United States Patent [19]

Saarup

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[45] **Sept. 18, 1973**

[54] **INGOT MOLD SEPARATOR**

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[52] **U.S. Cl.** **164/405**
[51] **Int. Cl.** **B22d 29/04**
[58] **Field of Search** 164/180, 186, 366, 164/405, 406, 407, 408, 412, 401, 402, 403, 164/404

[56] **References Cited**

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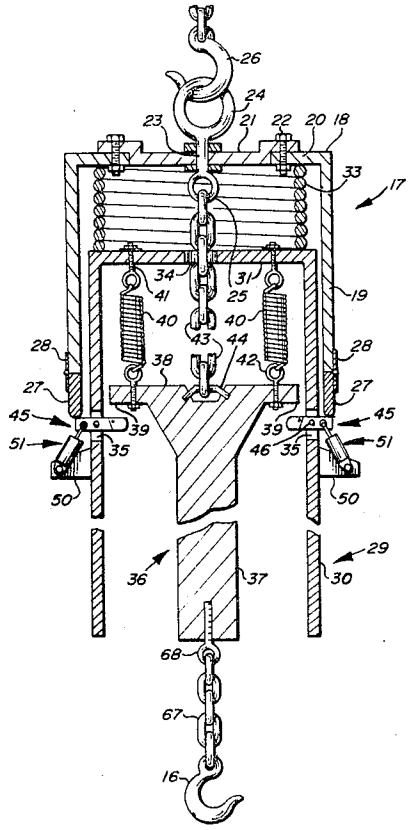
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Primary Examiner—J. Spencer Overholser
Assistant Examiner—John S. Brown
Attorney—Eric P. Schellin et al.

[57] **ABSTRACT**

This specification discloses a device for separating an ingot from a mold in which it is stuck and which operates on the principle of raising the ingot and mold as a unit from a supporting surface a predetermined distance and then letting the unit fall. The drop of the ingot is interrupted before the unit reaches the supporting surface, while the downward movement of the mold is continued under the momentum generated by the fall, to separate the ingot from the mold.

