly of pulleys P, whereafter the arm B is oscillated to transfer the spindle and bobbin from the forming station K to the tying-in and discharging station K'. The tensioned yarn connecting the bobbin to the device T of the cross-winding machine, as stated above, will move automatically to the necessary co-operating position with the devices 54 and 55. The cylinder 24 (Figure 3) is now activated automatically and moves the shaft 2 toward the spindle V to introduce first the centering tapered end 102 thereof into said spindle and then to effect the end-to-end coupling between the toothed bushing 1 and the front teeth

D formed on said spindle, as shown in Figure 4. The next step is the activation of the motor-reducer unit 14 to rotate the assembly M-V and bobbin RC as well as the shaft 2 with its equipment 50-51 at an appropriate speed, in clockwise direction, looking at Figure 2. The yarn guiding device 55 is in the position shown in Figure 12 with solid lines, whereby - due to the rotation of the bobbin - an apprpriate number of turns FX are formed in the region of the bobbin onto which sleeve 51 has been superimposed, and said turns force the assembly 50-51 to contact said bobbin, against the action of the spring 45, as shown in Figure 4. On completion of the turns FX as specified above, the yarn guiding device 55 is moved automatically to the position shown with broken lines in Figure 12, so that one turn or a portion of one turn FX' of said yarn F may reach the loop of the hook 150 of said needle 50, whereafter the unit 14 is automatically stopped and braked so as to stop the assembly 50-51 in a pre-established position, for example above the bobbin. The step of Figure 9 is now effected automatically. The cylinder 44 is activated to retract the needle 50 so that the hook 150 thereof will be moved to a co-operative position with the foremost edge of the end portion 151 of the sleeve 51, whereby the assembly 50-51 will clamp the yarn F though the latter may slide. In the next step the cylinder 24 is activated (Figure 3) to bring the apparatus again to a rest position and to retract the assembly 50-51 which, thus, effects the step of Figure 10. The tail end of the yarn forming the bobbin is pulled with a U-shaped configuration FX' beneath the last turns FX, which hold ir firmly by virtue of the appropriate tensioning

imparted to said last turns. Before the shaft 2 reaches the end of its return stroke, a suitable control discontinues the feeding of the cylinder 44 which will move the needle 50 outwards to protrude again completely from the sleeve 51 whereby, due also to an appropriate rounding off of the hook 150, said needle will release the now tied-in tail end FX' and the assembly 50-51 will return to its rest position as shown in Figure 6 due to the action of the return spring 45.

At this stage of the cycle, the device 54 is activated automatically to cut the yarn F from the winding machine and to frictionally retain the new leading end. The bobbin RC, tied-in at the station K', is thus separated from the winding machine and may be discharged. The spindle V is retracted into the body of the spindle shaft M and the bobbin RC, retained by the stationary collar E, will fall onto suitable collecting means (not shown) to be carried away. With the spindle V still in the retracted position, the arm B is raised to bring the assembly M-V back to the station K, close to the device T where, as shown in Figure 2, the axis of the spindle V lies substantially on the same imaginary plane containing the length of yarn F which is tensioned between the elements T and 54. When the spindle V is moved axially again to its operative position, its toothed end D necessarily engages said length of tensioned yarn F. The subsequent activation of the spindle shaft M pulls the leading end of the yarn F away from the device 54 and said yarn will be automatically held firmly by the spindle V for the formation of a new bobbin. After this last

step of the cycle, the devices 54 and 55 will be returned to their rest position.

