Nov. 4, 1958 E. URBANKE ET AL 2,858,585

# DEVICE FOR OPERATING CORE SHOOTING MACHINES

Filed March 19, 1957 3 Sheets-Sheet 1

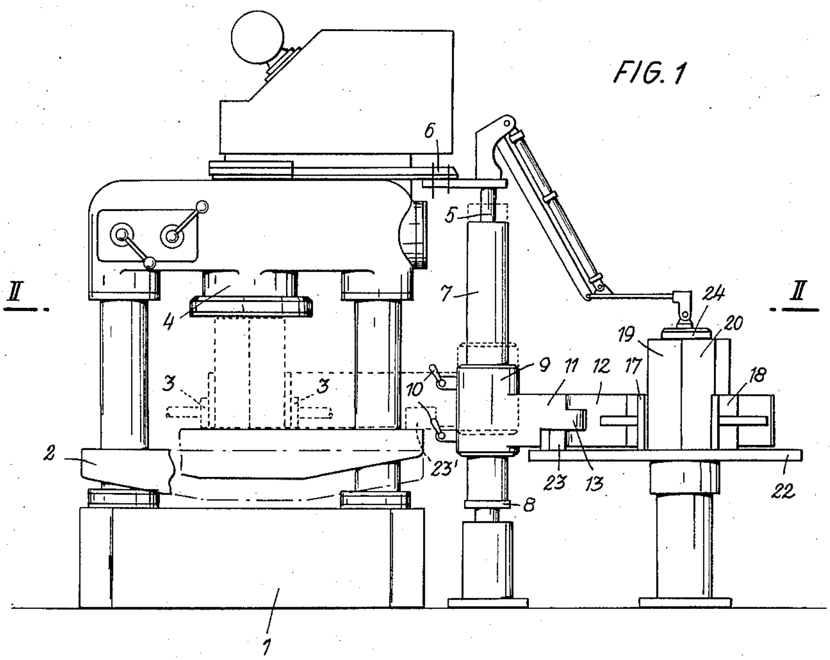


FIG. 1

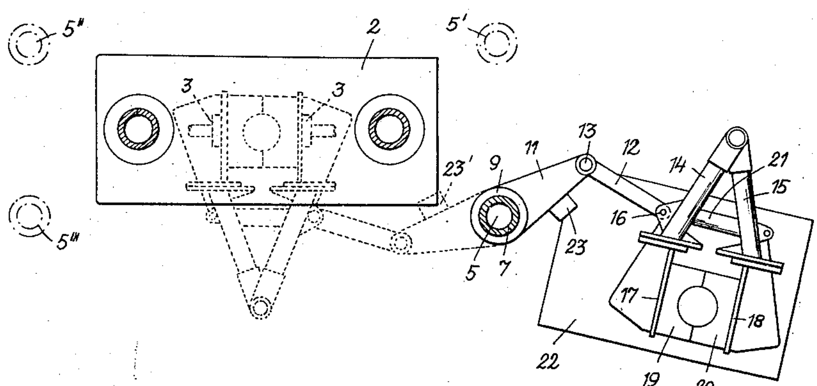


FIG. 2

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FIG. 5

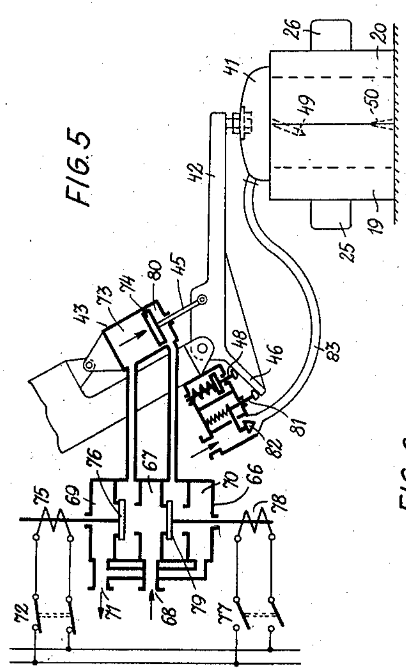

FIG. 6

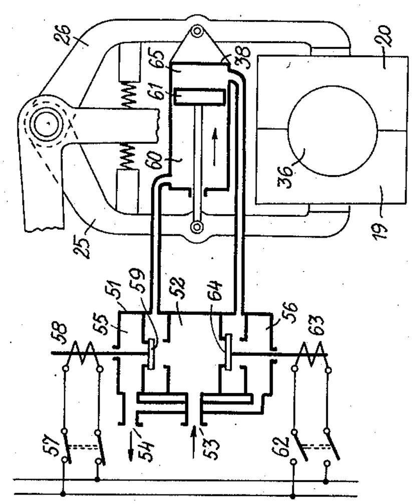

FIG. 3

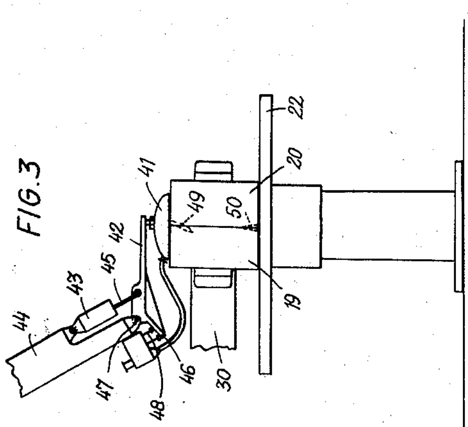

FIG. 4

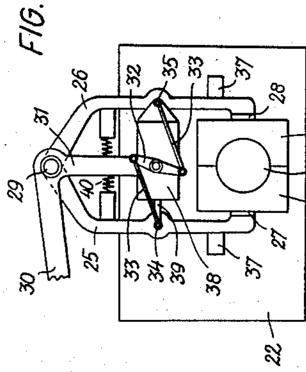

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FIG. 9

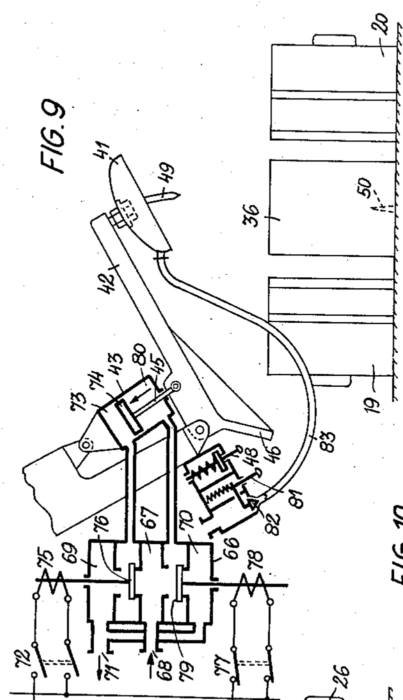


FIG. 10

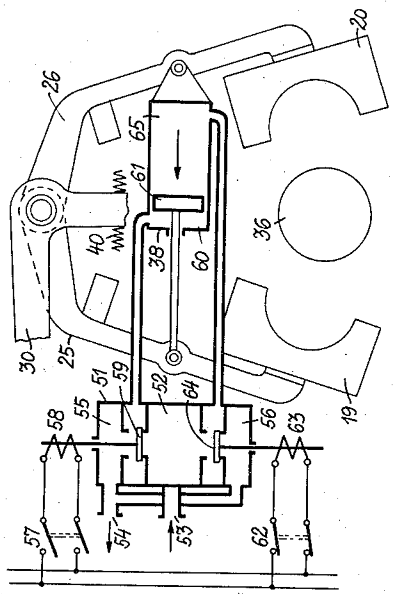


FIG. 7

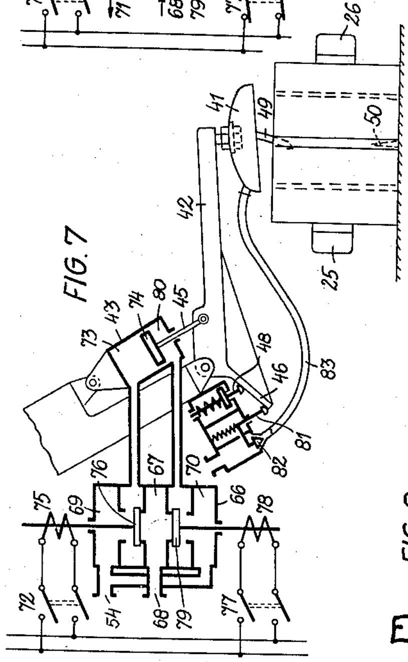
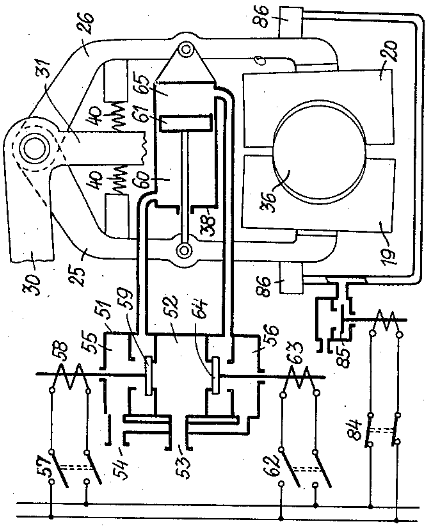


FIG. 8



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## DEVICE FOR OPERATING CORE SHOOTING MACHINES


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22 Claims. (Cl. 22—10)


In foundry practice it is known to produce cores by an operation called "shooting." Core shooting machines constructed for this purpose comprise a table which can be lifted and lowered and on which the core box is placed and with which the core box is lifted and forced against the shooting head, by which the core material is forced under superatmospheric pressure into the core box. Such core shooting machines are highly efficient and enable the elimination of manual core making work in a high degree. The operation of said core shooting machines, however, involves considerable