9 Claims, 14 Drawing Figures



3 Sheets-Sheet 1

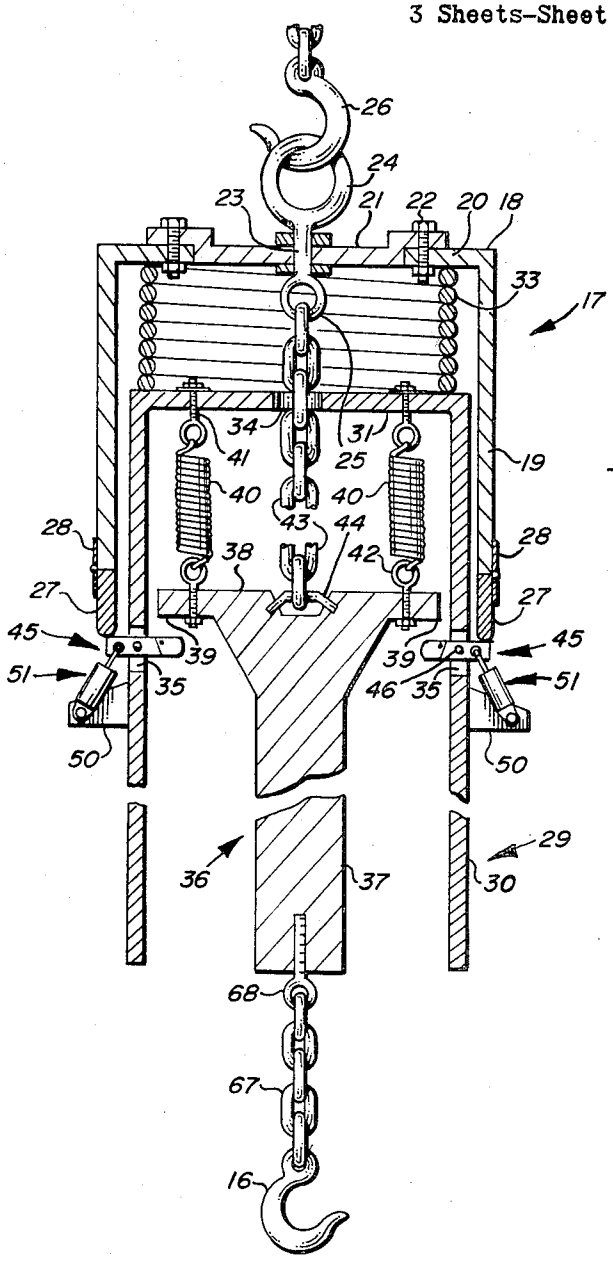


Fig. 1

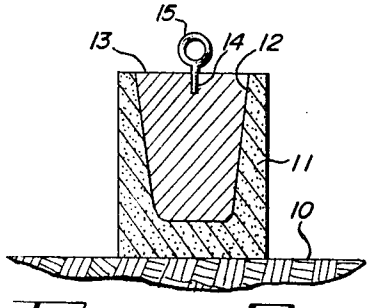


Fig. 2a

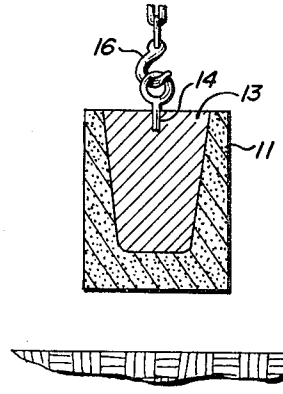


Fig. 2b

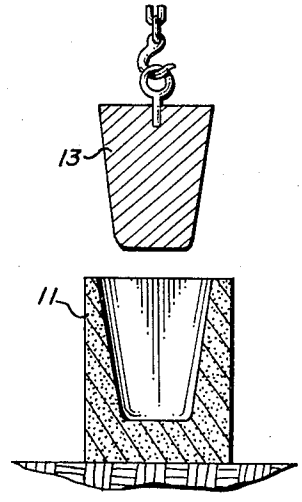
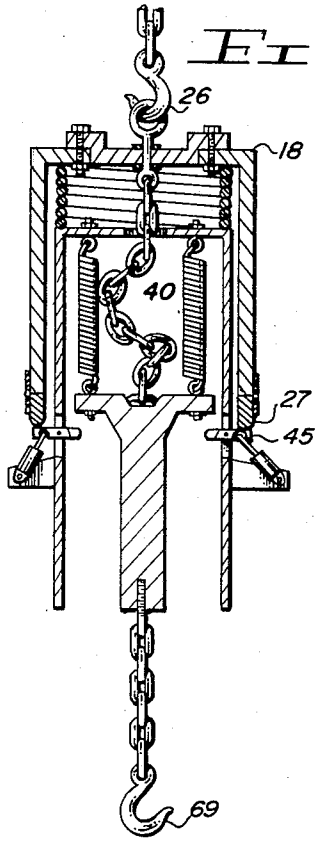


Fig. 2c

Fig. 3a



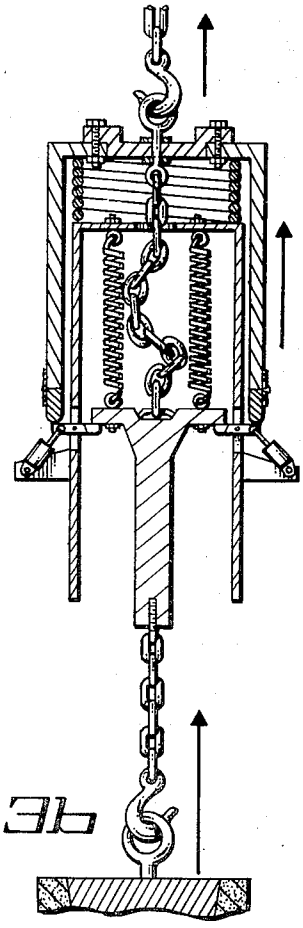
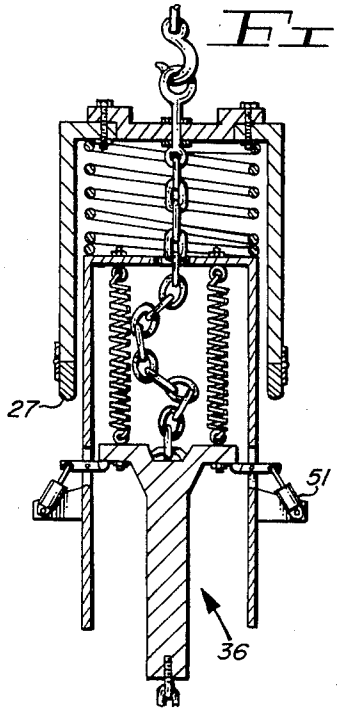


