United States Patent

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[33] **Great Britain**
[31] **29,680/68**

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[54] **MACHINE FOR CASTING AND TRIMMING BATTERY PLATE GRIDS**
12 Claims, 8 Drawing Figs.

[52] **U.S. Cl.** **164/262,** 83/395, 83/419, 83/467, 83/903
[51] **Int. Cl.** **B22d 31/00,** B26d 7/16
[50] **Field of Search** ..... 83/419, 903, 391, 394, 395, 467, 467 A; 164/262

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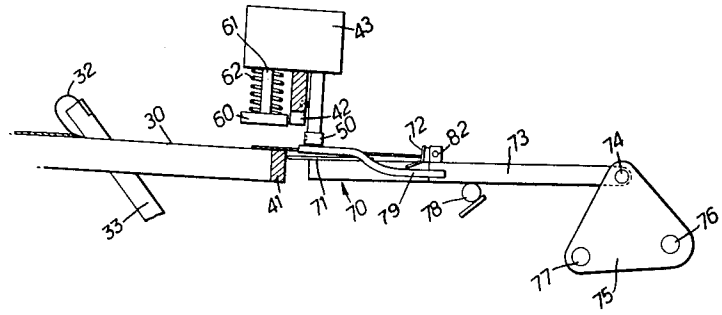
ABSTRACT: A machine for trimming and stacking lead-acid battery electrode grids has a single pair of blades for cutting off first the feet and bottom edge, and then the top edge of each casting. The grids are delivered from the casting mould on to a sloping slide on which each grid slides down past the blades to an upper stop for the first cut and then to a lower stop for the second cut. The lower stop has a transfer plate on which the grid is swung up to a vertical position to join a stack suspended on a pair of rails.



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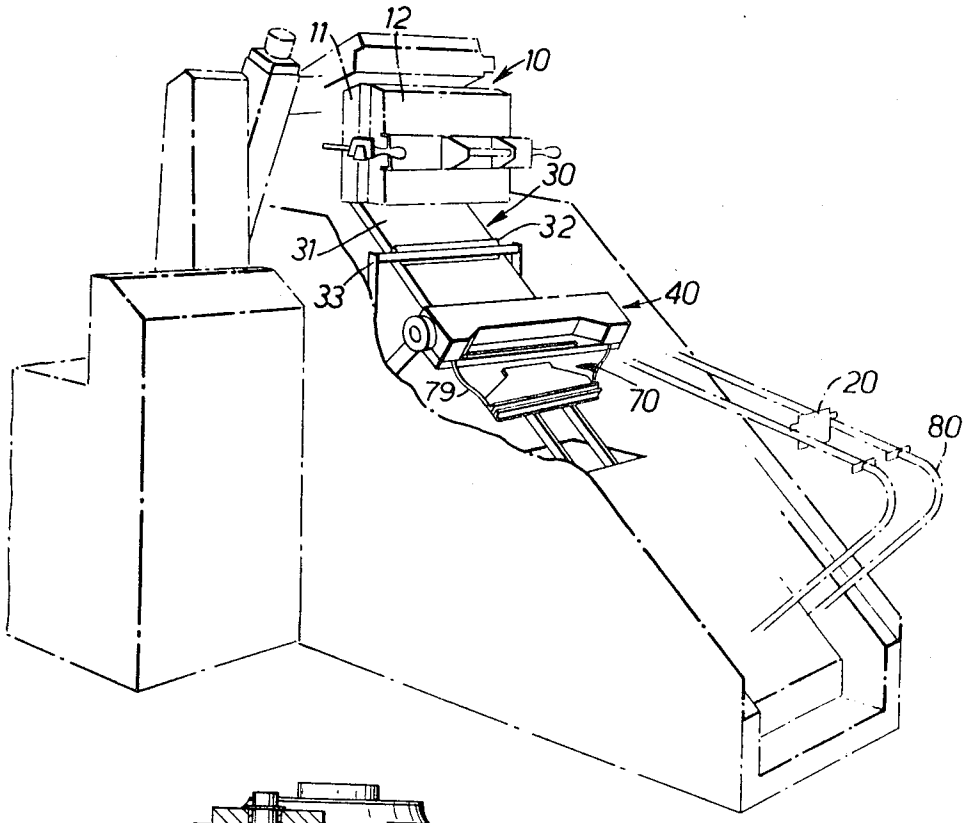

FIG. 1.

