T. McDONALD.

BLAST FURNACE CASTING APPARATUS.

APPLICATION FILED APR. 5, 1913.

1,210,091.

Patented Dec. 26, 1916.

3 SHEETS—SHEET 1.

FIG. 1

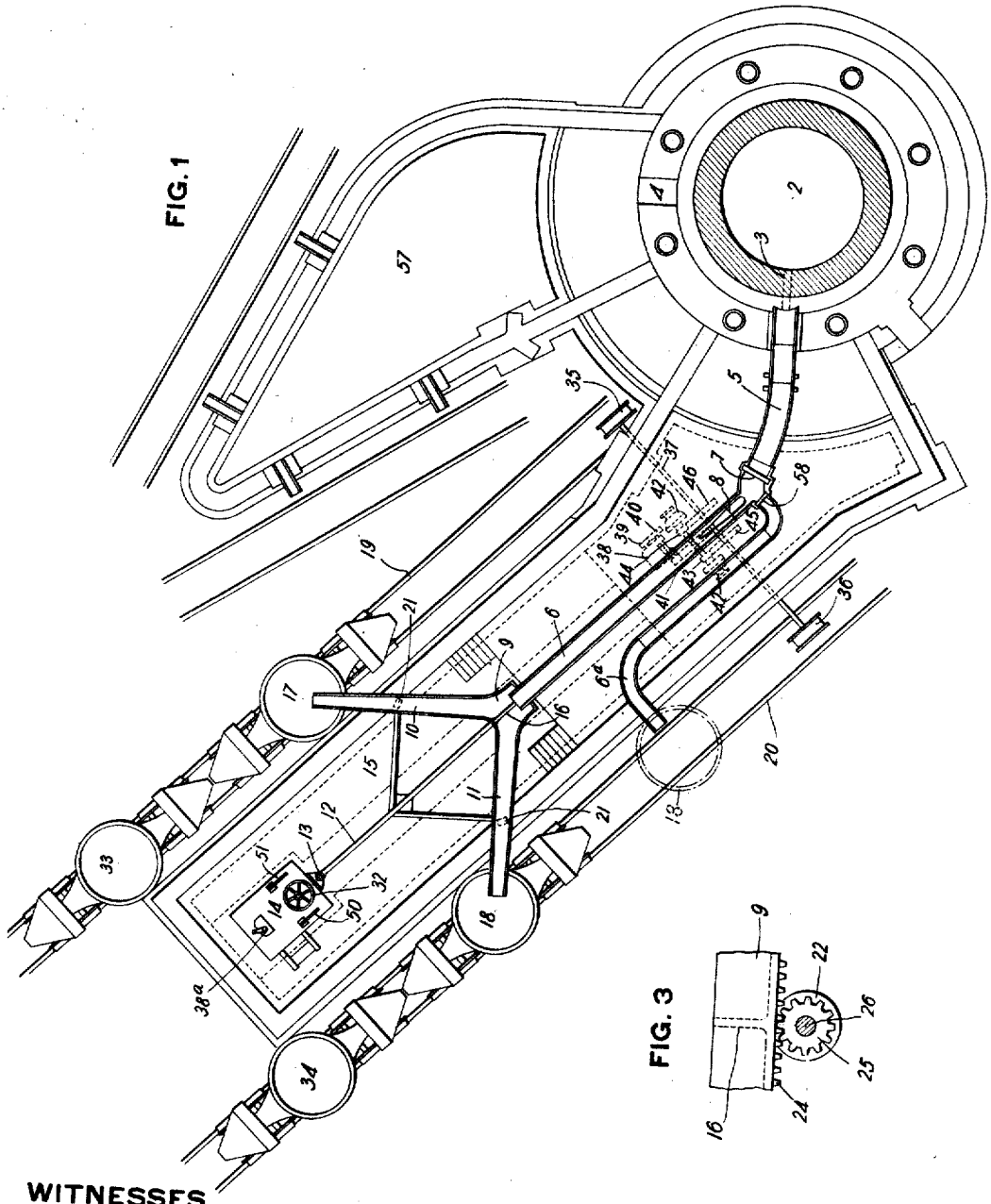


FIG. 3

WITNESSES

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3 SHEETS—SHEET 2.

