

March 12, 1968

D. L. HOCHBERG

3,373,438

JET PRINTER

Filed Jan. 3, 1966

2 Sheets-Sheet 1

Fig. 1

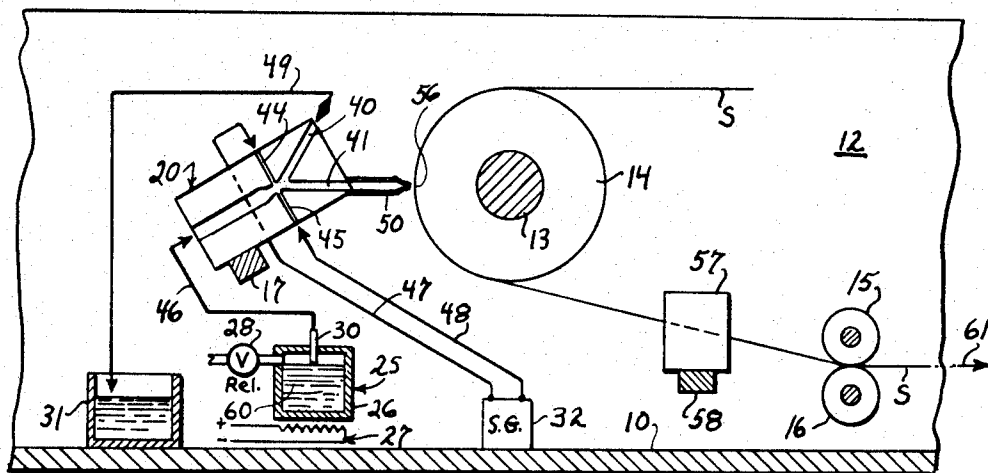


Fig. 2

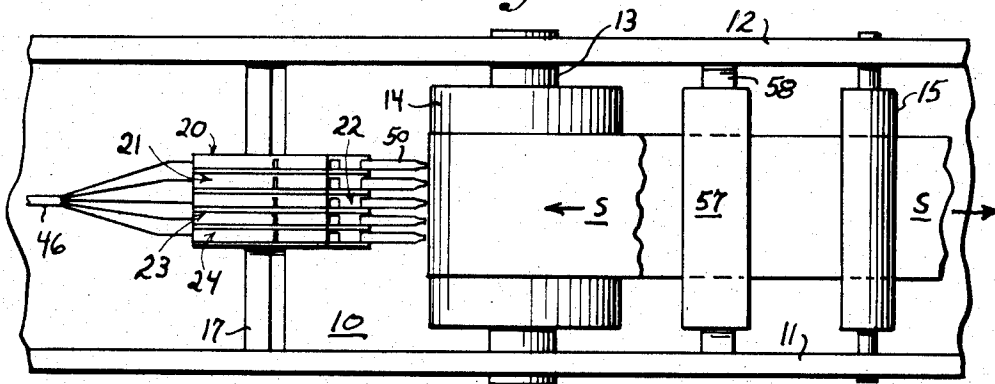


Fig. 3

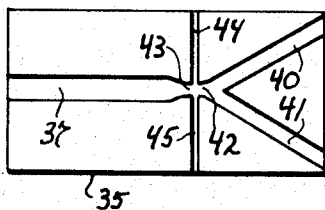


Fig. 4

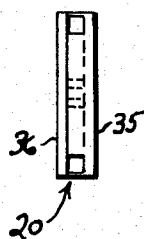
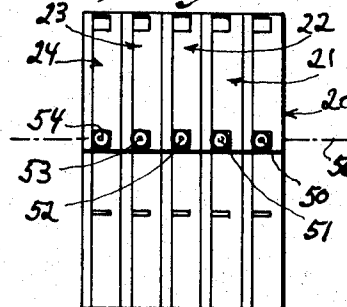


