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(54) INDEXING MECHANISMS

(71) We, UNITED KINGDOM ATOMIC ENERGY AUTHORITY, London, a British Authority, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to indexing mechanisms.

According to the invention an indexing mechanism comprises at least one pair of opposed cam profiles attached to a body member and a striker pin reciprocatable in a non-displacable path between the cam profiles for successive engagements therewith, the profiles each comprising a series of equally spaced teeth, the teeth spaces being of substantially triangular shape with the bases lying on datum lines which are spaced apart, the teeth of one profile being disposed in alignment with the teeth spaces of the other profile, the teeth each having one edge which is parallel to the reciprocal path of the strker pin the other edge being inclined to the reciprocal path of the strker pin and arranged so that successive reciprocal movements of the striker pin into engagement successively with inclined edges of teeth of the opposed profiles effects unidirectional displacement of the body member in step-wise manner in a path normal to the path of the striker pin.

The invention also resides in a nuclear reactor fuel element inspection rig comprising a primary indexing mechanism in accordance with the preceding paragraph wherein the body member is tubular and adapted to house a canister containing a plurality of fuel elements disposed with longitudinal axes parallel to the longitudinal axis of the body member, first and second chucks spaced apart on the longitudinal axis of the canister for displacing fuel elements longitudinally in stepwise manner, a plunger mechanism for displacing the fuel elements successively into the chucks, a measuring unit disposed between the chucks for measuring the diameter of the fuel elements at intervals about their circumferences and a secondary indexing mechanism for rotating the measuring unit in stepwise manner.

Constructional embodiments of the invention will now be described by way of example with reference to Figures 1 and 2 of the drawings accompanying the Provisional Specification and to the accompanying drawings designated Figures 3, 4 and 5 wherein:

Figure 1 is a side view in half section of a nuclear reactor fuel element inspection rig, and

Figure 2 is a fragmentary side view in half section of an indexing mechanism of the rig shown in Figure 1.

Figure 3 is a fragmentary plan view of a sliding table,

Figure 4 is a sectional view on line IV—IV of Figures 3, and

Figure 5 is a sectional view on line V—V of Figures 3.

In Figure 1 there is shown a housing 1 for a nuclear reactor fuel element canister the housing being surmounted by an indexing mechanism 2. Referring now to Figure 2, the indexing mechanism 2 comprises a tubular member 3 having a pair of opposed cam profiles 4, 5 and a strker pin 6 which is reciprocatable in a non-displacable path lying in a plane through the longitudinal axis of the tubular member. The cam profiles 4, 5 are formed on opposed ends of cylindrical members 7, 8 disposed co-axially with the tubular member 3 and the profiles each form an annular series of twelve spaced teeth 9. The teeth spaces are of substantially triangular shape with the bases lying on datum lines designated 'D' which are spaced apart. The teeth of the member 8 are in longitudinal alignment with the spaces between the teeth of the member 7. Each of the teeth has one edge 50 which is parallel to the reciprocal path of the striker pin and the other edge 10 has a portion 10(a) which is inclined to the reciprocal path of the striker pin and a portion

10(b) at the root region of the tooth space which is parallel with the reciprocal path of the striker pin. The striker pin 6 is carried by a shoe 11 slidable within a guide 12 on a rod 13. The rod 13 has a bridge 14 which is attached to a pneumatic ram (not shown) whereby the shoe 11 is reciprocated within its guide. The striker pin has a roller 15 which is engageable successively with the inclined edges 10 of the teeth 9. The tubular member 3 is carried on the housing 1 by roller and needle bearings 16, 17 and the guide 12 is secured to a flange 20.

In operation, the strker pin 6 is moved vertically upwardly from the position shown in the drawing to engage with an inclined edge of the cam profile 4 thereby causing the member 7 and the tubular 3 to rotate through 15° in a clockwise direction as viewed from above. A return stroke of the shoe 11 and striker pin 6 causes the lower member 5 (and the tubular member 3 to which it is attached) to rotate a further 15° in the same clockwise direction. By successive engagements of the striker pin with the root region of the tooth spaces a very precise indexing interval is achieved and the longitudinal spacing apart of the cam profiles ensures that the roller 15 is clear of the edge 50 at a tooth of one profile before it comes into contact with the edge 10(a) of a tooth of the other profile thereby avoiding jamming of the indexing mechanism.

