EUROPEAN QUALIFYING EXAMINATION 2006

PAPER A
ELECTRICITY / MECHANICS

This paper comprises:

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Client's Letter

From: Mr. Bob In
Threadneedle Street
New Jersey
ZIP Code 45823

To: Stitchup and Partners
European Patent Attorneys
The Old Cotton Club
Taylor St.
Darnington

Dear Mr. Stitchup,

I own a company which makes sewing machines for global markets. Due to their simplicity and robustness, my company's product range includes certain old models which have very high sales in third world countries. In addition to manufacturing and selling sewing machines, my company also runs service centres in which customers' sewing machines are repaired and upgraded.

Fig. 1 shows a sketch of an old-style treadle-driven sewing machine which we have manufactured and sold around the world for many years.

Figs. 2 and 3A show a simplified illustration of a similar sewing machine, but which been upgraded in one of our service centres to be electric-motor driven. Sewing machine 1 has a housing 18 and a shaft 20. A pulley 10 is fixed close to one end of shaft 20. At the same end of shaft 20 is mounted a handwheel 35 (not shown in Fig. 2), which is held in position by a screw 24 locating into an indentation in shaft 20 (see Fig. 3A). This handwheel 35 is used for fine rotation of the shaft 20, for example during delicate sewing operations. An electric motor 16 is mounted on the housing 18, and supplied with electricity through a switch (not shown). Shaft 4 of electric motor 16 is connected to shaft 20 via drive-belt 7 and pulley 10.

As originally constructed, when the sewing machine 1 was treadle-driven, pulley 10 was connected by a belt 12 (shown by a dashed line) to a flywheel 3. This flywheel 3 was connected by a link rod 11 to a treadle 5. Upon exertion of a rocking motion by foot, treadle 5 was made to oscillate about a pivot 13. The oscillating motion of treadle 5 was converted by link rod 11 into a rotary motion of flywheel 3, which in turn drove belt 12 and hence shaft 20.

Our customers were very pleased that their old sewing machines could be converted in such a simple but effective way into being electric motor driven. However, in many third-world areas the electric power supply is often interrupted. Therefore, when there is no electricity, the sewing machine operators disconnect the electric motor drive-belt 7 from pulley 10 and reconnect the belt 12. When the electricity returns, this procedure must be reversed. This can occur several times a day, leading to a loss of time and possibly income.

To avoid this disadvantage, the arrangement of Fig. 3A was replaced several yea by another arrangement, as shown in Fig. 3B. To obtain this arrangement, handwheel 35 was temporarily removed, and in its place a second pulley 10B was fixed to shaft 20. In this arrangement, second pulley 10B could remain connected to electric motor 16 via drive-belt 7, and pulley 10 could remain connected to treadle 5 via belt 12.

To fit second pulley 10B onto shaft 20, a known method was used whereby the pulley was heated so as to increase its inner diameter. It was then slid over shaft 20 and cooled so as to shrink. This resulted in a rigid joint between the two components. Unfortunately, with the installation of this second pulley 10B, there was not enough room to re-mount handwheel 35 onto shaft 20. As handwheel 35 is vital for sewing operations, an extension shaft 14 was mounted onto shaft 20. Handwheel 35 could then be re-mounted onto an external portion of extension shaft 14 having the same diameter as shaft 20, and fixed in position by means of screw 24 locating into an indentation in extension shaft 14. Extension shaft 14 was fixed to shaft 20 by a further screw 25 located in the indentation originally provided in shaft 20 for mounting handwheel 35.

A disadvantage of this arrangement is that when electric motor 16 drives shaft 20 via pulley 10B, pulley 10 is also rotated and drives treadle 5 via belt 12. Treadle 5 then moves up and down at a frantic speed close to the operator, which is both dangerous and wasteful of energy. Conversely, when the sewing machine is treadle driven, shaft 4 of electric motor 16 is also rotated via pulley 10B and drive-belt 7, leading to unnecessary wear on the motor and a very noticeable extra effort for the operator.

I therefore wanted to modify these known sewing machines so that they could be selectively, either by the electric motor or the treadle, without the above disadvantages. My idea was to connect both the electric motor and the treadle to the shaft of the sewing machine via respective one-way clutches. A one-way clutch allows a shaft to be driven in one direction of rotation, but not in the other. The most common example of a one-way clutch is the freewheel hub on the rear wheel of a bicycle. When cycling, the pedals drive the rear wheel via the chain, but the rear wheel cannot drive the pedals. Hence, when going down a hill, the bicycle can "freewheel"; that is, the pedals may remain stationary rather than being turned frantically by the rotation of the rear wheel.