Fig. 3b

Fig. 3c



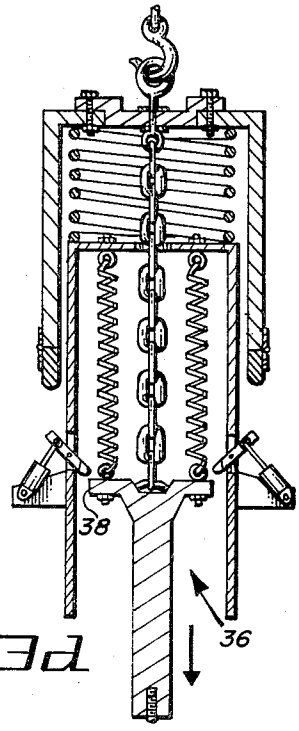


Fig. 3d

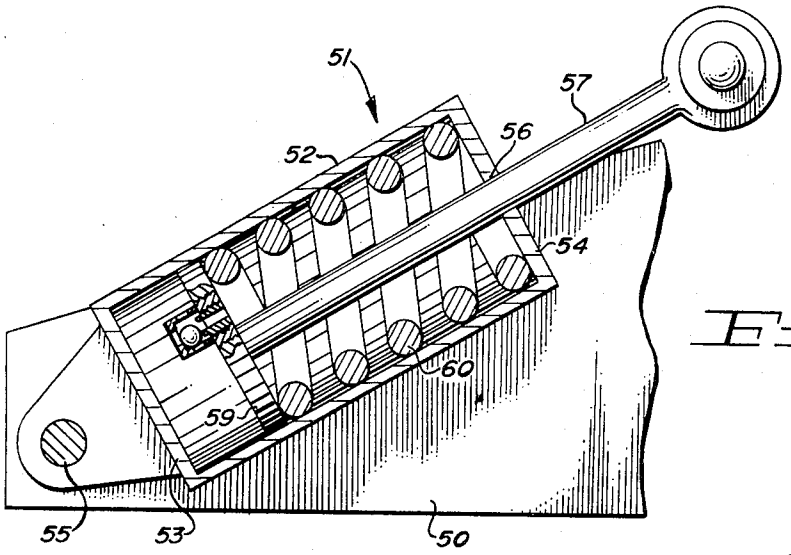


Fig-4a

Fig-4b

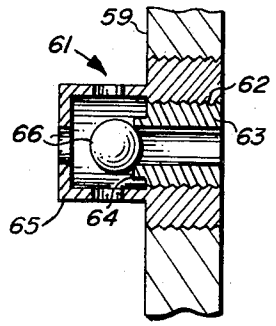


Fig-4c

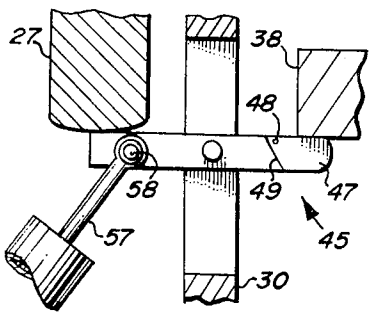


Fig-5a

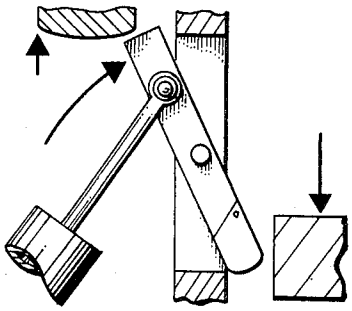


Fig-5b

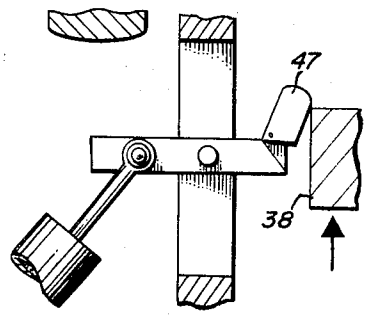


Fig-5c

INGOT MOLD SEPARATOR

The present invention relates to the separation of ingots from the molds in which they are cast, and is concerned primarily with the mechanical separation of ingots which have become stuck in the molds and which are not susceptible of removal by normal procedures.

