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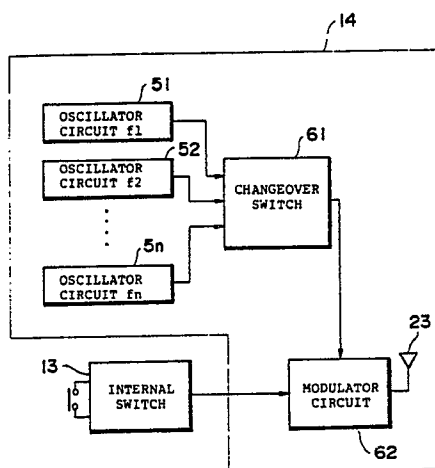
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54 **Wireless switch.**

57 A wireless switch includes an actuator displaced upon receiving an external force, a switch circuit (13) for outputting a switching signal in operative association with motion of the actuator, an oscillator circuit (14, 51 52, 5n, 62) for wirelessly outputting a signal

of a prescribed frequency to a remote location, which is spaced apart from the wireless switch, based on an output signal from the switch circuit, and changeover circuit (61) for changing over the oscillation frequency of the oscillator circuit.

Fig.5



## WIRELESS SWITCH

This invention relates to a switch in which the switch output (an ON or OFF signal) is delivered to external equipment in wireless fashion. More specifically, the invention relates to a wireless switch such as a limit switch, microswitch or photoelectric switch.

Limit switches in general use are as exemplified in Fig. 10. Here a pair of limit switches 93A, 93B are provided. The limit switches 93A, 93B are respectively situated at upper and lower limit positions of a vertically traveling slider 92 fitted on a moving machining table 91 of an apparatus. The limit switches 93A, 93B are connected to a switch control unit 95 via respective cables 96 which take into account the allowable traveling distance of the machining table 91. However, the cables 96 undergo flexing repeatedly whenever the moving machining table 91 travels, as a result of which fatigue develops in the terminal ends of the cables at which the connections are made. This can lead to severance of the cables.

In an attempt to solve this problem, wireless switches have been proposed having a switch portion which detects motion of an actuator, and an oscillatory output portion which delivers an output to a remote location wirelessly at a prescribed frequency on the basis of a detection signal from the switch portion. For example, see the specifications of Japanese Patent Application Laid-Open (KOKAI) No. 63-195921 and Japanese Utility Model Application Laid-Open (KOKAI) No. 57-173238. These wireless switches eliminate the need for wiring between the switch and the switch control unit.

In the wireless switch described in Japanese Patent Application Laid-Open No. 63-195921, the switch body proper is replaced when a battery is runs down or when a malfunction occurs. When the replacement is made, therefore, readjustment of the actuator is required. Another drawback is that since the switch employs an external antenna, the switch output is susceptible to outside influences and tends to fluctuate as a result.

In the wireless switch described in Japanese Utility Model Application Laid-Open No. 57-173238, no consideration is given to antenna directivity with respect to the receiver side. Consequently, depending upon where the switch is mounted, the switch output may become unstable. This can lead to erroneous operation due to an improper output.

Furthermore, with wireless switches of the kind described above, means ordinarily are not provided for indicating the amount of consumption of the battery incorporated within the switch. Accordingly, though the battery is replaced when battery capac-

ity diminishes and the wireless switch no longer produces an output, the equipment associated with the switch will suddenly cease operating when the switch is no longer capable of producing an output due to depletion of the battery. Such unexpected shutdown of the equipment can have undesirable consequences.

In addition, when the wireless switch is replaced due to depletion of the internal battery or malfunction, it is required that the replacement wireless switch have the same frequency as that it is replacing. Consequently, since it is necessary to store wireless switches identical with those already installed in order to make replacement possible, a large variety of wireless switches must be kept in stock. This is uneconomical.

Further, in wireless switches of this type, the arrangement is such that an internal switch, various circuits for controlling oscillatory output and a battery are housed within a switch case. This limits switch miniaturization and places a restriction upon battery size, as a result of which a sufficient battery capacity cannot be obtained. When the battery is replaced, moreover, operability in terms of battery and circuitry replacement is poor since the switch case often is located near the machining area of the apparatus or between mechanical members of the apparatus. Another problem relating to the oscillatory output section is that the oscillatory output tends to fluctuate if the switch is located in an environment where it is susceptible to output wave interference produced by the machining area of the apparatus.

An object of the present invention is to provide a wireless switch in which an antenna possessing transmission directivity is fitted within a switch case to improve the output capability of the switch.

Another object of the present invention is to provide a wireless switch in which the state of battery consumption is accurately ascertained so that stabilized switch operation relative to associated equipment can be achieved while supervising battery replacement timing.

A further object of the present invention is to provide a wireless switch in which one type of wireless switch can be used as a general-purpose wireless switch in place of other types of wireless switches.

Yet another object of the present invention is to provide a wireless switch in which an oscillatory output section is extracted from the switch case and disposed externally of the case, thereby making possible stable transmission without output interference.

According to one aspect of the present inven-

tion, there is provided a wireless switch having a switch case formed into a box-shaped configuration, an oscillator circuit housed within the switch case for wirelessly delivering a switch signal oscillating at a prescribed frequency to a receiver at a remote location, and an oscillator circuit antenna housed within the switch case. A side face of the switch case which corresponds to the receiver is formed to have an opening, and the opening is provided with a freely detachable switch cover. The antenna, which possesses transmission directivity with respect to the receiver, is fitted onto the inner surface of the switch cover.

In accordance with this aspect of the invention, the switch output signal is delivered to the receiver via the antenna, which is housed within the switch case and possessed of transmission directivity.

On the receiver side, therefore, the switch output signal exhibiting directivity is received with a high degree of assurance. In particular, the wireless switch obtained is reliable and highly stable, possesses a high output performance in which the directivity is highly resistant to noise, and raises reception sensitivity in an efficient manner.

In addition, if it is so arranged that various circuits such as the oscillator circuit and a battery are fitted on the inner surface of the switch cover along with the antenna, then depletion of the battery or a circuit malfunction can be dealt with merely by replacing the switch cover. This makes it possible to dispense with actuator readjustment, which is necessitated by switch replacement in the prior art. As a result, the efficiency of the switch replacement operation is improved.