difficulty. The shooting operation itself requires only a few seconds and in relation thereto the periods required for the other operations performed on the core are relatively long so that the advantages of such a core shooting machine cannot become fully effective. Particularly in processes in which an aftertreatment, e. g., a carbon dioxide hardening of the core material, is to follow the forming of the core, these disadvantages are effective in a particularly high degree. In the usual core shooting machines the carbon dioxide hardening is effected on the machine itself so that this machine is blocked during the time required for hardening. Furthermore, the opening of the core box and the removal of the finished core require a multiple of the time required for the shooting operation itself. Therefore, such core shooting machines, which are expensive, are utilized only in an entirely inadequate degree and in the known arrangements the operation of the core shooting machines requires a relatively large amount of manual labor, which involves great exertion particularly with the heavy core boxes often employed. For this reason an economically efficient work has not been possible so far with such core shooting machines.

The invention relates to a device for operating such core shooting machines, which use composite core boxes, particularly for cores which will be subjected to an aftertreatment including a carbon dioxide hardening, and has as its object to eliminate the disadvantages of core shooting machines. The invention is substantially characterized by at least one pivoted arm, which is freely pivotally movable and vertically adjustable carried on a vertical axis and has relatively movable holding means which carry the core box sections and effect the opening and closing movements thereof.

Thus an operating device for core shooting machines is provided which avoids manual work to a large extent and feeds the core boxes in an assembled condition to the core shooting machine so that the core boxes can be directly moved to the shooting head by the core shooting machine. In the making of casting moulds it is known to use pivoted arms which place the several flask sections on conveyor belts or feed them to the moulding machine; said pivoted arms engage the crane pin and serve only as a lifting means. Thereby that according to the present invention the core box sections of a composite core box are carried by relatively movable holding means of the pivoted arm the device according to the invention effects at the same time the assembly of the core box and the movement thereof to the shooting head of the core shooting machine. The vertically adjustable mounting of the pivoted arm enables the core box to follow freely the vertical movements of the core shooting machine without requiring a disengagement of the core box from the pivoted arm. After the shooting operation the core box with the core can be directly removed from the core shooting machine.

