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(54) **Actuation of the S-valve of a concrete pump prior to completion of piston stroke**

Betätigung des S-Ventils einer Betonpumpe vor Beendigung des Kolbenhubs

Actionnement de la soupape à S d'une pompe à béton avant la fin de sa course de piston

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Description

[0001] The present invention concerns improvements in concrete pumps, to automatically adapt their operation on changing of the working conditions, in view of the best performances thereof.

[0002] As known for example from US-A-5 458 470 concrete pumps comprise a pumping unit, fed from a hopper, and a transport and delivery duct to distribute the concrete on the working site. Generally, the pumping unit consists of a pair of concrete pumping cylinders alternatively operated by a pair of hydraulic cylinders and of a special rocking valve (S-valve) which connects the concrete transport and delivery duct to one of the two pumping cylinders, while the other cylinder draws concrete from the hopper. The rocking S-valve is alternatively moved by a second pair of hydraulic cylinders. By combining the movement of the S-valve with the movement of the pumping cylinders, the concrete flow is generated through the transport and delivery duct. Said concrete flow is apt to move through the duct in the two directions; the concrete is actually pumped when the flow is directed from the pumping unit towards the outlet end of the duct, so as to be delivered, while it is drawn when the flow is directed in the opposite sense. The two types of operations are obtained by suitably combining the movement of the pumping cylinders with the position of the S-valve.

[0003] In general, the movement of the S-valve is started with a certain advance in respect of the moment - detected by suitable sensors or stops - in which the piston of the pumping cylinder, feeding the concrete into the transport and delivery duct through the S-valve, reaches the top dead center.

[0004] At present, the advance time is not adjustable, but is set once and for all on construction of the pumping plant, and remains thus set while the plant is working. During the pumping operation, the reversal of the backflow hydraulic pump is controlled by stops positioned with a certain preset advance in respect of the top dead center of the pumping piston, said advance being thus optimal merely in correspondence of a certain number of pumping cycles per minute, which in turn depends on the operating conditions. For a lower number of pumping cycles the motion reversal of the piston, and the switching of the valve from one piston to the other, will take place too much in advance in respect of the moment in which the piston reaches the top dead center, and there will hence be a loss of working stroke. A higher number of cycles will instead determine an undesired rise in the hydraulic pressure and a corresponding impact of the pumping piston, which will be reaching the top dead center in advance in respect of the reversal of the backflow hydraulic pump. In either cases, the performance of the concrete pump is scarcely satisfactory and, at present, no means exist to overcome this drawback.

[0005] The present invention now proposes to positively improve this situation, by allowing to automatically set the advance of the starting movements of the S-valve according to the number of pumping cycles. This is obtained by locating the stops of the pumping cylinders in a position such as to set the optimal advance time for the highest number of pumping cycles per minute foreseen in the plant, and then automatically reduce said advance time according to the actual number of pumping cycles, detected by electronic means.

[0006] More precisely, the present invention concerns a concrete pump with the features of claim 1.

[0007] In this pump; said electronic means preferably comprise a microprocessor unit, into which are set the pumping cycles and which receives the signals issued by said stops, detects and reckons the number of pumping cycles per minute, and controls the movement of the S-valve and the reversal of the backflow hydraulic pump.

[0008] The invention is now described in further detail, with reference to the accompanying drawings, which illustrate a preferred embodiment thereof and in which:

Fig. 1 is a general diagram of a concrete pump comprising the means according to the invention; and

Fig. 2 diagrammatically illustrates how the means according to the invention are applied onto a pump as shown in fig. 1.

[0009] As shown on the drawings, a concrete pumping plant essentially comprises a pumping unit 1 fed from a hopper 2, and a transport and delivery duct (not shown) to distribute the concrete on the working site. The pumping unit 1 consists of a pair of concrete pumping cylinders 3 alternately operated by a pair of hydraulic cylinders 4 controlled in the two directions by a backflow hydraulic pump 5 operated by a prime mover 6, and of a rocking S-valve 7 which connects the concrete transport and delivery duct to one of the two pumping cylinders 3, while the other cylinder draws concrete from the hopper 2. The S-valve 7 is alternately moved by a second pair of hydraulic cylinders 8, fed by a hydraulic circuit with accumulator 9 and controlled by a set of solenoid valves 10. By combining the movement of the S-valve 7 with the movement of the pumping cylinders 3, a concrete flow is generated (the concrete being either pumped, or drawn) and moves, in a practically continuous manner, through the concrete transport and delivery duct.

