July 24, 1962 SANAE AMADA ETAL 3,045,590

HIGH SPEED PRINTER

Filed Dec. 4, 1959 2 Sheets-Sheet 1

Fig. 1A

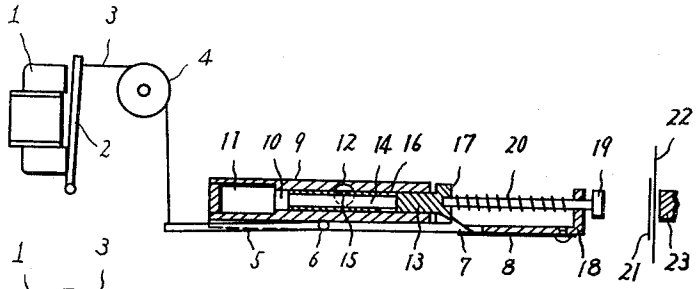


Fig. 1B

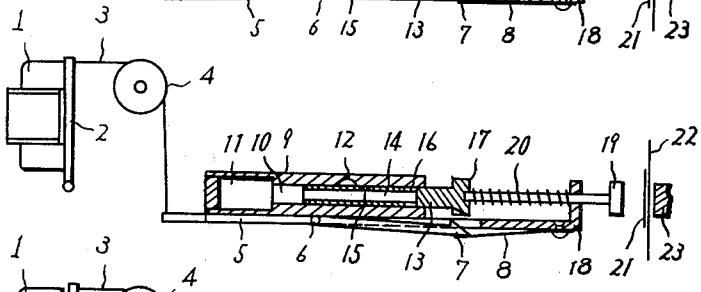


Fig. 1C

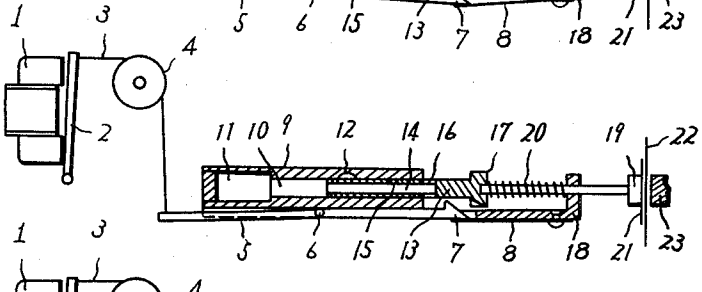
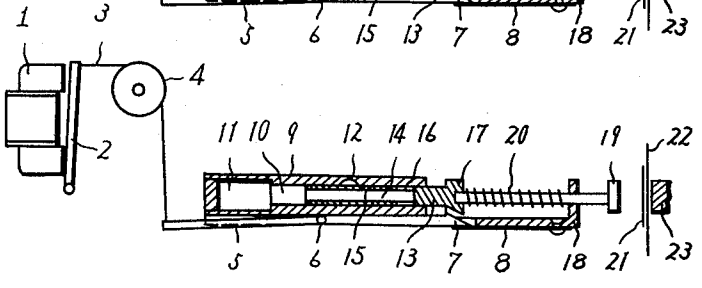


