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IN AN ELECTRIC PIPE ORGAN

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2 Sheets-Sheet 1

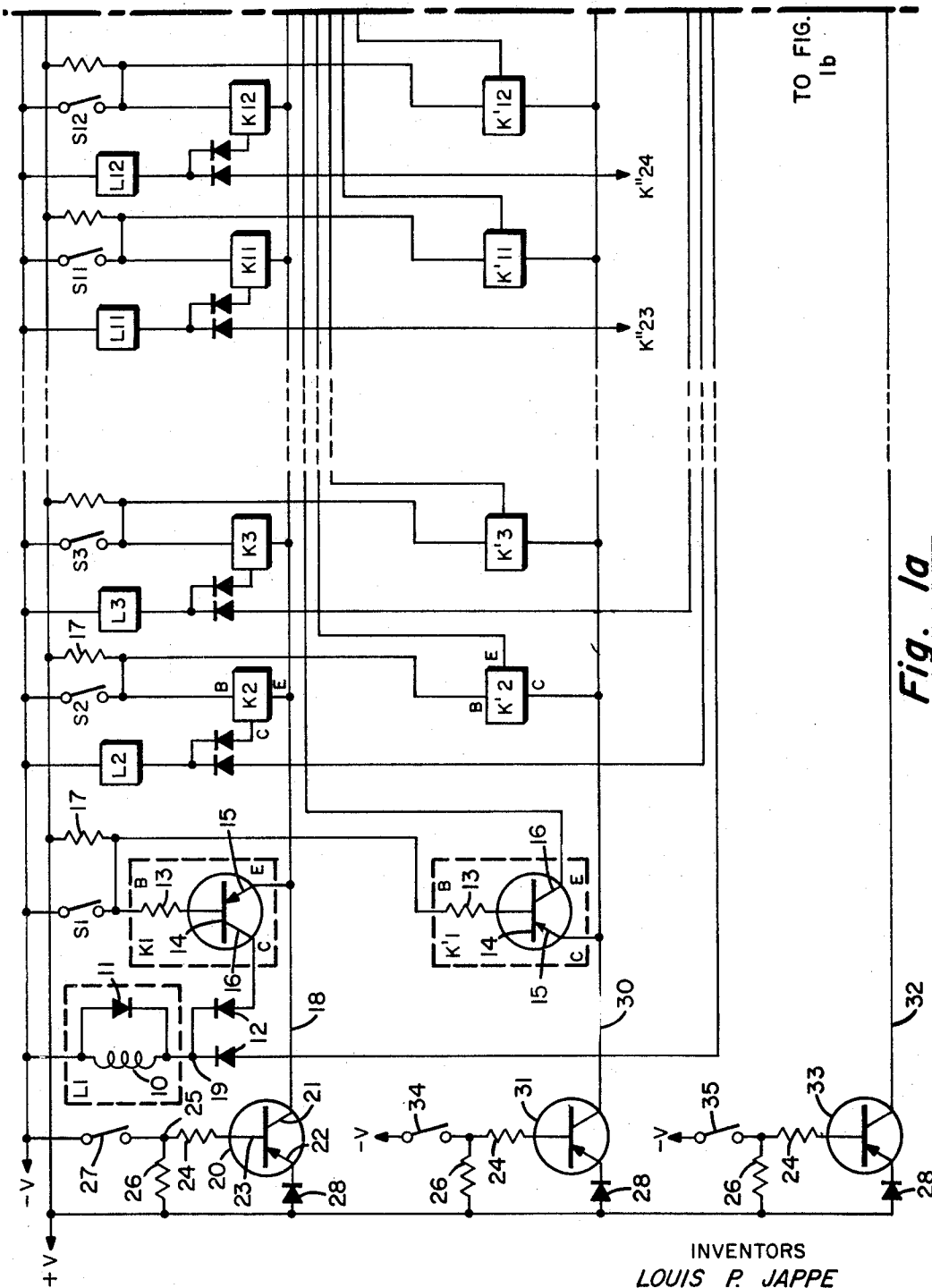


Fig. 1a