With reference to Figures 13 and 14, it will be noted that the device 54 comprises a slider 59 formed with an upper recess 60 having an inclinated side 160, said slider being disposed parallel to the spindle shaft M and being connected for movement to the rod of a fluid-operated cylinder-and-piston unit 61. The free end of the slider 59 is enclosed in a guide bore 62 formed in a stationary body 63 having affixed to its opposite sides one blade 64 and leaf springs 65, respectively. The yarn F from the winding machine engages the recess 60. When the slider 59 is moved leftwards (looking at Figures 13 and 14) as shown with dash lines, said slider co-operates first with the side springs 65 which frictionally hold the yarn F, and then it co-operates, at the other side facing the station K', with the blade 64 which severs said yarn F. The device 54 remains in its active position until the spindle shaft M has moved back to the station K and is activated to engage automatically the new leading end of the yarn F to be pulled away from the elements 59-65, whereafter said slider moves back to its rest position. Two proximity switches 67 and 67' detect the different positions of the slider 59.

CLAIMS

1) Apparatus for the automatic tying-in of the yarn (F) and discharge of a completed bobbin (RC), and for the resumption of the operative cycle of a cross-winding machine, characterized by the fact of comprising:

a) a spindle (V) on which the bobbin (RC) is formed, said spindle (V) being driven by a spindle shaft (M) and being axially shiftable from a retracted discharge position to an expanded working position, said spindle (V) cooperating with a fixed extractor (E) whereby when the said spindle (V) carrying the formed bobbin (RC) is retracted, the bobbin (RC) abuts against the extractor (E) and is discharged from the spindle (V), said spindle (V) being provided, on its free end, with a frontally toothed portion (D);

b) means (B) for displacing the spindle (V) from a bobbin forming station (K) to a tie-in and discharge station (K'), while the yarn (F) is maintained under tension;

c) means (2) for positioning on the side surface of the formed bobbin (RC) at the said tie-in and discharge station (K') at one end of the said bobbin (RC) and substantially parallel to the winding axis of the bobbin, a needle (50) having a hook (150) facing the other end of the bobbin;

d) means (11-14) for imparting a winding rotation to said bobbin (RC) and a concurrent and synchronous rotation to said needle (50) so that the body of said needle will be enfolded by a suitable number of suitably tensioned turns (FX) of yarn (F);

e) yarn guiding means (55) to displace the yarn coming from the winding machine so that said yarn (F) may form one turn or a portion of turn (FX') engaging the loop of the

hook (150) of said needle (50), said needle (50) and bobbin (RC) being thereafter stopped;

f) the said needle positioning means (2) serving also for retracting the needle (50) from said bobbin (RC) so that the moving needle will cause the tail end (FX') of the yarn to be bent into a U-shape and to be passed beneath the turns (FX) which enfolded previously the body of said needle, whereafter the needle will be released and moved away from said tail end;

g) cutting and retaining means (54) for cutting the yarn from the winding machine and for retaining the new leading end of said yarn;

whereby the said bobbin (RC) which has been tied-in will be discharged by retracting the said spindle (V) and subsequently the said spindle (V) is moved again by said spindle displacing means (B) to the bobbin forming station (K) where the spindle (V) will be extended back to its working position so that its tooted end (D) will engage the leading end of the yarn retained by the said cutting and retaining means (54) and a new operative cycle of the winding machine can be resumed upon re-starting the rotary motion of the said spindle (V).

2) An apparatus according to claim 1, characterized by the fact that the toothed end portion (D) of the spindle (V) cooperates as a front clutch with a complementarily shaped bushing (1) which is axially slidably keyed on one end (102) of a shaft (2) of an auxiliary spindle arranged at the tie-in and discharge station (K'), parallel to the spindle of the winding machine, said

auxiliary spindle being connected to means (20-24) for axially displacing same, said auxiliary spindle carrying a laterally projecting arm structure (42,42') on which there is swingably mounted an assembly carrying the said needle (50), whereby when the bobbin is moved to the tie-in and discharge station (K'), the spindle (V) carrying the bobbin will be rotated, through the said clutch, by the said auxiliary spindle which simultaneously positions the said needle (50) over the bobbin (RC).

