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Sommerfeld et al.

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[54] **MULTIPHASIC HEALTH SCREENING METHOD AND MODULE**

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[63] Continuation of Ser. No. 36,132, May 11, 1970, abandoned.

[52] **U.S. Cl.** ..... **128/2 D**

[51] **Int. Cl.** **A61b 5/00**

[58] **Field of Search** ..... 128/2 R, 2.05 A, 2.05 R, 128/2.06 A, 2.06 R, 2.1 A, 2.1 R, 2.1 P, 1 R

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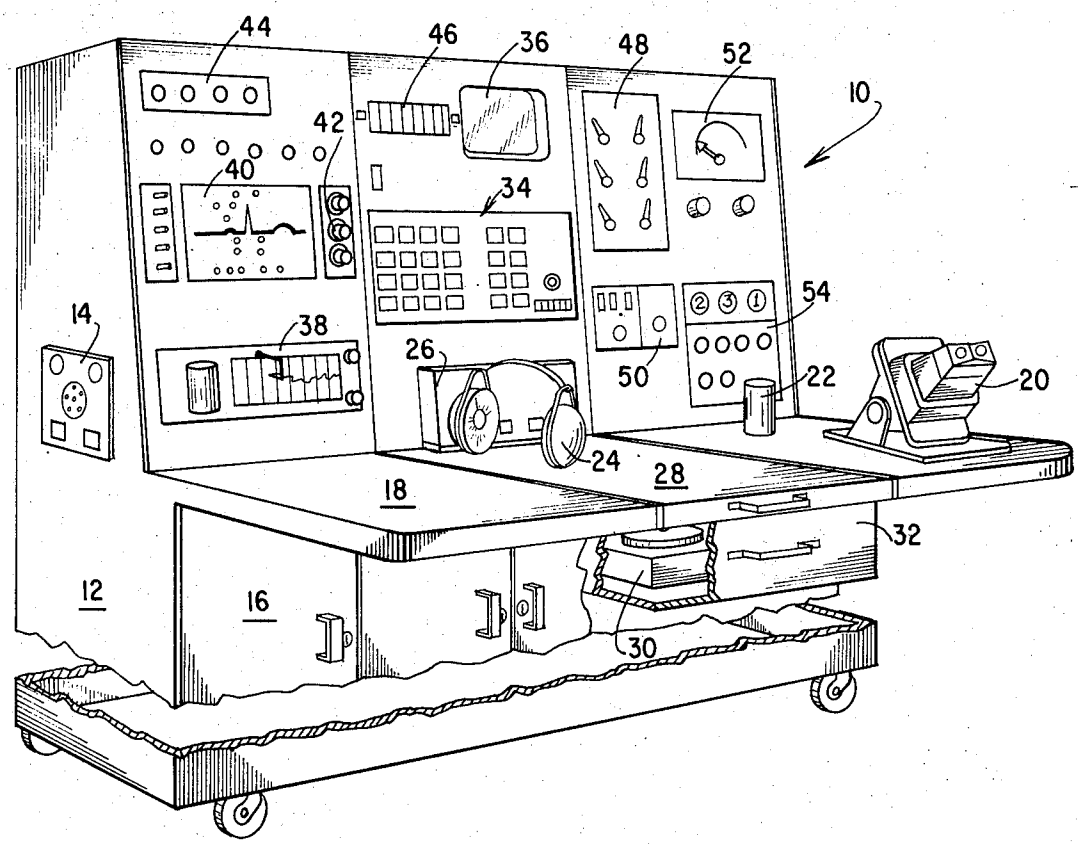
[57] **ABSTRACT**

The individual or individuals to be tested are positioned relative to a portable, multiphase module and are subjected to a plurality of sequential health screening tests, most of which require the individuals to provide an electrically transduced input to a portion of the module, some of the inputs requiring electronic sensors to be coupled to the individuals. Tests are sequentially programmed in a random and/or predetermined mode. Test conditions are initially monitored for acceptability and then are recorded by one or more of a plurality of instruments. The module houses all test equipment, controls and sequencing means, whereby a technician can speedily obtain at low cost a health screening profile.

