This invention relates to overhead travelling cranes and, more particularly, to interlock systems for overhead travelling cranes for maintaining the juxtaposed ends of said cranes in operative relationship with each other in order that the load carrying trolley means on the respective cranes may move freely from one crane to the other.

In wide span buildings of the character in which overhead travelling cranes of the type under consideration herein are usually installed, it is frequently necessary to move a load from one side of the building to the other so that it is necessary for the load carrying trolley on one travelling crane to move from the tracks of its own crane onto the track of an associated crane so that the load may be shifted from one side of the building to the other. Furthermore, it is frequently desirable to utilize the trolleys of two cranes in tandem so that the combined lifting effort of both trolleys may be applied to a cumbersome or unusually unwieldy load.

The major problems encountered in the provision of an interlock system for operatively connecting the juxtaposed ends of two overhead travelling cranes include the difficulty in aligning the ends of the cranes at a predetermined location so that the interlocking mechanism may be properly engaged. Another difficulty lies in the fact that the interlocking mechanism utilized must be such that the ends of the cranes will not be spread apart as the interlocking mechanism engages, but rather will be drawn into intimate relationship with each other to minimize the gaps between the ends of the rails on the cranes.

It is, therefore, an object of my invention to provide an interlock system for operatively connecting the juxtaposed ends of overhead travelling cranes which includes movable interlocking means mounted upon the end of one of the cranes and engageable with receiver means on the end of the other of the cranes, said movable interlocking means and receiver means co-operating to draw the ends of the respective cranes into more intimate engagement rather than causing the spreading of said ends as has occurred in prior art constructions.

An additional object of my invention is the provision of an interlock system for the juxtaposed ends of travelling cranes wherein the aforementioned movable interlocking means is actuable by a remotely controlled motor and wherein limit switch means is provided in association with said motor to automatically de-energize said motor when the interlocking means is either completely interlocked with its associated receiver means, or completely freed therefrom.

Another object of my invention is the provision of an interlock system of the aforementioned character wherein there is provided trolley blocking means on the juxtaposed ends of the travelling cranes to prevent inadvertent movement of the trolleys of the respective cranes past the ends of said cranes.

A further object of my invention is the provision of an interlock system for travelling cranes which includes trolley blocking means actuable concomitantly with the aforementioned movable interlocking means so that as the movable interlocking means engages the receiver means on the end of an associated crane, the trolley blocking means are concomitantly and automatically removed from the paths of the associated trolleys to permit free movement of the trolleys across the ends of the respective cranes to be accomplished.

Another object of my invention is the provision of an interlock system of the aforementioned character wherein the trolley blocking means are actuated by and operatively connected to the movable interlocking means so that the actuation of said movable interlocking means causes concomitant actuation of said trolley blocking means.

It is most desirable that the operative connection of juxtaposed ends of the overhead travelling cranes take place at a predetermined station and, as indicated previously, one of the major problems encountered in prior art attempts to solve the manifold problems inherent in operatively connecting the ends of juxtaposed cranes has been accurately aligning the ends in order that the tracks on the respective cranes may be maintained in proper registry or alignment to permit free movement of the respective trolleys across and beyond said ends.

A further object of my invention is the provision of an electrical interlock system at a predetermined station whereby when the juxtaposed ends of the travelling cranes are properly aligned with respect to each other, electrical energization of the various components of the overhead travelling cranes will be permitted. An associated object of my invention is the provision of an electrical interlock of the aforementioned character which will prevent energization of the appropriate electrical components of the overhead travelling crane unless the ends of said cranes are properly aligned with respect to each other.

A further object of my invention is the provision of an interlock system of the aforementioned character wherein detector means is provided on the ends of said cranes and at said predetermined station to visually or otherwise indicate to the operator of the cranes when the juxtaposed ends of said cranes are properly aligned with respect to each other so that an indication will be presented to the operator that the electrical interlock incorporated in the interlocking system for the cranes is in condition for operation. Therefore, the necessity for time-consuming and tedious manipulation of the cranes in an effort to ascertain whether the ends of said cranes are properly aligned is eliminated, since as soon as proper alignment has been accomplished a visual indication will be immediately presented to the operator of the cranes.

