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The New WAFIOS FSE 143 - An Economical Alternative for the Production of Compression Springs and Particularly Suspension Springs

The market requirements of the automotive industry and especially of suppliers of the automotive industry have changed continuously throughout the past 5 – 10 years. Many OEMs started to extend their product range into high-volume production segments. As development costs increase and “critical size” discussions are frequent, high-volume production segments gain importance. Therefore, spring coilers for the production of suspension springs with wire diameters between approximately 8 and 14 mm, which are typical in low- and medium-volume production segments, have to meet certain requirements. An apparent contradiction to high-volume production seems to be the increasing variety of products which requires highly flexible manufacturing machines with short tooling times that guarantee just-in-time deliveries while maintaining high output volumes. The high quality requested by the automotive industry inevitably requires zero-error productions. There is an enormous cost pressure which requires cost-effective solutions that enable a quick amortization of investments. The ambition to be a premium manufacturer requires the observance of safety standards while guaranteeing optimum operating convenience.



Fig. 1 WAFIOS FSE 143

Due to this variety of most diverse requirements, the WAFIOS FSE 143 has been designed with an optimum cost-per-unit ratio for high-volume production of suspension springs. Nevertheless, the production of other technical springs has

been included as an option. The FSE 143 succeeds the legendary WAFIOS FUL 10 of which more than 100 machines were manufactured throughout the past years. The following requirements had to be met ...

- ... **High precision and quality**
- ... **Optimum cost-per-unit ratio**
- ... **Operating convenience**
- ... **Ease of maintenance**

High precision and quality

As the body of the infeed and the coiling unit are connected by a cross bar, the FSE 143 is an extremely rigid machine construction which enables high-quality production over many years. The FSE 143 has been designed for the production of right-hand coiled springs. Therefore, it is equipped with a mass-reduced drive technology which has a positive effect on the machine's precision. Machines for the production of right-/left-hand coiled springs have so far been driven by cam followers and thus were subject to more clearance, e.g. by air in bearing points. The highly precise power transmission at the parallel pitch device is provided by the rigid tool head with directly acting, clearance-free ball screw drive. Smallest tolerances of the spring diameter can be guaranteed by the firmly mounted coiling plate with direct force transmission from the shape cam to the coiling pin without the use of elastic intermediate links (cam followers), also see fig. 1a Coiling area.

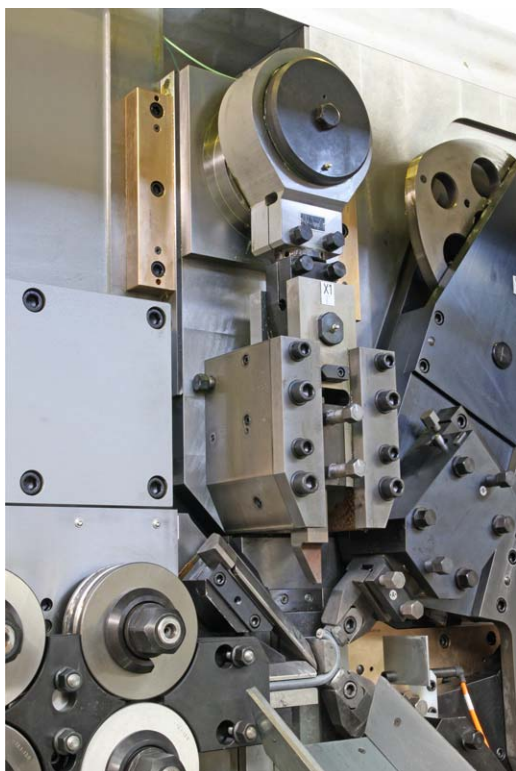


Fig. 1a Coiling area and cut

The distribution of the required contact forces to 4 (optionally 5) feed roller pairs guarantees non-slip wire feed while a relatively low contact pressure is required. Therefore, infeed bearings have a long service life and the wire is plastically deformed only slightly which improves the spring quality, see fig. 2 Comparison of three and five feed roller pairs.

