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## Description

The present invention relates to a printing wheel for a serial printer.

A printing wheel used in a serial printer is driven by a DC motor in order to select a desired one type element from the many type elements on the wheel. For this purpose, it is desirable to keep the outer diameter of the printing wheel small so as to make the load on the DC motor small. As the outer diameter of a printing wheel is increased the DC driving motor must also be increased in size and the time required for selecting a type element also increases.

On the other hand, accommodation of more type elements on a printing wheel results in an increase of the outer diameter of the printing wheel, because the minimum size of type element is limited and the minimum width of arms supporting type elements is also restricted.

Thus, a reduction in the outer size of a printing wheel and an increase in the number of type elements to be accommodated on the printing wheel are contradictory requirements.

Printing wheels of a variety of structures have already been proposed with a view to satisfying both these contradictory requirements. Examples of such structures will be explained with reference to Figure 1 and Figure 2. In the case of the printing wheel shown in Figure 1, a pair of type elements 3a, 3b are provided on each of the many arms 2 which extend radially from a hub portion 1.

A printing wheel having a structure as shown in Figure 1 is described in US—A—4 126 400 (see Figure 2 thereof).

In the case of the printing wheel shown in Figure 2, only one type element 6 is provided on each of the many arms 5 extending radially from a hub portion 4, but type elements 6a and 6b are located on circumferences of different diameters.

A printing wheel having a structure as shown in Figure 2 is described in US—A—4 126 400 (see Figure 11 thereof).

Each type of printing wheel shown in Figure 1 and 2 allows more type elements to be accommodated without increasing printing wheel diameter, but each printing wheel has such disadvantages as are explained below.

Namely, since the Figure 1 printing wheel has a pair of type elements on each arm, when a type element 3a, for example, is driven by a hammer mechanism for printing towards the printing paper, type element 3b naturally comes close to the printing paper, and a printing may also be made by the type element 3b, in addition to the printing by the type element 3a, resulting in side printing. Moreover, the printing wheel (of Figure 2) provides only one type element on one arm and therefore can avoid the disadvantage as mentioned above, but it has a disadvantage in that the printing characteristics of type elements on arms of different length are different. In other words, since the distance from hub portion 4 to a type element on an arm is different for arms support-

ing type elements 6a and arms supporting type elements 6b, conditions of deformation of an arm when a type element 6a is hit by a hammer mechanism are different from the conditions when a type element 6b is hit. As a result, impact conditions of type elements 6a and 6b on printing paper are different, resulting in differences of contrast and/or quality of printing.

US—A—4 126 400 also describes a printing wheel having two or more hub portions all of the same diameter and each carrying a set of arms, each arm with two or more type elements thereon. The arms of sets on different hub portions may be bent so that the type elements on all the arms lie in the same plane.

According to the present invention there is provided a printing wheel, for a serial printer, in which type elements, on respective arms radiating from a hub part of the printing wheel, only one type element being provided on each arm, are arranged around a plurality of circumferences of respective different diameters, characterised in that the hub part has a plurality of hub portions which support respective sets of arms, each set consisting of arms all with type elements arranged around a respective one of the said circumferences, the said hub portions being of respective different diameters and all the arms being of the same length.

An embodiment of the present invention can provide a printing wheel which can accommodate more type elements without any increase in outer diameter, and moreover which provides the same impact printing characteristics for all type elements.

Reference is made, by way of example, to the accompanying drawings, in which:—

Figure 1 is a schematic perspective view of a part of the structure of a conventional printing wheel;

Figure 2 is a schematic view of the structure of another conventional printing wheel;

Figure 3 is a front end on view of a printing wheel embodying the present invention;

Figure 4 is a cross-sectional view taken along the line IV—IV of Figure 3;

Figure 5a and 5b are respective diagrams illustrating parts of the printing wheel of Figure 3, disassembled for clarity;

Figure 6 is a schematic overall perspective view of a serial printer using a printing wheel embodying the present invention;

Figures 7a, 7b and 7c show the serial printer of Figure 6 in more detail, Figure 7a is a front view, Figure 7b is a side view and Figure 7c is a plan view; and

Figures 8a to 8d illustrate another embodiment of the present invention, Figure 8a is a view similar to that of Figure 3, Figures 8b and 8c are diagrams similar to those of Figures 5a and 5b, and Figure 8d is a view similar to that of Figure 4.

A printing wheel embodying the present invention will be explained with reference to Figure 3 and Figure 4 and Figures 5a and 5b. The printing wheel 30 has a disk-like hub portion 31, many

arms 32 and type elements 33. The arms 32 extend radially from the hub portion and only one type element 33 is provided at the end of each arm 32. Printing wheel 30 is obtained by combining the sub-wheels 30a and 30b as indicated in Figures 5a and 5b.

