# United States Patent [19]

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[54] **AIR TRAFFIC CONTROLLER AID**


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[73] Assignee: **The United States of America as represented by the Secretary of the Army, Washington, D.C.**



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[52] **U.S. Cl.** ..... **360/12**

[51] **Int. Cl.** ..... **G11b 5/00**

[58] **Field of Search** ..... 360/12; 340/22



[56] **References Cited**

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[57] **ABSTRACT**

A system for assisting air traffic controllers is disclosed. The system of this invention converts data obtained by sensing devices into a spoken number or statement. This conversion is accomplished automatically without the need of an individual in the conversion chain. The spoken number or statement is stored on storage device which is coupled to a transmitter so that the data can be transmitted in spoken form to pilots or other flight personnel. The system also provides means for entering verbal statements by air traffic controllers or other authorized personnel and means for these persons to override the automatic system.


**20 Claims, 3 Drawing Figures**

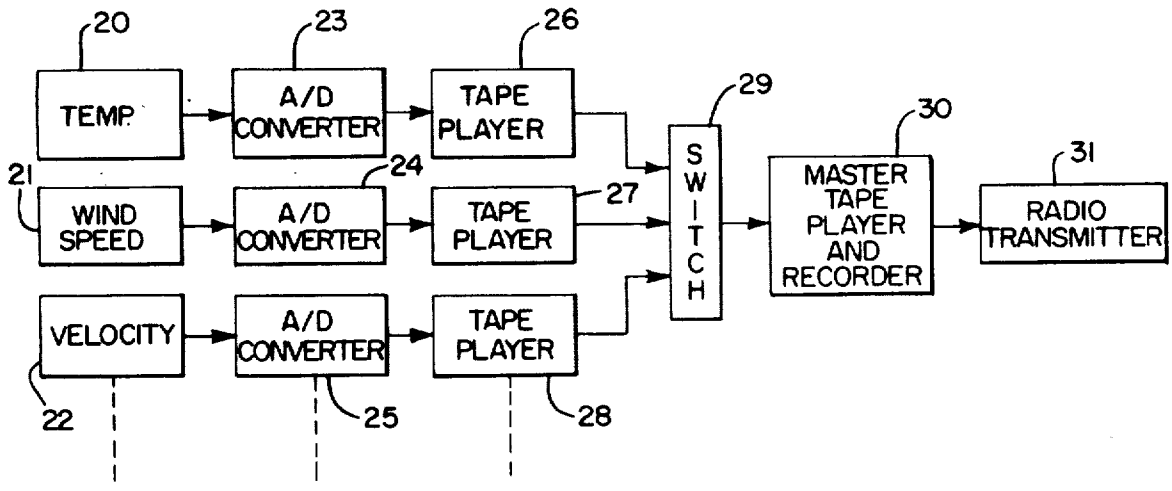


FIG. 1.

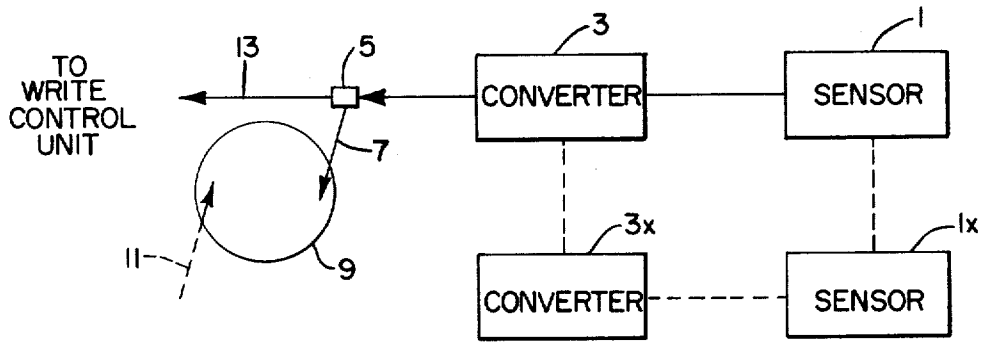



FIG. 2.

