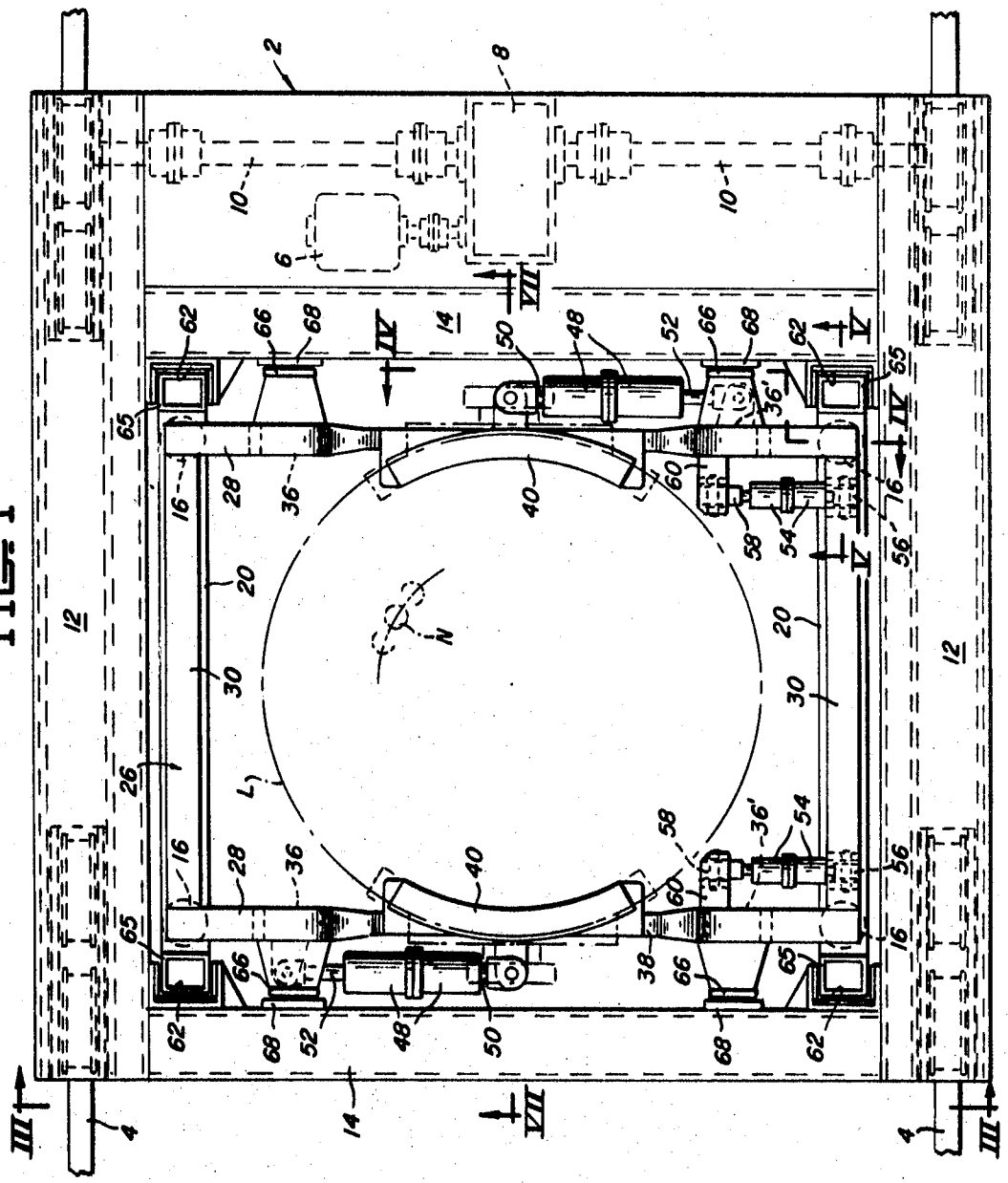
Aug. 5, 1969 H. H. BRITCHER, JR., ET AL 3,459,312

CAR HAVING LADLE SUPPORTING AND POSITIONING MEANS

Filed April 12, 1967 4 Sheets-Sheet 1

FIG. 1



INVENTORS
HARRY H. BRITCHER, Jr. and
FRANCIS GALLUCCI
By Donald G. Dalton
Attorney

