Nov. 23, 1965 G. NAMY 3,218,682

APPARATUS FOR MOLTEN METAL SUPPLY CHANGEOVER DURING CASTING

Filed March 19, 1963 5 Sheets-Sheet 1

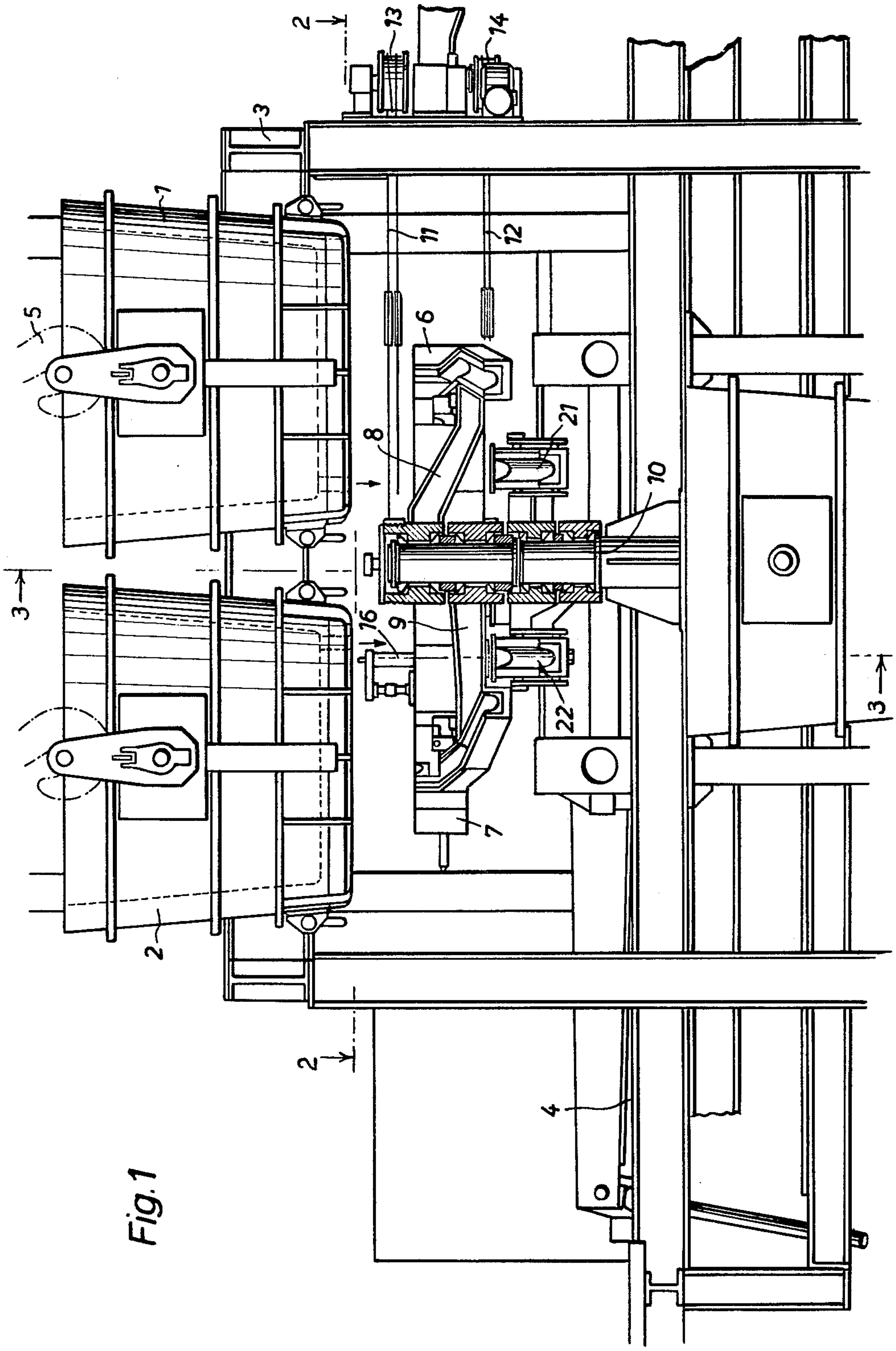

Fig.1

