

-1-

REPLACED SHEETS		SG
☐	Description : paged to paged	
☒	Claim(s) : paged ..17... to paged ..19...	
☐	Drawing(s) : paged to paged	
☒	Abstract : paged ..20... to paged	
DATE OF RECEIPT		

- 1 Sheet Conveying Means and An Ink Jet
Recording Apparatus Having the Same

BACKGROUND OF THE INVENTION

5 Field of the Invention

This invention relates to sheet conveying means and an ink jet recording apparatus having the same.

Related Background Art

- 10 Sheet conveying means for conveying a sheet conveys the sheet with a spur brought into contact with the sheet with a pressure force. In order to make the sheet conveying means compact, there is one in which the shaft of the spur is provided by a
15 resilient member to thereby obtain the pressure force against the sheet. In such construction, however, it has been difficult to obtain a stable pressure force irrespective of the thickness of a sheet being conveyed.

20 SUMMARY OF THE INVENTION

It is an object of the present invention to provide sheet conveying means in which a stable pressure force is obtained irrespective of the thickness of a sheet being conveyed.

- 25 Now, the following problems have been encountered when the above-described conventional sheet conveying means provided with a spur is applied

1 to the field of an ink jet recording apparatus.

Where an ink droplet is large, or where it is difficult for a sheet itself such as an OHP sheet to absorb ink, or where the ink fixativeness of plain
5 paper or the like is not good, if the pressure force of the spur against the sheet is too great, ink will adhere to the spur and the ink will again adhere to the sheet to stain the sheet.

Further, if the pressure force of the spur
10 against the uneven portion of a sheet which is created by being wet with ink is too great, stable conveyance of the sheet will not be realized.

So, it is another object of the present invention to provide an ink jet recording apparatus
15 provided with sheet conveying means which can realize stable conveyance of a sheet by an appropriate pressure force against the presence of the unfixed portion of an ink droplet and the presence of the uneven portion of the sheet wet with ink.

20 It is another object of the present invention to provide sheet conveying means for conveying a sheet characterized by a rotatable member, a spur provided in opposed relationship with said rotatable member, and a resilient member supporting said spur
25 and provided in a curved state so as to press said spur against said rotatable member.

It is another object of the present invention

1 to provide a recording apparatus for effecting
recording on a sheet characterized by sheet conveying
means having a rotatable member, a spur provided in
opposed relationship with said rotatable member, and
5 a resilient member supporting said spur and provided
in a curved state so as to press said spur against
said rotatable member, and recording means for
effecting recording on the sheet.

It is another object of the present invention
10 to provide an ink jet recording apparatus characterized
by a recording head having a discharge port for
discharging ink therethrough to thereby effect
recording on a recording medium, conveying means for
conveying said recording medium having a conveying
15 roller, a spur provided in opposed relationship with
said conveying roller, and a resilient member supporting
said spur and provided in a curved state so as to
press said spur against said conveying roller, and
a carriage capable of moving said recording head in
20 a predetermined direction.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1A is a perspective view showing an
embodiment of the present invention.

25 Figure 1B is a front view showing an embodiment
of the present invention.

Figure 2 is a schematic perspective view

1 showing an ink jet recording apparatus to which an
embodiment of the present invention is applied.

Figure 3 is a graph showing the relation
between the displacement and load of a spring in an
5 embodiment of the present invention.

Figure 4 illustrates a method of applying the
load of Figure 3.

Figures 5A and 5B show another embodiment of the
present invention.

