The invention relates to a wire guiding device for electroerosion working machines according to the preamble of Claim 1. Wire erosion machines with wire guiding devices of this kind permit the manufacturing of general cylindrical and conical workpiece forms in a variety of variants and combinations.

A wire guiding device of this type mentioned is known from the journal "precision", 10/81 pp. 49-57, in particular p. 51. The suggestion is made here to provide the wire guides lying opposite each other with independent, Cardan motion drives as well as a synchronization coupling. Such synchronization of the wire guide angle setting incurs considerable expense.

The object of the invention is therefore to create a wire guiding device for electroerosion working machines which is characterized by a simple construction that is comparatively inexpensive yet reliable. This object is achieved according to the invention by the features of the characterizing part of Claim 1.

The guide element thus provided according to the invention which connects the wire guide support members to each other automatically sets itself for each relative movement of these support members to each other, either in the longitudinal, transverse or vertical direction, in accordance with the variable angle position of the connecting line between the wire guides and hence represents at all times the nominal angle position for the axes of the two wire guides. This guide element can be designed expediently to be simple, for example as a cylindrical guide pin, and to be provided with a high degree of deformation rigidity so that a good setting accuracy is guaranteed in conjunction with the easily obtainable freedom from play of the corresponding swivel bearings of the guide element on the support members. This

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setting accuracy also applies to the wire guides themselves, since the angle position of the guide element is transmitted directly to the wire guides mounted pivotably by means of swivel linkages.

Similarly, simple constructions of a common kind which may easily be made deformation-resistant, may also be considered for these swivel linkages, so that overall a robust and reliable construction of the wire guiding device is obtained.

In an advantageous embodiment of the invention, the guide element is arranged outside the workpiece machining area offset with regard to the wire guides, the offset distance being bridged by the swivel linkage. In this manner the wire guide angle can be set correctly, even where the support members have a large working range, without adversely influencing the free workpiece machining area by means of the guide element and the linkage.

The guide element is designed to be telescopic or is connected displaceably in its longitudinal direction at least to one of the wire guide support members to take account, in a simple manner, of the change in the mutual distance of the wire guides for each relative movement. This permits relatively large adjusting movements of the wire guides to each other in a simple manner.

The swivel bearing of the guide element on the support members is expediently designed to be identical to the swivel bearing of the wire guides themselves, for example in the form of universal joints. In principle, however, a universal swivel bearing employing ball-and-socket joints, having the advantage of greater simplicity, may also be considered.

The invention will be explained in more detail with reference to the exemplary embodiment illustrated in the

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drawings, in which:

Fig. 1 shows a basic geometrical diagram of the coupling device according to the invention for omnidirectional relative movement of the wire guides to each other and

Fig. 2 shows a longitudinal and vertical section of a corresponding wire guiding device in a section plane through the axes of the wire guides and the guide element.

Within the longitudinally extending support members TO1 and TO2, shown interrupted in Fig. 2, wire guides DF1 and DF2 are mounted in such a manner that they may be pivoted in all directions by means of Cardan swivel bearing SLD. Central guide channels FK of the wire guides are provided with guide rings, not shown, of hard material and lead the wire electrode DE through the workpiece machining area WR. The supporting members TO1, TO2 and hence also the wire guides DF1, DF2 can be displaced and driven in a manner already known, and hence not illustrated in more detail, relative to each other, or independently of each other or also together with each other in the sense of a feed movement relative to the workpiece in accordance with the coordinates axis X-X,Y-Y or U-U, V-V or also in the direction of the vertical axis Z-Z, indicated in Fig. 1. The corresponding actuators and driving means are not part of the subject of the invention and are known from the prior art, so more detailed explanations are dispensed with.

The guiding of the supporting members by the machine ensures that during this relative movement the support members remain at a fixed angle to each other in a parallel position, in a manner known per se. Apart from that, the centre points of the wire guide swivel bearings SLD may take up any positions in space relative to each other,

the ideal wire guide axis D-D taking up corresponding angle positions. In Fig. 2, for example, only a relative displacement of the bearing members in a horizontal direction and parallel to the drawing plane is indicated. Corresponding relationships apply analogously for a relative displacement in the direction of the vertical axis as well as in the direction transverse to the drawing plane.

A bar-shaped guide element FG is provided which connects the two support members in a manner clear from Fig. 2 for the desired coaxial mandatory position of the wire guides DF1, DF2 in accordance with a common wire guide axis D-D, which guide element is arranged horizontally offset in the arrow direction VR against the wire guides or the wire electrode DE and is therefore arranged outside the workpiece machining area WR. The guide element FG is mounted in such a manner that it may be swivelled in all directions in both support members with swivel bearings SLF, the construction of which corresponds to that of the wire guide swivel bearings SLD. In addition the guide element is mounted displaceably in its longitudinal direction in a manner clear from Fig. 2 with respect to the swivel bearing SLF of the lower support member TO2, i.e. in the direction of the guide element axis F-F. This takes account of any relative movements of the support members to each other while retaining their parallel position.

As can be seen from Fig. 1, the coupling sections KA of the support members TO1 and TO2 have the same length between the respective associated swivel bearings SLD and SLF of the wire guides and the guide element respectively. The same applies to the effective length of the guide element between the swivel bearings SLF on the support member TO1 or TO2 with respect to the distance of the wire guide swivel bearings SLD. Geometrically this results in a jointed parallelogram which always keeps the

guide element axis F-F parallel to the ideal wire guide axis D-D. The guide element thus represents in each case at any relative positions of the wire guides the nominal angle position of the wire guide axis D-D.

