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Bok et al.

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[54] **INK JET PRINTING APPARATUS**

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[73] Assignee: **The Mead Corporation,** Dayton, Ohio

[21] Appl. No.: **339,255**

[22] Filed: **Jan. 13, 1982**

Related U.S. Patent Documents

Reissue of:

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Issued: **Aug. 11, 1981**
Appl. No.: **142,787**
Filed: **Apr. 22, 1980**

[51] **Int. Cl.**[3] **G01D 15/18;** G01D 9/00
[52] **U.S. Cl.** **346/75;** 346/25
[58] **Field of Search** 346/25, 75

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Primary Examiner—George H. Miller, Jr.
Attorney, Agent, or Firm—Biebel, French & Nauman

[57] **ABSTRACT**

An ink jet printing apparatus for printing addresses on documents being transported along an independently operated conveyor. The printing apparatus includes a control console, a printing arm telescopically received within the console, and an ink jet printing head mounted on a carriage which is vertically movable within the printing arm. A tachometer wheel is mounted on the printing carriage for contacting a document being transported past the printing head and generating a tachometer signal in response thereto. A programmed microprocessor generates printing control signals in synchronism with the tachometer signal.

22 Claims, 11 Drawing Figures

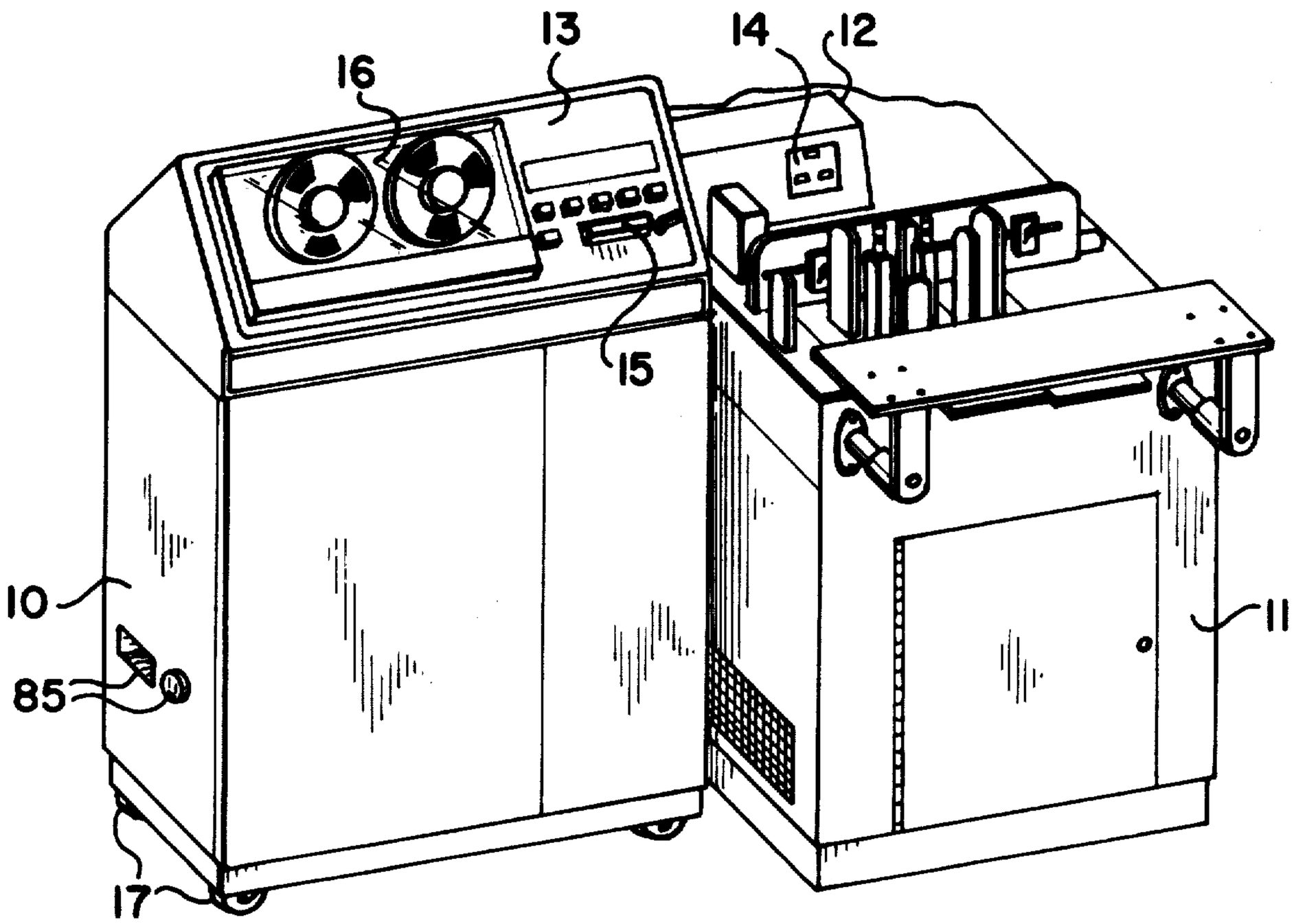


FIG-1

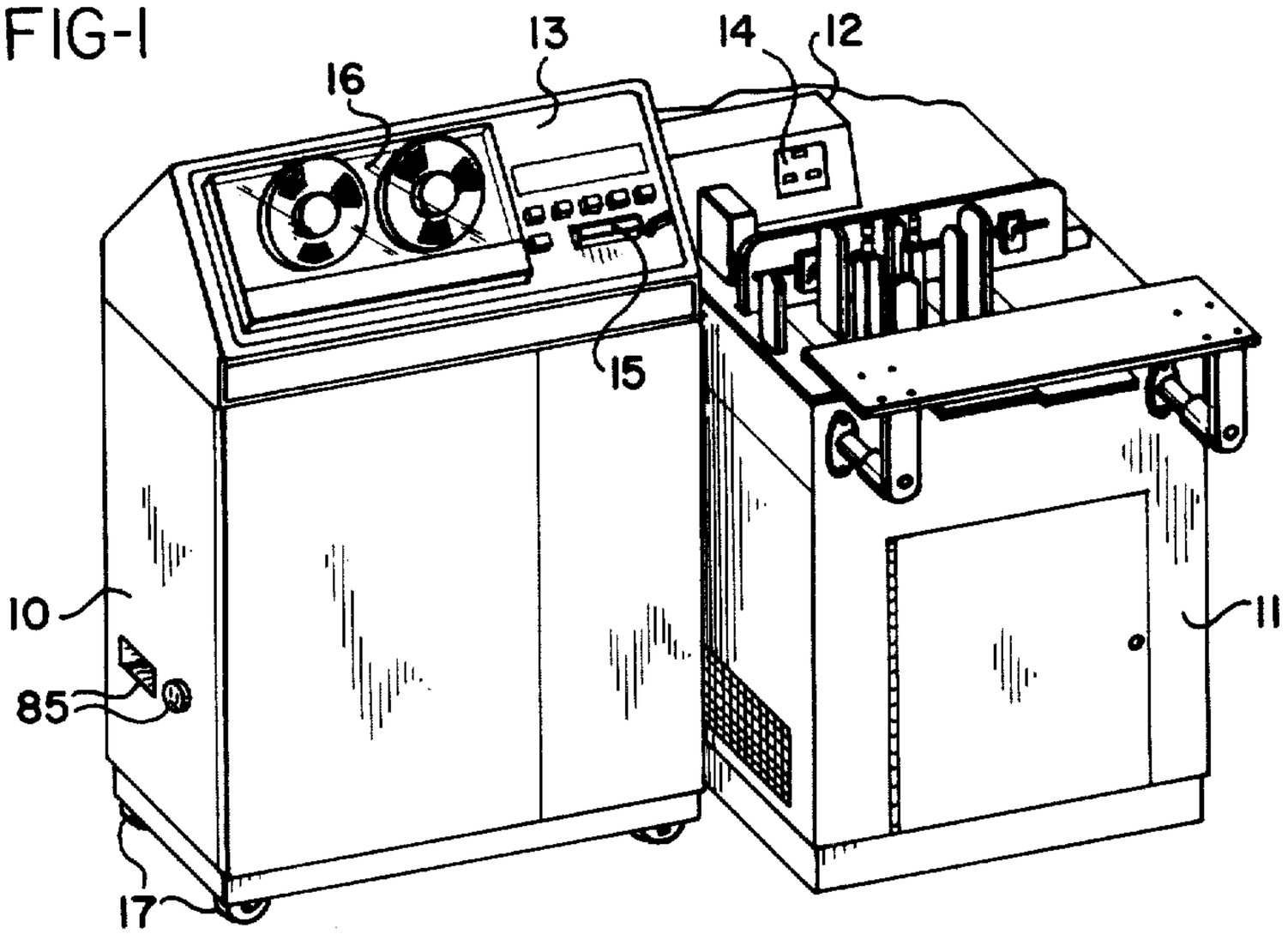

16
13
14
12
15
10
85
17
11

FIG-2

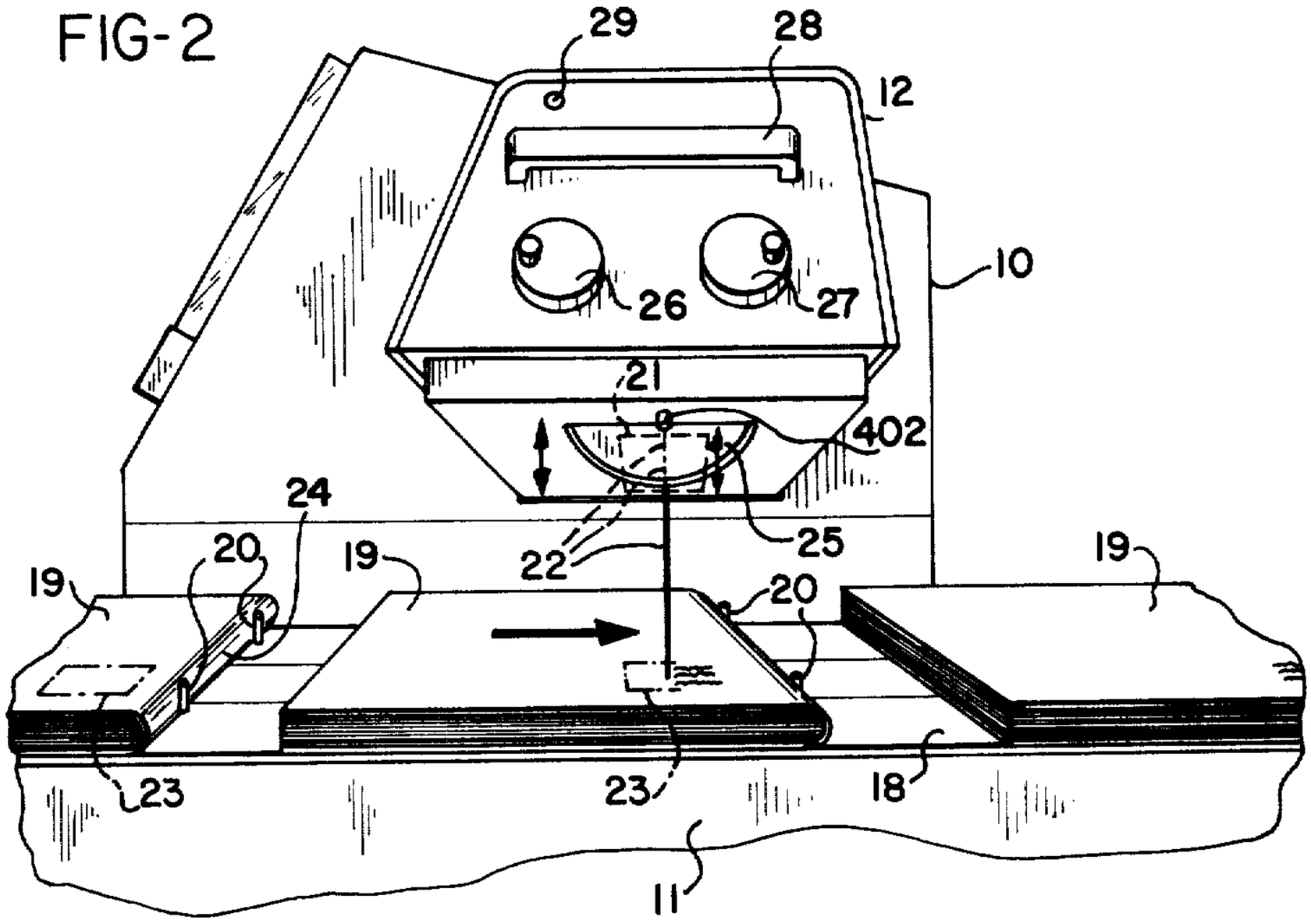

29
28
12
10
26
27
21
402
24
20
19
22
25
23
18
11

FIG-3

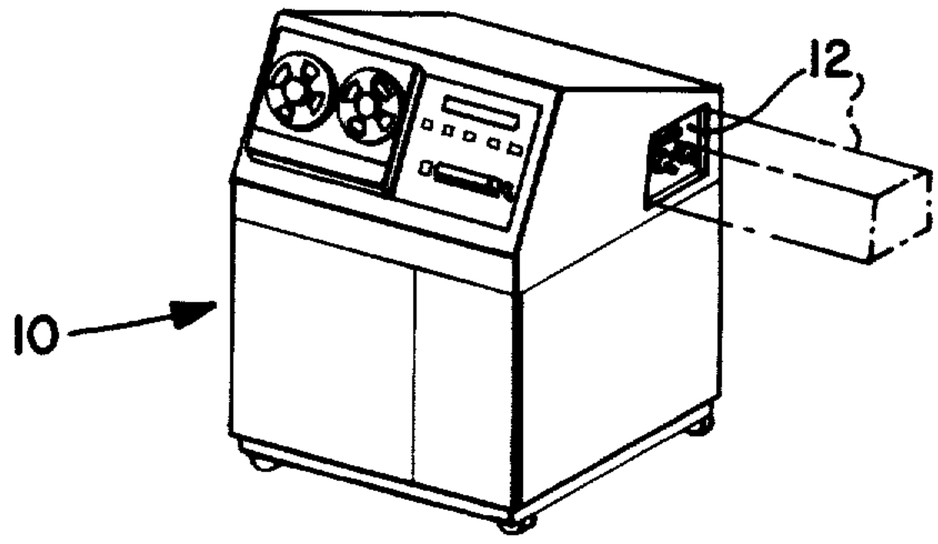
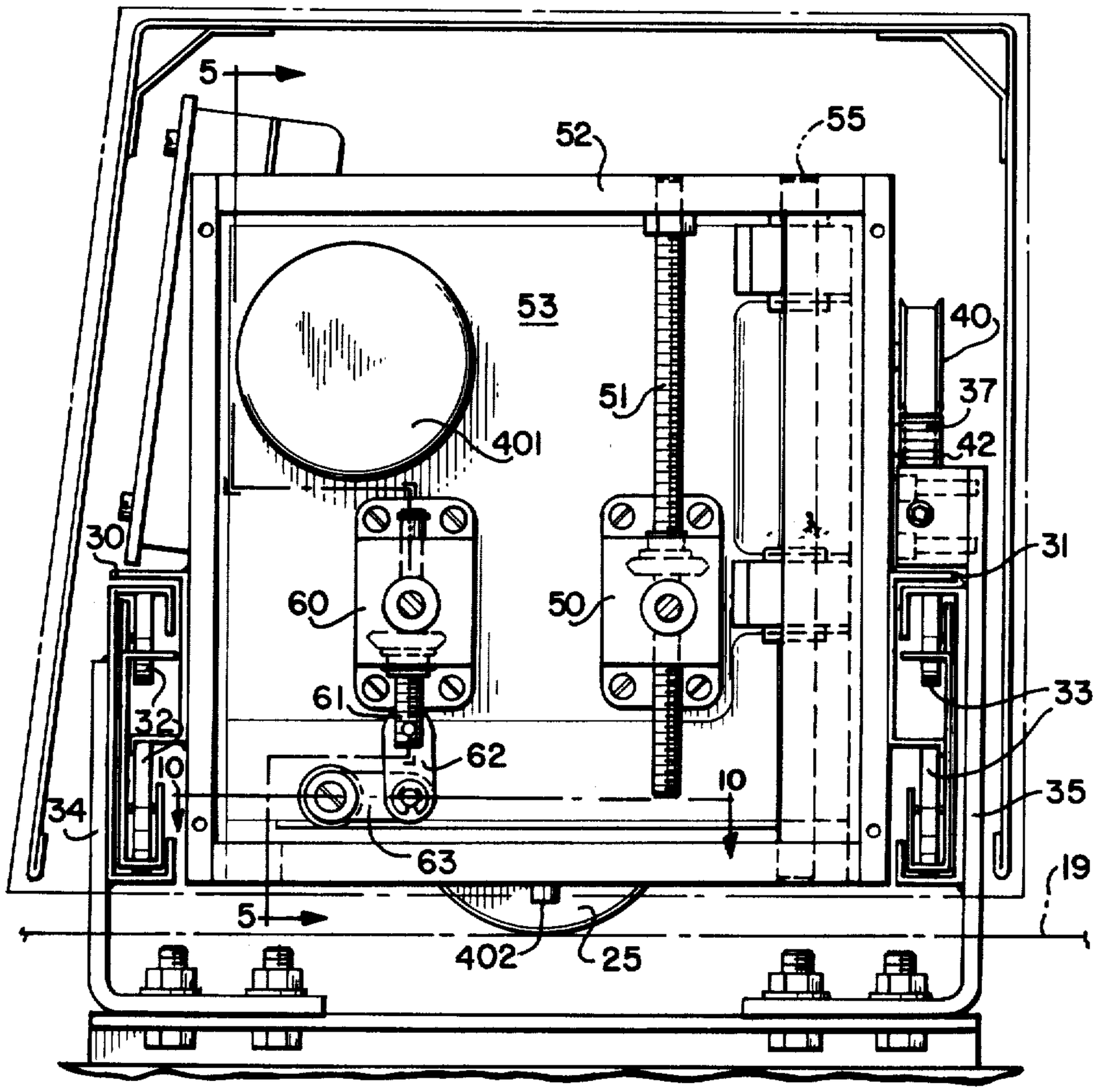
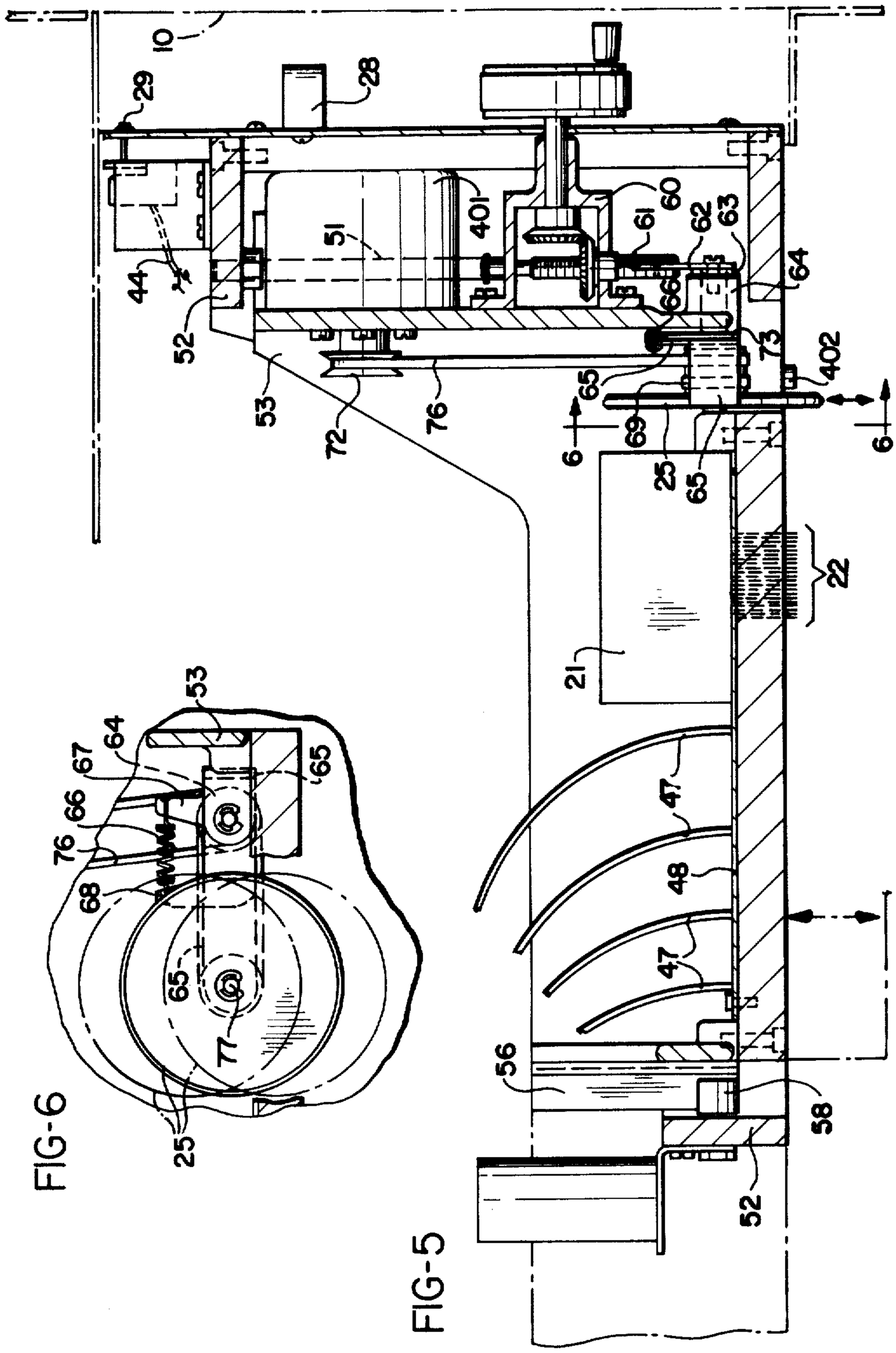

12
10

FIG-4


5
52
55
53
40
51
37
401
42
30
31
60
50
61
33
32
62
10
10
34
35
63
19
5
402
25


10
29
28
401
51
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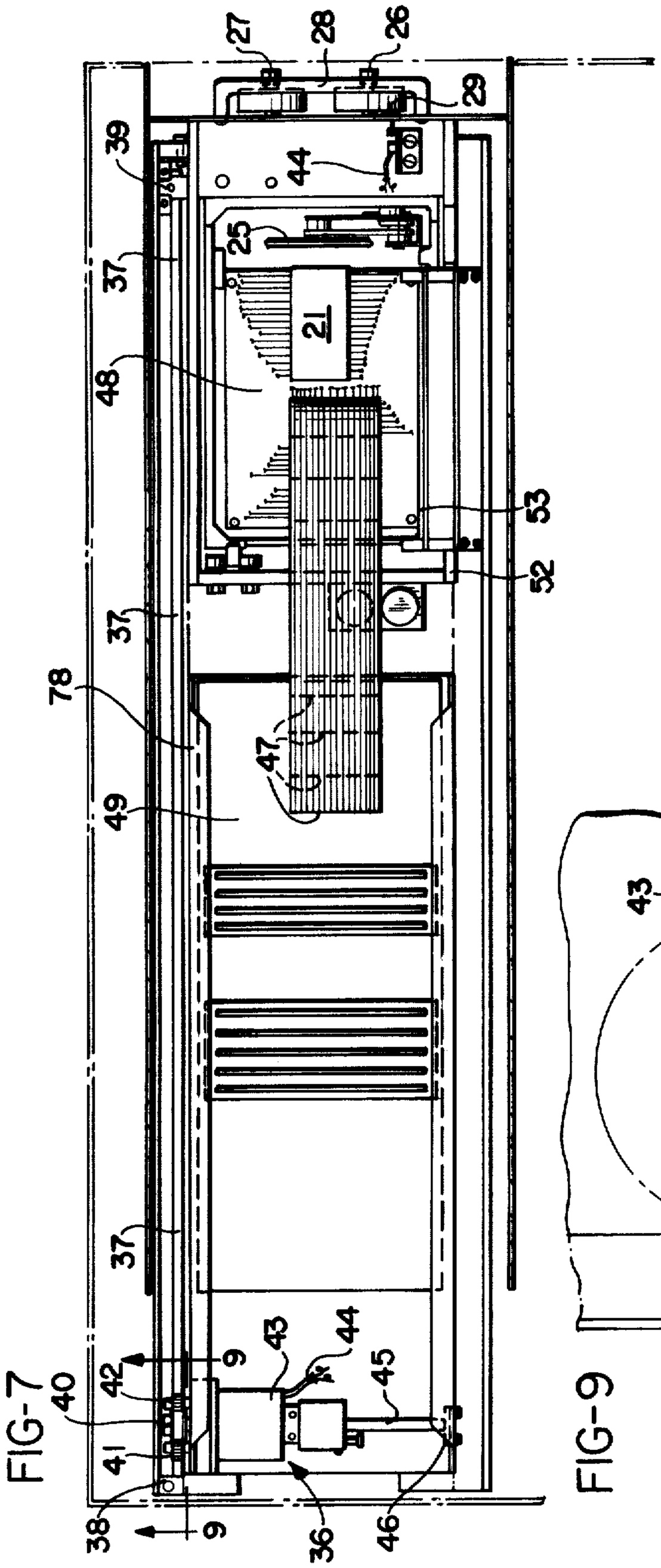
61
62
63
64
44
52
53
72
76
65
73
402
69
25
6
21
22
47
48
56
58

