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(54) A variable speed control device for fork lift equipment.

(57) In an electronic speed control device for fork lift equipment, which can be operated by a single knob or handle and features hardware comprising a single microprocessor controlled chopper circuit (1), both the elevation and the descent movement of the lift are piloted digitally using software written and stored in EPROM (14) so as to enable its subsequent modification if need be; the circuit thus controls not only the usual d.c. motor (3) coupled to the pump (5) which extends the hydraulic lift cylinder, but also the proportional valve (4) conventionally used to regulate descent.

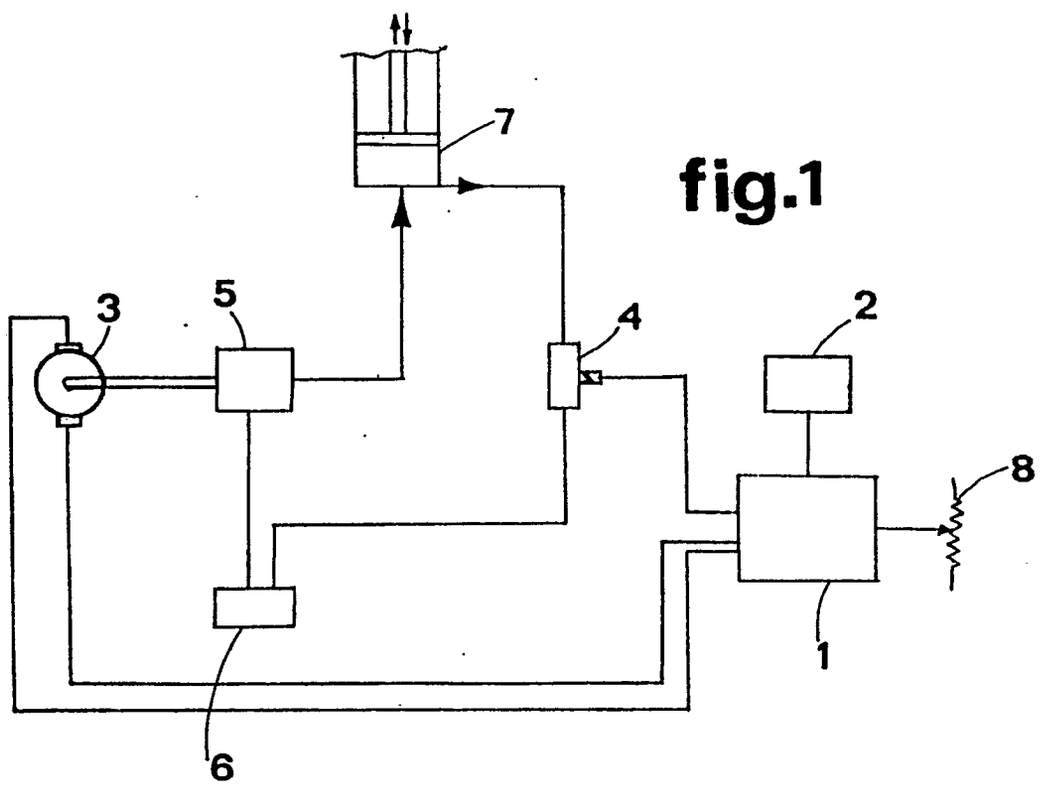

fig.1

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The present invention relates to a variable speed control device for fork lift trucks.

The prior art embraces fork lift trucks in which the operator seat is elevated and lowered together with the lifting gear of the truck, in such a way that the operator retains direct visual control when placing or picking up objects, typically in warehouse duties.

Accordingly, the elevating and lowering movements in question need to be as linear and continuous as possible, free of sudden variations in speed. This is a requirement likewise in the case of fork lift trucks used for handling particularly delicate objects or equipment.

For example, conventional fork lift trucks used in warehouse duties operate off a direct current power supply, and are equipped with a d.c. motor driving a hydraulic pump by which a hydraulic cylinder is extended upward to elevate the fork lift. The motor is piloted at variable speed by a control circuit commonly known as a 'chopper', powered by the truck battery and operated manually by way of a knob. The lift system also comprises a proportional valve serving to control the descent movement, which is interlocked to an electronic circuit board and operated by a further knob.