10

DESCRIPTION OF THE PREFERRED EMBODIMENTS

An ink jet recording apparatus to which sheet
conveying means according to the present invention can
be suitably applied will hereinafter be described
15 with respect to an embodiment thereof shown. Figure 2
schematically shows the construction of an ink jet
printer to which the present invention is applied.
In Figure 2, a recording head 1 discharges ink by a
recording signal, and is supplied with ink by an ink
20 tank 2. A carriage 4 carrying thereon the recording
head 1 and the ink head 2 is guided by guide shafts
3, and is reciprocally moved along the guide shafts 3
by a belt transmission mechanism and a driving motor,
not shown. A recording sheet 5 is held from the back
25 thereof by a platen 6 lying at a location opposed to
the recording head 1. The recording sheet 5 is
brought into intimate contact with the platen 6 by a

1 paper keep plate 7. The recording sheet 5 thus
brought into intimate contact with the platen is fed
by a paper feeding roller 8. The recording paper 5
on which recording has been effected is discharged
5 by a discharge roller 9. Spurs 10 are provided in
opposed relationship with the discharge roller 9 and
urge the recording sheet 5 against the discharge
roller. The spurs 10 are biased toward the recording
sheet 5 by an urging force by the flexure of a shaft
10 which will be described later. The roller 8 and the
roller 9 are driven by a paper feeding motor 12. A
recovery system device 13 performs the recovery
operation for preventing the clogging or the like of
the discharge port of the recording head 1, and
15 further performs the capping operation for preventing
the desiccation of the discharge port when recording
is not effected. This recovery system device 13 is
driven by a recovery system driving motor 14.

20 The recording sheet 5 is inserted along a
paper pan 15.

The operation of the above-described ink jet
printer will now be described. The recording sheet
5 inserted along the paper pan 15 is fed to the platen
6 with the inserted leading end thereof turned into
25 a U-shape by the roller 8 and is brought into
intimate contract with the platen 6 by the keep plate
7. Ink is jetted from the recording head 1 by a

1 recording signal and adheres to the recording sheet
5. By this adherence, characters or images are
formed. As this recording operation progresses, the
portions of the recording sheet 5 on which recording
5 has been effected are successively fed upwardly by
the roller 8. When the leading end portion of the
recording sheet 5 arrives at the spurs 10, the
recording sheet 5 is pushed from its recording surface
by the spurs 10 and the back of the recording sheet
10 is urged against the roller 9, and the recording sheet
is further conveyed upwardly by the rotation of the
roller 9 and is discharged outwardly.

Now, each spur 10 having pointed tip ends is
constructed as shown in Figures 1A and 1B.

15 In Figure 1A and 1B, the reference numeral 10
designates the spur, the reference numeral 22 denotes
the shaft of the spur which comprises a closely wound
tension coil spring, the reference numeral 9
designates the discharge roller formed of rubber or
20 the like, and the reference numeral 24 denotes spur
holders for supporting the spur 10 and the shaft 22
of the spur. In order that an appropriate pressure
force necessary to convey the recording sheet 5 may
be applied to the recording sheet 5 on which recording
25 has been effected and which passes between the spur
10 and the discharge roller 9, the positions of the
discharge roller 9, the spur 10 and the spur holders

1 24 are set so that the shaft 22 of the spur may
somewhat flex as shown in Figure 1B. An example of
the graph of the displacement and load of the closely
wound tension coil spring used in the present
5 embodiment is shown in Figure 3.

The graph of Figure 3 shows the relation
between the flexure δ of the center of the closely
wound tension coil spring when as shown in Figure 4,
a load is made to act vertically downwardly on the
10 center of the spring supported at its opposite ends
by a span l and said load.

When the experiment as shown in Figure 4 is
carried out by the use of a tension spring as a
heretofore used resilient member instead of the
15 closely wound tension coil spring, the following fact
is found.

When the vertical elastic modulus of said
tension spring is E and the cross-sectional secondary
moment thereof is I and the span thereof is l and the
20 flexure of the center of the span is δ and the load
acting on the center of the span is F , the following
equation is established:

$$\delta = \frac{Fl^3}{48EI} \quad (1)$$

25 This equation (1) is the linear function of
 δ and F within the limit of elasticity of the spring.

1 When this tension spring is used as the shaft of the
spur of the sheet conveying means, this shaft flexes
correspondingly to the thickness of the sheet being
conveyed, and there is created the pressure force
5 from the spur to the sheet which is found from
equation (1). Thus, the pressure force varies
greatly correspondingly to the thickness of the sheet
being conveyed (as shown by (c) in Figure 3). However,
when the closely wound tension coil spring according
10 to the present invention is used as the shaft of the
spur, it will be seen that a pressure force correspond-
ing to the initial tension F_0 can be created even if
flexure, i.e., the displacement δ of the shaft, is
almost 0, while on the other hand, a pressure force
15 slightly greater than the initial tension F_0 is
created even when the shaft is flexed by the sheet
being conveyed.

