United States Patent

[11] **3,547,183**

[72] Inventors **William R. Clingenpeel**
Middleburg Heights;
Charles L. Cain, Cleveland; Philip C. Hungerford, Jr., Cleveland Heights; Robert R. Hayes, Euclid, Ohio

[21] Appl. No. **643,574**
[22] Filed **June 5, 1967**
[45] Patented **Dec. 15, 1970**
[73] Assignee **ESB Incorporated**
Philadelphia, Pa.
a corporation of Delaware, by mesne assignments

[54] **MACHINE FOR CASTING BATTERY INTERCELL CONNECTORS AND TERMINAL POSTS**
11 Claims, 20 Drawing Figs.

[52] **U.S. Cl.** **164/333,** 29/204, 136/176, 228/58, 164/334, 249/84
[51] **Int. Cl.** **B22d 17/24**
[50] **Field of Search** ..... 164/333, 334, 332; 228/58; 136/176, 176.2, 176.1, 176M,P,S, (Inquired); 29/204; 249/84

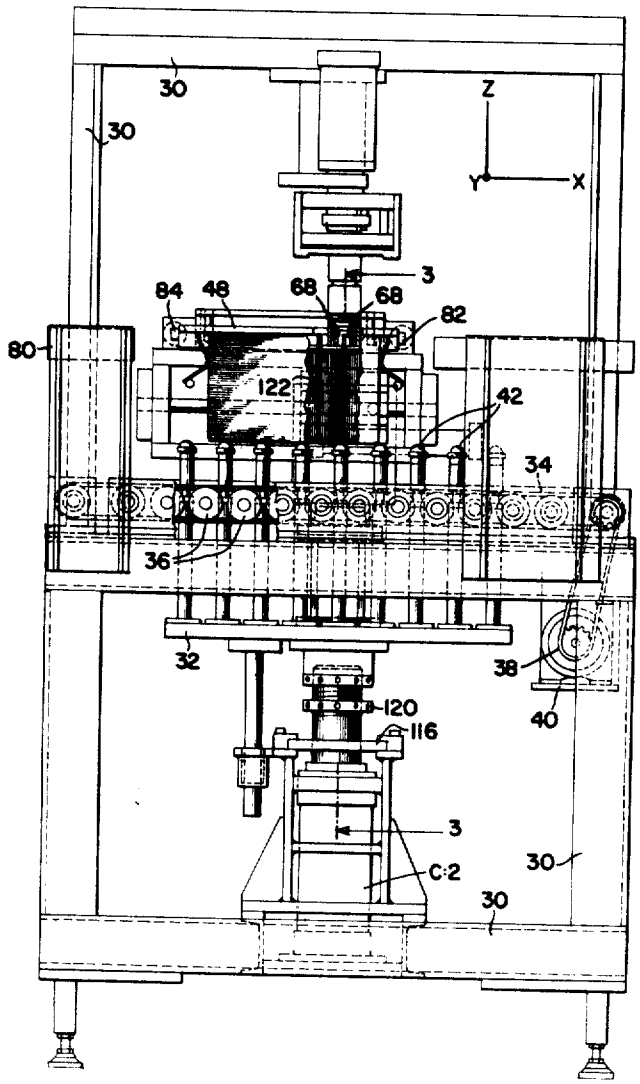
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Primary Examiner—J. Spencer Overholser
Assistant Examiner—V. K. Rising
Attorney—Alfred J. Snyder Jr., Robert H. Robinson and Raymond L. Balfour

ABSTRACT: A machine for casting intercell connectors through the partition of open-top battery containers. The machine may also be used to cast intercell connectors which go over the tops of the partitions, and to cast battery terminal posts.



