July 22, 1930. L. E. ALLEN 1,771,241

HOT METAL MIXER

Original Filed June 16, 1928 5 Sheets-Sheet 1

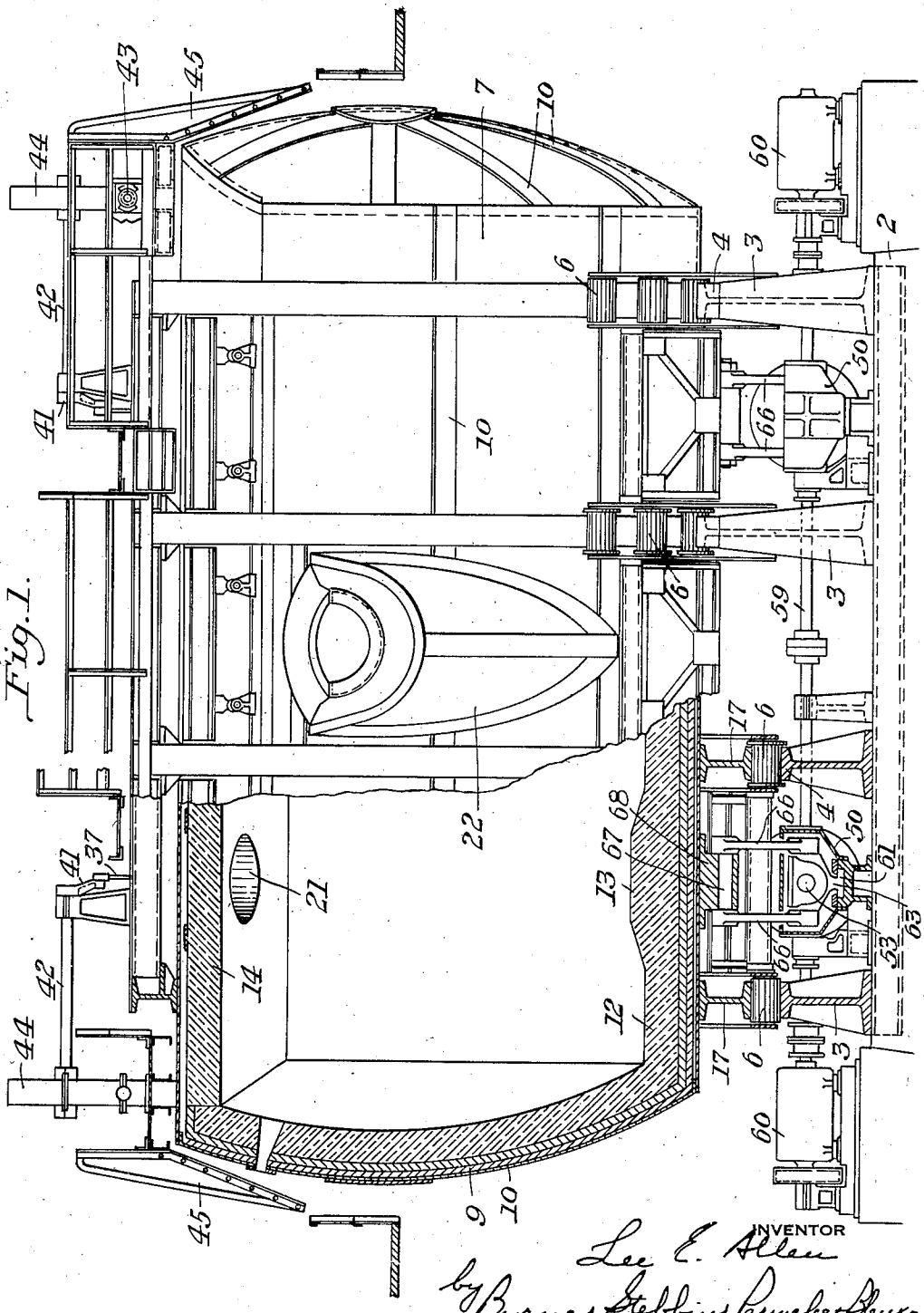


Fig. 1.

