April 18, 1939. H. A. WURSTER 2,154,967

MOLD CLAMPING MECHANISM

Filed March 24, 1937 3 Sheets-Sheet 1

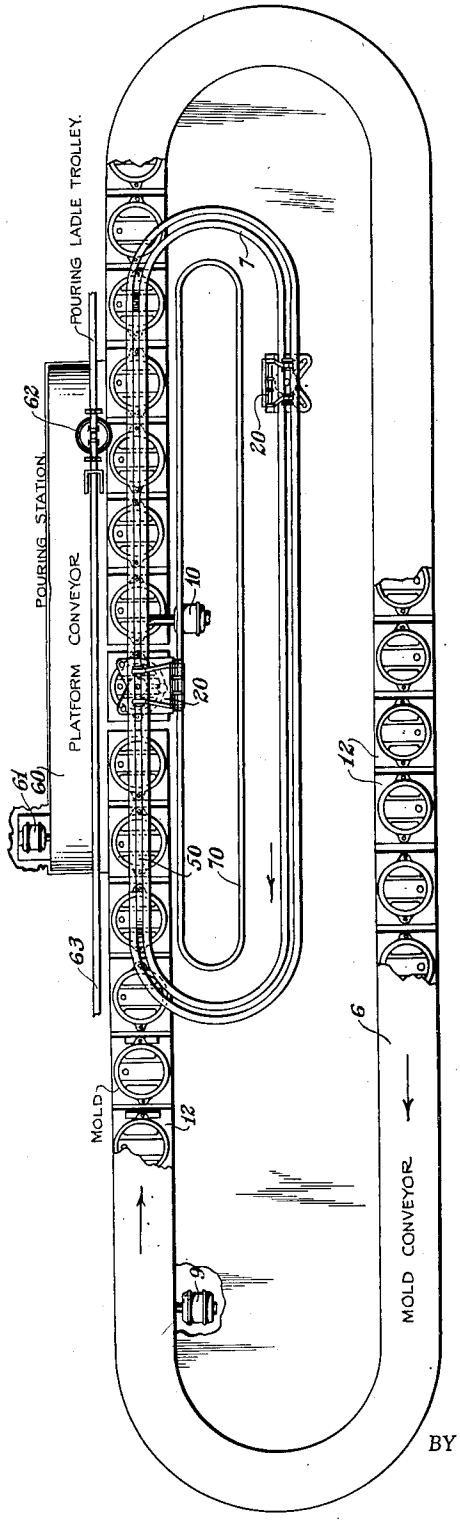


Fig. 1

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MOLD CLAMPING MECHANISM

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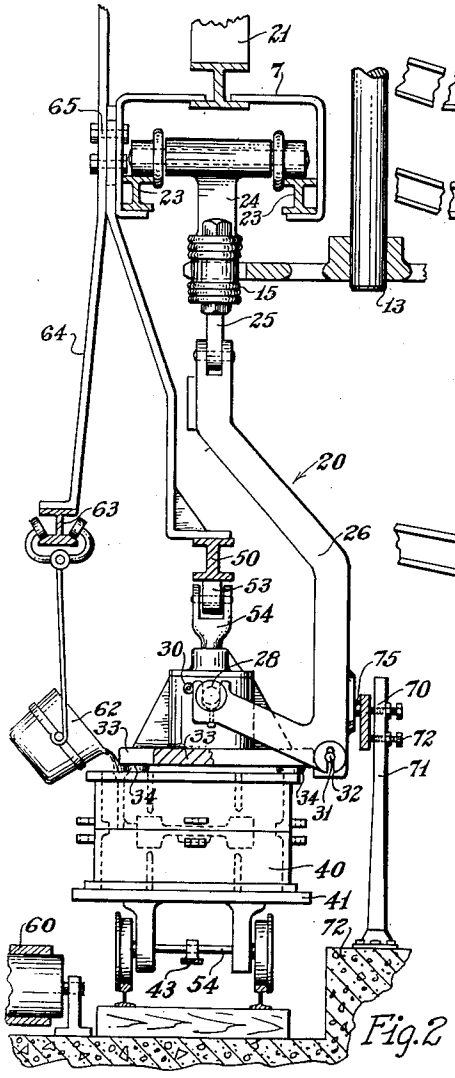


