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**SEMI-AUTOMATED MANIPULATOR FOR MANUAL SHEARING**
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- (56) Prior Art Documents  
**AU 665893 56367/94 A01K 15/04**  
**AU 598697 22059/88 A01K 15/04**  
**AU 583574 51586/85 A01K 15/04**

- (57) Claim
1. An animal manipulator including an animal support means for supporting the animal on its back along narrow generally parallel regions of support, drive means for moving said regions of support to rotate the body of the animal about a substantially central longitudinal axis, means for restraining the rear legs of the animal in a rotatable manner on a rear turret carried by a swinging arm, means for restraining the front legs of the animal in a rotatable manner on a front turret, means for restraining the head of the animal in a rotatable manner attachable to said front turret, front swing arm means carrying means for releasably attaching the front leg restraining means and the head restraining means, said swing arm means being pivotable to predetermined angular positions with respect to the support means, and programmable control means for causing predetermined movements of said parallel support regions and rotation of said front and rear leg supports and said head support, which, in conjunction with movement of said front swing arm means and said swinging arm, manipulates the body of the animal to expose various portions of the animal for desired treatments.
  2. The manipulator of claim 1, wherein said programmable means causes the drive means to operate in predetermined directions for predetermined times to cause

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means for blocking movement of said leg from engagement with said leg engaging means, one-way means for allowing pivotal movement of said pivoted clamping means in a direction towards said leg engaging means, and means for releasing said one-way means to allow pivotal movement of said pivoted clamping means away from said leg engaging means to facilitate release of the leg of the animal.

18. The manipulator of any preceding claim, wherein the means for restraining the front legs and head include a docking mechanism including locating means carried by said swing arm or said restraining means, clamping means moveable between a released position in which the swing arm means are free to move, and a clamped position in which the swing arm means and the attached restraining means are fixed to said front turret, said locating means engaging co-operating locating means associated with said clamping means to locate said clamping means with respect to said locating means, said clamping means and said guide means being constructed to allow rotation of said head restraining means and said front leg restraining means with respect to the front turret.

## SEMI-AUTOMATED MANIPULATOR FOR MANUAL SHEARING

### Field of the Invention

This invention relates to manipulators for use in the treatment or shearing of sheep and other animals, such as goats and other domestic animals. In particular, 5 the invention relates to a semi-automated manipulator for manual shearing by means of which the various parts of the fleece of a sheep are presented to a manual shearer without the need for the shearer to expend substantial physical energy in manipulating the sheep.

### Background of the Invention

10 It is well known that the manual shearing profession as practiced today in Australia has changed little in the past 100 years. Professional shearers still practice their trade by standing on a flat wooden floor and bending over the sheep in unnatural and highly stressful positions to manipulate and gain access to all surfaces of the sheep's body.

15 The end result is well documented. The physical stress and strain placed on shearers' bodies, day after day, week after week and year after year to achieve high daily tallies in practicing their profession, eventually becomes highly detrimental to their long term physical well being and gradually their financial quality of life. This in turn has a cascading financial effect on both the shearing contractor and the 20 woolgrower through higher worker's compensation costs and the loss of the industry's most qualified shearers to less strenuous fields of employment.

In our Australian Patents Nos. 567764 (AU-B-33725/84) and 598697 (AU-B-22059/88) we have described various manipulators for use in the automated shearing of sheep and other like animals. In each case, the manipulator is configured 25 to restrain the animal and to manipulate the legs, head and body of the animal to automatically present various portions of the fleece for shearing by means of an automated shearing head. The manipulators are of complex construction requiring a programmed controller which controls not only the various manipulations but also the movement of the automated shearing head to sever the fleece.

30 In the current economic climate, there is a need for a less complex semi-

restraining means to manipulate the body of the animal in a predetermined manner, said control means being operable in a stepwise manner under the control of an operator, said front and rear swing arms being movable by the operator to predetermined indexed positions at which indexed positions restrains said front and rear swing arms in a manually releasable manner to present different parts of the  
5 body of the animal to the operator for desired treatment.

In a more sophisticated form of the invention, the front and rear swing arms are also driven to the predetermined indexed positions under the control of the programmable means to effect desired manipulations of the body of the animal.

10 The front and rear turrets are preferably supported on longitudinal tracks on a frame which also supports the animal support means, and the turrets are either manually movable along tracks or driven by some suitable means to adjust the positions of the front and rear turrets to accommodate animals of different lengths, and to stretch the body of the animal to both restrain the animal and condition its  
15 skin for desired treatments.

It will be appreciated from the above that the manipulator embodying the invention enables a manual shearer to automatically initiate the necessary rotary motions to cause sheep body rotation as well as rear leg rotation and front leg and head rotation, as well as enabling stretching of the restrained sheep by movement of  
20 the front and rear turrets with respect to the supporting frame. Each of the shearing positions desired is programmed into the programmable controller to respond to the operator actuating either a foot switch or a manual input button to initiate the next sequence of motions to place the sheep rotationally in the next position desired for continuing the shearing process.

25 While in the preferred embodiment described in greater detail below the transfer of either of the front legs and/or the head to their appropriate front swing arms, and the swing rotation of the rear legs is presently performed manually, these motions may also be automated in a manner similar to the rotational movements. All of the automated motions, as well as a number of associated motions (such as  
30 rotating the sheep support rollers simultaneously with the two end turrets, either as

means away from said serrations to release said arms. The detente means preferably comprises serrations formed in a cylindrical surface carried by the lower jaw engaging arm at its pivot and a spring loaded ratchet pawl preventing reverse movement of the lower jaw engaging arm, said release means being positioned to  
5 forcibly disengage said ratchet pawl from said serrations to simultaneously release said lower jaw engaging arm when said eye cup arms are released.

The provision of a single release means for releasing both the eye cup arms and the lower jaw engaging arm greatly simplifies the release of the head restraint and facilitates the possibility of automated release of the head restraint if desired.

10 The front and rear leg restraining means may take any suitable form, but one preferably in accordance with the presently preferred embodiment described in greater detail below. Once again, the leg restraining means constitutes an improvement over the leg restraining means disclosed in our earlier Patents and may be used with restraining and manipulating means other than in accordance with the  
15 present invention.

The leg restraining means preferably includes leg engaging means for partly enclosing a leg in use, pivoted clamping means for blocking movement of said leg from engagement with said leg engaging means, one-way means for allowing pivotal movement of said pivoted clamping means in a direction towards said leg engaging  
20 means, and means for releasing said one-way means to allow pivotal movement of said pivoted clamping means away from said leg engaging means to facilitate release of the leg of the animal.

In one preferred form of the leg restraining means, the one-way means comprises a wrapped spring clutch means and said releasing means comprises a  
25 sleeve rotatably mounted on said spring clutch in such a manner that rotation of said sleeve means in a predetermined direction causes release of said spring clutch to allow pivotal movement of said clamping means away from said leg engaging means.