As indicated in Figure 5a, sub-wheel 30a consists of a hub portion 31a, arms 32a, with one type element 33a provided at the end of each arm 32a. The arms 32a are formed in groups of three arms, each group is provided with the same pitch with predetermined spacing, and the spacing of arms 32a in each group is the same. The radius of sub-wheel 30a is  $W_a$  in length, the length of the hub portion 31a is  $H_a$  and the length from a coupling portion of an arm 32a which joins the hub portion 31a to a type element 33a is set at  $A_a$ .

On the other hand, as indicated in Figure 5b, the sub-wheel 30b consists of a hub portion 31b, arms 32b with one type element 33b provided at the end of each arm 32b. The basic structure is the same as sub-wheel 30a, but the sub-wheels 30a and 30b are different in that the radius of sub-wheel 30b is set to  $W_b$  and the length of hub portion 31b is set to  $H_b$ .

However, it is important that the length  $A_b$  from the hub portion 31b end of an arm 32b to the type element 33b on the arm in the sub-wheel 30b is set to be equal to the length  $A_a$  of the sub-wheel 30a.

The sub-wheels 30a, 30b can desirably be formed by molding of plastics; each type element can be molded simultaneously.

The sub-wheels 30a, 30b are coupled through holes 34a, 34b provided for positioning in the hub portions 31a, 31b. They are fixed and settled together by means of a bonding agent for example. As a result, each arm 32b of sub-wheel 30b is positioned between groups of three arms 32a of the sub-wheel 30a and it is important that type elements 33a of the sub-wheel 30a are arranged on a circumference of radius  $W_a$ , while the type elements 33b of the sub-wheel 30b are arranged on a circumference of radius  $W_b$ . What is more important is that the length of an arm 32a supporting a type element 33a is equal to the length of an arm 32b supporting a type element 33b.

Such a printing wheel 30 is used for a serial printer as indicated in Figure 6.

In Figure 6, 61 is a carrier which moves reciprocally in a longitudinal direction along a platen 62. For this purpose, the carrier is supported by a guide bar 63a and a screw shaft 63b and moves when the screw shaft 63b is rotated by means of a pace motor 64 (DC motor). On the carrier 61, a type selection DC motor 66, a hammer mechanism 67 consisting of a plunger type magnet, and the printing wheel 30 are mounted.

The printing wheel 30 is fixed to the output shaft of the DC motor 66 for type element selection, and a desired type element is placed in a hitting position confronting a hammer 67a of the hammer mechanism 67 by rotating forwards or backwards the DC motor 66. When the posi-

tioning of the desired type element is complete, the magnet is excited and the hammer 67a shifts the type element towards the platen 62. As a result, the arm carrying the type element deforms and the type element hits the printing paper 68 set in the platen 62, thus effecting printing. When one printing operation is complete, the DC motor 66 causes the printing wheel 30 to rotate for selection of a next type element and the space motor 64 rotates, causing the carrier 61 to move to a next print position.

When fitting the print wheel 30 on the output shaft of the DC motor, it is important that the print wheel 30 should be fitted to the output shaft of DC motor 66 so that the sub-wheel 30a of the printing wheel 30 is located on the DC motor side 66, while the sub-wheel 30b is located on the platen 62 side.

Figures 7a, 7b and 7c show in detail the carrier 61 of Figure 6. Parts are given the same reference numbers. The carrier 61 is supported by the guide bar 63a and the screw shaft 63b and is provided with a bracket 72 which can move along a shaft 71 as a centre. This bracket 72 is always urged by a spring 73 in the direction indicated by the arrow mark in Figure 7b. To the bracket 72, the DC motor 66 used for type element selection and the hammer mechanism 67 are fitted. At the rear end of DC motor 66, a position detector 74 is provided and direction of rotation, speed and movement of the DC motor 66 are controlled in dependence upon an output from this position detector 74. The printing wheel 30 is coupled to the output shaft 66a of DC motor 66 via a universal joint 75. The rotating shaft of the printing wheel 30 is supported by a shift lever 76 with freedom of rotation. One end of the shift lever 76 is coupled to the bracket 72 with freedom of rotation, while the other end is engaged with a crank 78 which is fitted to the output shaft of shift motor 77. The shift motor 77, crank 78 and shift lever 76 constitute a shift mechanism. This shift mechanism is provided for shifting the printing wheel 30, in other words, for determining that printing is effected by a type element 33a (outer type element group) of the printing wheel 30 or by a type element 33b (inner type element group). In order to use a type element 33a for printing, the shift motor 77 is so controlled that the printing wheel 30 occupies the position indicated in Figure 7a, while in order to use a type element 33b for printing, the printing wheel 30 must be shifted up from the position indicated in Figure 7a by  $180^\circ$  rotation of the output shaft of the shift motor 77, and then a type element 33b must be located face to face with the hammer 67a of hammer mechanism 67. In this case, said universal joint 75 plays an important role. Namely the printing wheel 30 is shifted by the shift motor 77 but since the DC motor 66 for type element selection is fitted to the bracket 72, the rotating shaft of the printing wheel 30 and the output shaft of the DC motor do not form a straight line. Nevertheless, the rotation of DC motor 66 must be transmitted to the printing wheel, but this is successfully provided by the

universal joint 75 which allows misalignment between shafts.