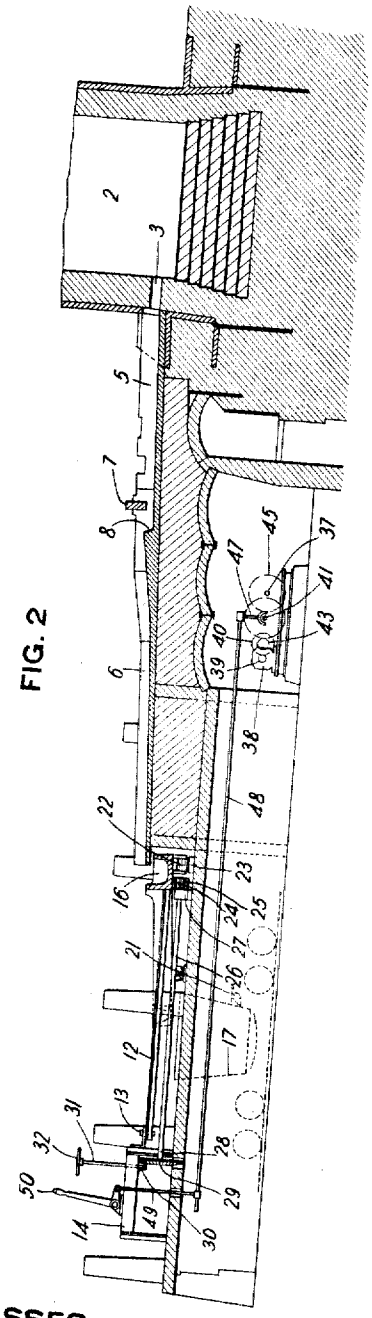


FIG. 2

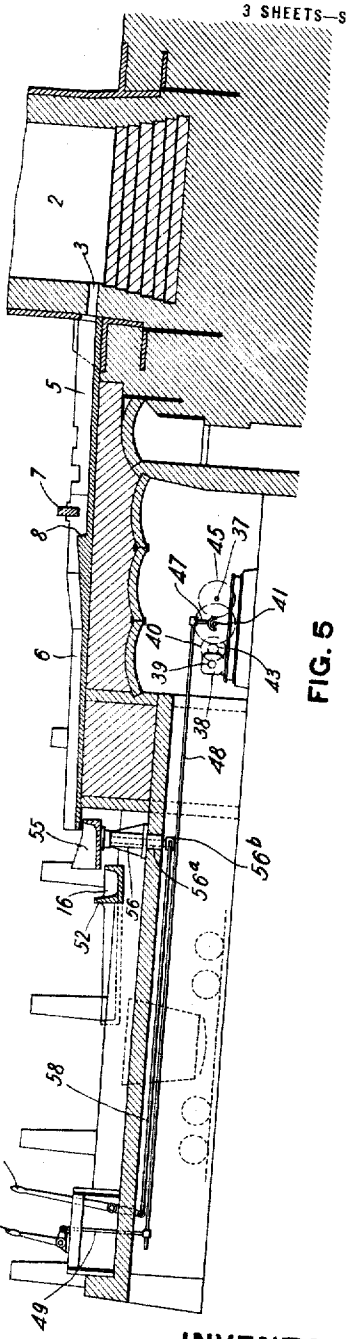


FIG. 5

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3 SHEETS—SHEET 3.