The means for restraining the head and the front legs on the front turret  
30 preferably includes docking means comprising locating means carried by said swing

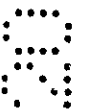
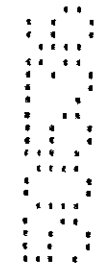


Figure 12 is a sectional plan view on line 12-12 in Figure 11 showing the eye cup mechanism;

Figure 13 is a sectional plan view on line 13-13 in Figure 12 of the head clamp showing the lower jaw clamping mechanism;

5        Figures 14 to 24 show the manipulator in plan view with a sheep restrained and manipulated to its various shearing positions;

Figure 25 is a side elevation of a further automated manipulator embodying the invention;

10        Figure 26 is a plan view of the manipulator of Figure 25 schematically showing the extreme positions of the front swing arms;

Figure 27 is a sectional plan view on the line 27-27 in Figure 25 showing the front swing arm operating mechanism;

Figure 28 is a sectional plan view through the front turret showing one of the docking mechanisms;

15        Figure 29 is a sectional plan view similar to Figure 28 showing the docking mechanism in the released position;

Figure 30 is an elevation on the line 30-30 in Figure 25 illustrating the front turret docking mechanisms;

20        Figure 31 is a perspective view of the docking mechanism of Figures 28 to 30;

Figure 32 is a perspective view of the front turret plate;

Figure 33 is a sectional elevation along the line 33-33 in Figure 26 showing the drive roller details and

25        Figure 34 is a sectional elevation along the line 34-34 in Figure 33 showing the modified roller detail.

### **Description of Preferred Embodiment**

The simple semi-automated sheep manipulator shown in Figures 1 and 2 of the drawings has been designed to restrain, stretch and present the various portions of the fleece of the sheep to the shearer during a manual shearing process.



In regards to wool harvesting industry in general, the technology should encourage more people to enter the industry by greatly reducing the learning curve for beginners, enabling them to become productive shearers in a relatively short time span, compared to current learning methods of requiring manual sheep restraint.

5 Furthermore, the technology may prove very valuable in the near future, should recent government moves to change occupational health, safety & welfare Acts regarding manual handling regulations be reactivated.

Referring firstly to Figures 1 and 2 of the drawings, the manipulator comprises a support frame 1, which may take any suitable form, including forms

10 which enable it to be transported from one shearing site to another, or relatively fixed in one shearing shed, said frame 1 pivotally supporting a rear swing arm assembly 2, front swing arms 3, a front turret assembly 4, a rear turret assembly 5 on the rear swing arm assembly 2 and a pair of parallel motor driven support rollers 5. The front turret 4 supports front leg clamp means 6 and 7 on a rotatable support

15 driven by motor M2 through a drive system (not shown). The leg clamps 6, 7 are independently dockable to the front swing arms 8 and 9 forming part of the swing arm assembly 3. The rear turret assembly 2A carries a rear leg clamp assembly 10 on a rotatable support 11 driven by motor M1 through a suitable drive system (not shown), and the rear turret assembly 2a is mounted on linear bearing tracks 12 to

20 allow the position of the rear turret to be adjusted and clamped in position by clamp means 13 to suit various lengths of sheep.

The rear swing arm 2 pivots about axis A1 to 20° to either side of the central axis. The swing arm 2 is held in its central position and each of its 20° swing positions by a detent mechanism released by a foot release lever 35 as will be

25 described in greater detail below. The front swing arms 8 and 9 each pivot independently about axis A2 through 20°, 60° and 117° from their central positions for sheep loading and unloading or redocking of the leg clamps 6, 7 to the swing arms 8, 9. Lever A releases the swing arm 8 while lever B releases the swing arm 9. Alternatively, hand releases may be provided on the swing arms 8 and 9.



by an hydraulically released clamp to allow for the common release and relocking of the front swing arms and the front turret slide as a combined assembly.

Referring now to Figures 5 and 6 of the drawings, each front swing arm 8, 9 is mounted on its own bearing B1, B2 for swinging movement to any one of three  
5 positions from the rest position, as shown most clearly in Figure 5 of the drawings. Each arm carries a spring biased pivoted locking bar 25 having an end collar 26 held by spring 27 in engagement with locating slots 28 in the edge of a part circular plate 29 secured to frame 1. The plate 29 has semi-circular cams 30 which are positioned to engage the collars 26 of the locking bars 25 to disengage the locking bar collars  
10 26 from the index slots 28. Release is achieved by operating the release levers A and B in the directions of the arrows in Figure 5 to cause the cams 30 to push the locking bars 25 out of the index slots 28 when movement of the arms 8 or 9 is required. When the swing arm 9 carries the head clamp, as described further below, movement beyond the 60° index slot 28 is prevented. The manipulations performed  
15 by pivotal movement of the swing arms 8 and 9 about their bearings B1 and B2 to each of the index positions defined by the slots 28 will be clear from the description relating to Figures 14 to 24.

Turning now to Figures 7 and 8 of the drawings, the rear swing arm 2 is mounted on a bearing 31 defining the pivot axis A1 and an index plate 32 is  
20 positioned under the arm 2 and is formed with three index notches 33 engaged by a spring biased pivoted locking bar 34 which engages each of the index slots 33 to hold the swing arm 2 in a central position or either of its indexed positions 20° to either side of the central position. As shown in Figure 2 of the drawings, the locking bar 34 is fitted with a foot release lever 35 which enables the operator to  
25 release the locking bar 34 against the action of the spring 36 to allow swinging movement of the swing arm 2 to either of its indexed positions.

As shown in Figure 2 of the drawings, the rollers 5 each comprise a standard proprietary motorized drum roller carrying a molded ribbed sleeve 38, only part of which is shown in Figure 2, to assist in sheep rotation. The length of each roller 5



dimensioned to engage a skull cavity behind the eyes of the sheep in a manner described in more detail in our earlier Patent No. 595129 (AU-B 20664/88) to positively restrain the head of the sheep in a manner which the sheep finds quite comfortable and soothing.

5 A rear support 67 carries a pivot 68 for a lower jaw support arm 69 which terminates in a shaped jaw engaging pad 70. Overlying the arm 69 and pad 70 is an arm 70a carrying a nose pad 70b the arm being rigidly attached to the top plate 63. A serrated circular ratchet 71 surrounds a uni-directional needle bearing 5X rotating on a hardened cylindrical sleeve 6X mounted on pivot 68. A torsion spring  
10 7X holds a ratchet pawl 72 against a stop face in the circular ratchet 71 so that as the arm 69 (which is attached to the cylindrical sleeve 6X) is raised, the uni-directional needle bearing 5X prevents reverse motion of the arm 69 while the outer race of bearing 5X is held from clockwise rotation (as shown in Fig 13) by the engaged ratchet and pawl. In this way the lower jaw of the sheep is fully supported  
15 by a jaw clamp pad 70 on the arm 69 with the sheep's nose being held against pad 70b. When the pawl 72 is forcibly disengaged from the ratchet 71 by means of the release lever and cam 73, then the lower jaw clamp 70 is released at the same time as the eye cups 65.

The eye cup arms 64 are formed with meshing gear teeth 75 and one of the  
20 arms has an extension 76 which carries a toothed ratchet quadrant 77 having fine serrations and which engage one of two spring loaded pawls 78. There are two pawls, one above the other with differing lengths equal to half the pitch of the ratchet segment. This allows for a finer more robust adjustment. The pawls 78 have teeth 79 which engage the ratchet teeth on the quadrant 77. Each pawl 78 is  
25 carried by a pivoted link 78a which can be rotated to its released position by lever 73 which engages the operative end 80 of the pawls 78 in a manner shown most clearly in the enlarged detail of Figure 13. When lever 78a is rotated in an anticlockwise direction to its operative position it places the pivots of the two pawls 78 to a supported overcentre position to the left of the line joining the tooth tip 79  
30 and the pivot of link 78a thus making the ratchet operative. Thus, by actuating the



the horizontal turret during preload or loading etc). In order to hold this nominal docking alignment magnets (not shown) can be used to hold the respective swing arms 8, 9 parallel to the front turret axis with a tapered alignment pin secured to each vertical slide assembly being inserted into a matching hole either side of the front turret slide assembly plates 17. Thus in the above described situation we can freely move both of the front swing arm vertical slide assemblies with the front turret all in a nominally docked alignment whether there is a sheep in the cradle or not so long as their respective clamps remain unlocked.