Fig. 1D

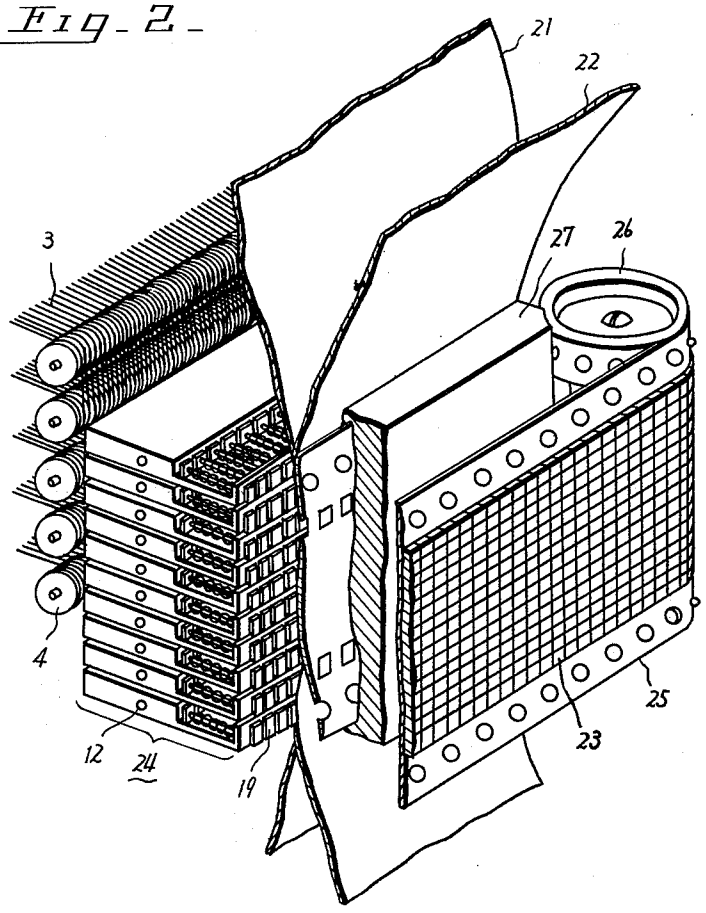


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Fig. 2.



United States Patent Office 3,045,590 Patented July 24, 1962

3,045,590

HIGH SPEED PRINTER

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Filed Dec. 4, 1959, Ser. No. 857,289
Claims priority, application Japan Dec. 6, 1958
7 Claims. (Cl. 101—93)

This invention relates to a high speed printer used as the output device of an electronic computer.

In general, in a high speed printer used as the output device for an electronic computer, a plurality of printing mechanisms corresponding in number to the maximum number of characters in one line is arranged laterally in one line, and characters of one line are printed in one operation of the printer. It has proven impossible to decrease substantially the time of one operation of the printer, and it has also proven impossible to increase beyond prescribed limits the number of characters in a line. Therefore, a high speed printer using such a printing mechanism has a limit of operation speed. Such a mechanism is generally considered to have a maximum printing speed of about a hundred-thousand characters per minute.

When a printing system in which a group of printing types is shifted laterally against a printing paper and the groups of printing types and type-hammers used are disposed in several vertical lines, as explained in Japanese patent application No. 23,682/57, (U.S. patent application 763,015), it is possible to print several lines for one printing operation of a printer, and the number of printed letters in one minute can be increased several times as many as that in a system known before.

However, in the construction shown in the aforementioned patent application the lines can be increased to only 3 or 4. The reason for such limitations is that in the design according to said Japanese application, the sizes of said electro-magnets cannot be decreased beyond a certain limit. Since the motive power for the printing action is supplied directly from electro-magnets it is difficult to achieve larger numbers of lines because of the connections required to be made to the type hammers in the space in both the lateral and vertical directions between adjacent characters.

An object of this invention is to increase substantially the printing faculty of a high speed printer in which N (the number of horizontal lines) can be increased beyond the above specified limit. The principal of this invention is that the electronic printing signal supplied from an electronic computer is not employed directly as the printing motive power, but is employed as a control motive power for starting the printing mechanism therefore the sizes of the electromagnets used in the printing mechanism are reduced and also the printing motive power is supplied from mechanical printing mechanisms which are started by said electro-magnets. Furthermore each of said printing mechanisms is formed in size within a cross-sectional area defined by the (letter spacing) in one direction and the (line spacing) in the other direction whereby the printing mechanisms can be arranged laterally and vertically in as many rows and columns as desired.

In the accompanying drawings,

FIG. 1 illustrates the actions of a printing mechanism employed in the high speed printer according to this invention; and

FIG. 2 is a perspective view of the principal portions of the high speed printer according to this invention.

According to this invention, a piston mechanism operated by a compressed air source is used as a printing unit in the printing device as shown in FIGS. 1A, B, C, and D.