Figure 8 shows another printing wheel embodying the present invention. This printing wheel 80 consists of, as indicated in Figure 8a and 8b, two sub-wheels 80a, 80b. The sub-wheel 80b is the same as the sub-wheel 30b of Figure 5, but the sub-wheel 80a is a little different from the sub-wheel 30a of Figure 5. This difference is that the hub portion 81a and arms 82a are not in the same radial plane in the sub-wheel 80a. In other words, coupling portions 84 of three arms 82a are provided to a side of the hub portion 81a and a gap is formed between respective coupling portions 84. Therefore, when the sub-wheels 80a and 80b are combined, an arm 82b of the sub-wheel 80b is located between said coupling portions 84, and the result is as indicated in Figure 8d, the arm 82a of the sub-wheel 80a and the arm 82b of the sub-wheel 80b are substantially arranged in the same plane. As in the case of the printing wheel 30 in Figure 5, the length of an arm 82a of the sub-wheel 80a is equal to the length of an arm 82b of the sub-wheel 80b. Arms 82a carry type elements 83a, and arms 82b carry type elements 83b.

As explained above, the printing wheel embodying this invention can accommodate more type elements without an increase in outer diameter of the wheel, and provides the same printing characteristics for all type elements because of the equal lengths of all arms.

Thus, an embodiment of this invention relates to a printing wheel for a serial printer and provides a printing wheel which can accommodate many type elements without an increase in outer diameter of the printing wheel and which gives the same printing characteristics to all type elements when they are hit by a hammer mechanism.

## Claims

1. A printing wheel, for a serial printer, in which type elements (33, 33a, 33b; 83a, 83b), on respective arms (32, 32a, 32b; 82a, 82b) radiating from a hub part (31) of the printing wheel (30, 80), only one type element being provided on each arm, are arranged around a plurality of circumferences of respective different diameters, characterised in that the hub part has a plurality of hub portions (31a, 31b; 81a, 81b) which support respective sets of arms (32a, 32b; 82a, 82b), each set consisting of arms all with type elements arranged around a respective one of the said circumferences, the said hub portions being of respective different diameters and all the arms (32, 32a, 32b; 82a, 82b) being of the same length.

2. A printing wheel as claimed in claim 1, wherein the type elements (33b; 83b) on a first set of arms (32b, 82b), supported by a first hub portion (31b), are arranged around a circumference smaller than that around which type elements (33a; 83a) on a second set of arms (32a, 82a), supported by a second hub portion (31a), are arranged, the first hub portion (31b) being

fitted to that side of the second hub portion (31a) towards which type elements face.

3. A printing wheel as claimed in claim 1 or 2, wherein all the printing elements on all the arms lie in the same plane.

4. A printing wheel as claimed in any preceding claim, engaged on a rotating shaft (66a) of a serial printer, so that upon rotation of the shaft a desired type element can be rotated to an orientation in front of a printing hammer (67a) of the printer, wherein the printer has means (76, 77, 78) for causing a shifting motion of the printing wheel, in a plane substantially vertical to the rotating shaft, such that type elements on respective different circumferences can be brought into a hitting position for hitting by the printer hammer.

5. A printing wheel as claimed in claim 4, engaged on the rotating shaft by way of a universal joint (75), wherein the means for causing the shifting motion comprise a shift motor (77) and a shift lever (76) arranged to be driven by the shift motor, connected to the hub part (31) of the printing wheel (30, 80), and operable to shift the printing wheel in the said plane, misalignment between the axis of the shaft (66a) and the axis of the printing wheel (30, 80) being taken up in the universal joint (75).

6. A printing wheel as claimed in claim 2 or 3, wherein the arms of the second set (82a) are arranged in groups of three with spaces between the groups, into which spaces arms of the first set (82b) extend.

## Patentansprüche

1. Typenrad für einen Seriendrucker, bei welchem Typenelemente (33, 33a, 33b; 83a, 83b) auf entsprechenden Armen (32, 32a, 32b; 82a, 82b), die sich radial von einem Nabenteil (31) des Typenrads (30, 80) erstrecken, wobei lediglich ein Typenelement auf jedem Arm vorgesehen ist, um eine Anzahl von Umkreisen von entsprechend verschiedenen Durchmessern angeordnet sind, dadurch gekennzeichnet, daß der Nabenteil eine Anzahl von Nabenabschnitten (31a, 31b; 81a, 81b) umfaßt, welche entsprechende Sätze von Armen (32a, 32b; 82a, 82b) tragen, jeder Satz aus Armen besteht, die alle Typenelemente aufweisen, die um einen entsprechenden der genannten Umkreise angeordnet sind, die genannten Nabenabschnitte von entsprechend unterschiedlichen Durchmessern sind und alle Arme (32, 32a, 32b; 82a, 82b) von derselben Länge sind.

