Description of the synchronous cylinder

General description

For 9 years already, Rpoint has been supplying the linear stroke volume synchroniser **RSH** for high-precision, synchronous operation. During this period, it has become a well-known item of equipment. There is a separate catalogue available for this, which you may already have or, if not, you can request it. Two years ago, the multi-chambered volume synchroniser **RSA** was added to our supply list. The synchronism which can be achieved with the new **RSC** is just as good as the **RSH** and the **RSA** and, therefore, much better than is the case with all flow dividers - please refer to our publications **"Hydraulic oil flow dividers"** and **"New gear-flow dividers"**. It differs from the otherwise very similar RSH in terms of construction.

Design and description of function

It is already clear from the name **"multi-chambered volume synchroniser"** what this equipment is and what it does. Instead of having just a single cylinder piston forming **one** piston chamber and one piston rod chamber with the wall of the cylinder, the base of the cylinder, the front cylinder head and the piston rod, the double **RSC** is made up of **two** piston rod chambers for the output of oil, a piston rod chamber for oil input and a piston chamber for oil input. There is just one disadvantage for the multi-chambered volume synchroniser resulting from this: with large volumes and more than three oil outlets, it becomes very long! This length is often a handicap. Help is once more provided by the linear travel cylinders **RSH** or a **RSC**, with an extra large diameter and only very small travel. For the **RSC**, piston diameters have meanwhile become available of up to 320 mm (!), as a standard item, and, if requested, up to 600 mm. With such possibilities, the **RSC** will also counter a solution which is much too long. The advantage of the **RSC** is, on the other hand, that one can make better use of it when the length of the equipment is not important, but the external diameter is, in contrast, important. For example, even a **RSC** with a length of 10m, mounted in the chassis of a lorry, will provide a better solution than a **RSH** with a length of 2 m, which is however so large in diameter that there is simply no space available in the lorry chassis. The **RSH** requires, in addition to the dosing cylinders, a main cylinder which has, for example, double the diameter of the dosing cylinder in the case of the fourfold distributor. With regard to the cost of the main cylinder, broadly speaking, the **RSH** is more expensive than the **RSC**. The **RSC** is therefore first considered in fundamental considerations, above all, when using large dosing volumes, for which the large, additional main piston plays a greater role in the calculation. The function is almost identical with that of the **RSH**: the volume of oil in the **RSC** is forced into the working cylinders by the outward driven multi-chambered volume synchroniser. Consequently, it is also essential that the working cylinders **always press on the fixed oil column**. In this way, the entry of air by suction is prevented. What is, in general, very important are the filling and safety valve blocks which are also delivered by us with the equipment. Because of the significant pressure increase potential (which sometimes is also desired), depending on the relationship of chambers which are under pressure compared with more or less pressure-free chambers, this part of the block is just as important as the valve circuit for filling the space between the volume synchroniser and the working cylinder. In the case of the **RSH**, these blocks are to be elegantly, directly flanged-mounted. With the **RSC**, this is not possible, because of its constructional design. Block and distributor have to be joined externally by pipes.
It is not absolutely essential that you buy the safety function with **our** filling and safety valve blocks, but at least a pressure safeguard for our maximum pressure values, with the specified maximum through flow current, is indeed very important.

Synchronism

What is important for synchronism is, of course, that the oil which is contained in the chamber has no air bubbles in it! Under ideal operating conditions, i.e. with the same loads on the working cylinders, the synchronism which is achieved is almost ideal. Errors only occur as a result of differences in tolerance of the cylinder components. These differences are minimal, due to the narrow tolerances. A further small source of error is due to the fact that the seals for avoiding the stick-slip effect

are not one hundred percent free of leaking oil. All of these possible sources of error result in a synchronisation which cannot be put at 100%. The deviation from the ideal value is, however, hardly noticeable in practice.
An error which cannot, however, be disregarded is that produced as a consequence of oil compression, when there are quite different loads on the working cylinders. A difference in pressure of 10 bar between two working cylinders will result in a difference in travel of 0.07%, with a difference of pressure of 100 bar between two working cylinders will result in a difference in travel of 0.7%. It is sufficient, therefore, to keep the pressure difference as low as possible by taking appropriate measures; for example, using pre-tensioning of the non-loaded working cylinders, by means of selecting low load pressures etc. The error resulting from compression remains the same over the travel, as the fixed volume does not change during travel.