In case you are not sure of how such a one-way clutch works, I will also describe it by means of Figs. 4A-D. These show schematic representations of the effect of such a one-way clutch C when it is interposed between a shaft S and a pulley P, and when a driving force is applied so as to rotate (as indicated by the solid arrow) either pulley P or shaft S. In Fig. 4A, when pulley P is driven in a clockwise direction, one-way clutch C is engaged, and shaft S also rotates in a clockwise direction (as indicated by the dashed arrow). In Fig. 4B, when pulley P is driven in an anti-clockwise direction, one-way clutch C is disengaged so as to freewheel, and shaft S remains stationary. In Fig. 4C, when shaft S is driven in an anti-clockwise direction, one-way clutch C is engaged and hence pulley P also rotates in an anti-clockwise direction (as indicated by the dashed arrow). In Fig. 4D, when shaft S is driven in a clockwise direction, one-way clutch C is disengaged so as to freewheel, and pulley P remains stationary.

The first example of my invention, shown in Fig. 5A, uses two one-way clutches 3[illegible] 31B. Each one-way clutch 31A, 31B forms, together with a pulley 32A, 32B, a respect[illegible] clutch-pulley assembly 30A, 30B. However, such a clutch-pulley assembly cannot be fixed to a shaft by the shrinkage method described above, as heating the one-way clutch would degrade the lubricating properties of the grease contained inside it. This known problem is solved by using other known fixing means, one of which is described below.

According to Fig. 5A, I use two adaptor bushings 22A and 22B mounted onto shaft 20, which adapt the external diameter of shaft 20 to the internal diameter of clutch-pulley assemblies 30A and 30B. The drivable connection between bushings 22A and 22B and clutch-pulley assemblies 30A and 30B may be established by various known means, such as a splined engagement. Appropriate bushings and clutch-pulley assemblies are commercially available in all sizes and combinations, so that any given shaft may always be provided with a clutch-pulley assembly. Clutch-pulley assemblies 30A and 30B are kept in position on bushings 22A and 22B by means of retainer rings 26 and screws 27. Bushings 22A and 22B are made from a copper-based alloy and fitted to shaft 20 by the same shrinkage method described above for pulley 10B of Fig. 3B. The use of bushings is an extremely convenient solution. It allows me to stock clutch-pulley assemblies of only one size, which in combination with bushings of different inner diameters, can be mounted onto all known sewing machine shafts. It also provides compensation for the large manufacturing tolerances of the diameter of these shafts.

Pulley 32A is connected by a belt to the flywheel. Pulley 32B is connected by a dr to the electric motor. Upon operation of the treadle, the associated belt rotates pulley 32A such that clutch 31A is engaged. Shaft 20 thus rotates in the drive direction (corresponding to the situation shown in Fig. 4A). However, this rotation of shaft 20 in the drive direction results in the other clutch 31B, which is associated with the electric motor, being disengaged. Hence pulley 32B and the shaft of the electric motor are not rotated (corresponding to the situation shown in Fig. 4D). Likewise, upon operation of the electric motor, clutch 31A associated with the treadle is disengaged, and hence pulley 32A and the treadle do not move. As is clear from the above, it is essential that the two clutch-pulley assemblies 30A and 30B are mounted onto shaft 20 so that they freewheel in the same direction of rotation.

Another example of my invention requires only a single bushing. This arrangement is shown in Fig. 5B, where clutch-pulley assemblies 30A and 30B are mounted on a common bushing 122. Bushing 122 is made from the same copper-based alloy as bushings 22A and 22B, and is shrink fitted to shaft 20 as previously described. As before, retainer rings 126 and screws 127 keep clutch-pulley assemblies 30A and 30B in position.

In the same way as described above for Fig. 3B, the examples of Figs. 5A and 5B comprise an extension shaft 14, onto which handwheel 35 is re-mounted.