Fig. 2

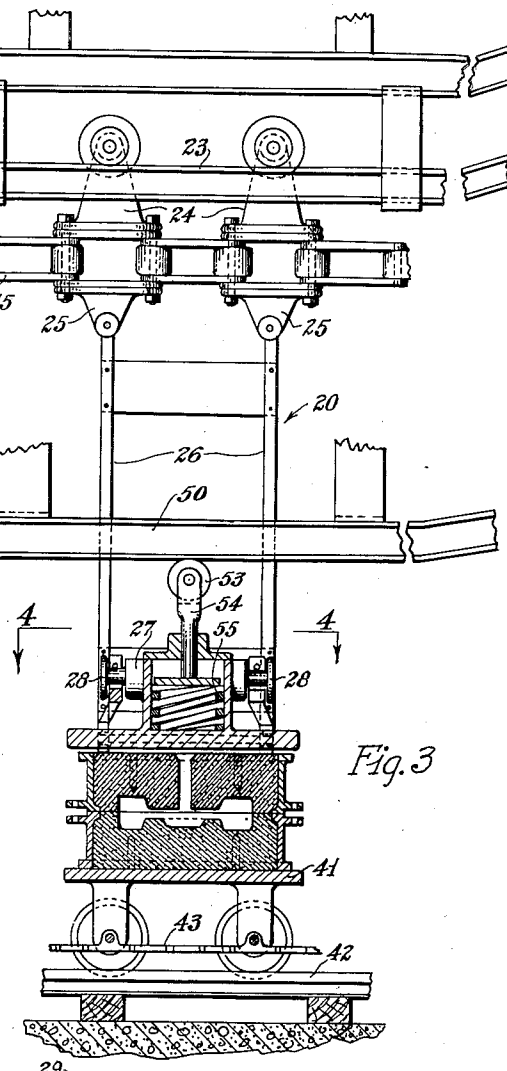


Fig. 3

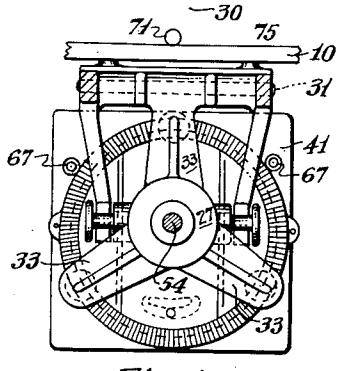


Fig. 4

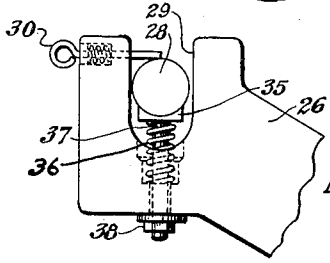


Fig. 5

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MOLD CLAMPING MECHANISM

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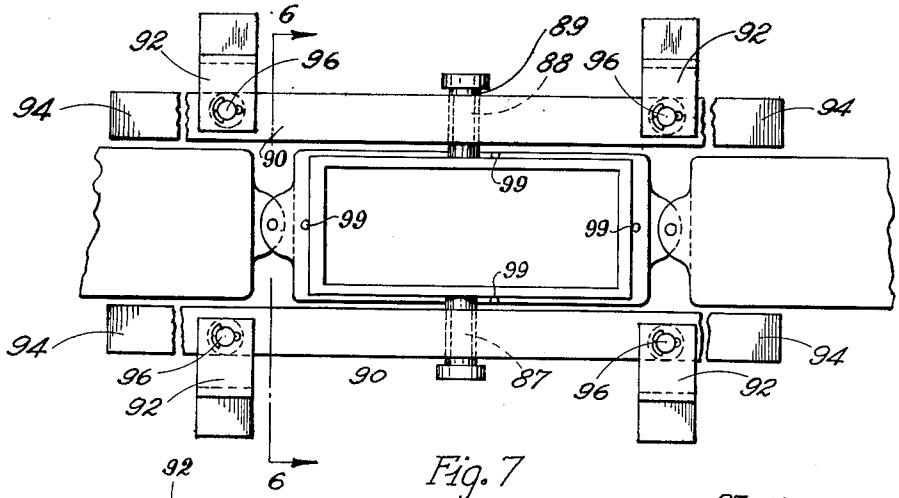