FIG. 4

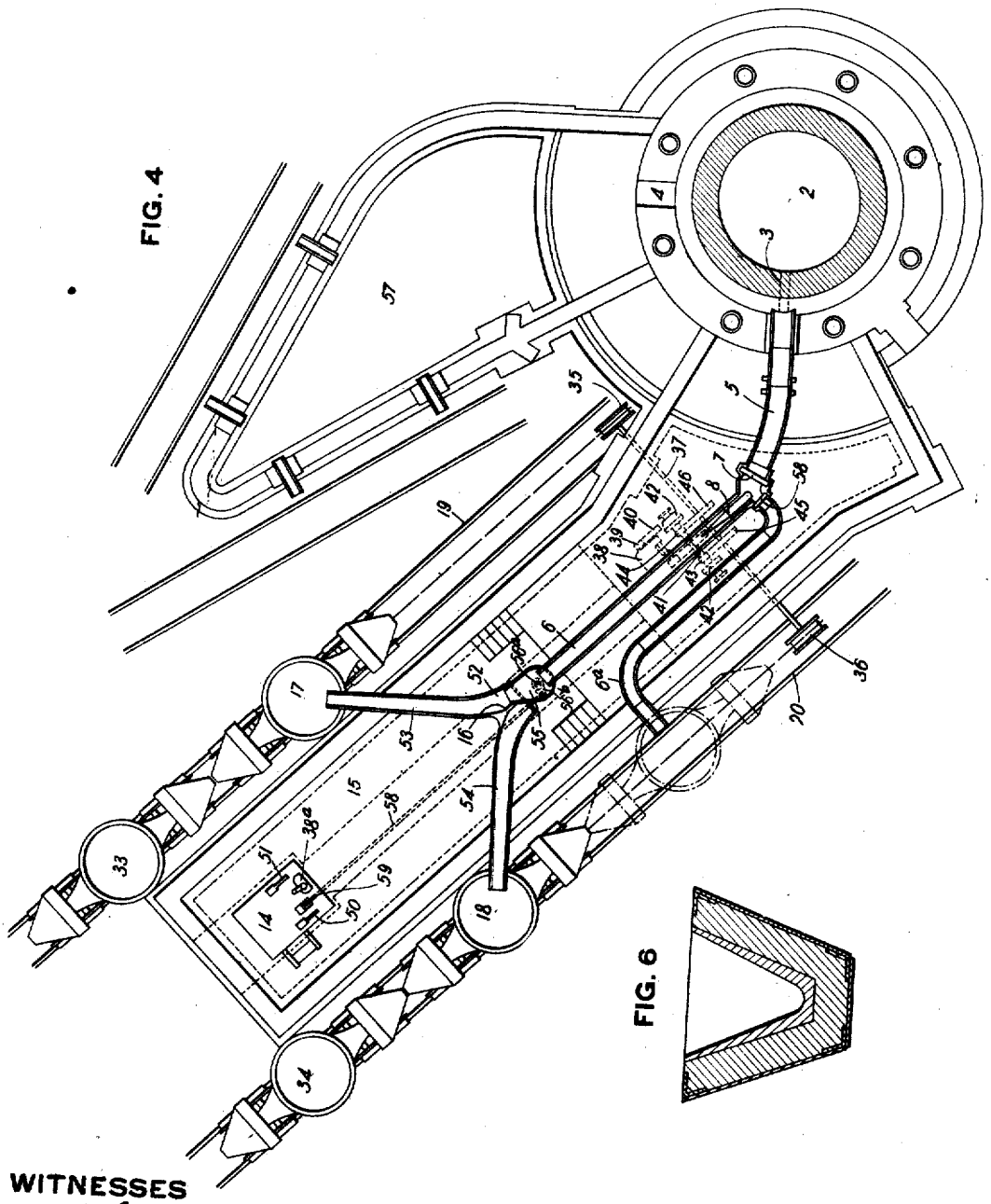


FIG. 6

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UNITED STATES PATENT OFFICE.

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BLAST-FURNACE CASTING APPARATUS.

1,210,091. Specification of Letters Patent. Patented Dec. 26, 1916.

Application filed April 5, 1913. Serial No. 759,282.

To all whom it may concern:

Be it known that I, THOMAS McDONALD, a citizen of the United States, and resident of Youngstown, in the county of Mahoning and State of Ohio, have invented certain new and useful Improvements in Blast-Furnace Casting Apparatus, of which the following is a specification.

My invention relates to the construction and arrangement of apparatus for handling and conveying molten iron from the tapping hole or iron notch of a blast furnace into the ladle cars in which the iron, in a molten condition, is transported to a metal mixer, casting machine, or other place of use.

Heretofore, it has been the practice in tapping blast furnaces to conduct the molten iron therefrom by means of a stationary main trough or runner to a selected number of the series of stationary branch troughs or runners which are positioned on one, or, usually, on both sides of the furnace cast house, the molten iron flowing from one or another of the branch troughs into one of the several ladle cars positioned one below each branch trough on depressed tracks arranged alongside the exterior of the furnace cast house. Of recent years the main troughs and the branch troughs have been made of iron, although in some cases sand runners are still employed to conduct the molten metal from the furnace tapping hole to iron spouts forming the branch runners which overhang the depressed ladle car tracks.

The ladle cars are necessarily of considerable length over all, and the distance from center to center of the branch troughs must be approximately the same as the distance from center to center of the ladle cars. As a number of ladle cars must be "spotted" or positioned beneath the branch troughs to insure sufficient ladle capacity to take care of the largest quantity of molten iron received in any one cast, the main troughs and branch troughs must be of considerable length, and as the iron received by each ladle car flows through its own branch trough, this practice results in the formation of a very considerable amount of scrap, the removal of which adds materially to the cost of the casting operations. The formation of such large amounts of scrap after each casting operation necessitates its removal and the cleaning and preparation of the troughs and branches for another cast after each casting operation, all of which adds considerable to the operating expense of the blast furnace.