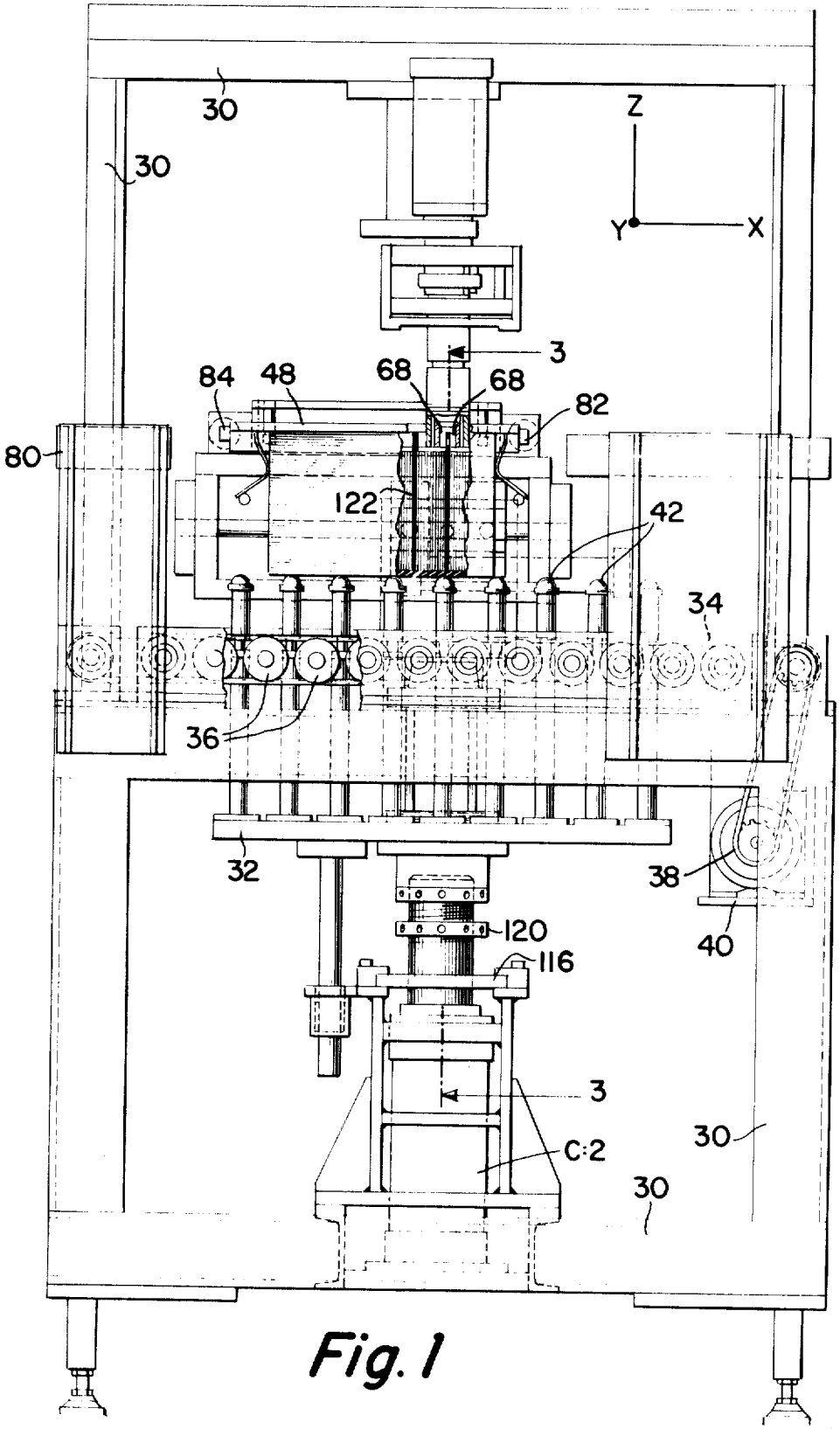


Fig. 1

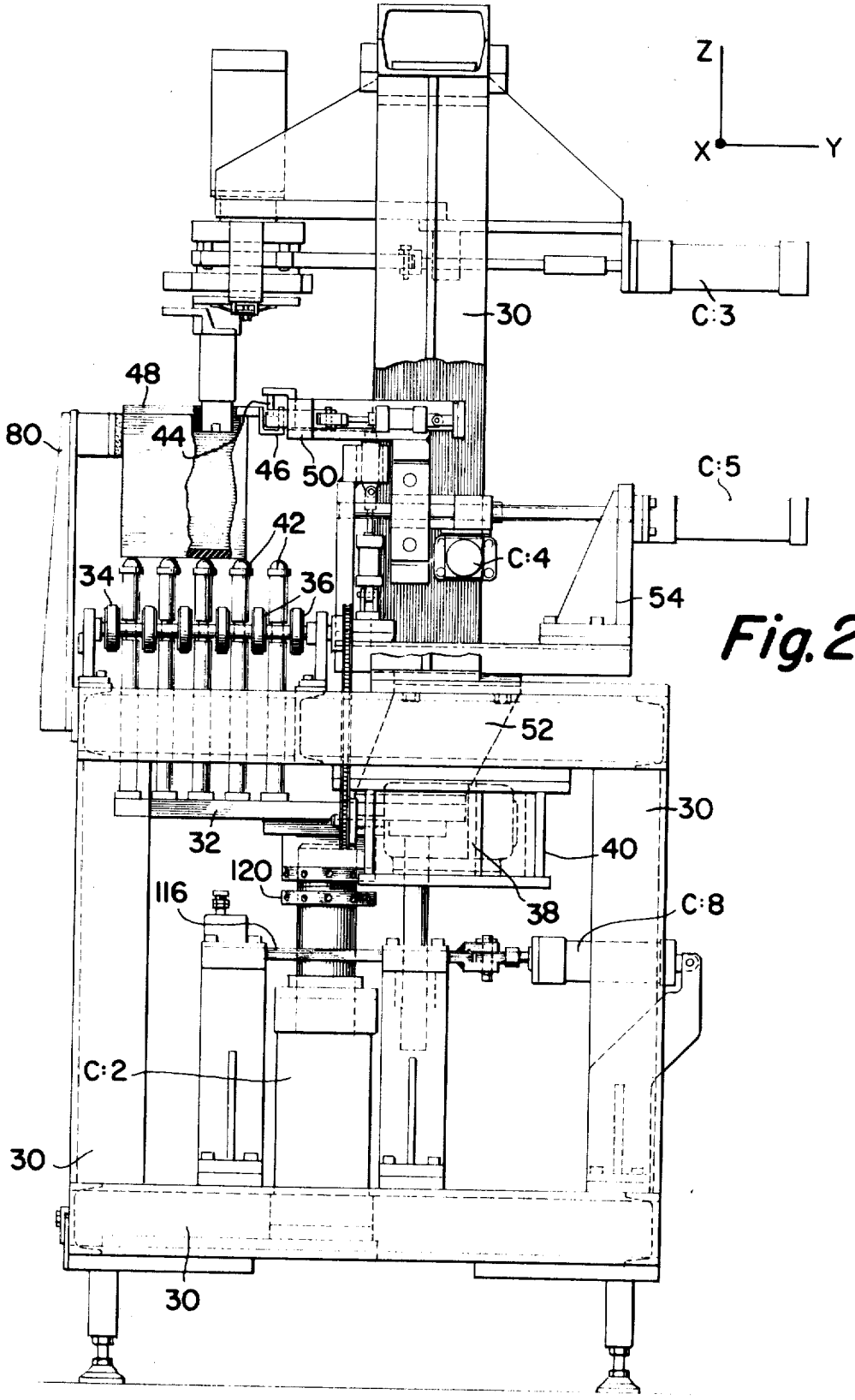
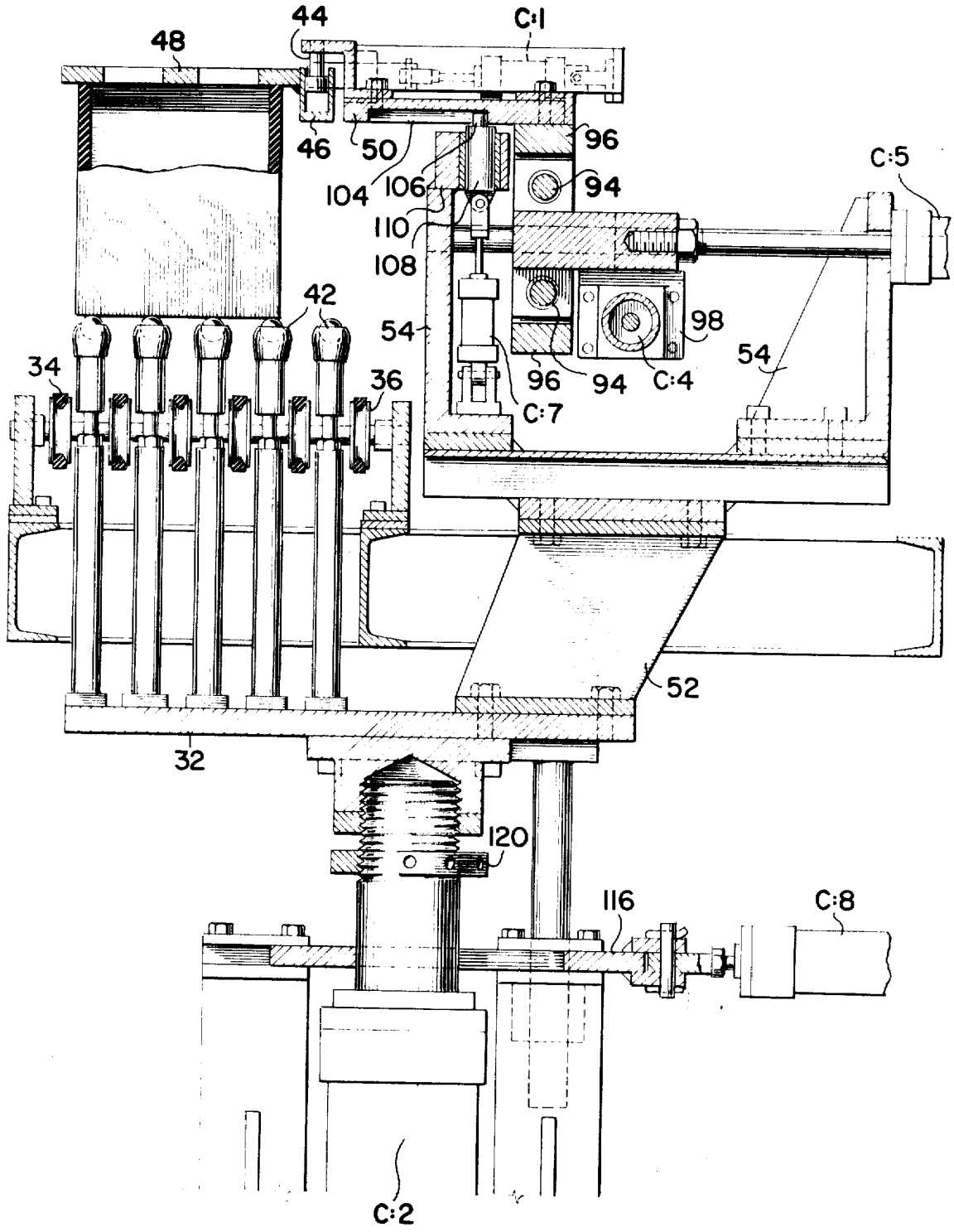