Fig. 5



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Fig. 6

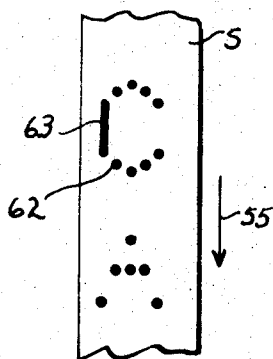


Fig. 7

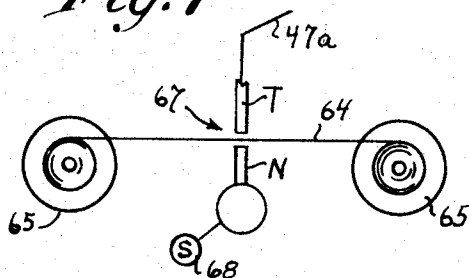


Fig. 8

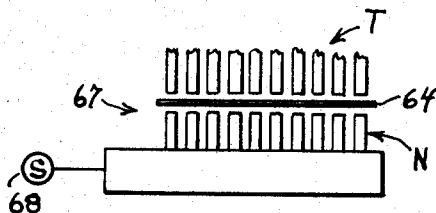
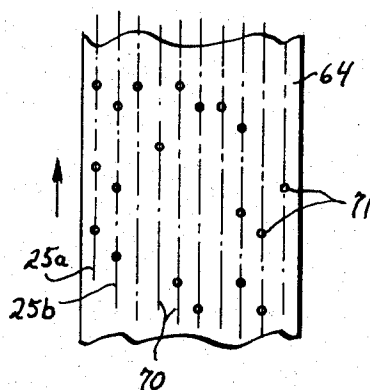


Fig. 9



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JET PRINTER

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1 Claim. (Cl. 346—75)

ABSTRACT OF THE DISCLOSURE

Fluid jet printing apparatus having a plurality of wall attachment type fluidic devices each of which is supplied with a printing fluid under pressure and each of which has two output lines. A nonprinting output line of each fluidic device is connected to a fluid reservoir while the other printing output line of each fluidic device is coupled with a nozzle that is adapted to direct the printing fluid against a record sheet. The printing fluid flowing through each fluidic device is selectively directed through the printing or the nonprinting outlet lines thereof by means of predetermined control signals.

This invention relates to a novel fluidic type jet printing device. More particularly the instant invention relates to an improved jet type printing apparatus wherein fluid amplifiers directly control the flow of printing fluid.

Various types of jet printers have been proposed, such printers having one or more fluid dispensing orifices and means to propel small amounts of ink or other printing fluid from said orifices towards a print receiving surface. One area which has presented operational difficulties here has been the obtaining of a proper valving action or fluid flow control for the flow of printing fluid from said orifices. This difficulty is at least partially attributable to the requirement that the successive quantities of printing fluid to be sequentially dispensed from said orifices be very small and that the response time for starting and stopping such fluid flows be very short and precise. The present invention contemplates a jet printer apparatus wherein very close control may be had over the flow of printing fluid from an orifice to the print receiving surface.

One object of the instant invention is to provide a novel jet printer which is capable of very precisely dispensing small successive quantities of printing fluid.

Another object of the invention is to provide an improved jet printer which is capable of very rapidly initiating and terminating the flow of printing fluid towards a record sheet.

A further object of the invention is to provide an improved jet printer wherein the printing fluid flows through a fluid amplifier just before being projected against a record sheet.

Other objects of the invention will become apparent as the disclosure progresses.

In the drawings:

FIG. 1 is a longitudinal sectional view showing one illustrative structural embodiment of the instant invention.

FIG. 2 is a plan view of the apparatus of FIG. 1.

FIGS. 3 and 4 illustrate the structural nature of a conventional type wall attachment fluid amplifier that is used in the present apparatus.

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FIG. 5 is an end view of the fluid nozzles associated with the instant set of fluid amplifiers.

FIG. 6 is a sketch illustrating the nature of the print work produced by the instant jet printer.

FIGS. 7 and 8 are sketches illustrating an exemplary type of signal generating means for controlling the present jet printer.

FIG. 9 shows a typical section of the perforated control tape that is used in conjunction with the apparatus of FIGS. 7 and 8.

Referring to FIGS. 1 and 2 the instant jet printer apparatus, which is shown in an illustrative embodiment, includes a base 10 and a pair of side frame plates 11 and 12 that are fixedly mounted on said base by any suitable means. Rotatably mounted on said side frames is a shaft 13 which fixedly carries a record feeding and supporting roll 14. Operatively mounted on said side frames by any suitable means is a rotatably driven pair of cooperating friction feed rollers 15 and 16 that are adapted to transport the elongated record sheet S at a predetermined speed through the instant printing machine. Fixedly mounted on the side frames is a cross bracket 17 to which is secured, by any suitable means, a plurality of fluid amplifiers 20, 21, 22, 23 and 24, each of which has no moving parts. Operatively supported on the machine frame is a fluid pressure source 25 which in this illustrative case comprises a conventional type boiler 26 and a cooperating electrical heater 27, the boiler 26 being equipped with a pressure relief valve 28 and an output line 30. Also supported on the machine frame is a printing fluid collector tank 31 and a signal generating device 32 which will be described below.

