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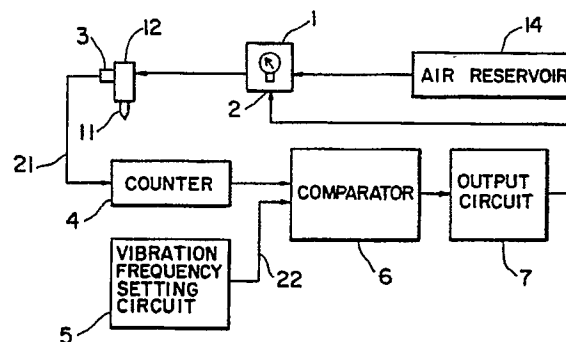
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54 **Vibration frequency setting mechanism of an engraving device provided with air pen.**

57 There is disclosed a vibration frequency setting mechanism of an engraving device provided with air pen. The vibration frequency setting mechanism comprises an engraving device provided with an air pen (11) vibration frequency of which is varied in response to compressed air to be supplied to the holder (12), a vibration frequency detector (12) for detecting the vibration frequency of the air pen (11) and providing a pulse signal (21) corresponding to the vibration frequency, a counter (4) for counting the pulse signal (21), a pressure regulator (1) provided with a regulating terminal (2), a vibration frequency setting circuit (5) for setting the vibration frequency (22) of the air pen(11), a comparator (6) for receiving the output of the counter (4) and the vibration frequency (22) and providing a logical "1" if the output of the counter (4) is greater than the vibration frequency (22) and a logical "0" if the output of the counter (4) is less than the vibration frequency (22), an output circuit (7) for receiving the output of the comparator (6) and decrementing the analog output at a given step if the output of the comparator (6) is a logical "1" and incrementing the analog output at a given step if the output of the comparator (6) is a logical "0", whereby the analog output of the output circuit (7) is supplied to the regulating terminal (2) so that the compressed air is

supplied to the holder (12).

FIG. 1



VIBRATION FREQUENCY SETTING MECHANISM OF AN ENGRAVING DEVICE PROVIDED WITH AIR PEN

The present invention relates to an engraving device provided with an air pen having a vibration frequency which can be set to a prescribed value by a vibration frequency setting means.

An arrangement of the prior art engraving device provided with an air pen will be described with reference to Figs. 3 and 4. The engraving device provided with the air pen is also described in Japanese Patent Laid-Open Publication No. 63-69700 (U.S. Serial No. 07/411 557). The prior art engraving device comprises a holder 12 for holding an air pen 11, an air cylinder provided with a pressure rod and connected to the holder 12 and interlocked with the air pen 11 for moving the air pen 11 so that the air pen 11 can engrave the surface of the work, a pressure regulator 13 connected to an air reservoir 14 and supplying the air pressure to the air cylinder so that the air cylinder can supply the air pressure via the pressure rod to the holder 12 at the state where the air pen 11 is brought into contact with the surface of the work and the air pressure applied via the pressure rod is regulated to be constant by the pressure regulator 13 when the air pen 11 is moved in response to the surface of the work.

Inasmuch as the air pen can be vibrated by merely regulating the pressure with use of the pressure regulator 13 according to the prior art engraving device, it was necessary to always pay attention to the variation of the quality of the air pen. The variation of quality defines as follows.

(a) Relationship between air pressure and vibration frequency of the air pen is varied for each air pen. For example, even if the air pen is operated under the same air pressure the vibration frequency of an air pen 11A is greater than that of an air pen 11B as illustrated in Fig. 4.

(b) Relationship between air pressure and vibration frequency is varied due to secular change of each air pen.

On the basis of the causes of the variation of quality as set forth in the above (a), (b), it was necessary to regulate air pressure at the optimum value every time the air pen is exchanged for another air pen.