APPARATUS FOR MOLTEN METAL SUPPLY CHANGEOVER DURING CASTING

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Fig. 2

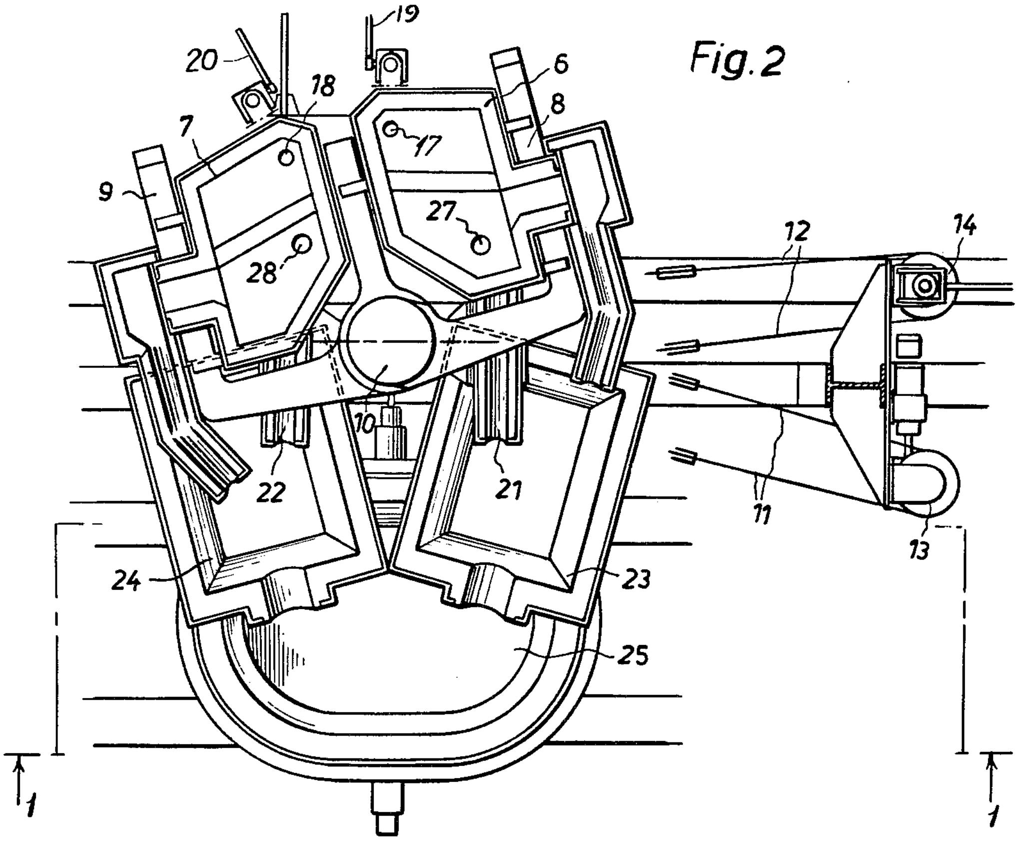
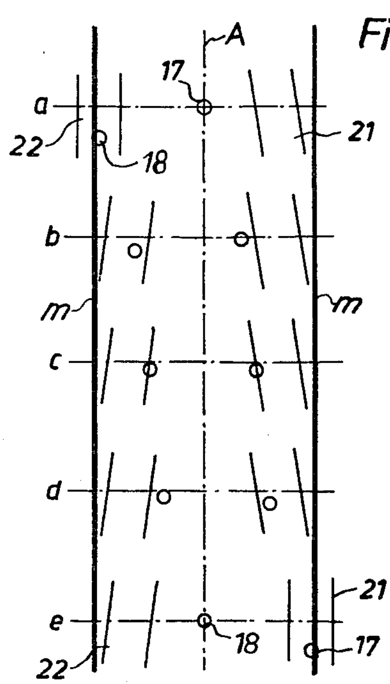