A further object of my invention is the provision of an electrical interlock system of the aforementioned character wherein contactor means is provided on each of the cranes engageable with corresponding contactor means at the predetermined station, said contactor means having circuitry associated therewith for permitting the energization of the motor means associated with the movable interlocking means and for simultaneously preventing energization of the motor means associated with the cranes, so that while the interlocking of the ends of the cranes is taking place no movement of the cranes on the respective trolleys is permitted.

An additional object of my invention is the provision of an electrical interlock of the aforementioned character wherein circuitry is provided between the aforesaid contactors which will prevent energization of the motor means associated with the movable interlocking means when the contactor means on the cranes and at the interlocking station are not engaged.

Other objects and advantages of my invention will be apparent from the following specification and the ac-
comprising drawings which are for the purpose of illustration only and in which:

Fig. 1 is a front elevational view showing a pair of overhead travelling cranes located at the interlocking station.

Fig. 2 is an enlarged, fragmentary, sectional view showing the juxtaposed ends of a pair of overhead travelling cranes located at the interlocking station.

Fig. 3 is an enlarged, fragmentary, sectional view taken on the broken line 3--3 of Fig. 5 of the drawings.

Fig. 4 is a view similar to Fig. 3 and showing the engagement of the movable interlocking means on the associated receiver means and the movement of the trolley blocking means associated therewith out of the paths of movement of the trolleys on the cranes.

Fig. 5 is a top plan view showing the juxtaposed ends of the overhead travelling cranes and the various components of the movable interlocking means and the electrical interlock mounted thereupon.

Fig. 6 is a top plan view of the interlocking station and showing the contactors incorporated in the electrical interlocking means for indicating the proper alignment of the juxtaposed ends of the travelling cranes.

Fig. 7 is an enlarged, fragmentary view taken on the broken line 7--7 of Fig. 5.

Fig. 8 is an enlarged, fragmentary, partly sectional view taken on the broken line 8--8 of Fig. 5.

Fig. 9 is an end elevational view taken from the broken line 9--9 of Fig. 5.

Fig. 10 is an end elevational view taken from the broken line 10--10 of Fig. 5.

Fig. 11 is an enlarged, partly sectional view taken from the broken line 11--11 of Fig. 5; and Fig. 12 is a circuit diagram showing the circuitry incorporated in the electrical interlock and between the contactor means on the travelling cranes and the contactor means located at the interlocking station.

Referring to the drawings, and particularly to Figs. 1--5 thereof, I show a pair of overhead travelling cranes 10 and 12 located at a predetermined interlocking station 14. Each of the cranes 10 and 12 includes a pair of laterally spaced bridge members 16 which are supported at their opposite ends for longitudinal movement upon longitudinally extending rails 18 by means of pairs of trolley wheels 20 engaging the rails 18.

It is, therefore, readily apparent that the overhead travelling cranes 10 and 12 are bodily movable in longitudinal directions upon the longitudinally extending rails 18 with respect to each other and that they can be interlocked into the interlocking station 14 to juxtapose their ends inoperative relationship with each other, as best shown in Fig. 1 of the drawings.

Supported upon the bridge members 16 for movement in a path transversely of the major axis of movement of said bridge members by means of trolley wheels 22 are load carrying and lifting trolleys 24 and 26 associated with the overhead travelling cranes 10 and 12, respectively.

The bridge members, and more particularly the lower flanges thereof, thus serve as rails for engagement by the wheels of the trolley 22 on the bridge member 24 and 26 and permit the trolleys 24 and 26 to be moved by associated motor means 28 and 30 upon said bridge members by the actuation of appropriate switch means incorporated in a switch box 32 connected to the trolleys 24 and 26 by means of conductors 33.

The overhead travelling cranes 10 and 12 are individually movable with respect to each other and their associated trolleys 24 and 26 are ordinarily limited to movement along the respective bridge members 16. However, it frequently becomes desirable to transfer a load from one side of the building in which the overhead travelling cranes 10 and 12 are located to the other side thereof; to accomplish such transfer it is necessary that the trolley upon one of the cranes be able to cross over to the other of said cranes. In order to accomplish this desirable end, it is necessary to juxtapose and interlock the contiguous ends of the respective cranes so that they will be properly aligned with each other to permit the free movement of the trolley means thereof from one crane to the other.