Fig. 7

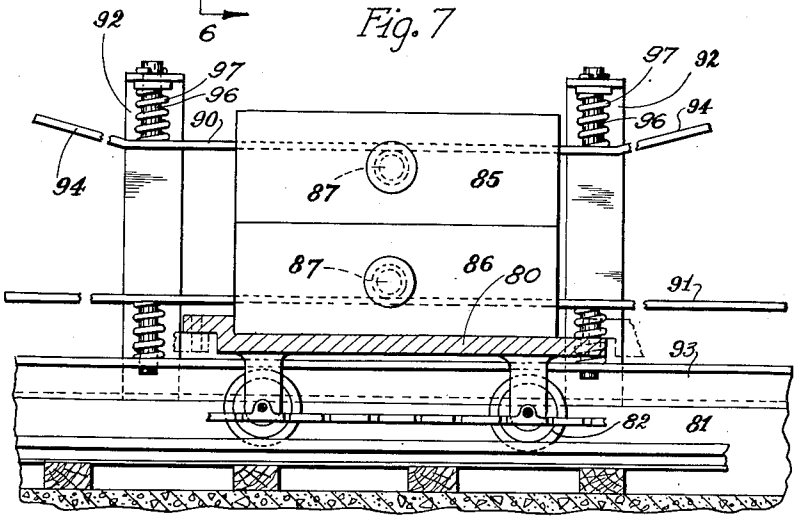


Fig. 8

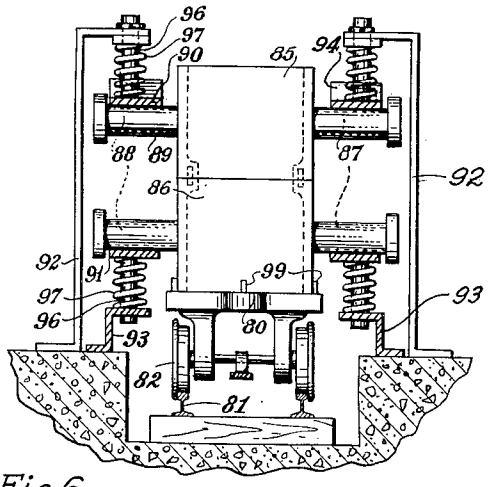


Fig. 6

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MOLD CLAMPING MECHANISM

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8 Claims. (Cl. 22—64)

This invention relates to foundry apparatus and more particularly to improvements in methods and apparatus adapted to facilitate the clamping of a series of molds and the pouring of the same.

Recent developments in foundry methods and apparatus have resulted in the general acceptance by the industry of a system wherein a moving conveyor carries a series of mold units in sequence through a mold assembly station, a pouring station, a cooling section on the conveyor and thence to a "shake-out" where the cooled castings are freed of the mold. Ordinarily the mold assembly station provides for the placing of the cope-flask on the drag-flask and a clamping of the two flask parts to insure the retention of the fluid metal during the pouring. Numerous expedients have been employed to clamp the cope and drag together including what is known in the art as a "dog clamp" or wedge type of clamp and the use of weights. The size or type of casting usually determines the nature of the clamping device required and the clamp-devices are ordinarily manually applied prior to the pouring and manually removed at the shake-out section of the conveyor subsequent to the cooling of the casting.

It will be understood by those skilled in the art that where clamps or weights are used to hold the cope and drag together according to the above described method the clamps or weights remain affixed to the mold throughout substantially the entire travel of the mold about the mold conveyor path. In the event relatively massive castings are being poured several heavy weights will be required for each mold and such weights must be manually handled prior to the pouring and at the shake-out. The time for the manual handling of the heavy weights or the manual application and removal of several clamps to each mold adds materially to the cost of the finished castings and is an important factor in the output of any foundry system.