In another aspect of the present invention, there is provided a wireless switch comprising switch circuit means for outputting a switching signal in operative association with motion of an actuator displaced upon receiving an external force, oscillator circuit means for wirelessly outputting a signal of a prescribed frequency to a remote location, which is spaced apart from the wireless switch, based on the switching signal from the switch circuit means, a battery for driving the oscillator circuit means, voltage detecting means for detecting a voltage drop in the battery, and modulator circuit means for modulating an output of the oscillator circuit means based on a detection output from the voltage detecting means.

In accordance with this aspect of the invention, a drop in the output voltage of the battery is detected by the voltage detecting means when such a voltage drop occurs. At the moment the voltage drop is detected, the modulator circuit means impresses a specific signal, which specifies the limit of the useful life of the wireless switch, on an oscillatory signal and transmits the result.

Accordingly, on the receiver side which has

received the transmitted signal, the operator is informed of the status of battery consumption, thus making it possible for the operator to know when to replace the battery and when to perform maintenance and inspection. As a result, a temporary interruption in the operation of the apparatus due to depletion of the battery can be avoided, and the battery can be replaced when the apparatus is not being used. This raises efficiency.

In yet another aspect of the present invention, there is provided a wireless switch comprising an actuator displaced upon receiving an external force, switch circuit means for outputting a switching signal in operative association with motion of the actuator, oscillator circuit means for wirelessly outputting a signal of a prescribed frequency to a remote location, which is spaced apart from the wireless switch, based on an output signal from the switch circuit means, and changeover means for changing over the oscillation frequency of the oscillator circuit means.

Further, there is there is provided a wireless switch comprising an actuator displaced upon receiving an external force, switch circuit means for outputting a switching signal in operative association with motion of the actuator, oscillator circuit means for wirelessly outputting a signal of a prescribed frequency to a remote location, which is spaced away from the wireless switch, based on an output signal from the switch circuit means, modulator circuit means for modulating the oscillation frequency of the oscillator circuit means into a prescribed signal, and adjusting means for adjusting the signal frequency used by the modulator circuit means.

According to this aspect of the invention, if the wireless switch is to be replaced, the changeover means is changed over in such a manner that the oscillation frequency of the already installed wireless switch fitted on the apparatus and the oscillation frequency of the new wireless switch will become the same. The new switch is then substituted for the old.

The modulation frequency of the modulator circuit can be suitably modulated by the modulator circuit adjusting means so as to obtain a prescribed signal.

Thus, by merely changing over the oscillation frequency of the oscillator circuit, an already installed wireless switch can be replaced by the same type of wireless switch having the same oscillation frequency. Hence, one type of wireless switch can be utilized as a variety of wireless switches.

In addition, a prescribed specific signal for distinguishing among a large number of mounted individual switches can be obtained merely by adjusting the modulation frequency of the modulator

circuit.

In yet another aspect of the present invention, there is provided a wireless switch comprising a switch portion for performing a switching operation in operative association with motion of an actuator displaced upon receiving an external force, and an oscillatory output portion for wirelessly outputting a switch signal to a remote location at a prescribed frequency based on an output signal from the switch portion, the oscillatory output portion being disposed separately at a position remote from a switch case housing the switch portion.

In accordance with this aspect of the invention, when the actuator is displaced upon receiving an external force, this motion is detected by the switch portion inside the switch case, and the resulting switch signal is outputted as oscillation to the receiver side from the oscillatory output portion at the location remote from the switch case.

Thus, the output signal from the oscillatory output portion is delivered stably without being adversely influenced by the machining area of the apparatus. The wireless switch obtained is reliable and highly stable, possesses a high output performance with high resistance to noise, and raises reception sensitivity in an efficient manner.

Since the oscillatory output portion is remotely disposed externally of the switch case, the switch case can be miniaturized. Since the battery of the oscillatory output portion also is situated externally of the switch case, a battery with a large capacity can be installed. Furthermore, if the oscillator circuit portion is to be replaced when the battery runs down, a circuit malfunction occurs or the frequency output is altered, the replacement can be made efficiently independently of the switch case.

Other features and advantages of the present invention will be apparent from the following description taken in conjunction with the accompanying drawings, in which like reference characters designate the same or similar parts throughout the figures thereof.

In the drawings:

Fig. 1 is a longitudinal sectional view illustrating a wireless limit switch according to an embodiment of the present invention;

Fig. 2 is a longitudinal sectional view illustrating a wireless limit switch according to a modification of the present invention;

Fig. 3 is a block diagram showing an electric circuit of the wireless limit switch;

Fig. 4 is a diagram showing the manner in which a battery incorporated within the wireless limit switch is supervised;

Fig. 5 is a block diagram showing another example of an electric circuit of the wireless limit switch;

Figs. 6 and 7 circuit block diagrams showing

modifications of a wireless limit switch according to the present invention;

Fig. 8 is a schematic side view showing the wireless limit switch when in use;

Fig. 9 is a longitudinal sectional view showing an oscillatory output device; and

Fig. 10 is a schematic side view showing a conventional limit switch when in use.

Fig. 1 illustrates the mechanical construction of a wireless limit switch. As shown in Fig. 1, a limit switch 11 comprises an actuator 12 for sensing an external force, an internal switch 13 which switches in operative association with motion of the actuator, an oscillatory output portion 14 for modulating the output signal of the internal switch 13 and wirelessly outputting this modulated signal to a switch control unit at a remote location remote from the internal switch 13, and a box-shaped switch case 15 for holding these elements.

The actuator 12 has a distal end portion projecting outwardly from the switch case 15 and provided with a roller 12a situated at a position at which it is capable of sensing the external force of an apparatus, and a base portion secured to a rotary shaft 16 projecting from one side face of the switch case 15.

The end of the rotary shaft 16 inside the switch case 15 is formed into a flat, plate-shaped configuration having an upper flat surface 16a opposing a return spring 18 supported on a vertically movable spring support cylinder 17, and a lower flat surface 16b opposing a plunger 20 via a downwardly movable member 19. In the ordinary unloaded state, the actuator 12 is in a standby mode in which it is capable of sensing an external force. When the actuator 12 senses an external force and therefore is loaded to assume an inclined state, the rotary shaft 16 turns in one direction against the force of the spring. Owing to the turning action of the rotary shaft 16, the plunger 20 is reciprocated via the downwardly movable member 19 so that a plunger projection 20a depresses a push button 13a of the internal switch 13 in operative association with the reciprocating motion of the plunger 20, thereby turning the switch 13 ON and OFF.

The output signal produced by the internal switch 13 is introduced, via a conductive coil spring 21, to an oscillatory output portion 14 mounted on a printed circuit board 22 and composed of an oscillator circuit, a modulator circuit and the like. The switch output signal is modulated by the oscillatory output portion 14, and the resulting modulated signal is transmitted wirelessly via a coil-shaped antenna 23.