FIG-5

53
64
67
66
76
68
65
77
25

FIG-6


27
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48
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78
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49
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42
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45
40
41
38
9
36
46

FIG-7

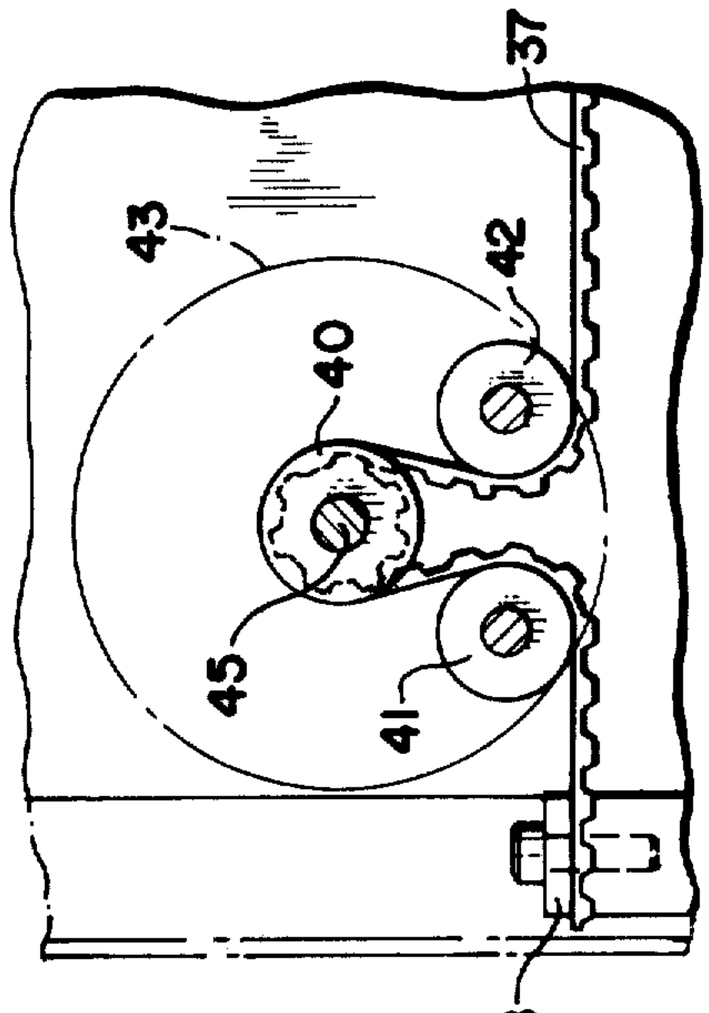

37
43
42
40
45
41
38

FIG-9

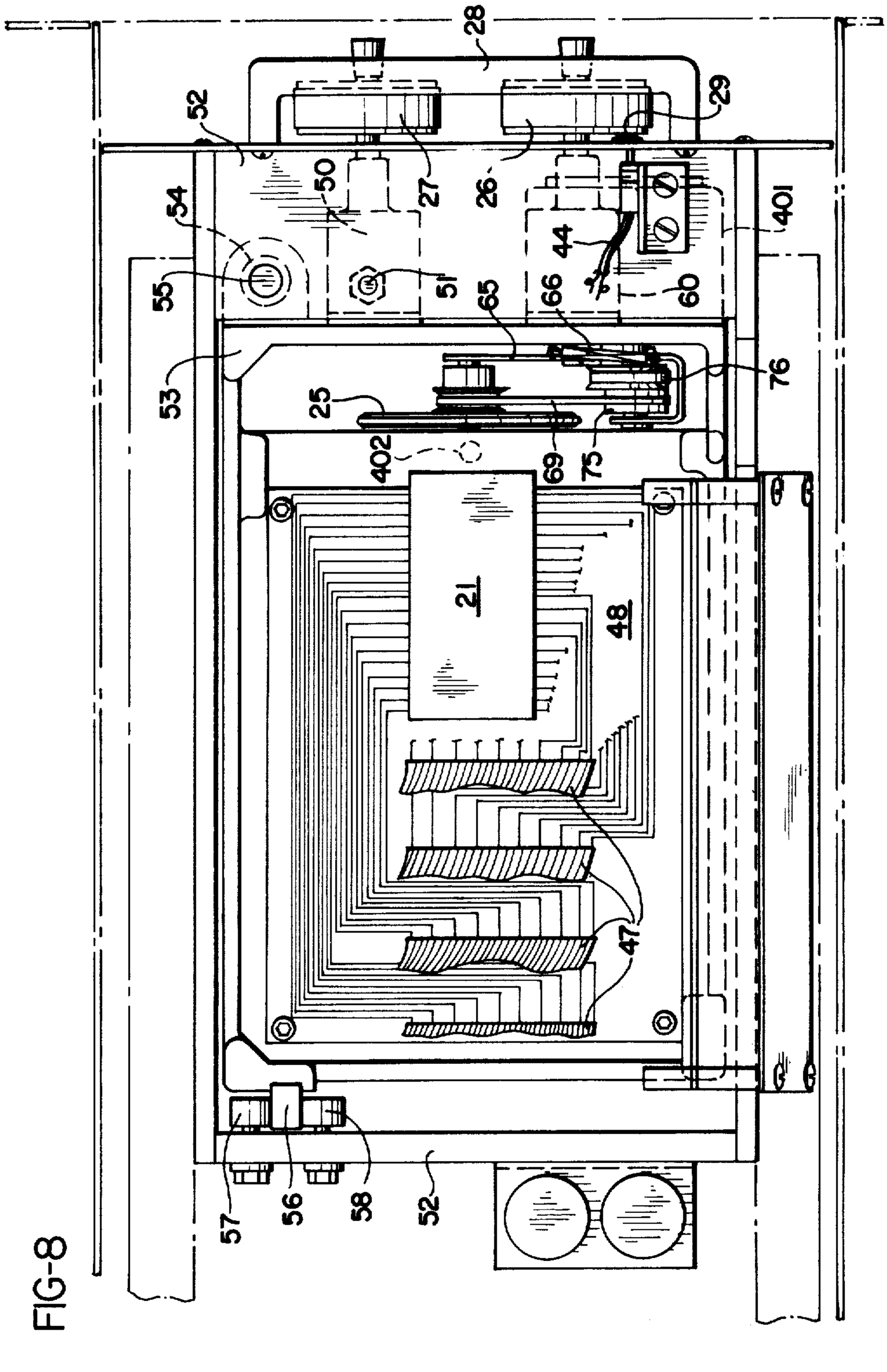
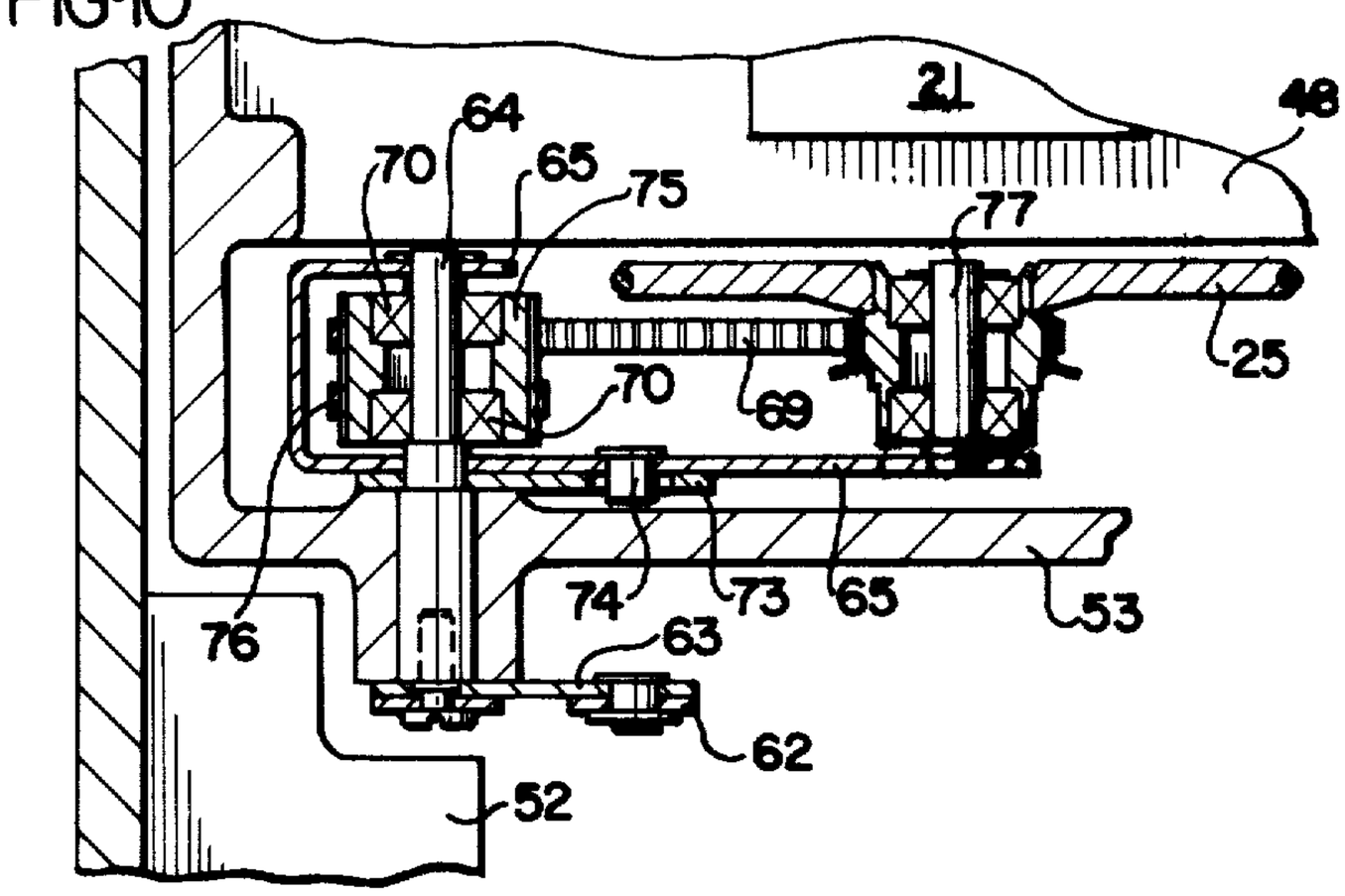

