Feb. 6, 1973 S. RAAB 3,715,048

COMBINED GRIPPING AND LIFTING MECHANISM FOR HANDLING ANODE PLATES IN AN ANODE PLATE CASTING PLANT

Filed Nov. 4, 1970 3 Sheets-Sheet 1

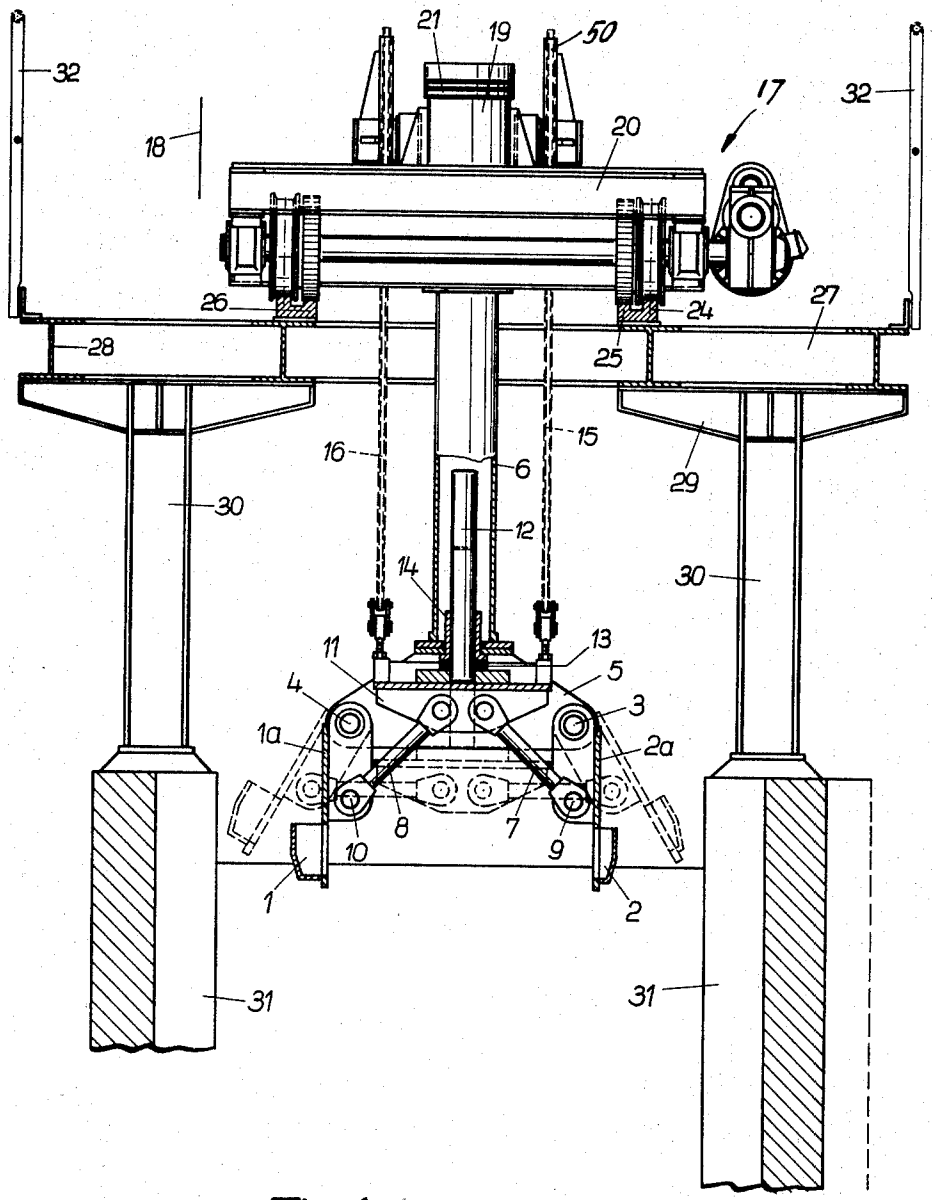


Fig. 1

Inventor
STEFAN RAAB

BY

McGlew & Tuton
ATTORNEYS

Feb. 6, 1973 S. RAAB 3,715,048
COMBINED GRIPPING AND LIFTING MECHANISM FOR HANDLING ANODE PLATES IN AN ANODE PLATE CASTING PLANT
Filed Nov. 4, 1970 3 Sheets-Sheet 2