Conventional arrangements of the type in question betray certain drawbacks, namely : two electronic speed control circuits are used, one for elevation of the lift and another for descent, both of which being high cost components ; twin manual controls are installed for elevation and descent movements, requiring respective sets of connections to the electrical and electronic components ; also, descent of the lift is somewhat sharp and jerky, by reason of the difficulty in controlling the proportional valve.

The object of the present invention is to overcome the drawbacks mentioned above, and in particular to afford control over the elevation and descent of a fork lift using a single electronic speed control circuit, thereby obtaining reduced cost, simplified construction and increased dependability.

A further object consists in making certain that elevation and descent movements are rendered free from sudden variations in speed, and providing a single manual control to operate both of the two functions, in such a way as to reduce costs and rationalize construction further still, increase long term reliability and ensure better handling and safety.

The stated objects are fully realized in a variable speed control device according to the invention ; such a device is intended for use in a fork lift truck comprising a hydraulic lift system, and a d.c. motor by which the pump of the lift system is driven, and characterized in that it comprises a single electronic circuit designed to pilot the operation both of the d.c. motor, in driving the hydraulic pump to elevate the fork lift, and of a proportional valve by which the descent of the fork lift is controlled.

The invention will now be described in detail, by way of example, with the aid of the accompanying drawings, in which :

- fig 1 is a block diagram of the device considered in its entirety, showing the mechanical parts of the truck relative to the fork lift system ;
- fig 2 is a block diagram showing the electronic circuit of the device.

Referring to the drawings, 1 denotes an electronic speed control circuit supplied with power from a battery 2, which is designed to pilot the operation of a d.c. motor 3 and a proportional valve 4.

The motor 3 drives a pump 5 by which fluid (oil) is drawn from a tank 6 and directed under pressure into a lift cylinder 7 so as to elevate a fork mechanism of conventional embodiment (not shown). Conversely, the proportional valve 4 serves to return oil from the cylinder 7 to the tank 6 with the lift descending.

8 denotes a potentiometer, operated manually by a knob, which provides the single selective input to the electronic circuit 1 and, according to the invention, the means by which both the motor 3 and the proportional valve 4 are operated. Other types of transducer might be used in preference to the potentiometer 8 without prejudice to the spirit of the invention.

The electronic circuit 1 comprises a microprocessor denoted 9 to which a plurality of inputs 10, ported externally of the enclosure housing the circuit, are connected by way of a relative interface 11. Similarly, a plurality of externally ported outputs 12 are connected by way of a further interface 13.

An 8-bit data transmission bus connects the micro processor 9 to an EPROM type memory 14 in which the reference software is stored, and in particular the operating curves of the proportional valve and the motor.

Finally, 15 denotes an analog/digital converter 15 by which signals from the motor, proportional valve and potentiometer are rendered intelligible for control purposes.

The foregoing description implies no limitation, inasmuch, for example, as the same effect might be obtained using a circuit with discrete rather than packaged components, i.e. without the integrated IP and EPROM.

Claims

1. A variable speed control device for a fork lift truck, comprising a hydraulic lift system, and a d.c. motor (3) by which the pump (5) of the lift system is driven,
characterized
in that it comprises a single electronic circuit (1) designed to pilot the operation both of the d.c. motor (3), in driving the hydraulic pump (5) to elevate the fork lift, and of a proportional valve (4) by

which the descent of the fork lift is controlled.

2. A device as in claim 1, wherein the electronic circuit (1) is designed to pilot the operation of the motor (3) and the proportional valve (4) by reference to a preset and adjustable operating characteristic stored in an erasable programmable read only memory (14).

3. A device as in claim 1, wherein both the elevating and descent movements of the fork lift are selected by way of a single manually operated control such as a knob linked to a potentiometer (8) or sensor wired into the electronic circuit (1).

4. A device as in claim 1, wherein the electronic circuit (1) comprises :
   - a microprocessor (9) affording a plurality of externally interfaced inputs (10) and outputs (12) ;
   - an 8-bit bus connecting the microprocessor with an erasable programmable read only memory (14) in which control software governing the elevating and descent movements of the lift system is stored ;
   - an analog/digital converter (15) in receipt of the signals from the motor (3), the proportional valve (4) and the potentiometer (8).