Fig. 4



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APPARATUS FOR MOLTEN METAL SUPPLY CHANGEOVER DURING CASTING

Filed March 19, 1963 5 Sheets-Sheet 3

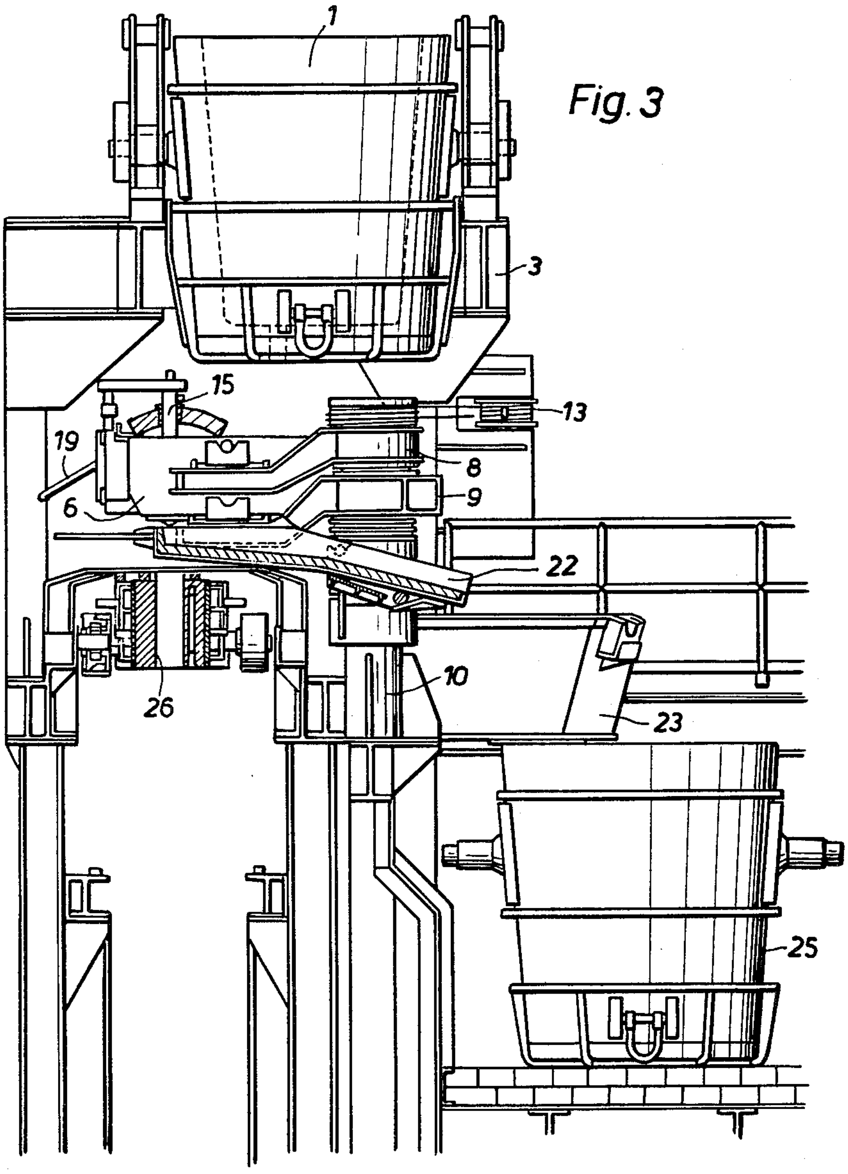

Fig. 3