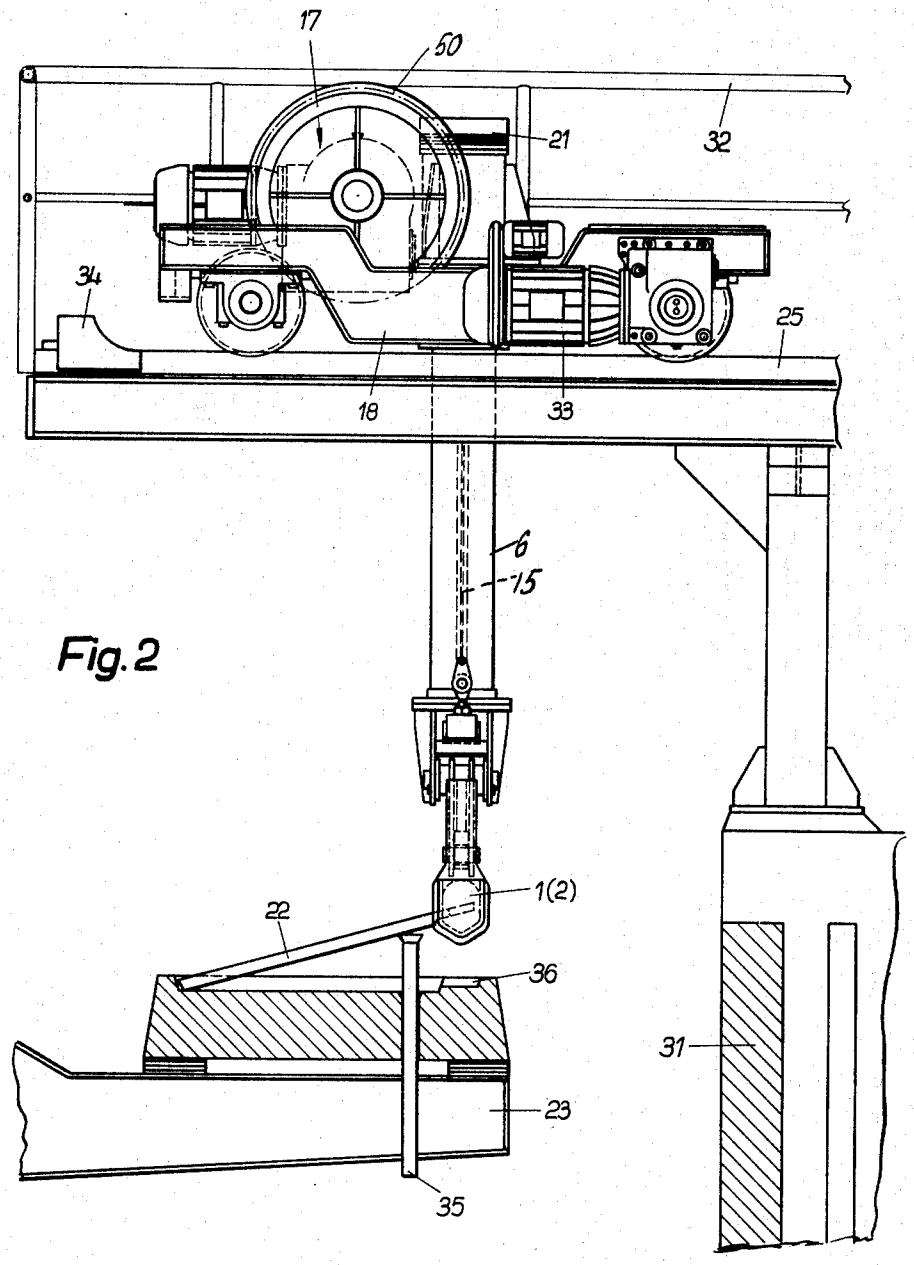


Fig. 2

Inventor
STEFAN RAAB

BY

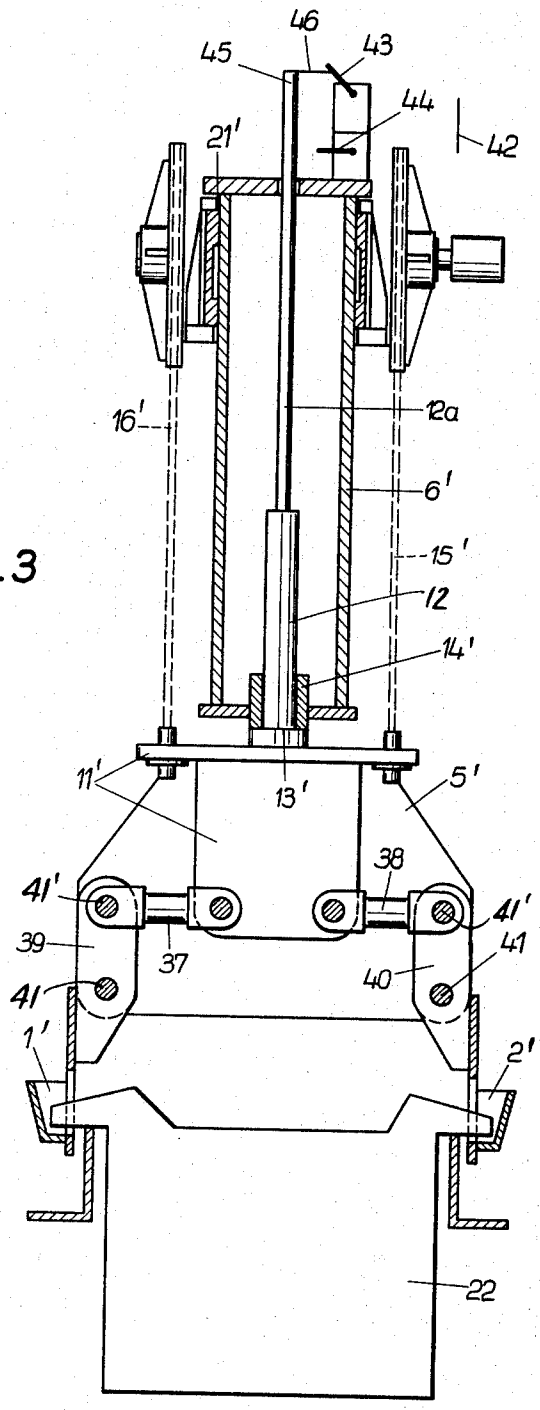
M. Glew & Foren
ATTORNEYS

Feb. 6, 1973 S. RAAB 3,715,048

COMBINED GRIPPING AND LIFTING MECHANISM FOR HANDLING ANODE PLATES IN AN ANODE PLATE CASTING PLANT

Filed Nov. 4, 1970 3 Sheets-Sheet 3

Fig. 3



Inventor
STEFAN RAAB

BY

McGlew & Toren
ATTORNEYS

United States Patent Office 3,715,048
Patented Feb. 6, 1973

3,715,048

COMBINED GRIPPING AND LIFTING MECHANISM FOR HANDLING ANODE PLATES IN AN ANODE PLATE CASTING PLANT

Stefan Raab, Essen, Germany, assignor to Demag A.G., Duisburg, Germany

Filed Nov. 4, 1970, Ser. No. 86,798
Claims priority, application Germany, Nov. 19, 1969, P 19 58 074.6
Int. Cl. B65g 1/04
U.S. Cl. 214—16 B 9 Claims

ABSTRACT OF THE DISCLOSURE

A combined lifting and gripping mechanism for use in an anode plate casting plant includes a vertically movable column which may be driven upwardly and downwardly for effecting the lifting of the anode plates in conjunction with a traverse carrying a pair of pivotally supported engagement members or grippers which have moved inwardly into gripping engagement during the initial stages of lifting, is carried on a lower end of a guide pin which is telescopic within the column. The traverse is moved vertically relative to the column by means of separate lifting elements such as lifting chains and these chains are moved upwardly and downwardly for the purpose of effecting a closing gripping movement of the grippers, or an outward releasing movement thereof for the engagement or disengagement of the associated anode plates.