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HOT METAL MIXER

Original Filed June 16, 1928 5 Sheets-Sheet 2

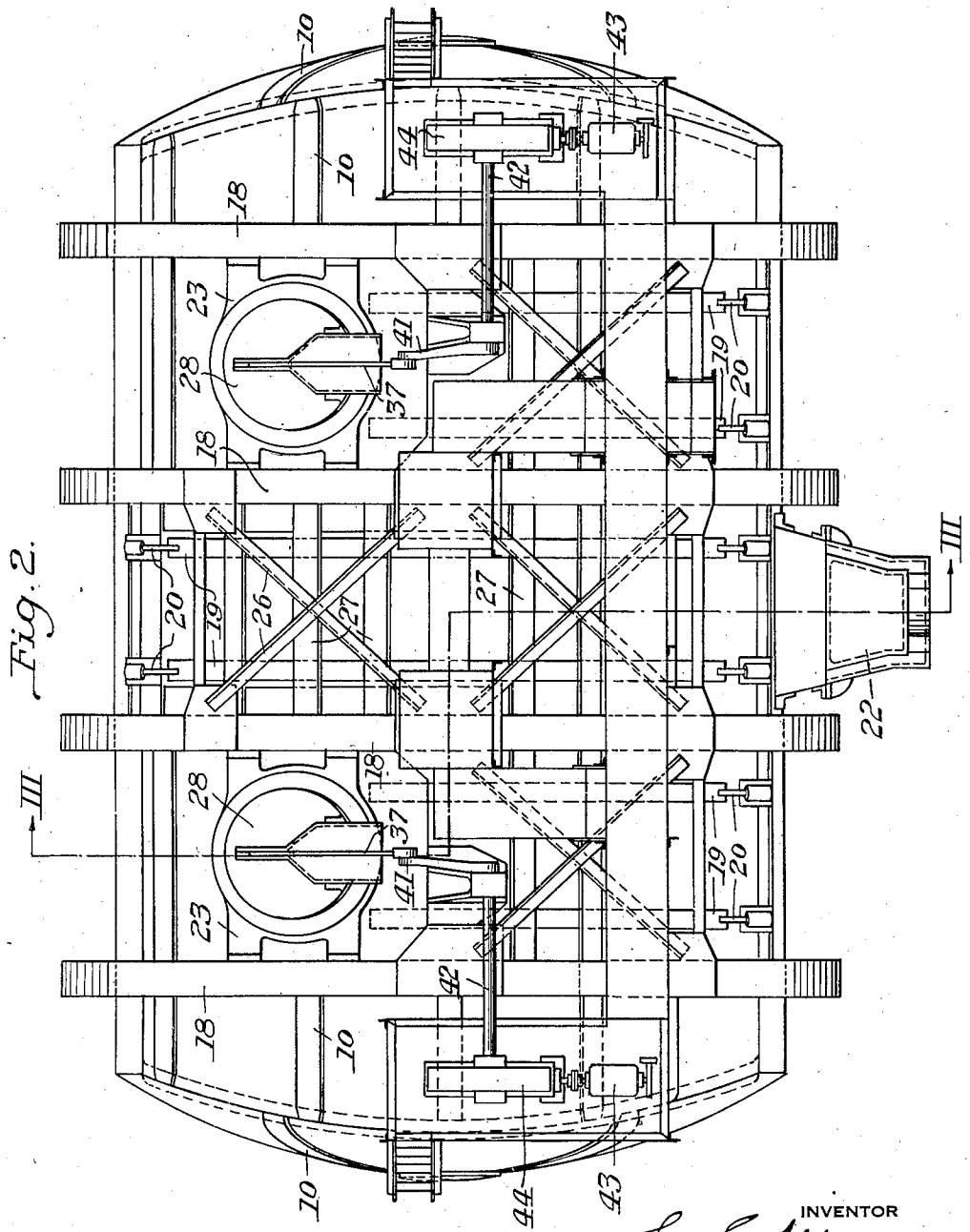



Fig. 2.