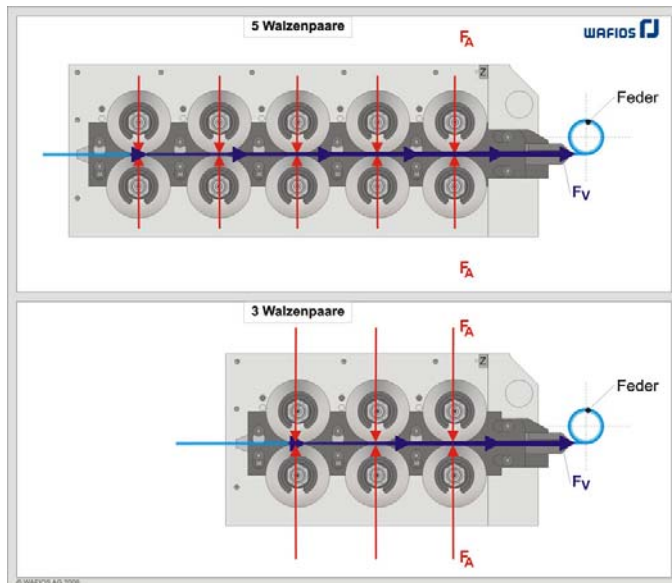


Fig. 2 Feed roller pairs, comparison of contact pressure

The FSE 143 can optionally be equipped with a camera measuring system (zero error control), a sorting chute and our reliable WAFIOS PTP coiling finger which enables an individual adjustment of the initial tension in springs.

Consistent optimization of cost-per-unit ratio

The WAFIOS FSE 143 is a dynamic and powerful machine, fitted with a modern drive concept, axes for infeed, shape, parallel and vertical pitch, mandrel up/down (optionally back/forth) and cut. The machine’s production speed is with an infeed speed of 70 m/min very high. Thanks to high-quality components and parts it can be employed in 3-shift operations.

Highly dynamic servomotors accelerate axes rapidly and guarantee high and reliable production outputs. Compared to machines for the production of right-/left-hand coiled springs that inevitably have slower systems due to the increased movement of masses, the FSE 143 has a faster response time. Therefore, a significantly higher output is possible (depending on the products to be produced), also see fig. 3 Performance chart

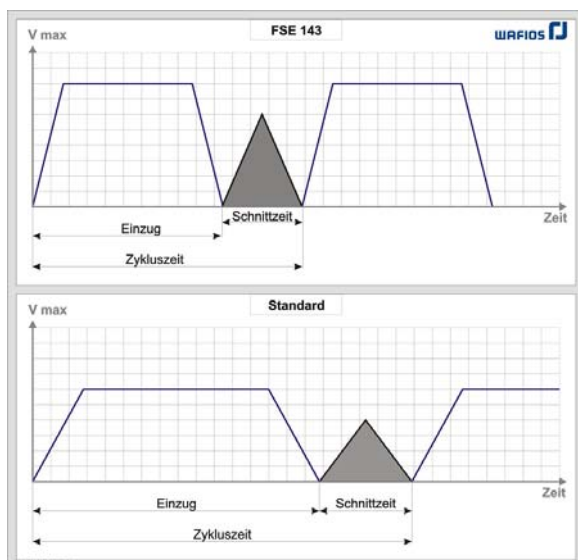


Fig. 3 Performance chart

A number of sophisticated and helpful features increases operating convenience and reduces tooling times considerably. Another advantage is that the spring geometry is not altered when changing from set-up operation (reduced speed) to producing operation (high speed) as well as that tools are easy to access. Repeatable set-up data of the electronically programmable pneumatic roller clamping device reduce tooling times and ensure consistent spring quality. The stable cutting-off system is free from hydraulic components and features short cutting times and at the same time high production outputs.