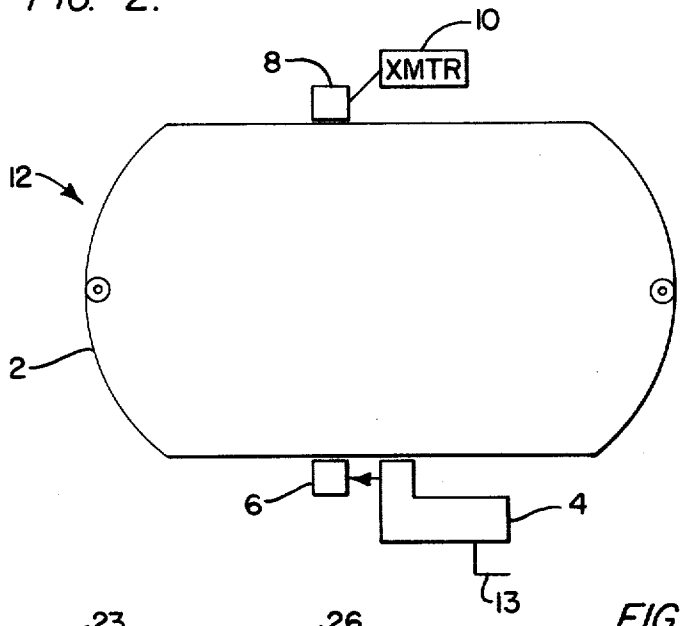
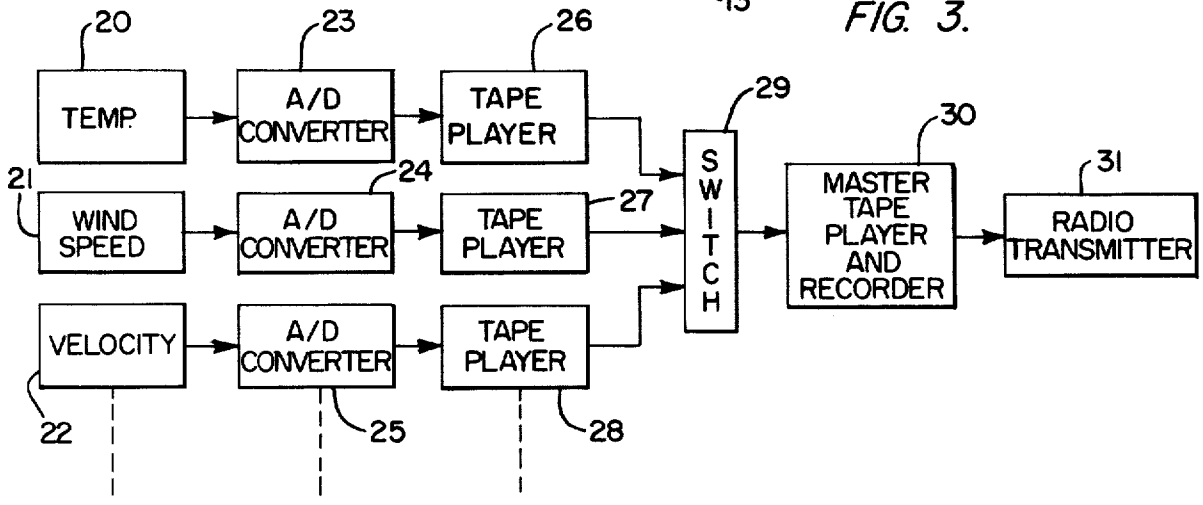



FIG. 3.



# AIR TRAFFIC CONTROLLER AID

The invention described herein may be manufactured, used, and licensed by or for the Government for Governmental purposes without the payment to me of any royalties thereon.

## BACKGROUND OF THE INVENTION

This invention relates to data conversion systems, and more particularly to data conversion systems for assisting air traffic controllers.

At the present time all or most verbal information provided flight personnel from an air traffic terminal is provided manually by air traffic controllers who speak to the flight personnel by radio transmitter. Much of the information provided by the air traffic controller is information originally read from instruments and compiled in a written report from which the controller reads. Thus, the controller merely relays information provided. Further, many of these bits of information remain relatively constant over a substantial period of time.

At many airports, the air traffic has become very heavy and the controller is kept quite busy just handling the landings and take-offs. Thus, having to provide flight personnel with temperature readings, wind velocity, weather conditions, etc. represents an extra burden on the air traffic controllers.

This invention provides a means for automatically providing to flight personnel such data as wind velocity, temperature, weather conditions, visibility, etc. With this invention the air traffic controller is not burdened with this responsibility. The information is automatically provided in verbal form to flight personnel. Further, the information is automatically updated continuously so that the information provided is always accurate information for that time.