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HOT METAL MIXER

Original Filed June 16, 1928 5 Sheets-Sheet 3

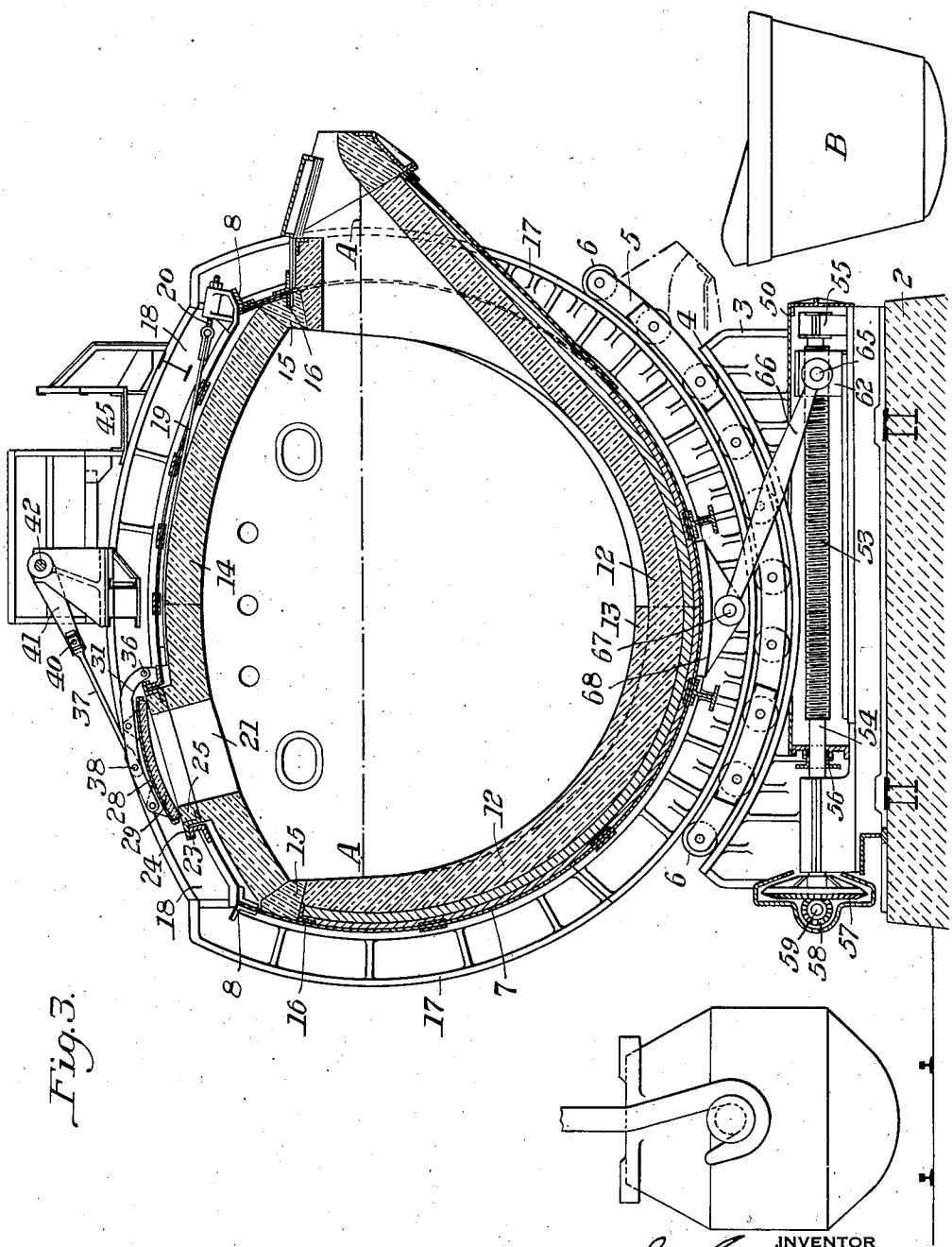



Fig. 3.

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HOT METAL MIXER

Original Filed June 16, 1928 5 Sheets-Sheet 4

Fig. 4.