The closely wound tension coil spring shown
in (a) of Figure 3 which is used in the sheet
20 conveying means according to the present invention is
such that the pressure force created within the range
of 0.5 mm to 2.0 mm of the displacement amount is
about 17g to about 21g. Further, by varying the
torsion applied to the coil when the coil is wound
25 into a closely wound form, the initial tension F_0
can be changed to F_0' . The closely wound tension coil
spring shown in (b) of Figure 3 is such that the

1 pressure force created within the range of 0.5 mm
to 2.0 mm of the displacement amount can be changed
from about 7 g to about 10 g.

5 Figures 5A and 5B show another embodiment of the
present invention. The closely wound tension coil
spring used in this embodiment is that shown in (b)
of Figure 3, and the spring constant thereof is 44 g/
mm, the diameter of the wire thereof is $0.2 \text{ mm} \pm 0.01$
mm, the outer diameter of the coil thereof is $\phi 9 \pm 0.05$
10 mm, the length thereof is 18.4 ± 0.2 mm, the effective
number of turns thereof is 92, the span thereof is
16 mm, and the load F when the spring is displaced by
 $\delta = 1$ mm at the center of the span is 9 ± 1 g. The
material of the spring is a so-called spring
15 material such as SUS or piano wire.

Also, the spur used is of a pillar-like shape
having a diameter of 6 mm and a thickness of 2.2 mm
and having pointed projections provided on the center
of the direction of thickness over the side of the
20 pillar. The material of the spur may be, for example,
a metal if it is a water repellent material, but may
suitably be fluorine resin, polyacetal or the like.

The spur 30 is threaded through a shaft made
of a closely wound tension coil spring, and is
25 resiliently mounted on the apparatus by means of
members 25 and 25. At this time, the spur is
provided so as to protrude toward the sheet conveying

1 surface by 1 mm. That is, the spring is provided in
a curved state on the apparatus while supporting the
spur. The spur is restricted in its horizontal
movement by the members 25 and 25.

5 When paper (having a thickness of 0.1 mm -
0.2 mm) or an envelope (having a thickness of about
0.5 mm) is to be conveyed as a sheet, the displacement
amount of the spring is 1.1 mm to 1.5 mm and the
pressure force can keep a substantially constant
10 value of about 9.5 g - 10.5 g. Therefore, where this
spur is used in an ink jet recording apparatus, the
pressure force obtained is substantially constant
even if the thickness of the paper material varies, and
stable conveyance of the paper material is possible.

15 Further, if the wire material of the closely
wound tension coil spring is thickened and the initial
tension is increased to 50 g - 100 g, there can be
provided sheet conveying means which will require a
great pressure force for the conveyance of a paper
20 material such as continuous paper.

The spring constant of the closely wound
tension coil spring which can be suitably used in
the present embodiment is greater than 10 g /mm and
less than 100 g/mm, and preferably greater than
25 30 g/mm and less than 50 g/mm, and most preferably
greater than 40 g/mm and less than 45 g/mm.

The outer diameter of the coil is greater than

1 0.5 mm and less than 2 mm, and preferably greater than
0.8 mm and less than 1.0 mm.

The thickness of the wire material used, with
about 1/5 of the outer diameter of the coil as the
5 standard, is greater than 0.1 mm and less than 0.4 mm,
and preferably greater than 0.15 mm and less than 0.2
mm.

The span is determined by the wire diameter
of the spring material used, the displacement amount
10 and the pressure force obtained, and is preferably
greater than 5 mm and less than 30 mm, and more
preferably greater than 10 mm and less than 20 mm.