2. Typenrad nach Anspruch 1, bei welchem die Typenelemente (33b, 83b) auf einem ersten Satz von Armen (32b, 82b), der von einem ersten Nabenabschnitt (31b) getragen wird, längs einem Umkreis angeordnet sind, der kleiner als derjenige ist, längs welchem Typenelemente (33a; 83a) auf einem zweiten Satz von Armen (32a, 82a) welche von einem zweiten Nabenabschnitt (31a) getragen werden, angeordnet sind, der erste Nabenabschnitt (31b) in diejenige Seite des zwei-

ten Nabenabschnitts (31a) eingepaßt ist, zu welcher die Typenelemente schauen.

3. Typenrad nach Anspruch 1 oder 2, bei welchem alle Druckelemente auf allen Armen in derselben Ebene liegen.

4. Typenrad nach einem der vorhergehenden Ansprüche, im Eingriff auf einer rotierenden Welle (66a) eines Seriendruckers, so daß bei Rotation der Welle ein gewünschtes Typenelement in eine Orientierung vor den Druckhammer (67a) des Druckers rotiert werden kann, in welcher der Drucker Einrichtungen (76, 77, 78) zur Bewirkung einer Verschiebewegung des Typenrades hat, in einer Ebene im wesentlichen vertikal zu der rotierenden Welle, so daß Typenelemente auf entsprechend verschiedenen Umkreisen in eine Schlagposition gebracht werden können, um von dem Druckerhammer angeschlagen zu werden.

5. Typenrad nach Anspruch 4, welches mittels eines Universalgelenks auf einer rotierenden Welle angeordnet ist, bei welcher die Einrichtung zur Bewirkung der Verschiebewegung einen Schiebemotor (77) und einen Schiebehebel (76) umfaßt, welcher so angeordnet ist, daß er von dem Schiebemotor angetrieben wird, und mit dem Nabenabschnitt (31) des Typenrads (30, 80) verbunden und zur Verschiebung des Druckrades in der genannten Ebene betätigbar ist, wobei eine Fehlausrichtung zwischen der Achse der Welle (66) und der Achse des Typenrads (30, 80) von dem Universalgelenk (75) aufgenommen wird.

6. Typenrad nach Anspruch 2 oder 3, bei welchem die Arme des zweiten Satzes (82a) in Gruppen von drei mit Abständen zwischen den Gruppen vorgesehen sind, in welche sich Arme des ersten Satzes (82b) erstrecken.

## Revendications

1. Roue d'impression, pour imprimante en série, dans laquelle des éléments de caractère (33, 33a, 33b; 83a, 83b), montés sur des bras (32, 32a, 32b; 82a, 82b) respectifs émanant d'un moyeu (31) de la roue d'impression (30, 80), un seul élément de caractère étant prévu sur chaque bras, sont disposés suivant plusieurs circonférences de diamètres respectifs différents, caractérisée en ce que le moyeu possède plusieurs parties de moyeu (31a, 31b; 81a et 81b) qui portent des ensembles respectifs de bras (32a, 32b; 82a, 82b), chaque ensemble étant constitué de bras tous dotés d'éléments de caractère qui sont disposés

sur l'une respective desdites circonférences, les dites parties de moyeu ayant des diamètres respectifs différents et tous les bras (32, 32a, 32b; 82a, 82) ayant la même longueur.

2. Roue d'impression selon la revendication 1, où les éléments de caractère (33b; 83b) se trouvant sur un premier ensemble de bras (32b, 82b), porté par une première partie de moyeu (31b), sont disposés sur une circonférence plus petite que celle sur laquelle les éléments de caractère (33a, 83a) se trouvant sur un deuxième ensemble de bras (32a, 82a), porté par une deuxième partie de moyeu (31a), sont disposés, la première partie de moyeu (31b) étant montée sur le côté de la deuxième partie de moyeu (31a) vers lequel les éléments de caractère sont tournés.

3. Roue d'impression selon la revendication 1 ou 2, où tous les éléments d'impression de tous les bras sont situés dans le même plan.