According to the invention, therefore, each of the core box sections can be rigidly affixed to one of the holding means of the pivoted arm so that the cores may be shot in succession, using the same core box. The holding means may comprise, e. g., fixing slots for mounting different core box sections. According to the invention these holding means consist suitably of holding jaws which can be opened like pincers and whose opening and closing movements are preferably effected by pneumatic means. A pneumatic or hydraulic operating device for the opening and closing movements may be controlled by flexible tubes. In view of the fact that the holding means or holding jaws are mounted on the pivotal arm for three-dimensional movement this is an advantage over a mechanical operating device.

According to the invention a vertically adjustable rest table is arranged adjacent to the pivoted arm and the release of the shot core from the core box and any aftertreatment of the core are effected on said table. Preferably a correspondingly vertically adjustable carbon dioxide nozzle is provided, with which the carbon dioxide hardening can be effected only outside the core shooting machine, more particularly on the rest table.

In a practical embodiment of the operating device a stationary vertical column is provided according to the invention and carries a freely rotatable and vertically adjustable sleeve, which is supported in its lowermost position by a stationary step bearing or the like. A ring which can be clamped to the sleeve carries the pivoted arm. The carbon dioxide nozzle may also be vertically adjustably mounted in a suitable manner on that stationary vertical column.

The drive for the lifting and lowering movement of the pivoted arm and core box may be derived from the machine table of the core shooting machine whereas the pivoted arm is mounted for free vertical adjustment. In order to relieve the pivoted arm and to avoid a canting of the vertically adjustable pivotal mounting means under the action of the lifting force acting on the protruding end of the pivoted arm, which end carries the core box, that part of the pivotal mounting means which carries the pivoted arm, e. g. the ring, comprises a stop, which rests on the table of the core shooting machine and transmits the lifting movement thereof to the pivoted arm.

In order to facilitate the release of the core from the core box when the same is being opened, the vertically adjustable carbon dioxide nozzle may also be formed with a holding member which engages the core so that that carbon dioxide nozzle can also be used for locating the core during the release of the latter from the core box. The rest table may carry an appropriate holding member for the core and a uniform opening of the holding means and of the core box sections away from the core thus located may be enforced by an appropriate link arrangement. The release of the core from the core box may also be facilitated by vibrators. Thus the release of the core from the core box may be fully automatically effected. Particularly with slender cores, which lack adequate stability after release from the core box, the fixing thereof with the aid of the carbon dioxide nozzle affords a substantial advantage.

If a core shooting machine has associated therewith a single one of these operating devices, comprising a pivoted arm, a rest table and, if desired, a carbon dioxide nozzle, this will save manual work and labour and will enable speedier operation so that the core shooting machine can be utilized more economically. If several such operating devices are associated with one core shooting machine, in a preferred embodiment of the invention, those operations which are not directly related to the shooting of the core, can be performed outside the core shooting machine so that the latter can immediately be made free for handling the next core after the shooting operation has been performed. Thus the capacity of the core shooting machine is not only increased but multiplied. This applies particularly to those cases in which the core is to be subjected to an aftertreatment, e. g., a carbon dioxide hardening, after the shooting because in that case the core shooting machine will not be occupied by such time-consuming aftertreatments. For this reason the invention offers the greatest advantages particularly for the making of shot cores which are subjected to an aftertreatment, such as a carbon dioxide hardening. For instance, the number of pivoted arms cooperating with a core shooting machine may be determined approximately in accordance with the ratio between the period required for the aftertreatment and, as the case may be, the release of the shot cores from the core box, on the one hand, and the period required for shooting the core and, as the case may be, for inserting the core, if the core is inserted by the same man, on the other hand. In practice it has been found that as much as four such operating devices may be associated with one core shooting machine in order to utilize the capacity of a core shooting machine in the fullest degree.

In such case the operating device according to the invention enables the making of four cores on the same core shooting machine in the time required for making one core. Since the use of the operating device according to the invention reduces also the time required for making that one core, the capacity of the core shooting machine is increased more than four times in that case.

Embodiments of the invention are shown by way of example in the drawing.

Fig. 1 is a side view showing the operating device and the core shooting machine whereas Fig. 2 is a sectional top plan view taken on line II—II of Fig. 1.