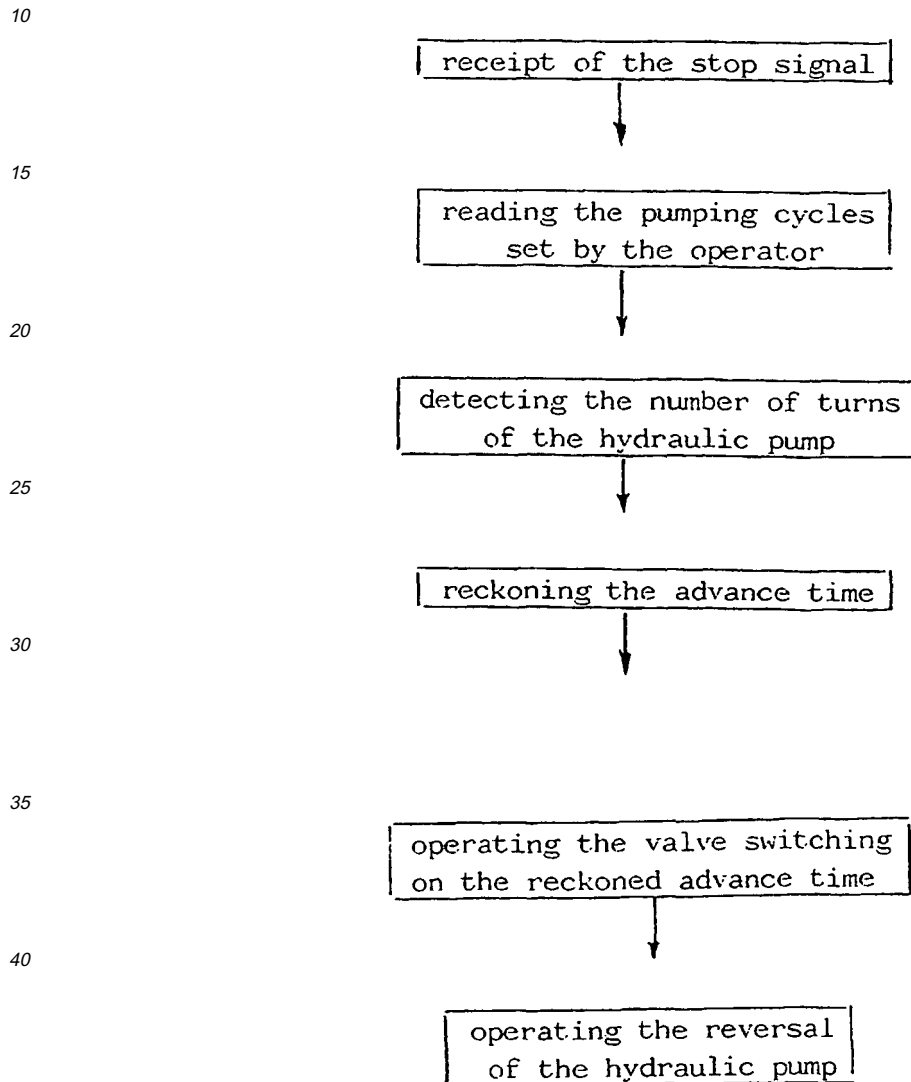
[0010] As already mentioned, the movement of the S-valve should be started with a certain advance in respect of the moment - detected by suitable stops 11 - in which the piston of the pumping cylinder 3, feeding the concrete into the transport and delivery duct through the S-valve 7, reaches the top dead center.

[0011] According to the invention, the advance time is set by locating the stops 11 in the position apt to guarantee the most efficient working with the highest number of pumping cycles per minute of the plant, and then delaying - by reducing said advance time - the starting movement of the S-valve and the reversal of the backflow hydraulic pump 5 according

to the actual number of pumping cycles per minute.

[0012] Preferably, said reduction of the advance time is controlled by electronic means which comprise a microprocessor unit 12, into which are set the pumping cycles by a panel 13 and which receives the signals issued by said stops 11, detects and reckons the number of pumping cycles per minute through a sensor 14, and controls both the movements of the S-valve 7 and the reversal of the backflow hydraulic pump 5, automatically adapting them to the number of pumping cycles per minute, on changing of the operating conditions.