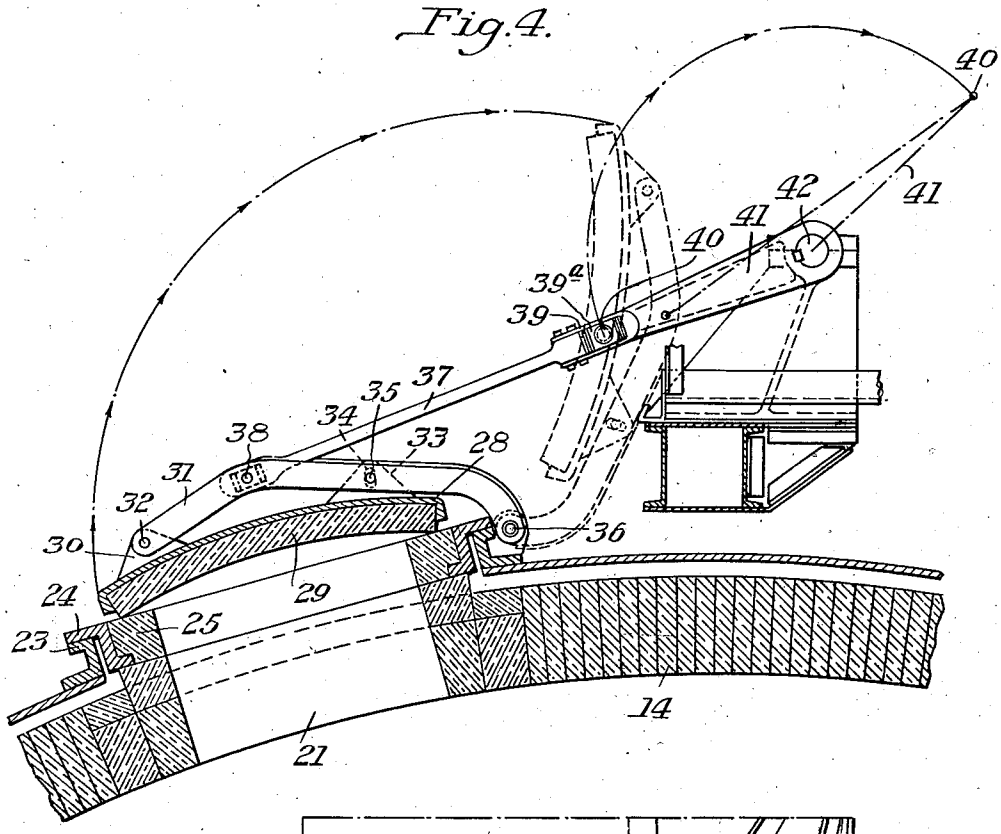
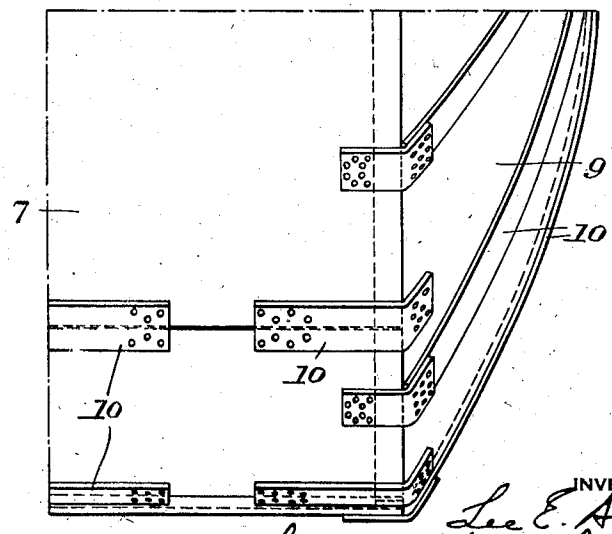



Fig. 5.




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HOT METAL MIXER

Original Filed June 16, 1928 5 Sheets-Sheet 5

Fig. 6.

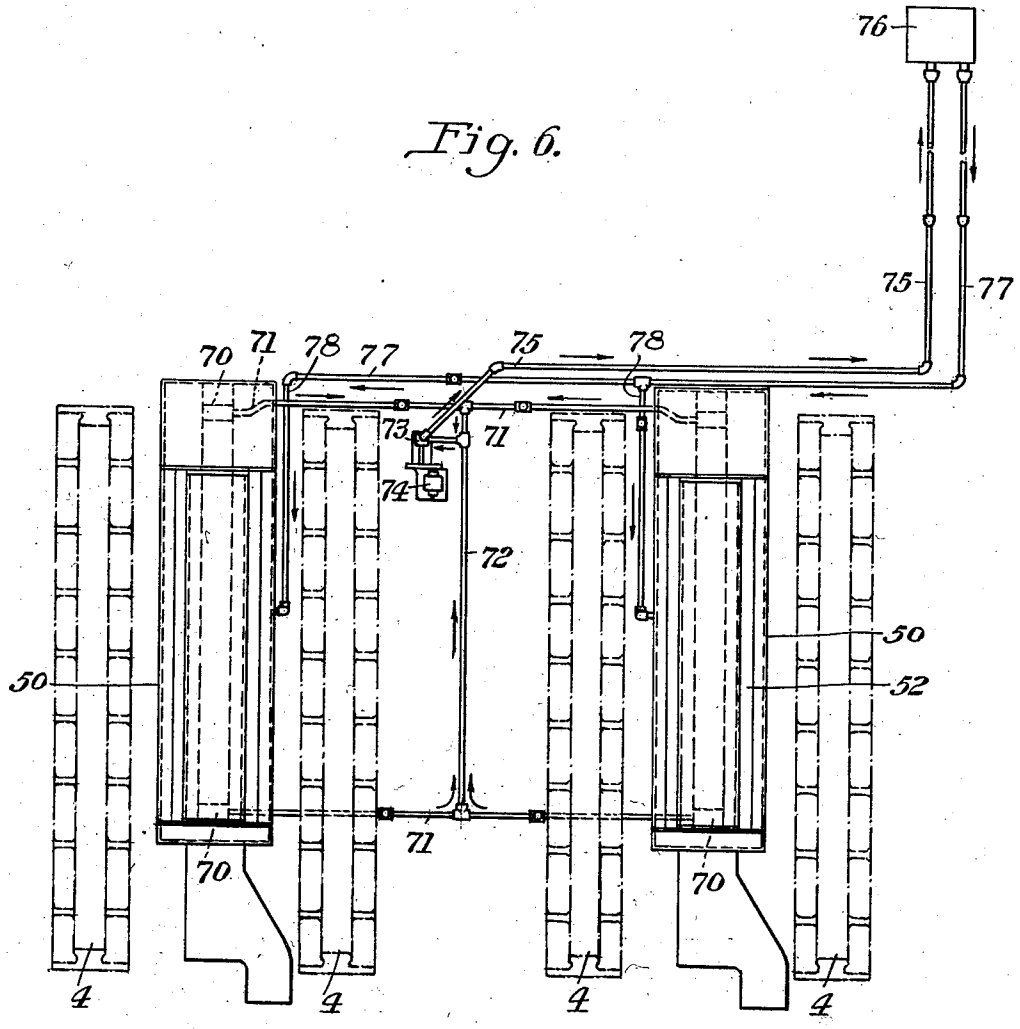
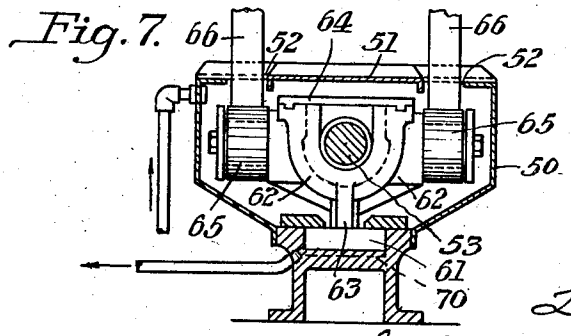