The transmission of this nominal angle position to the wire guides is effected by means of swivel linkages SK1 and SK2 respectively, which are assigned to the two support members. With respect to a swivel movement of the guide element about the longitudinal axis L-L extending in the displacement direction VR, this swivel linkage is effected by means of the rotatable coupling elements DK1, DK2 illustrated in Fig. 2, which are designed to be torsion-resistant and forked at their ends as well as being connected here by guide bearing FLD or FLF to the wire guides or the guide element respectively. These guide bearings are designed as single-axis swivel bearings with swivel axes Xd and Xf at right angles to the parallelogram plane in accordance with axes D-D and F-F respectively. The swivel movement of the guide element is consequently transmitted along the axis L-L exactly on the wire guides.

For a swivel coupling about the transverse axis Q-Q at right angles to the axis L-L, the swivel linkages SK1 and SK2 each form a parallelogram drive link mechanism LK (see Fig. 1). These drive link mechanisms are formed geometrically by the following elements:

a) A coupling section KA of the support member between the swivel bearings SLD, SLF of the wire guide DF1 on the one hand and of the guide element FG on the other hand;
b) A lever element HGD1 or HGD2 connected non-pivotably to the wire guide DF1 and extending parallel to the wire guide axis D-D from the swivel bearing SLD of the wire guide DF1 to a guide bearing FLD arranged on the wire guide axis D-D;

c) A lever element HGF connected non-pivotably to the guide element FG and extending parallel to the longitudinal axis F-F of the guide element FG from the swivel bearing SLF of this guide element to a guide bearing FLF arranged on the longitudinal axis F-F of the guide element, the length of which lever element corresponds to that of the wire guide lever element HGD1 or HGD2;

d) A coupling drive link DK1 DK2 connecting the guide bearings FLD, FLF of the wire guide lever element HGD1 or HGD2 and the guide element level element HGF1 or HGF2 to each other, the length of which coupling drive link corresponds to the opposite coupling section KA of the support member TO1.

Consequently a two-axis and hence complete swivel coupling is effected between the guide element and wire guide, the rotatable coupling element DK1 or DK2 performing a dual function, on the one hand as a torsion element with respect to swivelling about L-L and on the other hand as a coupling drive link within the associated parallelogram drive link mechanism LK. The lever elements HGD1, HGD2 and HGF1, HGF2 are designed in the example according to Fig. 2 as rotatable sleeves with regard to the axes D-D and F-F respectively, which is necessary in the interests of omnidirectional swivelling in view of the torsional rigidity of the universal joints about the vertical axis. This additional rotatable bearing may be omitted when ball-and-socket joints are used.

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PATENT CLAIMS

1. Wire guiding device for electroerosion working machines having two wire guides (DF1, DF2) on corresponding support members (TO1, TO2) arrarged in such a manner that they may be moved relative to each other on parallel planes and that they may be swivelled in all directions, and having a coupling device which mutually aligns the wire guides (DF1, DF2) with their guide axes, characterized in that the coupling device exhibits a parallelogram drive link mechanism (HGF1, DK1, HGD1, FG, HGF2, DK2, HGD2), connected to the wire guides (DF1, DF2) and pivotable in accordance with the relative movement of the support members (TO1, TO2), with a guide element (FG) which is offset with respect to the wire guides (DF1, DF2), mounted pivotably on the support members (TO1, TO2) and connected to the wire guides (DF1, DF2) by means of the coupling drive links (DK) extending parallel to the aforementioned planes.

2. Wire guiding device according to Claim 1, characterized in that the guide element (FG) is arranged outside the workpiece machining area.

3. Wire guiding device according to one of Claims 1 and 2, characterized in that the parallelogram drive link mechanism (LK) for the swivel coupling between guide element (FG) and wire guide (DF1, DF2) can be swivelled about a transverse axis (Q-Q) at least approximately at right angles to the displacement direction (VR) of the guide element (FG) with respect to the wire guides (DF1, DF2).

4. Wire guiding device according to one of the Claims 1 to 3, characterized in that the parallelogram drive link mechanism (LK) comprises the following elements:

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a) A coupling section (KA) of the support member between the swivel bearings (SLD, SLF) of the wire guide (DF1) on the one hand and of the guide element (FG) on the other hand;

b) A lever element (HGD) connected non-pivotably to the wire guide (DF1) and extending parallel to the wire guide axis (D-D) from the swivel bearing (SLD) of the wire guide (DF1) to a guide bearing (FLD) arranged on the wire guide axis (D-D);

c) A lever element (HGF) connected non-pivotably to the guide element (FG) and extending parallel to the longitudinal axis (F-F) of the guide element (FG) from the swivel bearing (SLF) of this guide element to a guide bearing (FLF) arranged on the longitudinal axis (F-F) of the guide element, the length of which lever element corresponds to that of the wire guide lever element (HGD);

d) A coupling drive link (DK1, DK2) connecting the guide bearing (FLD, FLF) of the wire guide lever element (HGD) and the guide element lever element (HGF) to each other, the length of which coupling drive link corresponds to the opposite coupling section (KA) of the support member (T01).

5. Wire guiding device according to Claim 4, characterized in that the guide bearings (FLD, FLF) of the wire guide lever element and the guide element lever element (HGD1, HGD2, HGF1, HGF2) are designed as single-axis swivel bearings with the pivot axis (Xd-Xd and Xf-Xf respectively) arranged at right angles to the plane of the parallelogram drive link mechanism (LK), and are connected torsion-proof transversely to their pivot axes to the rotatable coupling element (DK) acting as a coupling drive link.

6. Wire guiding device according to one of the preceding claims, characterized in that the guide element (FG) is designed to be telescopic or is connected displaceably in its longitudinal direction at least to one of the wire guide support members (T01, T02).