Aug. 5, 1969 H. H. BRITCHER, JR., ET AL 3,459,312

CAR HAVING LADLE SUPPORTING AND POSITIONING MEANS

Filed April 12, 1967 4 Sheets-Sheet 2

FIG. 2

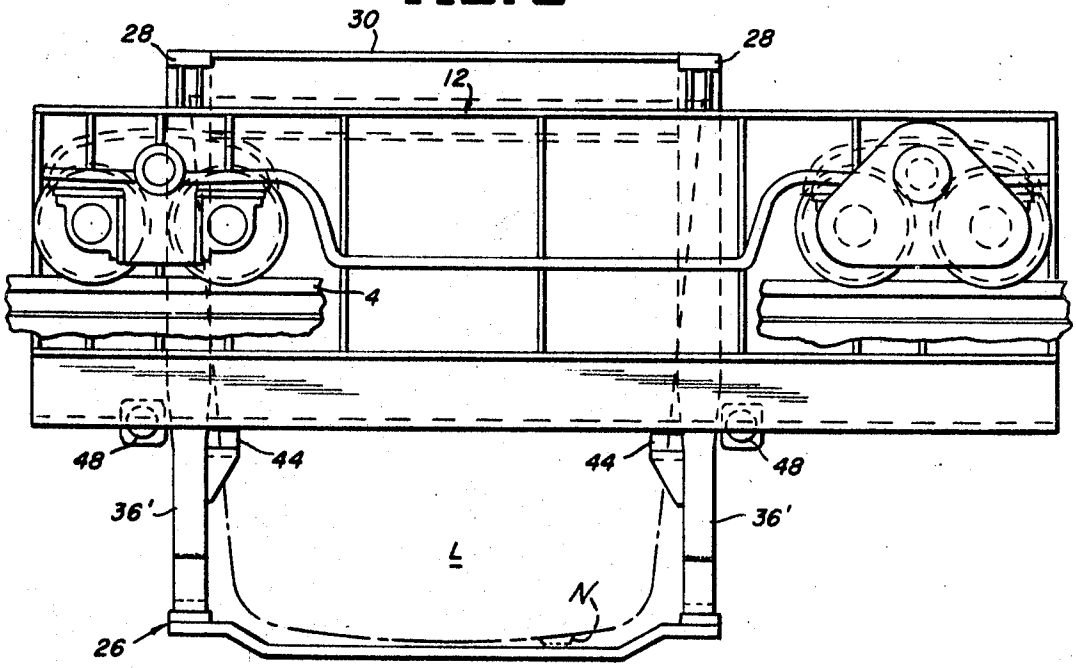
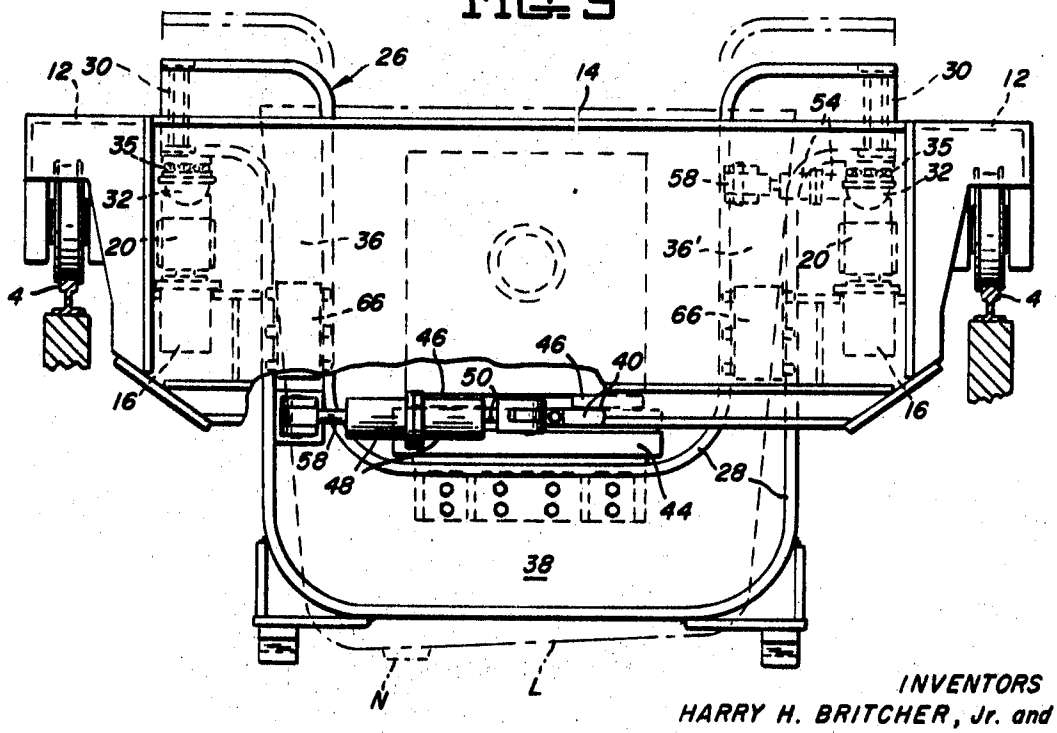