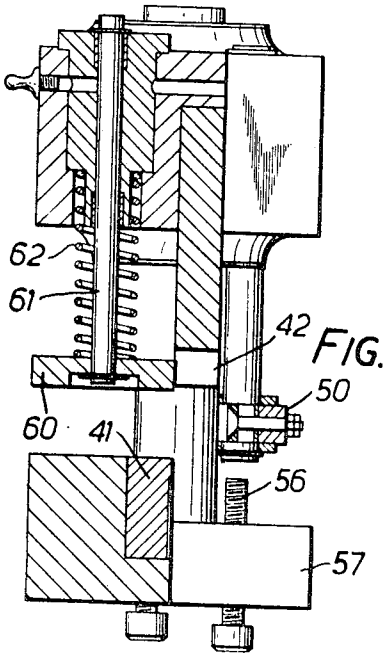

FIG. 7.

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FIG. 2

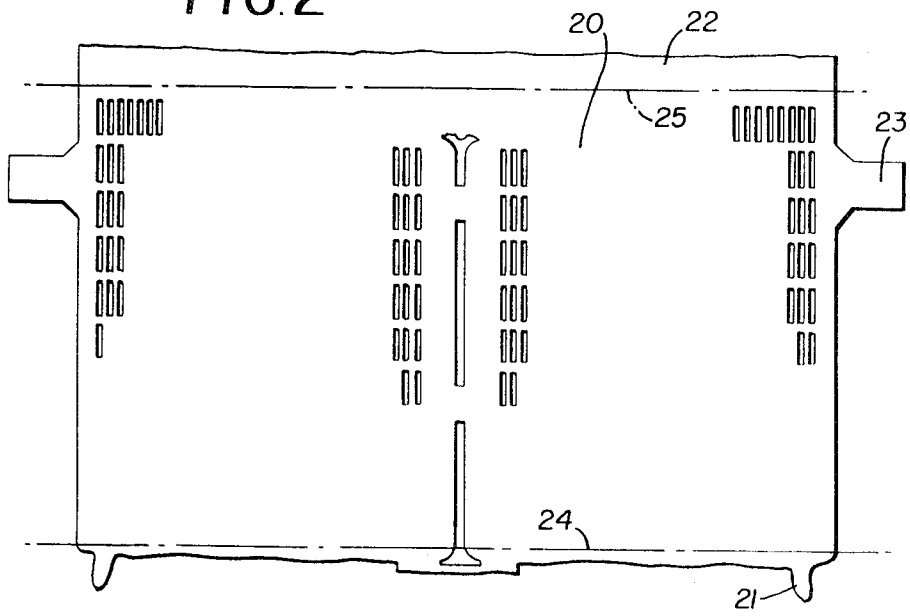
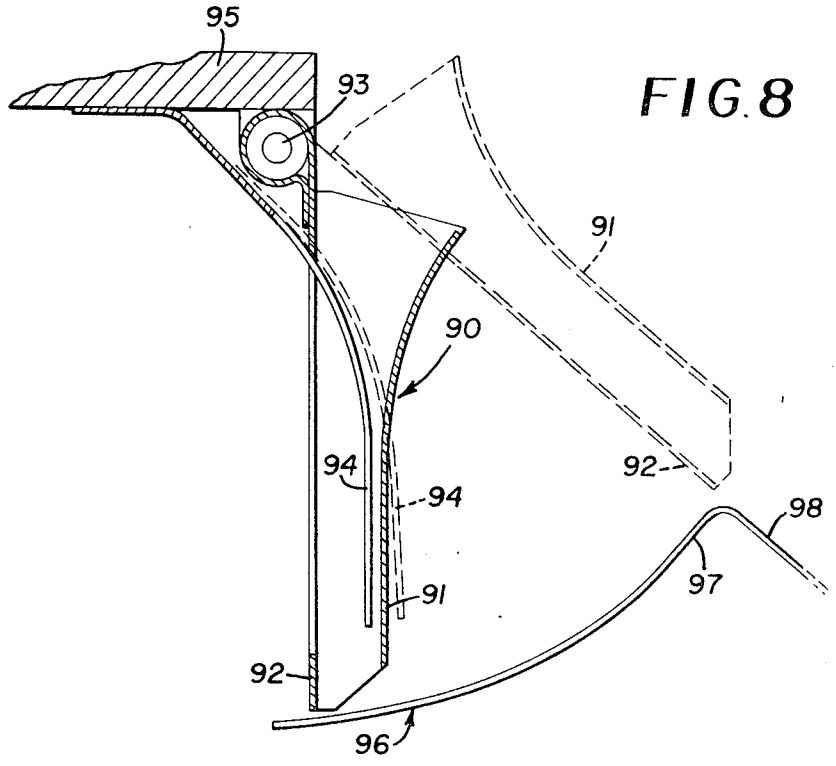