Figs. 3 and 4 respectively are an elevation and top plan view showing a modified form of the holding means for the core box and for the carbon dioxide nozzle, the latter being omitted in the top plan view of Fig. 4 for the sake of clarity.

Figs. 5 and 6 and Figs. 7 and 8 as well as Figs. 9 and 10 are elevations and top plan views, respectively, showing the various operating positions of a device according to Figs. 3 and 4.

1 is a core shooting machine with the machine table 2 which can be lifted and lowered. In a normal operation of such a core shooting machine the core box is placed on the machine table 2, held together by jaws 3 and forced against the shooting head 4 by lifting the table 2.

A stationary column 5 is arranged beside the core shooting machine 1 and is connected by a strap 6 to the upper part of the core shooting machine. That stationary column 5 has a tubular part 7 rotatably and vertically adjustably mounted thereon, which part is supported on a step bearing 8. A sleeve 9 is clamped at an appropriate height with the aid of clamps 10 to said tubular part 7. That sleeve 9 carries a pivoted arm which consists of two parts 11 and 12, which are hinged together by a torsion resisting joint 13. A pincers 14, 15 is linked by a torsion-resisting joint 16 to the part 12 of the pivoted arm and the parts 19, 20 of a two-part core box are affixed to the jaws 17, 18 of that pincers. In order to enable core boxes of different size to be mounted on said jaws 17, 18 the latter have fixing slots. The two jaw arms 14, 15 with the jaws 17, 18 and the core box sections 19, 20 can be closed and opened by a compressed-air cylinder 21, 22 is a rest table, which may be vertically adjustably arranged.

The pivoted arm 11, 12 enables the movement of the core box from the rest table 22 to the table 2 of the core shooting machine and back from the table 2 to the rest table 22. The vertically adjustable rest table 22 enables the use of core boxes of different height.

The sleeve 9 is clamped by means of the clamping toggles 10 to the tubular part 7 at an appropriate height, which may be determined in accordance with the height of the rest table 22 by a stop 23. The core box can be assembled on the rest table 22 and can be swung to the table 2 of the core shooting machine by a simple swing movement. The hinged construction of the pivoted arm 11, 12 enables the path of the core box to be selected so that it will not collide with any parts of the core shooting machine and can be set down on the table of the core shooting machine in the correct position. During that swing movement the tubular part 7 is supported on the step bearing 8. Now the core box 19, 20 is lifted and forced against the head 4 of the core shooting machine by means of the table 2 of the core shooting machine. The vertically adjustable mounting of the tubular part 7 enables the free lifting of the core box 19, 20 with the pivoted arm 11, 12 and the sleeve 9 by means of the tubular part 7. In order to avoid canting during that operation the stop 23 is arranged on the sleeve 9 to be engaged by the machine table 2 in the position 23' assumed by the step after it has been swung towards the core shooting machine 1. The lifting of the sleeve 9 by the tubular part 7, therefore, is effected by means of the stop 23. As soon as the shooting operation is terminated in that lifted position of the machine table, the latter is lowered, the core box 19, 20 is swung to the rest table 22 and placed on the latter. The further operation may be performed on said rest table 22. For instance, the carbon dioxide hardening may be effected with the aid of a head 24 which can be mounted on the upper end of the core box 19, 20. The core material may be further consolidated on that rest table. To this end a vibrator may be arranged, e. g., on the jaw arms 14 or 15.

After the lifting of the carbon dioxide nozzle 24 the fixing jaws 17, 18 are opened with the aid of a compressed-air cylinder 21 in order to facilitate the opening movement the vibrators attached to the fixing jaws 17, 18 are previously put into operation. After the core has been removed and the core box has been cleaned or blown out, the device is ready for the next operation.

In order to utilize the capacity of the core shooting machine in the fullest degree it is suitable to provide additional similar operating devices, e. g., a total of four of such devices, additional columns 5 being provided at 5', 5'' and 5'''.