SUMMARY OF THE INVENTION

This invention relates in general to metallurgical handling equipment in particular to a new and useful mechanism for gripping and lifting anode plates after they have been cast in order to position them for further treatment.

In anode plate casting plants, it is usual to cast the individual plates in one or several casting wheels and to thereafter remove the plates from the casting wheels for subsequent treatment such as in cooling basins or electrolytic baths. It is known to provide such plates with laterally extending ears or projections which are gripped by means of tong-like tools which are engaged at one of the ears to completely lift the casting mold out of the casting wheel and to bring each anode plate into a vertical position. It is subsequently lowered in a suspended position either to transfer them to a cooling bath or to lower the plate into an electrolytic bath. The lifting operations take place according to the properties of the gripping elements. There are always difficulties in gripping the anode ears in a manner such that they become properly coupled with the gripping elements before the lifting movement of the hoisting gear drive parts are effective. In most cases the anode plates are damaged because of improper gripping operations prior to their lifting and therefore it is difficult to position them in a precise vertical position in order to permit arrangement of a large number of such plates in closely spaced side by side relationship. Because of the difficulties in gripping and lifting these plates, the entire operation of an anode casting plant is considerably disturbed. Because the other operational parts of the casting plant work in rhythm completely independently of each other, it is a very serious disadvantage if the anode plates are distorted by improper handling because they cannot be subsequently gripped and they must be disarranged during their deposit.

In accordance with the present invention there is provided a combined lifting and gripping mechanism which insures proper engagement and deposit of the anode plates.

The mechanism is such that proper gripping of the anode plates is effected before any lifting occurs which may result in damage to the lateral projections or ears. The present invention provides an arrangement in which the gripping elements can be moved by means of a drive which operates either to only lift the guide column carrying the grippers or, to effect the opening and closing movement of the gripping elements themselves: With an improper engagement of an anode plate, the further operating movement of the gripping elements or the depositing process will stop so that the trouble can be eliminated in a short time by removing at least the plate that is not properly arranged. The dependence of the two movements of gripping and lifting and transporting has the advantage that major effects on the material flow of the anode casting plant can be prevented in time.

There are many other possibilities for interfering with the flow of materials through a casting plant. For example, an idle stroke can be provided during the casting. Since the trouble can be recognized in time according to the proposal of the invention, it can be eliminated in a very short time.

The basic concept of the invention can be carried out in a manner such that only a single hoisting gear drive is provided which can be switched in time sequence. The apparatus advantageously comprises a vertically movable guide column and gripping elements which are carried on a traverse which is guided in telescopic fashion by means of a guide pin in respect to the associated guide column. A single drive motor is used for raising and lowering the column and also for raising and lowering the traverse relative to the column which automatically effects the gripping engagement of the plate. The control mechanisms for the operation may include an electrical switching system to insure that there can be no further lifting or displacement of the parts if they are not in a selected operative position, that is, if the gripping elements are not properly closed or, if they are not properly opened.

It is known in the state of the art to provide tong-like gripping elements. The invention, on the other hand, provides as a special feature that the gripping elements comprise gripper shells which can be turned in opposite directions and which are secured on levers. They are rotated about their mounting pivots on a traverse member by means of levers which are turned in respective opposite directions. The opposite rotatability results particularly in very favorable centering operations in respect to the engagement of the shells with the associated ears of the respective size of the anode plates. The form of the particular engagement members or grippers is imoprtant in order to avoid damages during the gripping of the anode plate ears.