[0013] According to the present invention, the concrete pumping plant is controlled as per the following flow diagram:



which perfectly synthesizes the sequence of the operating steps.

[0014] There is no need to underline that the present invention achieves the important result - never obtained up-to-date - to put the concrete pumping plants in conditions to always operate with an optimal advance of the starting movements of the S-valve and of the motion reversal of the pistons in the cylinders, in respect of the moment in which said pistons reach the top dead center, to the full advantage of a far more continuous and smoother working of the pumps (which lengthens the life thereof and reduces their stresses) and of an increasingly reduced energy consumption determined by the full use made of the working strokes of the pumping pistons.

Claims

1. Concrete pump (1) of the type comprising a pair of pumping cylinders (3) alternat operating with respective pistons

under the control of a backflow hydraulic pump (5) to draw concrete from a hopper (2) and feed it, by way of a rocking S-valve (7) into the transport and delivery duct - wherein said cylinders are provided at or near their top dead center, with stops (11) controlling the starting movements of the S-valve (7) with a predetermined advance time in respect of the moment in which said pistons reach their top dead centers and reverse their movement, **characterized in that** said stops (11) are located in the position for the most efficient working conditions of the pump at the highest number of puniping cycles per minute, and **in that** electronic means (12, 13, 14) are provided to set said advance time, by delaying the starting movement of the S-valve and the reversal of the backflow hydraulic pump (5) according to the actual number of pumping cycles per minute.

2. Concrete pump as in claim 1), wherein said electronic means (12, 13, 14) comprise a microprocessor unit, into which are set the pumping cycles and which receives the signals issued by said stops (11), detects and reckons the number of pumping cycles per minute, and controls the movement of the S-valve (7) and the reversal of the backflow hydraulic pump (5).

Revendications

1. Pompe à béton (1) au type comprenant une paire de cylindres de pompage (3) fonctionnant alternativement avec des pistons respectifs sous la commande d'une pompe hydraulique refoulante (5) permettant de pomper du béton contenu dans une chargeuse (2) et de l'apporter, par le biais d'une soupape à S (7) oscillante, dans la conduite de transport et de déversement, dans laquelle lesdits cylindres sont munis, au niveau de leur point mort haut ou à proximité de celui-ci, de butées (11) contrôlant les mouvements de départ de la soupape à S (7) avec une avance prédéterminée par rapport au moment auquel lesdits pistons atteignent leur point mort haut et inversent leur mouvement, **caractérisée en ce que** lesdites butées (11) sont situées en un emplacement permettant les conditions de fonctionnement les plus efficaces de la pompe au nombre de cycles de pompage par minute le plus élevé, et **en ce que** des moyens électroniques (12, 13, 14) sont prévus pour instaurer ledit temps d'avance, en retardant le mouvement de démarrage de la soupape à S et l'inversion de la pompe hydraulique refoulante (5) suivant le nombre réel de cycles de pompage par minute.
2. Pompe à béton selon la revendication 1, dans laquelle lesdits moyens électroniques (12, 13, 14) comprennent une unité à microprocesseur dans laquelle sont instaurés les cycles de pompage et qui reçoit les signaux émis par lesdites butées (11), détecte et estime le nombre de cycles de pompage par minute, et contrôle le mouvement de la soupape à S (7) et l'inversion de la pompe hydraulique refoulante (5).