Fig. 7.




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Patented July 22, 1930 1,771,241

# UNITED STATES PATENT OFFICE

LEE E. ALLEN, OF NEW CASTLE, PENNSYLVANIA, ASSIGNOR TO PENNSYLVANIA ENGINEERING WORKS, OF NEW CASTLE, PENNSYLVANIA, A CORPORATION OF PENNSYLVANIA

## HOT-METAL MIXER

Original application filed June 16, 1928, Serial No. 285,836. Divided and this application filed August 8, 1929. Serial No. 384,389.

This invention relates to the manufacture of iron and steel, and more particularly to a hot metal mixer adapted to receive and retain hot metal in a molten condition.

The present invention relates particularly to a mixer of unusually large capacity and which is designed especially for the purpose of receiving metal from one or more blast furnaces during the time when the mill as a whole is not operating but when the blast furnaces are operating, such for instance, as during the week end shut down of the mill. Such a mixer must be capable of receiving and maintaining in a molten condition several hundred tons of metal, the particular installation hereinafter described in detail being designed to hold as much as fifteen hundred tons of metal at one time.

This application is a division of my copending application, Serial No. 285,836, filed June 16, 1928.

According to the present invention there is provided a mixer designed to receive and retain a large amount of metal with the receiving and pouring spouts so arranged as to secure thorough mixing of the metal and prevent to the greatest possible extent, stagnation at any point in the mixer.

A further purpose of the invention is to provide a mixer of large capacity which is firmly braced and which may be easily and conveniently operated.

According to the present invention there is also provided a mixer of large capacity wherein the lining for the mixer can be conveniently and easily repaired, or wherein the lining can be removed with a relatively small amount of labor.

These and other objects and advantages are secured by my invention, which may be readily understood by reference to the accompanying drawings showing a preferred embodiment of the invention and in which

Figure 1 is a side elevation of a mixer, part of the structure being shown in vertical section;

Figure 2 is a top plan view of the mixer;

Figure 3 is a staggered transverse section in the plane of line III—III of Figure 2;

Figure 4 is a detail view showing the cover of one of the receiving spouts and the operating mechanism for the cover;

Figure 5 is a detail view of a portion of the shell of the mixer at one end thereof;

Figure 6 is a more or less schematic view showing a top elevation of the lubricating system for the topping mechanism for the mixer; and

Figure 7 is a detail sectional view through the operating parts for said mechanism.

In the drawings, 2 designates a foundation on which are supporting standards 3 having a track 4 on the upper face thereof. On each of the tracks 4 is a rocker 5 having a plurality of anti-friction rollers 6 therein.

Resting on the rollers 6 is a hot metal mixer. This mixer has an outer shell 7 which is substantially cylindrical in transverse cross section below the center thereof, as best shown in Figure 3. As a matter of fact, the shell continues to be cylindrical to a point well above the center line thereof, it being cylindrical clear to the top thereof where the skew backs 8 are located. The ends 9 of the shell are outwardly bowed.