The printed circuit board 22 and the antenna 23 are fitted integrally on the inner surface of a switch cover 24. The latter has the shape of a flat plate and is detachably mounted on a case open-

ing 15a formed in one side face of the switch case 15. The coil-shaped antenna 23 is attached to the central portion of the cover 24 via an antenna support column 24a, and the output signal of the oscillatory output portion 14 is introduced to the antenna 23 via a connecting cord 25.

The transmitting direction of the antenna 23 is set at right angles to an outer face 24b of the support column 24a in order to take transmission performance into account. By adopting such an arrangement, the internal antenna is not readily susceptible to external influences, and an excellent transmission characteristic possessing directivity is provided. When the switch is attached, therefore, both transmission and reception sensitivity can be improved by facing the outer surface 24b of the support column toward the receiver side.

Further, in consideration of attachability of the switch to various kinds of apparatus, it will suffice to furnish several types of switches having different transmission directions in such a manner that the pointing direction of the antenna 23 opposes a prescribed wall surface of the switch case 15.

Fig. 2 shows another embodiment of a limit switch illustrating this example. Here an L-shaped switch cover 34 simultaneously covers both a side opening 32 and a bottom opening 33 of a switch case 31, the printed circuit board 22 is attached to the inner surface of the long side of the cover 34, and an antenna 37 supported on an antenna support column 36 is attached to the inner surface of the short side of the cover 34.

In this case also the antenna 37 possesses directivity and is arranged so that its transmission direction is at right angles to an outer face 36a of the support column. The reason for this arrangement is to obtain good transmission performance.

Fig. 3 is a circuit block diagram of the limit switch. An oscillator circuit 26 has an oscillator function for outputting an oscillating signal having a prescribed oscillation frequency. This oscillating output signal is produced based on an output from a switching circuit 27 which has received a signal from the internal switch 13 indicative of detection of an external force. The oscillating signal from the oscillator circuit 26 is modulated by a modulator circuit 28. As a result, a predetermined signal is outputted wirelessly to a switch control unit on the receiving side via the antenna 23.

A lithium battery 29 is accommodated in the case 15 as a power supply for driving each circuit. A voltage detector circuit 30 is provided for detecting the state of consumption of the lithium battery 29.

The voltage detector circuit 30 detects that the voltage of the lithium battery 29 has fallen below a predetermined value near the output limit of the wireless switch, and the wireless limit switch inter-

mittently outputs, e.g., in wireless fashion, the fact that a drop in battery voltage has been detected, via modulator circuit 28, thereby informing the operator that the lithium battery 29 should be replaced.

On the side of a switch control unit 41 which receives this signal, as shown in Fig. 4, the oscillating signal rendered intermittent by the end of battery life is received by a receiver 42, which outputs a signal indicative of the end of battery life to a controller 43. Upon receiving this signal, the controller 43 causes a warning indicator 44 to flash or emit a warning tone as a warning signal, by way of example. The operator is thus informed of the fact that the battery should be replaced or that maintenance and inspection should be carried out.

It is possible to adopt an arrangement in which the warning is not limited to the receiving side but is issued also on the transmitting side, which is the side of the wireless switch proper.

The limit switch thus constructed is such that when the actuator 12 is displaced under the influence of an external force, the internal switch 13 issues an ON signal in operative association with the motion of the actuator, and the oscillatory output portion 14 wirelessly outputs a signal to the receiver side via the antenna 23 based on this ON signal.

At this time, the signal is delivered to the receiver side via the antenna 23 housed in the switch case 15 and possessing directivity. On the receiver side, therefore, the output signal is received with assurance. In particular, the wireless switch obtained is reliable, the directivity is highly resistant to noise, and reception sensitivity is raised in an efficient manner.

In addition, the antenna and the printed circuit board on which the circuit and battery are mounted are integrally fitted on the inner surface of the switch cover. As a result, depletion of the battery, a circuit malfunction or a change in frequency output can be dealt with in a simple manner merely by replacing the switch cover. This makes it possible to dispense with actuator readjustment, which is necessitated by switch replacement in the prior art. Accordingly, the efficiency of the switch replacement operation is improved.

When the voltage of the lithium battery 29 falls below a predetermined value, the voltage detector circuit 30 detects this voltage drop. At the moment the voltage drop is detected, the modulator circuit 28 modulates the output signal with a signal specifying that the switch has reached the limit of its useful life. The resulting signal is transmitted. On the receiving side, the end of the life of the lithium battery 29 is sensed, before it occurs, in response to reception of the abovementioned signal. Thus, replacement of the lithium battery 29, maintenance

and inspection can be performed appropriately, and the battery replacement operation can be performed efficiently in order that temporary shutdown of the apparatus due to the end of battery life may be avoided.

Fig. 5 illustrates another example of the oscillatory output portion. As shown in Fig. 5, a plurality of oscillator circuits 51, 52, ..., 5n which oscillate at different frequencies  $f_1$ ,  $f_2$ , ...,  $f_n$ , respectively, are provided. A changeover switch 61 is capable of selecting any one of the oscillator circuits 51 - 5n. Thus, the oscillatory output portion is provided with an oscillation function that lends this portion to various types of switches. The changeover switch 61 can comprise an ordinary multiple-contact switch, short-circuit pins, etc.

In the oscillatory output portion 14 which has received the signal from the internal switch 13 indicating detection of the external force, the oscillatory signal from the selected oscillator circuit is modulated by a modulator circuit 62, from which a predetermined signal is wirelessly transmitted to the switch control unit on the receiver side via the antenna 23. In response to wireless reception of this signal, the switch control unit outputs a prescribed control signal to the apparatus to be controlled.

Fig. 6 is a circuit block diagram of a limit switch having a frequency divider circuit 64. The latter is capable of converting the oscillation frequency  $f$  of an oscillator circuit 63 into a specific frequency depending upon the frequency dividing ratio set by a changeover switch 61. As shown in Fig. 7, the carrier frequency of a modulator circuit 65 can be adjusted by being switched over to a predetermined modulation frequency by the changeover switch 61. Thus, by changing over the frequency dividing ratio of the frequency divider circuit 64 and the carrier frequency of the modulator circuit 65, the limit switch is specified and distinguished from other limit switches.