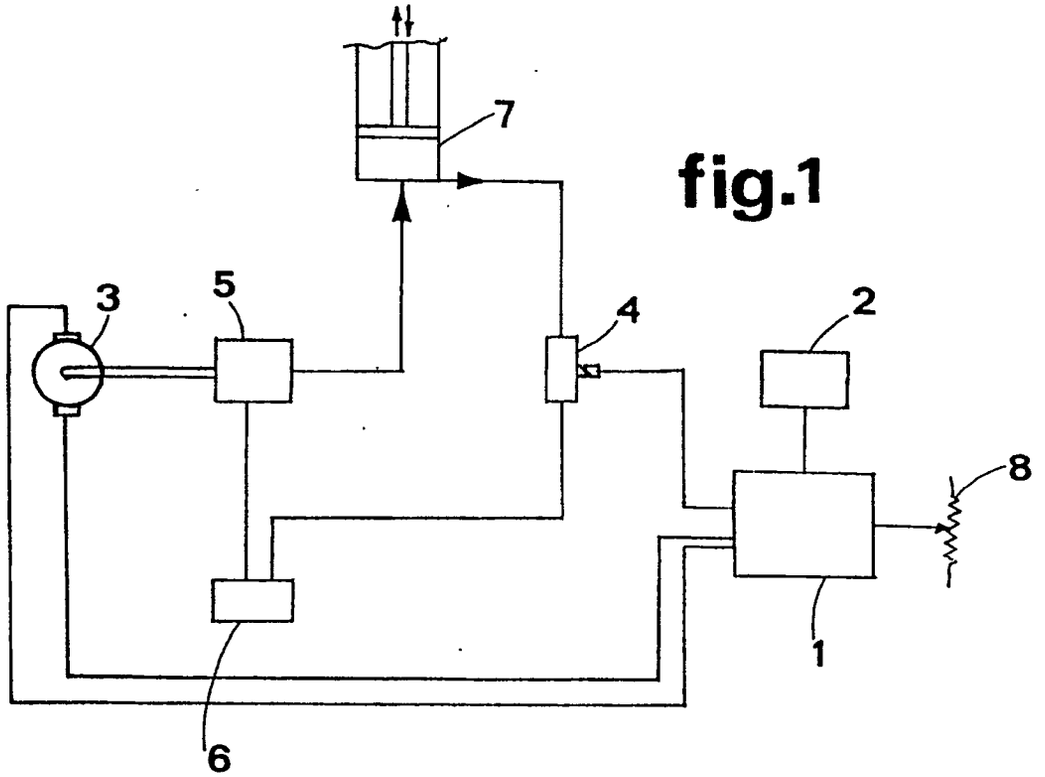

fig.1

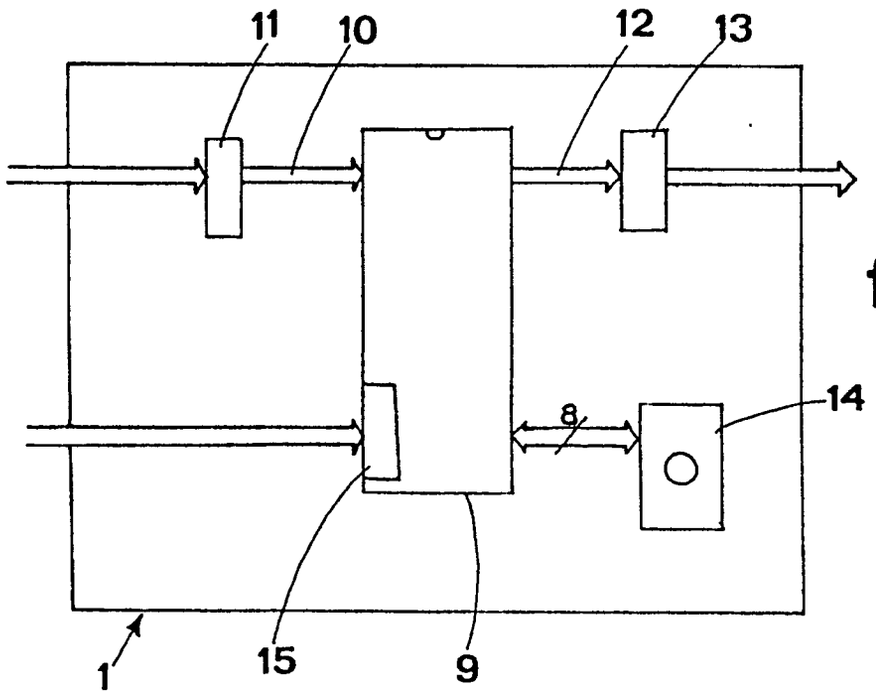

fig.2