3) An apparatus according to claim 2, characterized by the fact that the body of the needle (50) is slidably mounted in a sleeve (51) the end of which facing the hook of the needle is shaped like a flute mouthpiece, and the opposite end of which is secured to the body of a cylinder and piston unit (44) the piston rod of which is secured to said needle, in such a manner that when the needle is partially retracted inside the said sleeve the hook of the needle will be closed around the tail of the yarn, though consenting the sliding of the yarn, and the needle may be unthreaded from the turns of yarn (FX) which enfolded the body thereof.

4) An apparatus according to claim 3, characterized by the fact that the hook (150) of said needle has a suitably bevelled shape, apt to release the tail of the yarn upon suitable control.

5) An apparatus according to claim 4, characterized by the fact that said cylinder and piston unit

(44) for said needle is actuated through an axial duct (27) formed in the said shaft (2) of said auxiliary spindle.

6) An apparatus according to claim 2, characterized by the fact that the said laterally projecting arm structure (42,42') carrying the needle assembly can be adjusted in length so as to be adapted to different diameters of the bobbins (RC) to be tied-in.

7) An apparatus according to claim 2, characterized by the fact that the yarn guiding means (55) comprise a fork-shaped yarn guide mounted on a slide (56) which is parallel to the said auxiliary spindle and is connected to a double acting piston and cylinder unit (58).

8) An apparatus according to claim 1, characterized by the fact that the cutting and retaining means (54) comprise a slider (59) connected to a cylinder and piston unit (61), said slider being movable parallelly to the axis of the bobbin and being provided with a recess (60) adapted to be engaged by the yarn (F), said slider (59) being mounted on a guide (63) which is provided at one end with a cutting blade (64) cooperating with a side of the slider facing the tie-in and discharge station (K'), said guide (63) being provided on the other side with spring clamping means (65) for clamping the said yarn (F) before the slider reaches its yarn-cutting position.

9) A method for the automatic tying-in of the yarn and discharge of a completed bobbin, and for the resumption

of the operative cycle of a cross-winding machine, characterized by the fact of comprising the following steps:

a) displacing the completed bobbin (RC), wound on a suitable spindle (V), from a forming station (K) to a tie-in and discharge station (K') while the yarn is maintained under tension;

b) positioning on the side surface of the formed bobbin (RC) a needle (50);

c) imparting a winding rotation to said bobbin (RC) and a concurrent and synchronous rotation the the said needle (50) so as to enfold the body of said needle with a suitable number of tensioned turns (FX) of the yarn (F);

d) displacing the yarn (F) coming from the winding machine so as to form one turn or a portion of one turn (FX') engaging the loop of the hook of the needle (50);

e) stopping the rotation of the bobbin and of the needle and retracting the needle from the bobbin so that the moving needle will cause the tail end of the yarn to be bent into a U-shape and to be passed beneath the turns (FX) which enfolded previously the body of the needle, whereafter the needle will be released and moved away from the said tail end of the yarn;

f) cutting the yarn coming from the winding machine and retaining the new leading end of the yarn;

h) discharging the tied-in bobbin and moving the spindle (V) to the bobbin forming station (K) where it will engage the leading end of the yarn being retained, whereby a new operative cycle of the winding machine can be resumed upon re-starting the rotary motion of said spindle (V).