BACKGROUND OF THE INVENTION

At the present time, it is common practice in steel refineries and mills to cast an ingot in a mold. As the ingot is cast, a shank having a loop at its upper end is molded with the ingot to leave the loop in an exposed position. It is now common practice to form the mold cavity with a draft or pitch which facilitates removal of the ingot from the mold by a hoist having a hook which engages the loop aforesaid.

Under normal conditions which are generally prevalent, this draft in the mold cavity is sufficient to provide for the removal of the ingot. However, after service usage, and the elapse of time, the surface of the mold cavity becomes eroded and irregular. Under such conditions, the ingot becomes stuck in the mold and it is necessary to resort to extraordinary operations to remove the ingot. Present practice is to use a crowbar or lever in prying the ingot loose, or to strike the mold with a hammer. Such operations require substantial manual labor.

The present invention is founded on the concept of eliminating this manual labor and providing a device which removes an ingot from a mold in which it is stuck substantially automatically.

OBJECTS OF THE INVENTION

With the foregoing conditions in mind, the present invention has in view the following objectives:

1. To provide a device for separating an ingot from a mold in which it is stuck and which is mechanical and substantially automatically operated.

2. To provide a device of the character aforesaid which is operable to separate an ingot from a mold in the presently conventional manner, when the ingot is not stuck in the mold.

3. To provide, in a device of the type noted, mechanism for raising an ingot and a mold in which it is stuck as a unit a predetermined distance above a supporting surface, together with means for letting the unit fall, and mechanism for interrupting the drop of the ingot before the unit reaches the supporting surface, whereby the mold continues its downward movement under the momentum generated by the fall, and thereby becomes separated from the ingot.

Various other more detailed objects and advantages of the invention such as arise in connection with carrying out the above ideas in a practical embodiment will, in part, become apparent, and, in part, be hereafter stated as the description of the invention proceeds.

SUMMARY OF THE INVENTION

The foregoing objects are achieved by providing a device comprising an upper frame having a hook engaging element, a lower frame within said upper frame and connected thereto by a heavy expansion coil spring, a plunger mounted in said lower frame and connected thereto by return springs, a chain which normally is slack, connected at its lower end to the plunger and at its upper end to the upper frame, arms pivotally mounted on said lower frame having inwardly extending portions which are engaged by said plunger and outwardly extending portions which are normally engaged by the outer frame to hold said arms in horizontal positions, and dash pots mounted on said lower frame and connected to the outer ends of said arms to maintain the inner projecting portions thereof in engagement with said plunger for a predetermined interval.

The plunger carried a hook at its lower end which engages the loop that is cast into an ingot. Under normal conditions, that is with no sticking of an ingot in a mold, the hoist which is connected to the upper frame will separate the ingot from the mold in a conventional manner. However, when an ingot is stuck, the initial part of upward movement causes the two frames to move together until flanges on the plunger engage the inner projecting portions of the arms. Further upward movement causes the two frames to separate against the resistance of the spring by which they are connected. This separation moves the lower ends of the upper frame out of engagement with the outwardly projecting portions of the arms. These arms are thus free to pivot under the weight of the plunger and ingot mold unit suspended therefrom. However, this pivotal movement is resisted and slowed down by the dash pots, so that sufficient pivotal movement to free the arms from the plunger will not occur until after the elapse of a predetermined period of time. When this occurs, the plunger will drop the distance provided for by the slack in the chain to which it is connected. When the chain is taut, the fall of the plunger and ingot connnected thereto is abruptly interrupted. However, the mold will continue its downward movement under the momentum generated by the fall and thus become separated from the ingot.