FIG. 8



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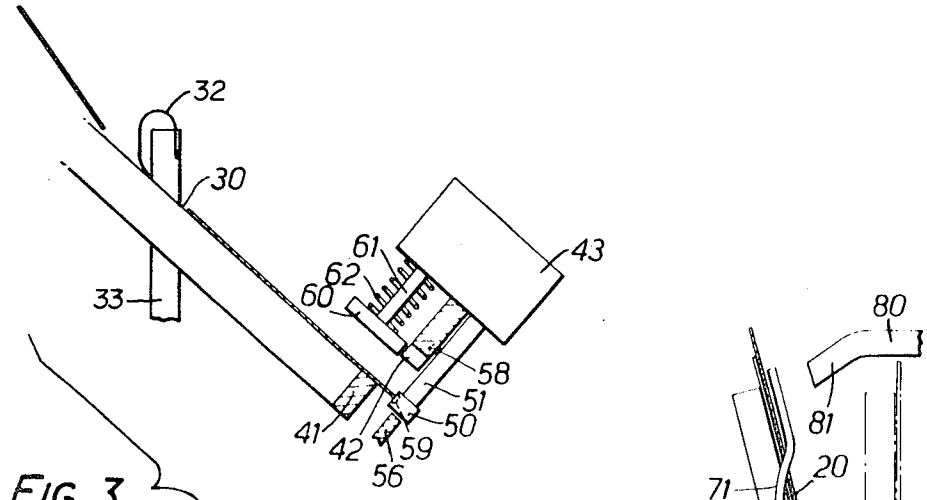

FIG. 3.

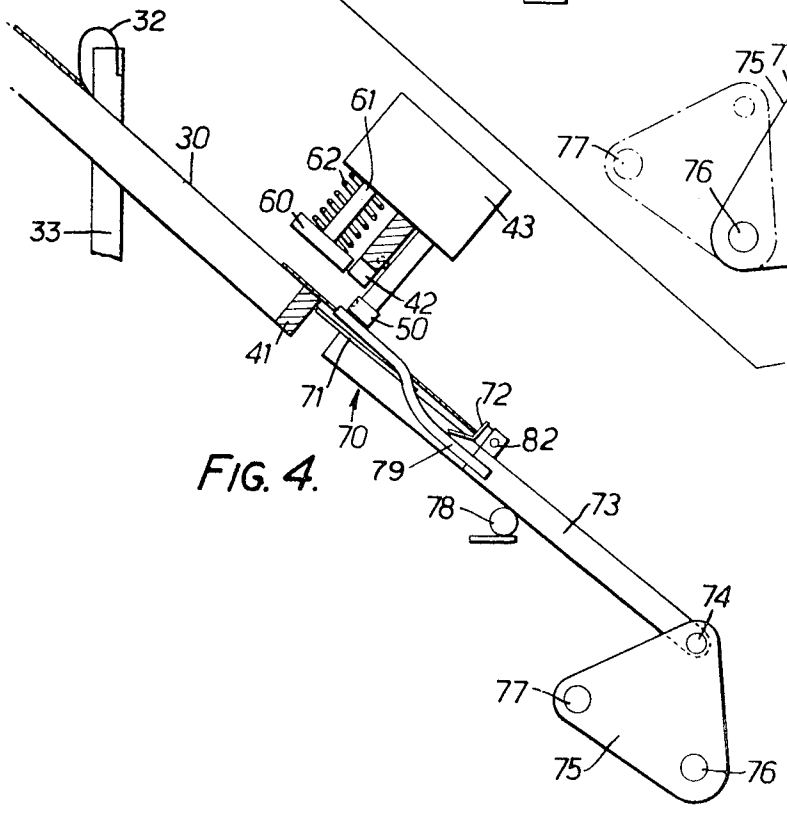

FIG. 4.