In order to counteract the very heavy loads to which the shell is subjected, it is of heavy construction. It is reinforced with buttstraps 10 on both the sides and the ends thereof. The buttstraps on the cylindrical portion are staggered or alternated with reference to those on the spherical ends, as best shown in Figure 5, and are extended around the corners for additional reinforcement of the connection between the ends and the cylindrical portion of the mixer.

The lining of the mixer is substantially semi-circular to the center line of the mixer. This lining is designated 12. Above the center line of the mixer, which is just below the metal line AA in Figure 3, the sides slope outwardly to a very slight extent to the point where the sides intersect with the roof. This design is of advantage in that there is no overhanging brick which may fall into the mixer in the event that the lining is cut back at the metal line. This outward sloping is also more stable when the mixer is tilted for pouring. The lining is of substantially uniform thickness except in the bottom of the

mixer directly under the charging openings, hereinafter described, where the refractories are made relatively thicker, as indicated at 13 in Figures 1 and 3 for the purpose of resisting the erosive action of the hot metal where it is poured into the mixer.

Supported over the top of the mixer is a relatively low flat transversely arched roof 14. This roof is supported along each edge of the cylindrical portion of the mixer on skew blocks 15. The skew blocks 15 set on angle bars 16 secured to the inside of the shell. With this arrangement the entire weight of the roof is supported on the angles 16, and not on the lining 12. This is an important feature of the construction because it makes the roof entirely independent of the lining, and even though the lining becomes badly eroded there is no danger of the roof falling into the mixer.

The shell of the mixer is encircled by a plurality of spaced apart curved beams or rails 17 that engage the rollers 6 on the rocker frames 5. The tops of the rails 17 are connected together by arched beams 18 which serve to hold the top of the mixer from spreading. Due to the fact that the arch of the roof is relatively wide, and relatively flat, roof ties 19 are preferably stretched transversely across the top of the structure, and these can be put under tension by taking up on the eye-bolts 20 at the ends thereof, these eye-bolts being secured to castings mounted on the skew backs 8. These roof ties place the arch under a strain, and there is no possibility of the stresses being reversed when the ladle is tilted for pouring.

In the top 14 at one side of the longitudinal center of the ladle are two charging openings 21. One opening is adjacent each end of the mixer, and the mixer itself is provided with a single pouring spout 22 which is at substantially the center of the mixer. The charging openings are formed of heavy steel castings 23 rigidly tied to the adjacent cross beams 18, the castings serving to connect the cross beams, as clearly shown in Figure 2. Set into each of the castings 23 is a cast thimble or ring 24 having a separate lining 25 therein, as best shown in Figure 4.

By reason of this arrangement the lining at the top of each hole can be quickly replaced when necessary by merely replacing one ring 24 with another ring having a fresh lining 25.

In addition to being tied together by castings 23 the roof is securely braced and the various members 18 tied together by structural braces 26 and by straps 27, as best shown in Figure 2. This bracing is comparatively open so as to allow for sufficient radiation of heat therefrom to protect the refractories of the roof. Each of the charging holes is provided with a cast cover 28 so mounted, as hereinafter described, that it can be swung entirely free of the charging opening. Each cover has a lining 29 therein.

The construction of the cover and the operation thereof may be best understood by reference to Figure 4. The cover 28 has a lug 30 thereon to which the end of a supporting arm 31 is pivotally secured by a pin 32. On the opposite side of the cover is a similar lug 33 having a short slot 34 therein, and a pin 35 on the arm engages in this slot. The arm 31 is pivotally mounted on the casting 23 at 36, and the arm is curved to be clear of the cover 28. When the arm 31 is swung upwardly, to the dotted line position shown in Figure 4, the cover 28 is positioned well back of the charging hole and is entirely clear of the hole. This permits metal to be easily poured into the charging hole without the pouring operation being interfered with by the cover. Covers as heretofore constructed have interfered more or less with the charging of the mixer.

For actuating the cover there is provided a link 37. One end of this link is pivotally connected at 38 with the arm 31 between the lugs 30 and 33. The connection between the link 37 and the arm 31 at 38 is preferably one which permits of a slight lost motion between the link and the cover. The other end of the link 37 has a bifurcated end portion 39 engaging a bearing block 39[a] on a crank 40 at the end of a crank arm 41. Shims may be provided at each side of the bearing block 39 as shown to permit of a slight adjustment of the link 37 longitudinally relatively to the crank pin 40. The crank arm 41 is keyed to a shaft 42 mounted on the top of the mixer. The shaft 42 is driven from a reversible motor 43 through a reducing gear 44, as shown in Figure 2.