It is an object of the present invention to provide a vibration frequency setting mechanism of an engraving device provided with air pen capable of eliminating both the exchange of the air pen and the regulation of variation of relationship between air pressure and vibration frequency due to secular change by setting vibration frequency of the air pen to an optimum value.

To achieve the above object of the present invention, the vibration frequency setting mechanism

of an engraving device provided with air pen comprises an engraving device comprising an air pen and a holder for holding the air pen, vibration frequency of the air pen being varied in response to a compressed air to be supplied to the holder, a vibration frequency detector attached to the holder for detecting the vibration frequency of the air pen and providing a pulse signal corresponding to the vibration frequency, a counter for counting the pulse signal, a pressure regulator provided with a regulating terminal for increasing or decreasing the pressure of the compressed air in response to a signal supplied thereto from an output circuit, a vibration frequency setting circuit for setting the vibration frequency of the air pen, a comparator for receiving the output of the counter and the vibration frequency and providing a logical "1" if the output of the counter is greater than the vibration frequency and a logical "0" if the output of the counter is less than the vibration frequency, an output circuit for receiving the output of the comparator and decrementing the analog output at a given step if the output of the comparator is a logical "1" and incrementing the analog output at a given step if the output of the comparator is a logical "0", whereby the analog output of the output circuit is supplied to the regulating terminal of the pressure regulator so that the compressed air is supplied from the pressure regulator to the holder.

The above and other objects, features and advantages of the present invention will become more apparent from the following description taken in conjunction with the accompanying drawings.

Fig. 1 is a view showing an arrangement of a vibration frequency setting mechanism of an engraving device provided with air pen according to a preferred embodiment of the present invention;

Fig. 2 is a view showing an arrangement of an output circuit, a constituent of arrangement of Fig. 1;

Fig. 3 is a view showing an arrangement of a prior art engraving device provided with air pen; and

Fig. 4 is a graph showing a relationship between vibration frequency and air pressure.

A vibration frequency setting mechanism of an engraving device provided with air pen according to a preferred embodiment of the present invention will be described with reference to Figs. 1 and 2.

The vibration frequency setting mechanism of an engraving device provided with air pen comprises an engraving device comprising an air pen 11 and a holder 12 for holding the air pen 11, vibration frequency of the air pen 11 being varied in response to a compressed air to be supplied to

the holder 12, a vibration frequency detector 3 attached to the holder 12 for detecting the vibration frequency of the air pen 11 and providing a pulse signal 21 corresponding to the vibration frequency, a counter 4 for counting the pulse signal 21, a pressure regulator 1 provided with a regulating terminal 2 for increasing or decreasing the pressure of the compressed air in response to a signal supplied thereto from an output circuit 7 (described later), a vibration frequency setting circuit 5 for setting the vibration frequency 22 of the air pen 11, a comparator 6 for receiving the output of the counter 4 and the vibration frequency 22 and providing a logical "1" if the output of the counter 4 is greater than the vibration frequency 22 and a logical "0" if the output of the counter 4 is less than the vibration frequency 22, an output circuit 7 for receiving the output of the comparator 6 and decrementing the analog output at a given step if the output of the comparator 6 is a logical "1" and incrementing the analog output at a given step if the output of the comparator 6 is a logical "0", whereby the analog output of the output circuit 7 is supplied to the regulating terminal 2 of the pressure regulator 1 so that the compressed air is supplied from the pressure regulator 1 to the holder 12.

The arrangement of the vibration frequency setting mechanism of an engraving device provided with air pen will be described more in detail.

The pressure regulator 1 increases or decreases the pressure of the pressurized air in response to amount of signal to be applied to the air regulating terminal 2. The vibration detector 3 detects the vibration frequency of the air pen 11 and provides the pulse signal 21 corresponding to the vibration frequency. A piezoelectric sensor is employed as the vibration detector 3.

The counter 4 detects the pulse signal 21 provided by the vibration frequency detector 3. The vibration frequency setting circuit 5 sets the vibration frequency 22 of the air pen 11 and employs for example a digital switch.

