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(54) **SOLENOID CONTROLLER FOR COLOR CHANGER**

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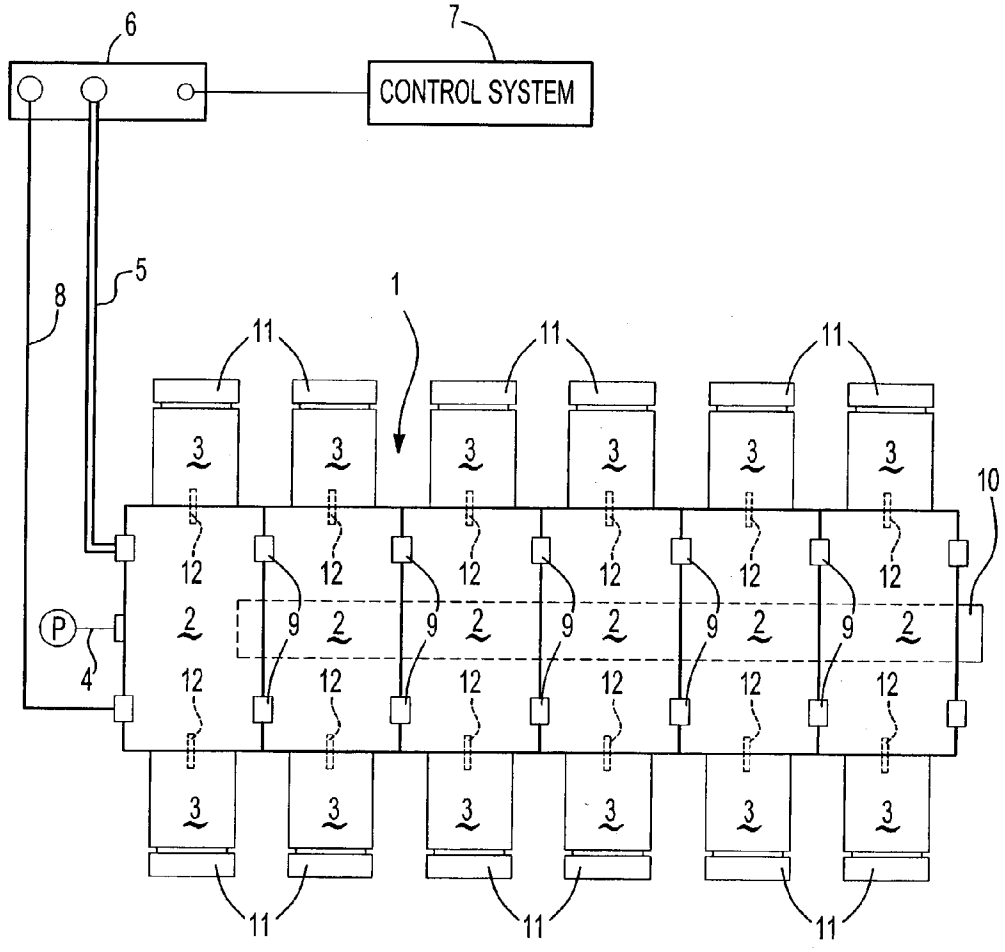
(57) **ABSTRACT**

The paint and rinsing-agent valves of a paint changer for connection of a number of paint lines for coating material of different, selectable paints with an application element are pilot-controlled pneumatically by a compressed air line common for all valves and placed permanently under pressure, and switched by attached electronically controlled electromagnetic valves. The electronic control takes placed by means of a field bus system electronically interfaced with each of the paint and rinsing-agent valves.