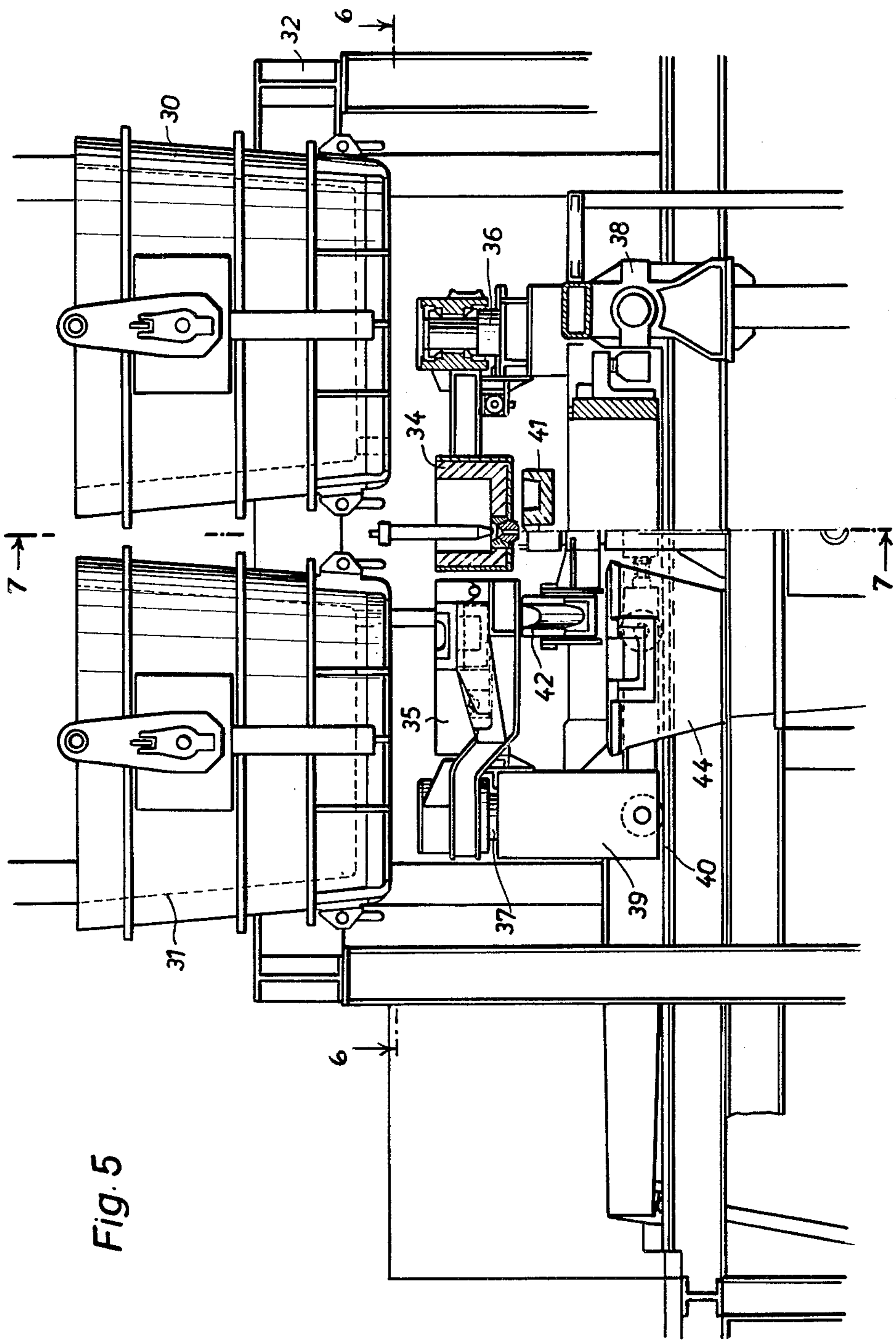

Fig. 5

APPARATUS FOR MOLTEN METAL SUPPLY CHANGEOVER DURING CASTING

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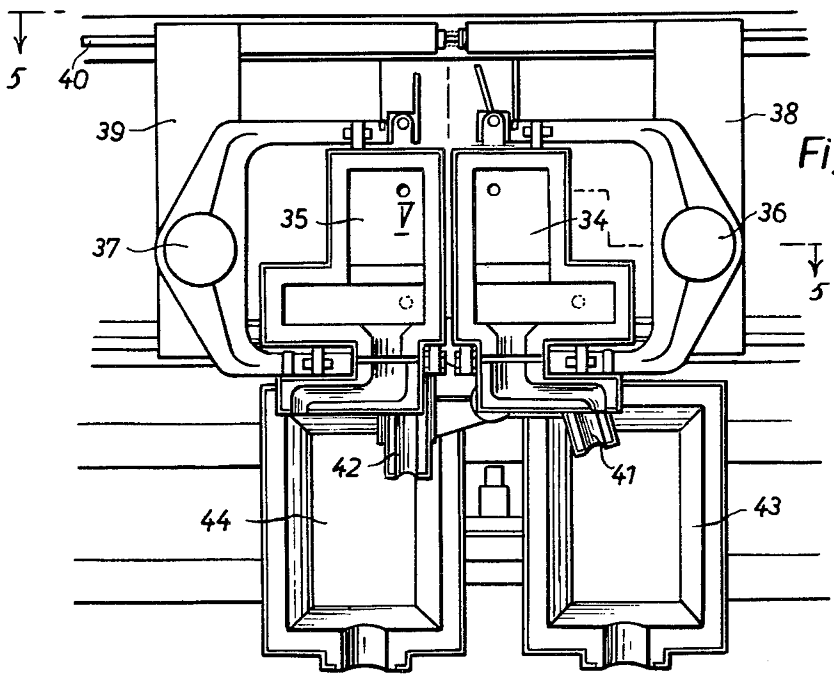