In order to ensure the proper interlocking and alignment of the juxtaposed ends of the cranes 10 and 12 at the interlocking station 14, I provide an interlocking system 36, as indicated in Figs. 2 and 5 of the drawings, which includes movable interlocking means 38 and an electrical interlock 40. The movable interlocking means 38 includes a pair of laterally spaced hook-shaped plates 42 which are mounted on the opposite ends of a rotatable axle 44, as best shown in Figs. 2--3 of the drawings. The axle 44 is driven by a chain drive 45 through a reduction gear 46 driven by electric motor means 47. Electrical bus bars, not shown, interconnect the switch means incorporated in the switch housing 32 with the motor means 47 for causing the rotation of the hook-shaped plates 42 incorporated in the movable interlocking means 38 between first retracted positions and second extended positions. Thus, when the electric motor means 47 is energized to cause the rotation of the elongated axle 44 in the appropriate direction and to cause concomitant rotation of the hook-shaped plates 42 in the desired direction.

The hook-shaped plates 42 are of a particular construction and include recesses 49 at their uppermost ends which are engageable upon receiver pins 53 mounted on the end of the adjacent crane 10. Therefore, when the hook-shaped plates 42 are rotated into the extended positions shown in Fig. 4 of the drawings by the rotation of the axle 44 in the appropriate direction, the receiver pins 53 are engaged by the recesses 49 to interlock the ends of the cranes 10 and 12 together.

The entrances to the recesses 49 in the hook plates 42 are provided with cam portions 55 which are initially moved into engagement with the receiver pins 53 so that the cam portions 55 tend to draw the ends of the cranes 10 and 12 into closer relationship with each other so that the ends of the bridge members 16 may be more closely juxtaposed. Therefore, if the ends of the cranes 10 and 12 are slightly spread when located at the interlocking station 14, the initial engagement of the hook plates 42 will cause the ends to be drawn together by the initial engagement of the cam portions at the entrance to the recesses 49 with the receiver pins 53.

Although it is desired that the trolleys 24 and 26 of the respective cranes 10 and 12 be permitted to move onto the bridge members 16 of each other when the juxtaposed ends of the cranes 10 and 12 are properly interlocked, it is necessary to provide trolley blocking means 60 and 62 on the ends of the cranes 10 and 12, respectively, which insures that the trolleys 24 and 26 will not inadvertently travel beyond the ends of said cranes when the interlock between said cranes has not been properly established. The trolley blocking means 62 is constituted, as best shown in Figs. 2--4 of the drawings, by an elongated arm 65 and an appropriate end of which is mounted for free rotation with respect to and upon the axle 44 adjacent the hook plate 42. One of the arms 65 is associated with each of the hook plates and depends downwardly onto the bridge member 16 into the path of the trolley wheels 22 of the trolley 26. In this manner, free movement of the trolley wheels 22 beyond the end of the bridge member is prevented when the ends of the cranes 10 and 12 are not properly interlocked to each other.

An actuating lug 67, as best shown in Figs. 3 and 4 of the drawings, is provided at the upper end of the arm 65 and is engageable by a pin 69 provided on the side of the hook plate 42. Therefore, during the initial rotation of the hook plate 42 from the first retracted to the second extended and interlocked positions, no
movement of the arm 65 constituting the trolley blocking means 62 will occur since the axle 44 for rotating the hook plate 42 is rotatable freely relative to the arm 65. However, after an initial arc of movement of approximately thirty to forty degrees has been accomplished, the pin 69 on the hook plate 42 will engage the actuating lug 67 to cause the trolley 24 to form part of an engaged and concomitant rotation of the arm 65 in an upward direction thus displacing the arm 65 from the path of movement of the trolley 26 on the crane 12 and permitting free movement of said trolley beyond the end of said crane onto the crane 10.

However, since the initial movement of the hook plate 42 is accompanied by concomitant movement of the blocking arm 65, a certain amount of lost motion between the hook plate 42 and the arm 65 is permitted, which thus prevents premature movement of the trolley 26 on the crane 12 before the proper interlocking of the hook plate 42 upon the receiver pin 53.