The comparator 6 receives the output of the counter 4 and the vibration frequency 22 and provides a logical "1" if the output of the counter 4 is greater than the vibration frequency 22 and a logical "0" if the output of the counter 4 is less than the vibration frequency 22. The output circuit 7 receives the output of the comparator 6 and decrements the analog output at a given step if the output of the comparator 6 is a logical "1" and increments the analog output at a given step if the output of the comparator 6 is a logical "0". The output circuit 7 may comprise, as illustrated in Fig. 2, a CPU 71 and a D/A converter. The CPU 71 provides a digital data which is incremented or decremented at a give step in response to the

logical state of the output of the copmarator 6. The digital data provided by the CPU 71 is converted to an analog signal by the D/A converter 72. Accordingly, the pressure regulator 1 can receive the analog output signal from the D/A converter 72 via the reglating terminal 2 which is incremented or decremented in the given step in response to the logical state of the output of the comparator 6. As a result, the air pen 11 receives the given vibration frequency which is same as the vibration frequency set by the vibration frequency setting circuit 5 from the pressure regulator 1.

According to the present invention, the vibration frequency of the air pen can be kept conformed to the vibration frequency set by the vibration frequency setting circuit 5. Hence, there are following advantages.

(a) Adjustment of the air pen due to the manufacturing variation is eliminated.

(b) Adjustment of the air pen due to secular change is eliminated.

(c) It is possible to diagnose the operation of the engraving device by monitoring the counted value of the vibration frequency of the air pen during the fixed time.

Although the invention has been described in its preferred form with a certain degree of particularity, it is to be understood that many variations and changes are possible in the invention without departing from the scope thereof.

The features disclosed in the foregoing description, in the claims and/or in the accompanying drawings may, both separately and in any combination thereof, be material for realising the invention in diverse forms thereof.

Claims

1. A vibration frequency setting mechanism of an engraving device provided with air pen comprising:
 - an engraving device comprising an air pen (11) and a holder (12) for holding the air pen (11), vibration frequency of the air pen (11) being varied in response to the compressed air to be supplied to the holder (12);
 - a vibration frequency detector (3) attached to the holder (12) for detecting the vibration frequency of the air pen (11) and providing a pulse signal (21) corresponding to the vibration frequency;
 - a counter (4) for counting the pulse signal (21);
 - a pressure regulator (1) provided with a regulating terminal (2) for increasing or decreasing the pressure of the compressed air in response to a signal supplied thereto from an output circuit (7) (described later);
 - a vibration frequency setting circuit (5) for setting

the vibration frequency (22) of the air pen (11);
a comparator (6) for receiving the output of the
counter (4) and the vibration frequency (22) and
providing a logical "1" if the output of the counter
(4) is greater than the vibration frequency (22) and
a logical "0" if the output of the counter (4) is less
than the vibration frequency (22);
an output circuit (7) for receiving the output of the
comparator (6) and decrementing the analog output
at a given step if the output of the comparator (6) is
a logical "1" and incrementing the analog output at
a given step if the output of the comparator (6) is a
logical "0";
whereby the analog output of the output circuit (7)
is supplied to the regulating terminal (2) of the
pressure regulator (1) so that the compressed air is
supplied from the pressure regulator (1) to the
holder (12).

2. A vibration frequency setting mechanism of
an engraving device provided with air pen accord-
ing to claim 1, wherein the output circuit (7) com-
prises a CPU (71) and a D/A converter (72),
the CPU (71) producing digital data which is incre-
mented or decremented at a given step in re-
sponse to a logical state provided by the compara-
tor (6) and the D/A converter (72) converting the
digital data provided by the CPU (71) into an
analog signal.