4. Roue d'impression selon l'une quelconque des revendications précédentes, montée sur un arbre de rotation (66a) d'une imprimante en série de façon que, à la rotation de l'arbre, un élément de caractère voulu puisse être amené par rotation jusqu'à une orientation le plaçant en face d'un marteau d'impression (67a) de l'imprimante, où l'imprimante possède des moyens (76, 77, 78) permettant de produire un mouvement de décalage de la roue d'impression, dans un plan sensiblement vertical à l'arbre de rotation, de sorte que les éléments de caractère se trouvant sur des circonférences respectives différentes puissent être amenés en position d'être frappés par le marteau de l'imprimante.

5. Roue d'impression selon la revendication 4, montée sur l'arbre de rotation par l'intermédiaire d'un joint universel (75) où les moyens permettant de produire le mouvement de décalage comprennent un moteur de décalage (77) et un levier de décalage (76) destiné à être entraîné par le moteur de décalage, relié au moyeu (31) de la roue d'impression (30, 80) et ayant pour fonction de décaler la roue d'impression dans ledit plan, l'absence d'alignement entre l'axe de l'arbre (66a) et l'axe de la roue d'impression (30, 80) étant compensé dans le joint universel (75).

6. Roue d'impression selon la revendication 2 ou 3, où les bras du deuxième ensemble (82a) sont disposés en groupes de trois de façon qu'il existe entre les groupes des espaces dans lesquels les bras du premier ensemble (82b) sont disposés.

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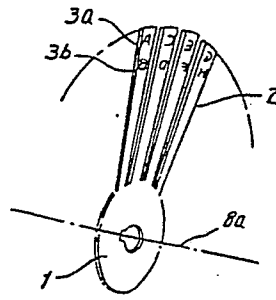