A docking mechanism 81 (Fig. 11) is carried by the side arm 62 and the top plate 63 is pivoted to the side arms 62 about axis E while a pin F carried by plates P attached to the top plate 63 slides in a groove G in the side arms 62 to allow the head clamp 60 to pivot about the axis E through about 45°. As shown clearly in Fig. 11, each docking mechanism 81 consists of a rotatable key pivoted at the top of each vertical slide arm on each front swing arm 6, 7. Each foreleg clamp arm and the head clamp assembly have identical pivoted inserts 50 (Fig. 10) with recesses to match the above keys in 6 and 7. The keys and inserts are limited to 90 degrees of rotation with appropriate stops. Each side of the rotating insert (in either of the fore leg arms or the head clamp) has a pair of external lugs on a common axis such that the lugs on one face are phased 90 degrees to the lugs on the opposite face. When a swing arm is docked with either a fore leg arm or a head clamp the pivoting key enters the pivoting insert and rotates it 90 degrees so that the outer lugs disengage from holding the fore leg clamp to the turret while simultaneously engaging the lugs on the opposing side to lock the fore leg clamp or head clamp to the vertical slide. This locking means is used to hold one assembly to the other axially while separate lugs on each assembly carry the longitudinal and twisting forces which may be applied.

As mentioned previously, a preferred feature of the manipulator is that it has a common clamping means for the three slides 15, 1X and 2X on the front turret 4. This is achieved by normally having all three slides clamped rigidly to their respective rails using disc springs to apply the required clamping force. A common



arms 64 holding the eye cups 65 are moved in to engage with the skull and a mechanical locking mechanism 77, 78 (Figs. 12, 13) prevents them from being separated until the animal is finally released. As a result, the sheep's head is rigidly held without obscuring any wool on the head but in a comfortable way that blindfolds the eyes, causing the sheep to relax during shearing.

Both the front and rear turrets 4, 2A are each mounted on a linear ball bearing track 15, 13 with lever or hydraulically actuated clamps that enable the shearer to freely slide either one when positioning sheep of different lengths longitudinally on the manipulator. In the normal loading sequence, only the front turret 4 would need to be moved to stretch the sheep's body longitudinally and locate its head in a preferred position consistent with the sheep's brisket longitudinal location. Extensive manual shearing trials using the manipulator have achieved loading/unloading times totalling an average of 15 to 30 seconds.

A shearing pattern has been developed to enable the fleece to be shorn off in one piece onto a gathering board or conveyor belt (not shown). Ease of access to all segments of the sheep's body is accomplished by rotating the sheep's body 360° and firmly stretching its legs and neck during the semi-automatic rotation process.

Shearing begins on the belly with the sheep resting upside down on the rollers (Fig. 14). The shearer removes the belly patch, then shears off any stained wool from the legs and crutch. At this point the shearer begins to open up the fleece along the side of the sheep, above the belly, by making long blows from the front legs to the rear legs (Fig. 15). As the shearing progresses up the sheep's near side to its back (Figs. 15, 16, 17), gravity causes the fleece to peel off in one piece onto the gathering board. This part of the shearing process is assisted by first pivoting the rear swing arm 2 to the left (Fig. 16) and then to the right (Fig. 17) to condition the skin of the sheep on either side to facilitate easier shearing. During the process, the sheep is rotated onto its side (Fig 18) by the shearer pressing a foot activated control pad (not shown) on the floor which causes the controller in cabinet C1 to rotate the rollers 5 in the required direction. The rear swing arm 2 is left in the



With about 3 days of training and practice, a professional shearer should be able to achieve shearing cycle time ranging from 2 to 3.5 minutes, depending on sheep type and their physical condition.

It will be appreciated from the above that the sheep manipulator described above provides a convenient semi-automated mechanism for manipulating a sheep which is capable of use by relatively inexperienced shearers with limited instruction to properly shear the fleece of the sheep in a single piece with less physical effort and skill than is required for normal manual shearing. A number of the functions presently performed manually by the operator may be automated, although the present degree of automation is believed to be about right having regard to limiting the complexity and cost of the mechanism.

It will also be appreciated that a number of the mechanisms described above are capable of being used with a more fully automated animal manipulator, such as those described in our earlier Patents referred to above. Similarly, many of the mechanisms described are also capable of use with manipulators of the type described by other workers in this field having varying degrees of automation and complexity.

Referring now to Figures 25 to 31 of the drawings, a further automated embodiment of the manipulator embodying the invention will now be described. In this embodiment, all of the significant functions of the manipulator according to the previous embodiment which were manually executed by the operator are now automated. The remaining manual operations are the application and release of the rear leg restraint clamps, the fore leg restraint clamps, the head clamp eye cups, the jaw clamp, the rear swing arm pivoting the rear turret stretch and the front turret positioning complete with the linear slides on the two front swing arms.

The manipulator shown in Figures 25 to 34 is similar in construction to the previous embodiment and includes a frame 100 pivotally supporting a rear swing arm assembly 102, front swing arms 103, a front turret assembly 104, a rear turret assembly 105 on the rear swing arm assembly 102, and a pair of parallel motor driven support rollers 106.



The swing arms 107, 108 have upper end portions 125, 126 which carry plates 127, 128 which in turn carry rollers 129 (only one of which is shown associated with the head clamp docking mechanism) which revolve within the T slots 116 in the turret 115 and in the matching T slots in the head clamp docking mechanism 119 and the near fore leg docking mechanism 120 respectively, which are clamped in alignment to the turret 115 by the clamping plate 123 which holds them to the turret 115 with sufficient force to prevent the sheep from pulling them clear of the face of the turret 115.

When the docking mechanisms 119, 120 are clamped to the turret 115, the clamp plate 123 is in contact with clamping pawls 130 so that the pawls 130 are pulled clear of the gap between the rollers 129 leaving the turret 115, with attached head clamp 112 and near fore leg clamp 111 free to rotate.

When it is desired to swing the arms 107, 108 and their respective end portions 125, 126 away from the turret 115 with their clamps 111, 112, the clamp plate 123 is axially displaced as shown in Figure 29 to release the docking assemblies 119, 120 from the turret 115. In this situation, the docking assemblies 119, 120 are prevented from rotating free of their swing arm portions 125, 126 by engagement between the pawl 130 and the rollers 129 to prevent the clamps 111 and 112 rotating relative to the arm plates 127, 128. Suitable actuator means (not shown) operates the clamping plate 123 which in turn operates the pawl 130 in the manner described above.

It is necessary to position the front turret assembly 104 and the swing arm end portions 125, 126 to suit the length of the sheep being loaded into the manipulator. The swing arm docking mechanisms 119, 120 are able to remain engaged with the turret 115 during loading and a hand release lever 131 and associated gripping bar 132 are provided on the front turret 104 (Fig. 25) enables release of the three slide mechanisms when the swing arms 107, 108 are parallel to the slide axis of the front turret assembly 104. The handle 131 raises a link 133 against the action of a spring (not shown) so that a lever 134 disengages a pin 135 from one of the slots 136 to allow adjustment of the slide mechanisms.



