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(74) Agent: **GALASSI, Alessandro**; c/o Bugnion, S.P.A., Via Dante, 17, I-25122 Brescia (IT).

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(71) Applicant (*for all designated States except US*): **WORLD-MAC S.R.L.** [IT/IT]; Via Enrico Fermi, 16, I-25020 San Paolo (IT).

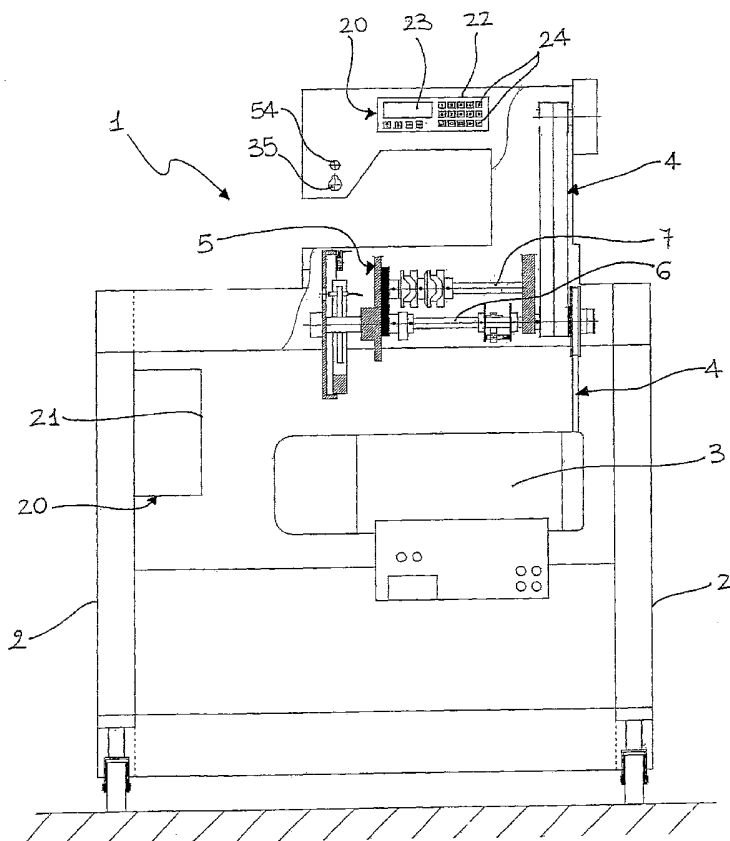
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(72) Inventor; and

(75) Inventor/Applicant (*for US only*): **BOSSONI, Domenico** [IT/IT]; Via Vittorio Veneto, 14, I-25020 Azzano Mella (IT).

[Continued on next page]

(54) Title: SEWING MACHINE



(57) Abstract: A sewing machine (1) comprising a frame (2) onto which a main motor (3) is mounted, the latter being connected through main driving means (4) to first actuating means (5) acting directly upon stitch-building means (8). Said sewing machine (1) further comprises means for conveying a fabric (17), which shift the fabric onto which seams are made, and second actuating means (15), and it is characterized in that it comprises a secondary motor (11), which is also mounted onto the frame (2), whose operation is driven by control means (20) and secondary driving means (12) for transmitting motion from the secondary motor (11) to the second actuating means (15).



Published:

— *with international search report*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

SEWING MACHINE

DESCRIPTION

The present invention relates to a sewing machine and in particular to a sewing machine of the so-called
5 "hand-stitch" type for decorative and functional seams.

A sewing machine according to the invention can thus be advantageously used when manufacturing items of clothing, especially high fashion clothing, for making
10 ornamental seams for instance on shoulders, necks, sleeves and pockets of jackets, coats and shirts, on skirt and trousers trimmings and on handbags, wallets, gloves, scarves and the like.

In particular, such sewing machines are used for running stitch also know as "filzetta" or "puntino". This
15 stitch is characterized by only one thread getting through the borders of the fabric for its whole length, technically known as "needleful", so as to lie alternatively on the right side and on the reverse
20 side of said fabric. Since this stitch is extremely soft, it does not suit in particular an assembling seam and it is therefore generally used for ornamental seams.

The following description will refer explicitly to
25 this kind of application, without however losing its

-2-

general character.

As is known, sewing machines for decorative and functional seams are equipped with only one motor handling the devices for stitch building and through a complex
5 leverage systems also the devices for conveying the fabric onto which the seam is made.

Conventionally, stitch building takes place in two steps. In a first step, the thread is carried by the needle under the fabric where it is discharged onto
10 particular hooking devices. While the needle goes up, said hooking devices push forward the thread required for needleful building under the fabric and keep it in the position thus reached when fabric-conveying devices are activated. In a second step, the needle goes
15 down discharged under the fabric where the thread is fed again thanks to a thread-pushing element. Once the lifting step is over, the fabric is carried again for building the needleful lying above and the thread is kept on the needle by means of an oscillating hook.

20 Sewing machines as described above have however some drawbacks. First of all, they are characterized by a highly complex mechanical structure, which makes the machine little flexible and difficult to be modified. Mechanical components are further easily subject to
25 wear, and therefore their operation could be jeopard-

-3-

ized as time goes on. Moreover, the suitable number of elements which the mechanical structure of the machine is made up of is difficult to be managed, for instance as far as warehouse is concerned, which increases the complexity of machine assembly, thus affecting negatively manufacturing costs. Finally, known sewing machines make very stiff seams characterized by regular stitches, whose appearance is very different from hand-made running stitches.

10 The present invention aims at proposing a sewing machine that can obviate the aforesaid drawbacks. An important aim of the invention is indeed to supply a sewing machine with a rational structure, of simple construction and with low costs, which is therefore

15 characterized by a smaller complexity of the mechanical structure it is made up of. A not less important aim resulting from the previous one is to propose a sewing machine that is less subject to wear. A further aim is to propose a sewing machine that is flexible as

20 far as stitch building is concerned and that can be easily modified for suiting best customers' needs (in this case tailors manufacturing items of clothing). Finally, still another aim of the invention is to supply a sewing machine that makes more elegant and valuable

25 able seams, similar to hand-made running stitches.