The respective fluid amplifiers 20-24 are similar in construction and operation and hence a discussion of just one thereof will suffice here. The wall attachment type amplifier 20 is conventional in nature and comprises a grooved plate 35, FIG. 3 and a cooperating cover plate 36, FIG. 4, that is sealingly secured thereto by any suitable means as is well understood in the art. The groove pattern formed in plate 35 is illustrated in FIG. 3 and comprises a supply line 37 and two divergent output lines 40 and 41 which communicate with said supply line through an interaction chamber 42 and a jet orifice 43. Two control lines 44 and 45 respectively communicate with opposite sides of said interaction chamber 42. In the operation of a fluid amplifier of the type illustrated in FIGS. 3 and 4, a jet of fluid moving from supply line 37 into the interaction chamber 42 exhausts through one or the other of the output lines 40 and 41 depending on the control signals that are impressed through control lines 44 and 45. This operation is bistable in nature and is well understood in the art and need not be further explained here.

The fluid amplifier 20 is coupled to the fluid circuit illustrated in FIG. 1 in the following manner. The amplifier supply line is connected by means of a line 46 to the output line 30 of the fluid pressure source 25, the two control lines 44 and 45 are connected to the signal generating means 32 by means of fluid conduit lines 47 and 48 respectively. The output line 40 is connected by means of a fluid conducting line 49 to the collector tank 31, and the output line 41 is coupled directly to

a nozzle 50 which has an outlet end thereof disposed very close to the printing line 56 of the machine which is located at the forward surface of the record sheet supporting roll 14. It will be understood that similar corresponding connections are made to each of the other fluid amplifiers 21, 22, 23 and 24. FIG. 5 shows a lateral array of the closely adjacent output ends of nozzles 50, 51, 52, 53 and 54 of the fluid amplifiers 20-24 respectively. Through these five nozzles printing fluid is caused to intermittently flow so that dotted and/or dashed character patterns such as those shown in FIG. 6 may be developed on the record sheet S as the latter is moved in a feed direction 55, past said printing line 56, FIGS. 1 and 5.

Considering the fluid flow control operation associated with just the amplifier 20 and its associated nozzle 50, printing fluid 60 in the boiler 26 is heated and vaporized by the heater 27 and is directed under pressure through line 46 to the bistable fluid amplifier 20. The normal operative condition or mode of amplifier 20 is such that printing fluid is normally discharged through the output line 40 and is then conducted to the collector tank 31 where it may be condensed and stored. Simultaneously, the feed rolls 15, 16 are driven to advance the record sheet S through the machine at a predetermined uniform rate as indicated by arrow 61, FIG. 1. When it is desired to direct some of the printing fluid through the nozzle 50 and against the record sheet S a control pressure pulse is initiated in the control line 47 and the printing fluid then moving into the interaction chamber 42 will immediately start flowing through the amplifier output line 41, nozzle 50 and onto the adjacent surface of the moving record sheet S. The fluid amplifier 20 will then be in and will remain in its other operative fluid flow condition or mode. Shortly thereafter a second control pressure pulse is initiated in the control line 48 so as to shift the fluid amplifier back to its said normal mode of operation wherein the printing fluid is again discharged through the amplifier output line 40. If the time duration between the said first and second control pulses is very short the fluid flow from nozzle 50 will constitute substantially a pulse and an effective fluid dot will thereby be deposited at the printing line 56 of the record sheet S as is illustrated at 62 of FIG. 6. If said time duration is relatively long then a substantially continuous vertical line will be deposited on the moving record sheet as is illustrated at 63 of FIG. 6. Thus the duration of the control signals for amplifier 20 may be differentially timed so as to give varying desired lengths to each successive fluid mark produced on the record sheet S. As will be apparent all five fluid amplifiers 20-25 are selectively employed as a group, the operation of the various amplifiers being respectively controlled in mutually timed sequence so as to deposit printing fluid on the moving record sheet in a manner so as to produce a desired series of effective character patterns as is illustrated in FIG. 6.