Z
X
Y
30
C:3
48
80
44
46
50
C:5
42
C:4
34
36
54
52
30
32
40
120
116
38
C:8
C:2
30
30

Fig. 2

Fig. 3


44
C:1
48
46
50
96
104
106
94
C:5
110
108
42
54
98
34
36
96
94
C:4
54
C:7
52
32
120
116
C:8
C:2

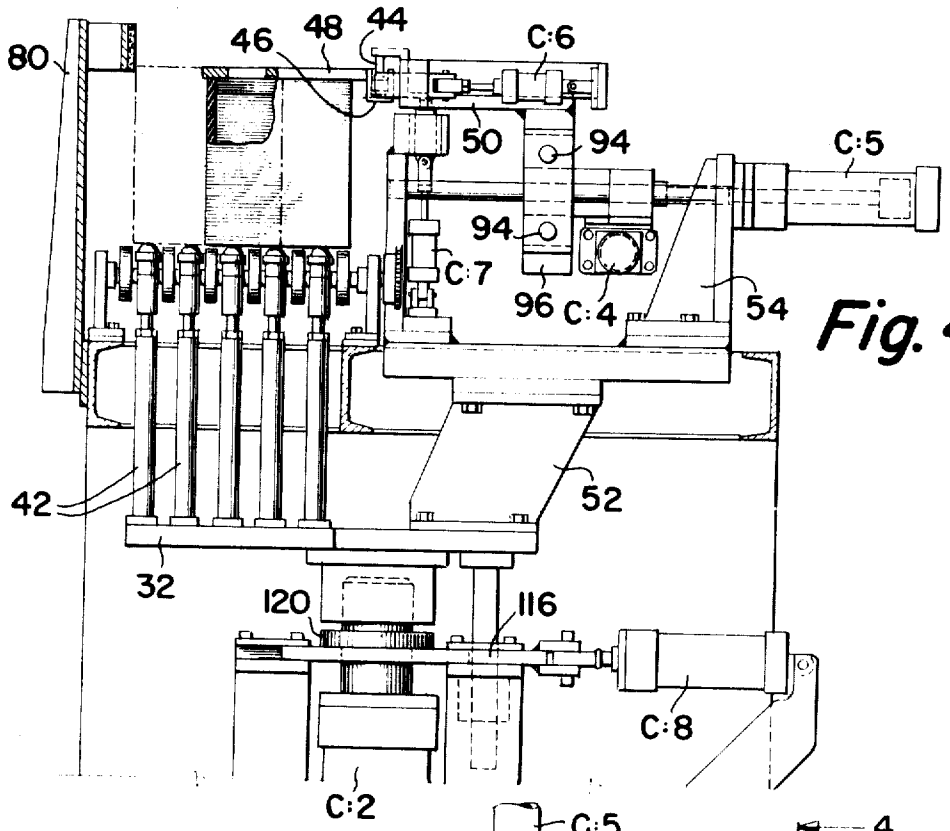

80
46
48
44
C:6
50
94
C:5
94
C:7
96
C:4
54
42
52
32
120
116
C:8
C:2

Fig. 4

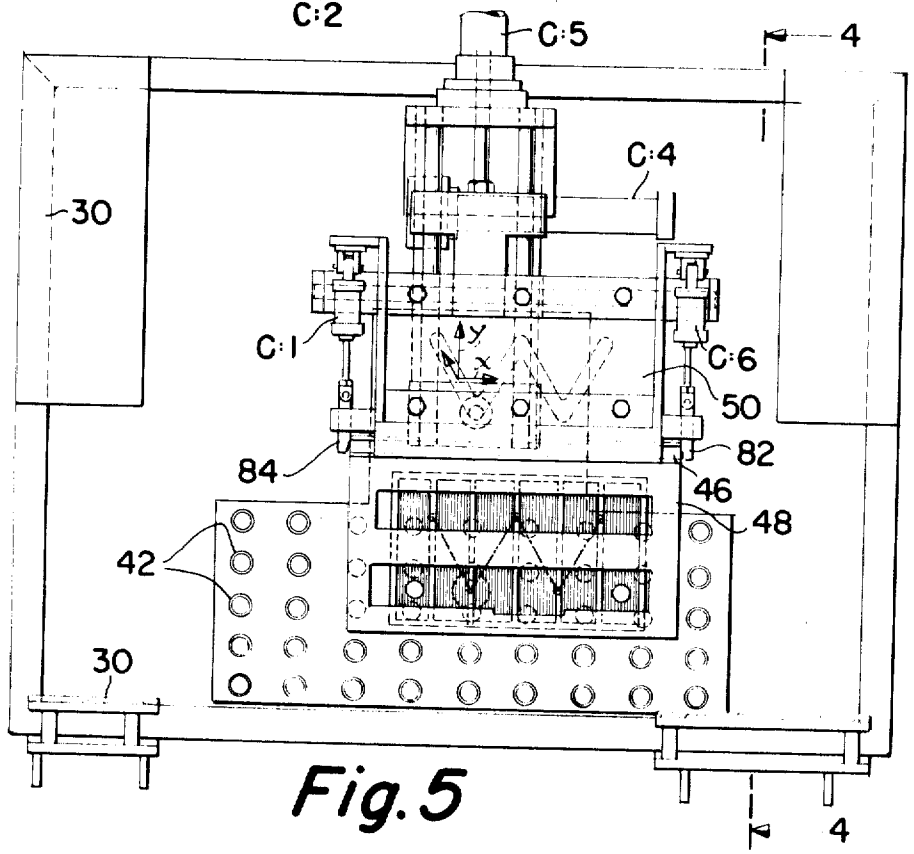

C:5
4
C:4
30
C:1
y
x
C:6
50
82
84
46
48
42
30
4

Fig. 5

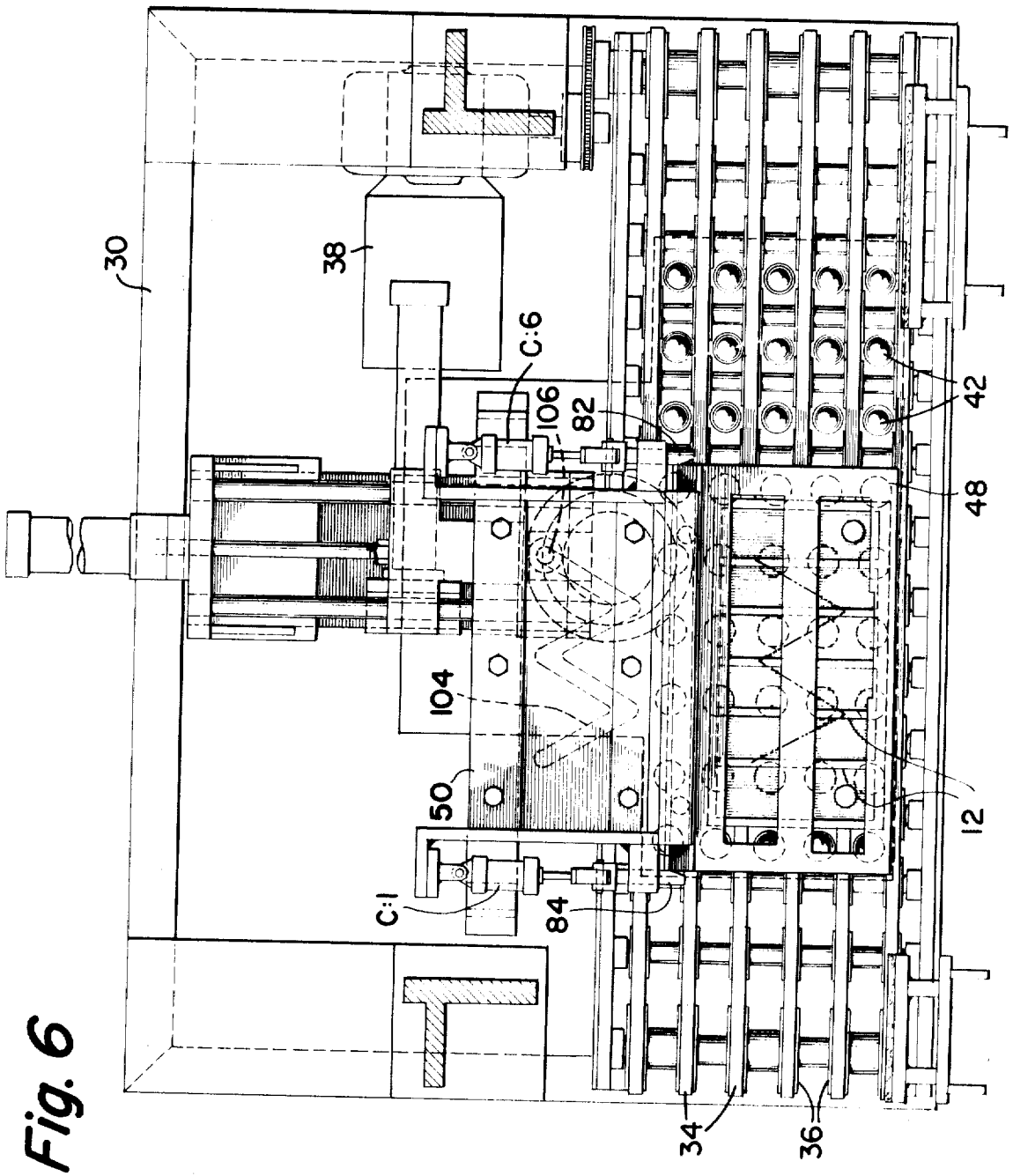


Fig. 6

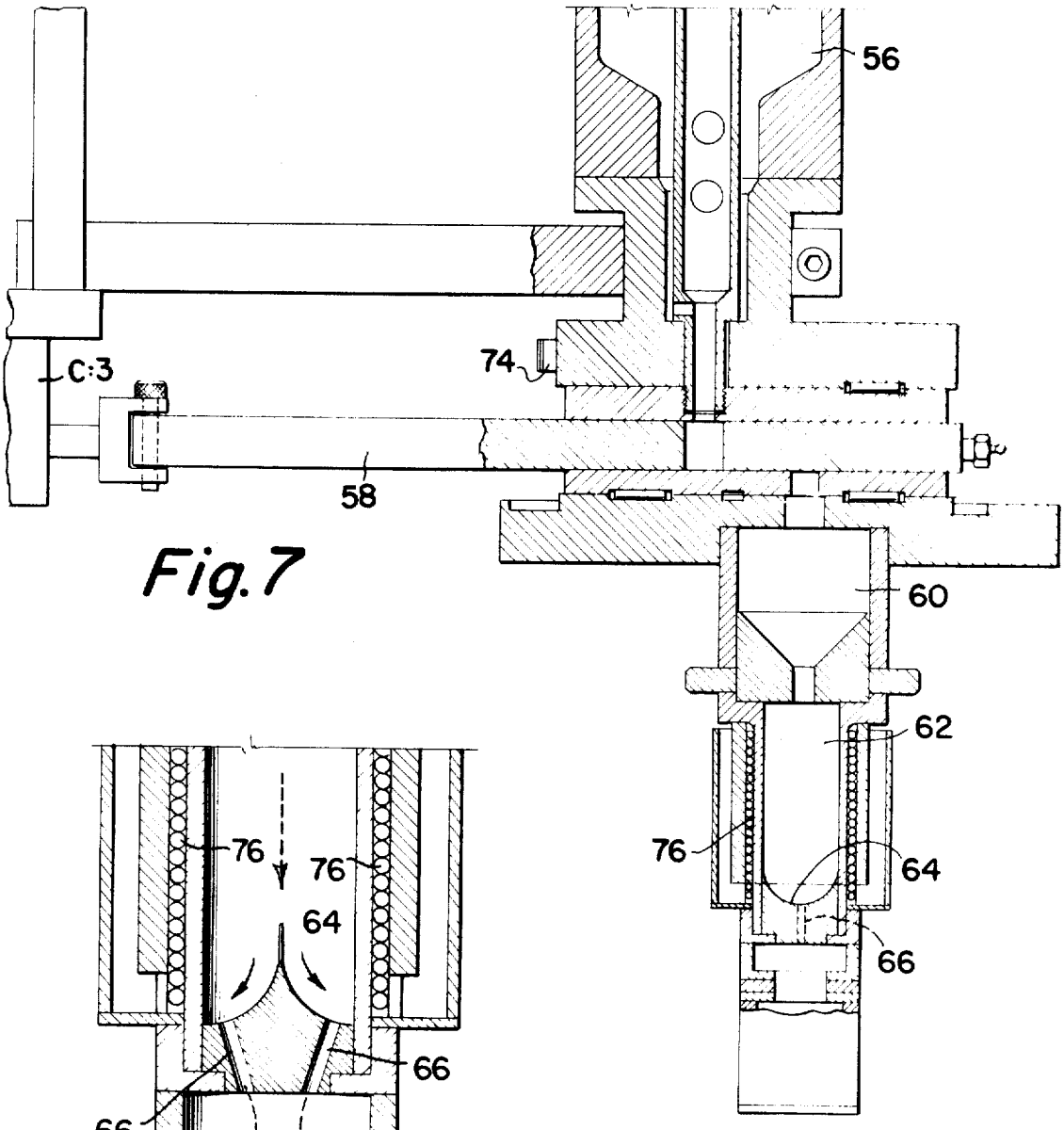