The limit switch thus constructed is such that when the actuator 12 is displaced under the influence of an external force, the internal switch 13 issues an ON signal in operative association with the motion of the actuator, and the oscillatory output portion 14 wirelessly transmits a signal to the switch control unit on the receiver side via the antenna 23 based on this ON signal.

Thus, by merely changing over the oscillation frequency of the oscillator circuit when the limit switch is replaced owing to a program alteration, an already installed wireless switch can be replaced by the same type of wireless switch having the same oscillation frequency. Hence, one type of wireless switch can be utilized as a wide variety of wireless switches.

In addition, a prescribed specific signal for

distinguishing among a large number of mounted individual switches can be obtained merely by changing over the frequency divider circuit or changing over the modulation frequency of the modulator circuit.

Fig. 8 illustrates another embodiment of the invention. The limit switch in this embodiment comprises an actuator 71A or 71B for sensing external force, a switch case body 72A or 72B for holding an internal switch (not shown) which performs a switching operation in operative association with motion of the actuator 71A or 71B, and an oscillatory output device 73 corresponding thereto.

This arrangement is provided with a vertically traveling slider 82 attached for vertical motion to a slide rail 83 erected on a moving machining table 81 of an apparatus. The upper and lower switch case bodies 72A, 72B are disposed at positions opposing upper and lower limit positions, respectively, of a detecting end portion 84 of the vertically traveling slider 82. The switch case bodies 72A, 72B are secured to upper and lower positions of a support column 74 erected on the moving machining table 81.

These switch case bodies 72A, 72B and the oscillatory output device 73, described below, are connected by cables 85.

The oscillatory output device 73 is erected on the moving machining table 81 at a position rearward of the positions at which the switch case bodies 72A, 72B are attached. Thus the oscillatory output device 73 is arranged separately of the switch case bodies 72A, 72B remote therefrom. Connected to the oscillatory output device 73 are cables 85 which allow entry of the switch signals from the upper and lower switch case bodies 72A, 72B. Oscillatory output functions corresponding to the upper and lower switch case bodies 72A, 72B are thus provided.

In this case, the oscillatory output device 73 is disposed spaced apart from the switch case bodies 72A, 72B at a position, which is free from external influences, remote from a machining area which is a source of output interference. As a result, the oscillatory output device 73 has improved output performance and performs stabilized transmission.

As shown in Fig. 9, a battery 77 having a comparatively large capacity and an oscillator circuit portion 78 such as an oscillator circuit and modulator circuit are housed within the oscillatory output device 73. Internal switch signals from the switch case bodies 72A, 72B are modulated into output signals of prescribed frequencies by the oscillator circuit portion 78, and the resulting modulated signals are wirelessly outputted, via an antenna 79, to the switch control unit 76 at a location remote from the oscillatory output device 73.

The limit switch thus constructed is such that

when the actuator 71A or 71B of the switch case body 72A or 72B is displaced under the influence of an external force, the internal switch issues an ON signal in operative association with the motion of the actuator, and the oscillatory output device 73, which is located rearwardly of switch case bodies 72A, 72B at a position remote therefrom, wirelessly outputs a signal to the switch control unit 76 on the receiver side based on the ON signal.

The output signal produced by the oscillatory output device 73 is sufficiently remote from the machining area of the apparatus and is not adversely influenced by electric wave interference generated by the machining area of the apparatus. This makes it possible to deliver a stable output. As a result, the wireless switch has an excellent output performance with a high resistance to noise, is highly reliable and capable of raising reception sensitivity in an efficient manner.

In addition, since the oscillatory output device 73 is disposed externally of the switch bodies 72A, 72B and spaced away therefrom, the switch bodies 72A, 72B can be reduced in size. Further, since the battery 77 of the oscillatory output device 73 also is situated externally of the switch case bodies, a large-capacity battery can be provided.

Furthermore, in a case where the oscillatory output device 78 is replaced when the battery runs out of power or a circuit malfunction occurs, or in the event of a change in frequency output, the replacement can be made efficiently without relation to the switch case bodies that are easy to install in small areas.

As many apparently widely different embodiments of the present invention can be made without departing from the spirit and scope thereof, it is to be understood that the invention is not limited to the specific embodiments thereof except as defined in the appended claims.

## Claims

### 1. A wireless switch comprising:

a switch circuit for outputting a switching signal in response to displacement of an actuator, and a transmitting circuit for wirelessly transmitting an output signal of a prescribed frequency in response to said switching signal.

2. The wireless switch according to claim 1, further comprising a switch case housing said switch circuit and said transmitting circuit; said switch case having one side face thereof formed to include an opening, said opening being provided with a freely attachable and detachable switch cover; said switch cover having an inner surface provided with an antenna for transmitting said output signal

of a prescribed frequency toward a receiver.

3. The wireless switch according to claim 1, further comprising:

a battery for supplying operating power to circuitry contained in the wireless switch;

voltage detecting means for detecting that output voltage of said battery has fallen below a predetermined value; and

means, responsive to detection by said voltage detecting means of a drop in battery voltage, for controlling said transmitting circuit in such a manner that said transmitting circuit transmits a signal indicative of the voltage drop.

4. The wireless switch according to claim 1, further comprising changeover means for changing over the signal frequency, which is used by said transmitting circuit, among a plurality of frequencies.

5. The wireless switch according to claim 1, further comprising:

a first case housing said switch circuit; and

a second case housing said transmitting circuit;

said first and second cases being provided at locations spaced apart from each other.

6. A wireless switch comprising:

a switch case formed into a box-shaped configuration;

an oscillator circuit housed within said switch case for wirelessly delivering a switching signal oscillating at a prescribed frequency to a receiver at a remote location;

an oscillator circuit antenna housed within said switch case, said switch case having a side face, which corresponds to the receiver, formed to include an opening; and

a freely attachable and detachable switch cover provided on the opening of said side face;

said antenna possessing transmission directivity with respect to said receiver and being fitted onto an inner surface of said switch cover.

7. A wireless switch comprising:

switch circuit means for outputting a switching signal in operative association with motion of an actuator displaced upon receiving an external force;

oscillator circuit means for wirelessly outputting a signal of a prescribed frequency to a remote location, which is spaced apart from the wireless switch, based on the switching signal from said switch circuit means;

a battery for driving said oscillator circuit means;

voltage detecting means for detecting a voltage drop in said battery; and

modulator circuit means for modulating an output of said oscillator circuit means based on a detection output from said voltage detecting means.