Referring again to Figure 1, the housing 1 has a plunger mechanism 18 and an internal spike 19 which serves to position a fuel element canister centrally within the body member. Although not shown, above the indexing mechanism there are two vertically spaced chucks and a measuring unit disposed between the chucks. The measuring unit has a pair of spaced electrical transducers arranged to transmit a signal proportional to their distance apart. The measuring unit is rotatable being connected by gears to a pair of secondary indexing mechanisms of similar construction to the mechanism 2. One of the secondary indexing mechanisms is arranged to rotate the measuring unit through 180° in 10° intervals whilst the other secondary indexing mechanism is arranged to rotate the measuring unit in the reverse direction in 10° intervals.

In use, a fuel element canister (shown in broken line designated 'C' in Figure 2) containing twelve equally spaced nuclear reactor fuel elements arranged in circular array and with longitudinal axes parallel to the longitudinal axis of the canister is contained by the housing 1. A flange F of the canister is located on the upper end face of the tubular member 3. The plunger mechanism 18 is arranged successively to displace the fuel elements upwards after each fuel element has been brought into register by the indexing mechanism 1. Each fuel element, after displacement by the plunger mechanism 18 is moved upwardly in successive steps by the pair of chucks. At each step the diameter of the fuel element is measured at 10° intervals about its circumference, the measuring unit being rotated through 180° by one secondary indexing unit and then reversed to its original position by the other secondary indexing unit before the next vertical displacement of the fuel element.

In a second constructional embodiment of the invention, not shown in the drawings, the opposed cam profiles are disposed co-axially within a tubular member and the striker pin reciprocates within the tubular member in a plane through the longitudinal axis of the tubular member.

In a third constructional embodiment shown in Figures 3, 4 and 5 an indexing mechanism for moving a table in step-wise manner comprises two spaced pairs of opposed cam profiles 31, 32 associated with a body member which forms a table 33 for supporting articles (not shown). The table 33 is slidable on horizontal linear guides 34 carried by a base member 35. Each pair of opposed cam profiles has a complementary striker pin 31a, 32a, reciprocatable between the cam profiles for successive engagements therewith. The cam profiles define linear series of spaced teeth 36, the teeth of one profile of each pair being disposed in alignment with the teeth spaces of the other profile of each pair. One edge 37 of each tooth is inclined to the reciprocal path of the complementary striker pin and the arrangement is such that successive reciprocal movements of a striker pin into engagement successively with the inclined edges of teeth of the complementary opposed profiles effects unidirectional linear displacement of the table in step-wise manner in the direction of the guides. The pairs of cam profiles 31, 32 are arranged of opposite hand so that the displacements effected by them are in opposed directions. The complementary striker pins are reciprocated by pneumatic rams 38 which can be arranged to park one strker pin between its cam profiles whilst the other striker pin and complementary cam profiles are displacing the table. The table 33 slides freely on the guides 34 by means of linear bearings 39 and the striker pins 31a, 32a are mounted on carriers 31b, 32b which reciprocate in needle bearings 40 within guides 41 (Figure 5).

WHAT WE CLAIM IS:—

1. An indexing mechanism comprising at least one pair of opposed cam profiles attached to a body member and a striker pin reciprocatable in a non-displaceable path between the cam profiles for successive engagements therewith, the profiles each comprising a series of equally spaced teeth, the teeth

spaces being of substantially triangular shape with the bases lying on datum lines which are spaced apart, the teeth of one profile being disposed in alignment with the teeth spaces of of the other profile, the teeth each having one edge which is parallel to the reciprocal path of the striker pin the other edge being inclined to the reciprocal path of the striker pin and arranged so that successive reciprocal movements of the striker pin into engagement successively with inclined edges of teeth of the opposed profiles effects unidirectional displacement of the body member in step-wise manner in a path normal to the path of the striker pin.

2. An indexing mechanism according to claim 1 wherein the cam profiles each define an annular series of spaced teeth, and the unidirectional displacement of the body member in step-wise manner is rotational about the longitudinal axis of the body member.

3. An indexing mechanism according to claim 1 wherein the cam profiles each define a linear series of equally spaced teeth and the unidirectional displacement of the body member in step-wise manner is linear.

4. An indexing mechanism according to any one of claims 1, 2 or 3 and having two pairs of opposed cam profiles associated with the body member and two complementary striker pins each reciprocatable between an opposed pair of cam profiles for successive engagements therewith, the cam profile and striker pin combinations being arranged so that, interchangeably, one combination is driven by the other combination whereby displacement of the body member can be effected in two opposed directions.