## SUMMARY OF THE INVENTION

Sensors such as wind velocity sensors, temperature sensors, weather sensors, visibility sensors, etc. are coupled to a first storage device such as a disk record or tape or other suitable storage medium through a converter or converters. The first storage device has verbal information stored thereon and the converter or converters provide means for selecting the proper stored information in response to an input from the sensors. The output of the first storage device is coupled to the record input of a second storage device which is a record/playback storage device. Thus, the verbal information selected from the first storage device is recorded on the second storage device.

The second storage device is preferably a tape recorder which has an endless tape, but may also be a wire recorder having an endless wire loop or and endless film-type sound recorder or any other suitable recorder which provides both record and playback. The playback output of this second storage device is connected to the input of a radio transmitter which transmits the stored information to pilots or other interested flight personnel. The person wishing to receive this transmitter information merely tunes his receiver to the frequency of the transmitter. The transmitter may be designed to transmit continuously or at repeated regular intervals. The sensors are continuously providing output information, thereby permitting the system to continuously provide correct data. In other words, at any given time the information being transmitted is the correct information for that time. Further, this continual updating of the information is accomplished automatically.



While the data sensed by the sensors is processed and transmitted automatically without the need of any action on the part of an air traffic controller, under certain conditions an air traffic controller may want to override the automatic system or may want to augment the information being provided by the system. With the system of this invention an air traffic controller can add verbal messages to the verbal messages being provided automatically, or he can override the automatic system if the need arises. Thus, this invention provides an automatic system which automatically provides a substantial amount of information that prior to this invention had to be provided manually by air traffic controllers. This relieves the air traffic controllers from providing such information, thereby permitting them to concentrate on other duties such as landing and take-off intructions.

## BRIEF DESCRIPTION OF THE DRAWING

A complete and full understanding of the objects and nature of this invention will be apparent from the following detailed description of the invention when read in conjunction with the annexed drawing in which:

FIG. 1 shows the sensor and first storage device section of a first embodiment of this invention;

FIG. 2 shows the second storage device and transmitter sections utilized with the apparatus of FIG. 1; and

FIG. 3 shows a second embodiment of the invention.

## DETAILED DESCRIPTION OF THE INVENTION

Referring to FIG. 1 and ignoring for the present the sensor 1*x*, the converter 3*x* and the tone arm 11, this figure shows a sensor 1 which may be, for example, a temperature sensor coupled to a converter 3. Converter 3, which is coupled to a tone arm positioner 5, converts the reading from sensor 1 to a tone arm position value to which arm positioner 5 responds. Arm positioner 5 is coupled to a tone arm 7 which is associated with the disk record 9. Record 9 is a disk record having concentric grooves each carrying a different segment of verbal information.

If sensor 1 is a temperature sensor, this sensor measures the prevailing temperature at the air terminal and transmits this reading to converter 3. Converter 3 converts this reading to a tone arm position value to which arm positioner 5 responds to place tone arm 7 in the appropriate groove of the record 9. Record 9 contains, in verbal form, a plurality of numerical values. Thus, if the temperature measured by sensor 1 is 80°, arm positioner 5 will place tone arm 7 in the proper position to pick up the verbal statement 80. This verbal information is transmitted by the line 13 to the write control unit 4 of FIG. 2. FIG. 2 shows a record/playback tape unit 12 having an endless tape 2. The tape unit 12 also includes a write head 6 and a read head 8. A radio transmitter 10 is coupled to read head 8. Write head 6 is coupled to write control unit 4.

Endless tape 2 contains present information such as station or airfield identification codes, statements such as temperature, degrees, and other statements as will become apparent. It was assumed that sensor 1 of FIG. 1 sensed a temperature of 80° which provided on line 13 in verbal form the numeral 80. Write control unit, in response to this information, conditions write head

6 to record the number 80 at the appropriate time on endless tape 2 so that endless tape 2 which contains the statement "temperature" followed by the statement "degrees" will have the number 80 recorded between temperature and degrees. This recorded temperature information is now available at read head 8 which picks up the statement "temperature 80 degrees" and voice modulates radio transmitter 10 which transmits the information to anyone tuned to the frequency of transmitter 10. Of course, along with this temperature information the station on air terminal identifier will also be transmitted.