The trolley blocking means 60 of the crane 10 is constituted by an elongated blocking arm 71 which depends into the path of the trolley 24 in the same manner as the arm 65 depends into the path of the trolley 26. The arm 71 is mounted for free rotation upon the receiver pin 53 and has associated therewith a laterally spaced plate 72 which is also freely rotatable upon the receiver pin 53 and, in conjunction with the upper end of the arm 71, mounts a transversely oriented pin 73 engageable by the straight edge 75, best shown in Fig. 3 of the drawings, on the hook plate 42. Therefore, when the hook plate 42 is rotated upon the axle 44, the edge 75 will engage the pin 73 as the recess 49 descends between the upper end of the arm 71 and the spaced plate 72 to engage the receiver pin 53.

Thus, the blocking arm 71 on the crane 10 is lifted upwardly from the path of the trolley 24 simultaneously with the lifting of the blocking arm 65 from the path of movement of the trolley 26 and the inactivation of both of said blocking arms is caused concomitantly by the rotation of the hook plates 42 incorporated in the movable interlocking means 38. Conversely, when the hook plate 42 is moved from the second extended to the first retracted position, the edge 75 will release the pin 73 simultaneously with the releasing of the pin 69 from the lug 67 to permit the blocking arms 71 and 65 to be returned to their blocking positions and to prevent the movement of the trolleys 24 and 26 to pass beyond the ends of their respective cranes. Thus, the means blocking means 60 and 62 are automatically moved from their inactive and active positions by the movement of the hook plates 42 into their extended or retracted positions, respectively, and it is impossible for the trolleys 24 and 26 to pass beyond the ends of their respective cranes if the movable interlocking means 38 is not properly interlocked upon the receiver pin 53.

It should be noted at this juncture that the end of the crane 12 is provided with rubber tired rollers 76, best shown in Figs. 2 and 5 of the drawings, said rollers being adapted to engage the juxtaposed end of the crane 10 in order to reduce any possibility of frictional drag between the juxtaposed ends of the cranes 10 and 12 as they are moved into the interlocking station 14. However, when the ends of the cranes are drawn together by the hook plates, the tires are compressed to permit the cranes to move toward each other.

In order to insure that overtravel of the movable interlocking means 38 constituted by the hook plate 42 will not occur, limit switch means 78, best shown in Figs. 5 and 7 of the drawings, is provided in conjunction with the transversely extended axle 44. Oppositely disposed limit switches 79 and 81 are mounted adjacent the periphery of the axle 44 in spaced relationship to each other and are respectively connected by leads 83 and 85 to the electrical motor means 47. Motors 47 mounted upon the periphery of the axle 44 are actuated by leads 87 and 89 for engagement with the limit switches 81 and 79, respectively. There-
Mounted for rotation on the upper ends of spaced pairs of contactor arms 114 are contactor wheels 118. Located at the interlocking station 14, as best shown in Fig. 6 of the drawings, are banks 120 and 122 of fixed contactors 124, the banks 120 and 122 of the fixed contactors being engageable by the contactor wheels 118 of the banks 110 and 112 of movable contactors. It will be noted that the movable contactor arms 114 are biased upwardly by means of springs 126 to engage the contactor wheels 118 with the fixed contactors 124. Therefore, when the movable contactors of the banks 110 and 112 are engaged with the fixed contactors 124 of the banks 120 and 122, the ends of the cranes 10 and 12 are properly aligned with the interlocking station 14 and with each other. If the end of either of the cranes 10 or 12 is not properly aligned with the end of the other crane and with the interlocking station 14, the movable contactors 118 of the respective bank of movable contactors will not engage the contactors 124 of an associated bank of fixed contactors, and electrical energization of the interlocking motor means 47 will be prevented. In this manner, the banks 120 and 112 of movable contactors of the banks 120 and 122 of fixed contactors serve as an electrical interlock, the elements of which must be in proper alignment with one another in order that the movable mechanical interlocking means may be energized.