In the embodiment according to Figs. 3 and 4 the jaw arms 25 and 26 carrying the holding jaws 27, 28 to which the two core box halves 19, 20 are affixed, are mounted on the pivoted arm 30 by means of their pivot 29. A uniform opening movement of the two core box halves 19 and 20 during the release out of the core 36 of the core box is enforced by a double-armed lever 32, which is pivoted to an angled extension 31 of the pivoted arm 30 and whose ends are connected by links 33 to pivots 34, 35 of the jaw arms 25, 26. The two jaw arms 25 and 26 carry vibrators 37, which are started during the opening of the core box and promote the separation of the core box halves 19 and 20 from the core 36. 38 is the pneumatic cylinder which operates the jaw arms 25, 26 and is pivoted at 35 to the jaw arm 26. The piston rod 39 of said cylinder is pivoted at 34 to the jaw arm 25. In the case of a relief of pressure in the pneumatic cylinder 38 the two jaw arms 25, 26 are forced apart by prestressed springs 40 so that the first part of the opening movement of the core box halves 19 and 20 will be effected under the action of these springs 40.

The carbon dioxide nozzle 41 is vertically adjustably mounted on a pivoted arm 42 and is adjusted by a pneumatic cylinder 43. The cylinder 43 is linked to a carrier 44 which is affixed on the column 5, whereas the piston rod 45 acts on the lever 42. A plunger 48 loaded by a prestressed spring acts on a second arm 46 of the lever 42 which carries the carbon dioxide nozzle 41 and is pivoted on a pivot 47. The plunger 48 will lift the carbon dioxide nozzle 41 slightly from the core box 19, 20, when the cylinder 43 is pressure-relieved.

The carbon dioxide nozzle comprises a mandrel 49, which is still engaged in the material of the core 36 at a time when the carbon dioxide nozzle 41 has already been slightly lifted. Thus the mandrel 49 locates the core 36 during the opening of the core box halves 19, 20. That mandrel is curved according to an arc of a circle having its center in the pivot 47. The rest table 22 may also be provided with a mandrel 50, indicated with dash lines, to prevent a displacement of the core so that the mandrels 49 and 50 will hold the core 36 during the opening of the core box halves 19 and 20 even if the core has no stability itself.

The mode of operation of the device shown in Figs. 3 and 4 will be explained hereinafter with reference to Figs. 5 and 6, 7 and 8 and 9 and 10.

After the core has been made on the core shooting machine the core box is placed on the rest table 22 and the carbon dioxide nozzle 41 is placed on the core box 19, 20. That position is shown in Figs. 5 and 6. The control valve 51 which is associated with the pneumatic cylinder 38 and controls the opening and closing movements of the jaw arms 25, 26, has a pressure space 52, which communicates with the compressed-air inlet 53, and two spaces 55 and 56 connected to the exhaust 54. By means of a switch 57 the solenoid 58 is energized so that the valve cone 59 connects the cylinder space 60 on the left of the piston 61 with the pressure line 53. The switch 62 being open, the solenoid 63 is deenergized and the valve cone 64 connects the right-hand side 65 of the pneumatic cylinder 38 to the exhaust 54. Thus the pincers 25, 26 is kept closed.

The control valve 66 which controls the pneumatic cylinder 43 has also a pressure space 67, which is connected to the compressed-air connection 68, and two pressure-relieved spaces 69 and 70 connected to the exhaust 71. In the position shown in Figs. 5 and 6 the switch 72 is closed and the solenoid 75 is energized. The space 73 above the piston 74, therefore, is connected by the valve cone 76 to the compressed-air supply 68, the switch 77 is open and the solenoid 78 is deenergized. As a result the valve cone 79 connects the space 80 below the piston 74 to the exhaust 71 so that the piston rod 45 forces the carbon dioxide nozzle 41 onto the core box 19, 20. The arm 46 is forced on a spring-loaded plunger 81, which opens the valve 82 which controls the carbon dioxide supply to the nozzle 41. As long as the carbon dioxide nozzle is forced on the core box 19, 20, carbon dioxide is supplied through the flexible tube 83.

