Sept. 15, 1964 W. HESS 3,148,420

MEANS FOR MOVING THE CHILL-MOULD IN CONTINUOUS CASTING PLANT

Filed Dec. 27, 1961 6 Sheets-Sheet 1

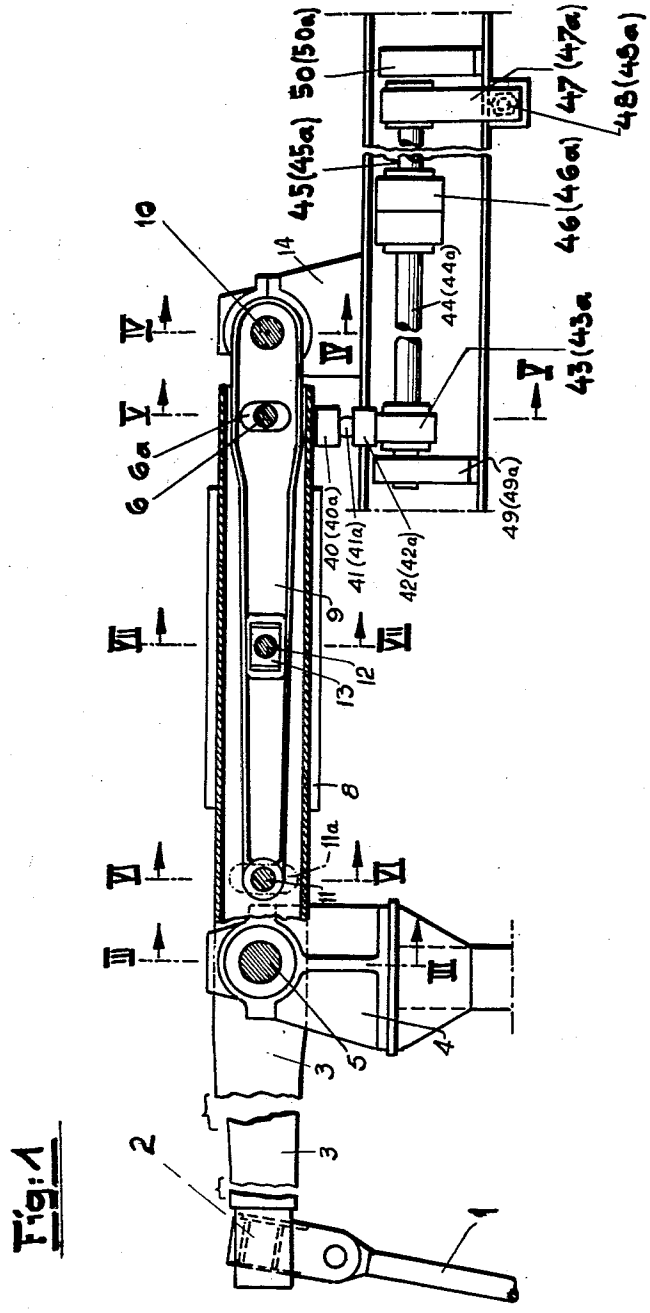

Fig. 1

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MEANS FOR MOVING THE CHILL-MOULD IN CONTINUOUS CASTING PLANT