Fig.6

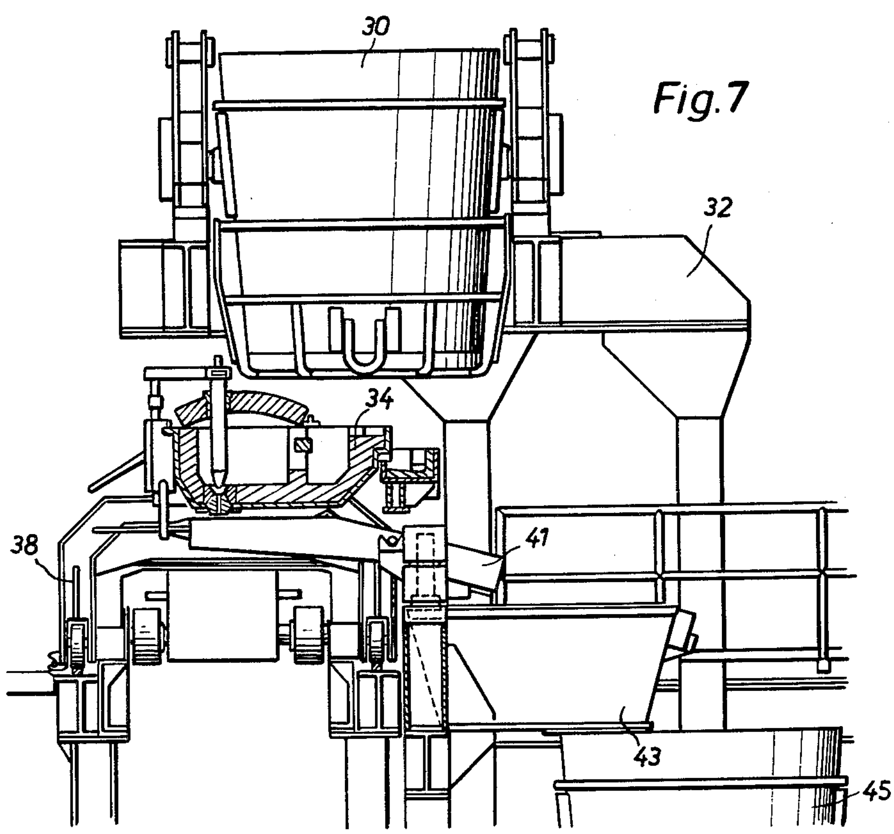

Fig.7

United States Patent Office

3,218,682
Patented Nov. 23, 1965

3,218,682
APPARATUS FOR MOLTEN METAL SUPPLY CHANGEOVER DURING CASTING

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Filed Mar. 19, 1963, Ser. No. 266,368
Claims priority, application France, Mar. 22, 1962, 891,898
5 Claims. (Cl. 22—79)

The invention relates to novel apparatus for the continuous casting of metals, especially steel, and in particular to the arrangement of ladles and distributor containers, over the ingot mold or die of a continuous casting machine.

In conventional equipment for continuous casting, a pouring ladle is arranged above the die or mold and supplies an intermediate container which in turn enables feeding of the metal into the die.

Normally, the casting operation is initiated with a cold-slab or dummy bar, which seals the die or mold at its base, prior to the casting, and is then pulled out downwardly and afterwards separated from the slab proper. When the pouring ladle is emptied the casting operation is then interrupted and a cold slab is once again inserted, so as to re-commence, and continue the casting operation. This procedure involves excessive down time, particularly when casting slabs. In addition, the first portion of the cast strand, which follows the dummy bar and the end portion (i.e., the portion formed by the molten material maintained in the mold as the feeding head) are discarded as scrap. This involves the loss of material. It has therefore been attempted, by a quick interchanging of the ladles, or by the arrangement of two ladles, provided each with a feeding channel to a common intermediate container to enable a quick change from an empty ladle to a full one. The proposed arrangement of two ladles on trucks, which successively pour into a common container has the disadvantage, that these trucks require excessive space in the already confined space of the pouring-floor. The intermediate container, must possess large dimensions, so as to form a buffer for the interrupted steel supply during the exchange of ladles. However, with this proposed arrangement the fabrication costs of the intermediate container are increased and the formation of slag is increased. Moreover, a large intermediate container, has the disadvantage of having a large heat radiation potential. This disadvantage causes either an overheating of the fused steel mass, or requires the installation of additional heating units on the intermediate container. The overheating of the fused steel mass causes disadvantages in the form of increased wear of the ladles, the increased accumulation of slag, and substantially higher melting costs. The heating appliance for the intermediate container renders the plant intricate and reduces the service life of the intermediate container. It has therefore been proposed to provide a quick interchanging device for the intermediate container. However, the proposed structures revealed disadvantages, in that the die and its suspension means were covered by dirt, when changing the intermediate container, by the steel still flowing out or by the slag. Furthermore, the cleaning of the die and its suspension is very difficult, because access is restricted.

Moreover, in the apparatus and processes known to the art, the material and production losses have increased manufacturing costs. To prevent inclusion of slag in the casting, which leads to the lack of homogeneity and production losses, the art has used large ladles. Although more metal may be poured from a large ladle, to avoid inclusion of material cooled below the casting temperature, changeover to another ladle must be made at a time when the first ladle holds a considerable amount of material. Thus, handling costs are increased. Further, on changeover, the slag carried in the stream of the new ladle enters the casting. Thus, the large ladles only decrease the frequencies of faults in the casting at the expense of increased handling costs.