The present invention relates principally to improved apparatus and methods of clamping the mold flask parts together in a manner which will provide for a marked reduction in the number of manual operations associated with the clamping of the mold flask parts. It is among the objects of my invention to provide a foundry system in which interconnected flask units are continuously moved along a conveyor path through automatic mold clamping devices operating to effectively clamp the flask parts together during the pouring. It is a further object of my invention to provide a foundry system in accordance with the preceding object in which the automatic clamping means includes a plurality of horizontally moving clamping units which are arranged to overhang the mold and travel therewith through a pouring station. It is also among the objects of my invention to provide a foundry system in which the mold units travel through a conveyor path having a substantially straight section wherein the mold units are automatically clamped to each other during a portion of their travel through said straight section. It is a further object of my invention to provide a foundry system in which the pouring section is provided with a series of horizontally moving clamping devices which are adapted to be raised and lowered with respect to molds moving through the pouring station and wherein said clamping devices are adapted to move horizontally with said molds during the pouring thereof. It is a further object of my invention to provide a foundry system in accordance with the preceding object in which the effective clamping action with respect to the molds is smoothly and positively applied through a cushioning means. It is a further object of my invention to provide a foundry system in accordance with the two preceding objects in which the mold clamping apparatus is suspended from an overhead trolley conveyor. It is also among the objects of my invention to provide a foundry system having a series of continuously moving mold units provided with a series of continuously moving mold clamping units in which a horizontally moving pouring station conveyor facilitates the pouring of the mold. It is a further object of my invention to provide a pouring station conveyor in accordance with the preceding object wherein the conveyor movement is synchronized with respect to the movement of the mold units so as to eliminate the necessity of the ladle-men walking along with the mold units during the pouring thereof. It is also among the objects of my invention to provide an automatic mold clamping apparatus suited for use with molds continuously moving through a pouring station in which the clamping apparatus operates to relieve the mold conveyor of any clamping pressure.

Further objects and advantages relating to the elimination of manual operations and other economies of manufacture will be apparent from the following description and appended drawings wherein:

Figure 1 is a diagrammatic plan view of a foundry system embodying my invention;

Figure 2 is an elevation with parts in section taken at the pouring station of the foundry system shown in Figure 1;

Figure 3 is an elevation with parts in section taken at right angles to the showing of Figure 2;

Figure 4 is a sectional view taken along the line 4—4 of Figure 3;

Figure 5 is a detailed showing of the trunnion support for a mold clamp unit;

Figure 6 is an elevation with parts in section of a modified form of mold clamping apparatus;

Figure 7 is a plan view of the modification shown in Figure 6;

Figure 8 is a longitudinal sectional view with parts broken away of that form of mold clamping device shown in Figure 6.

I have attained the objects above outlined and numerous other advantages by providing a mold conveyor system indicated as at 6 in Figure 1 with a mechanism which will automatically clamp the mold parts together as they travel through a mold pouring station as indicated in the legend of Figure 1. The clamping mechanism comprises, according to the embodiment illustrated, a trolley type of conveyor indicated at 7 having a portion of its path arranged to overhang a portion of the mold conveyor path and having clamping units 20 arranged to move along said trolley conveyor in synchronism with the mold units carried by the mold conveyor. To effect the above mentioned timed movements a motor indicated as at 9 in Figure 1 is arranged to drive the interconnected mold units 12 along the conveyor 6 at the same rate of travel as that effected by a motor 10 employed to drive the clamping units indicated generally at 20 about the orbit of the trolley conveyor. Preferably the trolley conveyor motor 10 acts through bevel gears (not shown) to rotate a sprocket shaft as at 13 (Figure 2) arranged to drive the chain 15 of the clamping unit 20. The mold conveyor assembly may be of the conventional type comprising a series of interconnected mold conveyor cars 41 arranged through the flanged wheels thereon to travel about the mold conveyor orbit defined by rails 42. Preferably a chain 43 is suspended beneath the mold conveyor cars and is driven along the mold conveyor path by a bevel gear and sprocket connection substantially as described above in connection with the trolley conveyor drive. As will be understood as the description of my invention proceeds, I contemplate that it will be unnecessary to replace the mold conveyor apparatus ordinarily found in the foundry and that such conventional mold conveyor apparatus is suited for combination with my mold clamping and pouring apparatus.