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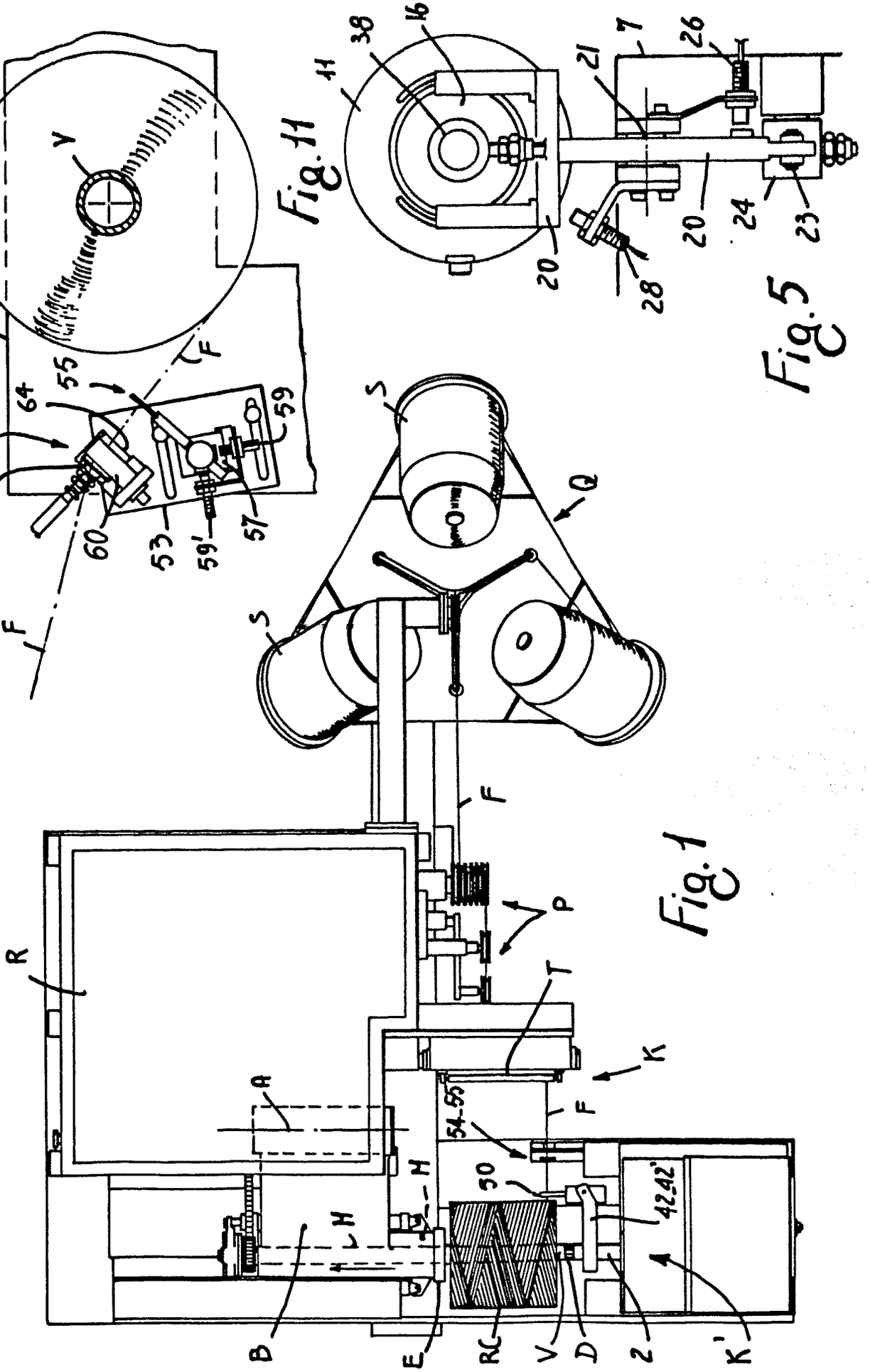