One object of my invention is to provide a blast furnace casting apparatus of improved construction having novel means whereby the flow of the molten metal is regulated and controlled in conducting the stream of molten metal from the furnace tapping hole into the ladle cars used in transporting the molten metal. In this connection it is proposed to conduct metal simultaneously into ladle cars standing on tracks at opposite sides of the apparatus, or into a car on either track.

Another object of this invention is to provide a furnace casting apparatus of improved construction having novel means whereby the distance traveled by the molten metal in being delivered into the ladle cars from the furnace tapping hole is lessened, and the formation of scrap is thereby materially decreased.

Another object of my invention is to provide a blast furnace casting apparatus having improved means by the use of which the amount of scrap formed in the casting operation is materially lessened and the work necessary in and cost of maintaining the iron runners in operative condition for the successive casting operations thereby greatly reduced.

A still further object of the invention is to provide a blast furnace casting apparatus having improved means whereby the necessity of using the usual manually operated gates or shutters in controlling the flow of the molten metal is avoided and overcome, and by which the flow of the metal is regulated and controlled by the operator from a safe distance.

Further objects of my invention will be disclosed hereinafter as the invention is more fully described and claimed.

Referring to the drawings forming part of this specification, Figure 1 is a plan showing a blast furnace cast house equipped with one arrangement of casting apparatus constructed and arranged in accordance with my invention. Fig. 2 is a sectional side elevation of the casting apparatus of Fig. 1. Fig. 3 is a sectional detail showing the construction of the turning mechanism by which the bifurcated trough forming part

of the apparatus of Figs. 1 and 2 is swung or oscillated in the operation of my improved apparatus. Fig. 4 is a plan showing a blast furnace cast house with a modified form of casting apparatus, constructed and arranged in accordance with my invention. Fig. 5 is a sectional side elevation of the casting apparatus of Fig. 4. Fig. 6 is a sectional end elevation showing a detail of the construction of the troughs or runners employed in the apparatus of the preceding figures.

In the accompanying drawings the numeral 2 designates the hearth or well of a blast furnace having the usual iron notch or tapping hole 3 and cinder notch 4. Leading from in front of the tapping hole 3 is the usual skimmer trough 5 by which any molten slag issuing from the tapping hole in the casting operation is separated from the stream of iron discharged from the blast furnace tapping hole.

The discharge or delivery end of the skimmer trough 5 is connected to a main runner or trough 6 which extends lengthwise away from the skimmer and a branch runner 6^a which is connected to the skimmer trough 5 behind the dam 8 in the skimmer trough to drain the skimmer trough of the pool of iron remaining behind the dam 8 after each casting operation. The furnace, furnace tapping hole and skimmer trough are constructed in the usual known manner.

As shown in Figs. 1 and 2, the rear end of a bifurcated or forked trough 9 having branches 10 and 11 is arranged to swing in a horizontal plane, the front end of the trough 9 being pivotally connected by the strut or arm 12 to a pivot pin 13 which is fixed to the operator's platform 14 at the lower end of the furnace cast house 15.

The trough 9 is provided with a vertical partition 16 which separates the branches 10 and 11 so that by swinging the rear end of the bifurcated trough 9 about the pivot pin 13 the main runner 6 is caused to deliver a stream of molten metal into either of the branches 10 or 11, and, through these branches, into the ladle car 17 or 18 positioned on opposite sides of the cast house on the tracks 19 and 20. By bringing the trough 9 into an intermediate position, as shown in Fig. 1, the metal may be conducted into both branches 10 and 11, and thereby simultaneously delivered to the ladle cars 17 and 18.

The rear end of the movable bifurcated trough 9 is provided with anti-friction rollers 21—21 and 22 to support the trough, the rollers 21 and 22 being arranged to travel on the roller tracks 23—23^a and the under side of the spout 9 is provided with rack teeth 24 which mesh with the bevel pinion 25 keyed or otherwise secured on one end of the horizontally extending operating shaft 26. The shaft 26 is mounted in fixed bearings 27 and 28 and, on its other end, is provided with a bevel gear 29 which meshes with the bevel gear 30 on the lower end of the vertical stem or post 31 having an operating hand wheel 32 on its upper end, the post 31 being rotatably mounted on the operator's platform 14 so that when the hand wheel is turned the horizontal shaft 26 and connecting gearing will swing or oscillate the bifurcated trough 9 to bring the branch 10 or branch 11 directly beneath the discharge end of the main trough 6 as desired. As will be seen from Figs. 1 and 2 there is but a single branch spout 10 or 11 leading to each side of the furnace cast house.