The mold clamping mechanism indicated generally at 20 is preferably supported by a trolley type of conveyor indicated generally at 7 comprising a depending bracket 21 arranged to support the flanged wheel suspension units 24. The trolley conveyor chain 15 is connected to the spaced suspension units 24 and hanger brackets 25 are in turn secured to the suspension units and chain as shown in Figure 3. Spaced clamping device hangers 26 depend from the brackets 25 and are offset from their point of suspension to provide a hook shaped support for the clamping unit 27.

To resiliently support the clamping units 27 and insure a smooth positive clamping action the units are preferably mounted upon the clamp unit support 26 by a resilient mounting shown in detail in Figure 5. The resilient mounting comprises a segmental bearing support 35 normally urging the trunnion 28 to a raised position in slot 29 through the coil spring 36 surrounding the stem 37 of the segmental bearing support 35. A stop means such as, for instance, the nut 38, is applied to the lower end of the stem 37 projecting below the support 26 to limit the upward movement of the spring pressed segmental bearing. The clamping units are preferably positively retained within the slot 29 by a spring pressed latch bolt 30 and in the event that it is desired to provide the assembly with clamping units of different shape or weight the unit may be tilted bodily on the trunnion 28 to rock the member 31 out of the slot 32 and the entire unit bodily removed subsequent to a withdrawal of the spring latch bolt 30. In this connection it is pointed out that the clamping pressure desired for any particular class of work may be obtained by suitable selection and construction of springs 55. For instance, for relatively light work a light weight coil spring 55 may be employed and on heavy work said light weight coil spring may be removed from the clamp unit and replaced by a heavier coil spring suited to transmit to the mold the desired heavy clamping pressure.

The clamping unit 27 is preferably provided with arms 33 spaced substantially 120° from each other carrying pressure pads 34 at the underside thereof to equally distribute the pressure applied through the unit 27 to the mold therebeneath.

To effectively move the clamping unit into position against the mold as the mold unit traverses the pouring station section of the conveyor, said section of the conveyor is provided with a clamping rail 50 and the trolley conveyor track 23—23 is arranged to "dip" or lower along the pouring station as indicated in Figure 3. The dip of the clamping rail at one end of the pouring station causes the roller 53 and push-rod 54 secured thereto to move downwardly and tend to compress the spring 55 within the clamp unit 27. As will be observed from Figure 3 the dip in the trolley conveyor occurs just prior to the dip in the clamping rail and thus the mold unit 20 in its entirety is lowered on to the mold 40 prior to the application of the clamping action obtained through the dip in the rail 50 and the spring mechanism in the clamping unit. The effect of the initial lowering of the entire clamping device 20 is to properly center and position the unit 27 on the mold unit 40 prior to the clamping thereof. As will be understood by those skilled in the art there is frequently slight variation in the overall height of a mold unit and the slots 29 and 32 provide the desired flexibility in the assembly to accommodate variations in overall mold height. During the application of the clamping pressure effected through the rail 50, member 54 and coil spring 55 it will be observed that the lowering of the member 54 functions to compress the relatively light spring 36 in the trunnion support assembly and this brings about a smooth positive lowering and centering action of the entire mold clamp unit.

An additional centering and guiding device for the clamping mechanism 20 to facilitate the proper positioning of the same is provided by the guide rail 70 which may be adjustably supported by means of bolt and lock nuts 72 on the standards 71 projecting upwardly from the mold floor. The guide rail 70 follows substantially the trolley conveyor orbit except, however, that the side of the guide rail 70 adjacent the pouring station is offset toward the mold conveyor so that the rail 70 will through the bearing pads 75 on the clamp-

ing mechanism swing the hangers 26 slightly toward the pouring station. While the clamping mechanism traverses that side of the trolley conveyor path remote from the pouring station the clamping devices are arranged to hang free or in a position determined by the weight suspended and as the units approach the pouring station they are swung out of said normal suspended position and maintained in accurate alignment above the molds throughout the pouring station.