The claims defining the invention are as follows:

1. An animal manipulator including an animal support means for supporting the animal on its back along narrow generally parallel regions of support, drive means for moving said regions of support to rotate the body of the animal about a substantially central longitudinal axis, means for restraining the rear legs of the animal in a rotatable manner on a rear turret carried by a swinging arm, means for restraining the front legs of the animal in a rotatable manner on a front turret, means for restraining the head of the animal in a rotatable manner attachable to said front turret, front swing arm means carrying means for releasably attaching the front leg restraining means and the head restraining means, said swing arm means being pivotable to predetermined angular positions with respect to the support means, and programmable control means for causing predetermined movements of said parallel support regions and rotation of said front and rear leg supports and said head support, which, in conjunction with movement of said front swing arm means and said swinging arm, manipulates the body of the animal to expose various portions of the animal for desired treatments.

2. The manipulator of claim 1, wherein said programmable means causes the drive means to operate in predetermined directions for predetermined times to cause rotation of the body of the animal, and at the same time causes driven rotation of said front and rear leg restraining means to manipulate the body of the animal in a predetermined manner, said control means being operable in a stepwise manner under the control of an operator, said front swing arm means and said swinging arm being movable by the operator to predetermined indexed positions at which indexed positions said front and rear swing arms are restrained in a releasable manner to present different parts of the body of the animal to the operator for desired treatment.

3. The manipulator of claim 2, further including means driving at least said front swing arms to their predetermined indexed positions under the control of said programmable means to effect desired manipulations of the body of the animal.



9. The manipulator of claim 7 or 8, wherein said detent means comprises serrations formed in a cylindrical surface carried by the lower jaw engaging arm at its pivot and a spring loaded ratchet pawl preventing reverse movement of the lower jaw engaging arm, said release means being positioned to forcibly disengage said ratchet pawl from said serrations to simultaneously release said lower jaw engaging arm when said eye cup arms are released.

10. The manipulator of claim 7, 8 or 9, wherein said head restraint is substantially as hereinbefore described with reference to Figures 11 to 13 of the accompanying drawings.

10 11. The manipulator of any preceding claim wherein said leg restraining means includes leg engaging means for partly enclosing a leg in use, pivoted clamping means for blocking movement of said leg from engagement with said leg engaging means, one-way means for allowing pivotal movement of said pivoted clamping means in a direction towards said leg engaging means, and means for releasing said one-way means to allow pivotal movement of said pivoted clamping means away from said leg engaging means to facilitate release of the leg of the animal.

12. The manipulator of claim 11, wherein said means for restraining the rear legs comprises a pair of inverted hooks carried by side plates, said pivoted clamping means including retainer arms carrying <sup>hook</sup>~~hook~~-engaging plates dimensioned to enter the inverted hooks, said arms being carried by a common shaft pivoted in bearings in the side plates.

13. The manipulator of claim 11 or 12, wherein said one-way means comprises a one-way clutch having a quick release mechanism.

14. The manipulator of claim 11, 12 or 13, wherein said means for restraining the rear legs is substantially as hereinbefore described with reference to Figure 9 of the accompanying drawings.

15. The manipulator of any one of claims 11 to 14, wherein each of said front leg restraining means includes an inverted hook carried by a plate and a pivoted clamping arm having a leg engaging portion dimensioned to enter said hook.



23. The manipulator of claim 22, wherein said shaft is a pull-shaft which carries said clamping plate at one end.

24. The manipulator of any one of claims 18 to 23, wherein said means for releasably attaching the front leg restraining means and said head restraining means  
5 to said swing arm means includes a T-shaped member secured to means carried by said swing arm and a correspondingly shaped groove in means attached to said restraining means configured to allow rotary movement of said restraining means with respect to the turret.

25. The manipulator of claim 24, wherein said means carried by the restraining  
10 means and said T-shaped member(s) each have a correspondingly segmented configuration such that said T-shaped members are received by the means carried by the restraining means in alignment with the corresponding grooves.

26. The manipulator of claim 24 or 25, wherein said T-shaped members and said  
15 means carried by the restraining means are substantially as described with reference to Figures 30 to 32 of the accompanying drawings.

27. The manipulator of any one of claims 18 to 26 wherein the docking mechanism is substantially as hereinbefore described with reference to Figures 1, 2 and 11, or Figures 25, 26 and 28 to 30 of the accompanying drawings.

DATED: 20 February 1997

**CARTER SMITH & BEADLE**

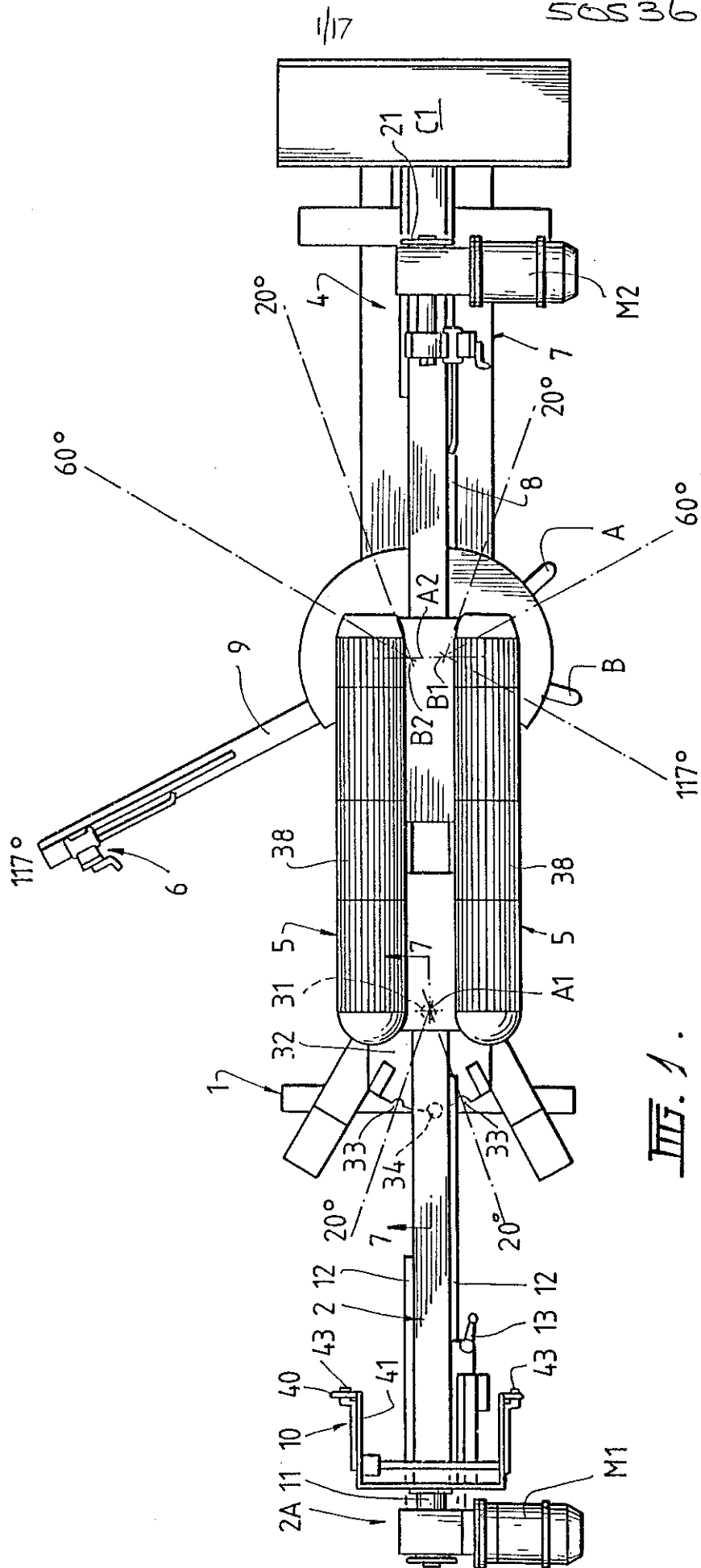
Patent Attorneys for the Applicant:

**WOOL RESEARCH & DEVELOPMENT CORPORATION**



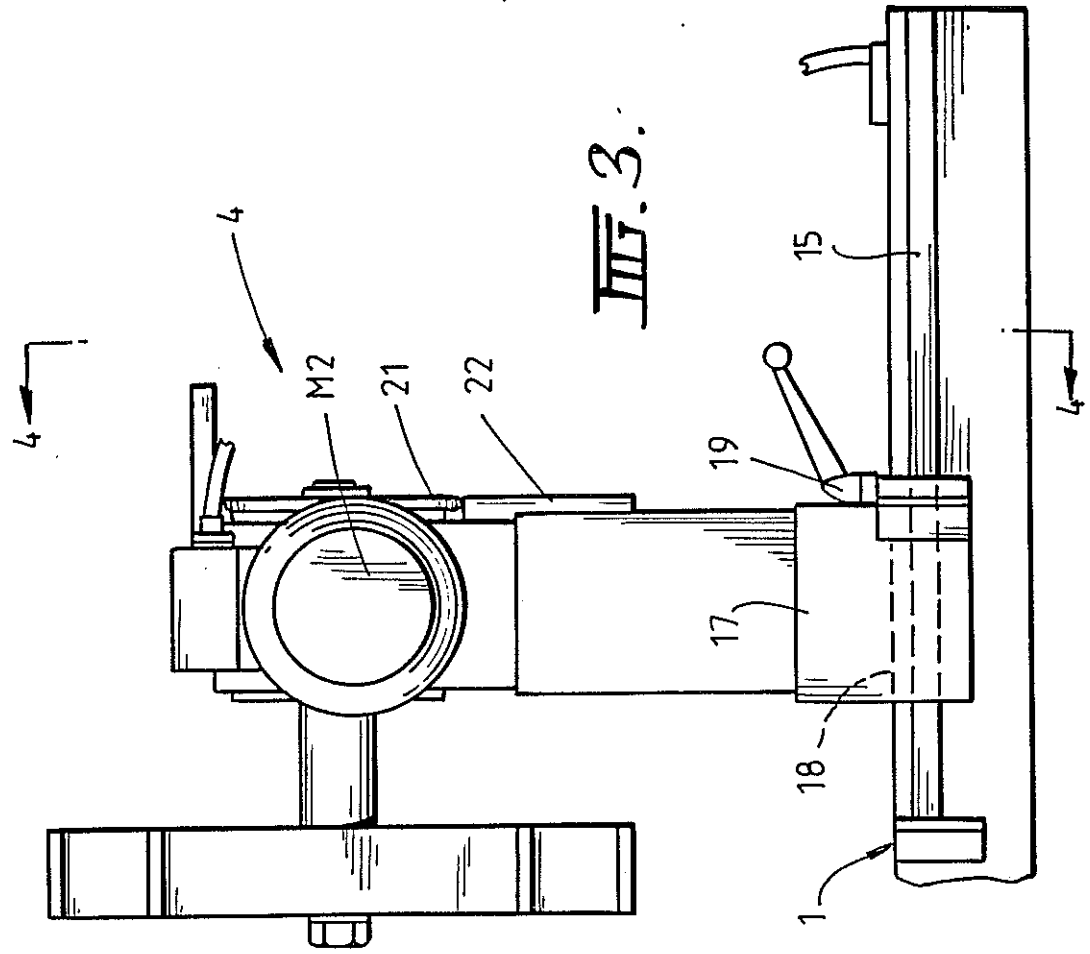
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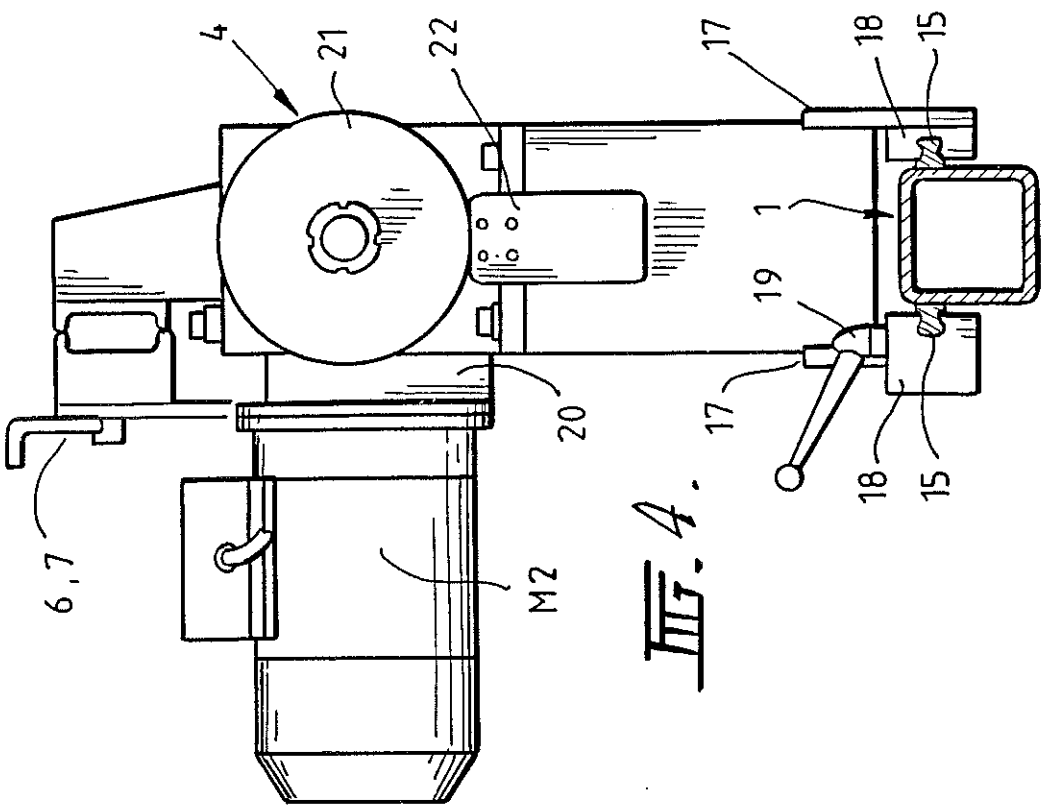