In the preferred form of the invention the gripping elements are carried on a traverse which is suspended on a pin which is telescopic within a central lifting column. The traverse is raised and lowered in respect to the associated column by means of traction ropes of chains and this relative movement between the traverse and the column provides for the pivotal inward and outward movement of the associated gripping members on the traverse to either close them into engagement with the associated anode plates or to open them to permit separation of the plates therefrom. The principal advantage of the construction is that both gripping and lifting movements take place successively and only by the operation of a single drive. During the initial operation of the drive the traverse is moved relative to the column so that the anode plates are gripped positively at the anode ears or lateral projections on each anode plate side due to the closing of the gripping elements which are effected by the relative movement of the traverse and the lifting column. If inac-

curacies of up to ±70 mm. in the spacing of the ends of the anode ears are caused in the anode plate by the casting process, this will no longer effect the gripping operation. The anode plates become centered automatically during the closing of the gripping elements. A particular advantage consists in the automatic centering of the anode plates within the gripping elements while they are still freely rotatable. The anode ears are neither deformed nor damaged on the surface. The anode plates are thus always suspended vertically after they have been engaged. The simple and rugged construction of the gripping mechanism particularly meets the requirements of the rough casting operation.

The traverse is mounted for vertical adjustment in respect to the associated guide column by means of a centrally arranged guide pin which is slidable within the column. The column thus forms a safe support for the traverse so that the gripper elements can always be moved symmetrically and in synchronism. A bearing bushing at the lower end of the column provides a bottom edge forming a stop face. This stop face prevents further movement of the traverse upon engagement therewith which corresponds to a position in which the gripping elements are in a striking position.

The guide column is mounted on a trolley and it is confined for movement in a vertical path within a bearing by means of a stop for a bottom position. In the bottom position as well as in all of the other vertical positions of the column the weight of the entire gripping mechanism including the guide column itself can be used to exert corresponding forces on the gripper elements which engage with the ears of the anode plates so that there is a good holding action.

Another feature of the invention is that the guide pin has an upper extension with a switch actuating element which may be moved into association with one or more switches for the purposes of indicating the particular operating position of the traverse and gripper elements. The movement of the guide pin corresponds to the opening and closing movement of the gripper elements so that the position of these elements can be derived from the movement of the guide pin. The individual gripping elements may advantageously be carried on a double armed lever which is pivotally mounted centrally on a respective side of the traverse member with which it is associated. The opening and closing movement is directed to these double armed levers, which are pivoted on a crosshead carried at the lower end of the lifting column, through toggle levers pivotally connected to the movable traverse. The traverse is displaced by lifting elements, such as lifting chains, for vertical movement relative to the associated guide column. The toggle levers effect an optimum force yield on the gripping elements for the centering of the anode plate. Upon completion of the gripping operation, accidental opening of the gripping elements is not possible, since they are self-locking in the engaged position which corresponds to the dead center position of the toggle levers. The electrical connection between the gripping elements and the hoisting elements may be set by electrical switches which prevent lifting drive in the event there is any difficulty in the engagement of the gripping elements.

A special advantage for all the individual measures of the gripping mechanism comprise not only the rugged construction of the gripping elements, but also that no driving elements or limit switches are arranged in the heat radiation range of the anode plates. It must be borne in mind that the casting of anode plates requires a large amount of heat and the plates themselves radiate a large amount of heat at temperatures of from 800 to 900° C. so that the use of hydraulic means is impossible. The gripping mechanism, according to the invention, is therefore principally a remotely controlled mechanism which can be operated under heat to manipulate the cast anode plates properly.

Accordingly, it is an object of the invention to provide an improved combined gripping and lifting mechanism for the gripping and lifting of anode plates which have been cast comprising a vertically displaceable column having a traverse at the lower end thereof which carries pivotally movable gripping jaws, and including a traverse which is guided on a guide pin which is telescopic within the column and which may be separately raised and lowered and which includes a lever connection between the traverse and each individual gripping member, the traverse being movable relatively to the lifting column to effect an opening and closing of the gripper jaws and the lifting of the column being effective after the jaws have been moved into a closed position engaged with the anode and after the traverse is shifted to cause engagement thereof with the column and the lifting of the column with the traverse.