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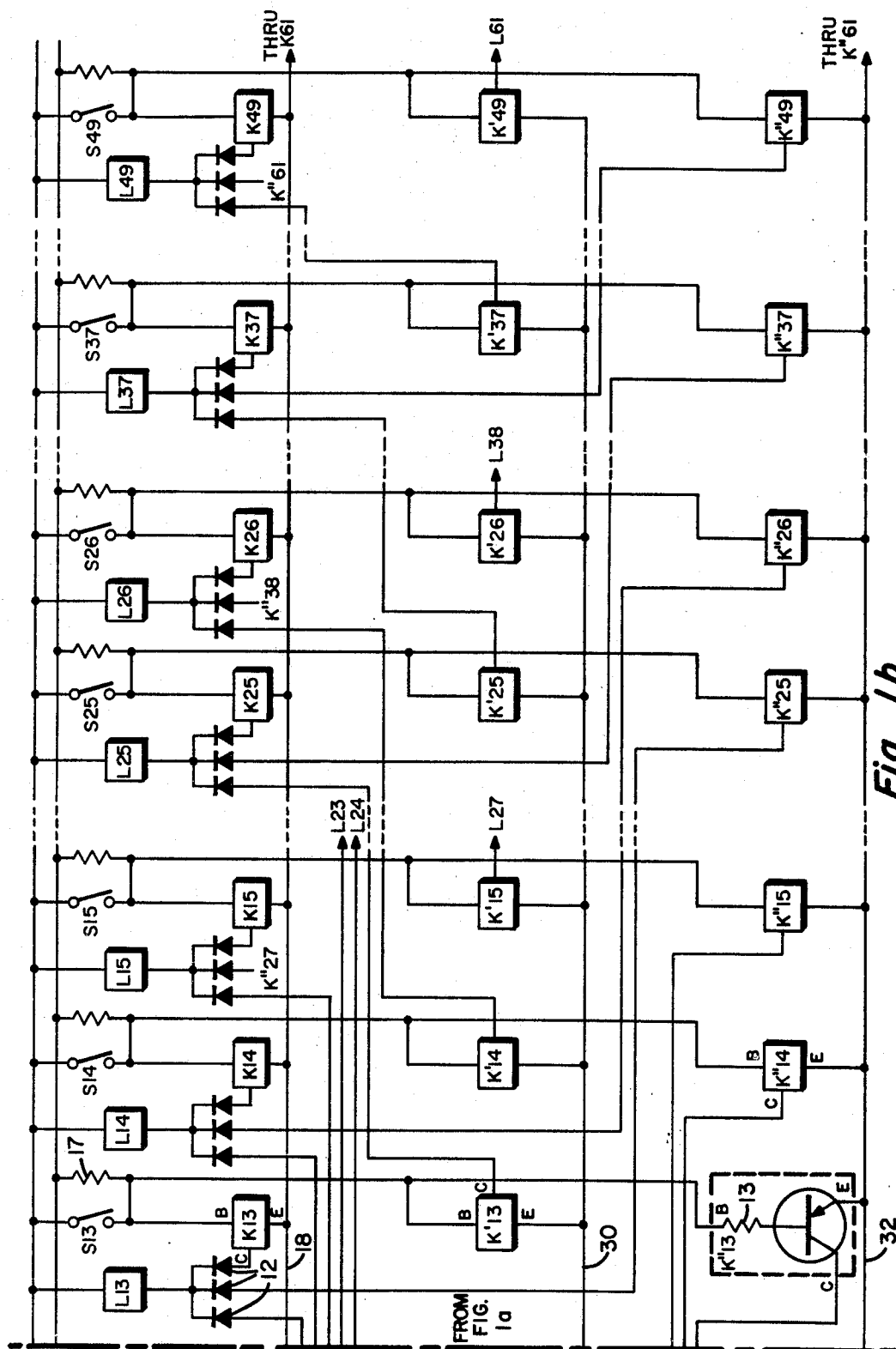
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TRANSISTORIZED SYSTEM FOR COUPLING AND UNIFICATION IN AN ELECTRIC PIPE ORGAN