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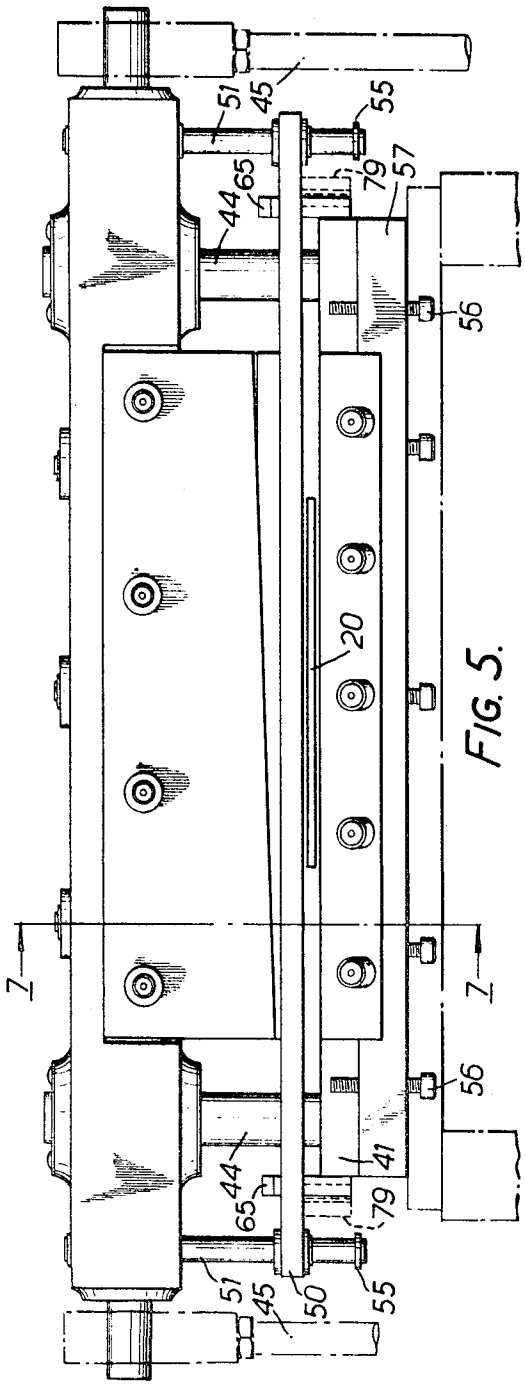

FIG. 5.

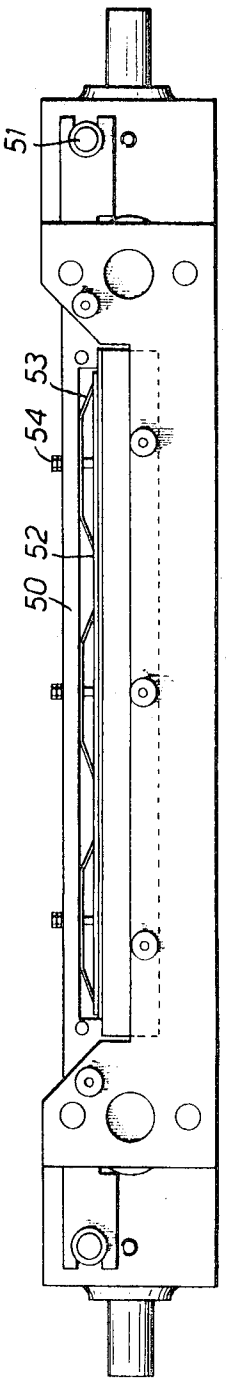

FIG. 6.

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MACHINE FOR CASTING AND TRIMMING BATTERY PLATE GRIDS

This invention relates to machines for handling battery plate grids and is mainly concerned with the arrangement of the machine for trimming the grids when cast.

According to the present invention a machine for trimming lead acid battery electrode grids includes a slide sloping down past cooperating blades, and one or more stops spaced and actuated so that a stop at a position slightly downstream from the blades will stop a grid for its lower edge to be trimmed off by a first cut of the blades, and a stop at a position spaced further downstream from the blades will stop the grid for its upper edge to be trimmed off by a second cut of the same blades. Thus the arrangement may include an upper cutting stop and a lower cutting stop and means for moving at least the upper stop between operative and inoperative positions in synchronism with the blades but at half the frequency.

In one form of the invention, in which the blades are respectively fixed and moving, the upper stop is connected to the moving blade by a releasable connection so as to be lifted to an inoperative position as the moving blade moves up away from the fixed blade whereupon the connection is released to allow the stop to return to an operative position before the moving blade descends for the first cut. Conveniently, the connection comprises a catch, such as a ball catch, released by relative movement, and the movement of the upper stop is limited by limiting stops located so that the catch will be engaged when the blade is in the region of its lowermost position and released when the upper stop reaches its highest position but the blade continues to rise. A part connected to the lower stop may be arranged to support the upper stop in an inoperative position, during alternate cutting strokes of the blade.

The moving blade may also carry a resiliently mounted pressure plate on its upstream side to grip part of the grid while it is being trimmed.

In one arrangement the lower stop is combined with a transfer plate which is mounted to swing about a transverse axis to carry each grid in turn to a stack in which it lies face to face with a previous grid.

Conveniently each grid has a pair of laterally projecting lugs near its upper edge and the lower stop swings it into a vertical plane with its lugs resting on a pair of rails, between which it hangs down.

For trimming off the unwanted portions of the casting it is generally convenient that the casting should be turned from a vertical position, in which it is cast, into an oblique or horizontal plane, and this has hitherto been done by allowing the casting to slide down a curved chute. This, however, tends to bend the casting so that an additional straightening operation is required.