III. 1.

III. 3.



III. 4.



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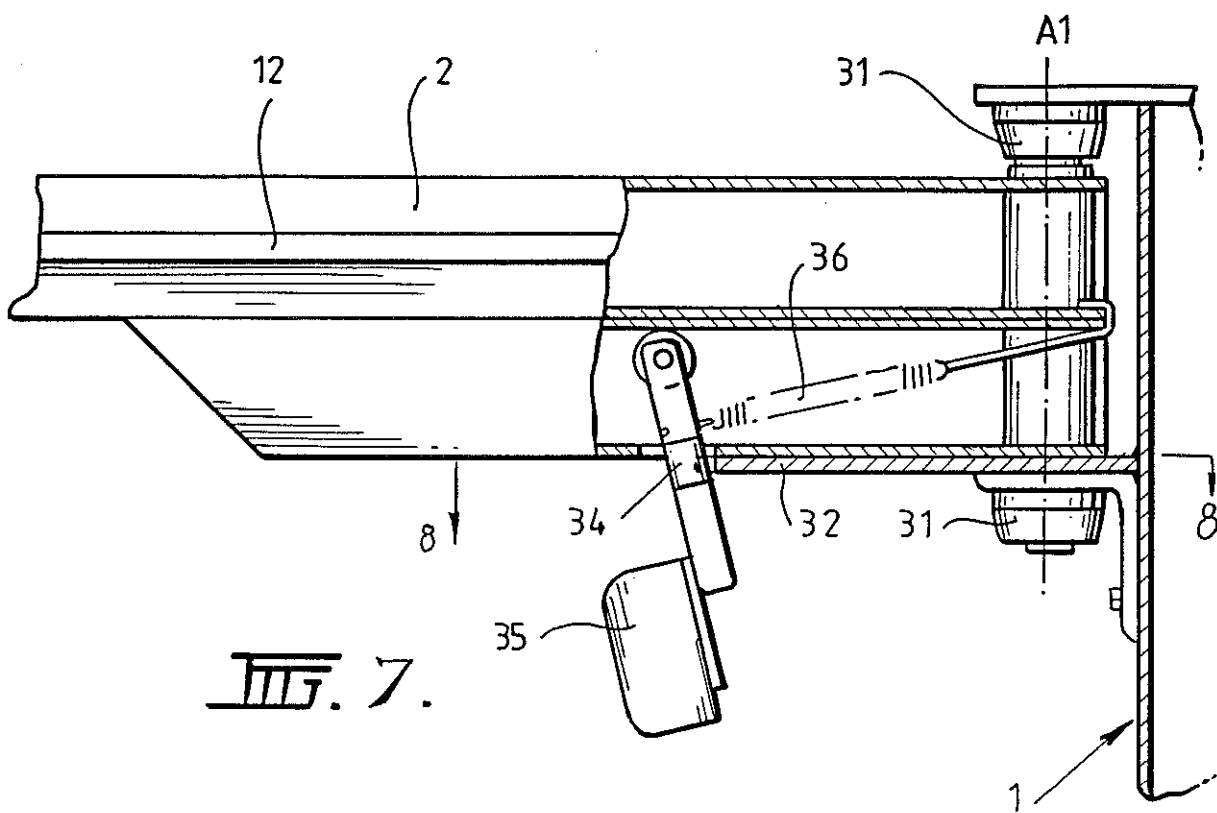


FIG. 7.

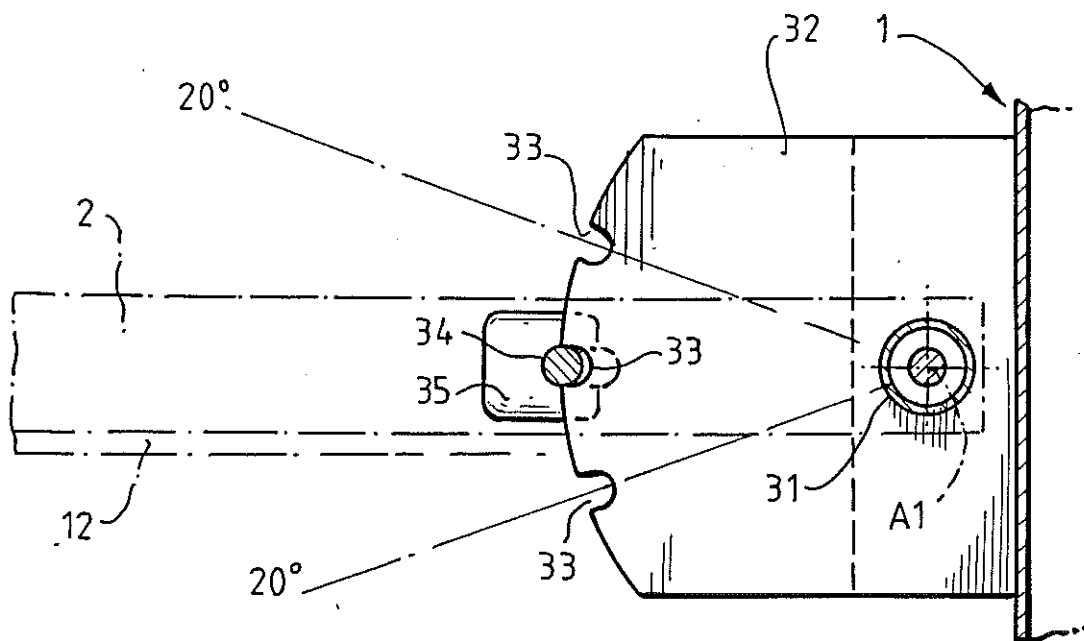


FIG. 8.



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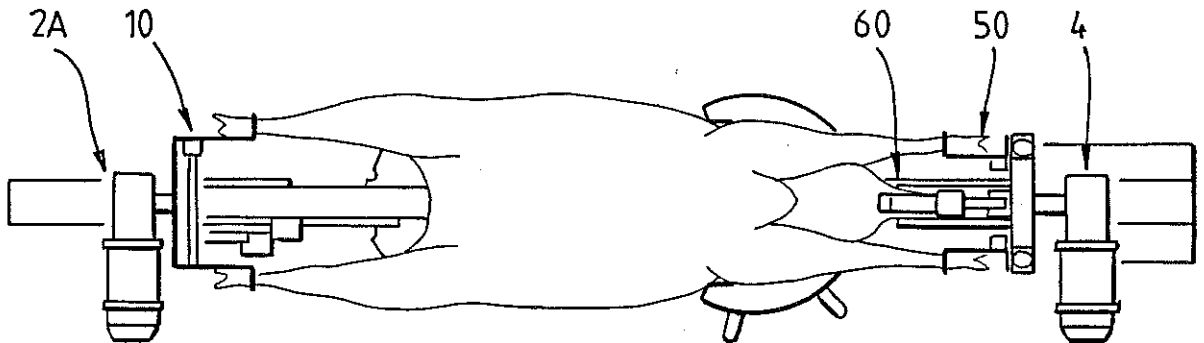