Fig. 7

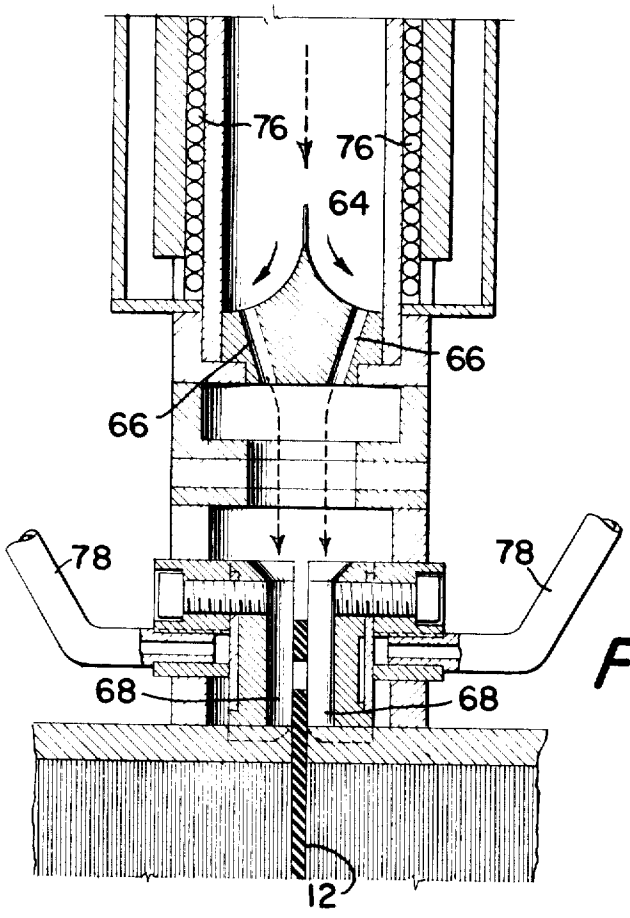


Fig. 8

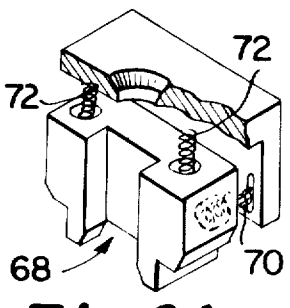


Fig. 8A

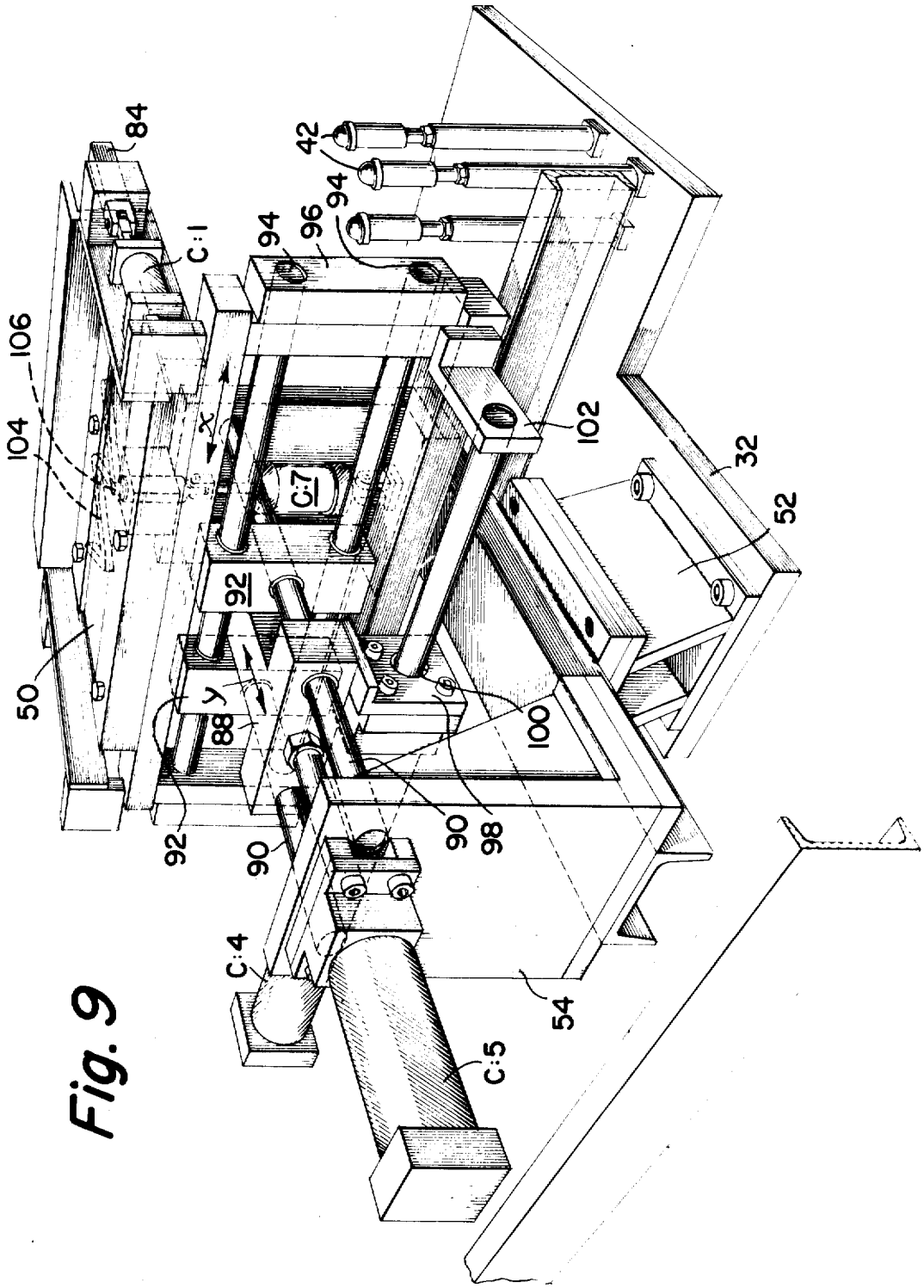

84
42
94
96
94
C:1
106
104
102
32
52
C:7
92
50
88
y
100
90
98
92
90
C:4
54
C:5

Fig. 9

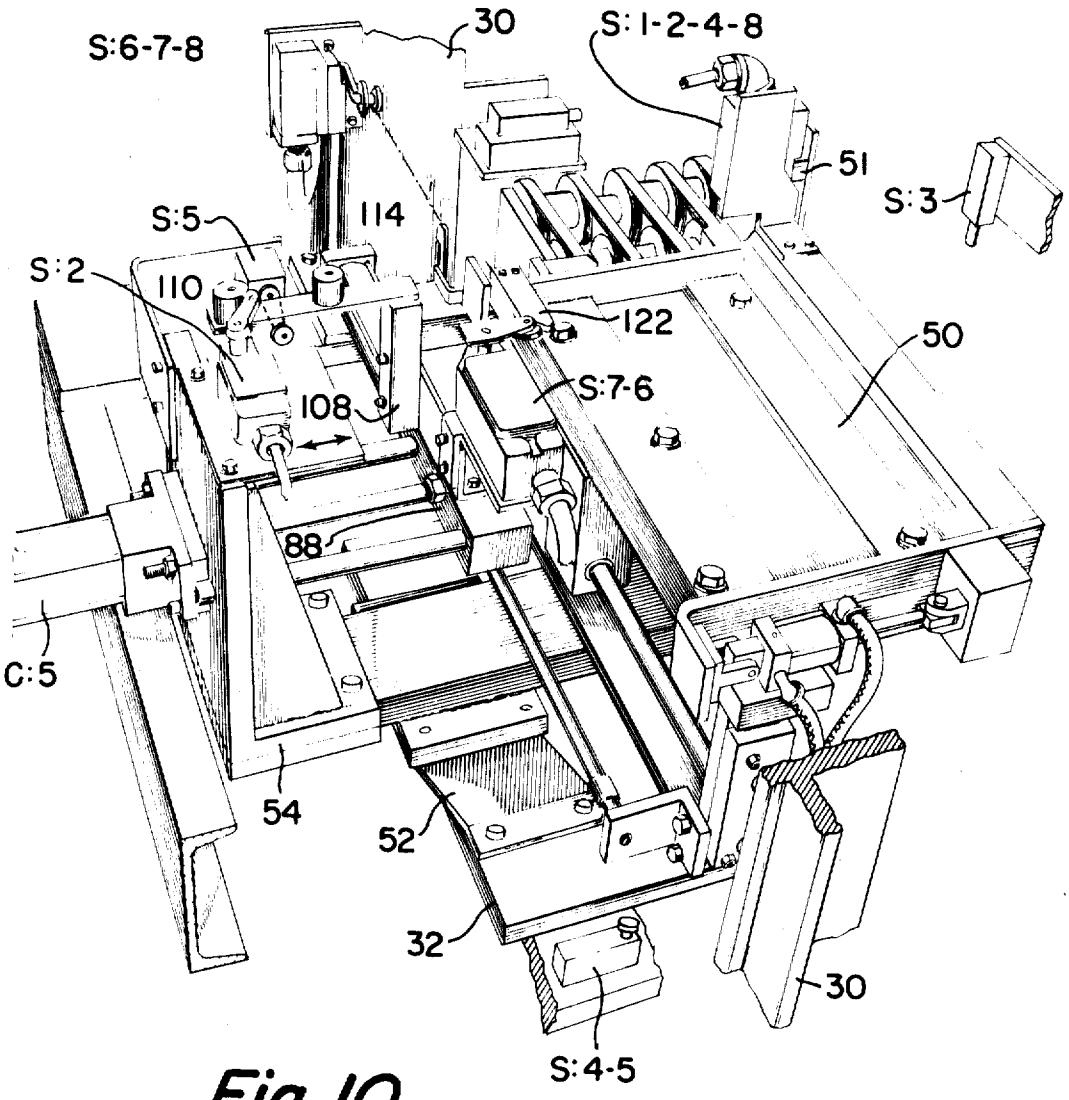

S:6-7-8
30
S:1-2-4-8
51
S:3
S:5
114
S:2
110
122
50
S:7-6
108
88
C:5
54
52
32
30
S:4-5

Fig. 10

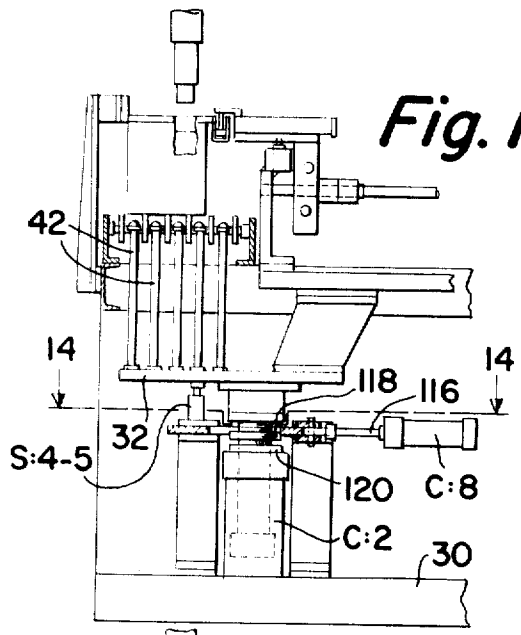


Fig. 11

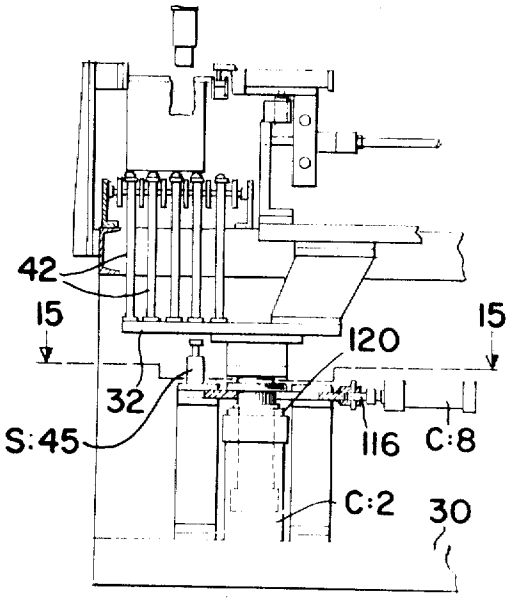


Fig. 13

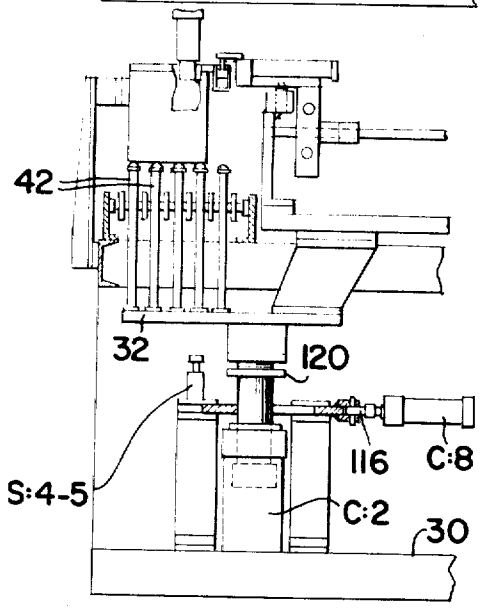


