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(54) **ECCENTRIC DRIVE MECHANISM FOR A FOLDING MACHINE**

(57) The invention relates to an eccentric drive mechanism (D¹) for a folding machine, comprising an driven wheel (9¹) driven by a drive means (8¹), the driven wheel (9¹) being connected to a clamping beam (1¹), which clamping beam (1¹) is provided with an upper clamping tool (3¹) arranged to cooperate with a lower clamping tool (5¹) so as to clamp a work piece there between when the

clamping beam (1¹) performs a movement towards the lower clamping tool (5¹). A connection between the driven wheel (9¹) and the clamping beam (1¹) is made by an in the longitudinal direction adjustable device (20¹), and a second end (6b¹) of said in the longitudinal direction adjustable device is eccentrically and pivotably connected to the driven wheel (9¹).

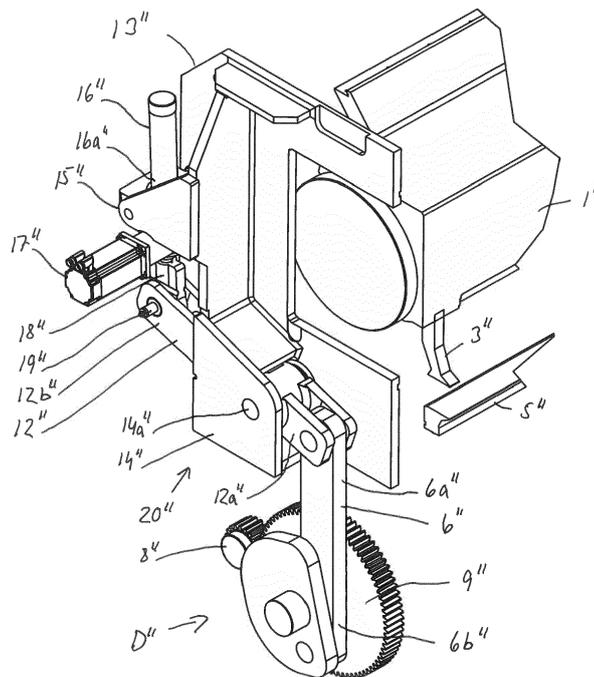


Fig. 3

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Description

Field of the invention

[0001] The present invention relates to an eccentric drive mechanism for a folding machine of the type defined in the preamble of claim 1, preferably for folding sheet material.

Background of the invention

[0002] At known folding machines, one way of achieving the clamping force necessary for clamping a work piece to be folded is to move the clamping beam by an eccentric drive mechanism.

[0003] By such a mechanism a number of advantages is obtained such as gives a very high clamping pressure, moves the clamping beam at best possible opening and closing speeds, has almost no wear and thereby low maintenance costs, requires no oil, and has low noise.

[0004] However, one problem with an eccentric drive mechanism is that the force obtained is strongly dependent upon an angle α formed between a vertical line through a bearing axis of the eccentric unit and a line drawn through both said bearing axis of the eccentric unit and a bearing axis of a pull down rod arranged to achieve the opening and closing movements of the clamping beam. See Fig. 1.

[0005] At an angle α of 0° the clamping force achieved by the eccentric drive is at its largest and at 90° the clamping force is at its weakest, but at about 0° it is difficult to control the clamping force. Therefore, the optimal angle is at about 15° .

[0006] This means that clamping force obtained by the eccentric drive mechanism will be optimal only for a particular thickness of material of the work piece in combination with a clamping beam tooling of a particular dimension/height.

[0007] Therefore, a problem will arise particularly when the thickness of material of the work piece is increased or decreased, whereby with increased thickness of material the above-mentioned angle will be larger than 15° with reduced clamping force as a result, and with decreased thickness of material the above-mentioned angle will be smaller than 15° and the clamping force obtained will possibly be too large which may result in damages to the eccentric unit and/or the drive mechanism.

[0008] The same problem will arise if the height of the clamping tooling is changed from a standard height.

[0009] Accordingly, an object of the present invention is to provide a new eccentric drive mechanism for a folding machine by which the above-mentioned drawbacks are eliminated.

Summary of the invention

[0010] This object is achieved according to the invention by an eccentric drive mechanism for a folding ma-

chine, comprising an eccentric wheel driven by a drive means, the eccentric unit being connected to a clamping beam, which clamping beam is provided with an upper clamping tool arranged to cooperate with a lower beam tool so as to clamp a work piece there between when the upper clamping beam performs a movement towards the lower clamping tool, characterized in that a connection between the eccentric unit and the upper clamping beam is made by at least one, in the longitudinal direction, adjustable device, and that a second end of said in the longitudinal direction adjustable device is eccentrically and pivotably connected to the driven wheel.