FIG. 14. Shearing position 1

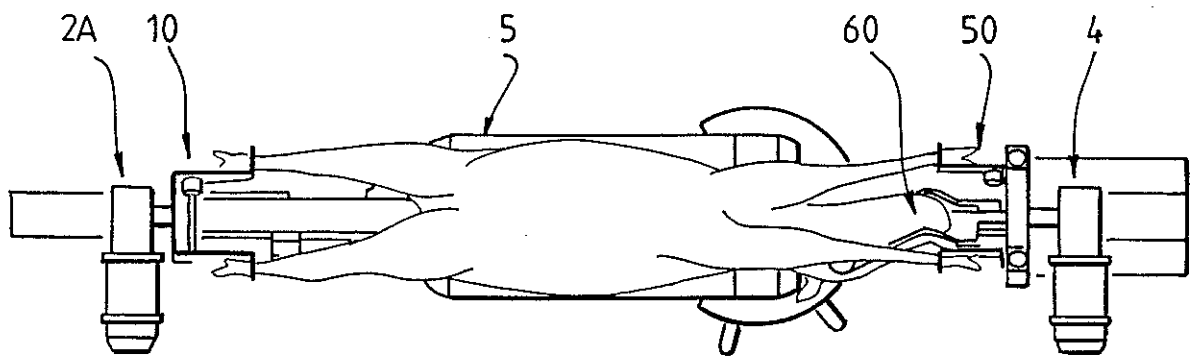


FIG. 15. Shearing position 2

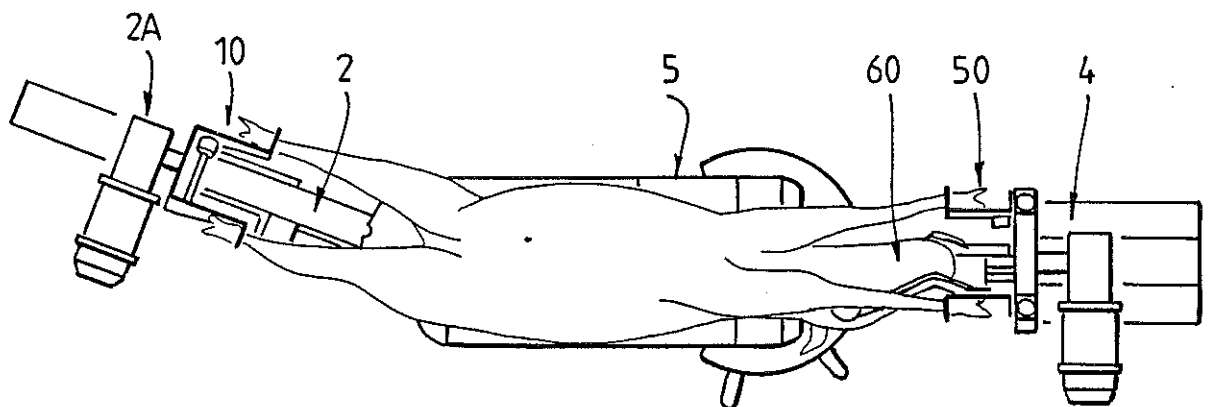


FIG. 16. Shearing position 3

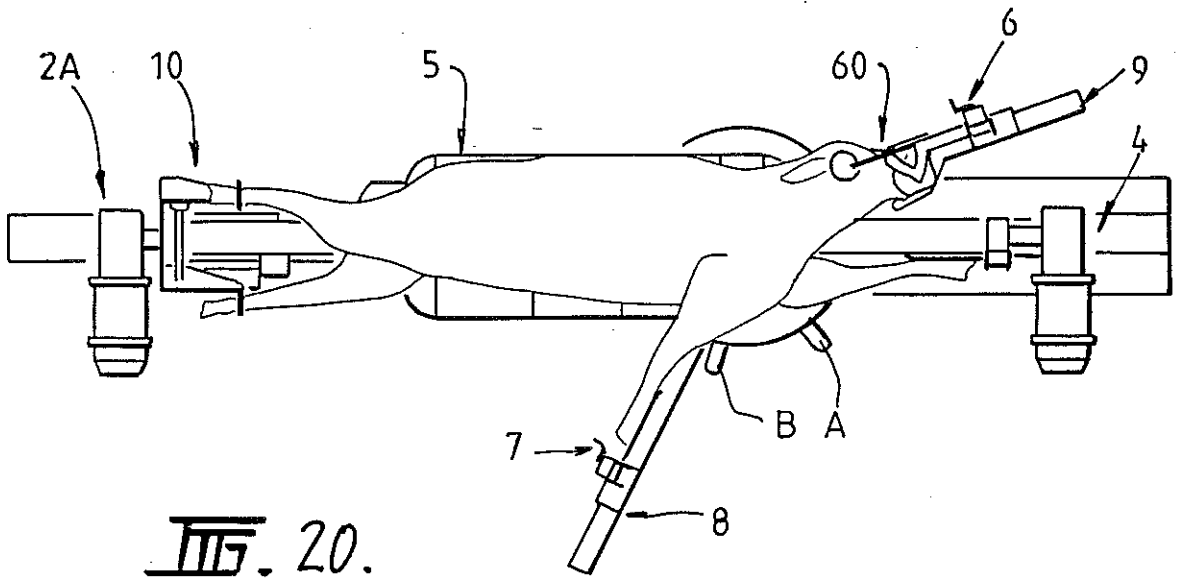


FIG. 20.

Shearing position 7

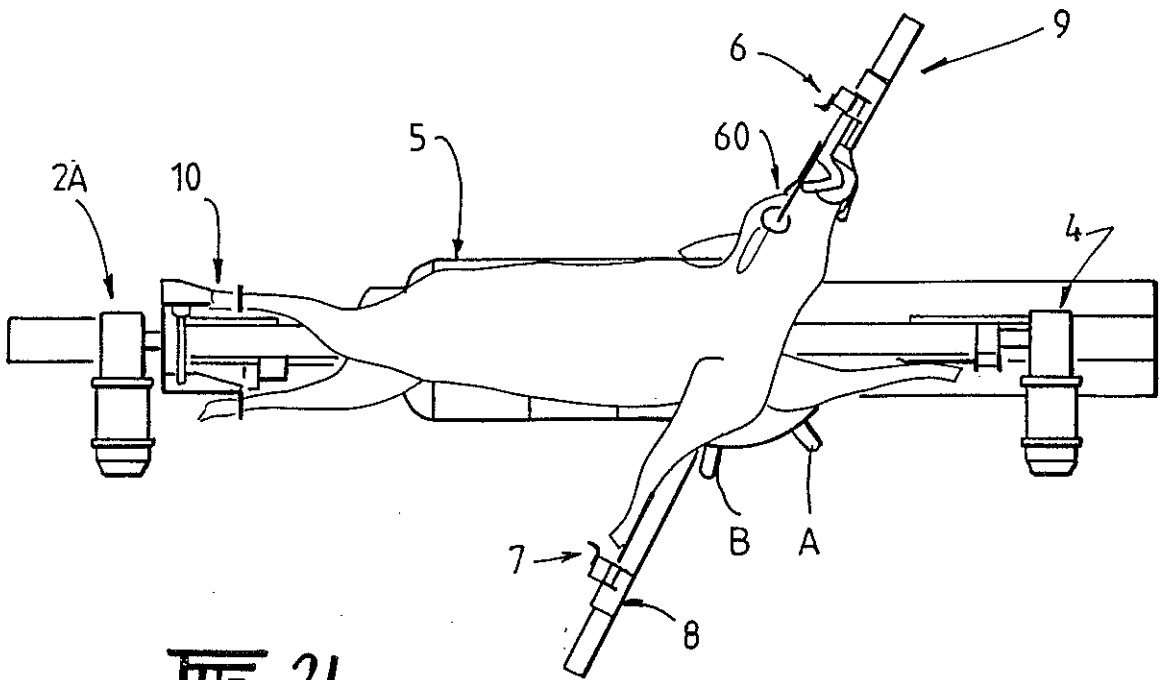
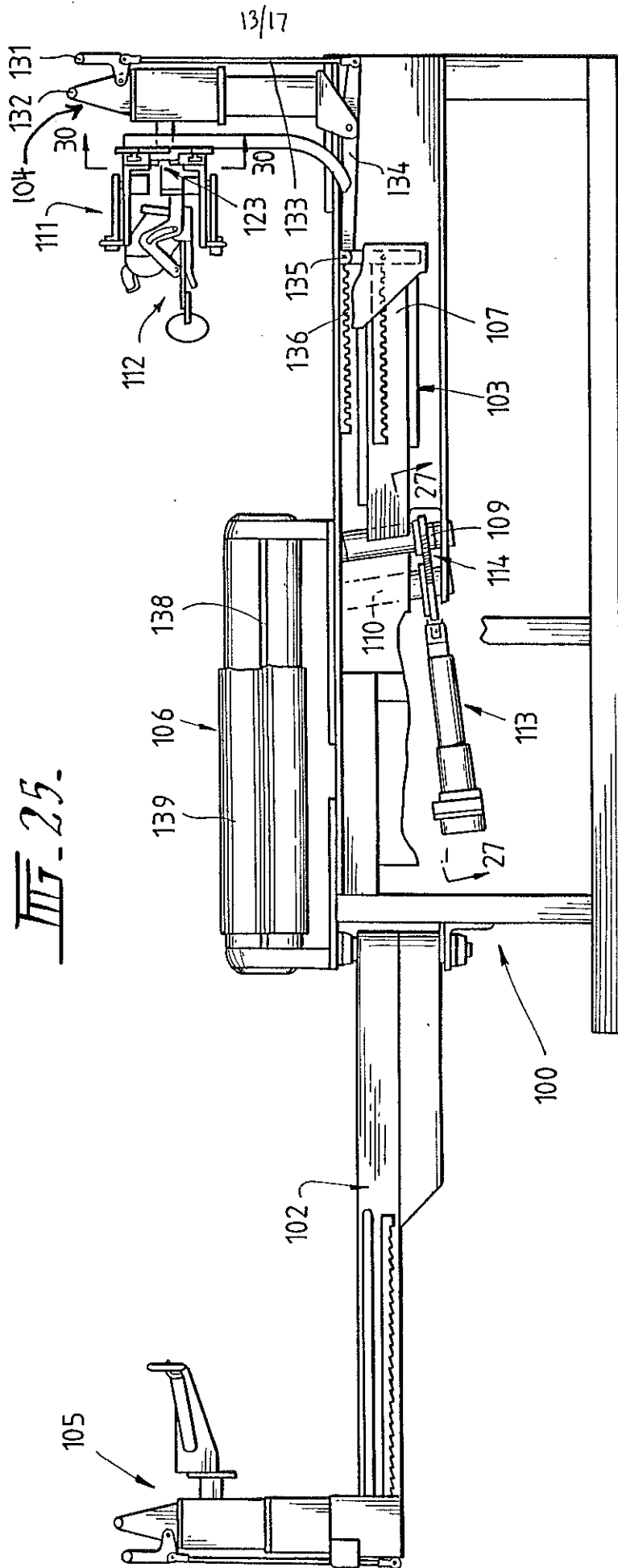