FIG. 3



INVENTORS
HARRY H. BRITCHER, Jr. and
FRANCIS GALLUCCI
By Donald G. Dalton
Attorney

Aug. 5, 1969 H. H. BRITCHER, JR., ET AL 3,459,312

CAR HAVING LADLE SUPPORTING AND POSITIONING MEANS

Filed April 12, 1967 4 Sheets-Sheet 3

FIG. 5

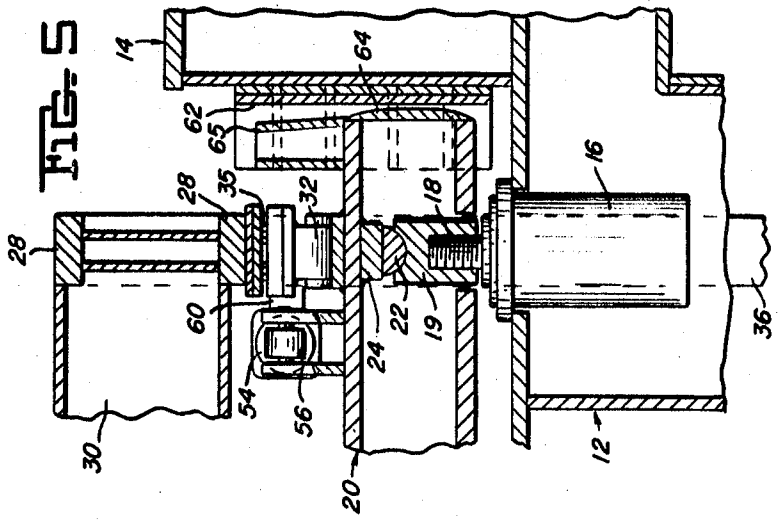


FIG. 6

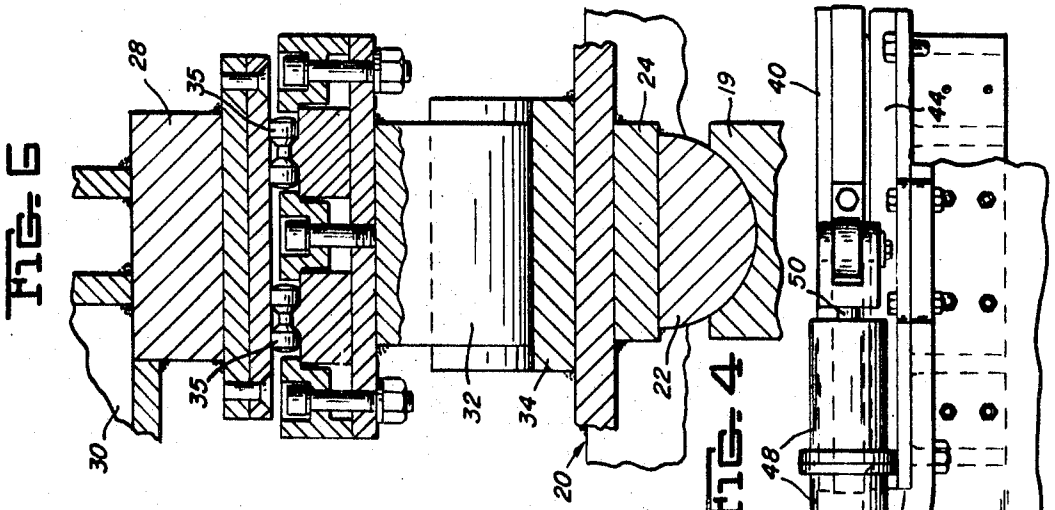
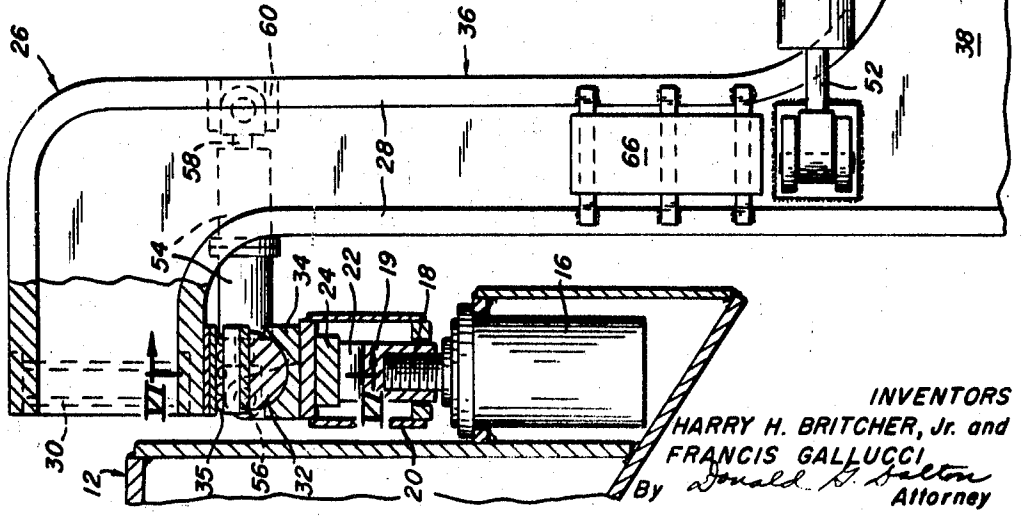


FIG. 4



INVENTORS
HARRY H. BRITCHER, Jr. and
FRANCIS GALLUCCI
By Donald G. Dalton
Attorney