Fig. 1

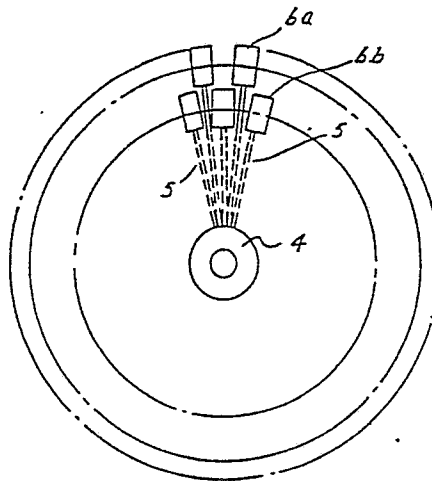


Fig. 2

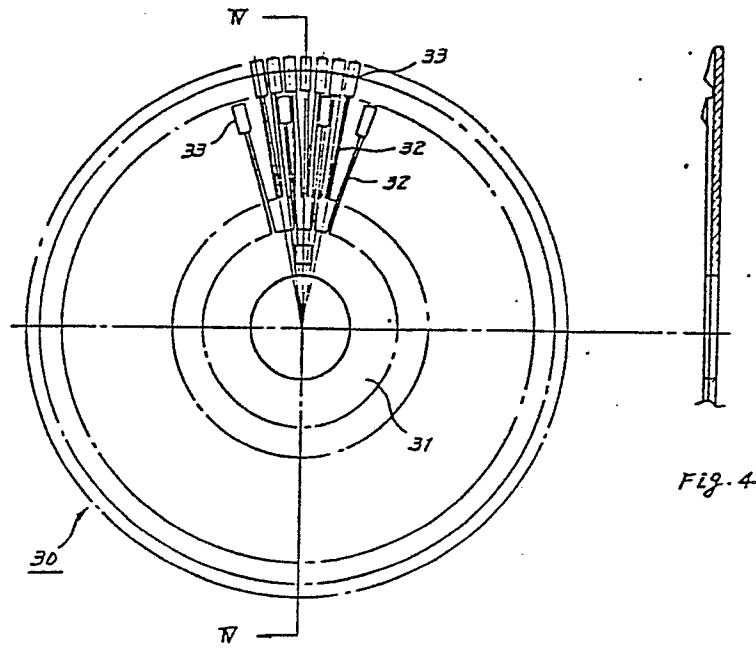


Fig. 3

Fig. 4

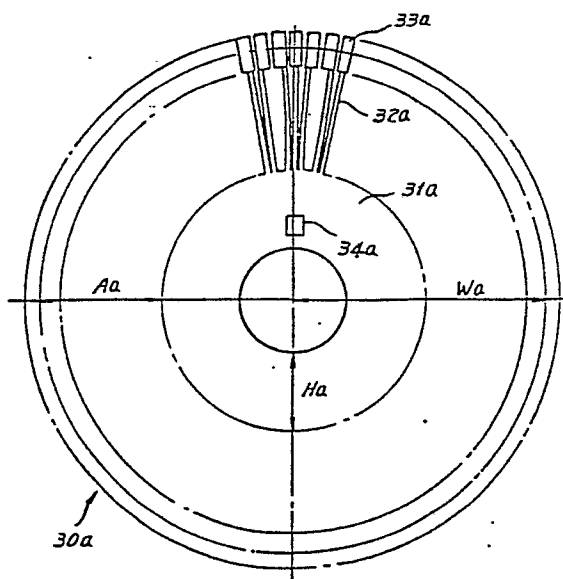


Fig. 5a

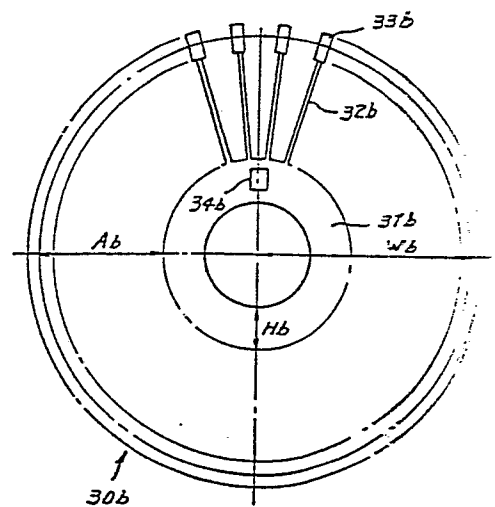