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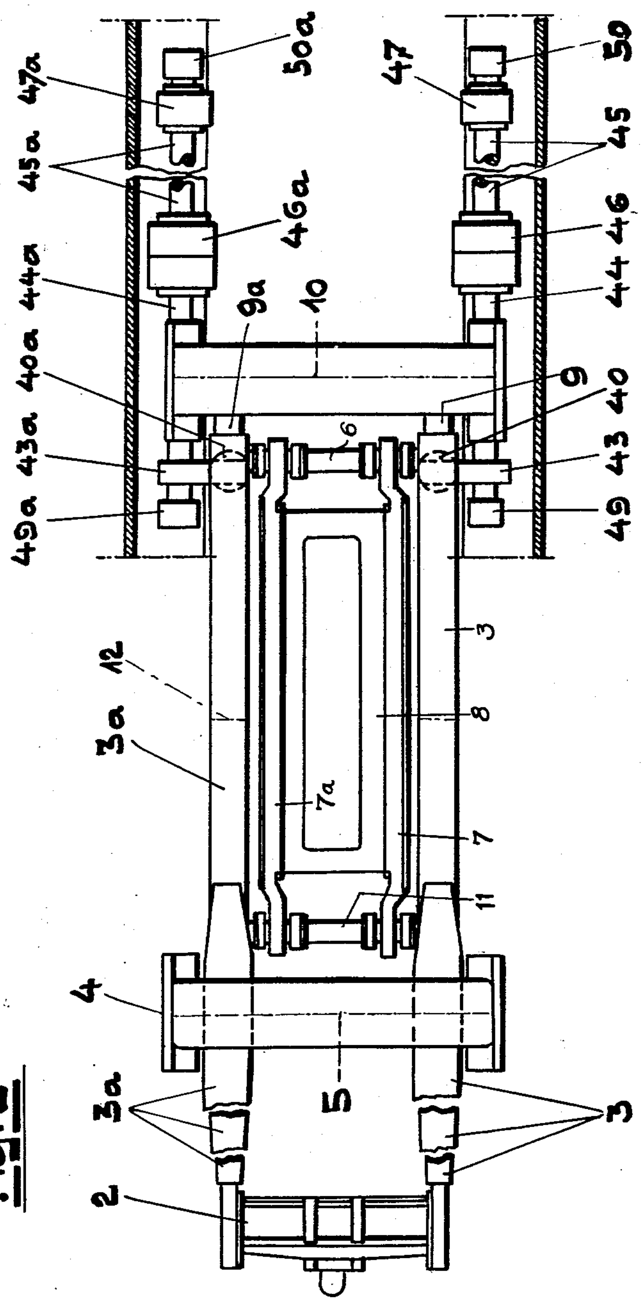

Fig: 2

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Fig. 3

(III-III)

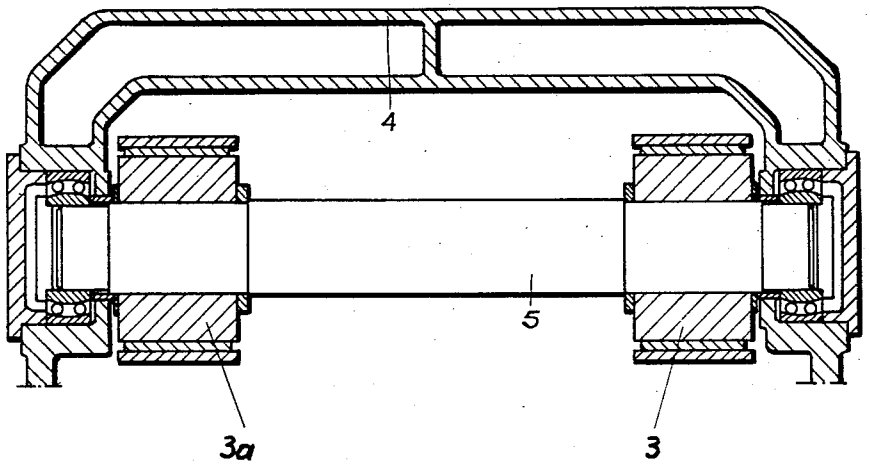

Fig. 4

(IV-IV)

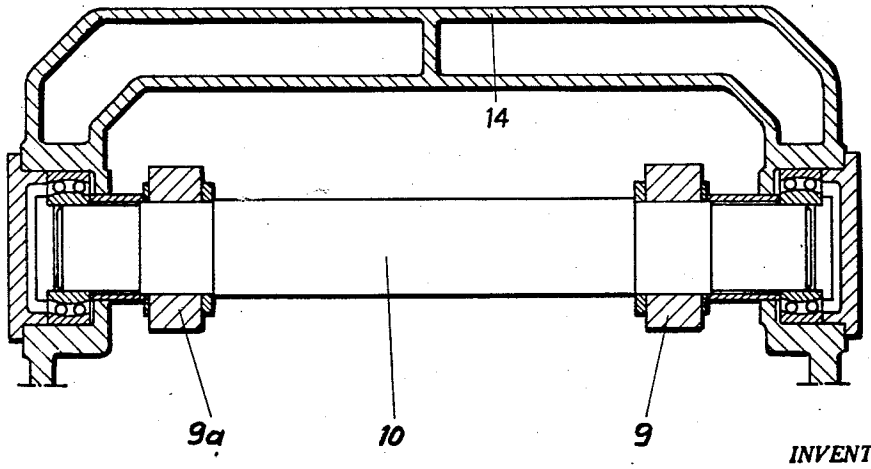

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Fig. 5
(V-V)