A further object of the invention is to provide gripping mechanism for anode plates in an anode plate casting plant which includes a raisable and lowerable column which carries the gripping elements and which is adapted to be carried on a trolley which is movable into association with a selected one of several casting wheels, and wherein the gripping elements can be moved by means of a drive whose power is transmitted either only as a lifting movement of the guide column or as a movement of the closed and opened position of the gripping elements.

A further object of the invention is to provide a combined lifting and gripping mechanism for handling cast anode plates in a casting plant which is simple in design, rugged in construction and economical to manufacture.

The various features of novelty which characterize the invention are pointed out with particularity in the claims annexed to and forming a part of this disclosure. For a better understanding of the invention, its operating advantages and specific objects attained by its uses, reference should be had to the accompanying drawings and descriptive matter in which there are illustrated preferred embodiments of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings:

FIG. 1 is a partial front elevational and partial sectional view of the combined gripping and lifting mechanism constructed in accordance with the invention;

FIG. 2 is a side elevational view of the device indicated in FIG. 1; and

FIG. 3 is a view similar to FIG. 1 of another embodiment of the invention.

GENERAL DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to the drawings in particular, the invention embodied therein in FIGS. 1 and 2 comprises a combined gripping and lifting mechanism for handling anode plates, particularly for handling such plates in a casting plant after they have been cast. The gripping mechanism of the device includes two hollow grab shells or grippers **1** and **2** which are rotatably supported on bolts **3** and **4** which are carried on a crosshead **5**. The crosshead **5** is rigidly mounted on the lower end of a guide column or a lifting member **6**. The grippers **1** and **2** are opened and closed by the raising and lowering of a traverse member **11** which carries a pair of tie rods or toggle levers **7** and **8** which engage respective gripper elements **1** and **2** and which are pivotally mounted at their inner ends on the traverse **11**. The traverse **11** carries a guide pin **12** which is telescopic within the guide column **6** and which includes a top stop face **13**. The guide pin **12** is arranged for vertical guiding movement in a bushing **14** of the guide column **6**. The traverse **11** is suspended on lifting means in the form of two chains **15** and **16** which are connected over sprockets **50** of hoisting gear or a drive mechanism generally designated **17** which is carried on an anode trolley **18**.

The guide column **6** can be displaced vertically in a bearing **19** which is secured on a frame **20** of the trolley **18**. A stop **21** on the guide column limits the downward stroke of the column.

The operation of the device is as follows:

In the open state of the gripping mechanism shown in dotted lines in FIG. 1, the tie rods **7** and **8** extend substantially horizontally and maintain the individual gripper elements **1** and **2** in a spread-apart opened condition. When the chains **15** and **16** are raised, the traverse **11** is moved upwardly and pulls the individual gripper elements **1** and **2** together by the movement of the associated tie rods **7** and **8**. The stop **13** on the guide pin **12** bears in the further course of lifting movement on the bush **14** of the guide column **6**. In this condition the gripping mechanism for the anode plates is thus closed and would normally engage each side of an anode plate such as an anode plate **22** shown in FIG. 2. By further lifting the chains **15** and **16** the guide column **6** is then moved vertically upwardly in its associated bearing **19**. The anode plate **22** which is lifted out of the mold **36** is then lifted vertically and transported.

When the anode plate **22** is lowered the guide column **6** will move downwardly until it bears with its stop **21** on the bearing **19**. The anode plate **22** is engaged before this by a suitable rigid depositing device or support which is arranged either in a cooling basin (not shown) or in an electrolytic bath (not shown) for example. When the grippers **1** and **2** are relieved from the anode plate **22** which is then supported, they are spread apart by the weight of the traverse **11** and the guide pin **12** acting through the associated tie rods **7** and **8**. The maximum spreading movement of the grippers **1** and **2** is achieved in the horizontal position of the tie rods **7** and **8** shown in broken lines in FIG. 1. This brings the gripping mechanism again to the starting position.