When the motor 43 is operated with the parts in the full line position shown in Figure 4, the shaft 42 is rotated through an arc to swing the crank arm 41, as indicated by the broken lines in Figure 4. As the crank arm 41 swings, it pulls the link 37 to the right, as viewed in Figure 4, swinging the cover to the open position shown. Due to the slight lost motion between the link and the cover at 38 the dead center relation of the shaft 42, the crank pin 40 and the connection 38 can be overcome.

For closing the charging hole the motor 43 is driven in the opposite direction whereupon the link 37 pushes the cover down. Due to the fact that the cover 28 has a floating connection on the arm 31 due to the pivot 32 and the pin and slot arrangement 34—35, the cover can adjust itself to any irregularity on the surface of the link 25 without damage to the parts.

It will be noted that the cover and all of its operating mechanism is mounted directly on the mixer, and the operation for both opening and closing each cover is positive. Door

operating mechanisms as heretofore provided have generally required the use of cables attached to operating means not mounted on the mixer, so that when the mixer is tilted a compensating movement for the cables must be provided. Furthermore, the arrangement as heretofore generally used did not provide for any positive closing of the door, it being necessary to initially push the door and rely on gravity to close it.

Due to the dead center relation between the link 37 and the parts with which it cooperates it is not possible for the charge door to swing open by gravity when the ladle is tilted for the pouring of metal from the mixer.

Platforms and walks are provided on top of the miver to provide convenient access for the making of repairs, and the platform is provided at each end with safety ladders 45 as illustrated.

Located under the mixer at each side of the pouring spout is a trough 50 having a cover 51 thereover, this cover having parallel slots 52 therein. The troughs extend transversely under the mixer, and extending along the length of the trough is a screw 53. This screw is formed on a shaft 54, best shown in Figure 3, one end of which is supported in a bearing 55 in one end of the trough. The other end of the shaft 54 passes through a gland 56 and has a driving gear 57 on its outer end that meshes with a bevel gear 58 on a cross shaft 59. The cross shaft 59 is arranged to rotate the gears 57 at the end of each trough, and at each end of the shaft 59 is a driving motor 60. The motors 60 are designed to be operated in unison, but either motor alone is capable of tilting the mixer through the operation of the screw mechanism in case the other motor is for any reason inoperative.

On the bottom of each trough 50 is a guideway 61. On the screw 53 is a nut 62 having a vertical T-shaped extension 63 that engages in the guideway 61. The nut 62 is preferably provided with a removable cover plate 64 which may be lifted off for examination of the nut for inspection to see when the nut is worn to such an extent that replacement is necessary. Projecting from each side of the nut 62 is a trunnion 65. Connected with the trunnions 65 are links 66. The other ends of the links 66 are pivotally connected at 67 to castings 68 secured to the bottom of the mixer.

With the parts in the position shown in Figure 3 the shafts 54 may be rotated to cause the nuts 62 to travel to the left as viewed in this figure. The links 66 impart a tilting motion to the mixer which rolls on the rockers 5. The pouring spout 22 is thus tipped downwardly so that metal can be poured into a ladle B. By reversing the direction of rotation of the shafts 54 the mixer can be righted.

The troughs 50 are filled with oil so that the nuts 62 operate in a bath of oil. By reason of the cover plate 51 the oil may be kept relatively clean. Any dirt which accumulates in the troughs tends to fall to the bottom thereof and be pushed to one end or the other of the troughs by the movement of the nut along the trough. At each end of the trough is a depression 70, as best shown in Figure 6. Leading from the depressions or pockets 70 are pipes 71 that communicate with a central pipe 72 leading to a pump 73 operated by a motor 74.

The pump 73 discharges into a pipe 75 leading to an oil filter 76. After passing through the filter 76 the clean oil is returned through a pipe 77 having branches 78, one of which leads to each of the troughs 50 and discharges into these troughs intermediate the ends thereof, and preferably at the top of the troughs. With this arrangement the oil in the troughs can be continuously circulated and filtered, thereby keeping the oil clean and the troughs relatively free from any accumulation of scale, mill dust and the like.

One feature of considerable advantage in this mixer is the provision of the charging holes adjacent each end of the mixer with a single pouring spout at the middle of the mixer and on the opposite side. As previously pointed out, a mixer of this type is intended primarily for the storage of a very large amount of molten metal. If there were but a single charging opening directly opposite the pouring opening, the freshly charged metal would flow straight across the mixer and out the pouring spout, and the metal at the ends of the mixer would become relatively stagnant and become cooler. Likewise if the charging opening were at one end of the mixer and the spout at the other end, the freshly charged metal tends to flow in a straight channel from one end of the mixer to the other, and the metal at each side of the middle tends to become stagnant.