8. A wireless switch comprising:

an actuator displaced upon receiving an external force;

switch circuit means for outputting a switching signal in operative association with motion of said actuator;

oscillator circuit means for wirelessly outputting a signal of a prescribed frequency to a remote location, which is spaced apart from said wireless switch, based on an output signal from said switch circuit means; and 5

changeover means for changing over the oscillation frequency of said oscillator circuit means. 10

9. A wireless switch comprising:

an actuator displaced upon receiving an external force;

switch circuit means for outputting a switching signal in operative association with motion of said actuator; 15

oscillator circuit means for wirelessly outputting a signal of a prescribed frequency to a remote location, which is spaced away from said wireless switch, based on an output signal from said switch circuit means; 20

modulator circuit means for modulating the oscillation frequency of said oscillator circuit means into a prescribed signal; and

adjusting means for adjusting the signal frequency used by said modulator circuit means. 25

10. A wireless switch comprising:

a switch portion for performing a switching operation in operative association with motion of an actuator displaced upon receiving an external force; and 30

an oscillatory output portion for wirelessly outputting a switching signal to a remote location at a prescribed frequency based on an output signal from said switch portion; 35

said oscillatory output portion being disposed separately at a position remote from a switch case housing said switch portion.

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Fig. 1

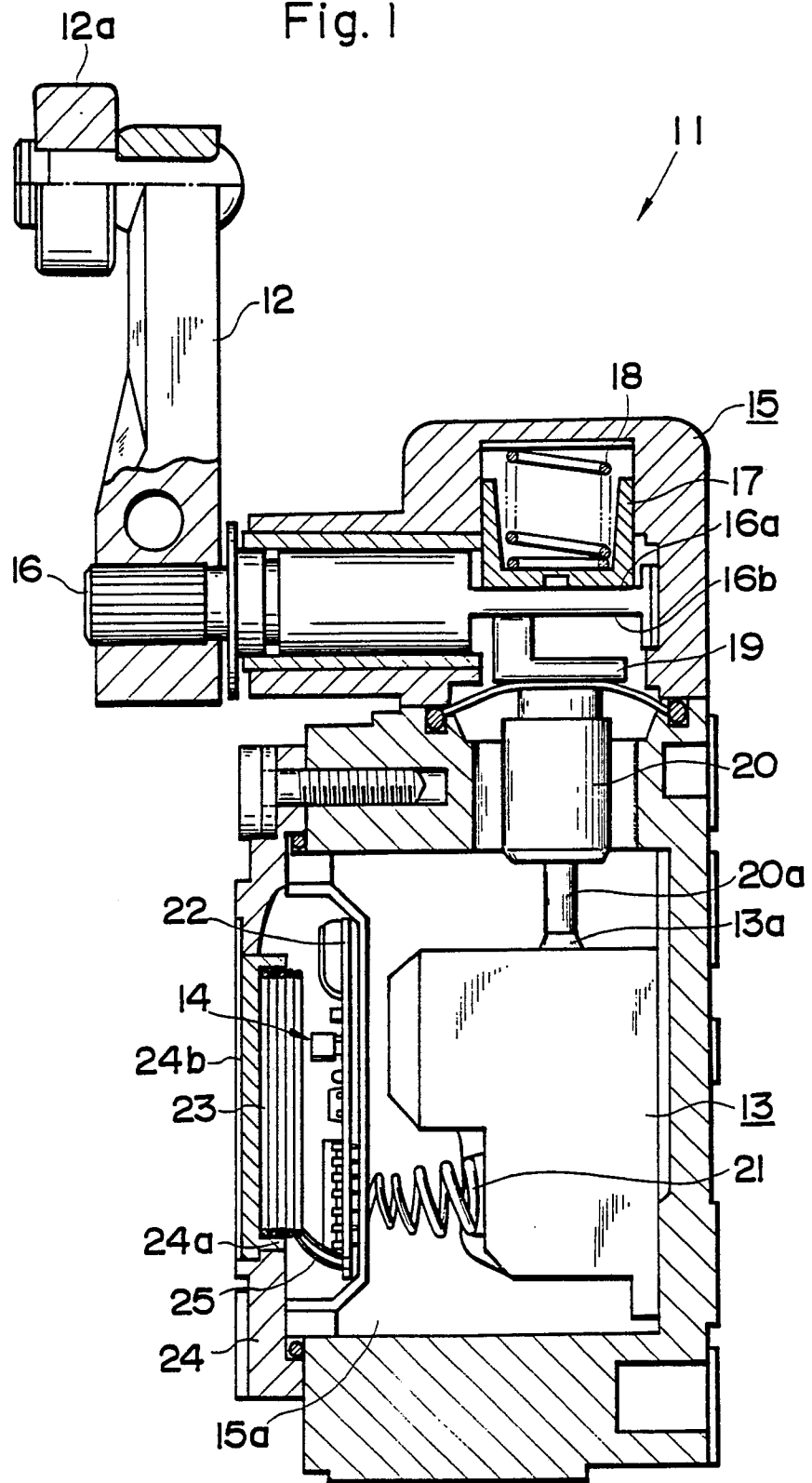


Fig. 2

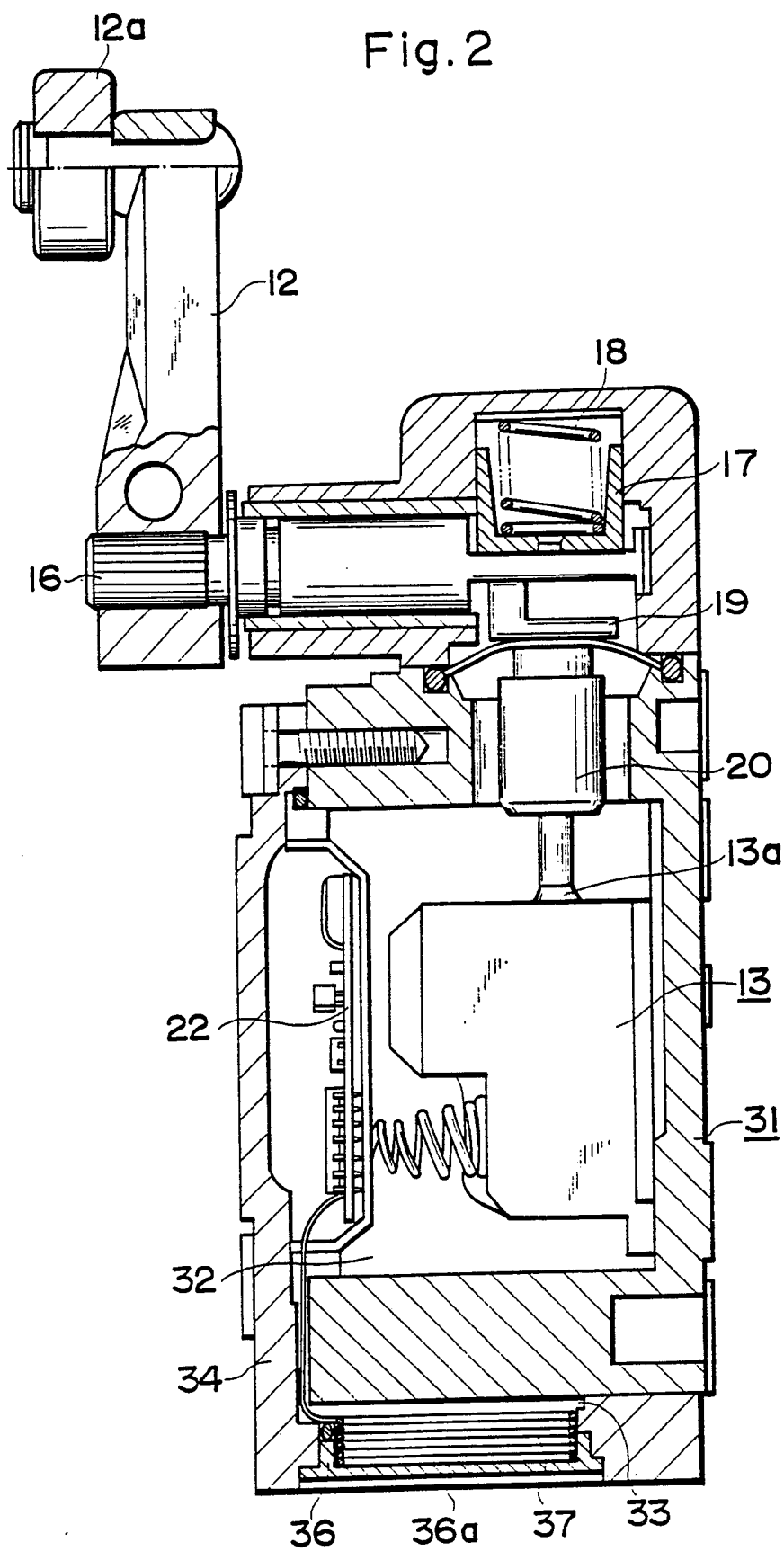


Fig.3

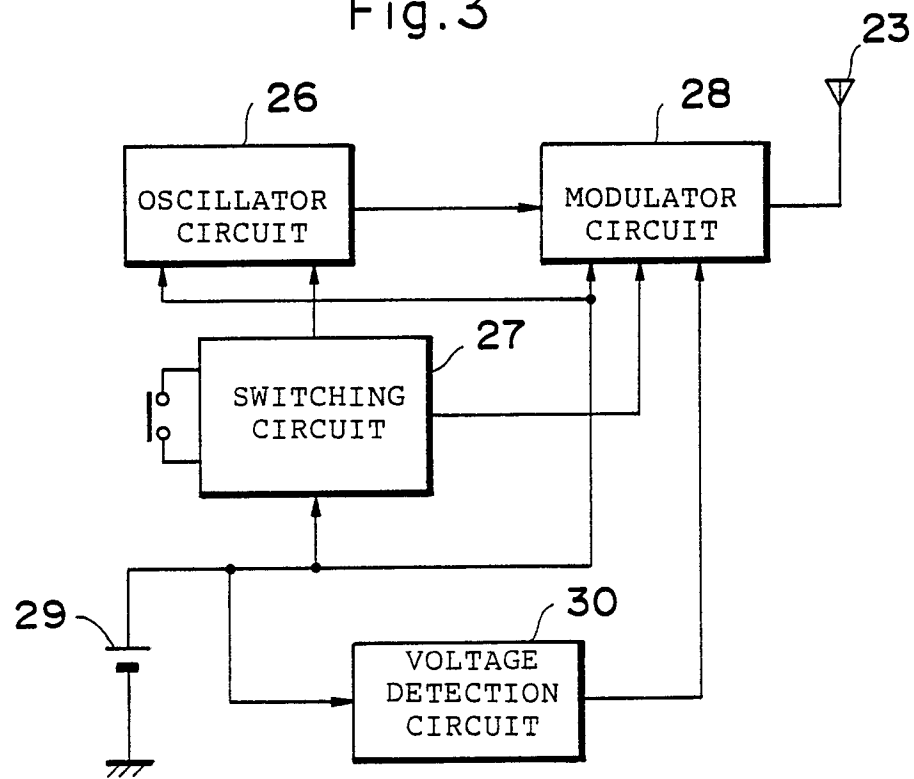


Fig.4

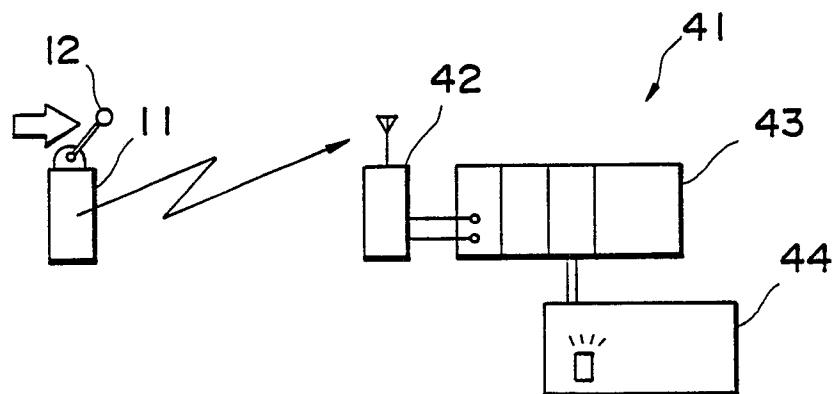


Fig.5

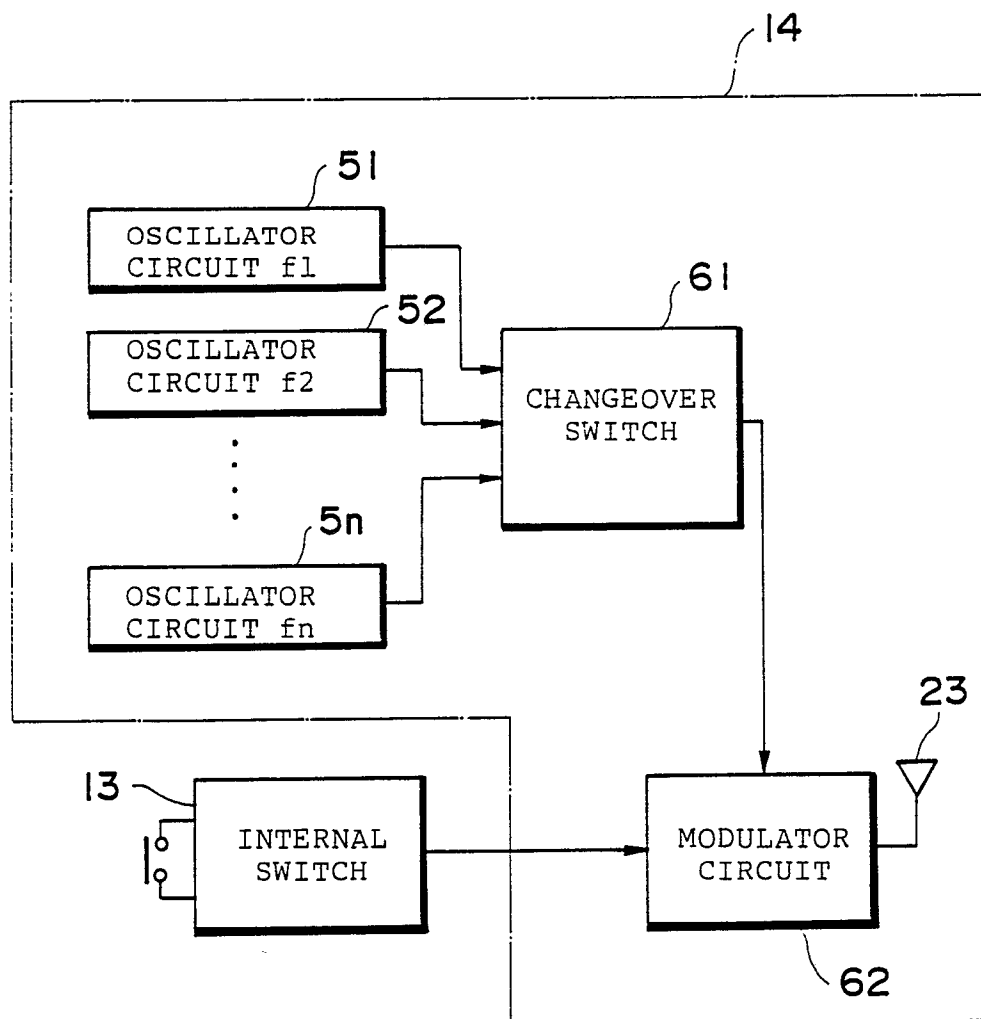


Fig.6

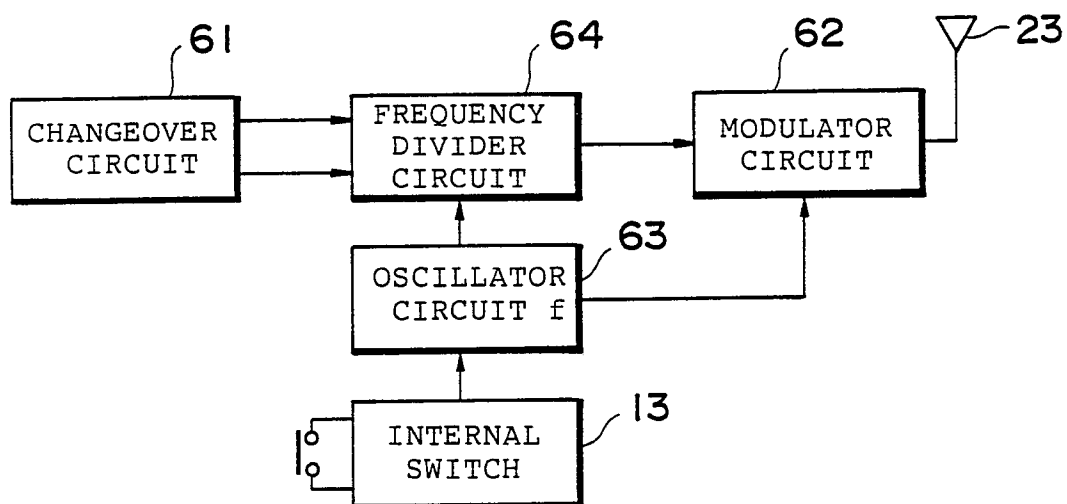


Fig.7

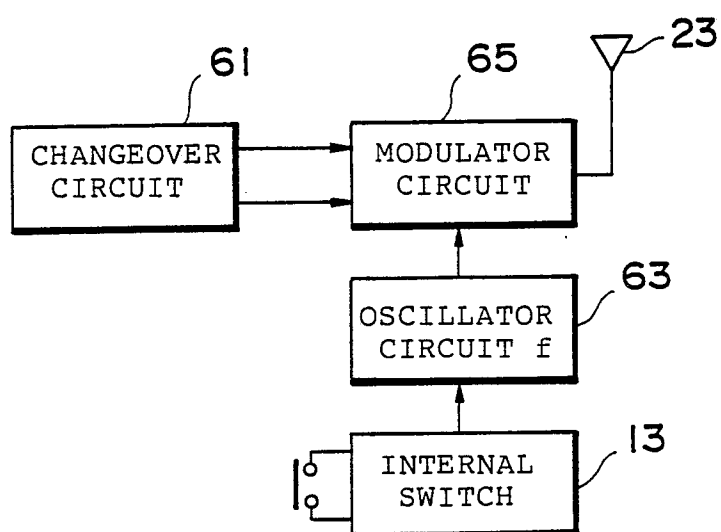


Fig. 8

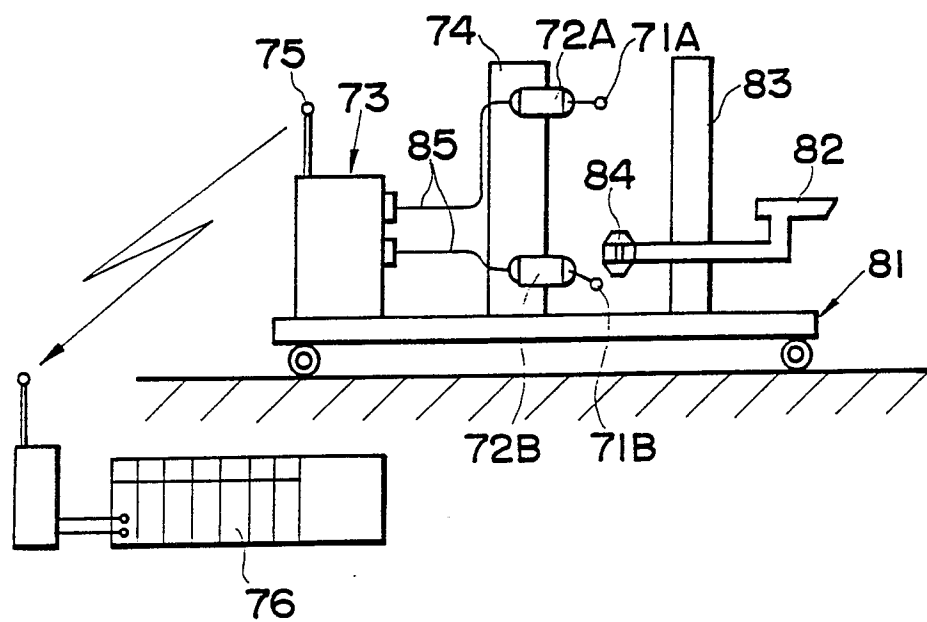


Fig. 9

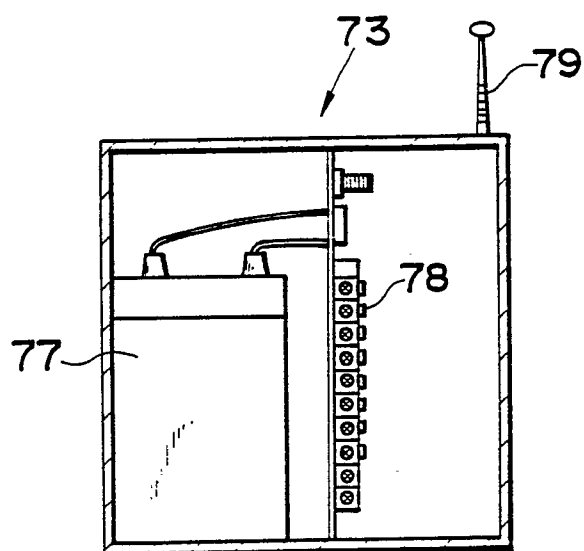
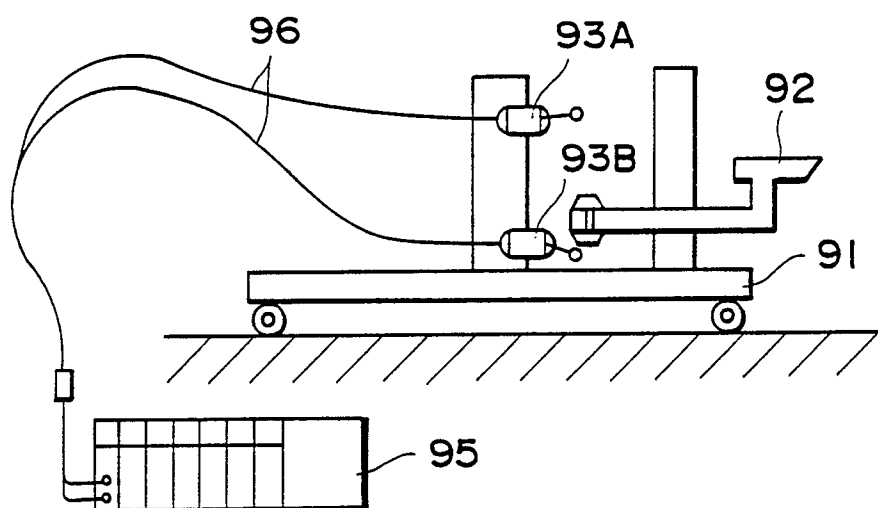


Fig.10 PRIOR ART





| DOCUMENTS CONSIDERED TO BE RELEVANT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                              |                                                |                                               |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------|-----------------------------------------------|
| Category                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Citation of document with indication, where appropriate, of relevant passages                                                | Relevant to claim                              | CLASSIFICATION OF THE APPLICATION (Int. Cl.5) |
| D,X                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | JP-A-63 195 921 (PUBL.: 15 AUGUST 1988)<br>* figures 1-3 k*<br>---                                                           | 1,6-10                                         | H 01 H 21/28<br>B 23 Q 17/22<br>G 08 C 17/00  |