The term clamping unit as used herein contemplates a unit capable of exerting a pressure acting to hold the mold parts together which pressure or force exceeds the force of gravity which would result from the mass of the unit as distinguished from a mold weight unit wherein the force acting to hold the mold parts together is due entirely to the mass of the weight employed. As will be understood by those skilled in the art the use of mold weights is well suited to relatively light work wherein the total mold weight may be easily handled by one or two workmen and that in heavier work it is necessary to clamp the two flask parts to each other.

Preferably the base 41 of each of the interconnected conveyor units is provided with upstanding pins or lugs 67 which serve to center the mold unit with respect to the base. As the cope and drag are arranged on the conveyor prior to the clamping and pouring of the mold the mold unit may be shoved into engagement with the pins or lugs 67 and thus each mold unit will be properly centered and positioned for the automatic mold clamping device 20. A further advantage obtained by the centering pins 67 is that the mold unit cannot be displaced with respect to the conveyor by the clamping mechanism nor by occasional movement of the workmen subsequent to the arrangement of the unit on the conveyor. I have shown centering or positioning pins 67 merely by way of illustration and it will be understood by those skilled in the art that different forms of flask will occasion a different arrangement of centering or positioning pins, and that means other than pins or lugs may be employed to accurately position the mold so that the same may co-operate with the automatic clamping mechanism.

As pointed out in the introductory matter of this specification it has been heretofore proposed to pour the molten metal into the molds as the mold conveyor moves along the pouring station and to accomplish this pouring it is conventional to suspend a small pouring ladle from a trolley and the ladle is carried along by the workmen as they walk alongside of the mold conveyor. It will be understood by those skilled in the art and familiar with the above described procedure that the movements of the workmen holding the pouring ladle must be well coordinated with mold conveyor movements and that considerable experience is required to pull the pouring ladle along its conveyor and pour molten metal into the mold as the same is moving. In spite of the skill and experience possessed by many workmen engaged in pouring molds according to the above described method a large number of castings must be discarded during the course of a day's run because of faulty pouring. It will be understood that in the event the molten metal is poured into the mold cavity and said cavity is half filled and the pouring through the sprue be discontinued for a fraction of a second that air will be trapped within the mold and that the second volume of metal poured therein will not "knit" to that metal poured prior to the interruption. To avoid a large number of imperfect castings it is, therefore, necessary to maintain a mold conveyor speed which the workmen carrying the ladle through the pouring station may conveniently follow by walking along the pouring station and accurately pour. Since the speed at which the molds may be poured determines the speed at which the conveyor may move through the pouring station, the entire output of the foundry is frequently controlled by the speed at which the ladle-men can efficiently fill the molds with molten metal.

According to my invention the foundry system provides that the mold clamping may be carried out more rapidly than according to the methods heretofore provided and a system in which the mold clamping will not act as a brake or control factor upon the entire foundry output. To contribute to the convenience with which the molds may be poured I prefer to employ a continuously moving platform conveyor 60 proportioned to extend throughout the pouring station. The entire platform conveyor system may be driven by a motor 61 and arranged within a pit so as to bring the upper surface of the platform conveyor into the plane of the floor 72. Preferably the motor 61 is geared to the conveyor mechanism to move the conveyor at the same rate of movement as the mold conveyor 6 and thus the workmen standing on the platform conveyor may without any appreciable effort on their part pull the pouring ladle 62 along the poring ladle trolley track 63 during the pouring of the mold. The ladle trolley conveyor may be conveniently supported as by depending brackets 64 adjustably secured to the clamping mechanism trolley conveyor 7 as at 65. It will be appreciated that the workmen controlling the tilting of the pouring ladle are not required according to my invention to walk or make any voluntary movements during the pouring of a single mold and that as soon as one mold is poured they may tilt the ladle back and walk to the next mold and without thereafter moving with respect to the mold conveyor pour the said next mold. This method of pouring which is facilitated by the mechanism of my invention is especially well suited to a foundry system in which the mold flasks are arranged to be clamped by an automatic mechanical device, since there are no manual movement limitations imposed upon the system by a clamping station. It will be observed that according to my system the rate of movement of the molds through the pouring station is immaterial so long as the platform conveyor is arranged to move at the same rate and it is within the scope of my invention that molds may be poured while the mold conveyor is moving faster than a workman could ordinarily walk and pull the pouring ladle as in the prior art methods.