High operating convenience

The reliable WAFIOS programming system WPS 3 offers an extensive control software with graphical programming and thus ensures rapid and easy programming of springs. Suspension springs, for example, have to be programmed with a smaller initial and a smaller final diameter. The central programming of spring eyes used to be a time-consuming problem. Today, spring eyes are pre-programmed in the software and can be easily created by means of simplified programming aides. The user-guided graphical programming process in the WAFIOS WPS 3 helps the operator to generate the production process.

As spring geometries remain unchanged when switching from set-up operation at reduced speed to producing operation, set-up tooling times are also reduced. This becomes even more important, the more frequently new products have to be set up. Another example is the graphical correction possibility. Individual segments of the spring body can be corrected separately on screen by simply clicking on the graphical display. Thus adjustment times are reduced and the availability of the machine is considerably increased, see fig. 4.



Fig. 4 Spring correction

Easy to maintain machine construction

As there are almost no hydraulic components installed and tools are easily accessible, the machine is easy to maintain. Downtimes are reduced and the machine's productivity is increased. The most extensive control software currently available on the market with graphical programming system contributes to the high availability of the machine.

The FSE 143 does not require a hydraulic system. The number of wearing parts is significantly reduced. Additional hydraulic functions, like mandrel clamping, mandrel

box clamping and roller clamping at the auxiliary feed are supplied by a low-maintenance compact hydraulic unit.

A stable, one-piece mandrel slide provides a consistent power flow between cutter tool and cutter mandrel during the cutting-off process. This ensures not only high cutting quality but also long tool lives, also see fig. 5 Consistent power flow.

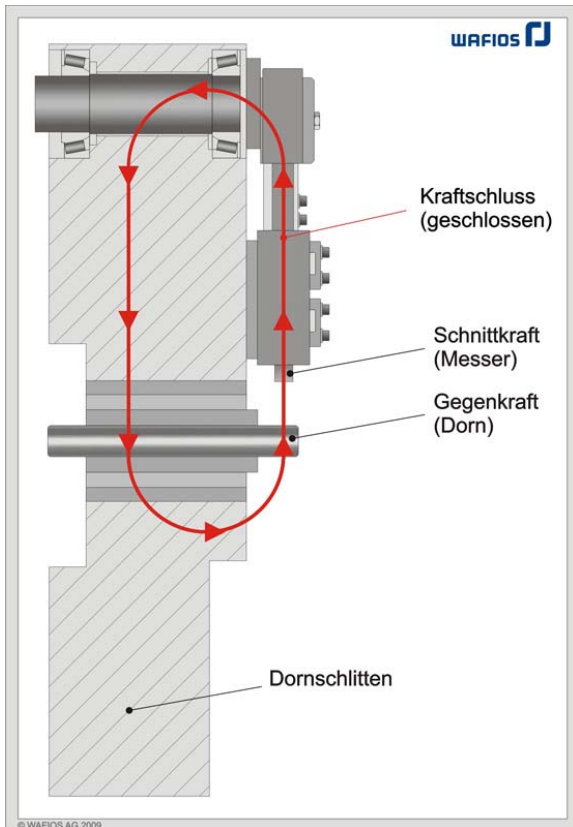


Fig. 5 Power flow

The distribution of the necessary contact forces to more than the usual feed roller pairs results in a longer service life of infeed bearing elements, also see fig. 6.



Fig. 6 Roller feed pairs

The entire machine concept is characterized by an optimum design of individual components and elements. Compared to predecessor machines, considerable increases in output were achieved in trial runs. However, the machine design also offers numerous upgrading possibilities. The machine can additionally be fitted with an optical measuring system, a torsion cut for the production of tightly coiled springs made of CrSi spring steel wire, a color detection system for process control or a scanning device (mass contact / laser) for scanning the position of tension spring ends or torsion spring legs.

Besides all performance features, extensive safety devices, like shut-down devices, e.g. when the end of the wire is reached, or a chip guard, a safety shutdown by means of a baffle plate, a wire breakage protection with mass shutdown between coiling pins or the separate erection of the switch cabinet remain essential for WAFIOS.