Fig. 12

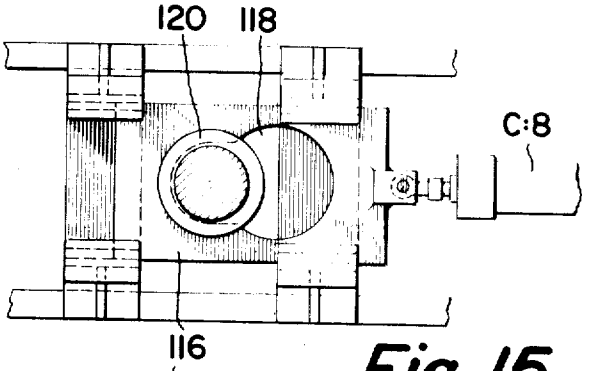


Fig. 15

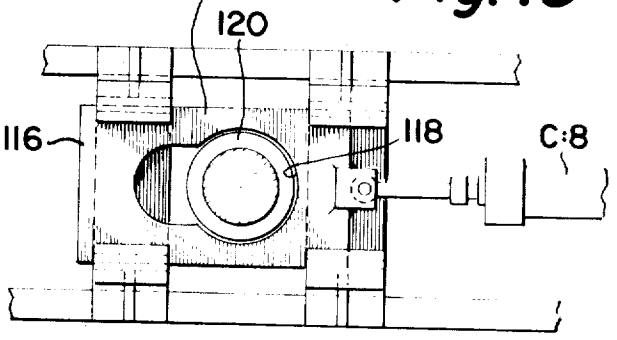


Fig. 14

Fig. 16

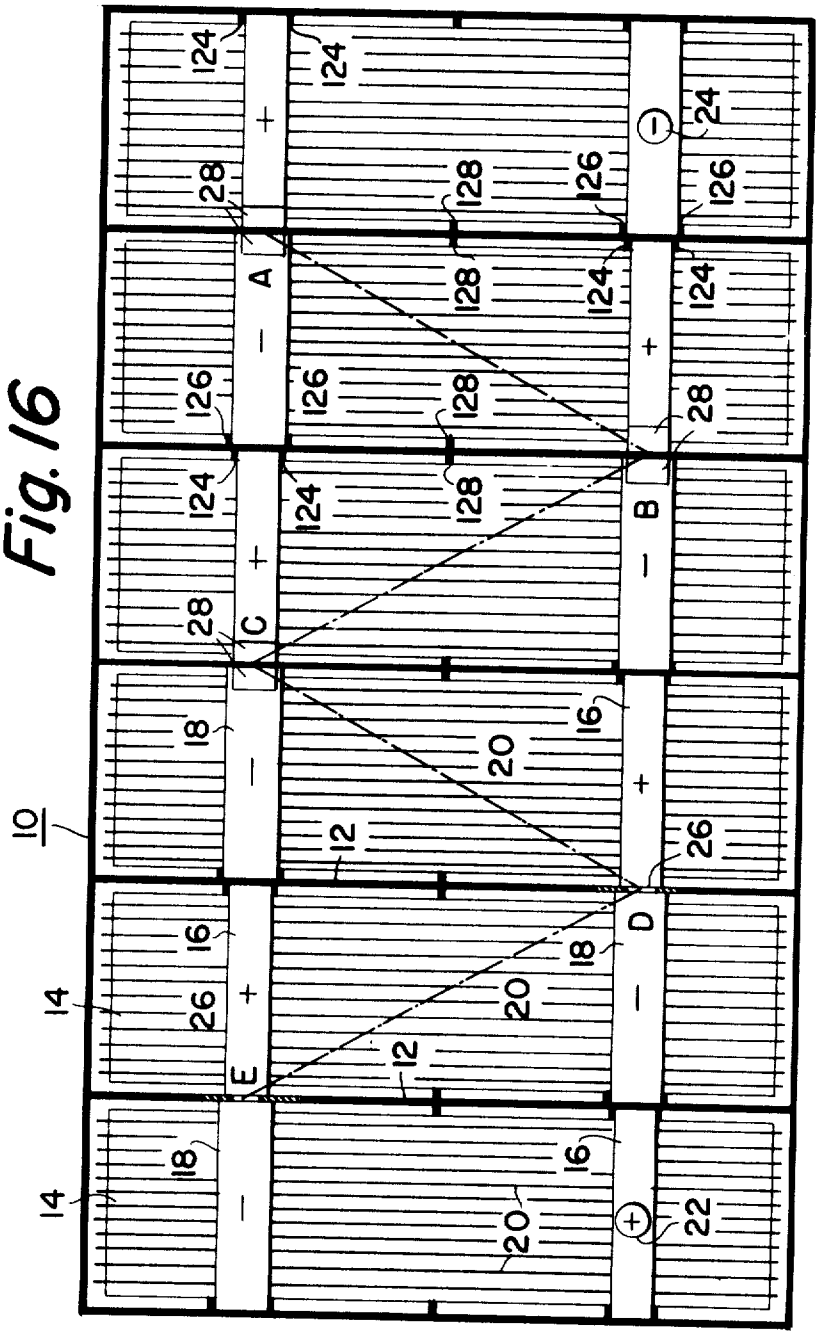
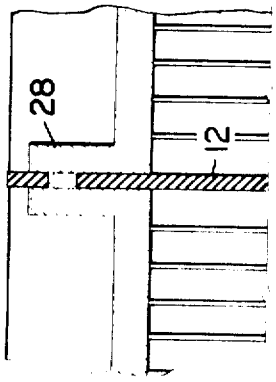


Fig. 17



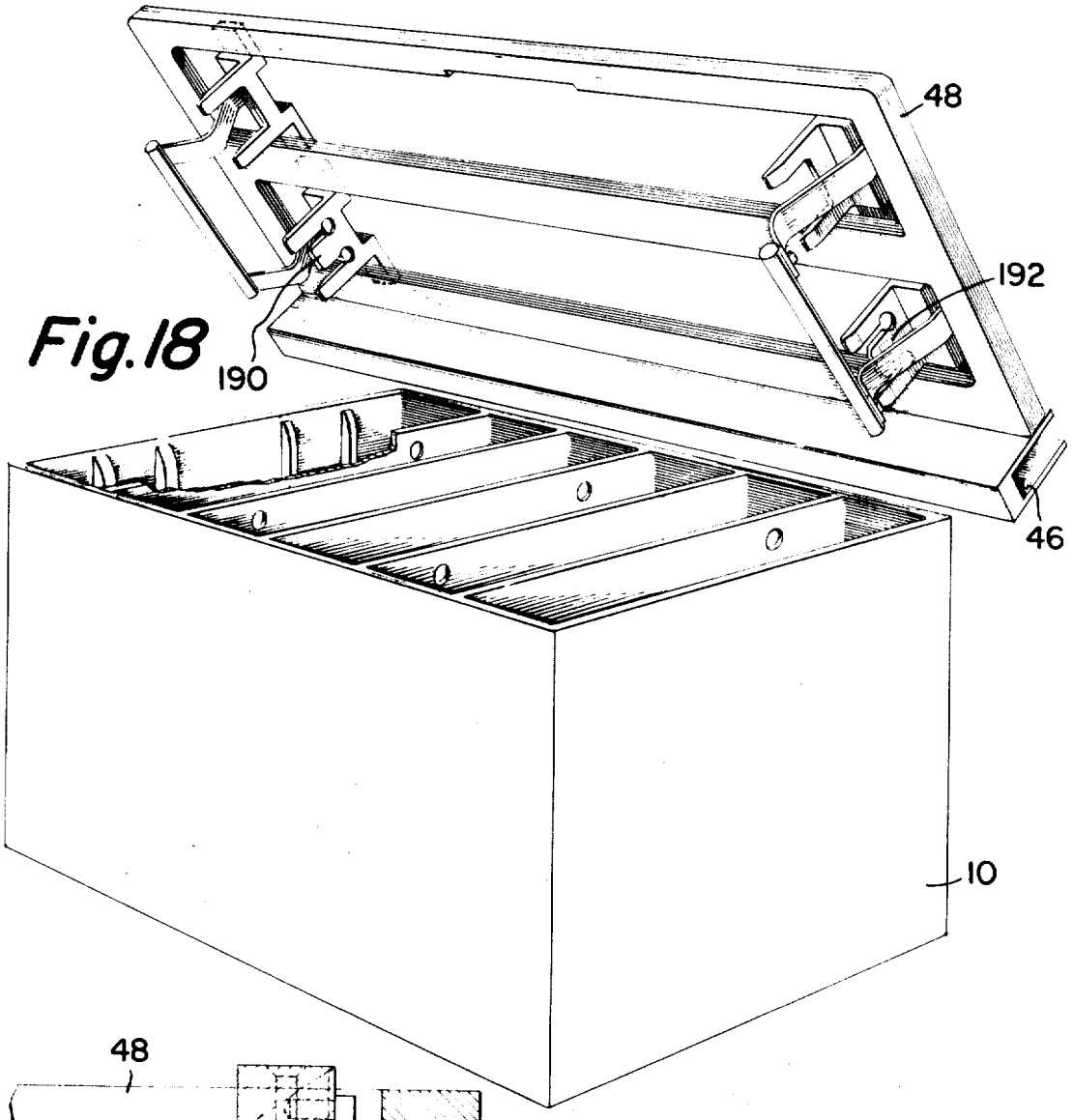


Fig. 18

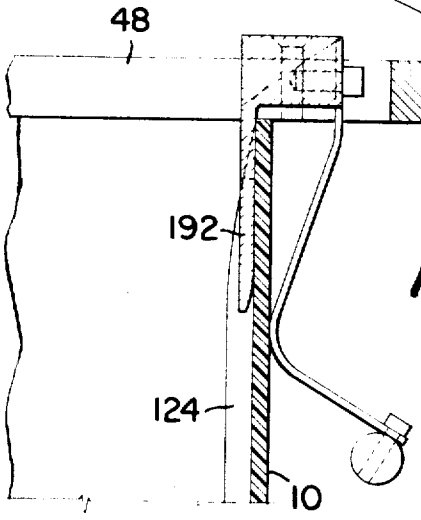


Fig. 19

MACHINE FOR CASTING BATTERY INTERCELL CONNECTORS AND TERMINAL POSTS

CROSS-REFERENCES TO RELATED APPLICATIONS

This application is related to the following other applications:

1. "Method for Casting Battery Intercell Connectors," Ser. No. 643,702, filed June 5, 1967, now abandoned;
2. "Machine for Crimping Battery Intercell Connectors," Ser. No. 643,632, filed June 5, 1967 now U.S. Pat. No. 3,508,313, and
3. Machine used in Electrically Testing Battery Intercell Connectors and Terminal Posts," Ser. No. 643,631, filed June 5, 1967, now abandoned.

All four applications bear common filing dates and have common ownership.

BACKGROUND OF THE INVENTION

This application relates to multicell storage batteries in which the elements in the various cells must be electrically connected together. Typical batteries are those used in automobiles, which today usually have six cells and in which the intercell connectors have traditionally been made of lead.

Previous through-the-partition methods of construction involved essentially two steps: either previously cast connector was inserted into the partition and then electrically connected to the plate connecting straps on both sides of the partition or, conversely, the connector was added to one of the straps and then a portion of that connector was inserted through the partition hole. Manual labor was involved with either method.

SUMMARY OF THE INVENTION

This invention provides a machine which simultaneously casts molten lead through an opening in the partition to form an intercell connector and fuses the molten lead to the straps on both sides of the partition thus combining into one step work which previously had to be done in two steps. The machine functions automatically, with subsequent labor savings. With minor modifications, the machine can be adapted to cast intercell connectors over the tops of the partitions, and to cast battery terminal posts.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a front elevation of the machine with the battery in its fully elevated position.

FIG. 2 is a side elevation of the machine with the battery in its fully elevated position.

FIG. 3 is a side elevation of a portion of the machine, with portions removed, showing the battery in its fully elevated position.

FIG. 4 is a side elevation of a portion of the machine showing the battery in a different vertical and horizontal position from FIGS. 2 and 3.

FIG. 5 is a plan view of the portion of the machine shown in FIG. 4.

FIG. 6 is a sectioned plan view of the machine together with the battery and its accompanying jig plate, taken along the section line A–A shown in FIG. 2.

FIG. 7 is a sectioned left side view of the upper portion of the pouring mechanism.

FIG. 8 is a sectioned view of the lower portion of the pouring mechanism of the machine.

FIG. 8A is an oblique view of the lower portion of the pouring mechanism with portions removed to shown the molds and the horizontal and vertical springs which act on the molds.

FIG. 9 is an oblique view of the mechanism which moves the battery horizontally between casting stations, looking from the rear of the machine toward the front.

FIG. 10 is an oblique view showing various switches in the machine.

FIG. 11 is a side elevation of a portion of the bottom of the machine, showing the piston of the main lift cylinder lowered so that its collar is below a cutout in a horizontal key.

FIG. 12 is similar to FIG. 11, but shows the piston fully elevated and the collar above the key.

FIG. 13 is similar to FIGS. 11 and 12, but shows the piston lowered so that the collar rests upon the key.

FIG. 14 is a plan view of the main lift cylinder and the key in the position shown in FIG. 11.

FIG. 15 is a plan view of the main lift cylinder and the key in the position shown in FIG. 13.

FIG. 16 is a top view of a six cell automobile battery before the cover is placed on.

FIG. 17 is a sectional elevation showing the intercell connector extending through the partition.

FIG. 18 is an oblique view of the battery and its accompanying jig plate.

FIG. 19 is a sectioned elevation showing how the jig plate engages the end of the battery container.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Before beginning a discussion of the machine which is the subject of this application, it is in order to give a brief description of typical battery on which the machine might perform its operations.

FIG. 16 shows a six cell automobile battery after the terminal posts and three intercell connectors are constructed but before the cover of the battery is applied. The drawing shows a container 10 having partitions 12 which divide the space inside the container into six compartments 14. Inside each compartment is a series of negative and positive plates, alternatively spaced and separated from one another by suitable separators. Extending across the compartments and electrically connecting all positive plates with each other and all negative plates with one another are positive and negative connecting straps 16 and 18, respectively. Collectively the plates, separators, and connecting straps constitute cell elements 20. Also, extending upward from their respective straps are positive and negative terminal posts 22 and 24, respectively. Inasmuch as all of this is typical of conventional battery construction, no elaborate explanation will be given, and the drawing shows the plates and separators schematically represented by lines. The cell elements 20 are understood to be assembled before they are placed in their compartments. Also, the partitions are provided with suitable holes 26 before the cell elements are inserted. FIG. 16 shows two of the partitions with portions broken away and before the intercell connectors are cast, so that the positions of the partitions holes 26 may be clearly shown. The elements are to be placed in the compartments before the intercell connectors are poured. FIG. 17 shows an intercell connector 28 in cross section.

Since the casting of the intercell connectors is work which must be done inside the battery container, it is necessary either to move the battery to the pouring mechanism or, conversely, move the pouring mechanism to the battery. The machine shown in the drawings moves the battery to the pouring mechanism, and in so doing requires movement along all three of the principle axes. For convenience, these axes are labeled X, Y, and Z, and are defined as shown in FIGS. 1 and 2.

The machine FIGS. 1 and 2) includes a frame 30 on which the functional parts are mounted. At the bottom and near the center of the machine is a hydraulic or air cylinder C:2, to the vertical piston of which is mounted a table 32. Mounted in the frame 30 is a series of horizontally aligned belts 34 (FIGS. 1, 2, 3, and 6) which move over pulleys 36 and which are driven by a combination electric motor and speed reducer mechanism 38 attached by a bracket 40 to the frame 30. These belts assist in moving the battery into the desired position for connector pouring and will normally constitute a segment of a longer conveyor system, the remaining portions of which lead to and from the machine and are not shown in the drawings.

To provide vertical movement to the battery, a series of risers 42 (FIGS. 1, 2, 3, and 6) are mounted on the table 32 and spaced between the belts 34 and their associated pulleys 36. The movements of the parts of the machine are programmed in such a manner that the piston of cylinder piston

C:2, and consequently the risers 42, are lowered when the battery is being received, but afterward rise to elevate the battery to the proper level for intercell connector casting. To facilitate horizontal movement of the battery, each riser is provided at its top with a ball castor.

In addition to the vertical movement, the machine must also impart horizontal motion to the battery. Although with sufficient casting mechanisms the machine could cast all intercell connectors simultaneously, the machine shown in the drawings casts only one intercell connector at a time, and in the process of casting all five intercell connectors will move the battery horizontally along the W-shaped path shown in FIG. 16; to facilitate later discussion, the five points of this letter W will be designated as points A, B, C, D, and E. The horizontal motion is transmitted to the battery by cam followers 44 (FIG. 2 through 4) which lock into position in the U-shaped channel 46 of a jig plate 48 fitting over the top of the battery, as shown in FIGS. 2 through 6 and FIGS. 18 and 19. The cam followers 44 are rigidly secured to, and moved in the X-Y plane by, a horizontally movable cam plate 50 which is suspended above the table 32 by means of a support bracket 52, a U-shaped bracket 54, and other associated parts whose operation will be described in detail later.

Although any mechanism capable of transmitting lead to the molds may be used, one such valve and pour mechanism is shown in FIGS. 7 and 8. The mechanism is suspended from the frame 30 above the cam plate 50. At the top of the mechanism is a multipiece lead receiving chamber 56 (FIG. 7) from which the molten lead first flows. Beneath the receiving chamber 56 is a slide valve 58 pivotally connected to the piston rod of an air cylinder C:3, which valve transports the molten lead horizontally to where it is discharged into a funnel-shaped housing 60. From the housing 60 the lead falls into a chamber 62 which is split into two portions by a dividing wall 64 at its bottom. (The portion of the valve and pour mechanism shown in FIG. 8 has been rotated 90° from its position in FIG. 7.) Through the passageways 66 leading from openings in the bottoms of the two portions of the chamber the lead flows finally into a pair of molds 68 surrounding the openings in the partitions. The molds 68 are normally spring biased toward one another by means of springs 70; additional springs 72 positioned between the molds 68 and the chamber 62 permit some vertical displacement of the molds with the respect to the remainder of the pour mechanism. The springs 70 and 72 may best be seen in FIG. 8A. The pour mechanism is made complete by the addition of various heating elements 74 and 76 situated within the receiving chamber 56 and the chamber 62 to maintain the lead at the desired temperature, as well as by air lines 78 leading to the molds 68 to chill and solidify the lead after it has been poured into the molds.

Before a charge of molten lead is discharged by the slide valve 58, the pour mechanism must be positioned properly with respect to the battery. This is accomplished when the risers 42 elevate to their final height, in the process of which the molds 68 separate and slip down on both sides of the partition to surround the partition holes (FIGS. 3 and 8). The bottoms of the molds come to rest on the tops of the connecting straps 16 and 18 beneath the hole. Thus the cavities of the molds 68 are both adjoining the partition hole so that the molten lead may flow into the mold cavities and through the hole in the partition to form the desired intercell connector. The springs 70 bias the molds 68 toward the partition, and the springs 72 bias the mold downward against the connecting straps.