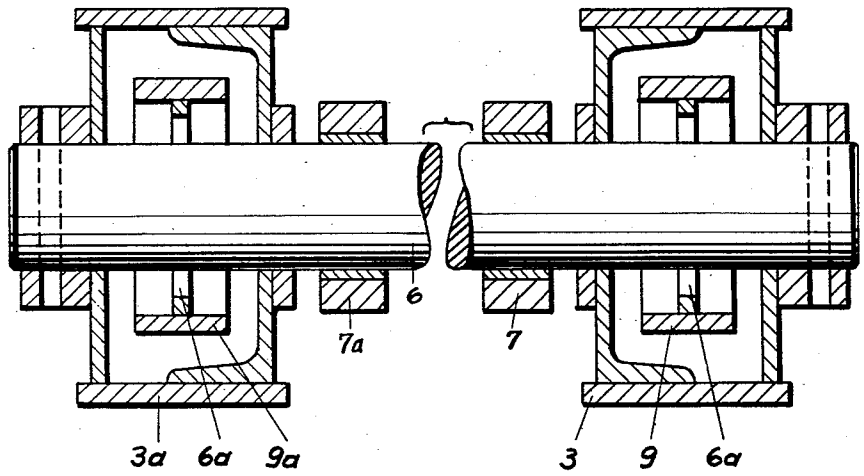

Fig. 6
(VI-VI)

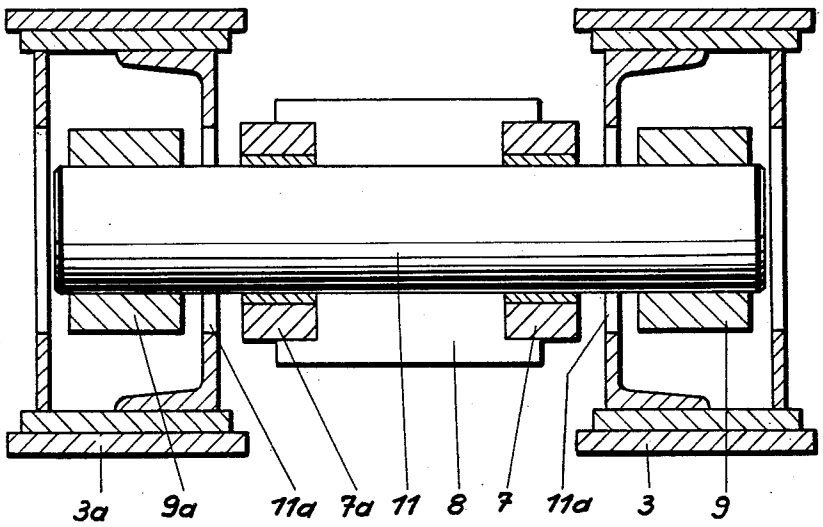

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Fig. 7

(VII-VII)

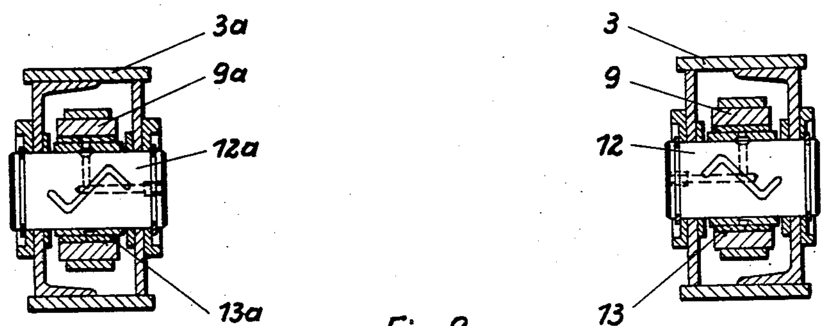

Fig. 9

(IX-IX)