For a full and more complete understanding of the invention, reference may be had to the following description and the accompanying drawings wherein:

FIG. 1 is a vertical section through an ingot mold separator embodying the precepts of this invention;

FIG. 2*a* is a section through a mold and ingot cast therein as resting on a supporting surface;

FIG. 2*b* is a view similar to FIG. 2*a* depicting the ingot and mold as raised into an elevated position as a unit;

FIG. 2*c* is a view showing the mold in section and the ingot in elevation after it has been separated from the mold;

FIG. 3*a* is a sectional view similar to FIG. 1 taken on a smaller scale and depicting the separating device in an at rest position;

FIG. 3*b* is a view similar to FIG. 3*a* illustrating the first stage of upward movement of the separator;

FIG. 3*c* is another view similar to FIGS. 3*a* and 3*b* showing the two frames as separated;

FIG. 3*d* is a view similar to FIGS. 3*a*, 3*b* and 3*c* showing the condition of the mechanism in which the plunger is free to drop;

FIG. 4*a* is a section through one of the dash pots, illustrating one position thereof;

FIG. 4*b* is another section through a dash pot, showing another position thereof;

FIG. 4*c* is an enlarged detailed section of the valve included in a dash pot.

FIG. 5*a* is a detail taken on an enlarged scale, illustrating one position of one of the arms;

FIG. 5*b* is a similar detail depicting another position of one of the arms, and

FIG. 5*c* is a similar detail showing how the plunger passes one of the arms on its return movement.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings wherein like reference characters denote corresponding parts, and more particularly to FIGS. 2*a*, 2*b* and 2*c*, a supporting surface, such as ordinarily is found in a steel mill, is designated **10.** Resting on the surface **10** is a mold **11** having a cavity **12** which is formed with the usual draft or pitch. An ingot **13** is cast in cavity **12** and a shank **14** is molded into ingot **13.** The upper end of shank **14** is provided with a loop **15.**

FIG. 2*b* shows the ingot **13** as stuck in mold **11** and the two elevated a distance above supporting surface **10** by the separator to be hereinafter described. This elevation is achieved by the engagement of a hook **16** with loop **14.**

FIG. 2*c* shows the ingot **13** as separated from mold **11** by the fall of the latter, after the drop of the ingot has been abruptly stopped.

Referring now more particularly to FIG. **1,** the separator device of this invention is identified in its entirety by the reference character **17.** Separator **17** comprises an upper frame **18.** While the upper frame **18** may consist of a spider-like structure, it is shown as a receptacle presenting vertical walls **19** terminating at their upper ends in inturned flanges **20** to which a closure **21** is secured as by bolts and nuts **22.**

A link **23** passes through closure **21** and at its upper end is formed with a loop **24** and at its lower end with another loop **25.** Loop **24** is engaged by hook **26** which is carried at the lower end of a conventional hoist.

At this point, it is well to note that the device **17** may well include four of the pivoted arms to be later described in detail, but inasmuch as two such arms are sufficient to provide an operative device, only two such arms are herein illustrated. Thus, the vertical walls **19** are shown as having two tabs **27** pivotally mounted on their lower ends and which are biased into a position aligning with the walls **19** by leaf springs **28.** The purpose of these tabs **27** will later become apparent.

A lower frame is referred to generally at **29.** It also might consist of a spider-like structure, but for simplicity of illustration, is shown as a receptacle presenting vertical walls **30** which define an open bottom and a top wall **31.** Lower frame **29** is assembled within upper frame **17** and secured thereto by heavy expansion coil spring **33,** the upper end of which is secured to the flanges **20** in any preferred manner, such as by welding, and the lower end is secured to the top wall **31** of lower frame **29** in any preferred manner, such as by welding. Spring **33** is sufficiently heavy to maintain frames **18** and **29** in contracted relation unless a unit of an ingot and mold are suspended from lower frame **29.** Top wall **31** is also formed with a central aperture **34.** Side walls **30** are formed with a pair of diametrically opposed openings **35.**

A plunger is designated generally **36,** and comprises a shank **37** and a head **38** which presents at least one pair of flanges **39.** A pair of expansion coil return springs **40** connect plunger **36** to lower frame **29.** Thus, each spring **40** has its upper end connected to top wall **31** of lower frame **29** as indicated at **41,** and its lower end to head **38** as indicated at **42.**

A heavy chain **43** passes through aperture **34** and its upper end is anchored to loop **25.** Its lower end is secured to the head **38** of plunger **36** as indicated at **44.** It is important to note that in the relative positions of the frames, as indicated in FIG. **1,** chain **43** has a predetermined amount of slack therein.