-4-

These and other aims that will result from the following description are achieved according to the present invention by means of a sewing machine according to the appended claims.

5 Further characteristics and advantages of the invention will be more evident from the description of a preferred though not exclusive embodiment of the machine.

The invention is disclosed in further detail thanks to
10 drawings showing an embodiment by mere way of non-limiting example.

- Figure 1 shows a front layout view of the sewing machine;
- Figure 2 is a schematic lateral view of the sewing
15 machine of Figure 1;
- Figure 3 shows a front view of the main inner mechanisms of the sewing machine of Figure 1;
- Figure 3a shows a magnified view of a detail of Figure 3;
- 20 - Figure 3b shows a view from above of the detail of Figure 3a;
- Figure 4 shows a sectioned view of the sewing machine of Figure 3 according to lines IV-IV;
- Figure 5 shows a view of the sewing machine of Figure 4 according to lines V-V;
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-5-

- Figure 6 shows a view from above of a magnified detail of Figure 3;
- Figure 7 shows a perspective view of stitch-building devices and of fabric-conveying devices.

5 With reference to the figures above, a sewing machine 1 according to the invention comprises a frame 2 onto which a main motor 3 is mounted. By means of main driving means 4, generally made up of a belt and pulley system, said main motor 3 imparts motion to first
10 actuating means 5 for stitch building. Advantageously, said first actuating means 5 comprise a lower shaft 6 upon which said main driving means 4 act directly, and an upper shaft 7 associated in its movement with the lower shaft 6, as can be seen from Figure 2.

15 The sewing machine 1 described above differs from conventional machines in that it comprises a secondary motor 11, which is also mounted onto the frame 2. It is preferably an electric step-by-step motor, since it should be characterized by a high movement accuracy.

20 Said motor 11 controls directly second actuating means 15 for shifting the fabric onto which seams are made, which mainly comprise a conveying shaft 16.

The secondary motor 11 is wholly actuated by control means 20. Said control means 20 are made up of a programmable electronic control card 21 with microchip (a
25

-6-

"Lite programmer card" EPS-PROG LT for instance) operating thanks to a suitable software. Preferably, control means 20 are operatively connected to all operating parts of the machine 1 so as manage their global operation. Advantageously, the aforesaid control means 20 comprise also means for setting sewing parameters 22, namely a user interface, made up for instance of a display 23 and of a keyboard 24 of conventional type (Figure 1), so as to enable the operator to set parameters for stitch building and thus for machine 1 operation. As a matter of fact, thanks to the use of the electronically actuated secondary motor 11, stitch length can be set and above all seams with stitches of different length can be made. The different length of the various sewing stitches is translated by the control card 21 into an irregular motion of the secondary motor 11 and therefore also of the conveying shaft 16, which actuates directly the fabric-feeding process. As a consequence, the operator can choose stitch basic length and the frequency of irregular stitches depending on the characteristics of the seam to be obtained. Thus, the secondary motor 11 carries out in a simple, accurate and far more flexible manner - thanks to electronics - the functions of the complex mechanical leverage system characterizing known sewing machines.

-7-

Since during the operation of the machine 1 the operating position of the secondary motor 11 should be known at every moment, the latter can be equipped with inner control devices, and in particular with inner encoder and control card. As an alternative, a traditional step-by-step motor 11 can be used, i.e. without inner control devices, and an outer encoder connected to the motor 11 and to the control means 20 or connected to the second actuating means 15 and to the control means 20.

It should be pointed out that the secondary motor 11 is connected to the second actuating means 15 and in particular to the conveying shaft 16 by means of second driving means 12. Said second driving means 12 are basically made up of two pulleys 13, preferably toothed pulleys, one being mounted onto the motor 11 and one onto the conveying shaft 16, and of a belt 14 associated with said two pulleys 13, which is also preferably a toothed belt, as shown in Figure 5.

The description of the main structure of the machine 1 ends with stitch-building means 8 associated to the aforesaid first actuating means 5. First of all, they comprise a needle 18 actuated by the lower shaft 6 and a needle plate 9 associated with the frame 2 of the machine 1 and having at least one opening 10 into

-8-

which the needle 18 can shift for building stitches under the fabric (Figure 7). Other components of said means are - as is known - a take-up hook and a thread holder, which are used for discharging thread from
5 needle 18, a thread-pushing element for feeding thread onto needle 18, and an oscillating hook placed above the fabric for thread guiding, especially during fabric conveyance for stitch building. Said devices are advantageously actuated by the upper shaft 7.

10 Anyhow, it should be pointed out that the various parts of the machine 1 which stitch-building means 8 are made up of are of conventional type and therefore will not be described and disclosed in further detail. A machine 1 according to the invention further re-
15 quires fabric-conveying means 17 (shown schematically in Figure 7 since they are of known type). They are connected to and activated by conveying shaft 16 and are made up of feet 19 mounted onto a jaw and materially conveying fabric for stitch building.

20 Since, as is shown above, the features of the seams to be made can be set every time, the machine 1 should be equipped with means for detecting the angular position
30 of the conveying shaft 16 so as to define the starting position, commonly known as "0 point", for
25 the sewing program that has been set. Preferably, said

-9-

means 30 are activated by the operator through a pushbutton 35 at startup so as to set control card 21. According to a preferred embodiment of the machine 1, shown in the accompanying drawings, said means for detecting the angular position 30 of the conveying shaft 16 are made up of a first disc 31 mounted onto the conveying shaft 16 and provided with a through hole 32, as can be seen in Figure 4, and of at least one first sensor 33. Advantageously, said sensor 33 is a position sensor for detecting the position of the hole 32 of the first disc 31 and for sending said piece of information to the electronic control card 21 to which it is operatively connected. Means 31 described above are further equipped with a stroke-end lever 34 mounted onto the conveying shaft 16, which lever abuts preferably against the lower shaft 6 and prevents the conveying shaft 16 from making a complete rotation on itself, so as to ensure the possibility to find the starting point for the sewing program. In an alternative embodiment (not shown), instead of using the first disc 31 with its related sensor 33 and the stroke-end lever 34, the machine 1 can be equipped with an encoder associated with the conveying shaft 16 and operatively connected to the electronic control card 21.