Aug. 5, 1969 H. H. BRITCHER, JR., ET AL 3,459,312

CAR HAVING LADLE SUPPORTING AND POSITIONING MEANS

Filed April 12, 1967 4 Sheets-Sheet 4

FIG. 7

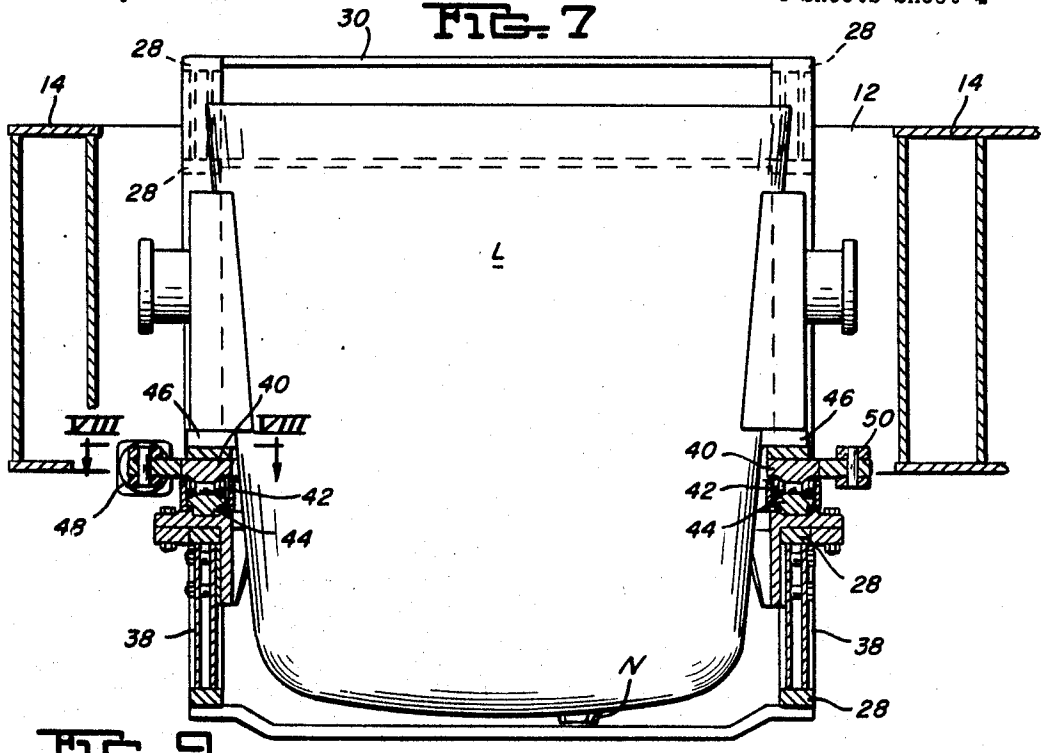


FIG. 9

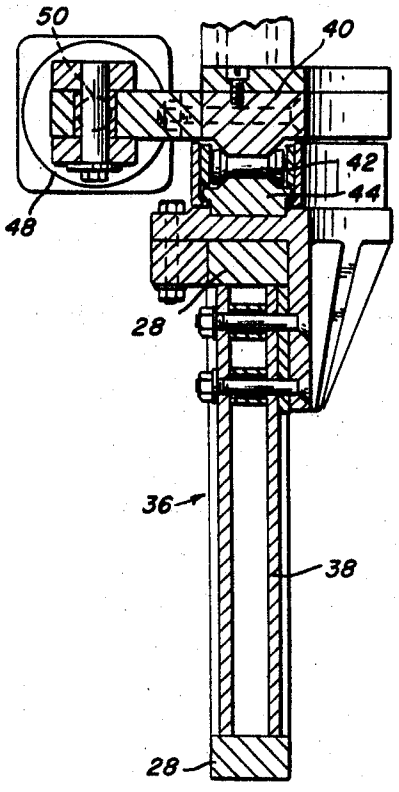
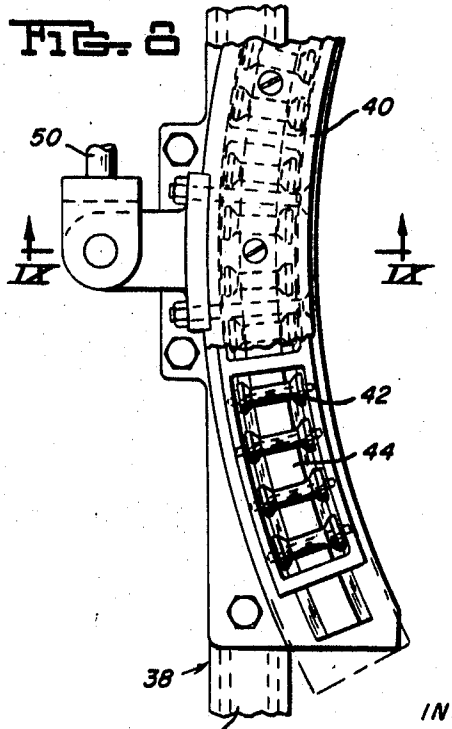


FIG. 8



INVENTORS
HARRY H. BRITCHER, Jr.
FRANCIS GALLUCI
By Donald G. Dalton
Attorney

United States Patent Office 3,459,312
Patented Aug. 5, 1969

3,459,312

CAR HAVING LADLE SUPPORTING AND POSITIONING MEANS

Harry H. Britcher, Jr., Johnstown, and Francis Gallucci, Irwin, Pa., assignors to United States Steel Corporation, a corporation of Delaware

Filed Apr. 12, 1967, Ser. No. 630,286
Int. Cl. B65g 67/32; B61d 5/00; B66f 7/22
U.S. Cl. 214—1 6 Claims

ABSTRACT OF THE DISCLOSURE

Car includes a movable ladle cradle disposed in the rectangular framework of the car. Segmental ladle-supporting bearings are provided on the cradle with hydraulic power cylinders connected therewith for moving the bearings to slew a ladle supported in the cradle. The cradle is supported at four corners by hydraulic lifting jacks which, when operated in pairs, effect tilting of the ladle, and when operated as a unit lift the ladle vertically. Push-pull hydraulic cylinders are provided for shifting the cradle transversely of the car.