A pair of arms, each of which is identified in its entirety by the reference character **45,** are pivotally mounted in the openings **35;** the pivots being shown at **46.**

Referring now more particularly to FIGS. 5*a*, 5*b* and 5*c*, an arm **45** is shown as having an inner end portion **47** which is pivotally connected to the main body portion of the arm at **48** and an inclined abutment **49** between these two parts of the arm. This abutment causes the inner end portion **47** to align with the main body portion of the arm as when downward p;essure is applied thereto by a flange **38.** However, upon return movement of the plunger, as illustrated in FIG. 5*c*, flange **38** will swing the inner end portion upwardly and thus permit the flanges **38** to pass the arms.

Referring now again to FIG. **1,** a pair of brackets **50** are mounted on walls **30** below openings **35** and project outwardly from lower frame **29.** Mounted on each of brackets **50** is a dash pot designated generally **51.**

Referring now to FIGS. 4*a* and 4*b*, dash pot **51** is shown as comprising a cylinder **52** which is filled with an hydraulic medium and which has end walls **53** and **54.** Extending downwardly and outwardly from end wall **53** is an ear which is pivotally mounted at **55** on a bracket **50.** End wall **54** is formed with an opening **56** which slidably receives a piston rod **57.** The outer end of piston rod **57** is formed with means for pivotally connecting it to the outer end portion of an arm portion **45** as shown in FIGS. 5*a*, 5*b* and 5*c*, the pivotal connection being designated **58.** Carried by the inner end of piston rod **57** and slidable in the cylinder **52** is a piston **59.**

An expansion coil spring **60** is interposed between end wall **54** in piston **59.** Its normal tendency is to urge the piston **59** towards end wall **53.**

Mounted in piston **59** is a check valve which permits rapid movement of piston **59** towards end wall **53** under the influence of spring **60** by providing free flow of the hydraulic medium through the piston, but which permits the piston to move only slowly towards end wall **54** as when weight is effective on the inner end portion **47** of arm **45,** as well be later described. There are several types of valves which are known and used in dash pots and one of these is illustrated in FIGS. 4a and 4b. Such a valve is identified in its entirety by the reference character **61.** Thus, piston **59** is formed with a threaded bore **62** into which is screwed a bushing **63** having a plurality of angularly spaced projections **64** on its upper end. Bushing **63** may be adjusted to vary the extent to which projections **64** extend above the upper face of piston **59.**

A valve cage **65** is mounted on the upper face of piston **59** in any preferred manner and loosely assembled within cage **65** is a ball valve **66.**

It is evident that on downward movement of piston **59,** that is towards end wall **53,** the hydraulic medium in cylinder **52** will flow through the bushing **63,** displace ball valve **66** from its seated position on projections **64,** and flow freely around ball valve **66** and cage

65. Thus, the hydraulic medium offers a minimum of resistance to downward movement of piston 59.

However, when weight is applied to the inner end of arm 45, the outer end portion of this arm will tend to move upwardly and will exert a pull on piston rod 57; thus, piston 59 is moved upwardly. As this movement takes place, the hydraulic medium will move ball valve 66 into a position in which it is seated on the projections 64 and, thus, define only very small spaces into which the hydraulic medium may flow. Thus, the upward movement of piston 59 is materially resisted and takes place at a slow rate.

A chain 67 is secured at its upper end to the lower end of plunger shank 37 by an eye bolt 68 and carries a hook 16 at its lower end which engages a loop on an ingot.