In these figures (A) shows the condition in which the mechaanism is at rest, and **1** is an electromagnet adapted to start the printing mechanism by means of a signal, which is amplified from an electronic computer, **2** is an armature for an electro-magnet, and **3** is a thread made of fine piano wires or fibers of a particular synthetic resin to transmit the motion of the armature to the printing mechanism. **4** is a small pulley of light weight in order to guide said thread **3**. **5** is a trip latch, **6** is the rotating axis for said trip latch. The right end **7** of said trip latch **5** is in the shape of a hook. **8** is a restoring spring for the trip latch **5**, **9** is a bracket, **10** is a cylinder in the bracket **9**, **11** is a hollow space and coupled to the left end of the cylinder **10**, **12** is a tube for supplying compressed air to the cylinder **10** with which it crosses at right angles, and **13** is a piston. An air conducting groove **14** is provided in said piston **13**, and said air conducting groove **14** is in communication by a small aperture **15** with the compressed air supply. The piston is also provided with an exhaust port **16**. **17** is a projection on the piston **13**, and this projection **17** is adapted to engage hook **7** on the trip latch **5** and also with the extension **18** of the bracket **9** to stop the rotation of piston **13**. **19** is a member adapted to act as a hammer, and one end of said hammer portion **19** is set and fixed into the right hand end **17** of the piston **13**. **20** is a restoring spring for hammer **19** and piston **13**. **21** is an inked ribbon, **22** is a sheet of paper which is to be printed, and **23** is a printing type.

In the FIG. 1A which shows the rest condition of the printing unit, compressed air is supplied through a supplying tube **12** and small hole **15** thereby uniformly filling up the air conducting groove **14**, cylinder **10** and hollow space **11**. Therefore piston **13** is urged towards the right. However, piston **13** is prevented from any movement in the right hand direction by means of the engagement projection **17** and hook **7**.

FIG. 1B shows the condition of the printing unit just after it has started to move. In this condition, the electromagnet has attracted armature **2**, causing trip latch **5** to be rotated in the clockwise direction about pivot **6**, the coupling between the hooked portion **7** of the trip latch and the projection **17** of the piston is thereby released, whereby the force of the air at high pressure rapidly moves piston **13** and the type hammer **19** to the right against the action spring **20** which is compressed. At this instant communication between small hole **15** and the compressed air tube **12** is lost, so that the supply of compressed air is terminated. But, since the unit still contains a high pressure, the movement of the piston **13** and the hammer **19** to the right is continued.

FIG. 1C shows the condition when the displacement of piston **13** is a maximum. The right hand end of the type hammer **19** is pressed against the inked ribbon **21**, paper **22** and the surface of the printing type **23**. At the same time, the compressed air in the hollow space **11** and cylinder **10** is rapidly discharged into the atmosphere through the air conducting groove **14** and the exhaust port **16**, since the exhaust hole **16** is opened to the atmosphere.

Therefore the pneumatic pressure in the hollow space **11** and cylinder **10** is reduced to atmospheric pressure and piston **13** begins a movement to the left by means of the force due to spring **20**. The impulsive force due to the impact of type hammer **19** and the printing type **23** is added to the restoring force of the spring, and the type hammer **19** and the piston **13** move to the left at considerable speed.

FIG. 1D shows the condition on return to the initial position, in which the projection on the piston slides on the sloped upper surface of the right end of the trip latch to restore the latch and piston to the original position by pressing downwardly the right end **7** of the trip latch. Thus a cycle of operation is completed. Small hole **15**

is returned to a position in communication with the air supplying tube **12** and thus high pressure air begins to flow into hollow space **11**. However, piston **13** has enough time to return to the original position before the projection **17** is associated with the hook **7** of the right hand end of the trip latch as shown in FIG. 1A. This is because piston **13** still has a certain degree of kinetic energy, the diameter of the hole **15** is small and a certain time is needed to fill hollow space **11** with the high pressure air.