On the depressed spur tracks 19 and 20 provided on each side of the cast house, are ladle cars 33, 34, in addition to the cars 17 and 18, which are "spotted" or positioned beneath the troughs 10 and 11 during the casting operation, and at the rear end of the tracks 19 and 20 are winding drums 35 and 36 which are mounted on the ends of a horizontal shaft 37 mounted in suitable bearings and extending across the width and beneath the floor of the furnace cast house 15.

The winding drums 35 and 36 are each provided with a cable or other flexible connection having a hook or link on the free end thereof by which the drums, when operatively connected, are detachably secured to the ladle cars to move the cars toward the end of the spur tracks 19 and 20, in positioning the ladle cars beneath the overhanging ends of the branch troughs 10 or 11. Also erected on a suitable foundation beneath the floor of the cast house is a motor 38 which is connected by slow down gears 39 and 40 with a coupling shaft 41 having clutch couplings 42 on the opposite ends thereof. The loose member of each clutch coupling 42 is rotatably secured to a spur pinion 43 or 44 which meshes with the spur-gear wheels 45, 46, on the drum shaft in such manner as to rotate one rope drum 35, or 36, while the other is disconnected and inoperative. The motor 38 is connected to the motor operating controller 38^a on the operator's platform 14.

The movable members of the clutch couplings 43, 44, are connected each to an operating lever 47 which in turn is operatively connected to horizontal shafts 48 extending from the couplings to the operator's platform 14 beneath the floor of the cast house. The ends of the operating shafts 48 are connected by a reach rod 49 to one of the hand operating levers 50 and 51 which are pivotally mounted on the operating platform 14.

In the construction shown in Figs. 4 and 5 the apparatus is very similar to that shown in the preceding figures, and like parts have

similar numerals applied thereto, and the arrangement with relation to the furnace of the skimmer trough and main trough leading therefrom is the same as in the preceding figures. In this construction, however, the bifurcated trough 52 is stationary and is constructed so as to in effect form two separate branch troughs 53, 54, one discharging on each side of the cast house 15.

The discharge end of the trough 6 leading from the iron skimmer is arranged to deliver the molten iron into a short swinging trough 55 and the rear end of the swinging trough is pivoted in the bearing 56 in such manner as to swing around a vertical axis so as to deliver the molten metal from the main trough into either of the two branches of the bifurcated trough 52. By bringing the swinging trough 55 into an intermediate position, the metal may be conducted into branch troughs 53 and 54, and thereby simultaneously delivered into the ladle cars 17 and 18. The trough 55 is connected through its pivot pin 56^a to the lever 56^b and the lever 56^b is operatively connected by the reach rod 58 to the lower end of the operating lever 59 on the platform 14. The discharge ends of the branch troughs 53 and 54 are positioned above the depressed tracks 19 and 20 located on each side of the cast house in the same manner as has been before described in connection with Figs. 1 and 2. The winding drum and cables by which the cars are drawn into position below the discharge ends of the branch troughs 53 and 54 are the same as in Figs. 1 and 2, and the motor 38 and drum shaft 37 are connected by slow down gears 43, 44, 45 and 46 with similar operating mechanism, the clutches 42 having similar hand operating levers.

In the operation of my improved apparatus illustrated in Figs. 1 and 2 the furnace 2 is tapped by opening the tapping hole 3 in the usual manner, and the stream of molten metal flows through the tapping hole to the downwardly sloping or inclined skimmer trough 5, the slag being skimmed from the top surface thereof in the skimmer trough in the ordinary known manner, the skimmed metal passing downwardly through the main trough 6 connected to the iron skimmer and flowing into the swinging trough 9, the molten slag flowing through the slag runner to the cinder garden 57. The stream of metal is then diverted by means of the swinging trough 9 into one or the other of the branch troughs 10, 11, so as to discharge into, for example, the ladle of the car 17 on the ladle car track 19. When the ladle of this car 17 has become filled with molten metal the swinging branch trough is swung to cause the metal issuing from the main trough 9 to flow into the branch 11 and be discharged into the ladle car 18 positioned beneath the discharge end of this trough on the ladle car track 20 located on the opposite side of the cast house 15. The cable on the drum 35 is then connected to the filled ladle car 17 and the drum shaft 37 is started to rotate, which winds the cable upon the drum and moves the filled ladle car 17 upon the track 19 so as to bring the ladle car 33 coupled to the filled ladle car 17 into position below the branch trough 10.