OPERATION

While the manner in which the subject separator operates is believed to be obvious from the illustrations of the drawings and description of parts set forth above, it is described as follows:

FIG. 3*a* illustrates the several elements of the separator 17 in what might be called an at rest condition. In this condition, arms 45 are substantially horizontal and their outer end portions are engaged by tabs 27 of upper frame 17. Flanges 38 on plunger 36 are spaced above the inner end portions 47 of arms 45 and are held in this position by return springs 40. With hook 16 engaging loop 15 of an ingot and an upward pull imparted to hook 26 by the hoist, the first thing that occurs is that the flanges 38 are moved downwardly into engagement with the inner end portions 47 of arms 45, as depicted in FIG. 3b.

With a mold and ingot suspended from hook 16, further upward pull causes the frames 17 and 29 to separate as illustrated in FIG. 3*c*. As this separation occurs, tabs 27 move away from engagement with the outer end portions of arms 45, thus permitting them to pivot under the influence of the weight on plunger 36. However, this movement is resisted by dash pots 51, and occurs at only a slow rate. This rate is adjustable by adjusting bushing 63 in each piston 59 of the dash pots. Thus, after the elapse of a predetermined interval, the flanges 38 will clear the inner end portions 47 of arms 45 and the plunger 36 will now fall free under the influence of the ingot mold unit secured to the lower end thereof. The fall of the unit continues until all of the slack in chain 43 is consumed and this chain becomes taut. Thus, the fall of ingot 13 is abruptly stopped, while mold 11 continues its downward movement under the momentum generated by the fall, and thus separates from the ingot.

After the weight of the mold and ingot is removed from the plunger, the springs 40 will return the plunger 37 into its upper position within lower frame 29. This movement is accommodated by the pivotally mounted inner end portions 47 of arms 45 as shown in FIG. 5*c*. Springs 60 in dash pots 51 will return arms 45 to their horizontal position, such movement being accommodated by the pivotally mounted tabs 27 on walls 19.

While a preferred specific embodiment is herein disclosed, it is to be clearly understood that the invention is not to be limited to the exact constructions, mechanisms and devices illustrated and described, because various modifications of these details may be provided in putting the invention into practice.

What is claimed is:

1. An apparatus for separating an ingot from a mold in which it is stuck by the use of a hoist, said apparatus comprising:
   a. an upper frame having hoist engaging means;
   b. a lower frame movable in said upper frame;
   c. a spring normally maintaining said frames in assembled relation;
   d. a plunger in said lower frame;
   e. return spring means normally retracting said plunger in said lower frame;
   f. ingot engaging means carried by said plunger;
   g. a pair of arms pivotally mounted on said lower frame and including inwardly and outwardly extending portions, said outwardly extending portions being engageable by said upper frame to hold the arms against pivotal movement, said inwardly projecting portions being engaged by said plunger;
   h. a dash pot connected to each of said arms for retarding pivotal movement thereof, said dash pots being mounted on said lower frame, and
   i. a chain having one end connected to said upper frame and its other end to said plunger, said chain being slack when said plunger is in a retracted position in said lower frame.

2. The apparatus of claim 1 in which said plunger includes a shank and a head presenting flanges which engage the inner ends of said arms.

3. The apparatus of claim 1 in which said upper frame includes vertical members together with a pair of spring biased tabs pivotally mounted on the ends of said vertical members and normally in alignment therewith.

4. The apparatus of claim 1 in which each of said arms includes a main body portion and an inner end portion pivotally mounted on said main body portion, together with abutment means for limiting relative pivotal movement between said main body portion and said inner end portion.

5. The apparatus of claim 1 in which the spring of element c) is a heavy coiled spring having its upper end anchored to said upper frame and its lower end to said lower frame.

6. The apparatus of claim 1 in which said lower frame includes a top wall formed with a central opening and said chain passes through said central opening.

7. The apparatus of claim 1 in which said return spring means comprises a pair of expansion coil springs each having an upper end connected to said lower frame with the lower end of each spring connected to the upper end of said plunger.

8. The apparatus of claim 1 in which each of the dash pots includes a cylinder containing an hydraulic medium, a piston slidable in said cylinder and formed with an opening, and a valve mounted on said piston in said opening which offers greater resistance to flow of the hydraulic medium through said opening in one direction, then in the opposite direction.

9. The apparatus of claim 8 in which said valve is adjustable to vary the resistance to flow of said medium in one direction.

* * * * *