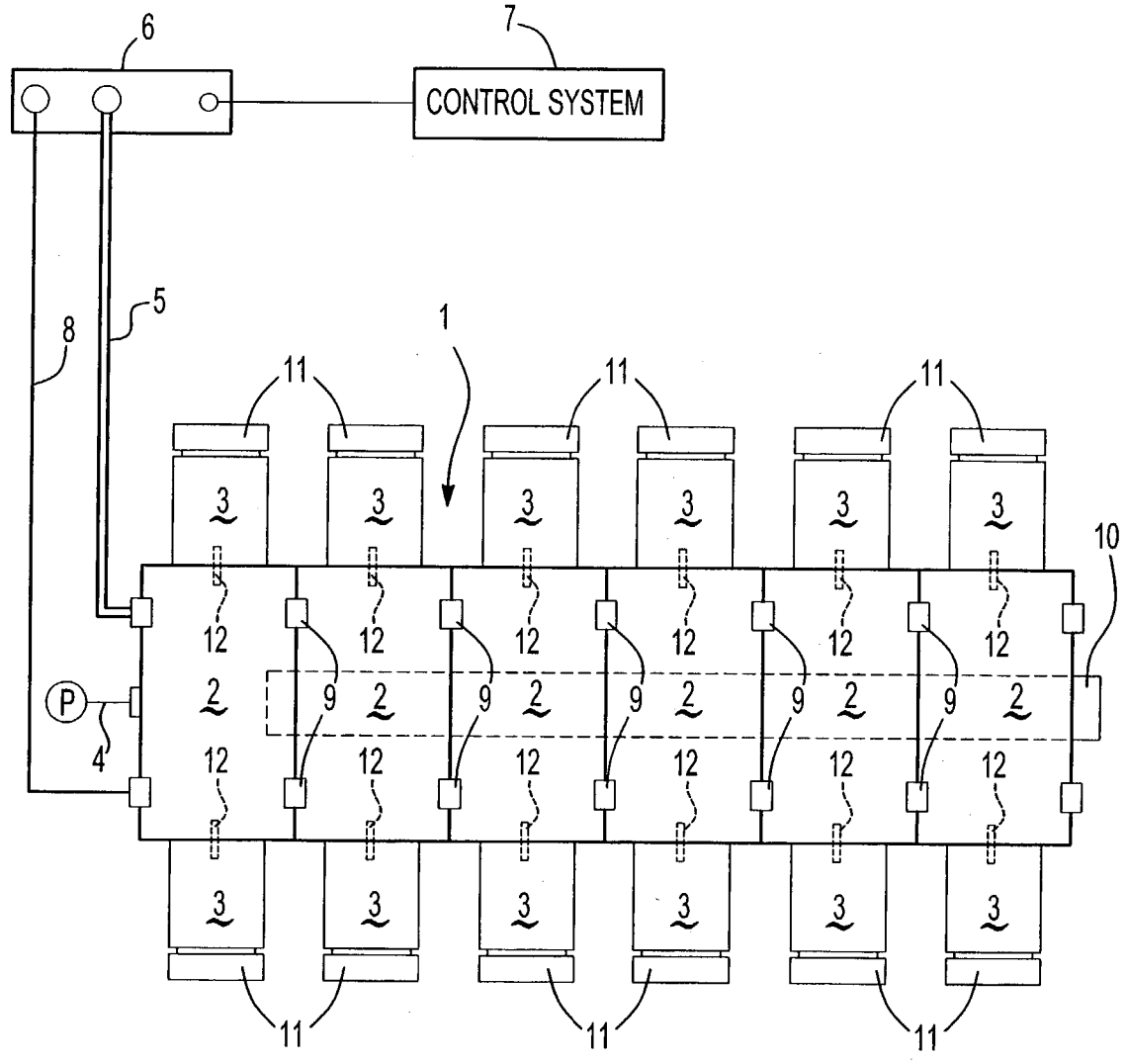


Fig-1

SOLENOID CONTROLLER FOR COLOR CHANGER

[0001] The present application claims priority to U.S. Provisional Patent Application No. 60/332,571 and to German Patent Application No. 100 56 259.6 filed Nov. 14, 2000.

BACKGROUND OF THE INVENTION

[0002] The invention pertains to a paint transfer-valve device for connecting a number of paint lines for coating material of different, selectable paints with an application element according to the upper clause of claim 1, and also to a method for control of this type of device.

[0003] Paint transfer valve devices, or briefly, paint changers, in painting or lacquering systems for coating of workpieces, such as motor vehicle chassis during the lacquering process, make possible a rapid switching from one paint to another, and consist primarily of a number of controllable paint valves which are distributed along a paint conduit carrying all paints. For adaptation to the particular painting system and the number of selectable paints, they are designed in a block construction from individual modules (connection blocks, connection strips, control heads) which can be lined up together, so that a variable, subsequently enlargeable or reducible number of connections for paint lines can be obtained. In addition to the paint valves, usually other, similarly constructed valves are provided for rinsing media, such as thinner fluids and pulsed air.

[0004] Known paint changers of this kind (Duerr, Technical Handbook, Introduction to the technology of passenger vehicle lacquering, April 1999) contain pneumatically actuated valves which are operated by compressed air signals from the valves of individually allocated hoses. These control-air hoses come from a distant pneumatic cabinet, where they are each opened and closed by a magnetic valve under the control of the electronic control system of the apparatus for generation of the compressed air control signals.