10 Claims, 2 Drawing Figures



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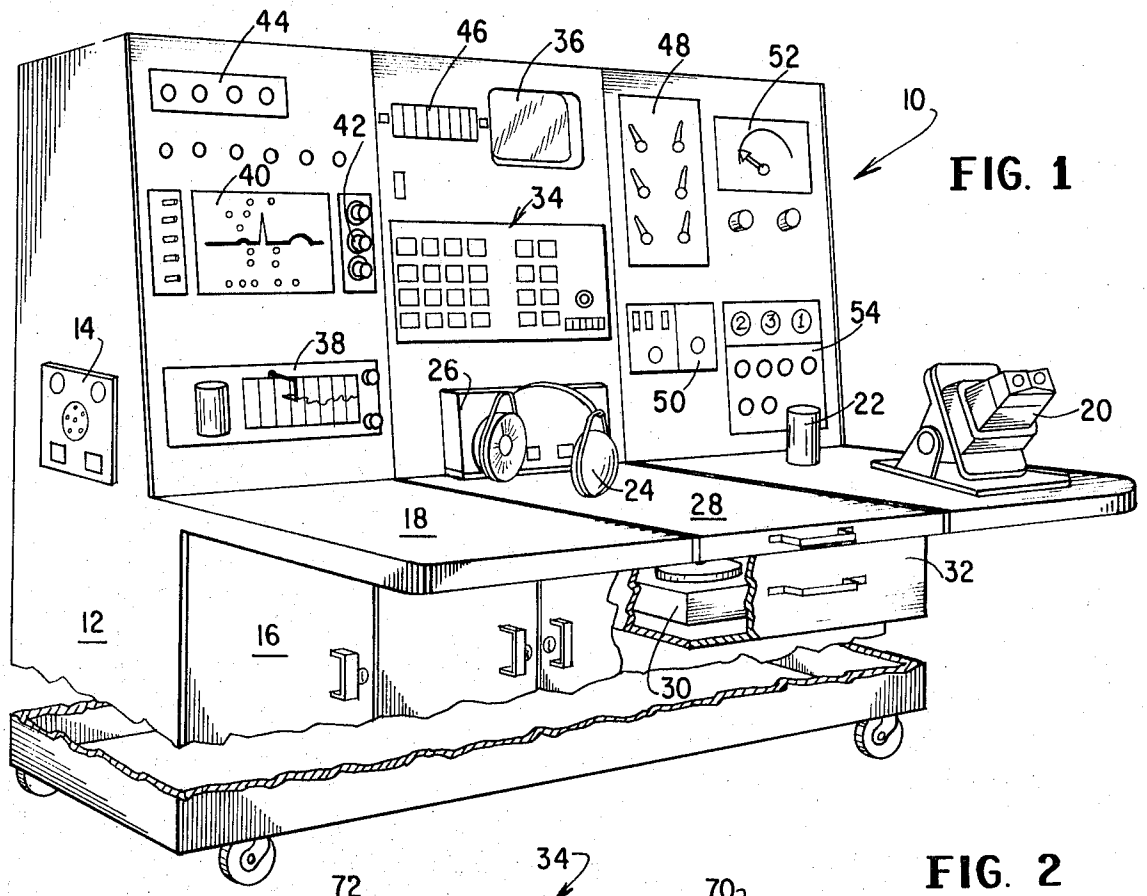