In one form of the invention the machine is combined with a mold for casting each grid in a substantially vertical plane, having ejecting means for ejecting the cast grid so as to turn as it falls towards the plane of the sloping slide, and a flat cooling plate which forms the upper end of the slide and is placed so that the grid will fall on to it. The cooling plate may be provided with a cooling stop to stop a grid in a position resting on it.

In an alternative form of the invention a carrier is adapted to receive a casting from the mold in a substantially vertical plane and to tilt with it into a plane substantially in line with the upper end of the slide.

The carrier may be in the form of a chute into which the casting falls vertically in its own plane and which is pivoted about an axis in or parallel to the said plane above the chute to tilt to an oblique plane. The chute may be open at the bottom but provided with a stationary curved stop which prevents the casting falling out and which terminates so that the casting clears it as it reaches an oblique slide down which it slides to the cutter.

Further features and details of the invention will be apparent from the following description of one specific embodiment which will be given by way of example with reference to

the accompanying somewhat diagrammatic drawings in which:

FIG. 1 is a general perspective view of a machine for casting, trimming and stacking battery plate grids;

FIG. 2 is a view of a typical grid as cast;

FIG. 3 is a diagrammatic side view of the machine showing the relationship of the various parts at one stage of the cycle;

FIG. 4 is a view similar to FIG. 3 with the parts at another stage of the cycle;

FIG. 5 is a somewhat more detailed view of the guillotine seen from downstream;

FIG. 6 is a similar view of the guillotine seen from underneath; and

FIG. 7 is a section of the line 7—7 of FIG. 5; and

FIG. 8 is a view of a modified construction for transferring the casting from the mold.

As shown in FIG. 1 the machine comprises a mold **10** consisting of a pair of slabs **11** and **12**, orientated in a vertical plane in order that the molten lead may flow satisfactorily and fill all the narrow passages required to form the grid.

Molten lead from a lead pot (omitted from the drawing for clarity) is pumped in metered quantities to a reservoir above the level of the mold whence it is admitted to the mold for each casting.

As shown in FIG. 2 each casting **20** comprises the grids for two plates with a pair of feet **21** projecting from the bottom of the casting, a sprue or gate **22** at the top of the casting and a pair of lugs **23** projecting from the sides of the casting so as to be one at the top of each finished plate grid. The feet and the bottom of the casting are to be trimmed off along the line **24** and the spine at the top along the line **25** to give clean edges to the finished plate.

The machine comprises an oblique slide or platform **30** sloping down from a point below the mold, past a guillotine **40** to a lower stop and transfer plate **70**. The upper end of the slide **30** is formed by a flat water-cooled cooling bed **31**.

The mold is provided with a ejecting means for releasing the grid and allowing it to fall in such a way that as it falls it will turn towards the oblique plane of the cooling bed and land substantially flat on the latter.

When the casting is sufficiently cooled it is passed from the mold to the guillotine **40** which makes two cuts, a first cut along the line **24** to trim off the bottom and feet, and a second cut along the line **25** to trim off the sprue. The grid is finally transferred to a pair of rails **80** where a stack of castings accumulate hanging down between the rails with their lugs resting on the rails.

For trimming off the unwanted portions of the casting it is generally convenient that the casting should be turned from the vertical plane into an oblique or horizontal plane. Hitherto it has been customary to do this by allowing the casting to slide down a curved chute but this tends to bend it so that an additional straightening operation is required.

In the arrangement shown in the drawings the casting falls from the mold and lands on the flat oblique cooling bed **31** so that no separate flattening operation is needed.

In an alternative arrangement, not illustrated, the casting is received in a flat chute which is then tilted to the required inclination, and again it has been found unnecessary to incorporate a separate straightening operation.

This is particularly important when manufacturing low antimony of lightweight grids. It is customary to incorporate a certain percentage of antimony in the lead of battery plate grids in order to strengthen them. It will be appreciated that the structure of a battery plate grid, consisting as it does of fine bars, is inherently weak, and in addition lead is a mechanically weak metal. The incorporation of a proportion of antimony, say 10 to 12 percent, adds substantially to its strength, but this has certain undesirable results on the electrical properties of the battery. It is, therefore, often preferable to reduce the proportion of antimony. The arrangements described give satisfactory results even with a grid of low physical strength.

The apparatus will now be described in more detail.

THE MOLD

The mold is generally of conventional construction comprising a fixed slab **11** at the back or upstream side, and a moving slab **12** at the front or downstream side. The moving slab **12** is supported on guide rods so as to remain parallel to the fixed slab as it is moved towards and away from it by the action of a pneumatic cylinder. The fixed slab has in it a number of openings through which ejector pins extend so that when the moving slab has moved away from the fixed slab a short distance the pins will be projected to eject the casting from the fixed slab.