[0005] The known pneumatic control system is very complicated, since for each switching function, one compressed air hose has to be laid from the pneumatic cabinet to the paint changer, and in addition, for each valve of the paint changer, and structurally and spatially separate, an external electromagnetic valve is needed. Furthermore, due to the control air hoses and the requirement for them to be compressed and relieved, switching delays of differing time length will occur, since depending on the particular installation (e.g., for side and roof machines), different hose lengths and accordingly different switching times will result within the system. Short and precisely-defined switching times are important, especially for newer rinsing programs for paint changers, where the opening times of the rinsing valves are typically on the order of fractions of a second (DE 199 51 956).

[0006] From EP 0 979 964 A, it is already known how to operate the valve needle of the paint control valves of a paint changer by electromagnetic means in order to use a direct electrical bus control to achieve the shortest possible switching times without the hoses needed for pneumatic control. But for a direct operation of the valve needle, relatively powerful electromagnets are required, which provide the needed blocking, but also may have undesirable, large electrical power consumption, which is particularly troublesome under consideration of the regulations on explosion prevention.

SUMMARY OF THE INVENTION

[0007] It is the purpose of the invention to specify a paint changer and a method for its control, which avoids the conduit outlay and the switch time latency of pneumatically controlled paint changers, without the requirements for the less desirable, powerful electromagnets.

[0008] This purpose is achieved by the properties of the independent patent claims.

[0009] Due to the invention, a compact and dependable unit is created which will require far lower installation and other expenses in comparison to standard pneumatically controlled paint changers. In particular, the formerly required, numerous control air hoses of the paint changer and also the large external pneumatic cabinet including its magnetic valves are omitted. Since the pressurizing and venting of hose lines is now omitted, much faster switching processes will result, which can additionally be determined accurately and are independent of the installation, so that often highly reproducible rinsing programs can be obtained with short switching times.

[0010] The installation expense will also be reduced because only electric lines are connected to the paint changer, in addition to the compressed air hose for pneumatic pilot control which is common to all valves. And in the preferred data bus controller, only this bus and a power supply line for the electromagnets and for the electronic control circuits of the valves are needed.

[0011] These advantages are combined according to this invention, with an efficient pneumatic valve actuation, so that a powerful electromagnetic drive is not needed. In addition, the invention has the advantage that the purely pneumatic valves in the paint changer, common today, can be easily replaced without other design changes by the new, electrically controlled valves.

BRIEF DESCRIPTION OF THE FIGURES

[0012] **FIG. 1** shows a schematic of the color paint changer of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0013] Using the design example shown in the figure, the invention will now be explained in greater detail. The figure schematically shows a paint changer with pneumatic valves controlled electronically by a field bus system.

[0014] The paint changer **1** consists in known manner of a modularly expandable or reducible group of sequential block units, each composed of housing elements **2** and, e.g., screwed in valves **3** for attaching therein paint lines and rinsing lines (not illustrated) to the mounted central paint conduit.

[0015] The valves **3** pertain to pneumatic valves pilot-controlled by an electromagnetic valve. Suitable designs for this are already well known to an ordinary technician skilled in the art, depending on the particular application. For

example, the valves **3** can contain a pneumatic base unit corresponding to **FIG. 2** of the aforementioned EP 0 979 964 A, in which a valve needle equipped with a piston is pressed by compressed air against the force of a spring into an open position, in which it releases the pathway for the paint or rinsing medium in the paint conduit of the paint changer. But whereas in the known case, the compressed air represents the control signal for opening and closing of the paint valve, in the paint changer described here, the compressed air connection is replaced by an electromagnetic valve unit **11** which is attached to the pneumatic base unit and electrically opens and closes the connection between a compressed air line **4**, permanently under a continuous pressure, and the pneumatic base unit. Under consideration of the design, the attached electromagnetic valve unit **11** can be configured similar to the already known pneumatic base unit and, for example, can contain a magnetic core moving as its needle **12**, to which a sealing seat is provided. If the magnetic core is attracted by an electric coil surrounding it, then the sealing seat will open and release the pathway for the compressed air from the line **4** into the pneumatic base unit. The compressed air line **4** used for pneumatic pilot control and connected at point P to a central pilot control air supply, runs through the housing element **2** of the paint changer **1** and is connected to all valves **3** within the paint changer. But instead of this, other known or expedient designs can be used for an electrically controlled valve for opening and closing of the pneumatic lines of the paint and rinsing agent valves.

[**0016**] In particular, when the known pneumatic valves **3** of the previously used paint changer are each provided with a directly attached electromagnetic pilot control valve **11**, then by use of an additional sensor per valve, the switch setting of the valve can be indicated and/or reported back to an electronic control system **7**.