Referring back to FIG. 1, this figure also shows a sensor 1*x* coupled by a dotted line to sensor 1. This indicates that a plurality of sensors 1 through 1*x* may be provided. Normally, a plurality of such sensors would be provided so that various information normally provided by the air traffic controllers can be provided automatically as described above with reference to sensor 1. These additional sensors may include, for example, a wind velocity sensor, a humidity sensor, a ceiling sensor, a visibility sensor, etc. In other words, any information of interest that can be sensed or measured can be processed by this invention by providing appropriate sensors.

FIG. 1 also shows a converter 3*x* connected by a dotted line to sensor 3 to indicate that a plurality of converters may be provided. If a plurality of converters are provided, the number provided would be equal to the number of sensors provided. Note, however, that only one converter is actually needed. If only one converter is provided, the converter would include a well known type of mechanical or electrical switch that would sequentially couple the plurality of sensors one at a time to the converter. Since the output of the converter is an arm position value, the single converter would position the tone arm 7 in the proper groove in record 9 to obtain the proper numerical value for each condition sensed. Since the switch provided in such a single converter is a sequencing switch which periodically repeats its sequence, write control unit 4 would be synchronized in a well known manner to properly sense the received information from record 9 and control write head 6 and endless tape 2 in order to record the information at the appropriate place on tape 2.

As was mentioned above, endless tape 2 contains preset vergal statements in addition to the station or airport identifiers and the assumed temperature degree statements. These additional statements correspond to the sensors provided. For example, for a wind speed sensor, endless tape 2 would have preset thereon the statement "wind speed" followed by the statement "knots". The numerical value of the wind speed obtained from record 9 would be inserted between these statements by write head 6 under the control of write control unit 4. Similarly, endless tape 2 would have the preset statement "visibility" followed by the appropriate number from record 9 followed by the preset statement "miles". Similar preset statements would be provided for each sensor. Write control unit 4 not only controls write head 6 so that the information from record 9 is recorded at the appropriate place on endless tape 2, but also may control the driving of endless tape 2 so that any portions of tape 2 not containing any information can be driven past read head 8 at a higher speed than the normal playback rate with the speed reduced to normal when a portion of tape 2 containing information passes by the read head 8. This, of course, eliminates dead transmission time from transmitter 10. In addition, write control unit 4 prevents erasure of the preset information and provides access to tape unit 12 for override or manual input. For example, if an air traffic controller wishes to record some special information on endless tape 2 that is to be transmitted by transmitter 10 wishes to override the system, he can do so through write control unit 4.

Referring back again to FIG. 1, if individual converters are provided for each of the sensors 1 through 1*x*, the outputs from each converter could be applied to arm positioner 5. In this case, arm positioner 5 would include the sequencing switch.

In place of a single tone arm, a plurality of tone arms equal in number to the number of sensors could be associated with disk record 9 as is indicated by the tone arm 11. Each tone arm would have an associated arm positioner with the output of but one converter coupled to each arm positioner. Under such conditions, write control unit 4 of FIG. 2 would include the sequential switching means to sequentially switch the plurality of tone arms. it should also be obvious that a number of tone arms less than the number of sensors but more than one tone arm could be provided with a plurality of converters associated with each tone arm. In other words, any combination of converters and tone arms can be provided so long as the appropriate switching mechanisms are provided. While these various combinations can be provided, the preferable embodiment of the FIG. 1 apparatus includes but a single converter which includes sequential switching for switching in sequence the plurality of sensors to a single tone arm. Providing a single converter, single tone arm and tone arm positioner reduces the complexity of the apparatus and is more economical than providing a plurality of converters or a plurality of converters and tone arms.

Some of the parameters sensed by the sensors may vary more rapidly than is desirable from an operational standpoint. If this is the case, the sensors whose output may vary too rapidly or all the sensors can be provided with an integrator such as an RC integrator to average the input to converter for that particular sensor or the converter could include an RC integrator or integrators if a single converter is used. If a plurality of converters are provided some or all of the converters could include an integrator if the sensors do not include integrators.