As soon as the carbon dioxide hardening of the core 36 has been terminated, which will be the case after 3–30 seconds, depending on the size of the core, the switches 57, 62, 72 and 74 will be switched to the position shown in Figs. 7 and 8, whereby all switches are opened. The spaces 60 and 65 in the piston 38 which actuates the pincer arms 25, 26 are non-pressurized, being connected to the exhaust 54 by the valve cones 59 and 64. The springs 40 bearing on the extension 31 of the pivoted arm 30 force the jaw arms 25, 26 apart so that the core box halves 19 and 20 open by a few millimeters. The opening stroke effected by the spring 40 is limited because these springs are prestressed and perform only a limited stroke, which is just sufficient to open the core box halves 19 and 20 by a few millimeters. At the same time a compressed-air valve 85 is opened by means of a switch 84, to actuate the pistons of vibrators 86 for a short time. Such a vibrator 86 is arranged on each of



the two jaw arms 25, 26 to facilitate by its vibration the separation of the core box halves 19, 20, from the core 36.

The spaces 73 and 80 on both sides of the piston 74 in the cylinder 43 have also become unpressurized by the opening of the switches 72 and 77. A prestressed spring acts by means of the plunger 48 on the second arm 46 of the pivoted arm 42 to lift the carbon dioxide nozzle 41 by a few millimeters so that the opening movement of the core box halves 19, 20 is not interfered with. At the same time the arm 46 releases the plunger 81 and the valve cone 82 closes the carbon dioxide supply to the nozzle 41. In order to locate the core 36 during the opening movement of the core box halves 19 and 20 the carbon dioxide nozzle 41 is lifted only to such an extent that the mandrel 49 is still engaged in the core 36.

Then the device is switched to the position shown in Figs. 9 and 10. The switch 57 remains open whereas the switch 62 is closed. The space 60 on the left of the piston 61 in the cylinder 38 remains connected to the exhaust 54 and pressure-relieved whereas the space 65 on the right of the piston is connected to the compressed-air supply 53 and is pressurized. For this reason the piston 61 is forced to the left and the core box halves 19, 20 are completely opened, the pre-stressed springs 40 lifting from the stops on the jaw arms 25 and 26. The vibrator 86 is not shown in Fig. 10 because it is no longer required for the function.

If the core 36 has such a compact form that it will stand on the rest table 22 without being held by the mandrel 49 of the carbon dioxide nozzle 41, the switch 77 is closed at the same time whereas the switch 72 remains open. Now the cylinder space 73 above the piston 74 of the cylinder 43 is connected to the exhaust 54 and the space 80 below the piston 74 is connected to the compressed-air inlet 68. Thus the arm 42 with the carbon dioxide nozzle 41 is lifted and the core 36 is completely released and can now be lifted by hand from the rest table 22.

If the core 36 is of such shape as to lack sufficient stability the switch 77 remains open until the core 36 is gripped by the hand. The carbon dioxide nozzle 41 with the mandrel 49 is then lifted by closing the switch 77. The purpose of the springs 40 and 48 is also apparent from this showing. The prestressed springs 40 cause a slight opening movement of the two core box halves 19, 20 when the piston 61 is relieved on both sides. If this slight opening movement was effected by pneumatic means a very complicated control or even a second additional cylinder would be required. The same applies to the resilient plunger 48, which will cause the carbon dioxide nozzle 41 to lift by a few millimeters when the piston 74 is pressure-relieved on both sides.

What we claim is:

1. In a device for operating core shooting machines for forming cores which are to be subjected to an after-treatment such as carbon dioxide hardening, having a core shooting head and a vertically adjustable table, the combination comprising a core box to be inserted between said head and table, said core box being vertically divided into two sections, a stationary vertical axle, a pivoted arm mounted on said vertical axle, freely pivotally movable around and vertically adjustable on said vertical axle, movably mounted holding means on said pivoted arm, each of said holding means carrying one of said core box sections, said holding means together with said core box sections being movable toward and from each other and drive means to effect said movement of said holding means toward and from each other in order to close and open said core box.

2. In a device as claimed in claim 1, wherein said core box sections are rigidly but demountably affixed to said holding means.