[0011] Other embodiments of the invention will be apparent from the accompanying dependent claims.

Brief description of the drawings

[0012] The invention will now be described by way of non-limiting examples with reference to the accompanying drawing, in which

- Fig. 1 shows a schematic end view of a prior art eccentric drive mechanism for a folding machine for sheet material,
- Fig. 2 shows a schematic end view of an adjustable eccentric drive mechanism according to a first embodiment of the present invention for a folding machine for sheet material,
- Fig. 3 shows a broken end view obliquely from above of an adjustable eccentric drive mechanism according to a second embodiment of the present invention for a folding machine for sheet material,
- Fig. 4 shows an end view of the eccentric drive mechanism according to the second embodiment of the present invention in which the upper clamping tool of the folding machine has a large height,
- Fig. 5 shows an end view of the eccentric drive mechanism according to the second embodiment of the present invention in which the upper clamping tool of the folding machine has an average/standard height, and
- Fig. 6 shows an end view of the eccentric drive mechanism according to the second embodiment of the present invention in which the upper clamping tool of the folding machine has a low height.

Description of preferred embodiments

[0013] Fig. 1 shows a schematic end view of a prior art eccentric drive mechanism for a folding machine for folding preferably sheet material. The eccentric drive mechanism D comprises a driven wheel 9 mounted in bearings at its center, bearing axis, and has preferably the form

of a driven gear wheel 9. A drive means 8, preferably an electrical motor provided with a driving gear wheel, is in mesh with said driven gear wheel 9. A second end 6b of a pull down rod 6 is eccentrically mounted in bearings to said driven gear wheel 9. A first end 6a of said pull down rod 6 is connected through schematically shown suitable means to a clamping beam 1 of a folding machine so as to achieve an opening and closing movement of said clamping beam 1. The clamping beam 1 is provided with an upper clamping tool 3 of a particular height and adapted to cooperate with a lower clamping tool 5. Said pull down rod 6 has a fixed length.

[0014] An angle α formed between a vertical line through the bearing axis of the driven gear wheel 9 and a line drawn through both said bearing axis of the driven gear wheel 9 and a bearing axis of the second end 6b of the pull down rod is about 15° when folding a work piece having a particular thickness of material and with an upper clamping tool 3 having a particular height.

[0015] However, this angle α will vary depending upon the thickness of material of the work piece processed and with the height of the upper clamping tool 3 and/or lower clamping tool 5 used.

[0016] In the prior art, the operation of the clamping beam 1 is made by only one drive means 8. Preferably, to enable such operation, a shaft 11 is rigidly connecting the driven gear wheel 9 with a wheel having a correspondingly pull down rod arranged at the opposite side (not shown) of the folding machine so as to simultaneously and synchronously move both sides of the clamping beam 1 downwardly and upwardly, respectively.

[0017] Fig. 2 shows an eccentric drive mechanism D' according to a first embodiment of the invention for a folding machine for sheet material. Said eccentric drive mechanism is similar to the one shown in Fig. 1, but the pull down rod 6 in Fig. 1 is formed as an in the longitudinal direction adjustable device 20', the length of which can be adjusted accordingly to the dimension of the work piece processed and the height of an upper clamping tool 3' and/or lower clamping tool 5' used. As in Fig. 1, the clamping beam 1' is provided with the clamping tool 3' which is adapted to cooperate with the lower clamping tool 5'. A second end 6b' of said in the longitudinal direction adjustable device 20' is eccentrically connected to a driven gear wheel 9'. Also, in this embodiment, the operation of the clamping beam 1' is preferably made by only one drive means 8 operatively connected to the driven gear wheel 9', and a shaft 11' is rigidly connecting the driven gear wheel 9' with a wheel having a correspondingly in the longitudinal direction adjustable device arranged at the opposite side (not shown) of the folding machine so as to simultaneously and synchronously move both sides of the clamping beam 1' downwardly and upwardly, respectively.

[0018] Fig. 3 shows an eccentric drive mechanism D'' according to a second embodiment of the invention for a folding machine for preferably sheet material. In said embodiment an in the longitudinal direction adjust-

able device 20'' comprises a pivotable arm 12'', a first end 12a'' of which is pivotably connected to a first end 6a'' of a pull down rod 6'' and a second end 12b'' of which is pivotably connected to an active end 18'' of a spindle gear means 16'' which is adjustable in the longitudinal direction. The spindle gear means 16'' is preferably driven by a servo motor 17''. A passive end 16a'' of spindle gear means 16'' is connected to a clamping beam 1'' via one hand a jacket bracket 15'' and on the other hand a bracket 13''. A second 6b'' end of said pull down rod 6'' is pivotably and eccentrically mounted in bearings to a driven gear wheel 9'' which is driven by a drive means 8''. The clamping beam 1'' is provided with an upper clamping tool 3'' adapted to cooperate with a lower clamping tool 5''.