FIG. 1

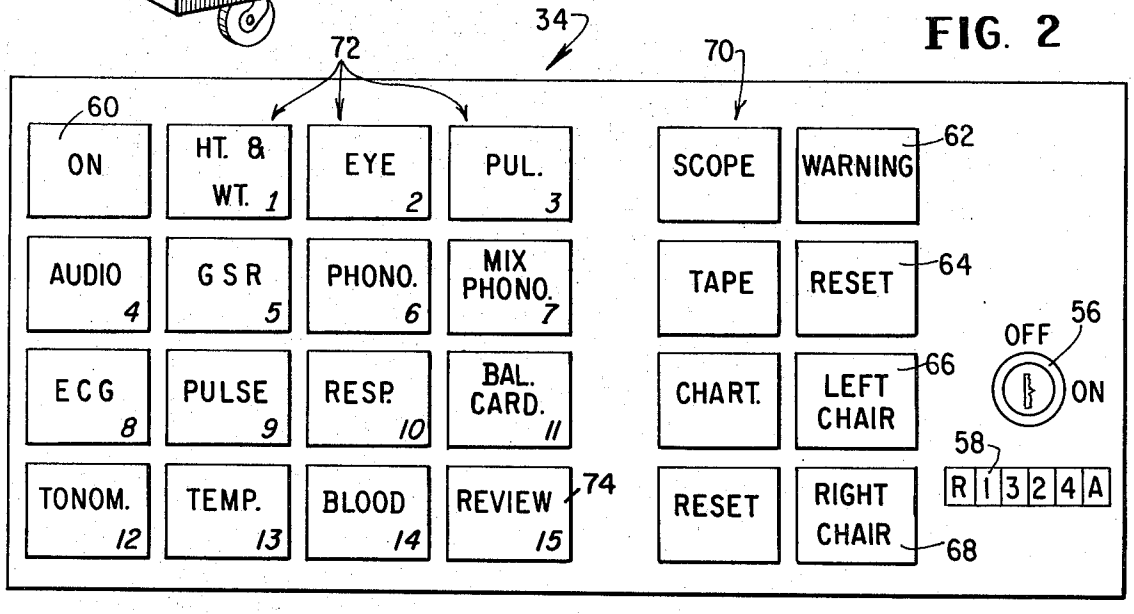

FIG. 2

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MULTIPHASIC HEALTH SCREENING METHOD AND MODULE

This is a continuation of application Ser. No. 36,132 filed May 11, 1970, now abandoned.

BACKGROUND OF THE INVENTION

Health screening per se is old in both method and apparatus. Typical in the prior art of health screening is an individual's annual physical examination. Dependent upon the individual, his prior health background, his financial position, available time, his doctor's laboratory facilities, etc., the physical examination might be relatively simple, speedy and of minimal expense; or might be complex, considerably time consuming, and proportionately expensive.

At the present time, it is the opinion of many that health screening reaches too small a segment of the population, is too costly, too time consuming for both the individual and his doctor, is too limited in its testing ambit and otherwise is deficient in meeting the health needs of the general public. Such situation obtains notwithstanding an increased awareness of a need and desire for improved health screening procedures and equipment. Not only has the medical profession been active in promoting this form of preventative medicine, but governmental agencies, labor unions, management, insurance companies, etc. all have encouraged the development and use of improved, accurate yet economic health screening facilities.

For the most part, individual doctors and small groups of doctors of different professional specialities who share common physical facilities, including laboratory equipment and technicians, find it too expensive to maintain a complete, or multiphasic, health screening facility. Moreover, even if many doctors were so equipped, a large segment of the population might not avail themselves of multiphasic health screening, because of apathy, possibly augmented by time and cost considerations.

If, however, a multiphasic health screening facility could be brought to the individual, such as to a factory site, an office complex, a college dormitory, institutions which house the elderly, etc. for a period of a few days, and thereby provide especially convenient, speedy, low cost, yet professionally accurate health screening data, then the health needs of the public would have taken a forward step.