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9 Claims

ABSTRACT OF THE DISCLOSURE

Intra and interdivisional coupling as well as unification is provided in an electric pipe organ by the use of transistor circuits. A host of transistors are arranged and connected in groups or sets to serve as gates between the manually operated keys and the organ pipe coils. The transistor gates are controlled or enabled by control transistors which are selectively set to the operable condition by tabs or stop switches which are manually operated by the organist. Interconnections for coupling within the divisions and between the divisions and for unification among the various ranks of pipes produced by the transistor circuits result in a myriad of possible combinations which the organist can select so that even a relatively small organ has a degree of versatility which heretofore has been difficult to attain.

BACKGROUND OF THE INVENTION

Field of the invention

This invention is directed for use in the field of multiple-ranked electric pipe organs. The invention is not concerned with the manner or means by which the tones are produced but with the controls by which the organist can select and choose the melodies and tones.

Description of the Prior Art

Coupling and/or unification in electric organs heretofore has been troublesome because the only way in which the necessary circuits could be arranged and connected together was through multiple-contact ganged, manually operable switches. The bulk of these switches plus the vast amount of wires and cabling running between the various organ units along with the susceptibility of the switch contacts to wear placed a severe restriction on the dependability and reliability of both inter and intra-divisional coupling as well as unification. In addition, the difficulty in tracing down the somewhat complex wire circuits in the bulky cabling to and from the multitude of switch contacts made maintenance expense and time consuming.

SUMMARY

Gating transistors are electrically connected between the coils, which are energized to actuate the various pipes to produce the desired notes and tones, and the keyboard keys, which may be physically located in a console and which are manipulated by the organist to select the tones, chords and melodies. Conduction through the respective gating transistors to energize the corresponding coils is only possible when the set of gating transistors is enabled by a corresponding control transistor. The latter is operatively responsive to a stop tab or switch which is also selected by the organist. Only when a gating transistor is enabled by a control transistor will it be able to conduct current when the appropriate keyboard key is selected to energize the coil or coils so that the pipes are played. To achieve versatility within a division the transistors are connected to selectively energize multiple coils when a single key contact is closed. Additional versatility can be

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achieved by electrically connecting the transistors between divisions so that the closure of a single key contact in one division keyboard can selectively play pipes in other divisions. Additionally, selection of ranks of a multiple-rank pipe organ can similarly be achieved in a myriad of possible combinations by similar interconnection of the transistorized circuits. The only manual or moving switches involved are of the single contact toggle-type variety so there is a minimum amount of wear on the contact points. Arcing and burning of switch contacts, which had been a major problem in electric organs heretofore, virtually has been eliminated because of the lower power requirements of the transistor circuits.

BRIEF DESCRIPTION OF THE DRAWING

FIGURES 1a and 1b are a combined functional schematic and functional block diagram of a preferred embodiment of the invention as used for coupling in a multiple ranked electric organ and including the various transistor circuits.

DESCRIPTION OF THE PREFERRED EMBODIMENT

A set of coils L1 through L61, provide the prime energization for the pipes associated with each of the keys S1 through S61 in the keyboard. In the wind chest of a straight organ, one coil in the chest provides the prime energization for all the pipes associated with a given key and the secondary selection of a particular rank of pipes is provided in some other manner, not shown. The secondary selection does not constitute an essential part of the present invention so is not described herein in any detail but a brief example of same will be set forth. Taking, for example, a five rank pipe organ, if coil L1 is energized, in a manner to be described later, a tone could be produced simultaneously from all five pipes associated with that coil in the wind chest. The secondary control, not shown, is used by the organist to select which of the five ranks (or all five) should be played.