[0019] The length of the spindle gear means 16'' is adjusted so that the angle α formed between a vertical line through the bearing axis of the driven gear wheel 9'' and a line drawn through both said bearing axis of the driven gear wheel 9'' and a bearing axis of the second end 6b'' of the pull down rod 6'', which bearing axis is eccentrically and pivotally connected to the driven gear wheel 9'', is between 0 to 30° , preferably between 5 to 25° , and more preferably between 10 to 20° , and most preferably is about 15° , when the clamping beam 1'' has obtained its optimal clamping force.

[0020] To increase the clamping force obtained by the clamping beam 1'' and/or reduce the dimensions of the spindle gear means 16'' and/or the drive means 8'' so as to be able to use less expensive ones, the arm 12'' is pivotably arranged about a shaft 14a'' arranged in a housing 14'' so as to form a transmission ratio between the second end 12b'' and the first end 12a'' of the arm 12'' of between $1:1$ to $1:10$, preferably $1:1$ to $1:5$, more preferably $1:1$ to $1:3$, and most preferably $1:2.4$.

[0021] At a joint 19'' pivotally connecting the second end 12b'' of the arm 12'' to the active end 18'' of the spindle gear means 16'' a pressure sensor and/or angle sensor (not shown) is arranged. This enables measuring the force exerted by the second end 12b'' of the arm 12'' on the active end 18'' of the spindle gear means 16'' and/or the angle between said the second end 12b'' and said active end 18'' and sending a signal to a control device (not shown) when the required force and/or angle is obtained so as to stop the movement of the clamping beam 1''.

[0022] In a preferred embodiment a corresponding eccentric drive mechanism D'' with said in the longitudinal direction adjustable device 20'' is arranged on the opposite side (not shown) of the folding machine. By such an arrangement a more accurate and uniform clamping force can be obtained by the clamping beam 1'', and said eccentric drive mechanisms D'' with said in the longitudinal direction adjustable device 20'' can be driven independently of each other.

[0023] Figs. 4 to 6 show different length of a spindle 21'' of the spindle gear means 16'' dependent upon the thickness of material of the work piece and/or the height/dimension of the upper clamping tool 3'' and/or

the lower clamping tool 5".

[0024] In Fig. 4 the length of the spindle 21" of the spindle gear means 16" is shown to be 17 mm at an upper clamping tool height of 254 mm and a thickness of material of the work piece being 2.5 mm.

[0025] In Fig. 5 the length of the spindle 21" of the spindle gear means 16" is shown to be 140 mm at an upper clamping tool height of 203 mm and a thickness of material of the work piece being 2.5 mm.

[0026] In Fig. 6 the length of the spindle 21" of the spindle gear means 16" is shown to be 263 mm at an upper clamping tool height of 152 mm and a thickness of material of the work piece being 2.5 mm.

[0027] It should be noted that the in the longitudinal direction adjustable device 20' in the first embodiment can in itself be continuously variably adjustable, and the in the longitudinal direction adjustable device 20" via the spindle gear means 16" can be continuously variably adjustable.