A further example of my invention is shown in Fig. 5C. Here, an extension shaft 21 serves as a common bushing for clutch-pulley assemblies 30A and 30B. Once again, retainer rings 226 and screws 227 keep clutch-pulley assemblies 30A and 30B in position. In this instance, extension shaft 214 is made from the same copper-based alloy as the bushings in the previous examples, and is shrink fitted onto shaft 20 in the same way as previously described for the bushings in Figs. 5A and 5B. Consequently, there is no need for any separate adaptor bushing in this configuration. This should reduce both manufacturing and installation costs. One additional advantage of this configuration is that a greater part of extension shaft 214 is mounted on shaft 20 than is the case for the other configurations. This provides an extension shaft with much greater stability.

I have yet to calculate the material and manufacturing costs of the different examples shown in Figs. 5A-5C, so at present I am not sure which one(s) we will commercialise.

I have noticed that my invention also overcomes, in an unexpected way, another difficulty associated with treadle-driven sewing machines as shown in Figs. 1 and 2. At the end of a sewing operation, link rod 11 can come to rest in such a position that, upon starting of the next sewing operation, flywheel 3 will start rotating in the wrong direction. If this happens, the operator has to reposition flywheel 3 by appropriate rotation of handwheel 35, so that link rod 11 is placed in a correct starting position. If the operator fails to notice incorrect rotation of shaft 20 and does not stop it, the sewing operation is ruined and the machine may even suffer damage.

However, when using a one-way clutch-pulley assembly interposed between sha and pulley 10, if treadle 5 rotates flywheel 3 in the wrong direction, the one-way clutch disengaged, and shaft 20 does not rotate (corresponding to the situation shown in Fig. 4B). Hence the clutch-pulley assembly that I use also acts as a safety device which prevents both spoiling of the sewing operation and damage to the sewing machine when driven by the treadle.

In the next few months I hope to define how, and where, my company will commercialise these ideas. Hence, I would be grateful if you could obtain appropriate protection for every eventuality.

Yours sincerely,

Bob In

Client's Drawings

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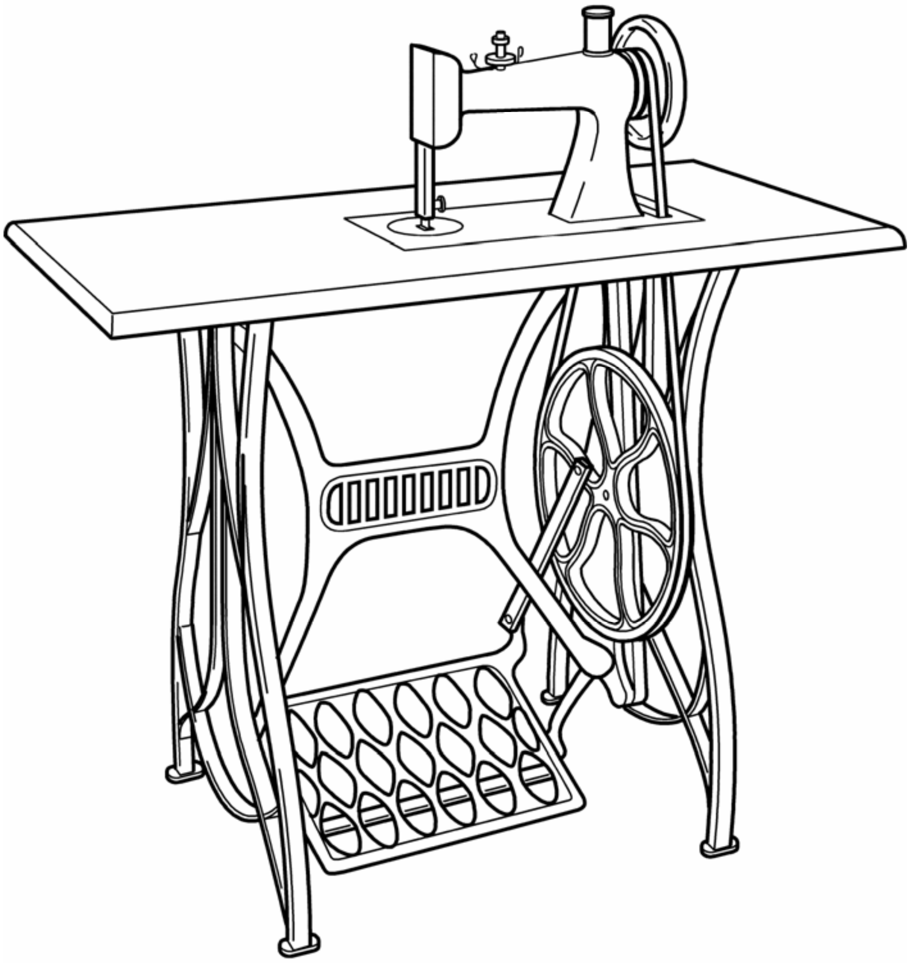