The use of the gripping mechanism constructed in accordance with the invention is dependent on the respective basic design of the anode casting plant. In the case of a casting wheel having radially arranged cooling basins, the gripping mechanism with the guide column **6** and the bearing **19** is placed on an anode trolley **18**. The trolley **18** moves with the hot anode plates **22** from the casting wheel **23** shown in FIG. 2 to the cooling basin which is not shown. With tangentially arranged cooling basins, the gripping mechanism can be mounted on the jib of a swivel crane, for example. It is also possible to make the movement of the gripper elements **1** and **2** independent of the lifting movement by pneumatically or hydraulically operated piston drives. It is then only necessary to use an additional grab hoist.

The anode trolley **18** runs on special rails **24** which have a rail section **25** and a rack **26**. The rails **24** are arranged on a scaffold which comprises a crossbeam **27** and longitudinal girders **28**. The crossbeams **27** bear on head portions **29** of columns **30** which in turn bear on a foundation **31**. The anode trolley **18** and the rails **24** are protected by a railing **32** to permit walking of personnel therealong. A special feature of the construction is the travelling drive **33** for the anode trolley **18** which can also be used as a hoisting gear drive. The travel range of an anode trolley **18** can be limited by brake shoes **34** or similar stopping elements. The plates **22** are moved at the lifting points of the casting wheel, **23** indicated in FIG. 2, by means of a special lifting mechanism **35** to place them in an inclined position at which the initial gripping action may take place.

In the embodiments shown in FIG. 3 similar parts are similarly designated, but with primes added. The gripping mechanism includes engagement members or grippers **1'** and **2'** which are carried on a crosshead **5'** which is mounted at the lower end of a lifting column **6'**. In the open position of the grippers **1'** and **2'**, the traverse **11'** is located in the bottom end position. The traverse **11'** keeps the grippers **1'** and **2'** in a spreaded part open position due

to the action of the conectiong rods **37** and **38**. By raising the chains **15'** and **16'** the traverse **11'** moves first alone upwardly and pulls the grippers **1'** and **2'** together, through the action of connecting rods **37** and **38**. The top surface **13'** at the bottom end of the guide column **6'** limits the stroke of the traverse **11'** and insures that the grippers **1'** and **2'** are maintained in the closed position when they are in an upper position as indicated in FIG. 3.

The connecting rods **37** and **38** extend substantially horizontally as represented in FIG. 3 in the lifting position and they exert on the grippers **1'** and **2'** the greatest possible force under a toggle lever principle. This is possible because the grippers **1'** and **2'** are secured on their outer ends to double levers **39** and **40** respectively which are pivoted about pivot bolts **41** carried on the crosshead **5'** and to pivot bolts **41'** carried on the toggle levers **37** and **38**. Because of the toggle lever connection inaccurately aligned anode plates can be centered during the closing movement of the gripper elements **1'** and **2'**.

After moving the gripper elements **1'** and **2'** into the closed position the entire gripping mechanism is again moved vertically by the movement of the column **6'**. The anode plate **22** can thus be lifted as shown in FIG. 2 until it has reached an upper end position of the guide column **6'**. The grippers **1'** and **2'** can preferably not be opened during the lifting movement since the connecting rods **37** and **38** assume a dead center position (toggle lever principle) in a horizontal position together with the traverse **11'**. During the lowering of the gripping mechanism all movements take place in a reverse order.

The gripping operations on the basis of the mechanism indicated in FIGS. 1 to 3 can be electrically secured by means of a limit switch **42** assembly including element or contacts **43** and **44** which are in connection with a copying attachment switch connected to the hoisting gear drive **17**. To this end a guide pin **12'** has an extension **12*a*** which extends into the range of the contacts **43** and **44**. Depending on the position of the upper edge **45** of the extension **12*a***, contact **46** actuates either the upper limit switch contact **43**, or the lower limit switch contact **44**. The drive of the hoisting gear is thus not actuated so long as the traverse **11'** and the rest of the lifting mechanism **37** to **40** have performed proper movements. In case of trouble in the gripping operation, the hoisting gear is immediately shut off. The position of the limit switch contact **43** and **44** is correspondingly selected.