Before describing the sequence of motions of the machine, it should be stated generally that these motions are produced by cylinders which are activated when associated switches are closed, tripped, or triggered. There must, of course, be some circuitry connecting the switches with the cylinders. Since these circuits may be electrical, air, or hydraulic and since numerous circuits accomplishing the same net result might be devised, no specific circuit diagram will be shown. Instead such terms as "triggering switch X causes cylinder X to function" or "cylinder X functions in response to the action of switch X" will be used, these terms being understood to imply that there is an appropriate circuit of some type between the switch and the cylinder.

The sequence of motions of the machine will now be described beginning with with the time when the battery and accompanying jig plate roll onto the belts 34 and are deflected by the guide fence 80 (FIGS. 1 and 2) into the proper horizontal position so that the cam followers 44 fit into the U-shaped channel 46 of jig plate 48. The forward motion of the battery along the X axis will come to a halt when the jig plate 48 bumps into the outwardly projecting stop pin 82 (FIGS. 1, 5 and 6). Simultaneously the advancing battery triggers switch S:1-2-4-8 (positioned above the cam plate 50 but having its actuator arm 51 extending downward below the cam plate to make contact with the jig plate on top of the battery, see FIG. 10), causing shot pin 84 (FIGS. 1, 5 and 6) to extend at the rear of the battery to lock the battery in place. Motion of shot pin 84 is produced by air cylinder C:1, which functions in response to the action of switch S:1-2-4-8.

Switch S:1-2-4-8, when triggered, also causes cylinder C:2 to function, raising the table 32, risers 42 and the battery upward. The battery is lifted so that the molds 68 slip around the partition at Position A, one of the five points on the figure W. At this time the molds are in position for pouring, as shown in FIGS. 1, 3, and 8.

When the piston of cylinder C:2 approaches the top of its stroke, switch S:3 (suspended from the frame 30, see FIG. 10) is triggered by an arm 86 extending outward from bracket 54, causing cylinder C:3 to function and move slide valve 58 so that a quantity of molten lead is discharged into the molds 68 and the intercell connector is poured. Switch S:3, in addition to triggering cylinder C:3, also triggers a remotely located timing mechanism which regulates the time during which cylinders C:2 and C:3 are functioning; after the intercell connector is poured and at the end of this predetermined period of time, cylinder C:3 retracts the slide valve and the piston of cylinder C:2 is lowered.

As the piston of cylinder C:2 lowers the battery, switch S:4—5 (located beneath table 32, as shown in FIGS. 11, 12, and 13) is triggered by the undersurface of table 32, causing table two-way air cylinders C:4 and C:5 to function. As shown in FIG. 9, cylinder C:5 the one which causes the cam plate 50 to move in the Y direction, is securely mounted in bracket 54, and the piston of cylinder C:5 acts against a block 88. Block 88 is free to slide along a pair of guide bars 90, and its motion is translated to tie blocks 92 through a projecting portion of block 88 which is rigidly connected to tie blocks 92. Thus tie blocks 92 may move in the Y direction, but not in the X direction.

FIG. 9 also shows a pair of guide bars 94 which extend through, and may slide with respect to, the tie blocks 92 in the X direction. The ends of bars 94 are secured in the vertical portions of a frame 96 which is constructed in the form of a rectangular loop; projecting outward from the top of this frame 96 is the cantilevered cam plate 50. Extending downward from the block 88 to which it is securely attached is a bracket 98; cylinder C:4, which is oriented in the X direction so as to produce motion of the cam plate 50 in the X direction, is in turn rigidly mounted on one side of bracket 98 so that its piston may slide freely through a hole 100 in bracket 98. The end of the cylinder C:4's piston is rigidly affixed to a bracket 102 projecting outward from frame 96. From this it can be seen that when cylinder C:5 is activated, its piston causes bracket 102, frame 96, guide bars 94, and cam plate 50 to move simultaneously in the X direction with respect to the tie blocks 92.

From the proceeding it can be seen that the frame 96—to which cam plate 50 is secured—will move in the Y direction in response to the action of cylinder C:5 and in the X direction in response to the action of cylinder C:4.

While the se action of both cylinders C:4 and C:5 is initiated by the triggering of switch S:4-5, cylinder C:5 is activated after

cylinder C:4; at positions B, C, D (see FIG. 16), this time delay is necessary or desirable to permit a cam guide 106 to move out of the peak at the position before cylinder C:5 is activated. When both cylinders C:4 and C:5 function, as they will when switch S:4-5 is triggered, cam plate 50 will move in the horizontal X-Y along a path which is predetermined by the shape of a groove 104 cut in the under side of cam plate 50. As is shown in FIG. 6, this groove 104 has the same W shape which appears in FIG. 16. The cam plate 50 is made to follow along this W-shaped path by reason of a cam guide 106 which, as can be seen in FIGS. 3 and 6, fits into the groove 104. The cam guide 106 is at the end of a linkage 108 which slides vertically through a block 110 affixed to the top of the bracket 54; this block 110 permits vertical but not horizontal motion of the linkage 108, the motion being produced at the proper time by cylinder C:7 below.

Since the cam plate must move in the Y direction both toward and away from the battery as it travels its W-shaped course, something must cause the two-way air cylinder C:5 to function in the proper direction. This is done by double-action switch S:5, which is located on the side of the bracket 54 as shown in FIG. 10 and which is triggered each time the piston of cylinder C:5 reaches an extreme position of its movement. Thus, when switch S:5 is tripped in one direction, cylinder C:5 advances the cam plate in the Y direction toward the battery, while when the switch S:5 is tripped the other way cylinder C:5 pulls the cam plate away from the battery. While one of the functions of switch S:4—5 is to cause cylinder C:5 to act at the right time, switch S:5 causes the cylinder C:5 to act in the right direction.

When cylinder C:5 reaches the end of its stroke (when the cam plate has moved from Position A to Position B along its W-shaped Path), the battery will be in position to have its second intercell connector poured. Something, however, must cause cylinder C:2, the main cylinder providing vertical motion to the table 32 and risers 42, to function and raise the battery up to the pouring molds. This is done by switch S:2 a double-action switch mounted on the top of bracket 54 (FIG. 10). An arm 108 extending upward from block 88 has two trips, 110 and 112, which engage the switch S:2 as cylinder C:5 comes to the end of its stroke in either direction along the Y axis. Regardless of which way switch S:2 is tripped, it causes cylinder C:2 to function and lift the battery. A new cycle of the machine then begins, with switch S:3 being triggered when cylinder C:2 approaches the top of its stroke, causing cylinder C:3 to function and move the slide valve 58 to discharge a quantity of molten lead into the molds 68 to pour another intercell connector. Successive cycles are repeated until the last of the five intercell connectors is poured.

After the last intercell connector is poured, at which time the cam plate will be at Position E along its W-shaped path, the table 32 once again begins to go down. During this descent a switch S:6-7-8, mounted on frame 30 as shown in FIG. 10, is tripped by the downward motion of arm 114 which is attached to the cam plate 50. Tripping of the switch S:6-7-8 activates cylinders C:6, C:7, and C:8, thus causing several events to occur. First, cylinder C:6 is activated, retracting the stop pin 82 (FIG. 6) which in turn permits the constantly rotating belts 34 to carry the battery away from the machine as soon as the battery is lowered sufficiently. Secondly, since the cam plate is now ready to move form from Position E back to Position A (FIG. 16) and there is no reason to travel backwards along the W-shaped path to get back to Position A, cylinder C:7 (FIG. 3) is activated, retracting the cam guide 106 to which its pistmDn is coAnnected from the groove of the cam plate, the cam plate is then free to move along a straight line path back to position A. Cylinder C:8 is also activated when S:6-7-8 is triggered; however, that cylinder should be discussed separately.

When the battery first as advances onto the machine it is transported by the constantly rotating belts 34 and is lifted from the belts when cylinder C:2 first functions to raise the battery toward its first intercell connector pour position. Although the battery must be lowered and raised again several more times before its ready to be removed from the machine, there is no need for the battery to come down on the belts 34 since the necessary horizontal motion in the X direction will be transmitted to the battery through the cam plate and jig plate. Indeed, it is preferable for the battery not to be on the moving belts 34 until after the last intercell connector is poured, so that the machine does not have to overcome the force of the belts in order to prevent undesired motion of the battery in the X direction. With this in mind, attention is directed toward FIGS. 11 through 15, which show a slidable key 116 located in the center of the machine's frame 30 and beneath the table 32. See also FIGS. 1 through 4 for the location of this key. As shown in FIGS. 14 and 15, the key 116 has a cutout 118 in it. Both the larger and smaller portions of the cutout 118 are of sufficient size to accommodate the piston of the cylinder C:2, but only the larger portion is of sufficient diameter to permit a collar 120 located on the piston of cylinder C:2 to go through the cutout 118. Horizontal sliding motion is provided to key 116 by the piston of two-way air cylinder C:8. Before a battery is received by the machine, the piston of cylinder C:2 is all the way down so that the collar 120 is below the key 116; at this time the larger portion of cutout 118 is directly above the collar. (In FIG. 11 the battery has been received, but has not yet been lifted. See also FIG. 14, a view taken at the same time as FIG. 11.) When the advancing battery triggers switch S:1-2-4-8, cylinder C:2 is activated, raising the battery. Following a suitable time delay sufficient to permit the collar 120 to raise up through the cutout in the key, cylinder C:8 is activated, moving the key horizontally (FIG. 12) so that when the piston of cylinder C:2 comes down later, the collar 120 will rest on top of the key (see FIG. 13); the piston of cylinder C:2 will go downward through the smaller portion of the cutout, but the collar will not (FIGS. 13 and 15). The vertical descent of the piston of cylinder C:2 will thus be limited. With the collar resting on the key, the molds 68 will clear the top of the battery permitting the battery to be moved along its W-shaped path; at the same time, the battery remains sufficiently elevated so that it doesn't rest on the revolving belts 34. After the last intercell connector is poured, it is desirable to have cylinder C:8 function again in the reverse direction so that the collar will lower through the cutout in the key and so that the battery will be lowered to the revolving belts where it can be transported away from the machine. This last motion of cylinder C:8 is caused when switch S:6-7-8 is triggered.