Claims

1. An eccentric drive mechanism (D', D'') for a folding machine, comprising a driven wheel (9'; 9'') driven by a drive means (8'; 8''), the driven wheel (9'; 9'') being connected to a clamping beam (1'; 1''), which clamping beam (1'; 1'') is provided with an upper clamping tool (3'; 3'') arranged to cooperate with a lower clamping tool (5'; 5'') so as to clamp a work piece there between when the clamping beam (1'; 1'') performs a movement towards the lower clamping tool (5'; 5''), **characterized in that** a connection between the driven wheel (9'; 9'') and the clamping beam (1'; 1'') is made by an, in the longitudinal direction, adjustable device (20'; 20''), and that a second end (6b'; 6b'') of said in the longitudinal direction adjustable device is eccentrically and pivotably connected to the driven wheel (9'; 9'').
2. The eccentric drive mechanism (D'; D'') according to claim 1, **characterized in that** the length of said in the longitudinal direction adjustable device (20'; 20'') is adjusted so that an angle (α) formed between a vertical line through a first bearing axis of the driven wheel (9'; 9'') and a line drawn through both said first bearing axis of the driven wheel (9'; 9'') and a second bearing axis of said second end (6b'; 6b'') of the in the longitudinal direction adjustable device (20'; 20'') is between 0 to 30°, preferably between 5 to 25°, and more preferably between 10 to 20°, and most preferably is about 15°, when the clamping beam (1'; 1'') has obtained its optimal clamping force.
3. The eccentric drive mechanism (D'; D'') according to claim 1 or 2, **characterized in that** the height of the upper clamping tool (3'; 3'') and/or the lower clamping tool (5'; 5'') is changeable.
4. The eccentric drive mechanism (D'; D'') according to one of claims 1 to 3, **characterized in that** the in the longitudinal direction adjustable device (20'; 20'') is continuously variably adjustable.
5. The eccentric drive mechanism (D'') according to any one of claims 1 to 4, **characterized in that** said in the longitudinal direction adjustable device (20'') comprises a pivotable arm (12''), a first end (12''a) of which is pivotably connected to a first end (6a'') of a pull down rod (6'') and a second end (12''b) of which is pivotably connected to an active end (18'') of a spindle gear means (16''), a passive end (16a'') of which being connected to the clamping beam (1''), and that a second (6b'') end of said pull down rod (6'') is pivotably and eccentrically connected to the driven wheel (9'').
6. The eccentric drive mechanism (D'') according to claim 5, **characterized in that** the arm (12'') is pivotably arranged around a shaft (14a'') so as to form a transmission ratio between the first end (6a'') and the second end (6b'') of the pull down rod (6'') of 1:1 to 1:10, preferably 1:1 to 1:5, and more preferably 1:1 to 1:3, and most preferably 1:2.4.
7. The eccentric drive mechanism (D'') according to claim 5 or 6, **characterized in that** at a joint (19'') pivotally connecting the second end (12b'') of the arm (12'') to the active end (18'') of the spindle gear means (16'') a pressure sensor and/or angle sensor is provided.
8. The eccentric drive mechanism (D'') according to claim 7, **characterized in that** said pressure sensor and/or angle sensor enables measuring the force exerted by the second end (12b'') of the arm (12'') on the active end 18'' of the spindle gear means 16'' and/or the angle between said the second end (12b'') and said active end (18'') and sending a signal to a control device when the required force and/or angle is obtained so as to stop the movement of the clamping beam (1'').
9. The eccentric drive mechanism (D'') according to any one of claims 4 to 8, **characterized in that** said eccentric drive mechanism (D'') is arranged at both sides of a folding machine.
10. The eccentric drive mechanism (D'; D'') according to any one of claims 1 to 9, **characterized in that** eccentric drive mechanism (D'; D'') is intended for a folding machine for folding sheet material.