The present invention relates generally to material handling equipment and more particularly to a ladle-supporting car especially suitable for conveying and supporting relatively large molten metal ladles in proper position for discharging the molten metal to a continuous casting mold.

In continuous casting, it is imperative that the ladle from which the stream of molten metal is discharged into a continuous casting mold is properly positioned so that the stream of metal is directed centrally of the mold cavity and does not impinge upon the inner side walls of the mold. Strict adherence to such casting technique is essential if metal of satisfactory quality is to be obtained from the continuous casting process when the molten metal is discharged directly into a mold rather than into a tundish.

It is, accordingly, the primary object of our invention to provide a ladle-supporting car which has means incorporated therein for not only supporting a molten-metal ladle but also includes means for positioning the ladle so that the stream of hot metal emitted from its discharge nozzle is directed properly into a continuous casting mold.

It is a more specific object of our invention to provide a ladle-supporting car made up of a wheeled rectangular frame having a movable cradle therein supported on a pair of spaced beams which, in turn, is supported on four corner-positioned hydraulic jacks which are operable to tilt the cradle and a hot-metal ladle contained therein; segmental bearings carried by the cradle for supporting the trunnion pads of the ladle; power means for moving the segmental bearings to slew the ladle to one side or the other; and push-pull power means for moving the cradle transversely of the car.

These and other objects will become more apparent after referring to the following specification and attached drawings in which:

FIGURE 1 is a plan view of a ladle-supporting car constructed in accordance with the invention;

FIGURE 2 is an elevational view looking toward the longitudinal side of the car;

FIGURE 3 is an elevational view taken substantially along the line III—III of FIGURE 1;

FIGURE 4 is an enlarged vertical sectional view taken substantially along the line IV—IV of FIGURE 1;

FIGURE 5 is an enlarged sectional view taken substantially along the line V—V of FIGURE 1;

FIGURE 6 is an enlarged detailed sectional view taken substantially along the line VI—VI of FIGURE 4;

FIGURE 7 is a cross-sectional view taken substantially along the line VII—VII of FIGURE 1;

FIGURE 8 is an enlarged cross-sectional view, with parts broken away for clarity, taken substantially along the line VIII—VIII of FIGURE 7; and

FIGURE 9 is an elevational view taken substantially along the line IX—IX of FIGURE 8.

Referring more particularly to the drawings, reference numeral **2** designates generally the ladle-supporting car of the invention which, as best shown in FIGURE 1, is wheel-mounted for travel along a pair of rails **4** above a continuous casting mold (not shown). The car is self-propelled by means of a motor **6**, gear reducer **8**, and power shafts **10**, all contained in the framework of the car at one end thereof. Power for the motor **6** may be obtained from a power mast (not shown). The framework of the car includes opposed longitudinal members **12** connected by transverse members **14**.

A hydraulic jack **16** having a piston rod **18** projecting therefrom is mounted in each of the inner corners of the car **2**. Each of the piston rods **18** is threaded into a block **19** which rests on the upper end of the cylinder when the piston rod is retracted. Beams **20** which are disposed parallel to the longitudinal members **12** and spaced inwardly thereof are each carried by the blocks **19** mounted on the piston rods **18** of a pair of jacks **16**. A rocker bearing **22** is interposed between the top of each of the blocks **19** and a spacer plate **24** on which the upper portion of each beam **20** rests.