Patentansprüche

1. Betonpumpe (1) der Bauart, die ein Paar von Pumpzylindern (3) umfaßt, die abwechselnd mit jeweiligen Kolben unter der Steuerung einer hydraulischen Rückströmungspumpe (5) arbeiten, um Beton aus einer Zuführungseinrichtung (2) abzuziehen und ihn mittels eines kippbaren S-Ventils (7) in die Transport- und Abgabelleitung zuzuführen, wobei die genannten Zylinder mit Anschlägen (11) versehen sind, an ihren oder in der Nähe ihrer oberen Totpunkte, die die Anlaufbewegungen des S-Ventils (7) mit einer vorbestimmten Vorlaufzeit in. Bezug auf die Bewegung, mit der die genannten Kolben ihre oberen Totpunkte erreichen und ihre Bewegung umkehren, steuern, **dadurch gekennzeichnet, daß** die genannten Anschläge (11) in der Position für die wirksamsten Arbeitsbedingungen der Pumpe bei der höchsten Anzahl von Pumpzyklen je Minute angeordnet sind, und daß elektronische Mittel (12, 13, 14) vorgesehen sind, um die genannte Vorlaufzeit **dadurch** einzustellen, daß die Anlaufbewegung des S-Ventils und die Umkehrung der hydraulischen Rückströmungspumpe (5) entsprechend der tatsächlichen Anzahl von Pumpzyklen je Minute verzögert wird.
2. Betonpumpe nach Anspruch 1, **dadurch gekennzeichnet, daß** die genannten elektronischen Mittel (12, 13, 14) eine Mikroprozessoreinheit umfassen, in der die Pumpzyklen eingerichtet sind, und die die Signale erhält, die von den genannten Anschlägen (11) abgegeben werden, die ADzahl von Pumpzyklen je Minute erfaßt und berechnet und die Bewegung des S-Ventils (7) und die Umkehrung der hydraulischen Rückströmungspumpe (5) steuert.

