PATENT CLAIMS

1. Contact force testing apparatus (10) comprising a measuring sensor, which measuring sensor (100) can be contacted with an electrical contact element (1, 2) and measures a contact force (F) of a contact with the electrical contact element (1, 2) and wherein the measuring sensor (100) receives the contact force (F) in a contact region (3) with a piezoelectric pick-up (11), characterized in that the measuring sensor (100) comprises a plurality of piezoelectric pick-ups (11, 11'); that the piezoelectric pick-ups (11, 11') are spaced apart from one another by pick-up gaps (12, 12'); that the measuring sensor (100) has a protective sleeve (107); that the protective sleeve (107) covers the piezoelectric pick-ups (11, 11') and the pick-up gaps (12, 12') in the contact region (3); and the protective sleeve (107) is made of electrically conductive material.

2. The contact force testing apparatus (10) according to claim 1, characterized in that piezoelectric pick-ups (11, 11') are arranged rotationally offset with respect to one another about a central axis (XX') of the measuring sensor (100); and that the protective sleeve (107) completely covers from the outside the piezoelectric pick-ups (11, 11') and the pick-up gaps (12, 12') with respect to the central axis (XX') in the contact region (3).

3. The contact force testing apparatus (10) according to claim 1 or 2, characterized in that the protective sleeve (107) abuts non-positively against the piezoelectric pick-ups (11, 11') in the contact region (3).

4. The contact force testing apparatus (10) according to claim 2 or 3, characterized in that the measuring sensor (100) has a base plate (101) which is disposed in the direction of an elongate extension of the measuring sensor

(100); and that the piezoelectric pick-ups (11, 11') are connected mechanically to the base plate (101).

5. The contact force testing apparatus (10) according to claim 4, characterized in that each piezoelectric pick-up (11, 11') has a first layer of piezoelectric material (102) which is connected in the contact region (3) via a side facing the central axis (XX') to the base plate (101); that each piezoelectric pick-up (11, 11') has an acceptor electrode (104) which is connected in the contact region (3) via a side facing the central axis (XX') to the first layer of piezoelectric material (102); that each piezoelectric pick-up (11, 11') has a second layer of piezoelectric material (103) which is connected in the contact region (3) via a side facing the central axis (XX') to the acceptor electrode (104); that each piezoelectric pick-up (11, 11') has a cover plate (105) which is connected in the contact region (3) via a side facing the central axis (XX') to the second layer of piezoelectric material (103).

6. The contact force testing apparatus (10) according to claim 5, characterized in that the first layer of piezoelectric material (102) has a first metallization on a side facing away from the central axis (XX'); that an electrical conductor (109, 109') is connected electrically to the first metallization; and that the protective sleeve (107) completely covers this electrical connection from the outside with respect to the central axis (XX').

7. The contact force testing apparatus (10) according to claim 5 or 6, characterized in that an outer side of the cover plate (105) facing away from the central axis (XX') is convexly shaped in the contact region (3); that the protective sleeve (107) is circularly symmetrical in the contact region (3); and that a radius of curvature of the outer side of the cover plate (105) is less than/equal to an inner radius of the protective sleeve (107).

8. The contact force testing apparatus (10) according to any one of claims 1 to 7, characterized in that the protective sleeve (107) has a thickness of less than/equal to 200 µm, preferably 50 µm, in the contact region (3).

9. The contact force testing apparatus (10) according to any one of claims 1 to 8, characterized in that the measuring sensor (100) has a protective cap (111) in a front region; that the measuring sensor (100) has a support (110) in a rear region; that the protective sleeve (107) abuts flush against the protective cap (111) in the front region of the measuring sensor (100); and that the protective sleeve (107) is connected in a firmly bonded manner to the support (110) in the rear region of the measuring sensor (100).

10. The contact force testing apparatus (10) according to any one of claims 1 to 9, characterized in that due to its mechanical extension, the protective sleeve (107) prevents the penetration of impurities into the measuring sensor (100).

11. The contact force testing apparatus (10) according to any one of claims 1 to 10, characterized in that due to its mechanical extension, the protective sleeve (107) forms an electrical shielding of the measuring sensor (100).

12. The contact force testing apparatus (10) according to any one of claims 1 to 11, characterized in that the protective sleeve (107) abuts directly against the electrical contact element (1, 2) upon contact of the measuring sensor (100) with the electrical contact element (1, 2).

13. Use of a contact force testing apparatus (10) according to any one of claims 1 to 12, characterized in that the contact force (F) of an electrical contact element (2) contacted in the contact region (3) by the contact force testing apparatus (10) acts obliquely to an elongate extension of the measuring sensor (100); the electrical contact element (2) is a contact socket with contact socket lamellae (21, 21'); and that the piezoelectric pick-ups (11, 11') lie underneath the contact socket lamellae (21, 21') with respect to the central axis (XX').

14. Use of a contact force testing apparatus (10) according to claim 13, characterized in that precisely one piezoelectric pick-up (11, 11') of the measuring sensor (100) lies underneath a contact socket lamellae (21, 21'); and that each piezoelectric pick-up (11, 11') measures the contact force (F) of a contact socket lamella (21, 21').

15. Use of a contact force measuring apparatus (10) according to claim 13, characterized in that all the piezoelectric pick-ups (11, 11') measure the contact force (F) of all the contact socket lamellae (21, 21').

16. Method for producing a contact force testing apparatus (10) according to any one of claims 1 to 15, characterized in that the piezoelectric pick-ups (11, 11') are connected mechanically to a base plate (101) of the measuring sensor (100); and that the protective sleeve (107) is pulled in the direction of the elongate extension of the measuring sensor (100) over the piezoelectric pick-ups (11, 11') connected mechanically to a base plate (101).