A cradle **26** made up of a pair of transversely extending yoke-shaped beams **28** and longitudinally extending tie members **30** is movably disposed inside the rectangular framework of the car with the ends of the yoke-shaped beams resting on rocker bearings **32** which, in turn, are supported on pads **34** carried by the beams **20**. As best shown in FIGURES 4, 5 and 6, each of the rocker bearings **32** is turned horizontally 90° from the rocker bearing **22** disposed therebelow. A plurality of rollers **35** is interposed between a wear plate on the undersurfaces of the ends of the yoke-shaped beams **28** and the rocker bearings **32** to facilitate movement of the cradle transversely of the car, as will become apparent hereinafter.

Each of the yoke-shaped beams **28** is formed with substantially parallel upright leg portions **36** and **36'** and a horizontal portion **38** extending between and connecting the bottom portions of the legs **36** and **36'**.

A segmental surface **40**, which constitutes the upper trackway of a segmental bearing including rollers **42**, and a lower trackway **44**, is carried by the horizontal portions **38** of each of the yoke beams **28**. The bearing surfaces **40** function to support trunnion pads **46** of a hot metal ladle L, as best shown in FIGURE 7.

Power means are attached to the upper trackway bearing surfaces **40** for shifting the surfaces in the general path of their curvature. Such power means may be in the form of a pair of hydraulic cylinders **48** mounted back-to-back, one pair adjacent each of the yoke-shaped beams **28**, with the piston rod **50** of one cylinder pivotally connected with one of the bearing surfaces **40** and the piston rod **52** of the other cylinder connected with a projection on the horizontal portion **38** of the cradle beam **28**. When the piston rods **50** are retracted and piston rods **52** are projected the bearing surfaces **40** are in center position. When it is desired to slew the ladle in counterclockwise direction, as viewed in FIGURE 1, the piston rods **50** and **52** of both pairs of cylinders **48** are projected. Slewing of the ladle in clockwise direction is achieved by retracting both piston rods of each pair of cylinders.

Power means are provided for shifting the cradle transversely of the car in the form of a spaced pair of double cylinders **54** at one side of the car. The piston rods **56** of each pair of the cylinders **54** are connected to the beam **20** at the one side of the car, while the piston rods **68** of the other cylinder in each pair are connected to projections **60** on the yoke-shaped beams **28**. When the piston rods **58** of the cylinders **54** are projected and the piston rods **56** are retracted the cradle is in center position. Maximum movement in one direction is achieved by projecting both the piston rods **56** and **58** of each pair of the cylinders **54**, while maximum movement in the oppo site direction is achieved by retracting both piston rods of each pair of the cylinders **54**.

The ends of each of the beams **20** are received in three-sided pockets or enclosures **62** formed on the inner surface of each of the transverse framework members **14** so that movement of each of the beam ends is substantially restricted to movement in a vertical plane. However, the end plates **64** of each of the beams **20** are partially rounded, as best shown in FIGURE 5, so as to permit tilting movement of each of the beams when it is desired to tilt the cradle and a ladle supported therein, as will will become more apparent. An upstanding projection **65** is formed on each of the beams **20** adjacent each end thereof for cooperating with the transverse framework members **14** to prevent end-wise movement of the beams when they are in tilted position.

As best shown in FIGURE 1, spaced pairs of laterally projecting bumper pads **66** are provided on each of the yoke-shaped beams **28** of the cradle **26** which are adapted to bear against mating bumper pads **68** on the transverse frame members **14** to limit movement of cradle **26** longitudinally of the car in the event the car is accelerated or decelerated at too great a rate or if the car is run into track bumpers at the ends of the path of car travel.

In operation, ladle L containing molten metal is placed in the car **2** by means of an overhead crane (not shown) with the ladle trunnion pads **48** resting on the segmental bearing surfaces **40** in the cradle **26**. The car is then propelled along the tracks **4** to a position overlying a continuous casting mold (not shown) into which the molten metal is to be discharged through the bottom pouring nozzle N of the ladle. In this position the pouring nozzle of the ladle should be centered over the opening of the mold; however, in many instances the pouring nozzle is tilted to one side or the other so that metal emitted through the nozzle might impinge upon the inner side walls of the mold during casting. To compensate for any such misalignment of the discharge nozzle with the center of the mold cavity, the ladle may be slewed clockwise or counterclockwise by actuating cylinders **48**; or the ladle may be moved transversely of the car by actuating cylinder **54**; or the ladle may be tilted by actuating a pair of the cylinders **16** so that one side of the cradle is lifted upwardly. Any or all of these positioning movements may be necessary to properly position the pouring nozzle. The ladle may also be lifted directly upwardly by actuating all four of the cylinders **16**.