Fig. 1

Fig. 5

Fig. 11

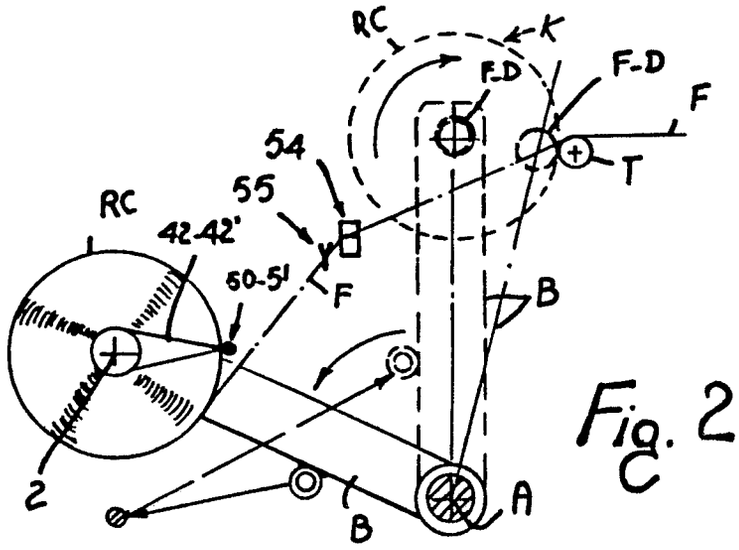

Fig. 2

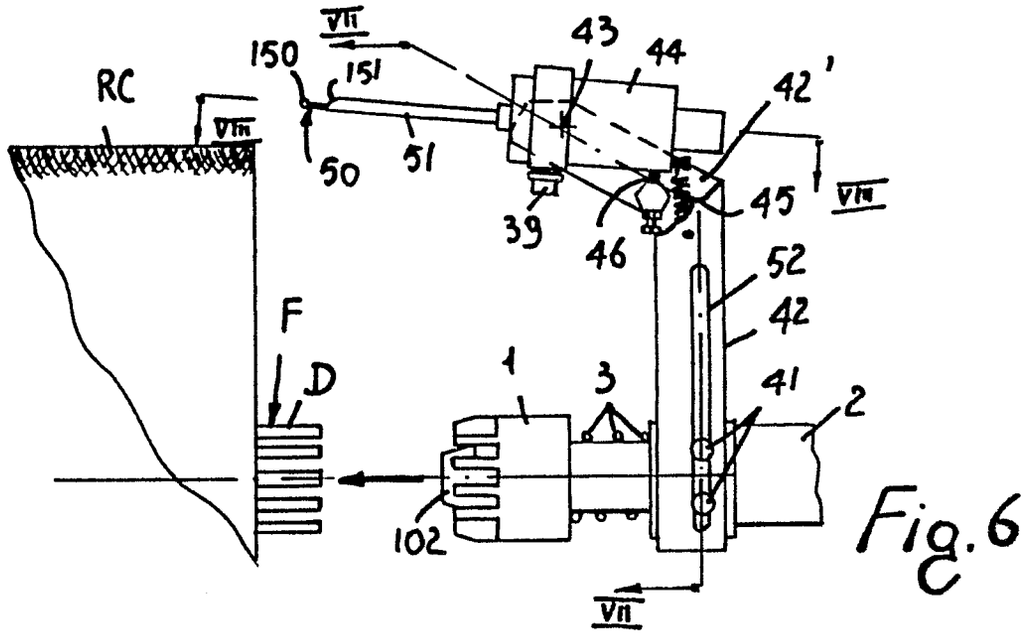

Fig. 6

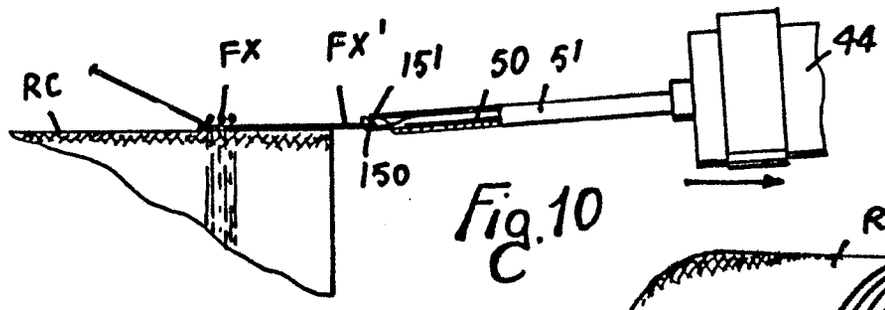

Fig. 10

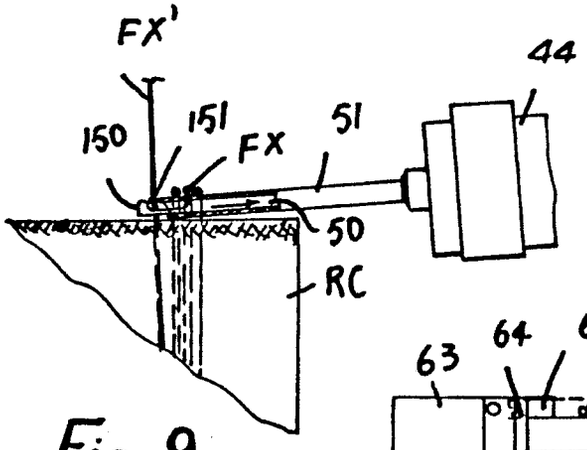