In recent times, hospitals have become equipped with patient monitoring apparatus, by which one or a few patients, typically those in intensive care, are electrically connected by electronic sensors to selected pieces of equipment which continuously monitor such parameters as heart rate, blood pressure and temperature. Such on-line monitoring can also be coupled to remotely positioned recording apparatus. Although such patient monitoring arrangements provide a significant improvement in hospital care, they are not adapted to meet the needs of multiphasic health screening.

The use of on-line monitoring has been considered for health screening purposes; however, it introduces problems, not necessarily medical in nature but in the form of inefficient data processing. Existing health screening devices generate several forms of data output, some of which are digital and easily suited for direct recording in data processing equipment. However, other outputs are graphic in nature, and yet still others

do not provide compatibility with conventional encoding and decoding formats. Moreover, data processors are expensive, somewhat bulky and not especially portable. Additionally, the ultimate task of decoding the health information from many individuals could be a difficult if not insurmountable task if on-line procedures were employed.

As a consequence, there has been and now exists an increasing need for a health screening procedure and facility which is relatively portable, yet sufficiently complete so as to encompass several phases of health screening and thereby be "multiphasic;" while, at the same time providing speedy, low cost screening, with a final data output that is easily decoded and/or otherwise placed into the hands of the individual's doctor almost immediately.

SUMMARY OF THE INVENTION

According to the invention, the deficiencies of the prior art are overcome by a portable module which houses numerous pieces of testing equipment, substantially all of which are connected to a central control and sequencing panel, which enables the outputs from the testing equipment to be shared by a common array of recorders and encoders. A medical technician operates the module in a semiautomatic mode so as to gather multiphasic data from one or more individuals coupled to the module. Output data is progressively accumulated and, at least in part, is transferred onto a composite health form, which can be machine readable. As a result, a multiphasic health profile or "base line" is derived in a few minutes and almost immediately is available to a doctor.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view, partly broken away, of a major portion of the subject module; and

FIG. 2 is a front view of the central control panel of the module.

DESCRIPTION OF THE PREFERRED EMBODIMENT

With reference to FIG. 1, the subject multiphasic health screening module is designated by the general reference number **10** and is housed in portable cabinetry **12.** The overall size may be approximately seven feet long, five feet high and three feet deep; however, the size and configuration could be varied depending upon the extensiveness of the desired testing procedure and thus the total amount and necessary configurations of individual testing instruments mounted within the cabinetry. The disclosed embodiment could be augmented by more test equipment; however, the invention will be clear by the following disclosure.

To be positioned adjacent the cabinetry **12** would be one or more seats for the individuals who are being tested. The term "individual" is employed rather than "patient" to emphasize the fact that the subject invention is designed primarily for use in an otherwise nonmedical environment by a technician. Reclining chairs or chaise lounges provide suitable seating comfort, while enabling the arms and legs of a test individual to be available for the easy attachment of test sensing electrodes and elements. Both the module and the seats are designed for transport in a small truck or small van, such that the only set up time required would be that of rolling the module and seats to any desired site and

plugging the module into a standard 115 volt wall socket.

On each side of the cabinetry **12** are electrical receptacles **14** for connecting sensor leads (not shown). These leads would then be coupled to the reclining test individual. The lower portion of the cabinetry, as at **16**, is provided with storage space for housing some portions of the testing devices, as well as their sensors, health forms, etc.

Projecting from the main body of the cabinetry is a desk-like shelf **18** for use by the operating technician and also for supporting equipment, such as a vision tester **20**, a pulmonary sensor **22**, and the ear phones **24** of an audiometer **26**. A central portion **28** of the shelf **18**, is slidable, inward from the position illustrated, so as to make accessible a tape recorder **30**, which is mounted in a drawer **32**, also illustrated in its forward position.

In the upper middle of the module **10** is a central control panel **34**, which is illustrated in greater detail in FIG. **2** and subsequently will be discussed.

Above the control panel is an oscilloscope **36**. Below and to the left of the control panel is a strip chart recorder **38**. The tape recorder **30**, the oscilloscope **36** and the strip chart recorder **38** are interconnected to the control panel and, to the extent desired, with all the test equipment so as to be common output recorders.