28
52
29
50
27
26
54
401
44
55
51
65
66
60
53
76
25
402
69
75
21
48
47
57
56
58
52

FIG-8

FIG-10



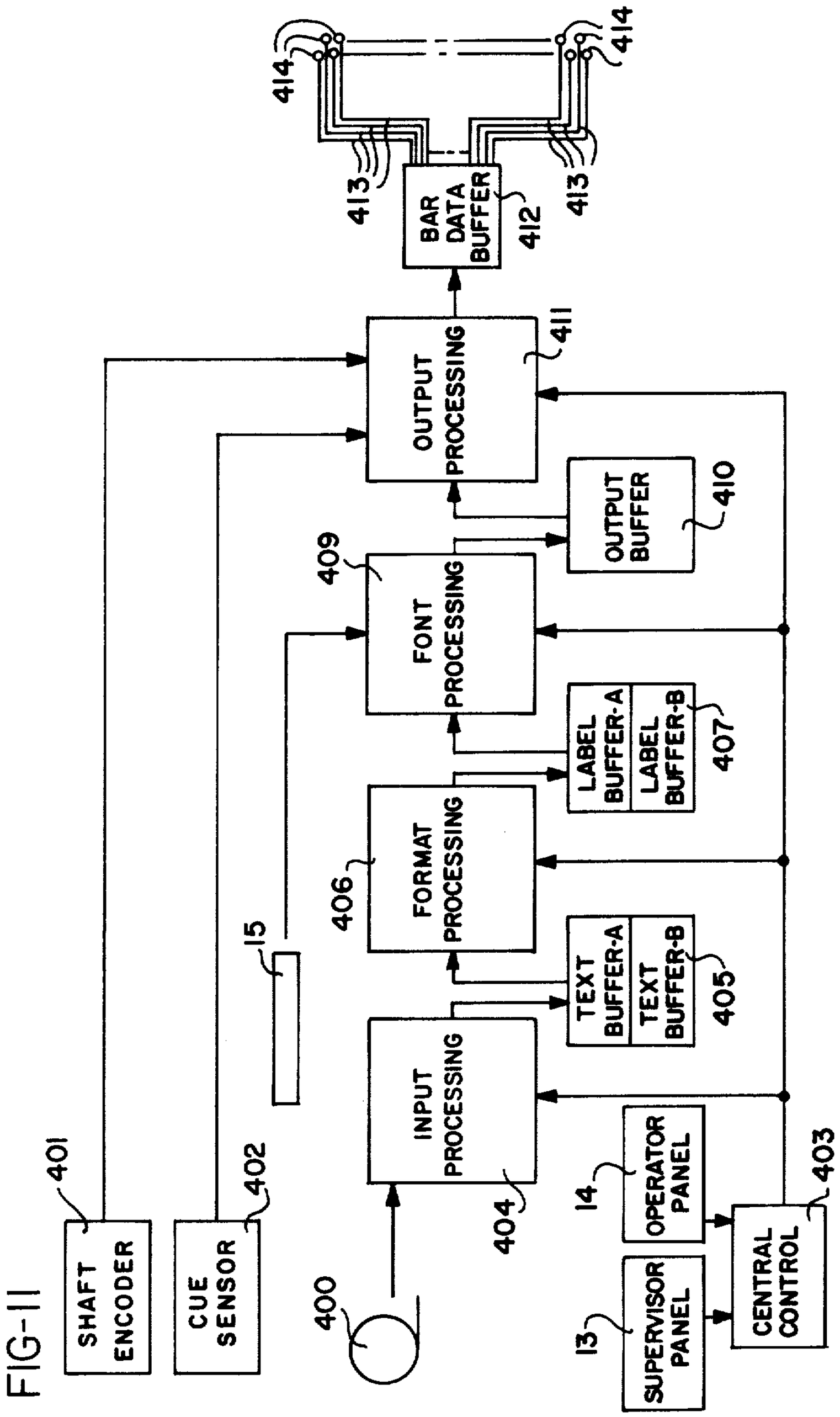

414
414
413
413
BAR DATA BUFFER
412
OUTPUT PROCESSING
411
OUTPUT BUFFER
410
409
FONT PROCESSING
LABEL BUFFER-A
LABEL BUFFER-B
407
406
FORMAT PROCESSING
TEXT BUFFER-A
TEXT BUFFER-B
405
15
INPUT PROCESSING
404
400
SHAFT ENCODER
401
CUE SENSOR
402
OPERATOR PANEL
14
SUPERVISOR PANEL
13
CENTRAL CONTROL
403

FIG-11

INK JET PRINTING APPARATUS

Matter enclosed in heavy brackets [ ] appears in the original patent but forms no part of this reissue specification; matter printed in italics indicates the additions made by reissue.