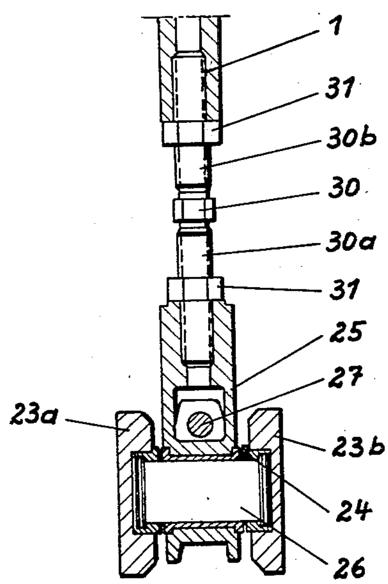

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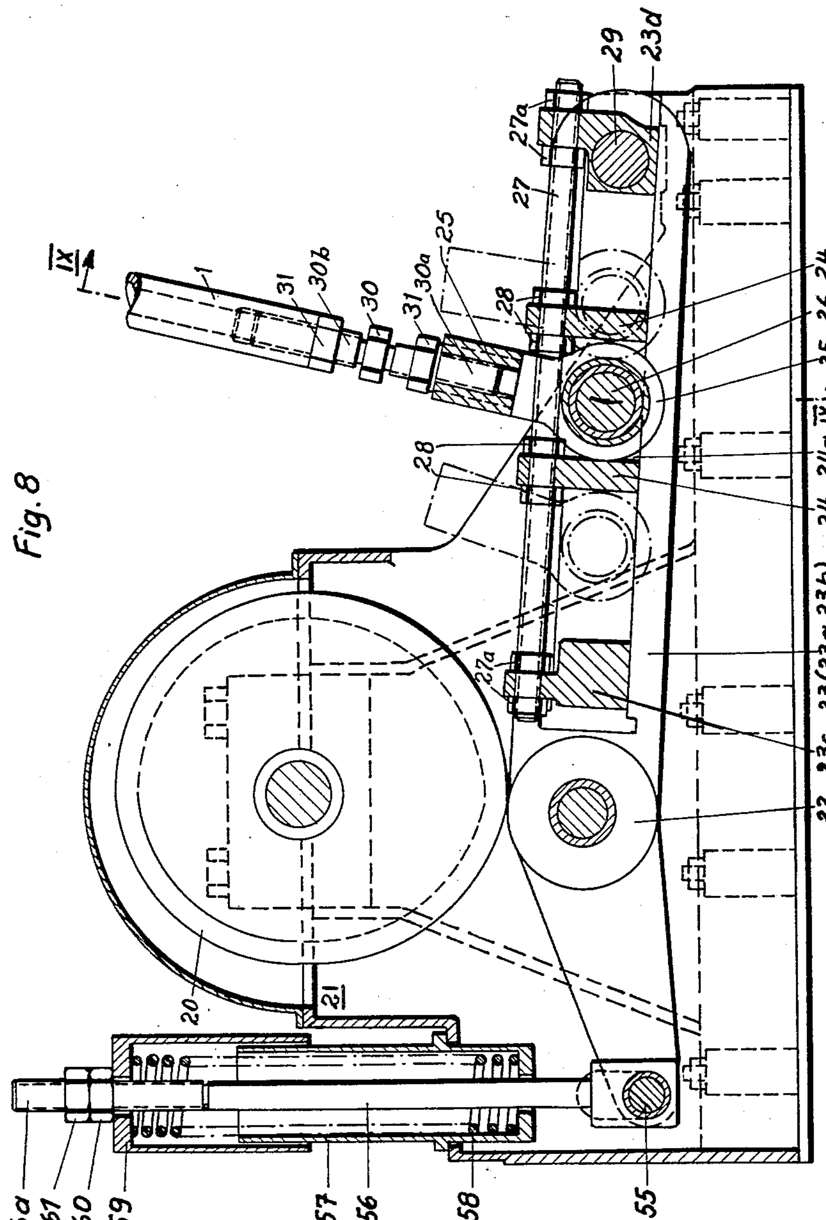
Fig. 8



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United States Patent Office 3,148,420 Patented Sept. 15, 1964

3,148,420

MEANS FOR MOVING THE CHILL-MOULD IN CONTINUOUS CASTING PLANT

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Claims priority, application Germany, Jan. 5, 1961, Sch 29,019
5 Claims. (Cl. 22—57.2)

This invention relates to continuous casting plants and, more particularly, to an improved arrangement for reciprocating the casting mould of a continuous casting plant.