An object of the present invention is the provision of apparatus for the continuous casting of metals which eliminates the above mentioned disadvantages. With this apparatus the liquid metal is directed successively from containers via associated intermediate containers and their outlets in a casting mold or die. According to the invention the method consists in placing, before emptying a first container, at least one collecting device leading to an emergency ladle beneath the outlet of an intermediate container associated with a second container, filling the second intermediate container and turning it with its collecting device into a position above the die, turning the collecting device from the outlet of the container and clearing the way for the jet of metal to the die, simultaneously placing the collecting device associated with said first intermediate container beneath the outlet of this container to divert its jet of metal into said emergency ladle, and then turning the first intermediate container with its collecting device away from the die, the said turning movements of the intermediate containers being synchronized so that the supply of metal to the die is not substantially interrupted.

This process enables the fully continuous casting of a faultless slab, since, during the changing of a ladle becoming empty for a full ladle, the intermediate container associated with the full ladle is filled, the cold steel and the slag in the intermediate container are drained by a channel of the collecting device, and in the appropriate moment, when the steel flowing out of the intermediate container has reached the desired temperature, the channel can be removed from underneath this container, while the channel associated with the intermediate container of the empty ladle is placed underneath this latter container for collecting the slag. During this procedure the two intermediate containers, together with their channels, are simultaneously positioned over the die and moved away from the die respectively. It is therefore, practically possible to produce a casting which apart from influences of the particular analytic composition, is of absolutely homogeneous structure, practically free of slag inclusions and solid throughout, and which results in a minimum waste. The intermediate containers can be interchanged without soiling the die, or its suspension. Furthermore, since the intermediate containers can be of reduced volume and accordingly the loss of temperature is small it is not necessary to overheat the steel, and therefore the costs for the brick-lining of the ladle and intermediate containers are reduced.

For carrying out the method according to the invention, provision is made for at least two intermediate containers, each provided with at least one outlet spout; each intermediate container is pivotally mounted on a suspension means and for each spout a channel is pivotally mounted on suspension means below each intermediate container. This arrangement has the advantage that the channels can be utilized not only when changing a ladle for another one, but also when a disturbance occurs during operation of the casting plant. According to a further feature of the invention, the intermediate containers and the channels are supported on a common suspension means. This arrangement results in an exceptional simplification of the control, and in an economical, and simple space, saving construction.

In a modification of the invention each intermediate container and its associated channel are pivoted on a common suspension means. This suspension means is mounted on a truck which is movable in a direction transverse to the casting axis.

This arrangement offers the advantage of effecting repair and maintenance of the intermediate containers and the channels outside of the casting floor and thus to keep the workmen concerned away from the immediate vicinity of the casting machine.

Several embodiments of apparatus according to the invention are illustrated in the accompanying drawings in which:

FIGURE 1 is a side-view of an apparatus for continuous casting according to a first embodiment of the invention, partly drawn in section along the line I—I of FIGURE 2.

FIGURE 2 is a horizontal section taken along the line II—II of FIGURE 1, with the stoppers omitted.

FIGURE 3 is a view in elevation, partly drawn in section along the line III—III of FIGURE 1 with the left intermediate container removed.

FIGURE 4 is an illustration of the progressive dislocation of the molten streams from the various intermediate containers above the ingot mould.

FIGURE 5 is a view in elevation partly shown in section along the line V—V of FIGURE 6 showing another embodiment of the invention.

FIGURE 6 is a plan view partly shown in section along the line VI—VI of FIGURE 5.

FIGURE 7 is a view in elevation partly drawn in section of the embodiment of FIGURE 6, with the left intermediate container removed.