The means for ejecting the cast grid from the mold are arranged so that the cast grid turns as it falls towards an oblique position so as to land substantially flat on the water-cooled cooling bed **31**. The cast grid is prevented from sliding down by the engagement of its lower edge with a cooling stop in the form of a curved spring steel plate **32** carried at the upper ends by a pair of vertical arms **33** which are pivoted at their lower ends **34**. The cast grid remains on the cooling bed for perhaps half a minute to allow it to cool, after which the cooling stop is moved about the pivot **34** to allow the grid to pass under it and slide down to the guillotine **40**.

THE GUILLOTINE AND TRANSFER STACKING UNITS

The guillotine unit comprises a fixed blade **41** forming the lower front end of the sloping platform or slide **30**, and a moving blade **42** carried by a beam **43** mounted to slide on guide rods **44** projecting perpendicularly to the plane of the sloping platform and having connecting rods **45** at its ends connected to cranks (not shown) at opposite ends of a rotating shaft to move it towards and away from the fixed blade. The moving blade has an oblique cutting edge and is set to rub against and cross the edge of the fixed blade with a scissor action to shear the metal of the grid.

An upper stop bar **50** is positioned on the downstream side of, and moves in sympathy with, the moving blade. Thus the beam **43** carrying the moving blade also carries a pair of guide rods **51** which pass through bushes in the ends of the upper stop bar **50**. As best seen in FIG. **6** the upper stop bar is provided with a buffer bar **52** urged upstream away from it by a number of leaf springs **53** such movement being limited by stops constituted by bolts **54** passing through the stop bar. Thus the engagement of a cast grid with the buffer bar **52** is cushioned, but the buffer bar returns to a predetermined position so that the grid is precisely located in a suitable position for cutting.

The downward movement of the upper stop bar **50** is limited in four different ways. First the guide rods **51** are provided with circlips **55** near their lower ends to limit the extend the bar can slide down them (see FIG. **5**). Secondly a pair of adjustable stop screws **56** projecting up from a fixed beam **57** set a bottom limit to the extent that the upper stop bar can descend in relation to the fixed blade **41**. When the bar engages these stop screws the buffer bar will be in an operative position, so as to stop a cast grid from sliding further down the slide.

Thirdly the moving blade is provided with a pair of ball catches **58** projecting from its downstream surface so as to engage recesses **59** in the upstream face of the upper stop bar when the latter is in its uppermost position in relation to the moving blade.

Fourthly the support for the lower stop, described below, has a pair of projecting horns **79** which, when the lower stop is in its upstream position, engage under the ends off the upper stop bar to prevent it from falling to its operative position, and hold it up in a position such that a cast grid can pass under it.

The beam **43** carrying the moving blade is also provided with a pressure plate **60** carried by guide rods **61** passing through guides in the beam and urged downwards relatively to the latter by springs **62** so as to grip the cast grid, or the sprue, while the guillotine makes a cut.

The upward movement of the upper stop bar **50** is limited by fixed stops **65**, which thereby serve to disengage the ball catches as described more fully below.

THE LOWER STOP AND TRANSFER PLATE

Cooperating with the guillotine unit is a lower stop and transfer plate **70** comprising a plate **71** with a flat face that can be brought to an upstream position in which it forms virtually a downward continuation of the sloping platform (roughly as shown in FIG. **4**) and a lower stop bar **72** extending horizontally across it to form a stop for the lower edge of a grid during its second cut.

The lower stop and transfer plate is carried by a pair of downwardly projecting arms **73** pivoted at their lower ends at **74** on a pair of bellcranks **75** mounted on a horizontal transverse shaft **76** and provided with a stop rod **77** which engages the arms after a certain angular movement in a clockwise direction (as viewed in FIGS. **3** and **4**). The shaft **76** is oscillated by a further crank and connecting rod driven by an eccentric, not shown.

In the position shown in FIG. **4** the arms **73** rest on a fixed transverse rod **78** and the plate **71** lies slightly below the plane of the slide and terminates close to the cutting edge of the fixed blade. As the bellcranks **75** turn in a clockwise direction, the lower stop bar and transfer plate are withdrawn in a downstream direction and at the same time slightly tilted in an anticlockwise direction about the fixed rod **78**. When the lower stop and transfer plate have been withdrawn a certain distance in a downstream direction the stop rod **77** of the bellcrank engages the arms **73** so that the latter, with the lower stop bar and transfer plate, turn with the bellcranks in a clockwise direction towards a vertical position as indicated in FIG. **3**. As they do so, with the cast grid **20** resting on the plate and its lower edge against the stop bar in the manner of a bookrest, the grid is delivered to a pair of rails **80** on which the finished grids are stacked.