Fig. 1

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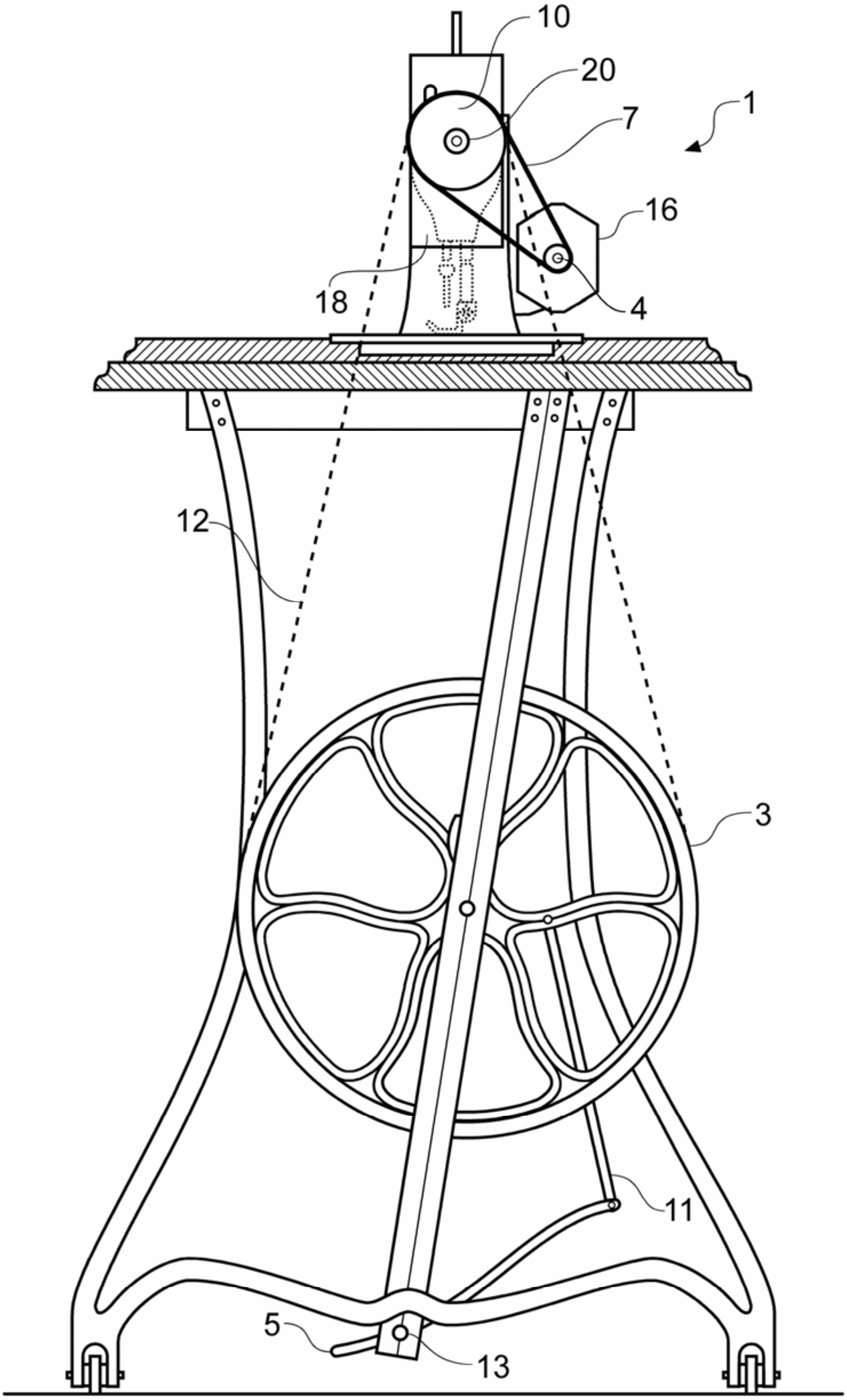