FIGURE 1 shows an arrangement of two ladles **1** and **2** mounted symmetrically to the casting axis, upon a stage **3** above a pouring floor **4**. The ladles **1** and **2** can be lifted out, or lowered into the stage **3**, by means of a crane **5**. Two intermediate containers **6** and **7** are arranged below the ladles **1** and **2**. The containers are interchangeably positioned on frames **8** and **9**. The frames **8** and **9** are pivoted on a pillar **10**. The pillar **10** runs parallel to the casting axis, and is symmetrically positioned to the ladles **1** and **2**. With the assistance of their frames, which can turn through 360°—in the practise, 180° is sufficient—the intermediate containers **6** and **7** can be turned to a bridge or similar platform (not shown), where they can be exchanged and/or pre-heated. The swivel-movement of the intermediate containers can be achieved for example by cables **11** and **12**, and by winches mounted on the stage **3**. Other means can however be utilized to swivel the intermediate containers **6** and **7**. Plugs **15** and **16** are arranged in the intermediate containers **6** and **7** to control the rate of pouring or to close the outlet nozzles **17** and **18** (FIGS. 2 and 4). The movement of the plugs **15** and **16** is controlled through compound lever systems **19** and **20** (FIG. 2). Channels **21** and **22** are arranged below the intermediate containers **6** and **7**. The channels are pivoted on the pillar **10**, and open into the slag containers **23** and **24**, which if need be, can overflow into an emergency ladle **25**.

In FIGURE 3 an ingot mold or die **26** is shown, which can be supplied with liquid steel alternatively from the outlet nozzle **17** or **18** of the intermediate containers **6** or **7**. In FIGURE 2, the reference numerals **27** and **28** mark the areas where the liquid steel which flows out from the ladles **1** and **2**, impinges upon the containers **6** and **7**. In FIGURE 4, the changing from one ladle to the other is schematically illustrated. When the ladle **1** is almost empty, the ladle **2** which is inserted at the correct time by the crane **5** into the stage **3**, starts to pour into the intermediate container **7**. The channel **22**, under the intermediate conatiner is driven beforehand under the spout **18**. The intermediate-container **7** is filled with liquid metal and the slag with the too cold metal is diverted through the channel **22** into the slag container **24**. If an additional plug **16** is available, as shown in the example concerned, then it will be closed, as soon as the slag container is thoroughly rinsed, and the cold steel and slag have finished running-off. After this the intermediate container **7**, together with the channel **22** is moved in the direction of the mold **26** into ready position. As soon as one observes that the metal flowing out of the ladle **1**, is no longer clean, i.e., mixed with slag, the plug **16** is opened. The stream from the nozzle **18**, is directed into the channel **22** until the stream has cleaned the nozzle and ceases to flap. Then the channel **22**, is moved away from under the molten stream coming from the nozzle **18**, and thereby, leaves the way free for the molten stream to flow into the ingot mold. The channel **21** is then simultaneously moved under the nozzle **17**, and the steel coming from the intermediate container **6** at present not yet mixed with slag, is directed through the channel **21**, into the slag container **23**. If no plugs are available, the steel flowing from the nozzle **18**, will be directed through the channel **22**, until the channel **21**, can be brought under the nozzle **17**. In this case, the intermediate container **7** is filled while in the ready position.

FIGURE 4 illustrates the progressive transfer of the molten-streams which come from the nozzles **17** and **18** when interchanging one intermediate container for the other, whereby the lines *m* correspond with the narrow side of the ingot mold **26**.

Position *a*: preparation for casting, filling of the intermediate-container. The molten stream coming from the nozzle **17** is still situated in the casting axis A, whilst the molten-stream coming from the nozzle **18** is directed through the channel **22**. The channel **21** stands in readiness.

Position *b*: immediately prior to the change. The intermediate container **7**, together with the channel **22**, is moved in the direction of the casting axis, the molten stream coming from the nozzle **18** is still being directed through the channel **22**. Simultaneously, the molten stream coming from the nozzle **17** wanders away to the right from the casting axis owing to movement of the intermediate container **6**. The molten stream however still flows into the mold.

Position *c*: the moment of changing from nozzle **17** to nozzle **18**. The intermediate container continues to be turned, whilst the turning movement of the channel **22** is stopped (the channel **22** can also be removed). Simultaneously, the intermediate container **6** is turned over the channel **21**, and the molten stream coming from the nozzle **17** flows into the channel **21** (the channel **21** can also be turned under the molten stream coming from the nozzle **17**), whilst the molten stream coming from the nozzle **18** flows into the die.

Position *d*: immediately after the moment of changing. The channel **22** remains still, whilst the intermediate container **7** is turned further towards the casting-axis. The intermediate container **6** is turned away from the die together with its channel **21**.

Position *e*: the change is completely effected by the molten stream coming from the nozzle **18**, is in the desired place, whilst the intermediate container **6**, together with the channel **21** is turned further. As soon as all the steel and slag has flowed out of this container, it can then be turned away up to 180° and more, from its original casting position. In this position, the container can be repaired or changed. When this work is completed, the container may receive a pre-heating device so as to keep it warm for the next casting operation. Likewise, repair-work can be undertaken on the channel **21**. The ladle **1** is lifted out of the stage **3** by means of the crane **5** and returned to the steelworks to be filled in preparation for the next casting. One could possibly omit completely the use of ladles, and thus feed the metal direct from the furnace, via channels into the casting machine.