When the second ladle car 18 on the track 20 (on the opposite side of the cast house) is filled, the trough 9 is again swung to cause the stream of metal to again flow down the branch 10 and be discharged into the ladle car 33 now positioned beneath the discharge end of this trough. The cable on the other drum 36 is then connected to the now filled ladle car 18 on the track 20, and the motor 38 is again started to rotate the drum 36 and wind the cable thereon so as to pull the ladle car 18 from its position beneath the trough into the position shown dotted beneath the branch drain trough 6^a leading from a point on the skimmer trough behind the dam 8 forming part of this skimmer trough. In moving the car from its position beneath the trough 11 into the position shown dotted, the car 34 which is coupled to the car 18 is moved forwardly until it is positioned beneath the branch trough 11 in readiness to be filled with molten metal.

When the second ladle car on the track 19 has been filled, the bifurcated trough is again swung about its vertical pivot to cause the molten metal to be discharged from the main trough 6 into the branch trough 11 and be delivered into the ladle car 34 which is moved into position beneath the trough 11 by the drum 36 through the cable and car 18 coupled thereto.

The ladles of the four cars will have sufficient capacity to handle all of the metal obtained from the blast furnace in any one casting operation.

After the above described operations have been completed a gate 58 is lifted to permit the pool of molten metal held behind the dam 8 in the skimming apparatus to flow into the branch trough 6^a and be discharged therefrom into the filled ladle car 18 which is now positioned beneath the overhanging end of the branch trough 6^a. As the amount drained from behind the dam 7 is comparatively small the ladle will take care of such amount of metal without overflowing.

With the construction shown in Figs. 4 and 5, the operation is the same as has been described before, except that instead of the bifurcated spout 52 being swung on a pivot the short intermediate spout 55 will be oscillated or swung on its pivot to deliver the stream of metal received from the main trough into the desired one of the two branch troughs 53 and 54 forming the bifurcated or forked trough 52.

The advantages of my invention will be apparent to those skilled in the art. By means of my improved apparatus the amount of scrap made in the casting operations is largely reduced, the cost of removing the scrap and maintaining the spouts in operative condition is decreased, and a large saving in the operating cost of the casting operations is effected.

Modifications in the construction and arrangement of the apparatus may be made without departing from my invention as defined in the claims.

I claim:—

1. The combination with a blast furnace having a tapping hole, a skimmer trough leading from said tapping hole, and a main trough leading from the skimmer trough, of car tracks having ladle cars thereon, an adjustable trough leading from the main trough to said ladle cars, and means for moving said adjustable trough to divert and control the flow of molten metal from the main trough into either or both of two of said ladle cars.

2. The combination with a blast furnace having a tapping hole, a skimmer trough leading from said tapping hole, and a main trough leading from the skimmer trough, of a car track on each side of the main trough, ladle cars on the tracks, metal conducting means leading from the main trough and adjustable to deliver metal into a car on either track, and means for adjusting said metal conducting means to divert and control the flow of metal into either or both of two said ladle cars.

3. The combination with a blast furnace having a tapping hole, a skimmer trough leading from said tapping hole, and a main trough leading from said skimmer trough, of car tracks having ladle cars thereon, an adjustable trough leading from the main trough to said ladle cars, means for moving said adjustable trough to divert and control the flow of molten metal in either or both of two of said ladle cars, and means for adjusting the cars on said car tracks into metal receiving position during the furnace tapping operation.

4. The combination with a blast furnace having a tapping hole, a skimmer trough leading from said tapping hole, and a main trough leading from said skimmer trough, of car tracks having ladle cars thereon, an adjustable trough leading from the main trough to said ladle cars, means for moving said adjustable trough to divert and control the flow of molten metal into either or both of two said ladle cars, and means for adjusting the position of said ladle cars on said car tracks during the furnace casting operation, said means being contiguous to said trough manipulating means.

In testimony whereof, I have hereunto set my hand.

THOMAS McDONALD.

Witnesses:
WARREN F. PERRY,
H. JAMES LITTLE.