Each of the coils L1-L61 actually is an assembly comprising a coil winding 10 having a diode 11 connected across the winding. The diode is for protection, to eliminate the danger of a large transient inverse voltage developing a cross the coil winding. One side of each of the coil windings 10 is connected to a DC voltage source, -V, which, in a typical case may be in the order of negative 12 volts. The other side of the winding 10 is connected to a common junction 19 of a plurality of input lines. The addition of diode 11 is the only change necessary to adapt a standard organ chest to the present invention. If any of the input lines connected to the junction 19 provides a closed circuit path, in a manner which will be described later, current will flow from the energy source -V through the coil winding 10 to energize it. Isolating diodes 12 are provided on each input line to eliminate cross coupling between the input lines.

In a typical illustrative case, with no limitation being intended, an organ division keyboard may contain sixty-one manually operable keys, S1-S61, which are the normally-open, momentarily-close variety. One side of each key is also connected to the -V energy source. Associated with each of the keys S1-S61 is a first set of key transistor circuits which are identified in the drawing as K1 through K61. The circuit which is identical for each key transistor contains a base control input terminal B resistor 13 connected from the input terminal B to the base electrode 14 of the PNP transistor, an emitter electrode 15 and a collector electrode 16 which are respectively connected to terminals E and C. The base control input terminal B of each of the key transistors K1-K61 is connected to the other side of a respectively

corresponding key switch S1-S61, and is also connected to energy source +V through a resistor 17. Typically the +V energy source is in the order of 12 volts. The emitter input terminal E is connected to a unison control bus 18 and the collector output terminal C is connected as one input to respectively corresponding coils L1-L61 through suitable isolating diodes 12. If the input to emitter terminal E in K1 is active, which is accomplished in a manner which will be described later, then a momentary closing of the associated key S-1 will complete the base-emitter circuit of the PNP transistor K1 so current will flow in the emitter-collector circuit from energy source -V through the coil L1 to energize it. It can be seen then that for any coil input line to be able to energize the coil, the key transistor to which that input line is connected must have both its control bus and its keyboard key in actuating condition.

Control bus 18 is energized by a unison control transistor 20. The collector electrode 21 is connected to control bus 18 and the emitter electrode 22 is connected to a DC energy source +V through diode 28. Diode 28 is a biasing diode and provides an approximate .6 volt drop to assist in rapid turn off of transistor 20. It also provides protection in the event the positive and negative leads for the organ wiring should erroneously reversed. The base electrode 23 is connected through resistor 24 to junction point 25 which is connected to one end of unison switch 27. Resistor 26 is connected between junction 25 and +V and the other end of unison switch 27 is connected to energy source -V. Unison switch 27 is an on-off toggle type. When switch 27 is closed, the negative potential on the base electrode of the unison control transistor 20 energizes the transistor and completes the collector-emitter circuit to activate bus 18 and places all of the key transistors K1-K61 in the enabled or ready condition.

The coupler circuit which is the embodiment of this invention illustrated in the figure, includes a second and third set of key transistors, respectively K'-K'49 and K''13-K''61. Each of the transistor circuits in these sets is identical to the circuit illustrated and described for the first or K set of key transistors. Each key transistor in the K' and K'' sets has its base input terminal B connected to a corresponding key in the keyboard. The K' set, however, only ranges from keys S1 through S49 and the K'' set ranges from keys S13 through S61. The reason for this will be explained later. For example, momentarily closing S13 will place -V on the base input terminal B of K13, K'13 and K''13. Similarly, each of the remaining keys in the keyboard, when closed, will place a negative potential on the base input terminal B of two or three key transistors, each in a different set. The K' set of key transistors has a 4' coupled control bus 30 which is activated by 4' coupler control transistor 31. Similarly the K'' set of key transistors has a 16' coupler control bus 32 which is activated by 16' coupler control transistor 33. The circuits for both coupler control transistors 31 and 33 are identical to the circuit for the unison control transistor 20 and they are respectively turned on and off in the same manner as the unison control transistor by their respectively associated toggle switches 34 and 35. The output terminals C, of each of the K' and K'' sets of key transistors provide additional inputs through suitable isolating diodes 12 to certain ones of the coils L1-L61. For example, key transistor K' is connected to the input of coil L13, K'2 is connected to the input of L14, and so forth, mutatis mutandi, up to K'49 being connected to the input of L61. K''13 is connected back to coil L1, K''14 is connected to L2, and so forth, mutatis mutandi, up to K''61 being connected to the input of L49. It can be seen then that any one of two or three different inputs to a coil can be used to energize that coil, and, therefore, select that group of pipes for playing. It should be pointed out that ordinarily unison switch 27 is in the closed condition so that depressing any one