The rocker bearings **22** and **32** prevent binding of the cradle **26** and beams **20** during tilting movement. Roller bearings **35** facilitate transverse movement of the cradle when repositioning of the ladle transversely of the car is required.

Although we have shown but one embodiment of our invention, it will be apparent that other adaptations and modifications may be made without departing from the following claims.

We claim:

1. A ladle-supporting car comprising a rectangular frame made up of spaced longitudinal and transverse members, a hydraulic jack secured to said frame in each corner thereof, beams parallel to said longitudinal members spaced inwardly thereof and carried each of a pair of said jacks, a cradle composed of spaced transverse yoke-shaped beams extending between and resting on said first-mentioned beams inwardly of the transverse car members and tie members extending between said yoke-shaped beams, segmented bearings on said yoke-shaped beams adapted to receive the trunnion pads of a ladle, and means for shifting said bearings in the general path of their curvature.

2. A ladle-supporting car as defined by claim **1** in which a first rocker bearing is interposed between each end of each of said beams and the hydraulic jack supporting the same, and a second rocker bearing rotated substantially ninety degrees horizontally from the position of said first rocker bearing is interposed between each of said beams and said cradle.

3. A ladle-supporting car as defined by claim **2** in which roller bearings are interposed between said cradle and said second rocker bearings.

4. A ladle-supporting car as defined by claim **1** in which a push-pull power means is mounted on one of said beams and connected with said cradle for moving the latter transversely of said car frame.

5. A ladle-supporting car as defined by claim **1** in which a retaining pocket is formed on the inner surface of each of said transverse members adjacent each end thereof, and the ends of said beams are received in said pockets whereby movement of each of said beams is substantially restricted to movement in a vertical plane.

6. A ladle-supporting car as defined by claim **1** including bumper means projecting laterally from the yoke-shaped members of said cradle toward said transverse members to thereby limit the movement of said cradle longitudinally of said car.

References Cited

UNITED STATES PATENTS

1,590,296	6/1926	Klein et al.	248—129 XR
1,612,901	1/1927	Bates	214—38
2,772,960	12/1956	Todd et al.	266—39 XR
2,889,597	1/1959	Griffiths	164—335
3,273,208	9/1966	Greenberger	164—337 XR
3,396,674	8/1968	Shoichi Tani	105—275

ARTHUR L. LA POINT, Primary Examiner

H. BELTRAN, Assistant Examiner

U.S. Cl. X.R.

105—163, 164, 238, 366; 164—335; 212—18; 214—17, 35, 38, 75, 146, 512, 674; 220—1; 222—176; 248—129, 131, 132; 254—45; 266—39; 308—15

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,459,312 August 5, 1969

Harry H. Britcher, Jr., et al.

It is certified that error appears in the above identified patent and that said Letters Patent are hereby corrected as shown below:

Column 2, line 54, after "support" insert -- the --. Column 3, line 5, "68" should read -- 58 --; line 12, "oppo" should read -- oppo- --. Column 4, line 10, "each of" should read -- each on --.

Signed and sealed this 28th day of April 1970.

(SEAL)
Attest:

Edward M. Fletcher, Jr.
Attesting Officer

WILLIAM E. SCHUYLER, JR.
Commissioner of Patents

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,459,312 August 5, 1969

Harry H. Britcher, Jr., et al.

It is certified that error appears in the above identified patent and that said Letters Patent are hereby corrected as shown below:

Column 2, line 54, after "support" insert -- the --. Column 3, line 5, "68" should read -- 58 --; line 12, "oppo" should read -- oppo- --. Column 4, line 10, "each of" should read -- each on --.

Signed and sealed this 28th day of April 1970.

(SEAL)
Attest:

Edward M. Fletcher, Jr.
Attesting Officer

WILLIAM E. SCHUYLER, JR.
Commissioner of Patents