In continuous casting installations the molten metal is poured into a cooled chill-mould. Accordingly the metal solidifies first in the marginal zones and forms a solid skin around the still molten metal in the core. To prevent the skin from sticking to the walls of the chill-mould, the chill-mould is oscillated moved up and down, or, in the case of horizontal installations, to and fro, by means of cams and push rods, through usual stroke, which may however be adjustable.

The reciprocation arrangement known and used by the art comprises a cam disc, which, by way of a rocker and a system of levers with columns, moves the chill-mould table up and down. The columns impair the accessibility of the device, and require a multiplicity of levers and pulling members between the cam disc and the chill-mould table; for in order to enable as uniform an action as possible to be exerted upon the chill-mould table, the columns, which are pivoted to bell-crank levers, and the other ends of which are provided on the chill-mould table, are long, and extend far beyond the chill-mould and cooling jaws of the continuous casting. The levers and columns must lie close beside the chill-mould, in order to obviate far-overhanging parts of the chill-mould table, which however has the disadvantage that owing to the parts located close to the continuous casting, the visibility and also the accessibility of the continuous casting and of the corresponding parts of the apparatus are hindered. Also, the arrangement known to the art is usually provided with two systems moving independently of one another and positioned on each side of the mould, which arrangement has the disadvantage that when one of the systems becomes worn, the mould will be tilted due to uneven displacement of each side of the mould. Such tilting is dangerous since the fragile skin is easily torn.

It is, therefore, one object of this invention to provide a reciprocation arrangement to reciprocate the chill mould table over a usual stroke maintaining parallelism of the table over the entire stroke, and which arrangement does not include columns and levers underneath the chill mould. A further aim of the invention is to make the device simple and advantageous in design. It is also an object of the invention to construct the device in such a way that as few individual parts as possible are necessary for carrying out this aim. Furthermore it is a purpose of the invention to design these parts in such a way that they are located in or near one another, so that the device forms a compact and coherent whole.

Accordingly, there is provided in a preferred embodiment of this invention, an open-ended chill mould for casting molten metal into a strand and a mould table carrying said mould. Pivots are fixedly mounted adjacent each end of the table. A first set of levers is positioned astraddle the table, each of the levers having one end coupled to a pivot at one end of the table and having the other end pinned to the opposite end of the table. A second set of levers is similarly positioned astraddle the table, each of the levers in the second set having one end coupled to the pivot at the other end of the table and the other end of the lever pinned to the opposite end of the

table. The respective levers of the first and second set on each side of the table are pivotally joined at the midpoint between pivots. Means are provided to reciprocate one lever set, resulting in reciprocation of the table over a stroke of conventional distance.

Thus an arrangement is provided which does not extend in the direction of the continuous casting issuing from the chill-mould, since the scissors-like lever sets are located above the casting and close to the axis of the chill-mould. Accessibility to the continuous casting and to the chill-mould is thus improved, and the lever sets arrangement operates to properly reciprocate the chill-mould. Thus the lever system is distinguished by a particularly small over-all height, forming a compact whole; and, as compared with known appliances, the advantage is also attained that the apparatus according to the invention comprises only a small number of individual parts.

The invention may also include the feature that on each side of the chill-mould table a similar system of levers is provided, the two lever system being connected with one another at their free ends by pins pivotally connected with the chill-mould table, and with a cross-bar provided on the other arm and co-operating with the cam disc. The advantage of this resides in the fact that the same pivots that serve for carrying the chill-mould table also connect the lever systems with one another. In this way the apparatus is simplified.

The invention may also include the feature that a rocker provided between the cam disc and the lever or pair of levers comprises an adjustable spring pressing the rocker against the cam disc. The advantage of this form of construction resides in the fact that a reliable method of working is effected by the spring.

It is particularly advantageous that the levers, in their longitudinal directions, lie in a plane which is perpendicular to the continuous casting direction, thus embracing the chill-mould table. On the basis of the horizontal arrangement of the lever system, the chill-mould table and the chill-mould are located freely, upwards and downwards, and on both sides of the levers, so that these members are readily accessible. The casting, and the cooling plates that act upon the casting, are thus accessible from all sides.