of the keys in the keyboard will energize the corresponding pipe organ coil. The 4' and 16' coupler switches 34 and 35, are ordinarily open and are only brought into play when certain pitches are desired by the organist.

For a better understanding of the function of this invention, assume, for example, the situation of unison switch 27, 4' coupler switch 34 and 16' coupler switch 35 all being closed. This is done merely by the organist flipping the toggle-type switches to the closed position. This places all of the key transistors in all three sets in the ready or enabled state in the manner described earlier. If the organist then presses key S13, transistors K13, K'13 and K''13 all become active to respectively energize coils L13, L25 and L1 to produce a resulting tone from the pipes associated with these coils. As stated earlier, depending on the rank or ranks of pipes chosen by the organist, a melodious tone made up of a combination of numerous pipes will be produced. In this example, if a five rank pipe organ were being used and all five ranks selected, the organist depressing the single key S13 will produce tones from fifteen different pipes.

Although the drawing illustrates the manner of coupling within a keyboard of a given unit or division, it can be visualized that inter-division coupling can be achieved in a like manner using sets of identical inter-coupling key transistors, control transistors and control stops or tabs or switches. For example, if it is desired to make the Swell division of an organ playable from the Great division on a key-to-key basis, which is commonly termed a Swell to Great eight, another set of key transistors having a circuitry identical to those described earlier would be necessary, one for each key in the Great division keyboard. A Swell to Great control transistor, identical to the control transistors described earlier along with a Swell to Great toggle switch would be provided to enable the additional set of key transistors. The Great division keyboard switches would be connected to the respective key transistors in an identical fashion as described earlier and the output of the key transistors would be connected as additional inputs, through isolating diodes, to the respective coils associated with the wind chest for the Swell division. This, of course, could be readily expanded as desired to cover a variety of inter-coupling systems such as Swell to Great 16', Great to Great 4', etc. Extensive coupling of this nature is accomplished under the teachings of this invention with a single switch contact under each key in lieu of a separate contact for each coupler as has been the case heretofore.

It has been found that in some instances, a negative energy source may not be available in a given console or unit. If such is the case, a conversion transistor must be connected between the keyboard switch and the key transistors. The conversion transistor is merely an NPN transistor which will then respond to an applied positive potential and provide a circuit path to complete the base circuit of the associated key transistors.

In a typical installation, using +12 volts and -12 volts as the energy sources, the control transistors 20, 31 and 33 were the 2N456 variety, resistor 26 was 470 ohms and resistor 24 was 100 ohms. The key transistors were the 2N321 variety and resistors 13 and 17 were the 2200 ohms. Diodes 11 and 12 were the 1N4001 variety and diode 28 a 1N1191. It should be understood that the foregoing are merely illustrative, no limitation thereto being intended.

We claim:

1. In a pipe organ having chest coils and a keyboard, electrical circuit apparatus for providing the organist with coupling and/or unification by the selective operation of single-contact key and stop switches, said circuit comprising in combination: a manually-operable normal-open single-contact electrical switch for each key; a plurality of sets of three-electrode key transistors; means electrically coupling the base element of one key transistor in at least two different sets to a single key switch con-