Fig. 9

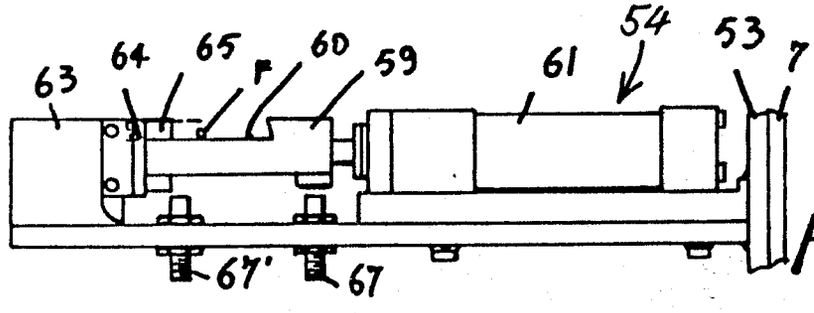

Fig. 13

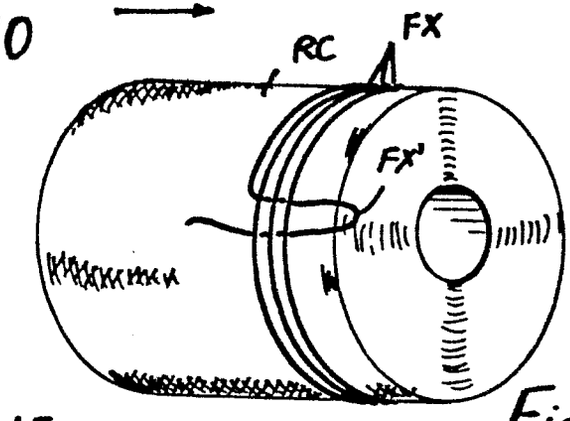

Fig. 15

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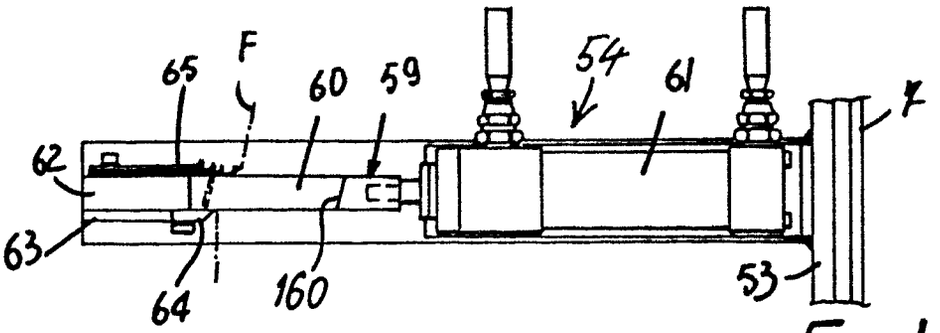