Application

The main areas of application of the **RSC** are similar to those of the **RSH**. All equipment with precise travel and very small oil flows (indeed with < 0.1 l/min per chamber), travel devices with the smallest possible oscillations and vibration, e.g. theatre stages, roller equipment in the printing industry, and also in the construction of heavy machines, tippers, etc. can be operated with the highest synchronisation values.

Dimensions

The dimensions are given in the following tables. The maximally possible volumes are determined by the maximum piston diameter of 320 mm with a piston rod diameter of 110 mm for the series equipment and the maximum travels per chamber permitted for the application. Naturally, the maximum volumes will be reduced as a function of the number of chambers. The parameters specified in the information sheets are the **dimensions which are currently available**. In time, depending on requirements, the **RSC** will be further developed in the direction of larger volumes and more chambers. In this way, the maximum possible volumes – in a special constructional form, with correspondingly longer delivery periods – with V = 550 litres per chamber are planned and possibly to be achieved with a piston diameter of the **RSC** of approx. 650 mm.
In addition, if sufficient numbers were requested, very small equipment, in particular for two-fold distribution could be developed. If you are interested in this development, please contact us.

Number of chambers

The equipment is basically designed for 2,3 and 4 chambers. Especially in the case of small dosing volumes, it is possible to construct with up to 12 chambers without problems and, should the need arise, special equipment with still more chambers would be possible. Please contact us if you require further information.

Pressure drop with RSC

A loss of pressure will only arise when the seals on both sides are acted upon. This is lower in comparison with radial flow distributors, but certainly higher than with the **RSH**. At the moment, too few measurement results are available to be able to make definitive statements. You should assume, at present, approx. 7 bar.

Speed of RSC movement

As a result of using cylinder seals with low friction, the **RSA** can be driven exceptionally slowly. Already with oil flows of < 0.1 l/min, stick-free movement is possible. The maximum oil flows are specified in subsequent data tables.

Filling and safety block

As the **RSC** can, without being noticed, become “de-tuned” after a large number of traverses, a large number of operating cycles can be made before an error compensation can be effected (reset) but, on the one hand, the system has to be filled in any case at the beginning and, on the other, effects such as oil leakage of the working cylinder may result, from time to time, in this reset being run. This takes place with the filling and safety block, which primarily has the function of limiting the pressure increase function of the **RSC**. Since one of the oil inflow chambers does not have a

piston ring surface, but instead a full piston surface, the pressures in the inflow chambers are in equilibrium with those of the outflow chambers, which means that with a **fourfold distributor**, one has to assume that with **three pressure-free dosing chambers**, the **pressure in the remaining chambers will increase to the fourfold value**! In practice, it may happen that for a particular distance covered, the working cylinder runs empty (pressure-free) and then one single cylinder will be stopped by the occurrence of a load. Here is a typical example: empty running of a press with four cylinders and the sudden appearance of resistance for only one cylinder! The pressure valves installed in the filling and safety block have to prevent such a build up of pressure and the designer of the machine must ensure that the sudden build up of pressure is not so dynamic that the safety valves react too slowly and that the peak pressure, which is set for only milliseconds, increases beyond the permitted value. If the series safeguard in the block is not sufficient for the required dynamics of the machine in which the **RSC** is mounted, then safeguarding must be effected outside, with suitable fast and large pressure valves.
Because of the importance of the dynamic build up of pressure, we also have two sizes of filling and safety blocks in our programme (information is given below).
Important points described: **Setting the pressure valves, filling and evacuation of air, "reset" volume adjustment, pressure ratios at the cylinder end positions** correspond to those given in the catalogue **RSH** and can and should be read there.

Noise during operation

As is usually the case with cylinder movements, there is hardly any noise made during operation. Due to the lack of vibration and oscillation, the **RSC** can be used especially where the absence of such accompanying noises is absolutely essential; for example, in hospitals, theatre stages, etc.