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FIG. 1

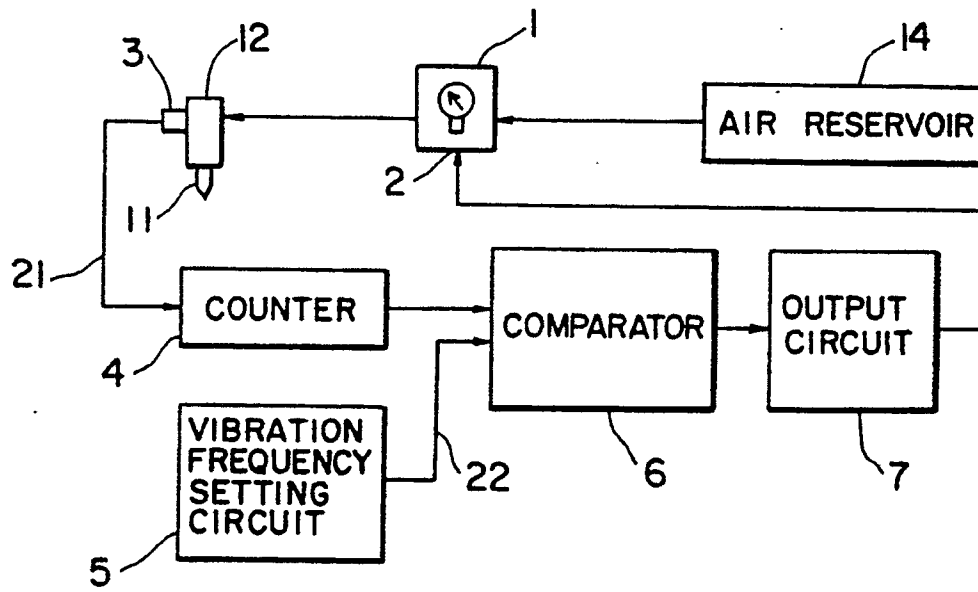


FIG. 2

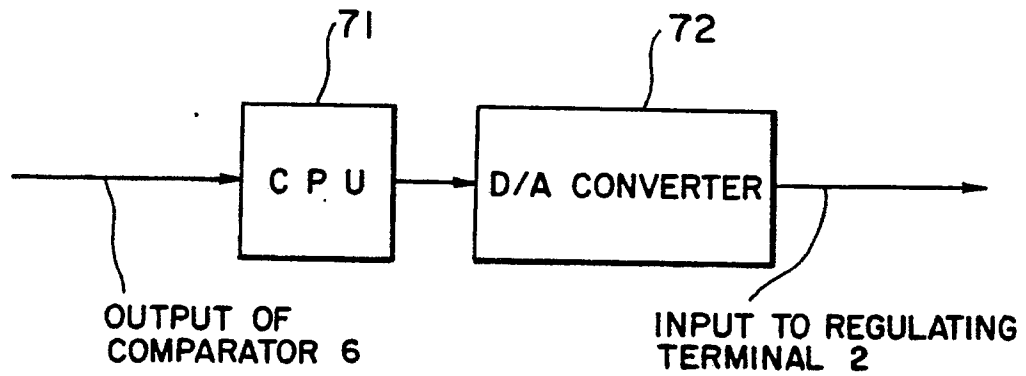


FIG. 3 (PRIOR ART)

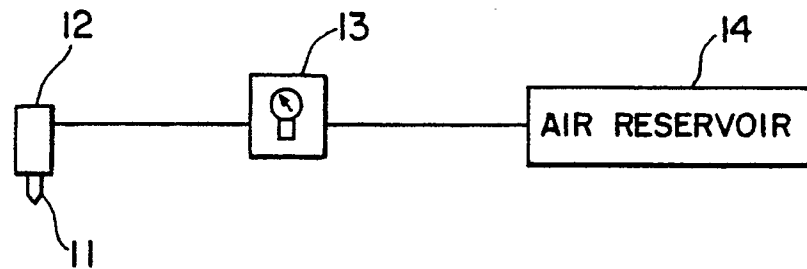


FIG. 4 (PRIOR ART)