5. A nuclear reactor fuel element inspection rig comprising a primary indexing mechanism according to claim 1 wherein the body member is tubular and adapted to house a canister containing a plurality of fuel elements disposed with longitudinal axes parallel to the longitudinal axis of the body member, first and second chucks spaced apart on the longitudinal axis of the canister for displacing fuel elements longitudinally in stepwise manner, a plunger mechanism for displacing the fuel elements successively into the chucks, a measuring unit disposed between the chucks for measuring the diameter of the fuel elements at intervals about their circumferences and a secondary indexing mechanism for rotating measuring unit in stepwise manner

6. An indexing mechanism substantially as hereinbefore described with reference to the drawings accompanying the Provisional Specification.

7. An indexing mechanism substantially as hereinbefore described with reference to Figs. 3, 4 and 5 of the accompanying drawings.

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1423522 PROVISIONAL SPECIFICATION
2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheet 1

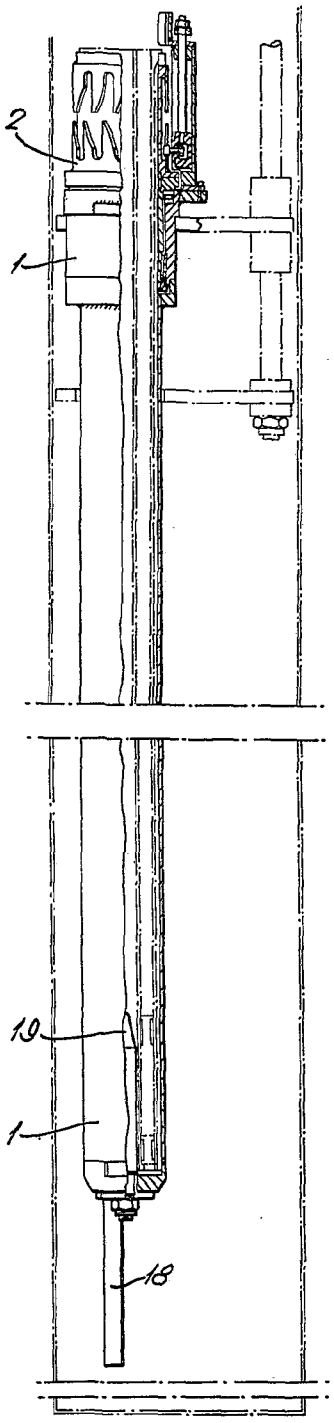
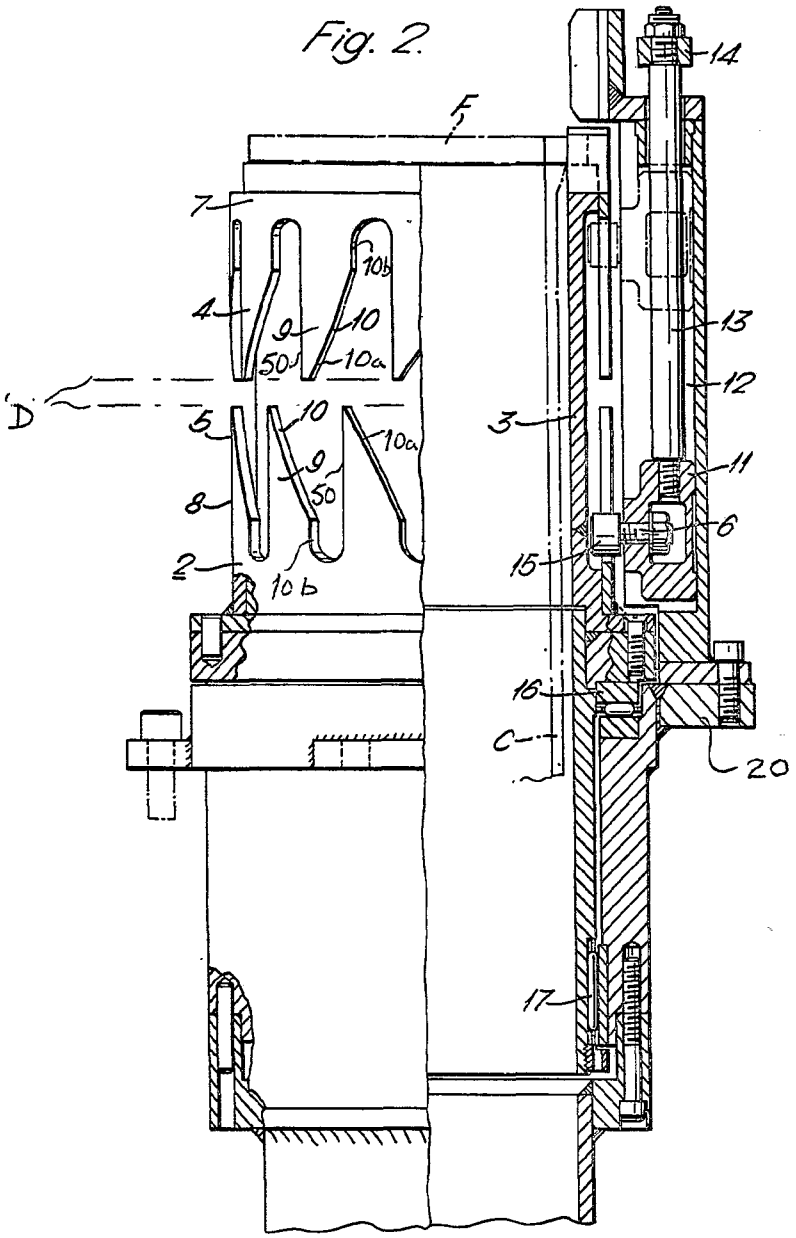