Referring again to FIG. 2, as has been mentioned the information recorded on endless tape 2 is transmitted by transmitter 10 which is coupled to read head 8. From the foregoing description of the system as shown in FIGS. 1 and 2, it should be obvious that the information recorded on endless tape 2, except for the preset information and any manual information and any manual information, is continuously upgraded by means of the apparatus of FIG. 1. Therefore, flight personnel having their receivers tuned to the frequency of transmitter 10 will always receive up-to-date information about a particular station or airfield. Transmitter 10 can be continuously transmitting or can transmit periodically. If the transmission is periodic rather than continuous, the transmission periods should be frequent and regular. The transmission periods should probably not be spaced more than 5 minutes apart so that flight personnel can obtain the information without undue delay.

FIG. 3 shows a second embodiment of the invention. In FIG. 3, three sensors, a temperature sensor **20**, a wind speed sensor **21**, and a velocity sensor **22** are shown. Of course, more than three sensors can be provided. The output of sensors **20, 21** and **22** are coupled to the input of the analog to digital (A/D) converters **23, 24** and **25** respectively. The output of A/D concerter **23** is applied to the input of a tape player **26**, the output of A/D converter **24** is coupled to the input of a tape player **27** and the output of A/D converter **25** is coupled to the input of a tape player **28**. The output from each of the three tape players **26, 27** and **28** is coupled to a separate input of a switch **29**. The single output of switch **29** is coupled to the input of the master tape player and recorder **30**. Switch **29** is a sequential switch that sequentially switches the output of each of the tape players **26, 27** and **28** to the input of master tape player and recorder **30**. The output of master tape player and recorder **30** is coupled to radio transmitter **31**. If more than three sensors are provided, each additional sensor will, of course, have an associated A/D converter and tape player and switch **29** will be designed to have additional inputs to accommodate these additional tape players.

The apparatus of FIG. 3 operates in a similar fashion to the apparatus of FIGS. **1** and **2**. In fact, master tape player and recorder **30** can be identical to unit **12** of FIG. **2**. Tape players **26, 27** and **28** have recorded thereon numerical information in verbal form. A/D converters **23, 24**, and **25** in response to input from the sensors **20, 21** and **22** respectively select the proper numerals on tape players **26, 27** and **28** respectively. This number in verbal form is then transmitted from each tape player via switch **29** to master tape player and recorder **30**. Switch **29** sequentially interrogates the tape players **26, 27** and **28** to provide the information in sequential fashion to master tape player and recorder unit **30**. Unit **30** is, of course, synchronized with switch **29** so that the control unit such as unit **4** of FIG. **2** properly controls the write head and the tape to record the information at the appropriate place on the tape for each sensor output. The recorded information on master tape player and recorder unit **30** is applied to transmitter **31** via a read head for radio transmission to interested persons. Thus, while the apparatus of FIG. **3** is somewhat different than the apparatus of FIGS. **1** and **2**, particularly FIG. **1**, the overall operation of the apparatus of FIG. **3** is essentially identical to the operation of the apparatus of FIGS. **1** and **2**.

From the foregoing description, it should be obvious that this invention provides a system that automatically supplies certain data to flight personnel that is now supplied manually by air traffic controllers. The ability to provide such data automatically permits the air traffic controllers to concentrate their time and efforts on their other duties. It should also be obvious from the description that the components of the invention represented in block diagram form in the three figures are components that are available on today's market. In other words, the invention is made up of known components and it is the manner in which these components are utilized together that constitutes the invention rather than any individual component of the system. Further, as has been mentioned, any suitable recorder, player and player/recorder can be utilized with this invention. In other words, the invention is not limited to the disk record and tape systems specifically disclosed.

While the invention has been shown and described with reference to particular embodiments, it will be apparent to those skilled in the art that various changes and modifications can be made to the embodiments shown and described without departing from the spirit and scope of the invention as set forth in the claims.

What is claimed is:

**1.** Apparatus for automatically providing air traffic control assistance comprising:

a. at least one sensor for sensing a specific parameter and providing an output indicative of the value of said specific parameter;

b. an information storage device having a plurality of different verbal data stored thereon;

c. pick-up means associated with said storage device;

d. converter means coupled to the output of said at least one sensor for converting the output of said at least one sensor to a position value of said pick-up means on said storage device;

e. means coupled between said converter means and said pick-up means for positioning said pick-up means to a specific location on said information storage device in response to said position value from said converter means, thereby selecting a specific data bit from said plurality of data stored on said information storage device, said specific data bit being a verbal statement of the value of said parameter as measured by said at least one sensor at that time, a different data bit being selected each time the output of said at least one sensor indicates that the value of said paramter has changed;

f. a record/playback storage device having a record input and a playback output;

g. means to couple said pick-up means to said record input of said record/playback storage device to thereby record at a specific location on said record/playback storage device in verbal form said selected data bit; and

h. a radio transmitter coupled to said playback output of said record/playback storage device for transmitting said selected data bit, whereby said radio transmitter transmits said value of said parameter with said value being constantly updated so that said value transmitted is the correct value of said parameter at the time of transmission.