| Y                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | EP-A-0 126 195 (RENISHAW PLC)<br>* figure 1; page 3, line 34 - page 4, line 20 *<br>---                                      | 1,6-10                                         |                                               |
| Y                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | WERKSTATT UND BETRIEB<br>vol. 109, no. 5, 1976, page 284, DE;<br>"Messen von der umlaufenden Spindel" *<br>figure 1 *<br>--- | 1,6-10                                         |                                               |
| A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | EP-A-0 221 513 (OMRON TATEISI ELECTRONICS CO.)<br>* figure 1; abstract *<br>---                                              | 2                                              |                                               |
| A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | US-A-4 056 815 (A.E. ANDERSON)<br>* figures 1,2; abstract *<br>---                                                           | 3                                              |                                               |
| A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | EP-A-0 216 032 (GTE VALERON CORP.)<br>* figure 1; abstract *<br>---                                                          | 3                                              |                                               |
| A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | DE-U-7 431 264 (CARL ZEISS)<br>* figure 1; claim 1 *<br>---                                                                  |                                                | TECHNICAL FIELDS<br>SEARCHED (Int. Cl.5)      |
| A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | DE-U-8 702 611 (PEKO KONSTRUKTIONSGMBH)<br>* figure 1; claim 1 *<br>-----                                                    |                                                | H 01 H<br>B 23 Q<br>G 08 C                    |
| The present search report has been drawn up for all claims                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                              |                                                |                                               |
| Place of search<br>BERLIN                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                              | Date of completion of the search<br>05-04-1990 | Examiner<br>BREUSING J                        |
| <b>CATEGORY OF CITED DOCUMENTS</b><br>X : particularly relevant if taken alone<br>Y : particularly relevant if combined with another document of the same category<br>A : technological background<br>O : non-written disclosure<br>P : intermediate document<br>T : theory or principle underlying the invention<br>E : earlier patent document, but published on, or after the filing date<br>D : document cited in the application<br>L : document cited for other reasons<br>-----<br>& : member of the same patent family, corresponding document |                                                                                                                              |                                                |                                               |