According to the construction of the printing unit, the operation of which is shown in FIGS. 1A to 1D, the printing mechanism possesses a sufficient printing power in a space having a small cross-sectional area. Therefore a plurality of such units can be arranged with a pitch corresponding to the letter spacings and line spacings of the printing.

FIG. 2 shows a perspective view of a principal portion of a high speed printer employing the printing mechanism shown in FIGS. 1A to 1D. In FIG. 2, members **3**, **4** and **19** indicate the control threads, pulleys and type hammers respectively as sown in FIGS. 1A to 1D, and **24** is an arranged combination of printing mechanisms. Said threads **3** are respectively connected to the armatures **2** of the electro-magnets **1** of FIGS. 1A to 1D, and the air supplying tubes **12** are adapted for connection to a high pressure air compressor which is not shown in the figure.

Though this invention can be applied to a high speed printer in which a type wheel having a plurality of types is rotated in a horizontal plane, the mechanism shown in FIG. 2 illustrates the application of the invention in a printer having a printing belt as shown in the aforementioned Japanese patent application. In this figure **22** is an inked ribbon, **21** is the paper which is to be printed on, and **23** shows the columns of printing types arranged in a plurality of lines upon a printing belt **25**. Further, **26** is a sprocket wheel, and **27** is a guide for the printing belt. The printing belt **25** is constituted by an endless ring belt, being moved transversely in front of the paper **22** and inked ribbon **21** by means of the sprocket wheel **26**, and the printing is effected by means of hammer **19** striking the paper **21** and the printing type **23**.

As clearly shown by the description of this invention, the printing mechanism can be composed by arranging printing units in both the horizontal and vertical direction in compliance with the letter spacings and line spacings. The printing of letters corresponding to any number of vertical lines can be finished in a single printing operation of a printer, therefore an extremely high speed printer is provided. Furthermore, as a secondary effect, the electric power necessitated to operate the required electro-magnets are decreased as compared with a construction in which the attracting powers of electro-magnets are directly used to make the required print.

What is claimed is:

1. High speed printing apparatus including a plurality of printing mechanisms, each mechanism comprising a housing having a chamber, a piston means in said chamber for reciprocal movement therein, a hammer on said piston and displaceable therewith, means operatively associated with the piston for selectively displacing the same to a printing position, means operatively associated with the piston for returning the same to a rest position, the first said means including a slender detent mechanism pivotally supported on the housing and selectively engageable with said piston to maintain the same stationary; activating means operatively associated with the detent mechanism for pivoting the same with respect to the housing thereby selectively disengaging the detent mechanism from the piston, said activating means including a control member independently of said housing and a thin flexible wire between the control member and the detent mechanism for transmitting movement therebetween.

2. Apparatus as claimed in claim 1, wherein said control member includes an electromagnet and an armature pivotally supported adjacent said electromagnet, for movement with respect thereto with said electromagnet energized.

3. Apparatus as claimed in claim 2, wherein said piston means is provided with a passageway and two ports in communication with said passageway, one port being in communication with a supply of compressed air with said piston in the rest position, the other port being in communication with the atmosphere with said piston in the printing position.

4. Apparatus as claimed in claim 3 wherein said piston means includes a protuberance, said detent mechanism having an end of hook shape engageable with said protuberance with said piston at the rest position, restoring means on said housing operatively associated with said detent mechanism to urge the same towards the protuberance on the piston.

5. Apparatus as claimed in claim 4 wherein said thin flexible wire is constituted by the fibres of a synthetic resin.

6. Apparatus as claimed in claim 4 wherein said mechanisms are cooperatively associated in a horizontal array at a determinable vertical spacing whereby said mechanisms are adapted for simultaneously printing a plurality of characters on a plurality of horizontal lines at a determinable vertical spacing.

7. Apparatus as claimed in claim 6 including a printing belt cooperatively disposed with respect to said hammer such that with said piston in the printing position said hammer presses against the belt to print a character.

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