What is claimed is:

1. A transport device, particularly for lifting cast anode plates from a casting mould and transporting the plates to a fixed support at a treatment station in a casting plant, comprising a support, means adapted to move said support backwardly and forwardly over the casting mould, a hollow lifting column on said support being movable upwardly and downwardly thereon, a crosshead connected to said column adjacent the lower end thereof, first and second gripper elements pivotably connected to said crosshead at spaced locations thereon and having gripping ends depending downwardly and being pivotably movable inwardly to engage the cast plates from respective opposite sides thereof and being pivotable outwardly to release said cast plates, a traverse below said column having a connecting link connected to each one of said gripper elements, said traverse including guide means movably guided within said hollow column, a lifting member connected to said traverse exteriorly of said column and being movable to lift said traverse upwardly and downwardly in respect to said column and to lift said column when said traverse is moved upwardly to an abutting engagement with said column, stop means on said support to limit the lowermost position of said column to a predetermined location, and a hoisting gear connected to said lifting member to lift said lifting member upwardly to move said traverse upwardly, said traverse being arranged in alignment with said column so as to engage said column after it has been moved upwardly by predetermined amount

and to lift said columns during continued upward movement of said traverse, said traverse being movable downwardly to displace said connecting link to each of said gripper elements in a direction to open the gripper elements outwardly, after said column has moved to a lowermost position and upon continued movement of said traverse downwardly after the cast plate has been supported at the treatment station.

2. A transport device, according to claim 1, wherein said traverse includes a pin portion guided telescopically within said column, said lifting member comprising a chain connected to respective ends of said traverse for lifting said traverse upwardly and downwardly said gripper elements comprising first and second lever members pivoted on said crosshead, a toggle lever pivotally connected to one arm of said lever member and to said traverse and extending substantially horizontally when said lever members are in closed position in which they grippingly engage an anode plate.

3. A transport device, according to claim 1, wherein said hoisting gear includes a driving motor, said lifting member comprising a flexible member connected to each side of said traverse, a winding drum, on which said flexible members are windable, connected to said motor for rotation by said motor.

4. A transport device, according to claim 1, wherein said support comprises a trolley, said drive motor being connected to drive said trolley for movement over the casting mould.

5. A transport device, according to claim 1, wherein said gripper elements are pivoted to said crosshead at locations beyond each respective end of said traverse, said connecting links being supported on said traverse at a spaced location from each of its ends and connected at respective spaced locations from their pivotal connections to said crosshead.

6. A transport device, according to claim 1, wherein said cast plates have projecting ears at each end, a support at the treatment station for supporting the cast plates by engagement beneath the ears thereof when the plate is lowered into said support, said gripper elements comprising plates having an opening adjacent each end for engagement over the ears of the cast plate.

7. A transport device, according to claim 1, wherein said first and second gripper elements comprise a double armed lever having one arm portion engageable with the anode plate and a second arm portion connected to said connecting link, said connecting link being connected to said arm portion through a toggle link.

8. A transport device, according to claim 7, wherein said traverse includes a top edge forming a stop face which abuts against said column at the uppermost position of its movement during the closing of said first and second gripper elements.

9. A transport device, according to claim 1, wherein said support includes a mounting collar for said column said column having a widened top portion forming a stop, engageable with said column at the bottom end position of said column.

References Cited

UNITED STATES PATENTS

84,510	12/1868	Rikey	294—106
321,158	6/1885	Thompson	294—106
1,317,500	9/1919	Holmquist	294—93
2,017,385	10/1935	Anderson	294—106
2,951,725	9/1960	St. Jean	294—106
3,251,623	5/1966	Fredholm	294—93
3,252,559	5/1966	Von Gal	294—115

FOREIGN PATENTS

1,022,361	1/1958	Germany	294—115

DRAYTON E. HOFFMAN, Primary Examiner

R. B. JOHNSON, Assistant Examiner

U.S. Cl. X.R.

294—86, 29; 214—658