With the present arrangement metal can be charged alternately into opposite ends of the mixer, tending to keep the metal at the ends of the mixer highly heated and preventing stagnation of the metal in the ends. In pouring, the metal flows equally from both ends to the spout. Stagnation of the metal at any point is thereby prevented and the metal is more thoroughly mixed than in structures of this nature heretofore provided.

It is necessary in mixers of this type to apply heat to the metal by means of burners at each end of the mixer above the top of the metal. In order to effectively heat the metal it is desirable that as large a surface as possible be exposed to the flames. A relatively wide flat arch of the present invention gives a relatively small combustion space having a large area over the surface of the metal. The wide flat arch is relatively close to the top

of the metal, and provides a large surface for radiating heat absorbed from the combustion of fuel to the metal. The mixer is therefore highly efficient in enabling the large body of metal therein to be kept at the desired temperature.

The top of the mixer and the parts supported thereon are entirely independent of the body of the mixer so that when it is necessary to reline the mixer the entire top can be lifted off with cranes without breaking the refractories in the top of the mixer. Due to the outward slope of the refractory walls above the line AA, the refractories can be broken into large pieces and removed with comparative ease after the top of the mixer has been removed, which is not the case with the usual mixer, or the fully cylindrical mixer.

The spherical shape of the ends throws the refractories in the ends in compression in every direction so that the ends of the mixer are strong and well able to resist the pressure to which they are subjected.

The removable rings in the charging holes enable the refractories around the charging holes to be kept in a good state of repair notwithstanding the fact that they are frequently subjected to the erosive action of hot metal poured directly thereon and notwithstanding the fact that metal will freeze thereon.

The arrangement of the doors whereby they may adjust themselves to irregularities at the surface of the charging holes, and the novel arrangement of the doors and the operating mechanism therefor is of considerable advantage as hereinbefore pointed out.

Although the invention is herein described as applied to a hot metal mixer, it is equally applicable for analogous purposes such as to a tilting open hearth furnace.

While I have illustrated and described a particular embodiment of my invention, it will be understood that this is merely by way of illustration and that various changes and modifications may be made in the construction shown within the contemplation of my invention and under the scope of the following claims.

I claim:

1. In a hot metal mixer, a ladle having a cover thereon, said cover having a charging hole therein, a casting surrounding the charging hole, and a removable ring in the casting having a refractory lining.

2. In a hot metal mixer, a ladle, a cover for the ladle having a charging hole therein, a lid for the charging hole pivotally supported on the cover, and operating means for the lid mounted entirely on the cover and adapted to both open and close the lid.

3. In a hot metal mixer, a ladle having a cover, said cover having a charging hole therein, a lid for the charging hole, an arm pivotally mounted on the cover at one side thereof on which the lid is hung, a link connected with said arm, and means mounted on the cover for reciprocating said link to open and close the lid.

4. In a hot metal mixer, a ladle having a body and a cover, said cover having a charging hole therein, a casting surrounding the charging hole, an arm pivotally supported on said casting, a lid suspended from said arm and adapted to cover the charging hole, a link connected with said arm, a crank connected with the link, and means for operating the crank to open and close the lid.

5. In a hot metal mixer, a ladle having a body and a cover, said cover having a charging hole therein, a casting surrounding the charging hole, an arm pivotally supported on said casting, a lid suspended from said arm and adapted to cover the charging hole, a link connected with said arm, a crank connected with the link, and means for operating the crank to open and close the lid, said lid being adjustably carried on the arm whereby it may accommodate itself to irregularities of the surface on which it is adapted to sit when closing the charging hole.

6. In a hot metal mixer, a ladle having a body portion and a cover portion, said cover portion having a charging hole therein, a casting surrounding the charging hole and supporting a refractory lining for said hole, an arm having an offset end portion pivotally supported on the cover and adapted to swing in a vertical arc over and away from the charging hole, a lid secured to the arm, a link connected with the arm, and an operating means for reciprocating the link to open or close the cover.

7. In a hot metal mixer, a ladle having a body portion and a cover portion, said cover portion having a charging hole therein, a casting surrounding the charging hole and supporting a refractory lining for said hole, an arm having an offset end portion pivotally supported on the cover and adapted to swing in a vertical arc over and away from the charging hole, a lid secured to the arm, a link connected with the arm, and an operating means for reciprocating the link to open or close the cover, said lid having a floating connection with the arm.

In testimony whereof I have hereunto set my hand.

LEE E. ALLEN.