3. In a device as claimed in claim 1, wherein said holding means comprise pincers arms pivotally mounted

on said pivoted arm and holding jaws on said pincers arms for carrying said core box sections, and pneumatically operated means for opening and closing said pincers arms.

4. In a device for operating core shooting machines for forming cores which are to be subjected to an after-treatment, such as carbon dioxide hardening, having a core shooting head and a vertically adjustable table, the combination comprising a core box to be inserted between said head and table, said core box being vertically divided into two sections, a stationary vertical axle, a pivoted arm mounted on said vertical axle freely pivotally movable around and vertically adjustable on said vertical axle, movably mounted holding means on said pivoted arm, each of said holding means carrying one of said core box sections, said holding means together with said core box sections being movable toward and from each other and drive means to effect said movement of said holding means toward and from each other in order to close and open said core box, a vertically adjustable rest table arranged within each of said pivoted arm and means for after-treatment of said core arranged adjacent to said rest table.

5. In a device as claimed in claim 4, wherein there is provided a sleeve freely rotatable and vertically displaceable on said stationary vertical axle, a stationary step bearing on said stationary axle supporting said sleeve in its lowermost position, a ring on said sleeve and means for clamping said ring to said sleeve, said ring carrying said pivoted arm.

6. In a device as claimed in claim 5, wherein there is provided a stop connected to said ring acting on said rest table, said stop transmitting the lifting movement of said table to said pivoted arm.

7. In a device as claimed in claim 4, wherein said holding means comprise pincers arms pivotally mounted on said pivoted arm and holding jaws on said pincers arms for carrying said core box sections.

8. In a device as claimed in claim 4, wherein there is provided fixing slots on said holding means and means for mounting said core box sections to said fixing slots in order to enable the mounting of core box sections of different size.

9. In a device as claimed in claim 4, wherein there is provided vibrator mounts on said holding means.

10. In a device as claimed in claim 4, wherein there is provided a linkage acting on said holding means and on said pivoted arm to enforce equal opening movements of holding means relative to said pivoted arm.

11. In a device as claimed in claim 4, wherein there is provided spring means acting on said holding means and forcing said holding means apart, said spring means being compressed during the last part of the closing movement of said holding means.

12. In a device as claimed in claim 4, wherein said drive means comprise a pneumatically operated piston and cylinder.

13. In a device as claimed in claim 4, wherein said drive means comprise a hydraulically operated piston and cylinder.

14. In a device as claimed in claim 4, wherein said means for after-treatment of the core comprises a carbon dioxide nozzle, means for adjusting said nozzle vertically and sealing faces on said nozzle, said sealing faces applying to said core box.

15. In a device as claimed in claim 14, wherein there is provided a holding means in connection with said nozzle and engaging said core.

16. In a device as claimed in claim 14, wherein there is provided a mandrel in connection with said nozzle, said mandrel penetrating said core when said sealing faces are lowered towards said core box.

17. In a device as claimed in claim 14, wherein there is provided means for pivotally mounting said nozzle for vertical adjustment, a mandrel in connection with said nozzle penetrating said core, said mandrel being arc shaped, whose radius corresponds to the radius of the pivotal movement of said nozzle.

18. In a device as claimed in claim 14, wherein there is provided a holding means on said rest table at the point where the core with the core box is placed thereon, said holding means preventing a lateral displacement of the core during the opening movement of the core box sections.

19. In a device as claimed in claim 14, wherein there is provided a mandrel on said rest table at the point where the core with the core box is placed thereon, said mandrel preventing a lateral displacement of the core during the opening movement of the core box sections.

20. In a device as claimed in claim 14, wherein there is provided spring means in connection with said nozzle holding said nozzle spaced from the core box, the force of said spring means being overcome during the last part of the setting-down movement of said nozzle when the same is forced against the core box.

21. In a device as claimed in claim 14, wherein there is provided a pneumatic piston and cylinder acting on said nozzle in order to effect the vertical movement thereof.

22. In a device as claimed in claim 14, wherein there is provided a hydraulic piston and cylinder acting on said nozzle in order to effect the vertical movement thereof.

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