-10-

The sewing machine described above further comprises means for detecting the position 40 of needle 18 with respect to the fabric. Said means 40 enable to activate the second actuating means 15 and therefore the fabric-conveying means 17 and the stitch-building means in the time lapse in which needle 18 is outside said fabric. Preferably, said means for detecting the position 40 of needle 18 comprise a second disc 41 mounted onto the lower shaft 6 and integral with the latter in its rotary movement, having a suitable angular opening 42, as can be seen in Figure 4, corresponding to the position in which the needle 18 lies outside the fabric. Said angular opening 42 is detected by at least one second position sensor 43 operatively connected to the electronic control card 21 (Figures 3 and 6).

A preferred embodiment of the sewing machine 1 according to the invention also comprises sealing means 50, advantageously activated by the operator by means of a pushbutton 54. It should be pointed out that "sealing" refers to the execution of two or more overlapping stitches, to be made as a rule at seam beginning and at seam end so as to prevent seam from getting loose. Preferably, said means 50 make use of the components of the means for detecting the position 40 of needle

-11-

18. Therefore, when the operator acts upon the pushbutton 54, the second sensor 43 of the means for detecting the position 40 of needle 18 is activated and reads the position of the opening 42 of the second disc 41 (Figure 6). The signal sent by the second sensor 43 tells the electronic control card 21 to invert the motion of the secondary motor 11 so as to push fabric back. As an alternative, sealing could be executed by means 50 that are not connected to the means for detecting the position 40 of needle 18. In such a case the lower shaft 6 would be equipped with a further disc having an opening, operating with a further position sensor for detecting said opening and suitably connected to the electronic control card 21.

15 A further characterizing element of the present sewing machine 1 consists in needle-cleaning means 60. They advantageously comprise a third disc 61 with an opening 62 mounted onto the lower shaft 6, and at least one third position sensor 63 for detecting the position of the opening 62 of the disc 61, which is also

20 operatively connected to the electronic control card 21. More to the point, this third sensor 63 detects the opening 62 of the third disc 61 when the needle 18 lies in the lower dead point of its stroke every two

25 operating cycles, i.e. when the needle 18 has ended

-12-

its descending step together with the thread and is going up discharged. Said sensor 31 starts - obviously through the control card 21 - cleaning devices 64 acting upon needle 18 in the lower dead point of its stroke (Figure 3a and 3b). When operating, they generate onto the needle 18 a sort of air jet 65 that keeps needle 18 and thread clean since, due for instance to thread waxing, dirt and dust particles build up on the needle's eye, thus reducing frictions and therefore breaking possibilities. Still according to the invention, the needle plate 9 is preferably modified. In particular, the opening 10 through which needle 18 moves is closed for about $\frac{3}{4}$ of its length so as to make the stitch softer and more suitable for manufacturing particular items of clothing, such as men's jackets and coats. Said plate 9 can be used also with known sewing machines.

In the light of the above description, the sewing machine 1 according to the invention works as follows.

At startup the main motor 3 is activated and induces a continuous rotary movement on the lower 6 and upper shaft 7.

When the operator acts upon the pushbutton 35, the first sensor 33 detects the opening 32 of the first disc 31 and sends this information to the control card

-13-

21, so as to define the starting point for the sewing program that has been set. As an alternative, the starting point can be defined thanks to an encoder, as was said above.

5 Simultaneously, the second sensor 43 detects the angular opening 42 on the second disc 41 and enables the electronic control card 21 to identify the time lapse during which the needle 18 lies outside the fabric.

Now the electronic card 21 processes information received by the first 33 and by the second sensor 43 and
10 information input by the operator through the user interface 22 and activates suitably, i.e. when the needle 18 lies outside the fabric, the secondary motor 11 and therefore the conveying shaft 17 and the conveying
15 means 17. Depending on the position of the needle 18, also the stitch-building means 8 operating with the lower 6 and upper shaft 8 are then shifted.

During the motion of the needle 18, the third sensor 63 detects the opening 62 of the third disc 61 so that
20 the control card 21 activates the devices for needle cleaning 64 every time the latter lies in the lower dead point of its stroke after descending together with the thread.

When, as a rule at seam beginning or at seam end, the
25 operator acts upon the pushbutton 54 for sealing, the

-14-

second sensor 43 detects the position of the opening 42 of the second disc 41 and sends a signal to the electronic control card 21. This signal is construed as an order to invert the direction of motion of the conveying shaft 16 by means of the secondary motor 11, so as to push the fabric back and make one or more stitches overlapping those made previously.

In practice, any material and size can be used depending on the various needs.

Moreover, all details can be replaced by technically equivalent elements.

The invention has important advantages. First of all, the integration of electronic devices into the machine has resulted in a series of positive effects. Firstly, the introduction of the secondary motor 11 controlled by its control means instead of the complex system of mechanical devices characterizing conventional machines has enabled to make machine structure simpler, easy to be carried out and durable. Secondly, the use of electronic devices allows to increase much the flexibility of the sewing machine. Thus, stitch length can be chosen in a broader size interval: the described machine can indeed make stitches with a length of 0.5 mm to 15 mm, whereas conventional machines make stitches with a maximum length of 7 mm. Moreover, a

-15-

seam made up of stitches having different lengths can be executed, which would be impossible with mechanically actuated machines, as in hand-made seams. A further important advantage consists in that the sewing
5 machine described above, thanks to its flexibility, enables to meet customers' needs and requests to a higher degree. Finally, it allows to adapt the elegance and value of hand-made seams to series production.

-16-

CLAIMS

1. A sewing machine (1) comprising:
a frame (2),
a main motor (3) mounted onto said frame (2),
5 first actuating means (5) for stitch building,
main driving means (4) for transmitting movement
from said main motor (3) to said first actuating means
(5),
stitch-building means (8) operatively associated
10 with said first actuating means (5),
fabric-conveying means (17) for shifting said fabric
onto which said stitches are made from said
stitch-building means (8), and
second actuating means (15) for said conveying
15 means (17);
characterized in that it further comprises:
a secondary motor (11) mounted onto said frame,
control means (20) acting upon said secondary motor
(11) for controlling its operation, and
20 secondary driving means (12) for transmitting movement
from said secondary motor (11) to said second actuating
means (15).
2. The sewing machine (1) according to the preceding
claim, characterized in that said secondary motor (11)
25 is an electric motor.