FIG. 21.

Shearing position 8

0011 33 3008

Fig. 25.



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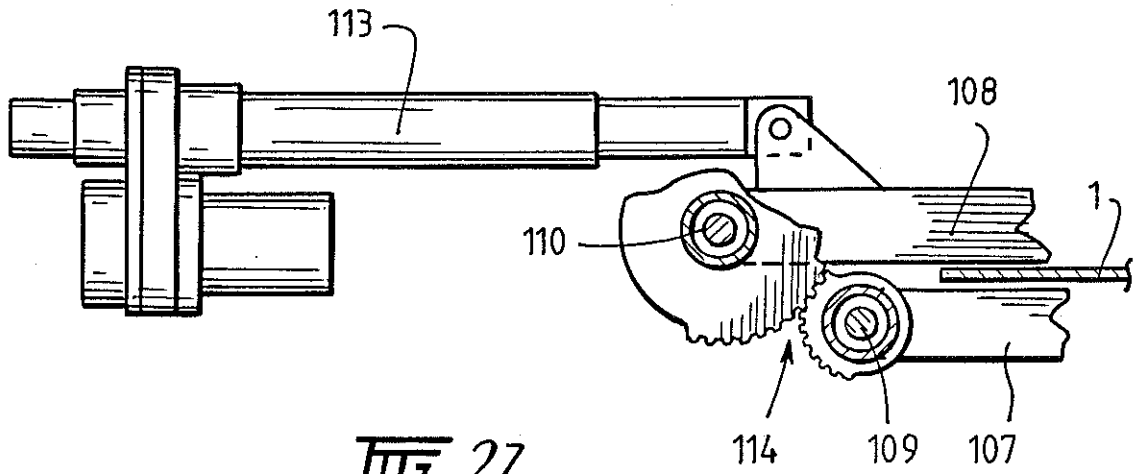


FIG. 27.

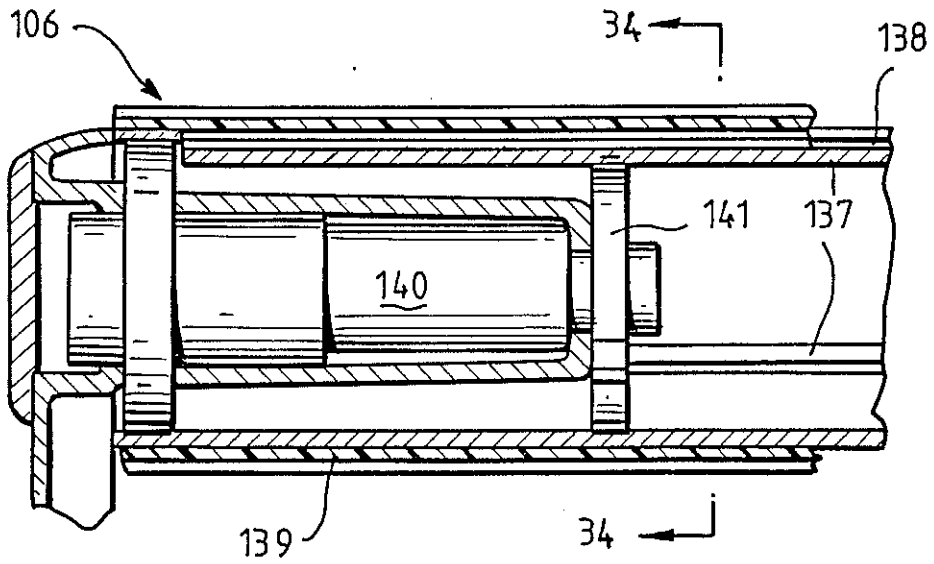


FIG. 33.

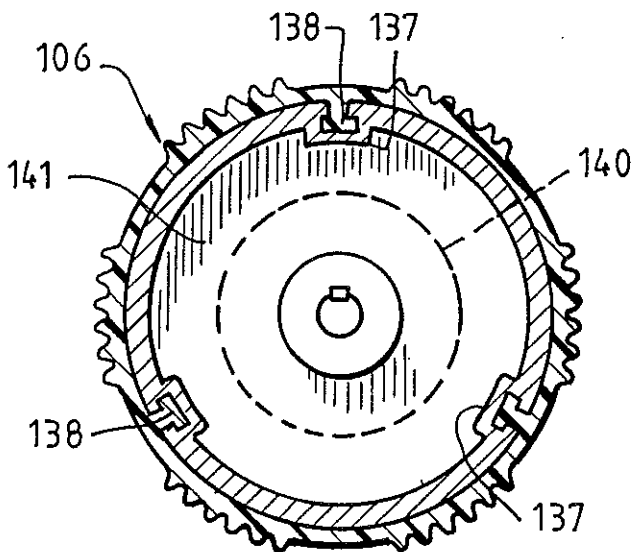


FIG. 34.