Fig. 2

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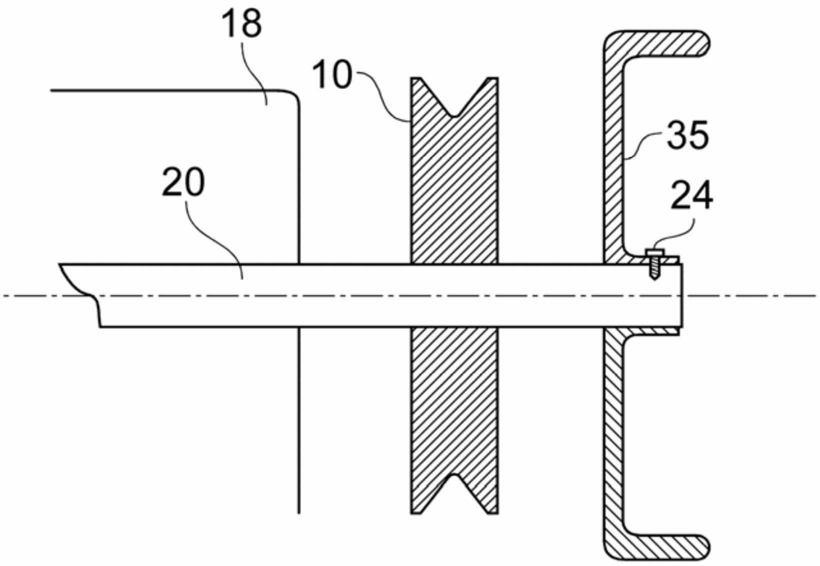

Fig. 3A

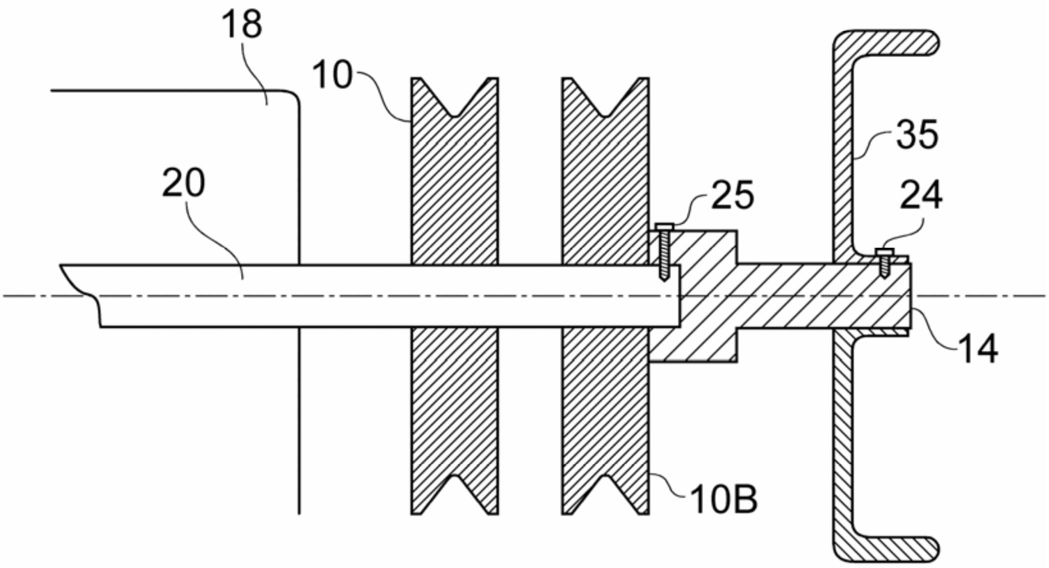

Fig. 3B

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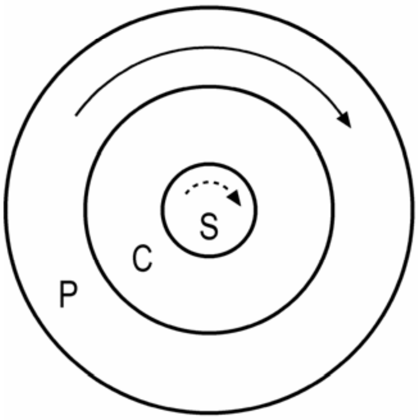