To enable the grid to be transferred to the rails the latter are provided at the forward ends with downwardly and outwardly curved portions forming horns **81** located so that the paths of the lugs and the vertical sides of the grid will intersect them at a small angle as the transfer plate swings up, so that the lugs are gently centralized and transferred to the horns and pushed along them. Thus the grid is added to the stack of grids already on the rails and pushes them along a distance corresponding to its own thickness.

The lower stop bar **72** is of obtuse angled V-section and is pivoted to the arms **73** abut an axis **82**. This axis is so located in relation to the center of gravity of the lower stop bar that as the arms **73** approach a vertical position, the stop bar topples over in a clockwise direction about its pivot **82** to the position shown in FIG. **3**. This has no effect on the grid, which by this time is supported on the guide rails, but it tilts the V-section stop bar so as to tip off any chips or cuttings which might otherwise interfere with the accurate positioning of the next grid. When the arms **73** return in an anticlockwise direction the stop bar swings back to its initial position under gravity.

As already mentioned the arms **73** are provided with a pair of extensions or horns **79** which in the upstream position of the FIG. **4** hold up of the upper stop bar while a grid is sliding under it on the transfer plate.

DRIVE UNIT

The machine is electrically driven through reduction gearing and a stepless speed change unit so that the casting rate can be adjusted to suit the type of grid being produced.

The cooling stop is driven at the same frequency as the lower stop and transfer plate but the guillotine is driven at twice this frequency. Thus during a complete cycle of movement the cooling stop **32**, and the lower stop and transfer plate **70**, the guillotine descends twice. During the first cut the lower stop is swung away to the region of the position shown in FIG. **3** so that its horns **79** cannot prevent the upper stop bar **50** from falling to its operative position. During the second cut the lower stop is in the region of the position shown in FIG. **4** in which its horns **79** hold the upper stop bar clear of the grid.

OPERATION

It is believed that the operation will generally be clear from the description of the construction given above.

As already indicated, when a grid has been cast the mold is opened and the grid falls, turning as it does so, and arrives substantially flat on the cooling bed **31** where it is prevented from sliding down by the cooling stop **32**.

After an appropriate period for cooling, which may for example be half a minute, the cooling stop is moved to the right by clockwise pivoting of the arms **33** about their lower ends, and the grid slides beneath it down to the guillotine. At this time the moving blade is raised and the upper stop bar **50** is resting on the stop screws **56** so as to be in the path of the grid and limit its downward movement down the slide **30**. The feet of the grid engage the buffer bar which cushions any shock but then returns to a predetermined position. The moving blade moves down towards the fixed blade with the pressure plate **60** slightly ahead of it, so that the pressure plate grips the cast grid and the moving blade then shears off the feet and irregular lower edge of the grid along the line of the lower cut **24**.

As the moving blade approaches or reaches its lowermost position the ball catches **58** carried by it engage the recesses **59** of the upper stop bar so that when the blade moves up again it carries the upper stop bar with it so as to allow the grid to slide down on to the transfer plate **71** until its lower edge (now accurately trimmed) engages the lower stop bar **72**.

As the moving blade approaches its uppermost position the upper stop bar engages the fixed stops **65** which prevent it from moving up further with the moving blade, thereby disengaging the ball catches and allowing the upper bar to fall by gravity. At this time the transfer plate is at or near its upstream position and hence the horns **79** prevent the upper stop bar **50** from engaging the grid. As it approaches this position the lower stop bar topples back in an anticlockwise direction about the axis **82** to the operative position shown in FIG. **4**.

The moving blade descends again to cut off the sprue and upper part of the grid along the upper cut line **25**, or more precisely to cut the grid from the sprue and upper part. While the cut is taking place, with the sprue gripped by the pressure plate, the transfer plate is in a position, such as that of FIG. **4**, below the plane of the slide, so as to allow the grid to yield as the moving blade descends.

When the second cut is completed the transfer plate and lower stop bar move downstream and rock first slightly anticlockwise and then clockwise about the fixed transverse rod **78**. When the horns **79** are withdrawn from the upper stop bar **50** the latter sinks down on to its stop screws **56**. When the bellcranks **75** have moved through a certain angle the stop rod **77** engages the arms **73** and the lower stop and transfer plate turn bodily with the bellcranks, carrying the grid upwards in the manner of a bookrest with the grid lying flat against the transfer plate and its lower edge prevented from sliding down by the lower stop bar. The grid is thus transferred as described above to the rails **80** so as to hand down between them with its lugs supported on top of them.