[**0017**] For electrical control of the valves **3**, we use preferably an internal data bus **5** passing through all modular housing elements **2**, and this can be a CAN-bus or any of the other known, standardized bus systems, and is connected via an interface **6** to the higher-order electronic control system **7**. Preferably, one of the modern field bus systems is used whose binary control data are allocated in the paint changer **1** to valves **3** to which they are respectively assigned. For allocation and addressing, electronic circuits (chips) are used in a known manner; they can be provided in the individual valves in order to link the mentioned coils of the electromagnetic valve units **11** for opening of the particular valve with a power supply line **8**, likewise running through the entire paint changer. Due to the low power consumption of the electromagnet valve units **11** now possible according to this invention, they can be driven from the electrical control directly with accordingly smaller output power.

[**0018**] Preferably, the modular block units are each formed from a housing element **2** and one or more valves **3** and can be easily plugged together for adaptation of the particular quantity of selectable paints, where the necessary strength is ensured by suitable locking features. In this configuration, the sections of the internal data bus **5** extending through the modular housing units are joined together by plug-in contacts **9**. The same also applies to the corresponding sections of the power supply line **8** and the compressed air line **4**.

[**0019**] Since paint changers in electrostatic coating systems usually have to be grounded, the housing parts of the paint changer **1** can consist of an electrically conducting material, for example, a conducting plastic.

[**0020**] Instead of the described bus control, single wiring of the electromagnetic valves is also possible, so that only the pilot control compressed air line will lead to the paint changer.

[**0021**] The invention has been described in an illustrative manner, and it is to be understood that the terminology which has been used is intended to be in the nature of words of description rather than of limitation.

[**0022**] Obviously, many modifications and variations of the present invention are possible in light of the above teachings. It is, therefore, to be understood that within the scope of the appended claims, wherein reference numerals are merely for convenience and are not to be in any way limiting, the invention may be practiced otherwise than as specifically described.

1. A paint transfer-valve device for connecting a number of paint lines for coating material of different, selectable paints with an application element, said device comprising:

a central paint conduit for supplying the coating material to be supplied to the application element;

a plurality controllable valves fluidly connected to said paint conduit for providing the selectable paints from the paint lines to said conduit;

an external electronic control system for actuating said controllable valves at desired intervals;

said controllable valves of said paint transfer-valve device being equipped with electromagnetic valves units connectable to said external electronic control system; and

wherein said controllable valves being actuated by compressed gas from a common compressed gas line leading through the paint transfer-valve device to each said controllable valve when signaled by said external electronic control system through said electromagnetic valve units.

2. A paint transfer-valve device according to claim 1, wherein a data bus for providing digital control data runs through said paint transfer-valve device, said data bus being coupled to said electromagnetic valves unit by an electronic circuit.

3. A paint transfer-valve device according to claim 2, wherein each said electromagnetic valve unit includes an electronic circuit.

4. A paint transfer valve device according to claim 3, wherein said electromagnetic valve units are mounted to modularly arranged, interconnectable housing units having a section of said data bus extending therethrough, each successive data bus connected by plug-in contacts.

5. A paint transfer-valve device according to claim 4, wherein one section of a power supply line for each said electromagnetic valve unit and said compressed gas line extends through said modules and being operably connected by plug-in contacts.

6. A paint transfer-valve device according to claim 1, wherein each said controllable valve section includes a valve needle forming a sealing surface, said valve needle being biased into a closed position thereby closing said valve.

7. A paint transfer-valve device according to claim 6, wherein compressed air provides a counter force to said needle bias thereby opening the compressed air pathway to said controllable valve as directed by said electromagnetic valve unit.

8. A paint transfer-valve device according to claim 7, wherein said electromagnetic valve unit is integrated with said controllable valve.

9. A method of controlling a paint transfer-valve device connecting a plurality of paint lines fluidly connected to a source of coating material of different, selectable paints with an application element through a central paint conduit, comprising the steps of:

providing a plurality of controllable valve units fluidly connected to said central paint conduit and being pneumatically actuated by compressed gas, said controllable valve units receiving pressurized gas from common gas line;

actuating said controllable valve units with electronically controlled electromagnets integrated with said paint transfer-valve device thereby providing paint to said central paint conduit.

10. A method according to claim 9, further including the step of signaling said electronically controlled electromagnets with a field bus system.

11. A method according to claim 9, further including the step of providing cleaning media to said paint conduit through at least one of said controllable valve units.

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