-17-

3. The sewing machine (1) according to claim 2, characterized in that said secondary motor (11) is a step-by-step motor.

4. The sewing machine (1) according to claim 3, characterized in that said secondary motor (11) has inner control devices for detecting the angular operating position of said secondary motor (11).

5. The sewing machine (1) according to claim 3, characterized in that it further comprises an encoder
10 operatively connected to said secondary motor (11) and to said control means (20).

6. The sewing machine (1) according to claim 3, characterized in that it further comprises an encoder
operatively connected to said second actuating means
15 (15) and to said control means (20).

7. The sewing machine (1) according to any of the preceding claims, characterized in that said secondary driving means (12) comprise at least two pulleys (13) and at least one belt (14).

20 8. The sewing machine (1) according to claim 7, characterized in that said at least two pulleys (13) and said at least one belt (14) are toothed.

9. The sewing machine (1) according to any of the preceding claims, characterized in that said control
25 means (20) comprise an electronic programmable control

-18-

card (21).

10. The sewing machine (1) according to claim 9, characterized in that said control means (20) further comprise means for setting sewing parameters (22) by
5 an operator.

11. The sewing machine (1) according to any of the preceding claims, characterized in that said first actuating means (5) comprise a lower shaft (6) associated with said main driving means (4), and an upper
10 shaft (7) associated with said lower shaft (6) and acting upon said stitch-building means (8).

12. The sewing machine (1) according to any of the preceding claims, characterized in that said stitch-building means (8) comprise at least one needle plate
15 (9) having at least one opening (10) and associated with said frame (2), and a needle (18) moving inside said at least one opening (10) of said needle plate (9).

13. The sewing machine (1) according to any of the preceding claims, characterized in that said second
20 actuating means (15) comprise a conveying shaft (16) acting upon said means for conveying said fabric (17).

14. The sewing machine (1) according to any of the preceding claims, characterized in that it further
25 comprises means for detecting the angular position

-19-

(30) of said conveying shaft (16) for defining the starting position of a sewing program that has been set.

15 15. The sewing machine (1) according to claim 14, characterized in that said means for detecting the angular position (30) of said conveying shaft (16) comprise a first disc (31) mounted onto said conveying shaft (16) and having a through hole (32) and at least one first position sensor (33) detecting the position
10 of said hole (32) of said first disc (31) and operatively connected to said electronic control card (21).

16. The sewing machine (1) according to claim 15, characterized in that said means for detecting the angular position (30) of said conveying shaft (16) further
15 comprise a stroke-end lever (34) mounted onto said conveying shaft (16) so as to prevent said conveying shaft (16) from making a complete rotation on itself.

17. The sewing machine (1) according to claim 14,
20 characterized in that said means for detecting the angular position (30) of said conveying shaft (16) comprise a first encoder associated with said conveying shaft (16) and operatively connected to said electronic control card (21).

25 18. The sewing machine (1) according to any of the

-20-

preceding claims, characterized in that it further comprises means for detecting the position (40) of said needle (18) with respect to said fabric, associated with said lower shaft (6) so as to activate said
5 second conveyance actuating means (15).

19. The sewing machine (1) according to claim 18, characterized in that said means for detecting the position (40) of said needle (18) comprise a second disc (41) mounted onto said lower shaft (6) and moving integrally with said lower shaft (6) and having an angular opening (42) corresponding to the position in which said needle (18) lies outside said fabric, and at least one second position sensor (43) detecting the position of said angular opening (42) of said second
10 disc (41) and operatively connected to said electronic control card (21).

20. The sewing machine (1) according to any of the preceding claims, characterized in that it further comprises sealing means (50) associated to said lower
20 shaft (6).

21. The sewing machine (1) according to claim 20 if dependent on claim 19, characterized in that said sealing means (50) comprise said second disc (41) of said means for detecting the position (40) of said
25 needle (18) and said at least one second position sen-

-21-

5 sor (43) of said means for detecting (40) the position of said needle (18), which can be activated by said operator and detect the position of said opening (42) of said second disc (41) and operatively connected to said electronic control card (21).

22. The sewing machine (1) according to any of the preceding claims, characterized in that it further comprises means for cleaning (60) said needle (18) associated with said stitch-building means (8).

10 23. The sewing machine (1) according to claim 22, characterized in that said means for cleaning (60) said needle (18) comprise a third disc (61) mounted onto said lower shaft (6) and having an opening (62), at least one third position sensor (63) for detecting
15 the position of said opening (62) of said third disc (61), representing the condition in which said needle (18) lies in a lower dead point of its stroke every two operating cycles, and operatively connected to said electronic control card (21), and cleaning de-
20 vices (64) actuated by said electronic control card (21) and acting upon said needle (18) in said lower dead point.

24. The sewing machine (1) preferably according to any of the preceding claims, characterized in that
25 said opening (10) of said needle plate (9) has a

-22-

length below 5 mm for obtaining a softer stitch.

25. Textile manufactured items, characterized in that they are provided with seams obtained with a sewing machine (1) according to any of the preceding claims.