BACKGROUND OF THE INVENTION

This invention relates generally to ink jet printing apparatus of a type suitable for printing addresses on preprinted documents, such as magazines, newspapers and the like. Prior art systems for such purposes have generally employed electrostatic printers or other devices for printing a strip of labels. The printed labels then have been applied to the magazines or newspapers by a suitable label application device. A typical prior art apparatus for feeding preprinted documents and applying such labels thereto is disclosed in Ridenour U.S. Pat. No. 2,606,681.

An example of a prior art system which feeds preprinted documents and prints addresses directly thereon is disclosed in Erikson et al U.S. Pat. No. 4,122,457. The Erikson system utilizes a plurality of ink jet printing nozzles which are oscillated back and forth across a moving document to print lines of characters. The printing speed of the jets limits each jet to a printing output rate of about 250 characters per second. This translates into a document feed rate of only about 125 ft./min., which is much too slow for many applications.

It is well known that ink jet printing can be carried out at much faster speeds than the upper limit mentioned above in connection with the Erikson system. Printers for such high speed printing may generate rows of closely spaced jets, which may be stimulated, charged, deflected, and selectively caught as taught in Mathis U.S. Pat. No. 3,701,998. Such print heads are commercially employed for business forms printing and routinely print documents as they are being transported at a speed of 600 ft./min. Still higher speed applications are described in Frey U.S. Pat. No. 3,913,719 which teaches an ink jet printing apparatus operating in combination with a conventional newspaper printing press.

Heretofore the above mentioned high speed ink jet printers have not been used for addressing purposes due to their relatively high cost and also due to the fact that the industry already has a large investment in conventional addressing systems of the general type described in Ridenour U.S. Pat. No. 2,606,681. Such conventional addressing systems are able to address documents at a reasonably fast speed, but the requirement for off-line printing of address labels and the application of such labels to the documents has been both cumbersome and expensive.

SUMMARY OF THE INVENTION

This invention provides improved high speed document addressing by combining a known high speed ink jet printer in a novel manner with a conventional document handling and feed system. The print head is supported by a printing arm which is movably mounted on a portable control console. The control console is adapted for placement adjacent the document feeder, and the printing arm is mounted on the control console in such a manner that it extends into a printing position over the feeder when the control console is placed adjacent thereto. Means are provided for moving the printing arm into a storage position which is clear of the document feeder, when printing has been completed.

The printer prints directly upon the face of documents, without any need for application of address labels. Thus compatibility with existing addressing systems is achieved by merely removing the label applicator therefrom. When the print arm of the present invention is extended into the printing position, it occupies the space which previously had been occupied by the label applicator.

For further compatibility with existing document feeders, the print head of the present invention is supported for vertical movement relative to the printing arm. Thus when the printing arm is in the printing position, the print head may be lowered to the correct height for printing documents of any desired thickness. A sensor mounted on the printing arm senses the approach of a document to be printed, and tachometer means, which are also mounted on the printing arm, sense the speed of movement of the document and generate a speed synchronizing signal. In this manner the printed area is maintained in registration on the documents, and the printing operation proceeds in synchronism with document movement.

BRIEF DESCRIPTION OF THE DRAWING

FIG. **1** is a pictorial illustration of an addressing system including a prior art document feeding apparatus and an ink jet printer which is constructed in accordance with this invention;

FIG. **2** is a pictorial representation of the printing operation of the ink jet printer of this invention;

FIG. **3** is a pictorial representation of the ink jet printing apparatus with its printing arm in the storage position;

FIG. **4** is a side elevation view of a printing arm, with the front arm plate removed;

FIG. **5** is a view taken along lines **5—5** of FIG. **4**;

FIG. **6** is an illustration of a tachometer wheel;

FIG. **7** is a partially cut away top plan view of a printing arm;

FIG. **8** is an enlarged view of a portion of FIG. **7**;

FIG. **9** is a view taken along lines **9—9** of FIG. **7**;

FIG. **10** is a view taken along lines **10—10** of FIG. **4**; and

FIG. **11** is a block diagram of the data processing subsystem of the novel ink jet printing apparatus.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

A document addressing system in accordance with this invention is illustrated in FIG. **1**, wherein a portable ink jet printing console **10** is positioned alongside a document feeder **11**. Concole **10** is supported by a set of wheels **17** for ready portability and has an extendable printing arm **12**, which extends out over feeder **11**. Document feeder **11** may be any one of a number of commercially available devices, such as, for instance, a device known in the trade as a Cheshire, Model 524.

Document feeder **11** includes means for removing individual documents from a stack, means for feeding the documents in single file under printing arm **12**. An ink jet print head, as hereinafter described, is carried by print arm **12** for addressing the documents during passage thereunder. Since document feeder **11** forms no part of this invention and is well-known in the trade, descriptive details thereof are not contained herein. For a general description of the operation of such document

unstacking, feeding, and stacking mechanisms, reference may be made to Ridenour U.S. Pat. No. 2,606,681. As described in the Ridenour patent, there is a label application device for applying preprinted address labels to magazines being transported thereunder. For use in connection with this invention, the label application device is removed to make room for printing arm **12**.

A supervisor control panel **13** is mounted on the front of console **10**. Control panel **13** includes a series of switches for enabling a supervisory employee to make all the necessary settings and adjustments for a particular addressing job. The controls on control panel **13** ordinarily are not operated by production personnel. An operator control panel **14** is mounted on print arm **12** for such use. The controls on control panel **14** are relatively simple on/off print head operating controls. Control panel **14** preferably also includes an error light, for indicating system conditions requiring intervention by the supervisor or skilled non-production personnel.

Data codes corresponding to the mailing addresses to be printed are carried by a magnetic tape, which is mounted on a tape drive unit **16** within console **10**. There is an opening within supervisor control panel **13** into which may be inserted a font cartridge **15**. A series of font codes representing dot matrix characters to be printed by the ink jet printer are carried by a read only memory, which is installed within cassette **15**. The data processing subsystem reads the magnetic tape on the ROM and controls the ink jet print head, as hereinafter described.

The printing operation of the system may be generally understood by reference to FIG. **2**, wherein a conveyor **18** is transporting a series of documents **19** under printing arm **12**. Documents **19** are positioned against timing lugs **20**, which provide timing control for document feeder **11**. Timing lugs **20** do not control the operation of ink jet printer in any way.

Mounted within printing arm **12** is an ink jet print head, which is illustrated generally at **21** and which generates a series of jets **22**. Print head **21** may be constructed as generally described in Mathis U.S. Pat. No. 3,701,998, and a detailed description thereof is not contained herein. A jet printer of this type generates two parallel rows of closely spaced jets. A stimulation device as described in Mathis, or other stimulation device as disclosed in Cha U.S. Pat. No. 4,095,232 causes the jets to break up into streams of uniformly sized and regularly spaced drops. A series of charge rings **414** (see FIG. **11**) produce electrical charging of selected ones of the drops, as required for printing the desired addresses. Those drops which are so charged are deflected by a pair of deflection fields into a pair of catchers. The drops which are uncharged fall toward documents **19** and print addresses within address areas **23**.

For illustration purposes FIG. **2** shows a large vertical separation between print arm **12** and documents **19**. In reality this distance is only about 2 inches. As hereinafter described in detail, vertical positioning means, including a control knob **27**, are provided for lowering print head **21** relative to printing arm **12**, so as to achieve a printing distance of about 0.25 inches. Jets **22** generally occupy a region as illustrated in FIG. **5**, although it will be understood that FIG. **5** illustrates print head **21** in a fully raised position wherein printing is not performed.

In order to maintain registration of the ink jet printing within the address areas **23** of documents **19**, printing arm **12** carries a cue sensor **402**. Cue sensor **402** is a conventional two-way photoelectric sensor which is positioned for illuminating and sensing the leading edge **24** of a document **19**. Cue sensor **402** provides a control signal, which enables the data processing subsystem to initiate printing at the proper time.