Fig. 4A

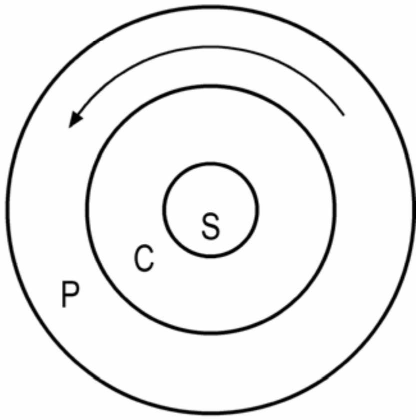


Fig. 4B

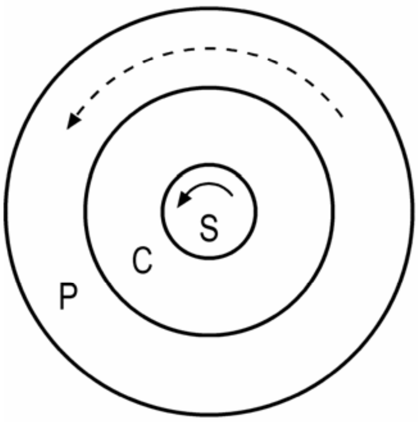


Fig. 4C

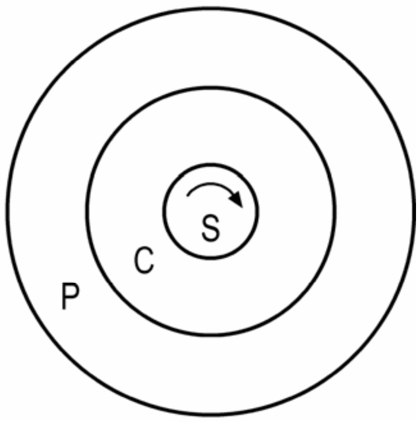
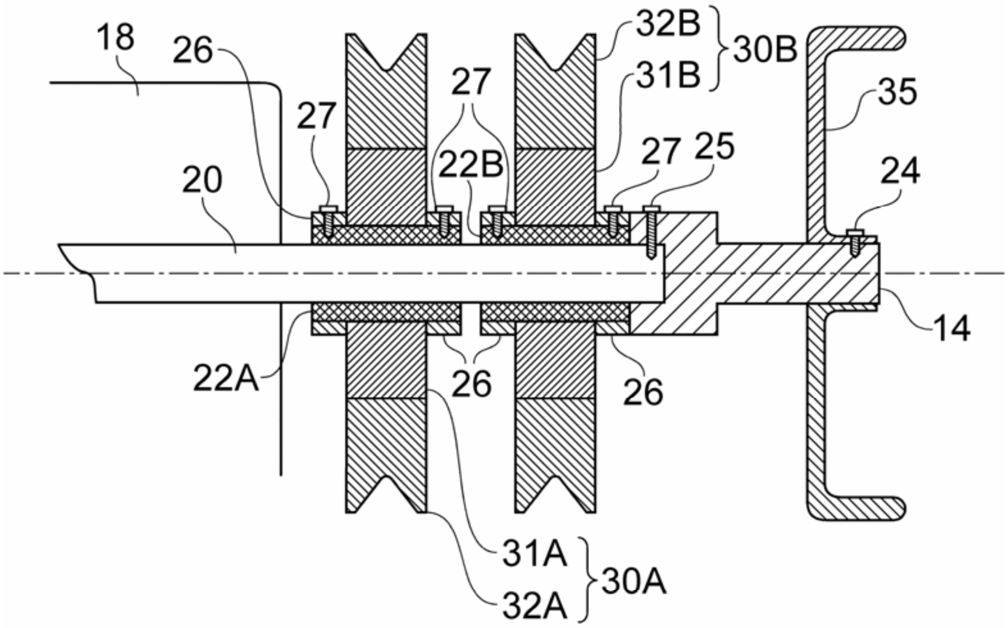
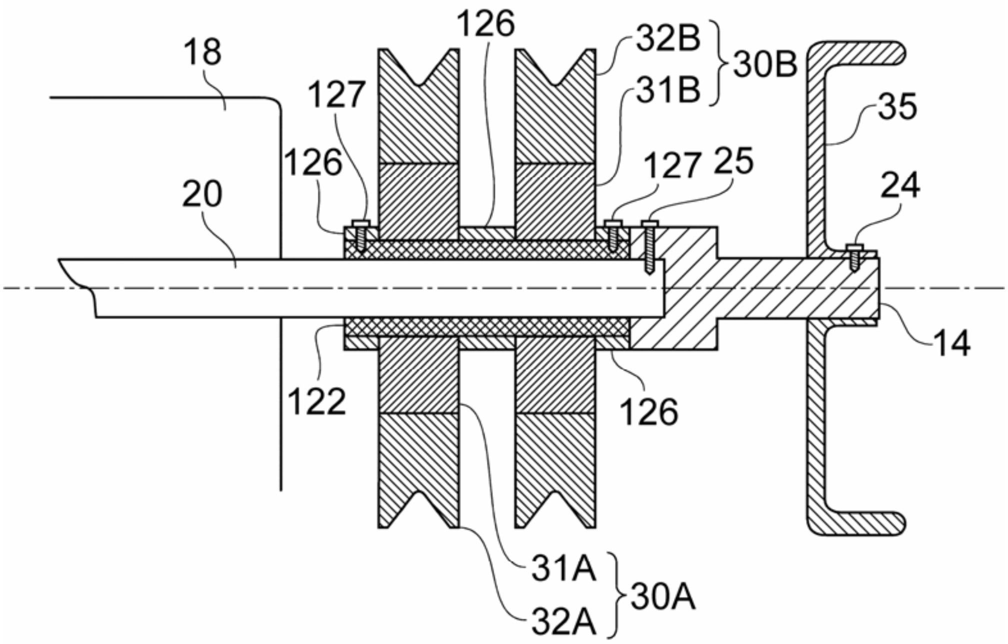