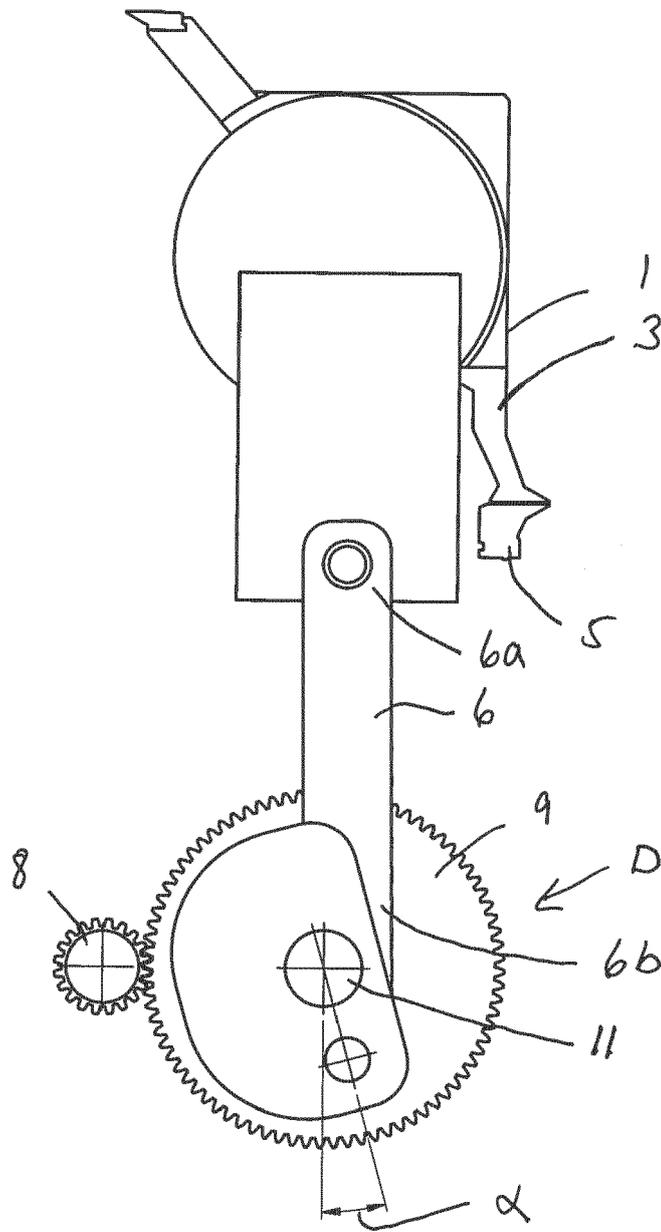


Fig. 1
Prior art

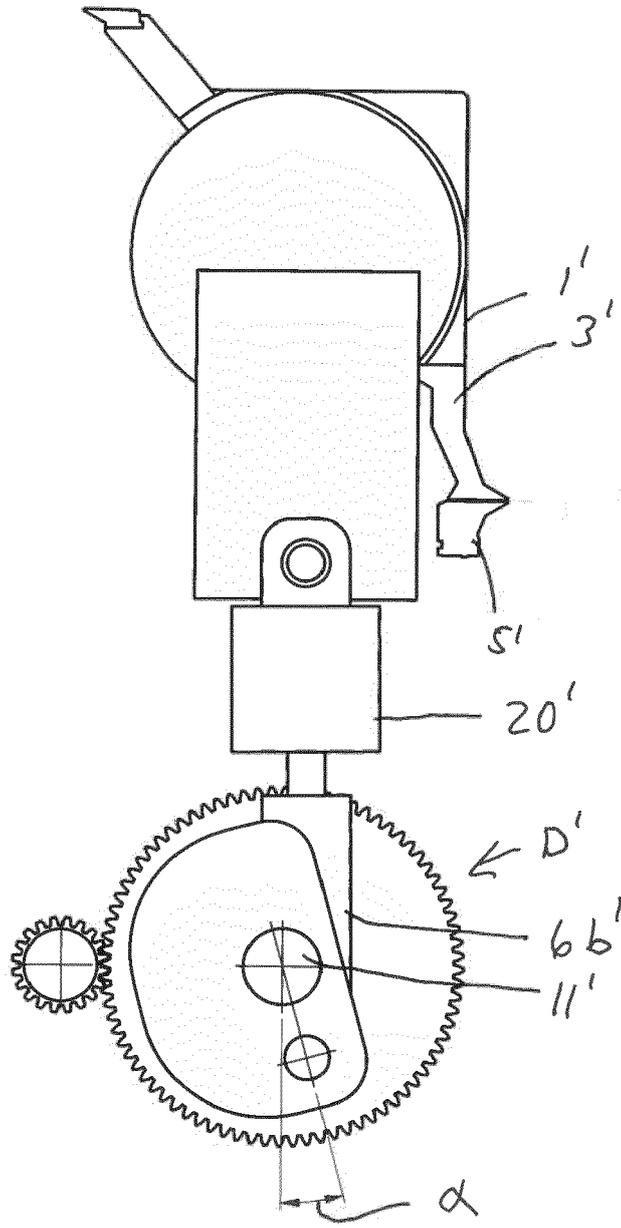


Fig. 2

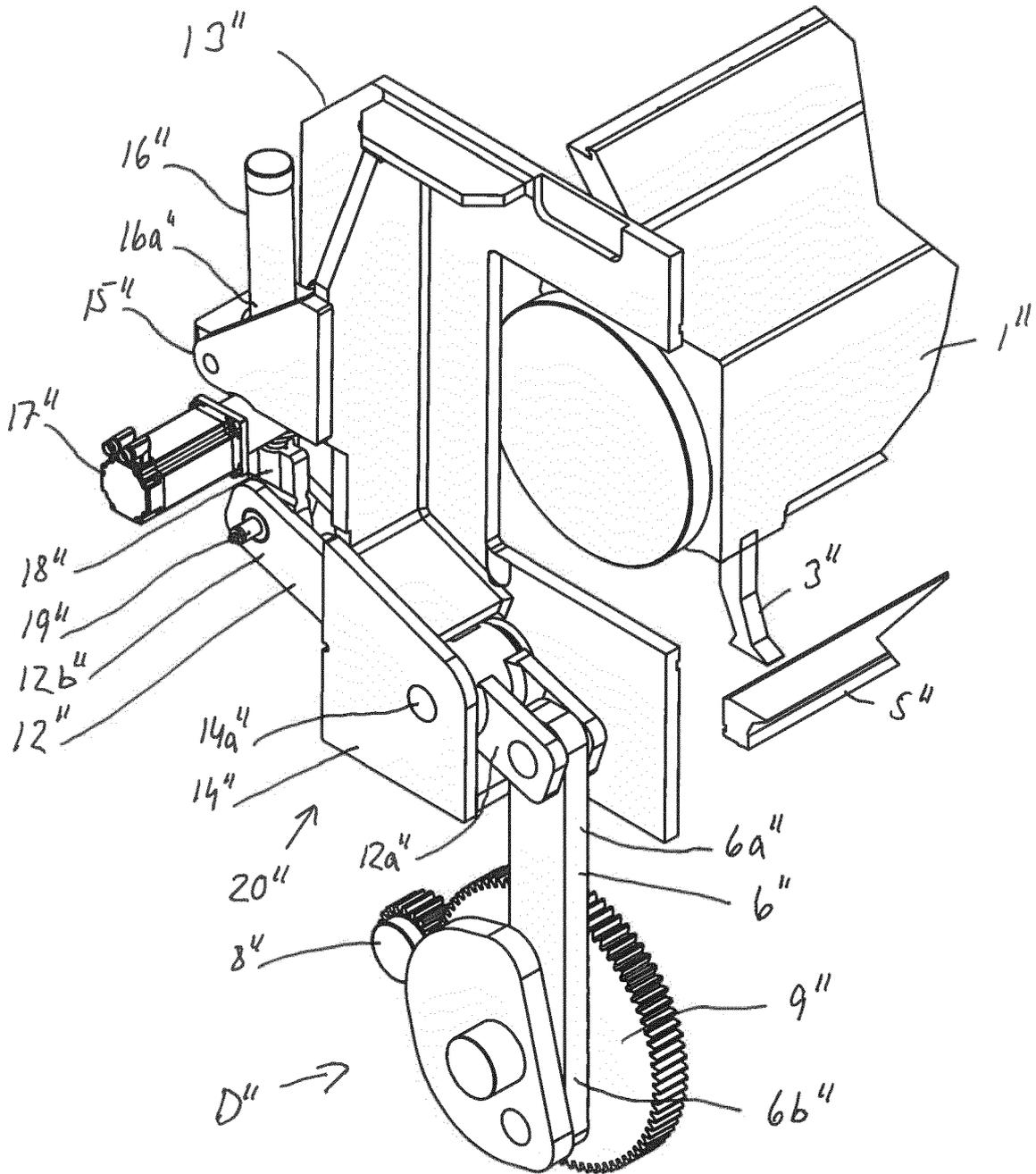


Fig. 3

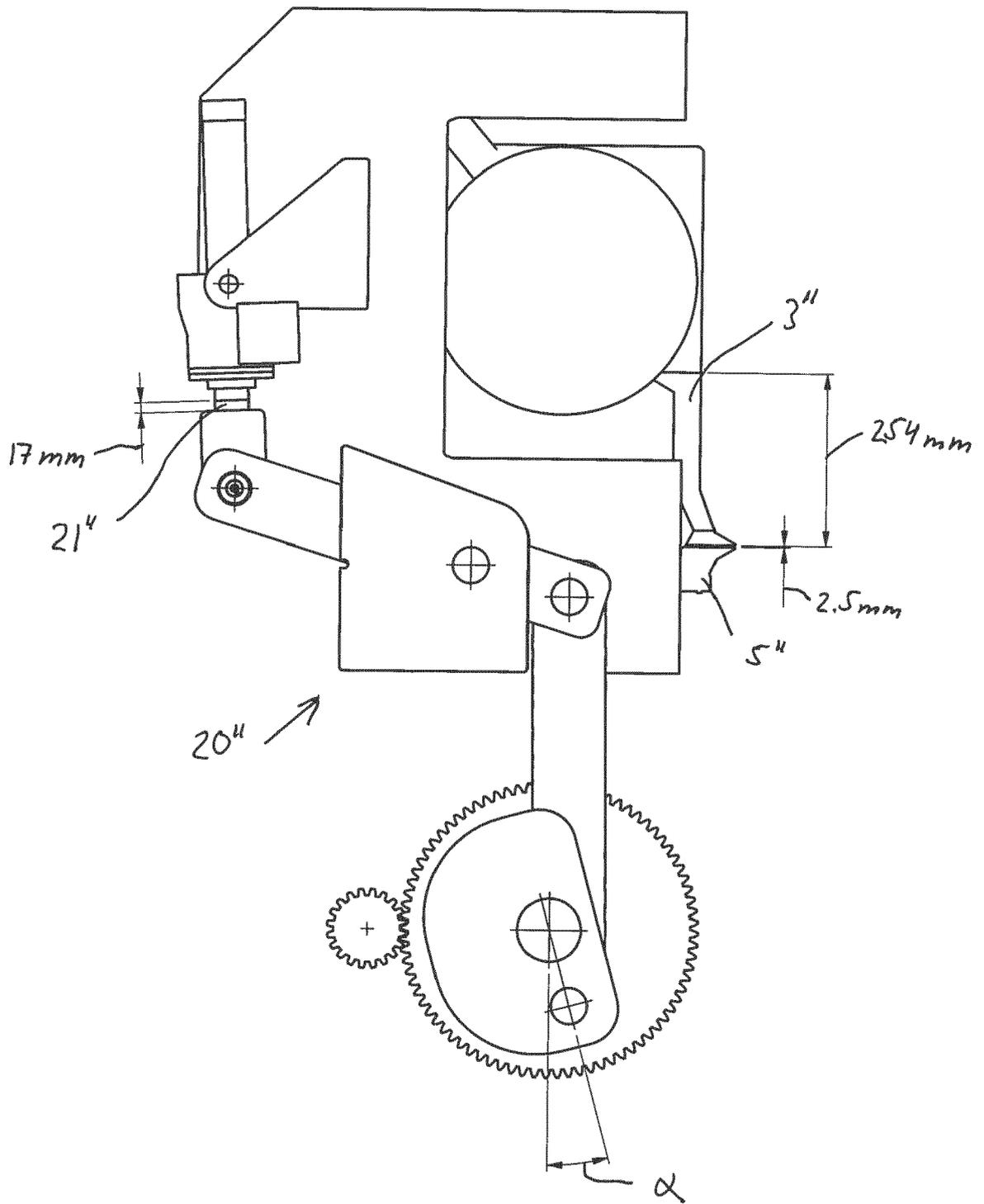


Fig. 4