Also, the flexure amount (the displacement
amount) δ is greater than 1 mm and less than 2 mm,
15 and preferably greater than 1 mm and less than 1.5 mm
if the sheet material is plain paper, and preferably
greater than 1 mm and less than 1.2 mm if the sheet
material is continuous paper.

The present invention brings about an excellent
20 effect particularly in a recording head and a
recording apparatus of the ink jet type which utilize
heat energy to form flying droplets and accomplish
recording, among the ink jet recording systems.

The typical construction and principle of
25 such system may preferably be based on the basic
principle disclosed, for example, in U.S. Patent
No. 4,723,129 or U.S. Patent No. 4,740,796. This

1 system is applicable to both of the so-called on-
demand type and the so-called continuous type, and
particularly in the case of the on-demand type, it
is effective because at least one driving signal
5 corresponding to recording information and providing
a rapid temperature rise exceeding nuclear boiling
is applied to an electro-thermal conversion member
disposed correspondingly to a sheet or a liquid path
in which liquid (ink) is retained, whereby heat
10 energy is generated in the electro-thermal conversion
member to thereby cause film boiling on the heat-acting
surface of a recording head with a result that a
bubble in the liquid (ink) corresponding at one to
one to said driving signal can be formed. By the
15 growth and contraction of this bubble, the liquid
(ink) is discharged through a discharge opening to
thereby form at least one droplet. If this driving
signal is made into a pulse-like shape, the growth
and contraction of the bubble will take place
20 appropriately on the spot and therefore, the
discharge of the liquid (ink) particularly excellent
in responsiveness can be achieved, and this is more
preferable.

The signal as described in U.S. Patent No.
25 4,463,359 or U.S. Patent No. 4,345,262 is suitable
as said pulse-shaped driving signal. The adoption
of the conditions described in U.S. Patent No.

1 4,313,124 which discloses an invention relating to
the temperature rise rate of said heat-acting surface
would lead to the possibility of accomplishing more
excellent recording.

5 As regards the construction of the recording
head, besides the combination (straight liquid flow
paths or right-angled liquid flow paths) of discharge
ports, liquid paths and electro-thermal conversion
members as disclosed in the above-mentioned patents,
10 a construction using U.S. Patent No. 4,558,333 or
U.S. Patent No. 4,459,600 which discloses a construc-
tion in which the heat-acting portion is disposed in
a crooked area is also covered by the present
invention.

15 In addition, a construction based on Japanese
Laid-Open Patent Application No. 59-123670 which
discloses a construction in which a slit common to a
plurality of electro-thermal conversion members
provides the discharge portion of the electro-thermal
20 conversion members or Japanese Laid-Open Patent
Application No. 59-138461 which discloses a
construction in which an opening for absorbing the
pressure wave of heat energy corresponds to a
discharge portion is also effective for the present
25 invention.

Further, the full line type recording head
having a length corresponding to the width of the

1 largest recording medium on which recording can be
effected by a recording apparatus may be either of
the construction as disclosed in the above-mentioned
publications wherein the length of the head is
5 satisfied by a combination of a plurality of recording
heads and a construction as a unitarily formed
single recording head, and the present invention can
display the above-described effect more effectively.

In addition, the present invention is
10 effective when use is made of an interchangeable chip
type recording head which can be electrically connected
to the apparatus body or can be supplied with ink
from the apparatus body by being mounted on the
apparatus body, or a cartridge type recording head
15 having an ink tank integrally provided in itself.

Also, the addition of recovery means,
preliminary auxiliary means, etc. to the recording
head in the construction of the recording apparatus of
the present invention is preferable in that it can
20 more stabilize the effect of the present invention.
More specifically, these include capping means for
the recording head, cleaning means, pressing or
suction means, an electro-thermal conversion member
or a heating element or preheating means comprising
25 a combination of these, and carrying out the
preliminary discharge mode in which discharge
discrete from that during recording is effected is

1 also effective to accomplish stable recording.