Further details of the invention are explained with reference to a constructional example which is illustrated in the accompanying drawings, in which:

FIGURE 1 shows a side view of the apparatus, one lever being shown partly in section;

FIGURE 2 shows a plan of the apparatus shown in FIGURE 1;

FIGURE 3 shows a section on the line III—III in FIGURE 1;

FIGURE 4 shows a section on the line IV—IV in FIGURE 1;

FIGURE 5 shows a section on the line V—V in FIGURE 1;

FIGURE 6 shows a section on the line VI—VI in FIGURE 1;

FIGURE 7 shows a section on the line VII—VII in FIGURE 1;

FIGURE 8 shows in section the chill-mould drive according to the invention; and

FIGURE 9 shows a section on the line IX—IX in FIGURE 8.

By 1 is denoted a rod member which transmits the stroke movement of a drive, more fully described later, to a lever system carrying a chill-mould table. The rod member 1 is for this purpose pivotally connected with a cross-bar 2, and the latter, in its turn is pivotally connected with levers 3 and 3*a*. The levers 3 and 3*a* are rockably journalled about a pivot 5 in a bearing block 4,

and preferably as a welded rigid construction. Their arms are of channel-shaped cross section between the cross-bar 2 and the pivot 5, and of box-like cross-section between the pivots 5 and 6. At their ends remote from the cross-bar 2, the levers 3 and 3*a* are connected by a pivot 6 (FIGURE 5) to which girders 7 and 7*a* of the chill-mould 8 forming the chill-mould table, are pivoted. Thus the pivot 6 extends through levers 9 and 9*a* which project into the box-like open ends of the levers 3 and 3*a*, and are rockably journalled in a bearing block 14 about a pivot 10. Bores 6*a* in the levers 9 and 9*a*, through which the pivot 6 extends, are constructed as slots. The levers 9 and 9*a* are connected at their ends by a pivot 11 (FIGURE 6) which passes through the levers 3 and 3*a*. The levers 3 and 3*a* are provided with elongated holes 11*a* for the passage of the pivot 11. The pivot 11 and the pivot 6 together carry the beams 7 and 7*a*, forming the chill-mould table.

In order to obtain a transmission of motion from the levers 3 and 3*a* to the levers 9 and 9*a*, these are connected with one another midway between their pivots 6 and 11 or the pivots 5 and 10, as seen from their fulcra, by means of knock-out spindles 12 and 12*a*. For this purpose, bores for the accommodation of the knock-out spindles 12 and 12*a* are provided in the levers 3 and 3*a*. In the levers 9 and 9*a* on the other hand, longitudinal slots are provided for the accommodation and guidance of bearing stones 13 and 13*a*, which are provided with a bore and a bushing for the knock-out spindles 12 and 12*a*. The change occurring, during the rocking of the levers 3, 3*a*, 9 and 9*a*, in the distance between the pivots 6 and 11, is so slight that the bearing clearance at the spindles 6 and 11, is sufficient to compensate for this change, without special constructional provision having to be made, as in the case of the connection of the levers 3 and 3*a* with the levers 9 and 9*a*. The levers 3 and 9, and the levers 3*a* and 9*a*, therefore move like scissors, with members rockable about the pivot 12, the ends of which carry the chill-mould 8.

The stroke movement is produced by a driven cam disc 20, which is journalled in a casing 21, as shown in FIGURE 8. A pressure roller 22, which is rotatably supported in a swing lever 23, bears against the periphery of the cam disc 20. The swing lever 23 consists of two plates 23*a* and 23*b*. The distance between the plates 23*a* and 23*b* is given by connecting pieces 23*c* and 23*d* which are set between the plates 23*a* and 23*b*, and with which these are releasably connected by means of screws. On the sides facing one another the plates 23*a* and 23*b* each have a guiding groove, into which the connecting pieces 23*c* and 23*d*, which are square in shape, are inserted, and in which a sliding-piece 24 is guided. The sliding-piece 24 consists of a block, out of which is milled a portion which forms a break-through or opening 24*a*, in which there engages a head-piece 25 connected with the rod member 1 and pivotally connected with the slide-piece 24 by a bolt 26. In eyes in the connecting pieces 23*c* and 23*d* is inserted a screw-threaded rod 27, which is firmly clamped by nuts 27*a*. The slide-piece 24 is likewise provided with eyes, through which the threaded rod 27 passes. By means of nuts 28 the slide-piece 24 can be fastened, in relation to the threaded rod 27, at a desired distance from the pivot 29 round which the swing lever 23 is rockable in the casing 21, whereby also the magnitude of the chill-mould stroke can be adjusted. The head-piece 25 of the rod member 1 comprises a window 25*a* for the screw-threaded spindle 27, and is connected with the rod member 1 by a clamping screw or turnbuckle 30. The clamping screw 30 has two threaded shanks 30*a* and 30*b* with threads of opposite pitch. By means of the lock-nut 31, the turnbuckle 30, which is inserted by one threaded shank 30*a* in a corresponding threaded bore in the head-piece 25 and by its other threaded shank 30*b* in a corresponding threaded bore in the rod member 1, can be secured against accidental rotation relatively to the head-piece 25 and to the rod member 1.