Fig. 5b

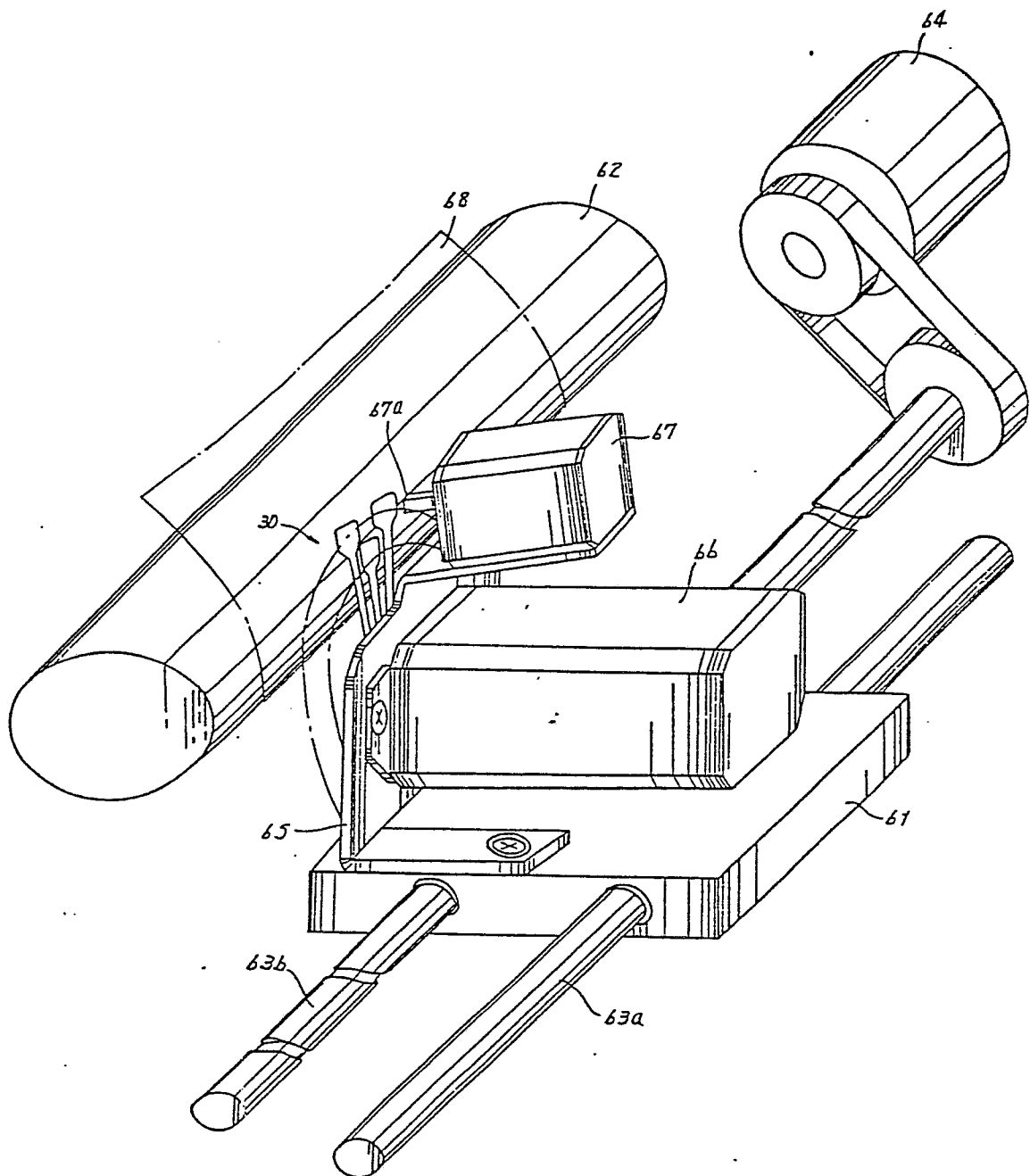


Fig. 6

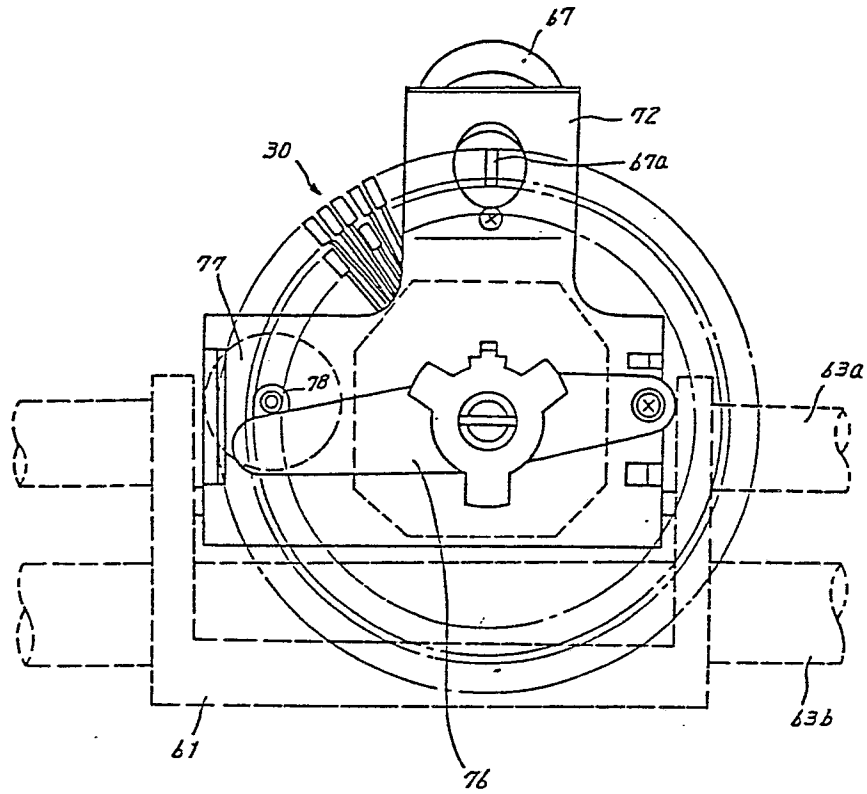


Fig. 7 a

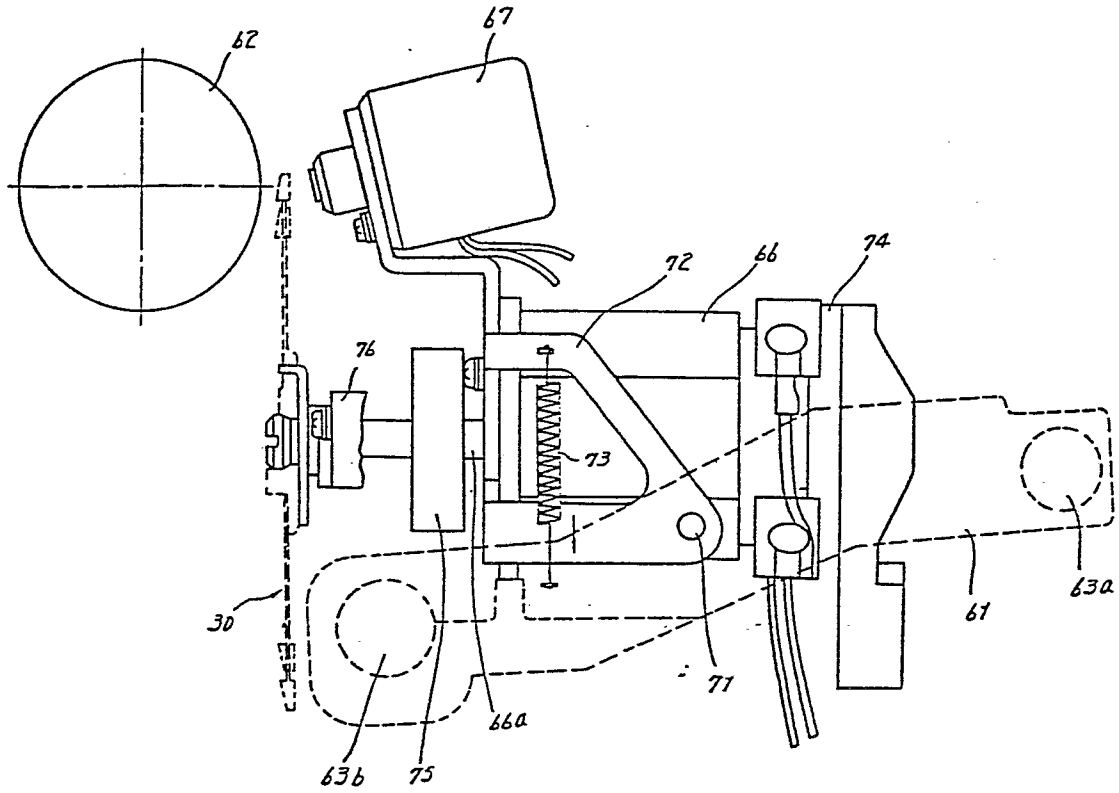


Fig. 7b