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tact for completing the respective base circuits when the corresponding key switch is closed; a plurality of manually-operable, single-contact, open-close electrical stop switches, one for each stop key, a three-electrode control transistor for each of said stop switches, the base element of each of said control transistors being electrically coupled to a respective stop switch for energizing the corresponding transistor when the switch is closed; conducting means electrically coupling one of said control transistors to the emitter elements of a first of said sets of key transistors for completing the emitter circuits of said first set when said one control transistor is energized; further conducting means electrically coupling at least a second control transistor to the emitter elements of at least a second of said sets of key transistors for completing the emitter circuits of said second set when said second control transistor is energized; and additional conducting means electrically coupling the collector elements in each of said sets of key transistors to a selected chest coil for energizing the chest coil when the emitter-base circuit of the corresponding key transistor is completed by the closing of a key switch contact and energizing a control transistor.

2. The invention as described in claim 1 wherein said base coupling means includes means electrically coupling the base element of at least two key transistors, each in a different set of key transistors, to one key switch contact.

3. The invention as described in claim 2 wherein said collector coupling means includes isolating diode means coupling the collector elements of at least two key transistors, each in a different set of key transistors, to one chest coil.

4. The invention as described in claim 3 wherein at least one set of said plurality of sets of key transistors contains one transistor for each keyboard key.

5. The invention as described in claim 4 wherein said collector coupling means is arranged to couple the collector element of each transistor in one set of key transistors to a respective chest coil associated with the key switch contact which is coupled to the base element of the same transistor.

6. The invention as described in claim 5 wherein said collector coupling means is arranged to couple the collector element of each of the transistors in said other sets of key transistors to a respective chest coil which is associated with a key switch contact other than the one coupled to the base element of the same transistor.

7. In a pipe organ having chest coils and a keyboard, electrical circuit apparatus for providing the organist with coupling and unification by the selective operation of single contact key and stop switches, said circuit comprising in combination: a manually-operable, normally-open single-contact electrical switch for each key; a plurality of sets of three-electrode key transistors; means electrically coupling each key switch to the base element of one key transistor in at least two different sets for completing the respective base circuits when the corresponding key switch is closed; a plurality of manually-operable, single-contact open-close electrical stop switches, one for each stop key; a three-electrode control transistor for each of said stop switches, the base element of each of said control transistors being electrically coupled to a responsive stop switch for energizing the corresponding transistor when the switch is

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closed; conducting means electrically coupling each of said control transistors to all of the emitter elements in respective ones of said sets of key transistors for completing the emitter circuit of all of the transistors in the said set when the corresponding control transistor is energized; and conducting means electrically coupling the collector elements of the transistors in each of said sets of key transistors to certain ones of the chest coils for energizing the said corresponding chest coils when the emitter-base circuit of the respectively corresponding key transistor is completed by the closing of a key switch and energizing a control transistor.

8. The invention as in claim 7 further including a set of transistor inverters having their inputs respectively connected to corresponding conducting means between the key transistors and the chest coils for providing an inverted signal of proper polarity to another group of sets of key transistors for providing coupling and unification in the same organ with single contact key switches.

9. The invention as set forth in claim 8 wherein said another group of sets of key transistors includes: a second group of a plurality of sets of three-electrode key transistors; means electrically coupling the base element of one second group key transistor in at least two different sets to a corresponding one of said transistor inverters for completing the respective base circuits when the corresponding inverter is active; a second group of a plurality of manually-operable single-contact open-close electrical stop switches, one for each of a second group of stop keys; a three electrode control transistor for each of said second group stop switches, the base element of each of said second group control transistors being electrically coupled to a respective second group stop switch for energizing the corresponding transistor when the switch is closed; conducting means electrically coupling one of said second group control transistors to the emitter elements of a first of said sets of second group key transistors for completing the emitter circuit of said first set when said one control transistor is energized; further conducting means electrically coupling at least another second group control transistor to the emitter elements of at least another set of second group key transistors for completing the emitter circuits of said another set when said another control transistor is energized; and additional conducting means electrically coupling the collector elements in each of said sets of second group key transistors to a selected second group chest coil for energizing the chest coil when the emitter-base circuit of the corresponding second group key transistor is completed by the closing of the key switch contact.

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