The switch S:1-2-4-8 (see FIG. 10) whose arm 51 makes contact with the jig plate on top of the battery is released when the battery advances in the X direction away from the machine and the switch arm 51 drops off the back of the jig plate. When switch S:1-2-4-8 is so released, cylinder C:1 activates to retract shot pin 84 and simultaneously cylinder C:4 functions, returning the cam plate along a straight line path from position E to position A. When the cam plate reaches Position A, switch S:7-6 (FIG. 10) is triggered by an arm 122 mounted from and above block 88. This causes cylinders C:6 and C:7 to again function but in reverse direction to their previous motions so that the stop pin 82 again projects outward and the cam guide 106 is inserted into the W-shaped groove of the cam plate.

At this point the machine is finished with its work on one battery and is ready to receive another. The piston of cylinder C:2 is all the way down. The stop pin 82 is extended, while shot pin 84 is retracted. The cam plate is back to Position A, and the cam guide 106 is inserted into the groove of the cam plate.

It should now be apparent that the machine could easily be modified to cast connector for batteries having other than six cells, and using a cam plate having a groove other than W-shaped. The six cells automobile battery and the W-shaped cam plate groove described above have been described simply as one typical example in which the machine might find use.

While the machine's preferred application is to cast an intercell connector which extends through a hole in the battery partition, the machine is not so limited. If for some reason it were described to have the connector extend over the top of the partition, the machine could be easily used for this purpose simply by increasing the height of the mold cavities and adding more lead so that the lead built a bridge across the top of the partition.

It was also stated in the title and the abstract of disclosure that this machine could also be used to cast the terminal posts for the battery. From the description which has thus far been given, the necessary modifications to achieve this result will be apparent. A different cam plate having only two stop positions rather than the five shown in the drawings is required. The molds **68** which fit around the partition would be replaced by a one-piece, hollow mold having a cavity therein of the size and shape desired in the terminal post which would be placed on top of the connecting straps. A different quantity of lead might be required to cast a terminal post than is necessary for an intercell connector, and so the valve and pour mechanism might require simple adjustments.

Certain other refinements in the battery as shown in FIG. **16** should also be pointed out. It will be noted that pairs of ribs **124** and **126** have been integrally formed with the partitions to engage the positive and negative connecting straps, respectively, and that the ribs **124** are a different distance apart than are ribs **126**. An inspection of FIG. **16** will also reveal that the positive and negative connecting straps are of unequal width. Several significant features result from these characteristics. Since the tops of the connecting straps are to serve as the bottoms of the mold cavities when the intercell connector are cast, it is essential that the connecting straps be properly positioned to prevent the lead from flowing down onto the elements below; the ribs **124** and **126** offer a convenient means of positioning the straps. By making the negative connecting straps wider than the positive straps and their associated ribs, it becomes impossible to get the cell element in a compartment in reversed position, for the wide negative connecting strap will not fit between the narrow ribs **124**. Similarly, by equipping the jig plate with downwardly extending fingers **190** and **192** (FIG. **18**) of different widths which snuggly fit between the pairs of ribs **124** and **126** at the end of the container **10**, it becomes impossible to put the jig plate **48** on backward, for the wide finger will not fit between the narrow ribs **124**; this prevents the battery from inadvertently being placed in the machine backwards and thus prevents the W defined by the five castings from being inverted with respect to the W defined by the partition holes. See FIG. **19** for the engagement of finger **192** with ribs **124**. Finally, the ribs **124** and **126** together with the additional ribs **128** formed at the middle of the partitions, prevent or greatly reduce the vibration or horizontal displacement which the cell elements may undergo.

It is expected that the lead which flows into the partition holes might seal to the partition and thus prevent electrolyte leakage between the cells. As an added safety feature, however, it might be desirable to apply a compressive force against both sides of the intercell connector to crimp the connector into the partition, the partition then becoming in effect a gasket. The crimping, then, would be a step after the construction of the intercell connector rather than a step in the construction. With modifications, the machine described above can also be used to perform this crimping function. An application disclosing and claiming the machine as arranged to crimp the intercell connectors is being filed along with this application.

The machine described above may also be modified so as to function as part of an automatic testing device to determine whether the castings have been properly poured and fused to the connecting straps. An application disclosing and claiming the machine as so modified is also being filed along with this application.

We claim:

1. A machine for casting a battery intercell connector over the top of a partition in the battery container comprising:
   a. a frame;
   b. means supported by the frame for receiving the battery container;
   c. a pair of molds, each mold being supported by the frame and each mold having a cavity constructed in such a manner that when the mold contacts a connecting strap of a battery cell element and adjoins the battery container partition then molten metal can be discharged into the mold cavity and the cavity will be exposed to both the connecting strap and the top of the partition;
   d. mechanical means associated with and supported by the frame for moving and positioning the molds on opposite sides of the battery container partition so that the molds come in contact with the connecting straps of the battery cell elements and so that the molds are adjoining and in sealing engagement with the partition, the mechanical means comprising:
      i. mechanical means for moving the battery container horizontally to a point beneath the molds; and,
      ii. mechanical means for elevating the battery container so that the partition is raised to a position between the molds; and,
   e. means supported by the frame for discharging molten metal into the mold cavities.

2. A machine for casting a battery intercell connector through a hole in a partition in the battery container comprising:
   a. a frame;
   b. means supported by the frame for receiving the battery container;
   c. a pair of molds, each mold being supported by the frame and each mold having a cavity constructed in such a manner that when the mold contacts a connecting strap of a battery cell element and adjoins the battery container partition then molten metal can be discharged into the mold cavity and the cavity will be exposed to both the connecting strap and the hole in the partition;
   d. mechanical means associated with and supported by the frame for moving and positioning the molds on opposite sides of the battery container partition so that the molds come in contact with the connecting straps of the battery cell elements and so that the molds adjoin and sealingly engage the partition hole, the mechanical means comprising:
      i. mechanical means for moving the battery container horizontally to a point beneath the molds; and,
      ii. mechanical means for elevating the battery container so that the partition is raised to a position between the molds; and,
   e. means supported by the frame for discharging molten metal into the mold cavities.

3. The machine of claim 1 in which the means for moving the battery container horizontally comprise:
   a. a cam plate supported by the frame;
   b. means associated with the cam plate for securely engaging the battery container;
   c. a cam guide in engagement with the cam plate; and,
   d. means supported by the frame for causing the cam plate to move with respect to the cam guide.

4. The machine of claim 2 which the means for moving the battery container horizontally comprise:
   a. a cam plate supported by the frame;
   b. means associated with the cam plate for securely engaging the battery container;
   c. a cam guide in engagement with the cam plate; and,
   d. means supported by the frame for causing the cam plate to move with respect to the cam guide.

5. The machine of claim 1 in which the means for elevating the battery container comprise:
   a. a cylinder mounted in the frame and having a vertically movable piston therein;
   b. a table mounted on the piston of the cylinder; and,
   c. risers mounted on the table, the risers being arranged to elevate the battery container when the cylinder's piston lifts the table.

6. The machine of claim 2 which the means for elevating the battery container comprise:
a. a cylinder mounted in the frame and having a vertically movable piston therein;
b. a table mounted on the piston of the cylinder; and,
c. risers mounted on the table, the risers being arranged to elevate the battery container when the cylinder's piston lifts the table.

7. A machine for casting intercell connectors through a hole in the partition of a battery container comprising:
a. a frame;
b. pulleys mounted in the frame;
c. belts engaging the pulleys for receiving the battery container;
d. a motor adapted to drive the pulleys and belts;
e. a cylinder mounted in the frame and having a vertically movable piston therein;
f. a table mounted on the piston of the cylinder;
g. risers mounted on the table and spaced between the belts and the pulleys;
h. a cam plate supported by and above the table;
i. means associated with the cam plate for securely engaging the battery container;
j. a cam guide in engagement with the cam plate;
k. means supported by the frame for causing the cam plate to move with respect to the cam guide;
l. molds supported by the frame and having cavities therein; and,
m. means supported by the frame for discharging molten metal into the mold cavities, in which the battery container is brought into position so that the mold cavities adjoin the partition hole by the combined movements of the cylinder piston and the

8. A machine for casting battery terminal posts onto the connecting straps of cell elements comprising:
a. a frame;
b. means supported by the frame for receiving a battery container having a cell element therein;
c. a mold supported by the frame and having a cavity therein of the size and shape desired in the terminal post, the cavity being constructed in such a manner that when the mold engages a connecting strap of the battery cell element then molten metal can be discharged into the mold cavity and the cavity will be exposed to the connecting strap;
d. mechanical means associated with and supported by the frame for engaging the mold with the top of a connecting strap of the cell element, the mechanical means comprising:
i. mechanical means for moving the battery container horizontally to a point where the connecting strap is directly beneath the mold, and,
ii. mechanical means for elevating the battery container until the mold comes in contact with the connecting straps; and,
e. means supported by the frame for discharging molten metal into the mold cavity.

9. The machine of claim 8 in which the means for moving the battery container horizontally comprise:
a. a cam plate supported by the frame;
b. means associated with the cam plate for securely engaging the battery container;
c. a cam guide in engagement with the cam plate; and,
d. means supported by the frame for causing the cam plate to move with respect to the cam guide.

10. The machine of claim 8 in which the means for elevating the battery container comprise:
a. a cylinder mounted in the frame and having a vertically movable piston therein;
b. a table mounted on the piston of the cylinder; and,
c. risers mounted on the table, the risers being arranged to elevate the battery container when the cylinder's piston lifts the table.

11. A machine for casting battery terminal posts onto the connecting straps of cell elements comprising:
a. a frame;
b. pulleys mounted in the frame;
c. belts engaging the pulleys for receiving the battery container;
d. a motor adapted to drive the pulleys and belts;
e. a cylinder mounted in the frame and having a vertically movable piston therein;
f. a table mounted on the piston of the cylinder;
g. risers mounted on the table and spaced between the belts and the pulleys;
h. a cam plate supported by and above the table;
i. means associated with the cam plate for securely engaging the battery container;
j. a cam guide in engagement with the cam plate;
k. means supported by the frame for causing the cam plate to move with respect to the cam guide;
l. a mold supported by the frame and having a cavity therein of the size and shape desired in the terminal post; and,
m. means supported by the frame for discharging molten metal into the mold cavities, in which the battery container is brought into position by the cylinder piston and the cam plate moving means to a point where the mold is above but in contact with the connecting strap.