The term printing fluid as used herein means any fluid which when projected against or deposited on the record sheet S forms a visible or latent image thereon. Where a latent image is formed the instant machine would of course be provided with a suitable developing means 57, FIG. 1, that is mounted on a cross bracket 58 secured to the machine side frames. Mineral oil, kerosene, turpentine, ethylene glycol are examples of a printing fluid that may be used here to produce a latent image on the record sheet, which latent image may thereafter be developed by said means 57 using printing toners or similar techniques. Sensitized paper or coatings may be used with the record sheet S, such being thermally, chemically or otherwise reactive to the printing fluid deposited on the record sheet by the operation of the fluid amplifier nozzles 50-54. Examples of printing fluid and record sheet combinations that can be used here are as follows:

(1) Gaseous ammonia and diazo paper with subsequent stabilization by actinic light.

(2) Steam and air with a heat sensitive (Thermofax) paper.

(3) Steam and air with a colored fusible layer coated on a transfer sheet that is superimposed on the record sheet.

The signal generating means 32, FIG. 1, for the instant apparatus may be of a conventional nature. One exemplary arrangement illustrated in FIGS. 7-9 comprises a pneumatic signal generator unit that includes a previously prepared perforated tape 64 adapted to be advanced between reels 65 and 66 and through an air sensing head 67. The sensing head 67 comprises an air source 68 and a group of ten manifolded nozzles N coupled thereto. Respectively coaxially spaced from said nozzles N are ten cooperating receiver tubes T which are respectively connected to the ten control lines for the five fluid amplifiers 20-24. The perforated tape 64 has ten columns 70, FIG. 9, of holes 71 formed therein, one column for each nozzle N and associated receiver tube T. In operation the tape 64 is moved through the air sensing head in timed relation to the speed of movement of the record sheet S through the machine, hence a predetermined timed series of pneumatic switching pulses or signals will be initiated in the various fluid amplifier control lines which correspond to the size, spacing and location of the various holes in the perforated tape 64. In this manner information recorded in tape 64 will be effectively printed out on the moving record sheet S. It is to be understood that the above described signal generating means is shown for illustrative purposes and that other types of signal generating means may be used with equal facility to control the operation of the fluid amplifiers 20-24.

The instant jet printer is capable of high printing speeds in that, inter alia, the quantities of printing fluid directed at record sheet S are very small and the response time for each fluid amplifier is very short. One or more of the fluid amplifiers used here may be turbulence amplifiers, also monostable wall attachment type fluid amplifiers may be used. As will be apparent the pressure source 25 used here for the printing fluid may comprise an air compressor type of unit. Where a boiler type pressure source and a condensable printing fluid are used suitable heating and insulating means are used to insure that the printing fluid remains in the vapor state at all points between the boiler 26 and the nozzles 50-54.

Since many changes could be made in the embodiment of the invention as particularly described and shown herein without departing from the scope of the invention, it is intended that these embodiments be considered as exemplary and that the invention not be limited except as warranted by the following claim.

What is claimed is:

1. A jet printer: comprising
 - a support means for supporting a movable record sheet;
 - drive means for longitudinally advancing said record sheet;
 - a pressurized source of printing fluid;
 - a plurality of fluid amplifiers each having its inlet coupled to said pressurized source;
 - each amplifier having two output lines and being adapted to continuously conduct printing fluid from said source to and through a first one or a second one of said output lines, said flow of said printing fluid normally being through the first one of the output lines of each of said fluidic devices;
 - a nozzle means coupled to said second one of said output lines of each of said fluidic devices and being adapted to direct printing fluid from said second one of said output lines of each of said fluidic devices to said record sheet;
 - conduit means coupled to the said first one of said output lines of each of said fluidic devices for con-

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ducting the flow of printing fluid from the said fluidic devices to a reservoir;

signal conduit means for selectively controlling the operation of each of said fluidic devices so that said printing fluid may flow through the said second one of said output lines of each of said fluidic devices; and

signal generating means operable to apply control signals to said signal conduit means in timed relation to the operation of said record sheet drive means; and

record sheet developing means for developing a visible image from a latent image that is established on said record by said printing fluid;

said pressure source including means to direct a vaporized fluid to said inlets of said fluid amplifiers.

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