During the operation of a foundry system according to the preferred embodiment of my invention the mold conveyor 6 is driven by the motor 9 to carry the mold units 12 through the pouring station at the same rate of speed and in synchronism with the clamping units 20 moved by the motor 10. As the clamping units approach the pouring station part of their conveyor travel they are arranged through a dip in the trolley conveyor to be lowered on to the mold flasks and subsequent to their lowering on the mold flask they are securely pressed into clamping engagement by the clamping rail 50 and the mechanism on the clamping unit including roller 53 and spring 55. To properly center the clamp-

ing units on the mold flask as they approach the pouring station the guide rail 70 is offset toward the pouring station and holds the suspended clamping units slightly out of their normal depended position in a manner which takes all of the sway out of the units which might be occasioned by their movement along the trolley conveyor 7.

As soon as the cope and drag are effectively clamped to each other workmen standing on the platform conveyor may move the pouring ladle 62 into position to pour a mold and may walk along the moving platform conveyor to pour other molds as permitted by the length of the platform conveyor and the speed of the associated mechanisms. The track 63 for the pouring ladle may continue in a path of any desired shape away from the platform conveyor towards a cupola or a larger ladle where the ladle 62 may be refilled. In certain installations the track 63 may be oval in shape and the workmen pouring the molds may follow said oval path and refill the pouring ladle at that side of the oval remote from the pouring station. The length of the pouring station need not be limited to a particular number of units such as I have shown, but may be of any desired length and thus accommodate two or more groups of ladle pouring workmen. The molds remain in a clamped condition to the end of the pouring station where the clamping units are again raised by reason of an elevation in the trolley 7 and the clamping rail 50 to free the molds of any restraint and permit them to continue along the mold conveyor path. Thereafter the molds continue to move through the cooling section of the conveyor and down to a shake-out mechanism (not shown).

In Figures 6 to 8, inclusive, I have shown a modified form of my invention which is suited to installations wherein it is desired to clamp the mold parts together automatically without transmitting the force of the clamping action to the mold conveyor mechanism. In this form of my invention the mold conveyor system comprises a series of interconnected units 80 arranged to be continuously moved about a mold conveyor path through rails and wheels 81 and 82 substantially as in the preferred form of my invention. In the modification of Figures 6 to 8, however, each of the mold flask parts 85 and 86 is provided with oppositely extending pins 87 and 88 arranged transversely of the direction of mold conveyor travel. Each of the pins 87—88 projecting laterally of the flask parts is surrounded by sleeves or bearings 89 which are arranged to bear against longitudinally extending fixed clamping rails 90 and 91. The fixed clamping rails 90 are supported by suitable brackets 92 and the rails 91 by Z-shaped bars 93 secured to the floor of the foundry at each side of the mold conveyor. Said clamping rails may extend longitudinally the full length of the pouring station. Preferably the ends of the rails 90 diverge from the lower rail 91 as at 94 at each end of the pouring station so that as the mold units move into the pouring station the rails urge the flask parts 85 and 86 toward each other to effect a clamping of the mold.

Preferably the support of the rails by foundry floor members 92 and 93 includes a flexible mounting of the rails as provided by pins 96 and coil springs 97 arranged thereabout so that the rails 90 and 91 may have a limited cushioned movement with respect to their support and thus accommodate slight variations in mold parts and irregularities in conveyor movement. It will be understood that in this form of my invention the clamping action or squeeze of the complementary mold flask parts is effected by a wedging action in the rail parts 94 and 95 due to the movement of the mold therealong and therefore it will be desirable to center and secure the mold to the conveyor plate 80 by means, such as pins 99.