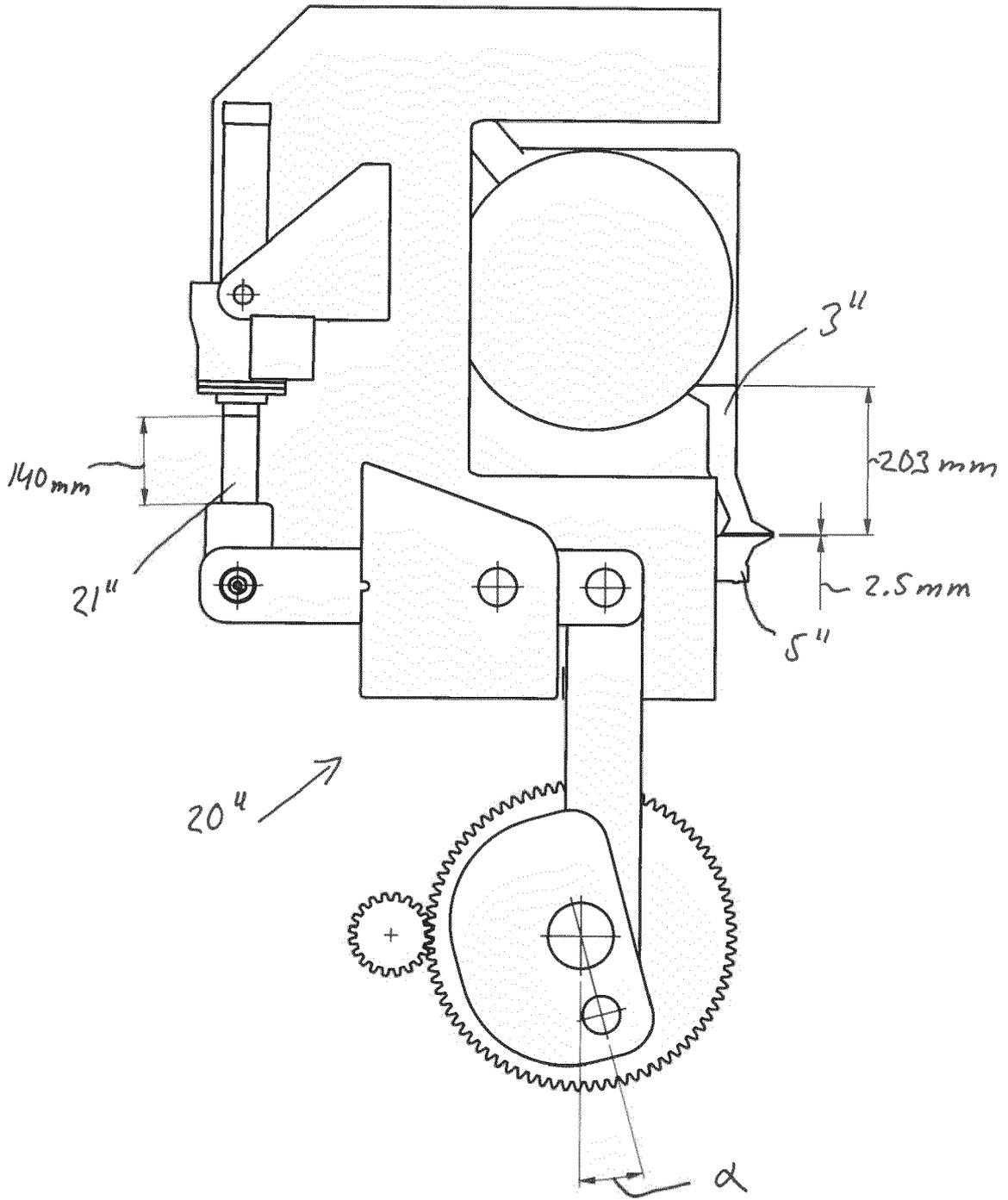


Fig. 5

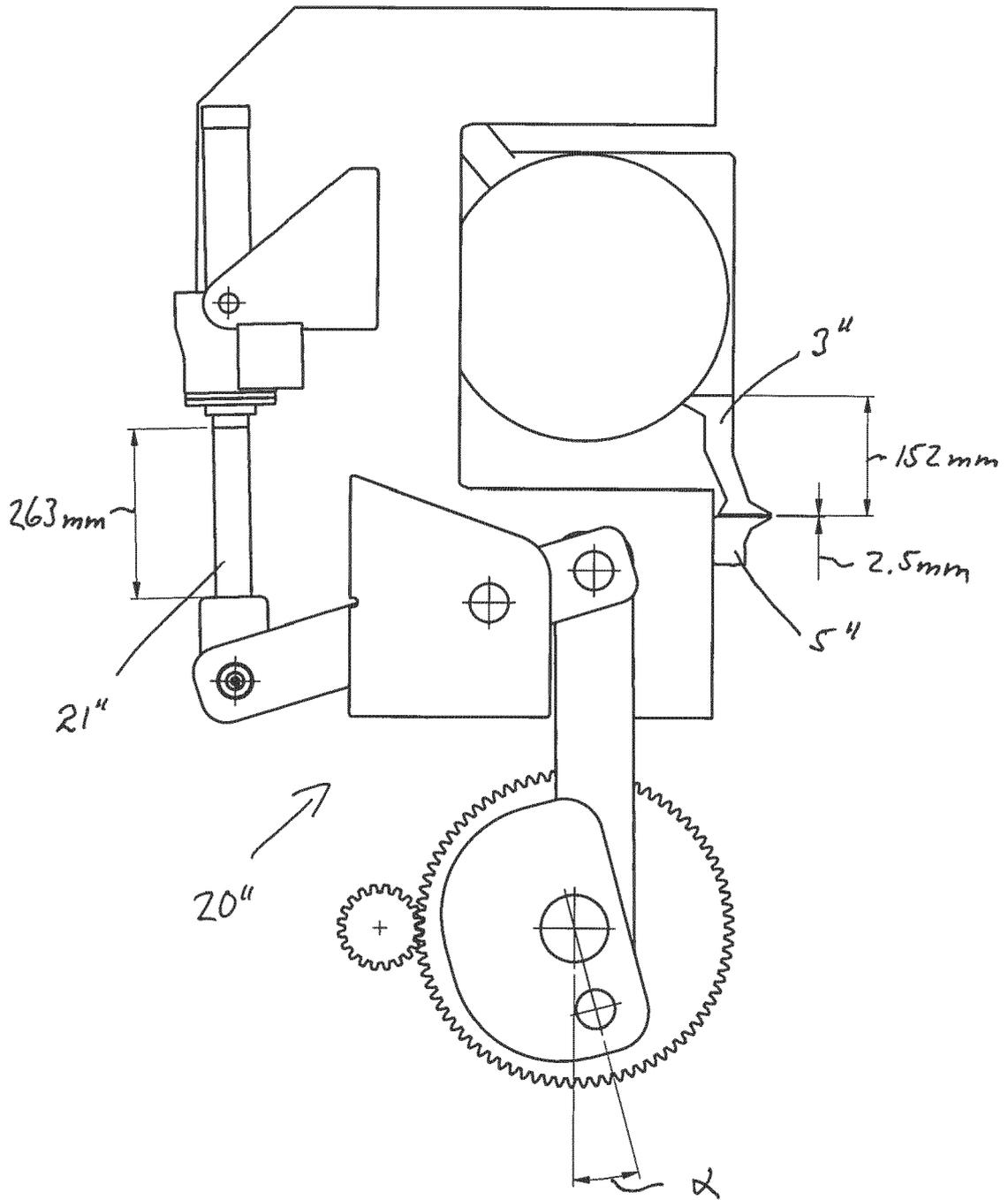


Fig. 6



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Application Number
EP 16 18 4948

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The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 24 January 2017	Examiner Pieracci, Andrea
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

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ANNEX TO THE EUROPEAN SEARCH REPORT
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5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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