Fig. 14 C

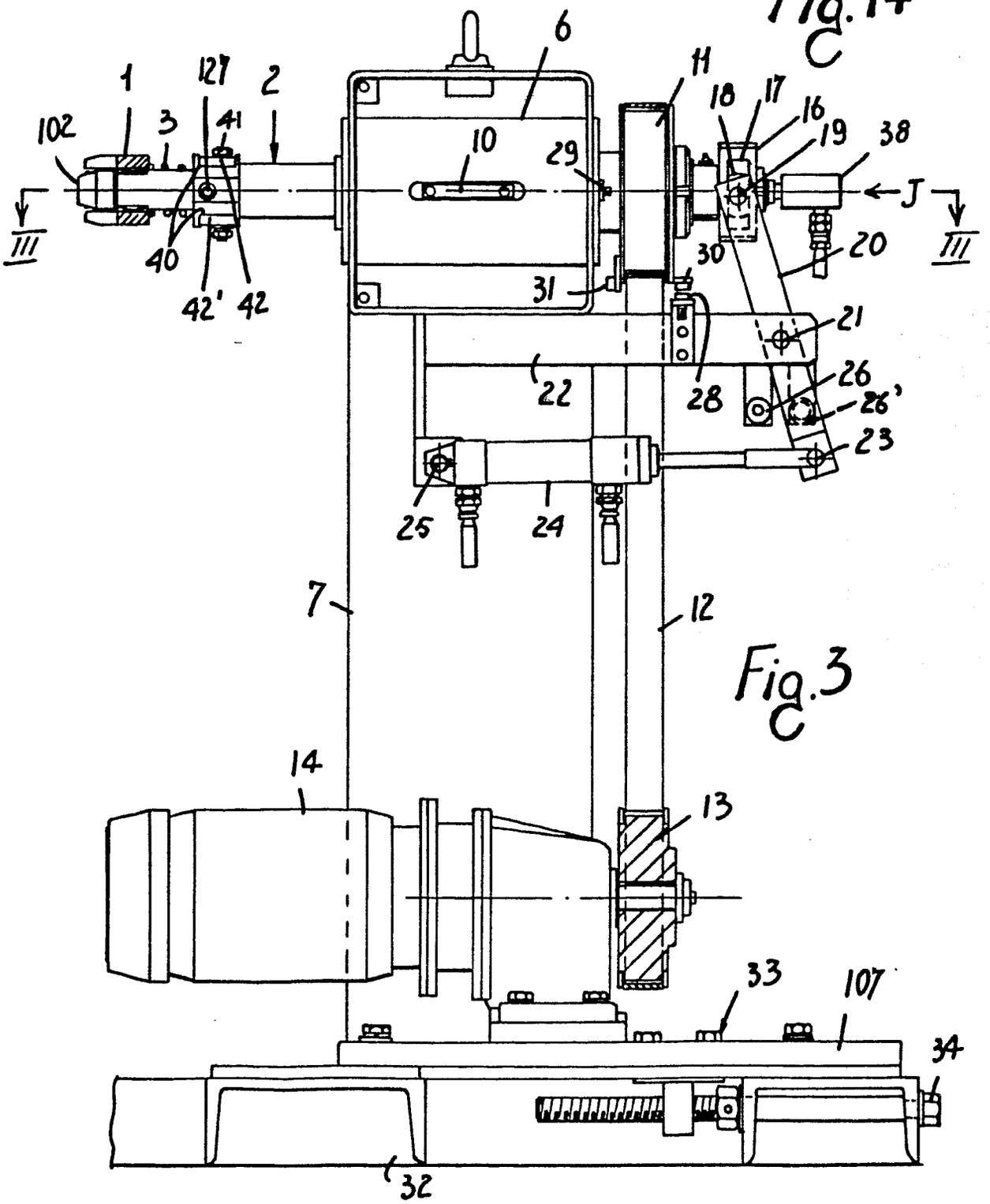

Fig. 3 C

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