In order to hold the swing lever 23, with the pressure roller 22, firmly on the cam disc 20, there is secured to the free end of the swing lever 23, with a bolt 55, a tie-rode 56, which is provided with a screw-threaded shank 56*a*. In the casing 21 is inserted a spring cage 57, through the pierced bottom of which the tie-rod 56 extends. In the spring cage 57, a spring 58 is inserted, and over the spring cage 57 and the spring 58 is slipped a second spring cage 59, which is mounted upon the tie-rod 56. By means of a nut 60 and a locknut 61 on the threaded shank 56*a* of the tie-rod 56, the tension of the spring 58, and with it the application pressure of the pressure roller 22 against the cam disc 20, can be adjusted. Whilst, during the upward movement of the chill-mould, the force of gravity counteracts the inertia forces, during the downward movement of the chill-mould the inertia forces are in the same direction as the force of gravity. In order to counterbalance these forces, a spring restraint provided, which, towards the end of the downward movement, increasingly opposes the descent of the chill-mould. In the constructional example, the levers 3 and 3*a* are for this purpose provided at their free ends with brass bushings or pan bearings 40 and 40*a*. These brass bushings 40 and 40*a* are supported upon balls 41, 41*a* on brass bushings or pan bearings 42, 42*a*. The ball cups 42, 42*a* are located on levers 43, 43*a*, which are mounted rotationally fast upon torsion-bar springs 44, 44*a*. The torsion-bar springs 44 and 44*a* are connected by means of couplings 46 and 46*a* with second torsion-bar springs 45 and 45*a*. At the ends of the torsion-bar springs 45 and 45*a* opposite to the couplings 46 and 46*a*, levers 47 and 47*a* are pivoted rotationally fast, which are supported, by their free ends, each over an adjusting screw 48, 48*a*, upon the housing of the continuous casting plant. The adjusting screws 48 and 48*a* are for the purpose of imparting the requisite initial stress to the torsion-bar springs. The torsion-bar springs are supported on the bearing blocks 49, 49*a* and 50, 50*a*.

This invention may be variously modified and embodied within the scope of the subjoined claims.

I claim:

1. Apparatus for the continuous casting of metal comprising an open-ended chill mould for casting molten metal into a strand, a mould table carrying said chill mould, a first pivot fixedly mounted adjacent one end of said table and separated therefrom, a second pivot fixedly mounted adjacent the second end of said table, and separated therefrom, a first and second lever, one end of each of said first and second levers being pivoted about said first pivot, said first and second levers being positioned astraddle said mould table, the other end of said levers being pivotably connected to said mould table at the second end thereof, a third and fourth lever, one end of each of said levers being pivoted about said second pivot, said third and fourth levers being positioned astraddle said mould table, the other ends of said third and fourth levers being pivotably connected to said table at the first end thereof, said first and third levers being pivotably coupled together at a position between said first and second pivots, said second and fourth levers being pivotably connected between said first and second pivots, said pivotal connections being slidable within at least one of the levers coupled together thereby, and means coupled to said first and second levers to periodically deflect said levers thereby to reciprocate said mould.

2. Apparatus in accordance with claim 1 in which said first and second levers comprise a hollow box-shaped cross section and in which said third and fourth levers respectively extend into the hollow interior of said respective first and second levers.

3. Apparatus in accordance with claim 1 in which said deflecting means comprises a cam, the surface of which defines the desired deflection characteristics, a push rod coupled to said cam to move in accordance with the cam surface thereof, and means coupling the other end of said push rod to said first and second levers.

4. Apparatus in accordance with claim 3 which includes spring means for restraining the reciprocation of said mould table.

5. Apparatus in accordance with claim 4 in which said spring means comprises torsion bars having one end fixedly coupled and having lever means coupling the other end of said bars to said other end of said first and second levers to springably restrain table movement.

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