In order to maintain the printing in synchronism with the movement of document **19** printing arm **12** carries a tachometer wheel **25**. Tachometer wheel **25** drives a conventional shaft encoder **401** (FIGS. **4** and **5**), which generates tachometer pulses in synchronism with document movement. These pulses enable the data processing subsystem to exercise proper timing control over the operation of the ink jet printer. For a better understanding of matters relating to such timing control, reference may be made to Van Brimer et al U.S. Pat. No. 3,588,906, Van Brimer et al U.S. Pat. No. 3,803,628, and Frey U.S. Pat. No. 3,913,719. Tachometer wheel **25** is vertically adjustable for surface contact against documents **19**. For this purpose there is provided a hand operated control knob **26** on printing arm **12**.

As illustrated in FIGS. **1** and **2**, printing arm **12** is extended toward an operating position. When not in use, printing arm **12** is moved inwardly toward a storage position, as best illustrated in FIG. **3**. A handle **28** is provided for moving print head **12** from the storage position to a printing position. A release button **29** is provided for releasing a "fail-safe" braking arrangement to enable positioning of the print arm **12** at any desired position of extension over conveyor **18**. The braking arrangement, as hereinafter described, is normally engaged and is momentarily released by a solenoid, which is connected for activation by button **29**.

The system as herein described prints addresses on documents moving along conveyor **18** at speeds up to 460 ft. per minute. A resolution of 120 lines per inch is maintained by selective charging of drops in 128 jets arranged in two staggered lines, the jets in each line being spaced at a spacing of 60 jets per inch. Coordinated charging of the jets in the two rows is carried out as taught by Taylor et al U.S. Pat. No. RE28,219. Each jet is stimulated to produce dots at a frequency which may be in the order of about 50 KHz.

Telescopic motion of printing arm **12** is facilitated by left and right drawer slides **30** and **31**, as best illustrated in FIG. **4**. Drawer slides **30** and **31** ride on pairs of rollers **32** and **33**, which are supported by left and right slide brackets **34** and **35** respectively.

The operation of the braking device for printing arm **12** is best understood with reference to FIGS. **7** and **9**. As illustrated in FIG. **7**, printing arm **12** is fully retracted within console **10**. As printing arm **12** moves from the fully retracted, storage position to an operating position, it pulls a brake **36** along the length of a toothed belt **37**, which is stretched between a pair of clamp plates **38, 39**. Clamp plates **38, 39** are secured to side bracket **35**. Brake **36** comprises a toothed pulley **40** for engaging the toothed side of belt **37** and a pair of idler rollers **41, 42** for engaging the smooth reverse side of belt **37**.

Pulley **40** is mounted on a shaft **45**, which rides in a bearing assembly **46** mounted within a horizontally extending channel in a vertical frame of console **10**. During movement of printing arm **12**, shaft **45** rotates within a solenoid **43**. Brake **36** also comprises a braking disc (not illustrated) and a brake pad which is spring biased against one face of the disc for normally preventing rotation of shaft **45**.

Solenoid **43** is connected by a line **44** to button **29** and also to an interlock circuit, not illustrated. The interlock circuit provides a safety feature preventing application of an actuating current to solenoid **43** when print head **21** is in a lowered position. When button **29** is depressed, with print head **21** in a fully raised position, solenoid **43** is actuated to force the above mentioned brake pad away from the brake disc. This allows rotation of shaft **45** by rolling action of pulley **40** against belt **37**. During this condition the operator may position printing arm at any desired extension position by manual effort against handle **28**.

Electrical connections to print head **21** are made via a series of flexible cables **47**, which are connected to a printed circuit board **48** mounted for movement with print head **21**. Electrical cables **47** extend inwardly toward another printed circuit board **49**, which is mounted in frame **78**. Frame **78** is mounted between drawer slides **30** and **31**. Flexible fluid lines (not illustrated) supply pressurized printing ink from a supply tank in console **10** to print head **21**. This accommodates both horizontal and vertical movement of print head **21** relative to console **10**. Receptacles **85** (FIG. **1**) are provided at a convenient location on console **10** to permit ready connection and disconnection of external electrical lines.

Vertical movement of print head **21** within printing arm **12** is controlled by manual operation of control knob **27**, as above described. Control knob **27** is connected to miter gear box **50** (see FIG. **4**), which rides vertically up and down threaded shaft **51**, when control knob **27** is rotated. Threaded shaft **51** is mounted on the frame **52** of printing arm **12**. Miter box **50** is secured to carriage **53**, which functions as a print head support member. Print head **21** and its printed circuit board **48** are mounted within carriage **53**. Carriage **53** has a pair of linear ball bushings **54**, which are guided vertically along a guide rod **55** (see FIG. **8**). Carriage **53** also has a guide bar **56**, which is guided by a pair of cam followers **57**, **58**. This arrangement provides smooth, controlled vertical movement of carriage **53** and print head **21** in response to rotation of control knob **27**.

Tachometer wheel **25** is also mounted upon carriage **53** for vertical movement therewith. However, tachometer wheel **25** has an adjusting mechanism for producing additional vertical motion of the tachometer wheel relative to the motion of print head **21**. This movement of tachometer wheel **25** is generally illustrated by FIG. **6**. For producing the above mentioned relative vertical movement of tachometer wheel **25**, there is a miter gear box **60** connected to control knob **26**. As control knob **26** is manually rotated by the operator, miter box **60** causes vertical movement of a threaded shaft **61**, which is pivotally connected to a link **62** (see FIG. **4**) Link **62** is pivotally connected to another link **63**, which is fast to a shaft **64**. Shaft **64** is journalled within carriage **53**, so that shaft **64** is rotated relative to carriage **53**, when control knob **26** is rotated (see FIGS. **5** and **10**).

There is a link **73** (FIG. **10**), which is mounted fast on shaft **64** and connected to a lever arm **65** by means of a loose fitting pin **74**. Tachometer wheel **25** is pivotally mounted on a pivot pin **77** which is attached to lever arm **65**, so that tachometer wheel **25** undergoes the motion illustrated in FIG. **6**, when control knob **26** is rotated. The angular movement of lever arm **65** is about plus or minus 15°, so that the pivot point of tachometer wheel **25** moves vertically about plus or minus one-half inch relative to carriage **53**. A spring **66** is connected between an ear **67** of lever arm **65** and an ear **68** of link **73**. This permits slight movement of lever arm **65** relative to link **73** (as limited by the loose fitting connection at pin **74**), while downwardly biasing tachometer wheel **25** against documents **19**. Thus tachometer wheel **25** remains pressed against the documents during normally occurring variations in document thickness.

Tachometer wheel **25** engages a first timing belt **69**, which drives a pulley **75**. Pully **75** is mounted on ball bearings **70** for rotation about shaft **64**. A second timing belt **76** engages pulley **75** so as to be driven thereby. Timing belt **76** engages another pulley **72** (FIG. **5**), which provides rotational input to shaft encoder **401**. Shaft encoder **401** is a conventional encoding device, which provides a digital output signal representing the speed of rotation of tachometer wheel **25**.

The output from shaft encoder **401** is utilized for data output processing control, as generally illustrated by block **411** of FIG. **9**. Block **411** represents a functional operation of a programmed microprocessor, but all functions thereof could be performed by hard wired elements. Other such data processing functional blocks are referred to on FIG. **9** as input processing **404**, text buffer **405**, format processing **406**, label buffer **407**, font processing **409**, output buffer **410**, bar data buffer **412**, and central control **403**.

Central control **403** responds to switching controls on the supervisor control panel **13** and switching controls on the operator control panel **14**. As shown in FIG. **9**, the central control **403** exercises general supervisory control over input processing **404**, format processing **406**, font processing **409** and output processing **411**. Printing control information for an addressing job is carried by data tape **400** and font cartridge. Data tape **400** is mounted on tape drive unit **16**, and font cartridge carries a programmed ROM as previously stated. Data tape **400** carries a series of binary codes representing the characters which are to be printed by the printing system. Font cartridge carries a series of bit patterns corresponding to the patterns of printed dots which are to be used for representing the characters in the preselected font.

During input processing the microprocessor reads tape **400** and transfers the information to text buffer **405**. Text buffer **405** comprises first and second buffer portions A and B, as indicated on FIG. **9**. Text buffers A and B are utilized on an alternating basis, with one buffer receiving processed input information, while the other buffer is reading out information for format processing.