Fig. 1.

1423522 PROVISIONAL SPECIFICATION
2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheet 2

Fig. 2.



1423522 COMPLETE SPECIFICATION
1 SHEET This drawing is a reproduction of the Original on a reduced scale

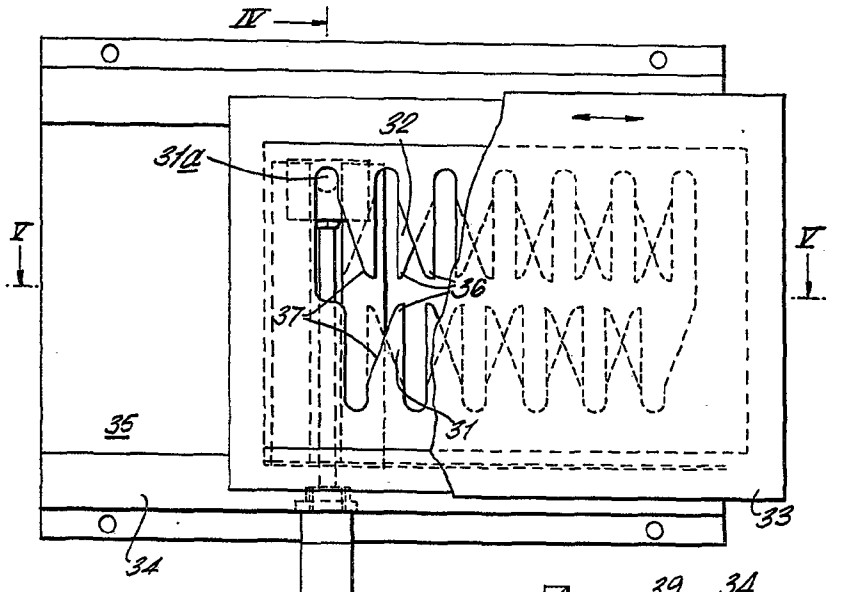


Fig. 3.

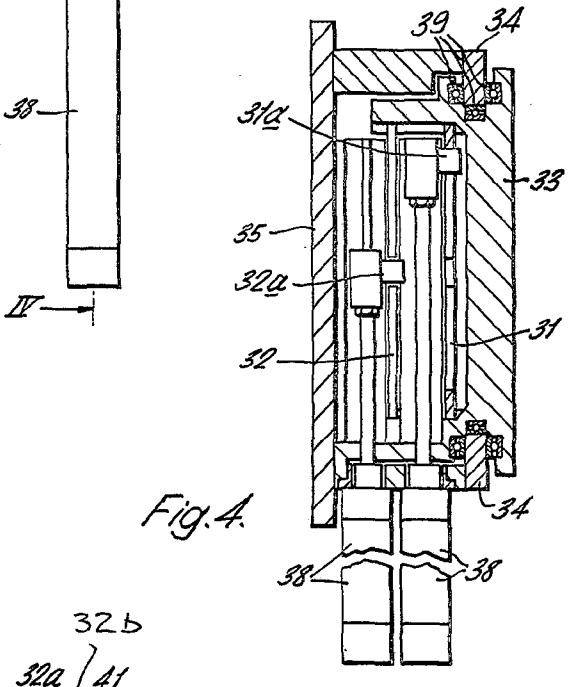


Fig. 4.

Fig. 5.