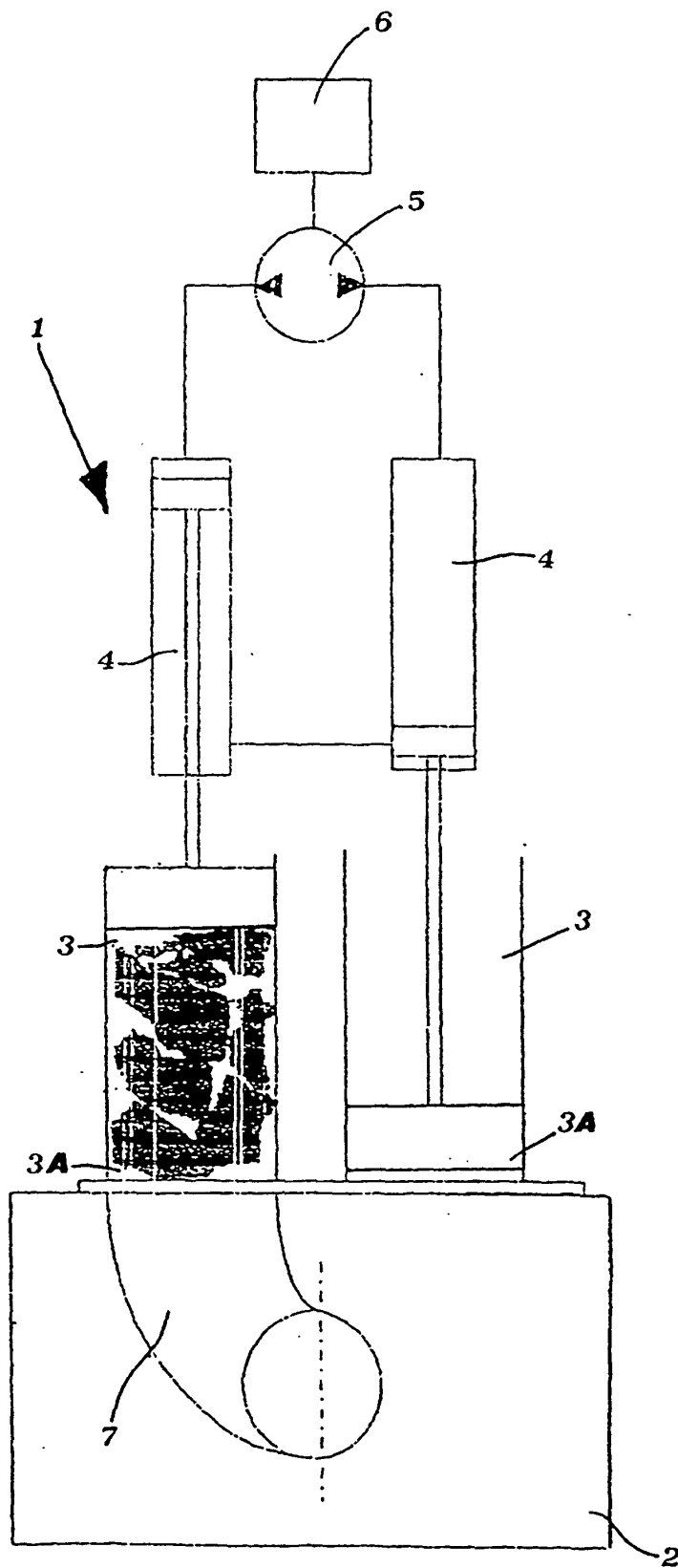


FIG.1

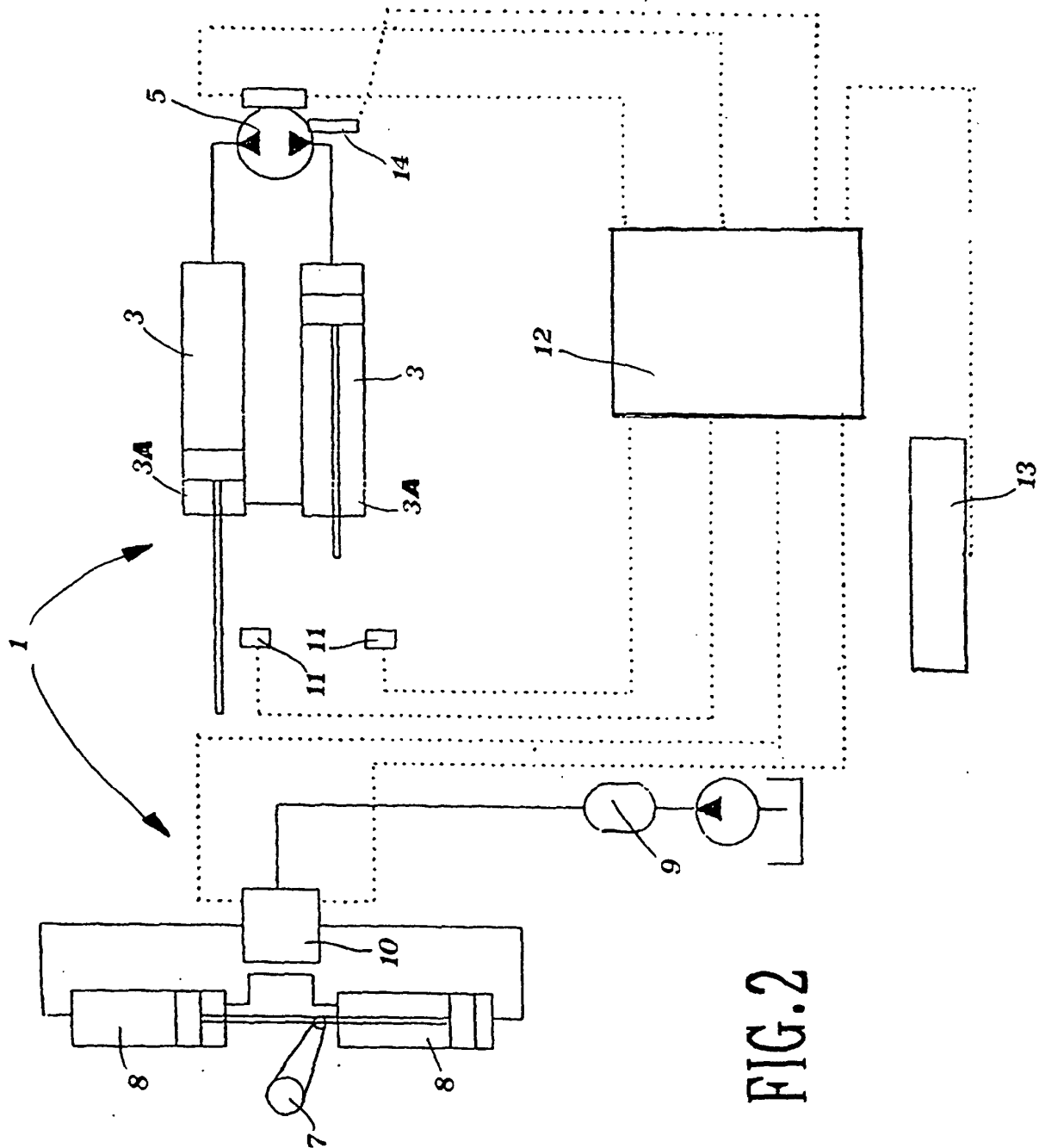


FIG. 2