**2.** The apparatus as defined in claim **1** wherein said record/playback storage device is a magnetic tape unit having an endless magnetic tape.

**3.** The apparatus as defined in claim **2** wherein said record input of said record/playback storage device includes a conventional magnetic tape write head.

**4.** The apparatus as defined in claim **3** wherein said playback output of said record/playback storage device includes a conventional magnetic read head.

**5.** The apparatus as defined in claim **4** wherein said means to couple said pick-up means to said record input of said record/playback storage device is a control unit.

**6.** The apparatus as defined in claim **5** wherein said endless tape has preset verbal data stored thereon, said preset verbal data including identifier codes, a statement identifying said parameter and a statement of the unit by which said parameter is measured, said control unit controlling said endless tape and said write head in such a manner as to insert between said statement iden-

tifying said parameter and said statement of said units, the value of said parameter as provided by said pick-up means.

**7.** The apparatus as defined in claim **6** wherein said information storage device is a record disk with said plurality of different data being carried in concentric grooves on said record disk.

**8.** The apparatus as defined in claim **2** wherein said pick-up means is a tone arm.

**9.** The appartus as defined in claim **8** wherein said means to position said pick-up means is a mechanical positioner coupled to said tone arm to mechanically position said tone arm to a specific location on said record disk in response to the output from said converter means.

**10.** The apparatus as defined in claim **9** wherein a plurality of sensors are provided, each sensor measuring a different parameter and providing an output indicative of the value of the parameter measured by that sensor, said plurality of sensors continuously providing updated values of each parameter being measured.

**11.** The apparatus as defined in claim **10** wherein the value indicated by the output of each of said plurality of said sensors is selected from said record disk and recorded on said endless tape at a given position on said endless tape.

**12.** The apparatus as defined in claim **6** wherein said information storage device is a tape player.

**13.** The apparatus as defined in claim **12** wherein said endless tape has preset thereon in addition to said identifier code, statements identifying all the parameters sensed by said plurality of sensors with said parameter identifying statement being followed by a statement of the units by which each parameter is measured, the value of each parameter as measured by each of said plurality of sensors being inserted on said endless tape between the appropriate said parameter identifier statement and said associated units statement.

**14.** The apparatus as defined in claim **13** wherein said converter means is an analog to digital converter.

**15.** The apparatus as defined in claim **14** wherein said pick-up means is a playback head associated with said tape player, said playback head being controlled by said analog to digital converter to pick up a specific data bit of said plurality of data, said specific data bit being a verbal statement of said parameter as measured by said at least one sensor.

**16.** The apparatus as defined in claim **15** wherein a plurality of sensors are provided, a plurality of analog to digital converters equal in number to said plurality of sensors are provided, and wherein a plurality of tape players equal in number to said plurality of analog to digital converters are provided, each one of said plurality of sensors being coupled to a different one of said plurality of tape players through a different one of said plurality of analog to digital converters.

**17.** The apparatus as defined in claim **16** wherein each of said plurality of tape players has a playback head controlled by the one analog to digital converter of said plurality of analog to digital converters associated with that tape player.

**18.** The apparatus as defined in claim **17** wherein a switching means having a plurality of inputs equal in number to said plurality of tape players and a single output is provided, and wherein means are provided to couple each one of said plurality of said switch inputs to the output of a different one of said tape players and means is provided to couple said single output to said control unit.

**19.** The apparatus as defined in claim **17** wherein each tape player has recorded thereon a plurality of different verbal data corresponding to different values of the parameter measured by the sensor coupled to that tape player.

**20.** The apparatus as defined in claim **19** wherein the value indicated by the output of each of said plurality of said sensors is selected from said associated tape player of said plurality of tape players and recorded on said endless tape at a given position on said endless tape.

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