Although I have shown and described two embodiments of my invention in considerable detail it will be appreciated by those skilled in the art that numerous variations may be made therein, such as, for instance, the clamping mechanism of the preferred embodiment may be supported by a conveyor mounted on the foundry floor, and that other modifications may be made in the apparatus shown without departing from the scope of the invention as defined by the following claims.

I claim:

1. A foundry system comprising a series of interconnected mold units arranged to be moved through a pouring station, means to clamp said mold units as they traverse said pouring station comprising a clamp unit support arranged to be moved through said pouring station in synchronism with said mold units, a clamp unit mounted on said support for limited movement with respect thereto, a fixed clamping rail extending along said pouring station arranged to bear against a portion of said clamping unit and move the same into engagement with the upper edges of the flask of said mold units to hold the mold unit in clamped position during the pouring thereof.

2. A foundry system comprising a series of interconnected sand casting mold units continuously moved through a pouring station, means to clamp said mold units as they traverse said pouring station comprising a clamp unit support arranged to be moved in synchronism with said mold units, a clamp unit mounted on said support comprising a lower mold engaging part proportioned to overhang and bear against the upper edges of the upper flask of said mold unit, an upwardly projecting part arranged to bear against a fixed clamping rail extending along the pouring station and spring means interposed between said two parts to resiliently transmit the clamping action effected by said clamping rail to the lower mold engaging part.

3. A foundry system comprising a series of interconnected sand casting mold units continuously moved through a pouring station, means to clamp said mold units as they traverse said pouring station comprising a clamp unit support arranged to be moved in synchronism with said mold units, a clamp unit resiliently mounted on said support for limited movement with respect thereto, a fixed clamping rail extending along said pouring station arranged to bear against a portion of said clamping unit and move the same in opposition to the said resilient mounting and into engagement with the upper edges of the flask of said mold units to hold the mold unit in clamped position during the pouring thereof.

4. A foundry system comprising a series of interconnected sand casting mold units mounted for movement through a pouring station, a fixed clamping rail overhanging said mold units in the pouring station, means to clamp said mold units as they traverse said pouring station comprising a clamp unit support arranged to be moved in

synchronism with said mold units, a clamp unit mounted on said support comprising a mold engaging part proportioned to overhang and bear against the upper edges of the upper flask of said mold unit and a part projecting upwardly from said mold engaging part arranged to bear against said clamping rail, and spring means interposed between said two parts to resiliently transmit the clamping action effected by said clamping rail to the lower mold engaging part.

5. The combination of a suspended mold clamping mechanism with a pair of spaced supports arranged to overhang a mold, comprising a clamp actuating rail mounted above the mold, a vertically extending upwardly open slot formed in each of said supports, a clamping unit provided with oppositely extending trunnions supported in said slots, said clamping unit provided with portions arranged to bear against the upper edge of the flask of the mold to be clamped, a member carried by said clamping unit and movable with respect thereto arranged to engage the clamp actuating rail, means carried by said clamp unit interposed between said portions and said member to transmit the clamping action of said rail to said mold.

6. A suspended mold clamping mechanism including a pair of spaced supports arranged to overhang a mold, a slot formed in each of said supports, a clamping unit provided with oppositely extending trunnions supported in said slots, said clamping unit provided with spaced bearing portions arranged to bear against the mold to be clamped, a movable actuating member carried by said unit, a coil spring interposed between said portions and said member to resiliently transmit the movement of said member to said portions.

7. A suspended mold clamping mechanism including a pair of spaced supports arranged to overlie a mold, compression springs mounted on said supports, a clamping unit, opposed trunnions thereon mounted upon said compression springs, arms on said clamping unit arranged to engage the mold to be clamped, a push rod, carried by said clamping unit, a compression spring mounted thereon and arranged in conjunction with the first named springs to effect the compressive engagement of said arms with the mold.

8. A suspended mold clamping mechanism including a pair of spaced supports arranged to overlie a mold, compression springs mounted on said supports, a clamping unit, opposed trunnions thereon mounted upon said compression springs, arms on said clamping unit arranged to engage the mold to be clamped, a push rod, carried by said clamping unit, a compression spring heavier than the first named springs mounted on said push rod and arranged to augment the compressive engagement of said arms with the mold.

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