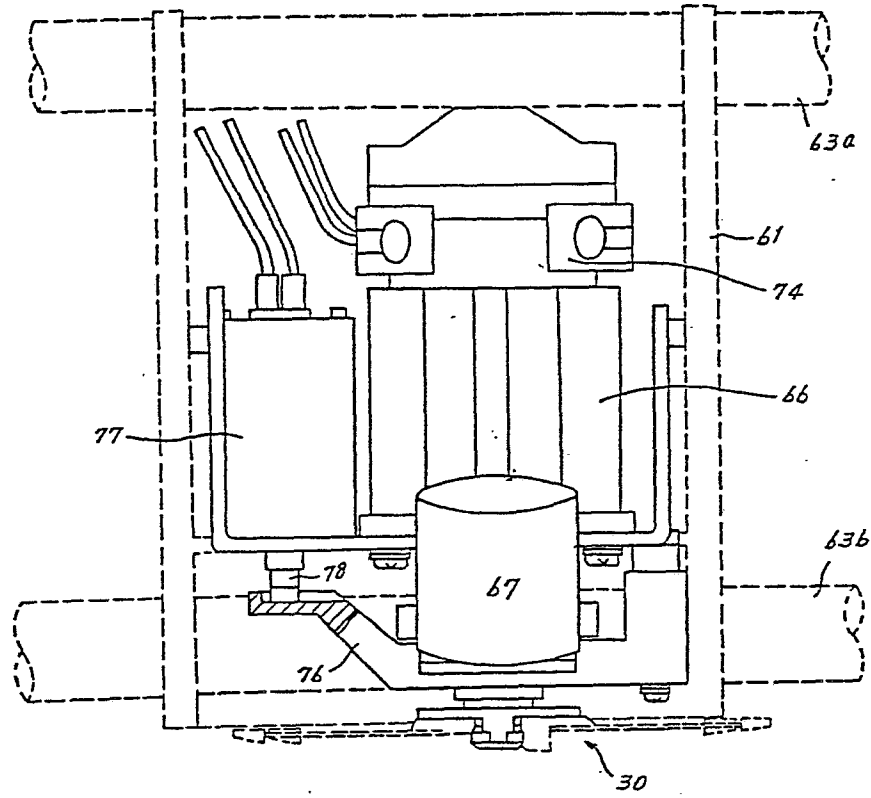


Fig. 7C

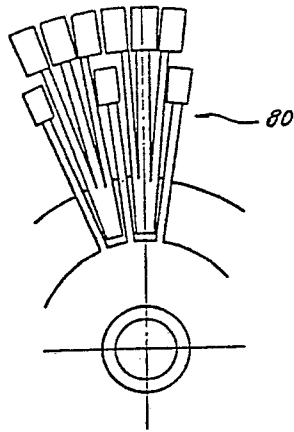


Fig. 8a



Fig. 8d

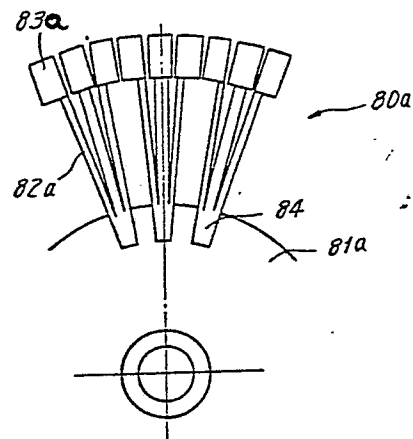


Fig. 8b

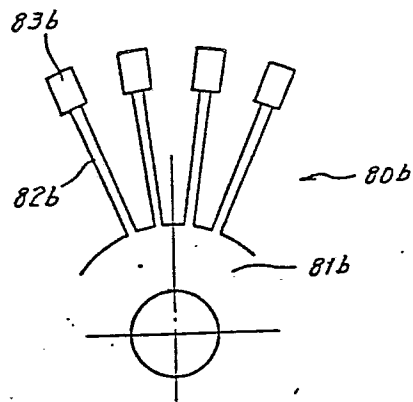


Fig. 8c