To the left of the control panel **34** is an electrocardiography analyzer **40**, which, when enabled via the control panel, is selectively operable by its selector switch **42** for receipt of the five standard ECG parameters, from respective sensors attached to the test individual and connected into the receptical **14**. If desired, the more complete twelve lead ECG response could be obtained by bypassing the selector switch **42** and/or augmenting it by providing, in conjunction with the control panel, a switching matrix, such as by relays, which would appropriately select the various sensor leads and permit the responses to be transduced, as by the strip chart recorder **38**.

Above the ECG analyzer **40** is a phonocardiograph **44** for the monitoring of heart sounds. To the right thereof, above the control panel, in an ECG amplifier, having a meter scale **46** that advises the technician of heart or pulse rate.

To the right of the oscilloscope is a galvanic skin response device **48**. Below which is a blood pressure monitor **50**. Above and to the right thereof is a pulmonary function monitor **52**, the sensor of which **22** was previously mentioned. Adjacent thereto is the readout portion **54** of an automatic height and weight recorder, not illustrated, which would be placed on the floor next to the module **10**.

Although not individually emphasized above, all of the above mentioned equipment have a common power input, are controlled via the control panel **34**; to the extent necessary, have sensor connections at the receptacles **14**, and have selective access to the output recorders **30, 36** and **38**.

Considering next the control panel **34**, shown in detail in FIG. **2**, at the right end thereof is a key operated power on-off switch **56**, which is connected to the 115 volt AC input line of the module. Below the switch **56** is a progressive counter **58** which identifies the test individual for purposes of correlation with the health form and any other data and bookkeeping purposes. The counter can be manually advanced and reset on demand; also, it can be connected to a test sequence ON button **60**, located at the top left of the control panel, such that each time the test sequence is started for an individual, by use of the ON button, the counter **58** is advanced.

At the upper right of the array of control buttons is a WARNING light **62**, which signals an alarm condition, such as improper amount of electric current, potential, etc. being applied to the sensing leads connected to the receptacles **14**, or a power surge into the module, or a malfunction of any of the testing devices. The first of these conditions is, of course, the most important with respect to the safety of the test individual. Accordingly, not only will the warning light be turned on, but also a highly sensitive, fast acting safety switch will be activated to remove all electric power from the receptacles **14**. Activation of the alarm system can also disable the "on" condition set by the ON button **60**. In this event, a RESET button **64** would have to be depressed after the alarm condition was removed and before the ON button **60** again could be effective in closing its associated switch. In a preferred embodiment, each button in the control array would be connected to its respective test device in such manner that a malfunction in a test device would cause a lamp behind the button to flash on and off. Of course, an audible alarm can be triggered in conjunction with the above mentioned visual alarm and the automatic disabling safety switches.

Below the RESET button **64** are LEFT CHAIR and RIGHT CHAIR select buttons **66** and **68** which are respectively connected to the receptacles **14** and to each of the test devices having leads connectable to the receptacles **14**. In the illustrated embodiment, two individuals can be tested at a time; one in the left chair or reclining seat, who is connectable to leads from the left side receptacle, and one in the right seat, who is connectable to leads from the right side receptacle **14**. Accordingly, whenever a particular test is to be performed on a particular individual, the associated chair and test button both must be depressed to enable their respective control switches.

A column **70** of readout control buttons respectively marked SCOPE, TAPE, and CHART is provided for the selection of the desired readout mode and its associated device, earlier referred to as the oscilloscope **36**, the tape recorder **30**, and the strip chart recorder **38**. One or more of these readout devices can be activated at any one time. To conserve upon the use of tape and chart paper and, more importantly, to avoid the recording of useless, or otherwise undesired data, it is recommended that the scope first be enabled alone so as to act as a preliminary monitor. When the test data, as seen on the scope, appears stable and/or otherwise significant for perminent recording, then the tape and/or chart devices would be enabled by their respective control buttons. At the bottom of the column **70** is a RESET button, which, as its name designates, is connected to each of the above disclosed readout devices so that, at the conclusion of the recording of a particular test, the recording device or devices can be reset for the next test in the sequence.