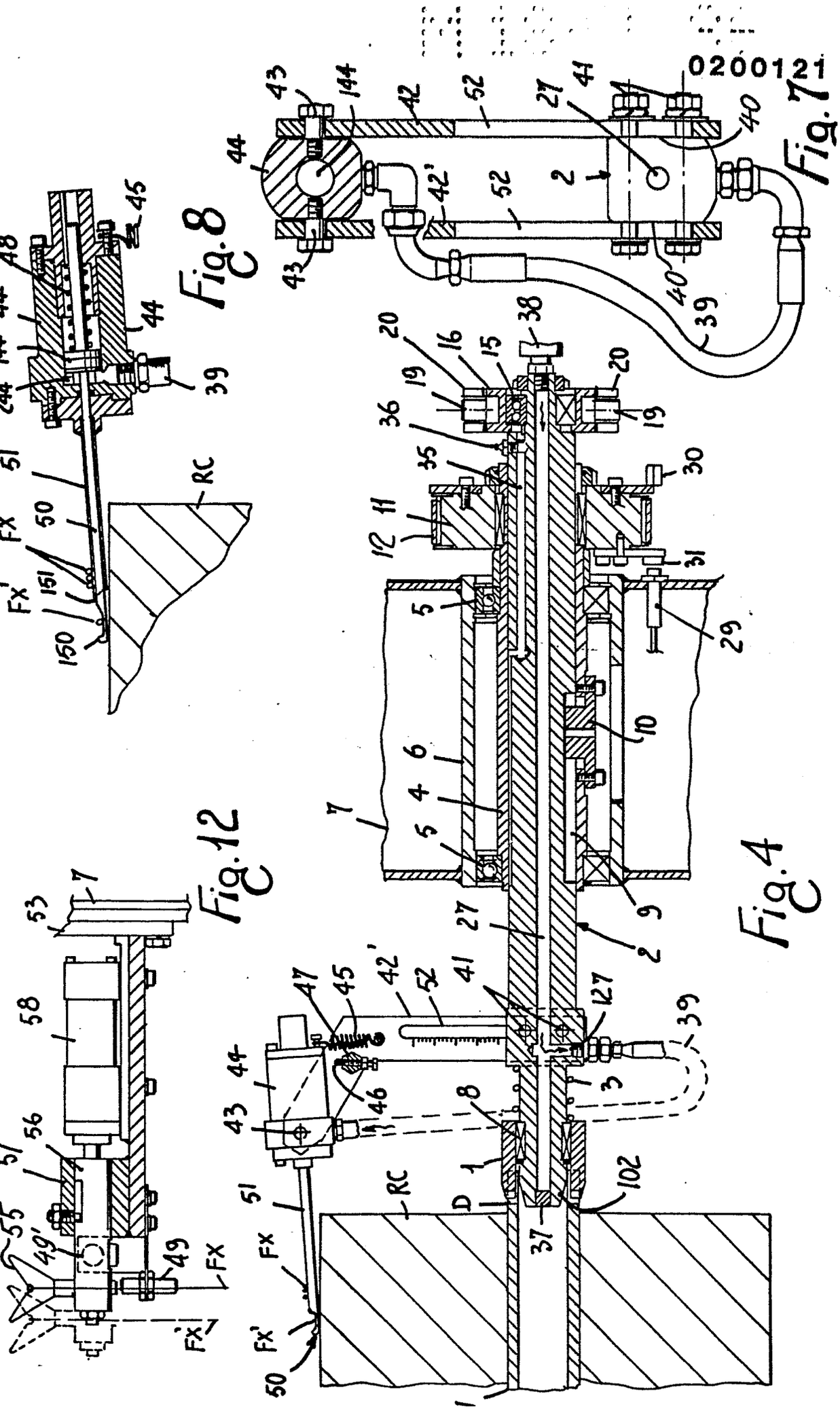

Fig.4

Fig.7

Fig.8

Fig.12