When the stop bar and transfer plate reach an approximately vertical position the stop bar topples over in a clockwise direction about the pivot **82** to tip out any chippings that may have collected in it and would otherwise prevent the next grid from being accurately located. The lower stop and transfer plate then swing back anticlockwise to their initial position in readiness for the next grid.

In a modified construction shown in FIG. **8** the guillotine is as described above but the arrangement for transferring the casting from the mold to the sloping slide differs.

In this construction, when the casting is ejected from the mold it falls by gravity into a tilting chute **90**. This is in the form of a narrow box open at the top and bottom and having a flat front wall which is generally parallel to a slotted flat rear wall **92**, but has an upper portion curving slightly away from it. The chute is pivoted about a pivot **93** at its upper edge and, when the casting drops into it, it lies in a vertical plane with its center plane in line with that of the mold. The rear wall of the chute has in it a number of vertical slots and a corresponding number of curved leaf springs **94** extend through the slots each being fixed at its upper end to a stationary part **95**. Thus as the casting falls it is caught between the curved leaf springs **94** and the flared front wall **91** of the chute **90** and gently brought to rest between their flat lower portions.

Opposed to the open bottom of the chute is a curved stationary stop **96** of part cylindrical form concentric with the pivotal axis of the chute. This terminates at its front edge **97** at the rear edge of the flat sloping platform **98** the front edge of which is formed by the fixed blade of a guillotine unit.

Thus when the casting has been caught in the chute **90** and gripped between its front wall **91** and the blade springs **94**, the chute pivots about its upper edge until it is in line with the sloping platform **98**. During the initial movement the front wall **91** of the chute moves away from the blade springs **94** so that the casting is no longer gripped and it slides down the chute till the feet at its bottom end rest on the curved stop and when they reach the front end of the latter the casting slides down the sloping platform to the guillotine unit.

We claim:

1. A machine for trimming lead-acid battery electrode grids, including a slide sloping down past cooperating blades and for engaging a grid sliding down the slide to locate it for trimming by the blades, an upper cutting stop and a lower cutting stop and means for moving at least the upper stop between operative and inoperative positions in synchronism with the blades but at half the frequency, said stops being so located that the upper stop locates a grid in a position for its lower edge to be trimmed off by a first cut of the blades, whereafter the grid slides down until the lower stop locates it at a position for its upper edge to be trimmed off by a second cut of the same blades.

2. A machine as claimed in claim **1** in which the blades are respectively fixed and moving and the upper stop is connected to the moving blade by a releasable connection so as to be lifted to an inoperative position as the moving blade moves up away from the fixed blade whereupon the connection is released to allow the upper stop to return to an operative position before the moving blade descends for the first cut, and means for preventing the upper stop from returning to its operative position prior to alternate cuts.

3. A machine as claimed in claim **1** in which the connection comprises a catch, such as a ball catch, released by relative movement, and the movement of the upper stop is limited by limiting stops located so that the catch will be engaged when the blade is in the region of its lowermost position and released when the upper stop reaches its highest position but the blade continues to rise.

4. A machine as claimed in claim **3** wherein said preventing means comprises a part connected to the lower stop arranged to support the upper stop in an inoperative position, during alternate cutting strokes of the blade.

5. A machine as claimed in claim **3** in which the moving blade also carries a resiliently mounted pressure plate on its upstream side to grip part of the grid while it is being trimmed.

6. A machine as claimed in claim **5** in which the lower stop is mounted to swing about a transverse axis to carry each grid in turn to a stack in which it lies face to face with a previous grid.

7. A machine as claimed in claim **6** including a pair of rails so situated that, if each grid has a pair of laterally projecting lugs near its upper edge, the lower stop will swing it into a vertical plane with its lugs resting on said pair of rails, between which it hangs down.

8. A machine as claimed in claim **7** in combination with a mold for casting each grid in a substantially vertical plane, having ejecting means for ejecting the cast grid so as to turn as it falls towards the plane of the sloping slide, and a flat-cooling plate which forms the upper end of the slide and is placed so that the grid will fall on to it.

9. A machine as claimed in claim 8 in which the cooling plate is provided with a cooling stop to stop a grid in a position resting on it.

10. A machine as claimed in claim 1 in combination with a mold for casting each grid in a substantially vertical plane and a carrier adapted to receive a casting from the mold in a substantially vertical plane and to tilt with it into a plane substantially in line with the upper end of the slide.

11. A machine as claimed in claim 10 in which the carrier is

in the form of a chute into which the casting falls vertically in its own plane and which is pivoted about an axis in or parallel to the said plane above the chute to tilt to an oblique plane.

12. A machine as claimed in claim 11 in which the chute is open at the bottom but provided with a stationary curved stop which prevents the casting falling out and which terminates so that the casting clears it as it reaches a position in line with the upper end of the slide.

* * * * *