The remaining control buttons on the central control panel **34** define an array **72** in which each testing device and/or test procedure is represented by a selection button which, in the illustrated embodiment, comprises

fifteen buttons, not including the ON button **60**, but including a REVIEW button **74**. These buttons and their respectively associated switches can be connected for two different modes of operation — random sequence selection or predetermined sequence selection.

In the random sequence mode, the operating technician is free to select any test after the completion of any test. To do this, the technician would depress a first button, such as the GSR button, to enable the galvanic skin response test to commence. At the completion of this first test, the GSR button is again depressed to inactivate the GSR device **48**. Of course, during this test the recording instruments **30, 36** and **38** also would have been selectively activated and subsequently reset, and the technician would have made appropriate data entry on the health form. Thereafter, the testing procedure is free to commence again for any desired test.

In the predetermined sequence select mode, the array of control buttons would have its associated array of controlled switches interconnected in a release and latch configuration, such that the release of any specific one of the switches by its push button at the end of a test would enable only the sequentially next push button to be effective in latching its switch to enable the next sequential test. Although the release and latch arrangement could be connected to operate automatically as a step switch that is automatically advanced, it would be preferred to retain the step advancing control in the hands of the technician.

If the predetermined sequence control mode is employed, there may develop a situation in which an already completed test should be repeated, either because a review of the test results indicates a possible inaccuracy or, more likely, because another intervening test has indicated the possibility of some form of health condition, such that a recheck of the prior test could provide some additional or verifying data. In such circumstance, the REVIEW button **74** would be selected and would disable the predetermined sequence control and enable random selection of any test button and its test procedure.

Quite possibly a hybrid of the random sequence and the predetermined sequence control would be desired. For example, since the MIX PHONO button calls for the phonocardiograph response to be superimposed upon the response of a specific portion of the ECG test procedure, it might provide more accurate data analysis if the phonocardiograph, the mixed phonocardiograph, and the ECG tests were sequentially obtained; hence, these three tests would be connected by the control panel **34** and its switches in the predetermined sequence mode, and the remaining tests would be operable in the random sequence mode.

The health form, not illustrated, would be progressively filled in by the technician as the sequential testing progressed and would be reviewed by the technician at the end of the testing program or any portion of it to ascertain if any test should be redone while the test individual is still coupled to the sensors. As a result, as soon as the last test and a review are completed, the health form, the strip chart and the tape recorded data can all be put together physically in a common envelope or the like and be ready for a doctor's analysis; the entire testing procedure having been completed in a relatively few minutes, and needless to say in a manner which should cost a small amount compared to the prevalent costs of multiphasic health screening examinations.

It is believed that those knowledgeable in the electronic equipment oriented medical testing field will find the hereinabove presentation more than sufficient to appreciate the teachings of the invention and to practice same. Although specific electrical control schematics have not been illustrated, the operational description thereof should be enabling to those skilled in the art.

What is sought to be protected by United States Letters Patent is:

1. A semi-automatic, multiphasic health screening method for human individuals comprising the steps of: orienting at least two individuals adjacent to a multiphasic health screening module having therein a plurality of different electronically operable health parameter measuring test devices coupled to a common group of test readout recorders, whereby the entire screening is accomplished adjacent the module; electronically coupling each individual to the one module by way of a plurality of sensors and leads which transmit a plurality of different health parameters to at least some of the test devices in the module; automatically selecting a predetermined sequence of health screening tests to be performed on each individual by use of the test devices said selecting including the step of directing electrically which test is being performed upon each individual, such that at any one time a different test is being directed to each individual; performing each selected test for a relatively short period of time, and only once per individual by way of said automatically selecting; encoding, at least in part by the readout recorders, the data results from each test prior to advancing to the next test; and automatically enabling the performing of the next of the predetermined sequence of health tests and then accomplishing said steps of performing and encoding.