Fig. 4D



18
26
27
27
22B
32B
30B
31B
35
27
25
24
20
14
22A
26
26
31A
30A
32A

Fig. 5A



126
18
32B
30B
31B
127
35
126
127
25
24
20
14
122
126
31A
30A
32A

Fig. 5B

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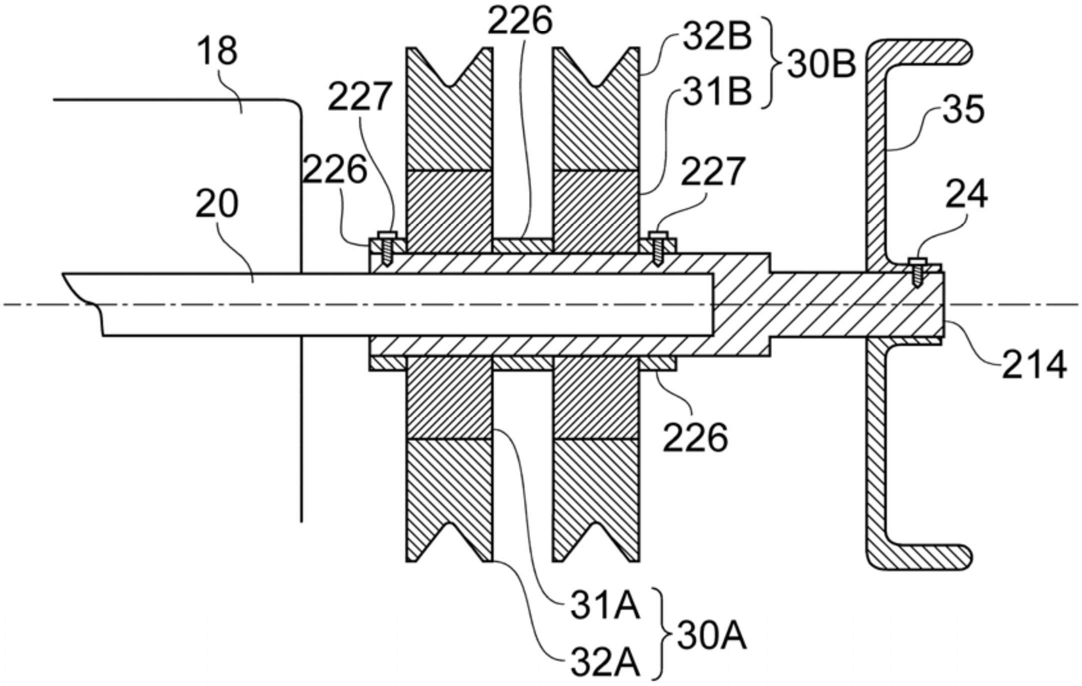

Fig. 5C