Format processing block **406** designates that portion of the imaging process wherein the data from the text buffer is rearranged in "label" format. The information which is read out from one of the text buffers is reorganized so as to define a plurality of addresses (typically 16 or more). These addresses are stored in label buffer **407**, which has label buffer portions A and B. Label buffer A and label buffer B operate on an alternating basis, with one buffer portion receiving information from format processing, while the other buffer portion supplies information for font processing.

Typically test buffer **405** comprises two 4 Kilobyte buffers. During format processing the characters within the text buffer are fetched one-by-one and used to fetch corresponding characters from a look-up table in a ROM. The translated characters are then stored in the label buffer being updated. The traslation is required to

produce seven bit font call-out characters from six bit text data read from magnetic tape **400**.

During font processing the microprocessor assembles charge ring control data through a character generation process performed on the label buffer characters. In order to perform this process the microprocessor reads a series of font control codes from the ROM within font cartridge **15**. These codes are selectively read out therefrom as accessed by the codes in label buffer **407**. The codes stored in the font ROM represent the actual dot patterns defining the various characters in the font which will be used for a particular addressing job.

The codes which are read out from the font cartridge are transferred to output buffer **410**, which operates on a first-in-first-out basis. The data which is so stored in and read out from output buffer **410** is utilized for output processing, as generally indicated by block **411** of FIG. **9**. The output processing function reorganizes the data from buffer **410** to accommodate the specific geometry of the jet arrangement and stores the reorganized data as printing control codes. As previously mentioned the jets are arranged in two staggered rows, and this therefore requires row-to-row switching delays as taught in Taylor et al U.S. Pat. No. RE28,219.

During output processing the microprocessor also responds to output signals from cue sensor **402**. When cue sensor **402** provides a signal indicating the approach of a leading edge **24** of one of documents **19**, the microprocessor begins a counting sequence during which tachometer signals from shaft encoder **401** are counted. The count continues until the document **19** has moved a sufficient distance for the address area **23** to be positioned beneath the jets **22**. Printing control codes from bar data buffer **412** are transmitted along lines **413** as printing control signals to the charge rings **414**. Charge rings **414** charge individual drops of ink on a selective basis, as previously described.

A suitable microprocessor for use in carrying out this invention is the Intel Model 8085, manufactured by Intel Corporation, but other microprocessors of at least equivalent data handling capability as required by this invention may be utilized. The microprocessor is programmed in a routine manner using a programming language appropriate to the particular equipment involved. It will be readily apparent, however, that the printing control signals need not be generated under control of a microprocessor. Alternatively suitable printing control signals may be generated by apparatus as taught in Van Brimer et al U.S. Pat. No. 3,803,628 or in Frey U.S. Pat. No. 3,913,719.

While the forms of apparatus herein described constitute preferred embodiments of the invention, it is to be understood that the invention is not limited to these precise forms of apparatus and that changes may be made therein without departing from the scope of the invention.

What is claimed is:

1. Ink jet printing apparatus for printing documents being transported along an independently operated conveyor comprising:

a control console;

a printing arm movably mounted on said control console for movement between a storage position which is clear of said conveyor and a printing position above said conveyor;

tachometer means supported by said printing arm for sensing the speed of movement of said documents and generating a corresponding tachometer signal;

printing control means mounted within said control console for receiving said tachometer signals and generating printing control signals in synchronism therewith;

a print head carriage movably supported by said printing arm;

print head positioning means for adjusting the vertical position of said carriage relative to said printing arm; and

an ink jet printing head mounted on said carriage; said ink jet printing head comprising means for generating a plurality of printing jets arranged in at least one line extending in a sideward direction generally transverse to the direction of document travel along said conveyor, and means for controlling the printing operation of said printing jets in response to said printing control signals.

2. Apparatus according to claim **1** wherein said control console is mounted on wheels for ready portability.

3. Apparatus according to claim **1** and further comprising sensing means for sensing the leading edges of said documents; said printing control means being responsive to said sensing means for timing the initiation of printing by said ink jet printing head.

4. Apparatus according to claim **1** wherein said sensing means comprise a non-contact sensor mounted on said carriage.

5. Apparatus according to claim **1**, further comprising tape drive means mounted on said console for receiving and reading a magnetically encoded data tape, and cartridge receiving means within said console for receiving a cartridge carrying programmed font storage means; said printing control means being connected for reading said tape and said programmed font storage means and generating said printing control signals in correspondence therewith.

6. Apparatus according to claim **1** further comprising a first control panel mounted on said control console and a second control panel mounted on said printing arm; said control panels being connected for controlling operations of different degrees of complexity.

7. Apparatus according to claim **1** wherein said printing arm is telescopically received within said console and is moved to said printing position by sliding movement in said sideward direction.

8. Apparatus according to claim **7** and further comprising a normally actuated brake for preventing sliding motion of said arm and manually actuated release means for momentarily releasing said brake and enabling said sliding motion to occur.

9. Apparatus according to claim **1** wherein said tachometer means are mounted on said print head carriage.

10. Apparatus according to either of claims **1** or **9** wherein said tachometer means comprises a tachometer wheel rotatably mounted for rotation by contact against said documents and an encoder driven by said tachometer wheel and operative to generate said tachometer signal.

11. Apparatus according to claim **10** and further comprising means for changing the vertical position of the axis of rotation of said tachometer wheel relative to said carriage.

12. Apparatus according to claim **11** and further comprising means permitting slight vertical adjusting movement of said tachometer wheel and spring means biasing said tachometer wheel downwardly within the stroke of said adjusting movement.

13. Ink jet printing apparatus comprising:
a control console;
a printing arm telescopically received within said console and slidably movable between an internal storage position and an external printing position
a print head carriage movably supported by said printing arm;
print head positioning means for adjusting the vertical position of said carriage relative to said printing arm;
printing control means mounted within said console for generating printing control signals; [and]
an ink jet printing head mounted on said carriage and connected for control by said printing control signals[.]; *and means for maintaining said printing control signals in synchronism with the movement of a document being transported past said ink jet printing head.*

14. Apparatus according to claim 13 [and further comprising] *wherein said last named means comprises* tachometer means supported by said printing arm for generating a tachometer signal indicating the speed of movement of a document being transported past said ink jet printing head, and means within said printing control means for causing said printing control signals to be generated in synchronism with said tachometer signal.

15. Apparatus according to claim 13 wherein said print head positioning means comprises a first threaded shaft vertically mounted within said print arm, a first miter box secured to said carriage and in engagement with said shaft, and a first adjustment knob for adjusting the engagement position between said miter box and said shaft.

16. Apparatus according to claim 15 [and further comprising] *wherein said synchronism maintaining means comprises* a tachometer wheel pivotally supported by said carriage, tachometer wheel positioning means for vertical movement of said tachometer wheel relative to said carriage, encoding means connected to said tachometer wheel for generating a tachometer signal indicating the rotational speed of said tachometer

wheel, means for carrying said tachometer signal to said printing control means, and means within said printing control means for causing said printing control signals to be generated in synchronism with said tachometer signal.

17. Apparatus according to claim 16 and further comprising a lever arm which is pivotally supported by said carriage and a pivot pin for mounting said tachometer on said lever arm; said tachometer wheel positioning means being connected for causing pivotal movement of said lever arm about its point of pivotal support.

18. Apparatus according to claim 17 wherein there is a loose fitting connection between said lever arm and said carriage; said apparatus further comprising spring means for downward biasing of said lever arm against said loose fitting connection.

19. Apparatus according to claim 18 wherein said tachometer wheel positioning means comprises a second threaded shaft connected to said lever arm, a second miter box secured to said carriage and threadably engaging said second threaded shaft, and a second adjustment knob for adjusting the engagement position between said second miter box and said second threaded shaft.

20. Apparatus according to claim 19 and further comprising a normally actuated brake for preventing sliding motion of said arm and manually actuated release means for momentarily releasing said brake and enabling said sliding motion to occur.

21. Apparatus according to any of claims 13 through 20 and further comprising sensing means supported by said printing arms for sensing the leading edge of a document being transported past said ink jet printing head and generating a cue signal in response thereto; said printing control means comprising means for timing the initiation of said printing control signals in response to said cue signal.

22. Apparatus according to claim 21 and further comprising a plurality of support wheels mounted on and supporting said console.

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