2. The method according to claim **1** further including monitoring electronically the data results prior to said encoding, and enabling said encoding by at least a portion of the recorders during said period of time and only after acceptable data has been monitored.

3. The method according to claim **1** further including the steps of: overriding said automatically selecting, electrically selecting on demand a repeating of any of said health screening tests, and repeating said steps of performing and encoding for any selected test repeating.

4. The method according to claim **1** including programming electronically said selecting and enabling in an automatic and sequentially predetermined mode, and manually commencing and terminating each said step of performing.

5. A multiphasic health screening module comprising: cabinetry, a plurality of different medical testing means for measuring medical health parameters housed within said cabinetry, a common electric power input to said module and said testing means, a plurality of test data recording means interconnected in common to at least some of said plurality of testing means, means for coupling said testing means to a plurality of individuals to be tested, central control means, including a central control panel which interconnects said testing means with said recording means and with said coupling means, said central control means further including programmed selecting means connected to said

testing means and said recording means, operation selection means also being on said central control panel, said selecting means including interconnecting means which defines a sequential, repetition-free mode of programmed testing by said central control means, whereby a plurality of multiphasic health screening tests can be obtained by means of said module only in a sequentially programmed mode, and said control panel includes direction control means interconnected to said coupling means, said testing means and said recording means, for selectively directing a test to a particular individual, while at the same time another test can be directed to another particular individual, whereby a plurality of individuals can be coterminously screened by said module.

6. A module according to claim **5** wherein said recording means include test output monitoring means for assisting in determining the acceptability of test data output, and said selecting means includes structure for enabling said monitoring means prior to the enabling of a remainder of the recording means, and for enabling at least a portion of such remainder upon a determination that acceptable test data is being generated by way of a testing means.

7. A module according to claim **5** wherein said testing means selecting means includes means for repeating any desired test, independent of the programmed sequential mode of testing.

8. A module according to claim **5** which includes electronic safety and alarm means connected at least to said coupling means and said selecting means and responsive to any abnormal electric parameter being applied from the module to the coupling means to speedily decouple said coupling means electrically and inhibit the testing means in an alarm condition, and said selecting means having a reset control for terminating the inhibit state after termination of an alarm condition.

9. A semi-automatic, multiphasic health testing method for human individuals comprising the steps of: orienting at least two individuals adjacent to a modular console having therein a plurality of different health parameter measuring instruments and readout recording means; electrically coupling each individual to the console by way of a plurality of sensors and leads which transmit a plurality of different health parameters to at least some of the test instruments in the console; selecting a predetermined sequence of tests to be performed on each individual by use of the test instruments; directing electrically which test is being performed upon each individual, such that at any one time a different test is being directed to each individual; performing each selected test for a relatively short period of time, and only once per individual by way of said selecting; encoding into the readout recorders, the data results from each test prior to advancing to the next test; advancing to the next of the predetermined sequence of health tests and then accomplishing said steps of directing, performing and encoding for such next test.

10. A multiphasic health screening apparatus comprising: cabinetry, a plurality of different medical testing means and data recording means housed within said cabinetry for measuring and recording medical health parameters, means for coupling said testing means to a plurality of individuals to be tested, central control means, including a central control panel which interconnects said testing means with said recording means and with said coupling means, said central control means further including test selecting means connected to said testing means and said recording means, and including interconnecting means which defines a sequential, repetition-free mode of testing by use of said central control means, and said central control means includes direction control means interconnected to said coupling means, said testing means and said recording means, for selectively directing a test to a particular individual, while at the same time another test can be directed to another particular individual, whereby a plurality of individuals can be coterminously screened by said apparatus.

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