Servicing and maintenance

Simple installation ensures a large measure of operating safety, combined with little maintenance work being required, which is basically limited to a periodic control of any losses due to leakage. It is essential that care is taken to ensure the purity of the oil, with regard to our pressure and check-valves. Precisely when operated for the first time, there are often cuttings in the equipment. If synchronisation is also not then achieved following successful filling, it is recommended that you check these valve for particles. The valves can be very easily removed from the block. If needed, a drawing of the block can be requested from us. If one does not care to entrust the maintenance personnel to exchange individual valves, then we would recommend also a separate filling and safety block as a reserve part. These blocks are constructed as elements in a sandwich design, so that an individual section for a chamber represents, as a replacement part, a good safeguard against problems during operation. With reference to this point, please read to the final section of this catalogue! No special equipment is needed for mounting the equipment. Especially in the case of heavy and large equipment, from time to time, it is an advantage that customers - even those in the farthest corner of the world - can make do with repairs.

Acknowledgement of the final position

This is produced by the driving out of the piston rod, as an accessory which is free of charge.

Slight pressure transmission

Since the RSC does not have a continuous piston rod on one side, there is a slight pressure increase, depending on the size of the equipment and the number of chambers, which, on the one hand, compensates for the loss of pressure and, on the other, often produces an undesired residual increase in pressure. The percentage increase is given in the following tables. Naturally, the pressure transmissions are dependent on the number of chambers and are the greatest when there are two chambers. For an additional charge, the RSC can be also be supplied with suitable piston rods on both sides. Under these conditions, this pressure transmission does not occur.

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Oil leakage connection

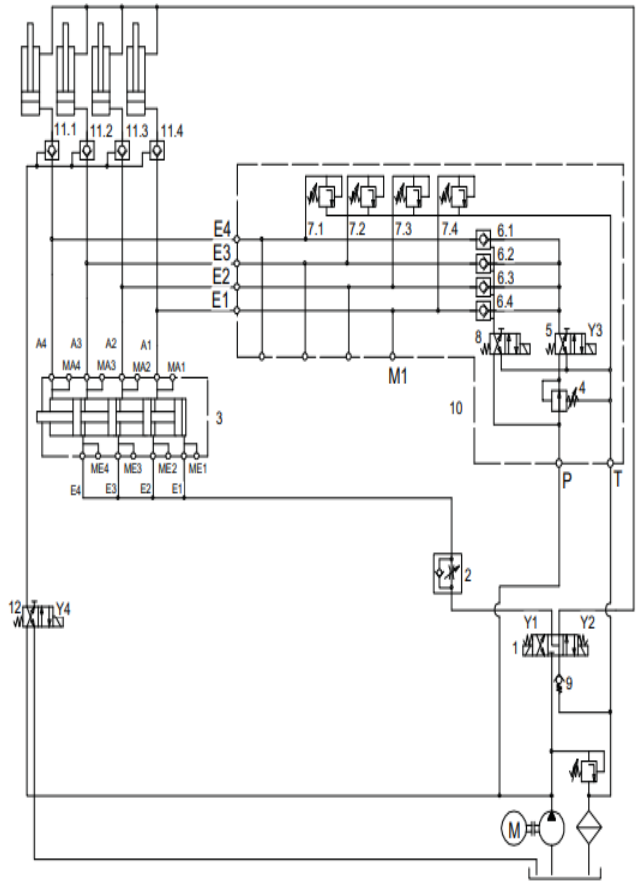
The constructional design of the RSC, in contrast to the RSH, does not require an oil leakage connection. The oil leaking from the first chamber flows into the second chamber etc.

Normal thread connections / special connections e.g. SAE

The thread connections are relatively small in comparison with the size of the equipment. The reason for this is that, with most applications, the oil flows are not so great that larger connections would be needed.
If requested, larger thread connections can be provided which does, however, have an effect on the thickness of the connecting flange. The same applies for SAE connections, whereby the connecting flanges are even thicker.

Standard strokes for the RSC, in order to achieve shorter delivery times and better sales prices

As can easily be appreciated, it is technically not difficult to realise every conceivable travel in the **RSC** up to some forced or natural limit. For reasons related to price and delivery, it would not be sensible, at all, to produce a large number of different travels, especially since one can, to a great extent, use quantity parts for a particular volume of the working cylinder without any disadvantage. The volume synchroniser does not then drive to the final position, because the working cylinders are already at the stop. This consequently has just the positive effect that all working cylinders come to the final position, even if a small leak were to arise somewhere in the connection (safety reserve).
In the following tables, for each size there are **first of all**, in each case, two or three **standard strokes** with data and then a small selection of other possible volumes.



General schematic diagram