FIG. 1

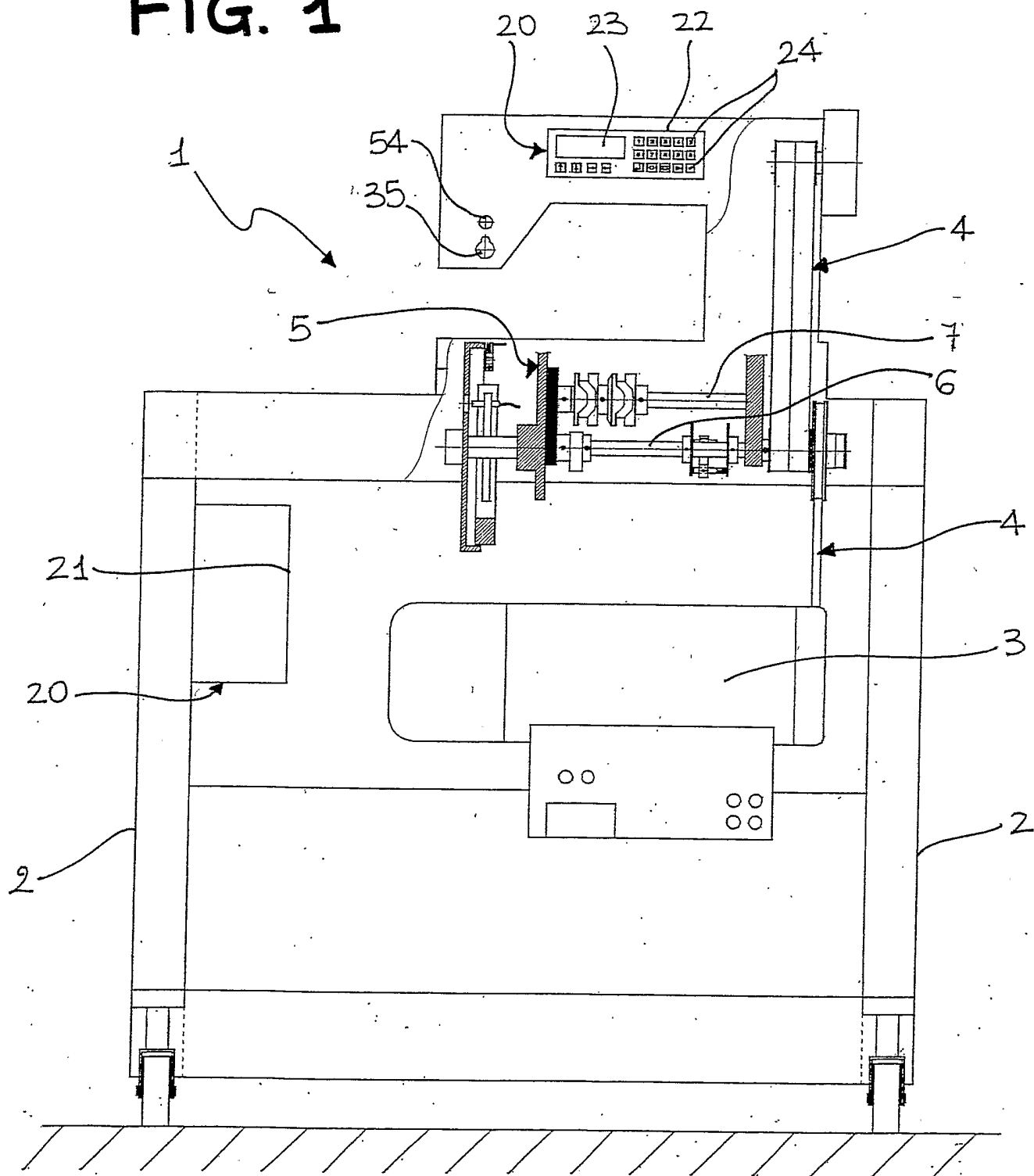


FIG. 2

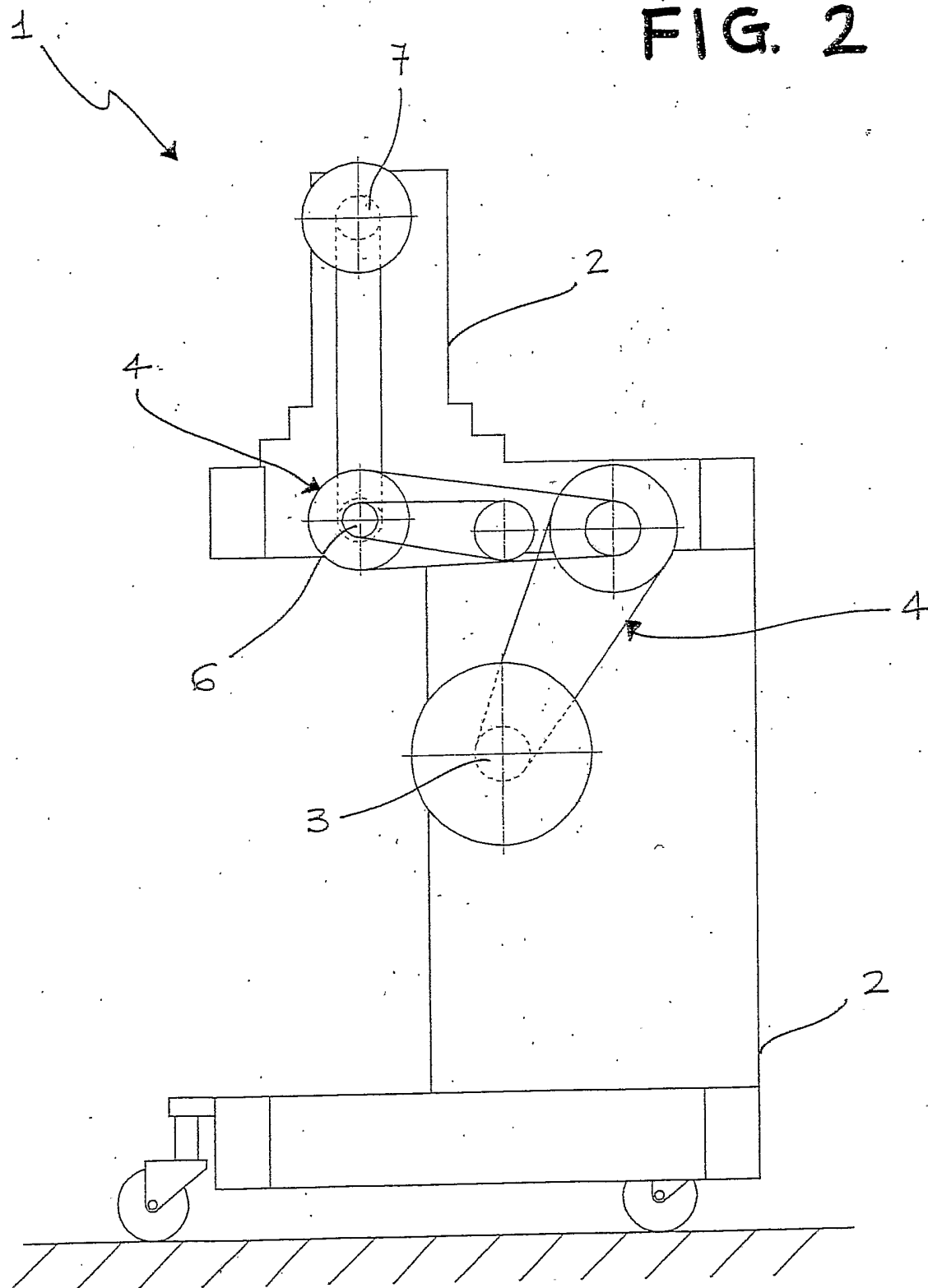


FIG. 3

FIG. 3b

FIG. 3a

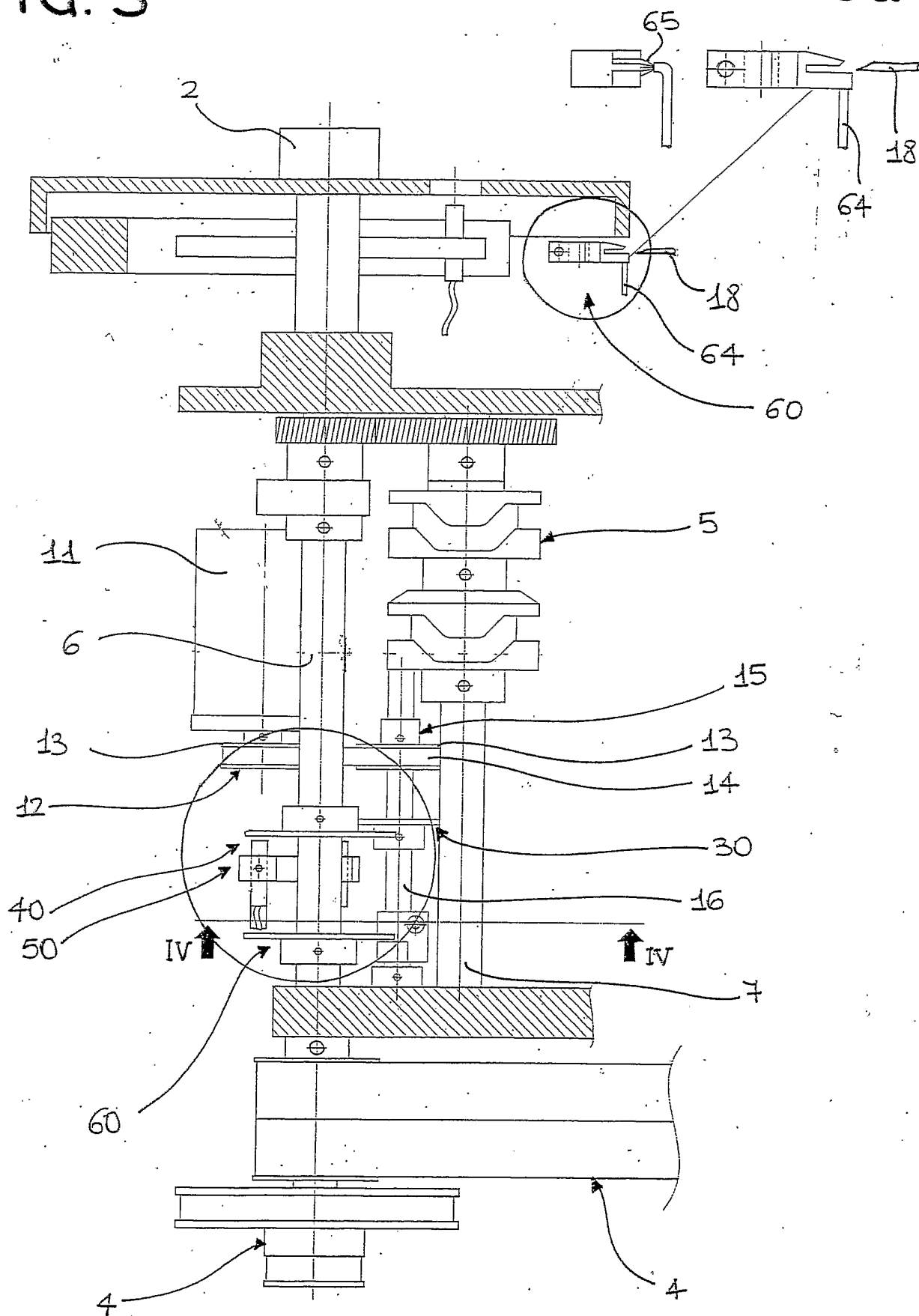


FIG. 4

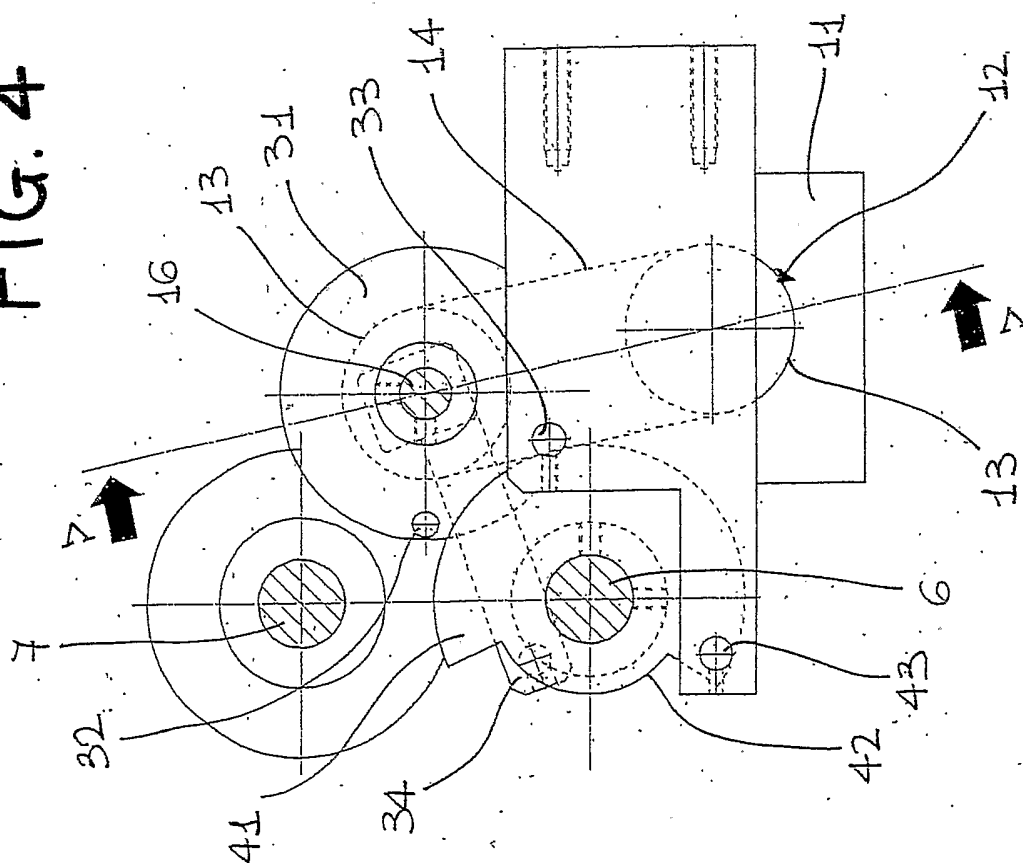


FIG. 6

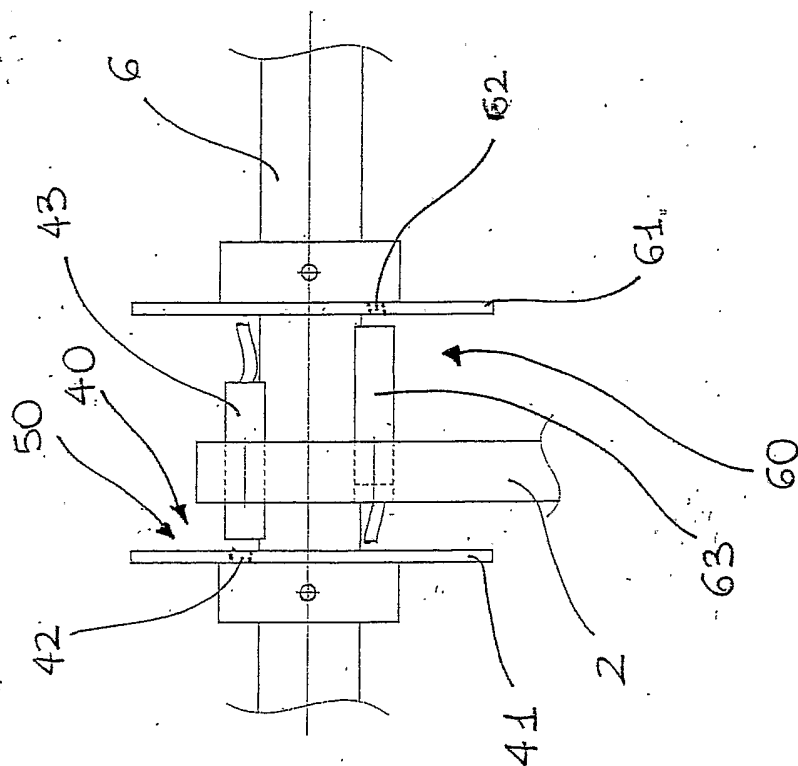


FIG. 5

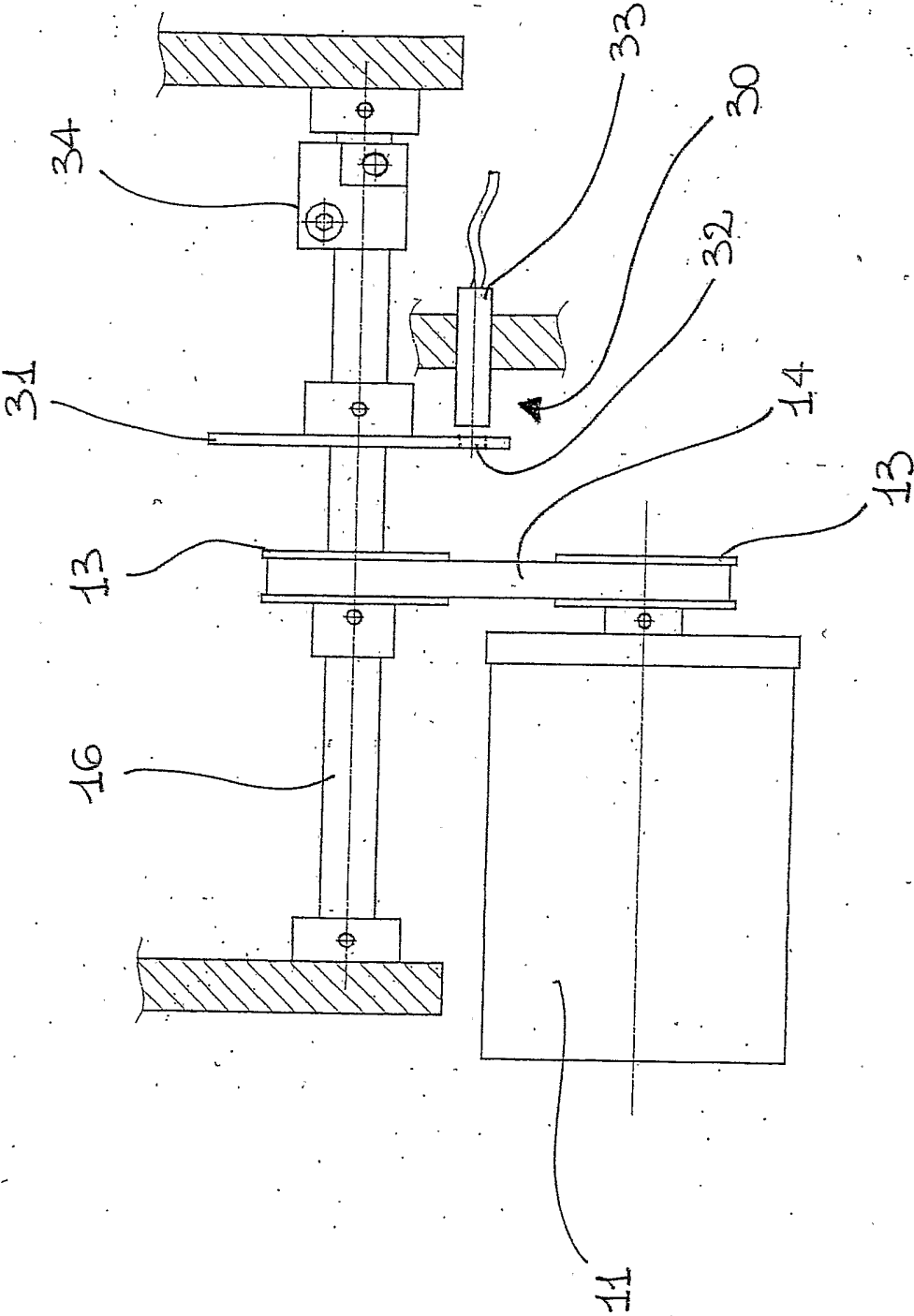
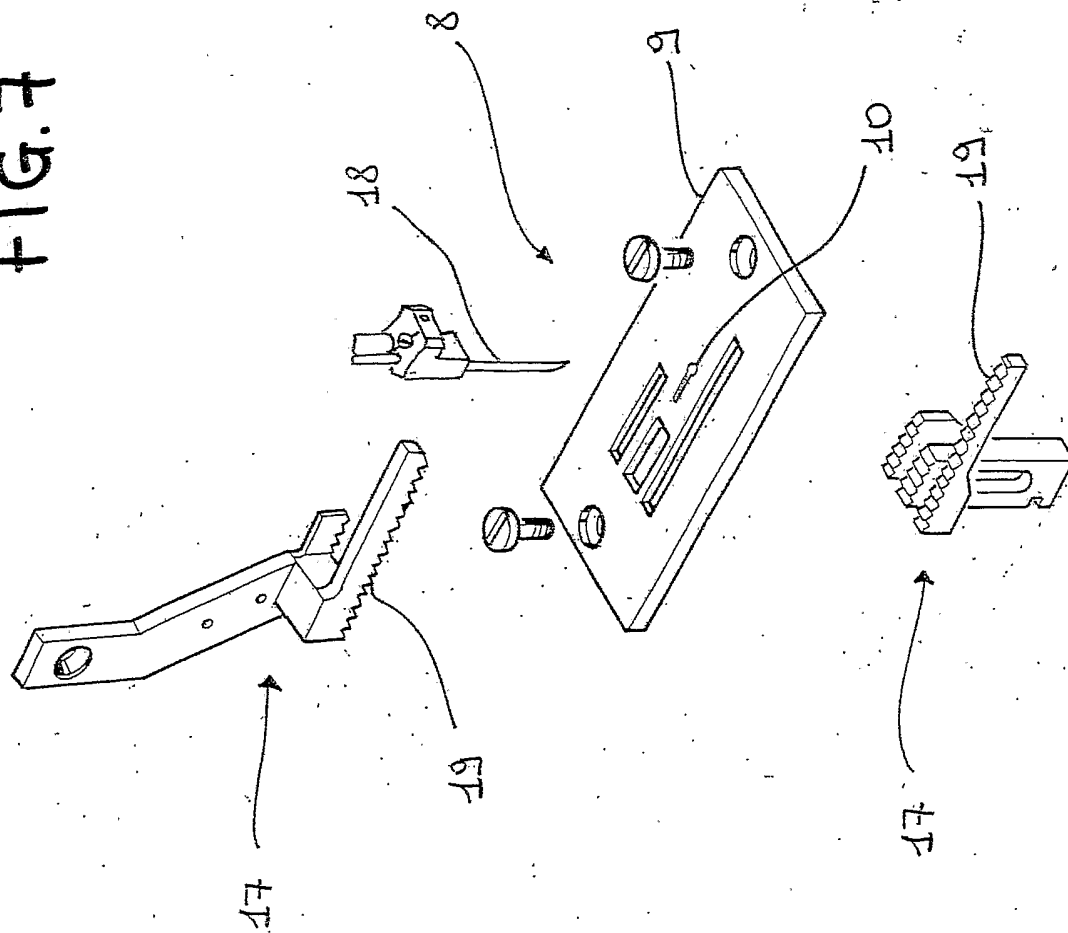


FIG. 7



INTERNATIONAL SEARCH REPORT

International Application No
PCT/IT2005/000070

A. CLASSIFICATION OF SUBJECT MATTER
D05B1/04 D05B27/22

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
D05B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EP0-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2 368 066 A (JOHNSON CARL W) 23 January 1945 (1945-01-23)	1
X	the whole document	25
A	US 4 122 787 A (CONTI ET AL) 31 October 1978 (1978-10-31)	1
X	the whole document	25
X	DE 103 21 266 A1 (JUKI CORP., CHOFU) 18 December 2003 (2003-12-18) the whole document	1-23

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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"A" document defining the general state of the art which is not considered to be of particular relevance

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Date of the actual completion of the international search

3 October 2005

Date of mailing of the international search report

18. 01. 2006

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European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax: (+31-70) 340-3016

Authorized officer

Debard, M

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IT2005/000070

Box II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:
1-23, 25.

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.
- ☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-23,25

sewing machine with secondary motor, driving and control
means for driving and controlling conveying means

2. claim: 24

sewing machine with opening in needle plate

INTERNATIONAL SEARCH REPORT

International Application No
PCT/IT2005/000070

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