Further, the recording mode of the recording apparatus is not limited to the recording mode for the main color such as black, but the recording head
5 may be unitarily constructed or provided by a combination of a plurality of heads, and the present invention is also very effective for an apparatus provided with different colors or at least one of full colors by mixed colors.

10 In the above-described embodiment of the present invention, the ink has been described as liquid, but the ink may be ink which solidifies at room temperature or below and softens or is liquid at room temperature, or ink which assumes its liquid
15 phase when the recording signal used is imparted, because it is usual with the above-described ink jet system that ink itself is temperature-controlled within the range of 30°C to 70°C so that the viscosity of the ink may be within a stable discharge range.

20 Furthermore, the recording apparatus according to the present invention may adopt the form of an apparatus provided integrally with or discretely from an information processing instrument such as a word processor or a computer as the image output end
25 thereof, or a copying apparatus combined with a reader, or a facsimile apparatus having the signal transmitting and receiving functions.

1 As described above, according to the present
invention, there is provided sheet conveying means
which creates a stable pressure force irrespective
of the thickness of a sheet material being conveyed.

5 Further, according to the present invention,
there is provided an ink jet recording apparatus
provided with sheet conveying means which can realize
stable sheet conveyance by an appropriate pressure
force against the presence of a portion to which
10 an ink droplet does not yet adhere and the presence
of the unevenness of the sheet material wet with ink.

Sheet conveying means for conveying a sheet
includes a rotatable member, a spur provided in
opposed relationship with the rotatable member, and
15 a resilient member supporting the spur and provided
in a curved state so as to press the spur against the
rotatable member.

20

25



5

1 WHAT IS CLAIMED IS:

1. Sheet conveying means for conveying a sheet,
including:

a rotatable member;

5 a spur provided in opposed relationship with
said rotatable member; and

a resilient member supporting said spur and
provided in a curved state so as to press said spur
against said rotatable member..

10

2. Sheet conveying means according to Claim 1,
wherein said resilient member is a closely wound
tension coil spring.

15

3. Sheet conveying means according to Claim 1,
wherein said rotatable member is a roller for
conveying said sheet.

20

4. A recording apparatus for effecting recording
on a sheet, including:

sheet conveying means having a rotatable member,
a spur provided in opposed relationship with said
rotatable member, and a resilient member supporting
said spur and provided in a curved state so as to
25 press said spur against said rotatable member; and

recording means for effecting recording on said
sheet.

This Sheet Has Been Replaced





1 5. A recording apparatus according to Claim 4,
wherein said rotatable member is a roller for
conveying said sheet.

5 6. A recording apparatus according to Claim 4,
which is a printer.

7. A recording apparatus according to Claim 4,
wherein said resilient member is a closely wound
10 tension coil spring.

8. A recording apparatus according to Claim 4,
wherein said recording means has a recording head
provided with an electro-thermal conversion member
15 generating heat energy in conformity with a recording
signal, and utilizes said heat energy to discharge ink.

9. A recording apparatus according to Claim 4,
wherein said recording means is provided with an
20 electro-thermal conversion member generating heat
energy which causes film boiling in ink.

10. An ink jet recording apparatus including:
a recording head having a discharge port for
25 discharging ink therethrough to thereby effect
recording on a recording medium;

conveying means for conveying said recording

This Sheet Has Been Replaced





1 medium, said conveying means having a conveying
roller, a spur provided in opposed relationship with
said conveying roller, and a resilient member
supporting said spur and provided in a curved state
5 so as to press said spur against said conveying roller;
and

a carriage capable of moving said recording head
in a predetermined direction.

10 11. An ink jet recording apparatus according to
Claim 10, wherein said resilient member is a closely
wound tension coil spring.

15 12. An ink jet recording apparatus according to
Claim 10, wherein said recording head has an electro-
thermal conversion member, and causes ink to be
discharged from said discharge port by the growth of
a bubble by film boiling caused by heat energy
generated by said electro-thermal conversion member.

20

25

This Sheet Has Been Replaced