By moving the channel **21** or **22**, it is possible in case of emergency, to immediately discontinue the casting operation and to divert the steel into the slag containers **23** and **24**, and into the emergency ladle **25**.

FIGURES 5, 6 and 7 show a modification of the invention. The ladles **30** and **31** are interchangeable their frame, arranged above the die or mold and can be emptied into the intermediate containers **34** and **35**. The intermediate containers **34** and **35** are pivoted on pillars **36** and **37**. These pillars are secured on trucks **38** and **39**, which are movable on rails **40**. The arrangement of the pillars **36** and **37**, and the containers **34** and **35** is so, that when being ready for casting the pillars **36** and **37** are situated externally and the containers **34** and **35** internally alongside one another (FIG. 6). The channels **41** and **42** are likewise pivoted on pillars **36** and **37**, below the intermediate containers, and serve exactly as described in the first example, to direct the cold steel and the slag, into the slag containers **43** and **44**, and an emergency ladle **45**. The change from an empty ladle to a full one is achieved as described in the first example. The modified arrangement has the advantage, that the intermediate containers can be brought further away from the casting machine so that the immediate vicinity around the casting machine is free of reserve intermediate containers, working tools, etc. The change from one intermediate container to another is effected as described for the first example.

Instead of the suspension arrangement of the intermediate containers and the channels as shown in FIGURES 5 to 7 it is possible to provide separate suspension means for the containers and the channels should the construction of the machine necessitate this separation.

The arrangement of the suspension for the channel, either in front of or alongside of the suspension of the intermediate container, can possibly offer certain advantages.

I claim:

1. Apparatus for changeover of the supply of molten metal being poured into a mold without introduction of slag or solidified metal into the pour during the changeover, comprising a mold, a first ladle of molten metal, a first intermediate container positioned below said first ladle to receive the molten metal flowing from said first ladle, said first intermediate container being provided with a first outlet nozzle to pour said received metal into said mold, a first channel positioned below said first intermediate container and adjacent said first nozzle, a second ladle of molten metal, a second intermediate container positioned below said second ladle to receive the molten metal flowing from said second ladle, said second intermediate container being provided with a second outlet nozzle through which said received molten metal flows, a second channel positioned below said second intermediate container and aligned with said second outlet nozzle, said first and second intermediate containers being rotatably mounted about vertical axes, and means for swinging said intermediate containers about the respective axis simultaneously to position said first nozzle over said first channel and to position said second nozzle over said mold, thereby to change the supply of molten metal flowing into said mold from said first ladle to said second ladle, said channels directing the flow of metal poured therein to a repository so that slag introduced during changeover is diverted from the mold.

2. Apparatus for changeover of the supply of molten metal being poured into a mold without introduction of slag or solidified metal into the pour during the changeover, comprising a mold, a first ladle of molten metal, a first intermediate container positioned below said first ladle to receive the molten metal flowing from said first ladle, said first intermediate container being provided with a first outlet nozzle to pour said received metal into said mold, a first channel positioned below said first intermediate container and adjacent said first nozzle, a second ladle of molten metal, a second intermediate container positioned below said second ladle to receive the molten metal flowing from said second ladle, said second intermediate container being provided with a second outlet nozzle through which said received molten metal flows, a second channel positioned below said second intermediate container and aligned with said second outlet nozzle, said first and second channels being pivotally mounted about vertical axes, and means for swinging said channels about the respective axis simultaneously to position said first channel underneath said first outlet nozzle and to move said second channel out of alignment with said second outlet nozzle, thereby to change the supply of molten metal flowing into said mold from said first ladle to said second ladle, said channels directing the flow of metal poured therein to a repository so that slag introduced during changeover is diverted from the mold.

3. Apparatus according to claim **1**, in which said intermediate containers and said channel means are all pivotally mounted on a common suspension means.

4. Apparatus according to claim **1**, in which each of said intermediate containers together with its associate channel means are pivotally mounted on a separate suspension means.

5. Apparatus according to claim **4**, in which said suspension means are each mounted on a truck which is movable in a direction transverse to the axis of the casting.

References Cited by the Examiner

UNITED STATES PATENTS

2,202,702	5/1940	Lindner et al.	
3,066,364	12/1962	Baier	22—57.2

FOREIGN PATENTS

704,620	2/1954	Great Britain.

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