A schematic diagram of the circuitry involved in the electrical interlock 40, as best shown in Fig. 12, indicates the provision of switch means 127 in the switch box 32 associated with the crane 12 and, more particularly, the trolley 26 thereof mounting the interlocking means 38 and switch means 128 associated with the trolley 24 of the crane 10 mounting the receiver means constituted by the receiver pins 53 for the movable interlocking means 38. Thus, the movable interlocking means 38 can be energized from either crane 10 or 12 by the utilization of switch means 126 or 127, respectively, associated therewith.

The switch means 127 is connected by means of conductors 33 to conductor rollers 133, 134, and 135 which are, in turn, disposed in engagement with bus bars 143, 144, and 145 mounted, in a manner not shown, on the frame of the traveling crane 12 to establish electrical connection with the drive motor means 47 of the movable interlocking means 38.

An input conductor 147 is connected to the bus bar 143 and potential is imposed upon the switch 127 through the respective conductor 33. Therefore, when the switch 127 is closed to cause the energization of the electric drive motor 47 of the movable interlocking means 38, potential from the input conductor 147 will pass through the contacts 149 or 150 of said switch to the conductor rollers 134 or 135, respectively.

The bus bar 145 engaged by the conductor roller 135 is connected by means of a lead 155 to a conductor roller 118 which is, in turn, engaged with a fixed conductor 124 at the interlocking station 14. The fixed contactors 124 of the banks 120 and 122 are interconnected by means of leads 152 to each other.

When the current flows through the switch contacts 150, the conductor 33, the conductor roller 135, the bus bar 145, the lead 155 and into the contactor roller 118 of the electrical interlock 40. From the movable contactor roller 118, current flows through the fixed contactor 124 and the conductor 152 which connects it to a mating fixed contactor of an oppositely disposed bank of fixed contactors 124. Current flows thence into the mating contactor roller 118, a lead 156, and another group of fixed and movable contactors 124 and 118, respectively, to a motor contactor 158 for energizing the electrical drive motor 47 for the movable interlocking means 38.

Potential at 110 v. is imposed upon the motor contactor 158 through an input line 160. If it is desired to energize the motor in the opposite direction and the contacts 149 are closed, potential is fed through said contacts to the contactor roller 134 and into the bus bar 144. Current flows thence through a lead 162 and pairs of mating movable and fixed contactors 118 and 124 at the interlocking station 14 through another lead 163, thence through mating pairs of movable and fixed contactors 118 and 124, a lead 164, and to a motor contactor 165 for the electrical motor means 47 for driving the movable interlocking means 38.

It is obvious, therefore, that in order to energize the motor means 47 of the movable interlocking means 38, it is always necessary that accurate registry of the movable and fixed contactors 118 and 124 at the interlocking station 14 be achieved, since current must flow through at least four pairs of mating movable and fixed contactors before a signal can be impressed on either one of the motor contactors to energize the electrical drive motor 47. Therefore, the electrical interlock 40 which is constituted by the movable and fixed contactors 118 and 124 must be properly interengaged before the energization of the drive motor 47 can be accomplished to cause the movement of the movable interlocking means 38 from retracted to extended to accomplish the interlocking of the contiguous ends of the cranes 10 and 12.

It is, of course, undesirable that any movement of the crane 10 or 12 be accomplished during the movement of the overhead travelling cranes 38 from retracted to extended positions or while the interlock between the ends of the cranes 10 and 12 exists. Therefore, the limit switch 78, as best shown in Fig. 12 of the drawings, is interposed in the lines to the crane motors 168. Thus, when the movable interlocking means 42 moves in the direction of the arrow 90 to cause the movement of the limit switch actuator 87 out of engagement with the limit switch 81, the circuit to the crane drive motors 168 is broken to prevent energization of said motors and inadvertent movement of the cranes during the interlocking process or while the interlock between the ends of the cranes exists.

However, as soon as the axle 44 upon which the movable interlocking means is mounted is rotated to cause said movable interlocking means 38 to be disposed in retracted position, the limit switch actuator 87, as best shown in Fig. 7 of the drawings, will engage the limit switch 81 to both de-energize the electrical drive motor 47 on the movable interlocking means 38 and to place the drive motors 168 of the crane in circuit once again to permit the energization thereof.

I thus provide by my invention an interlocking system for overhead travelling cranes which incorporates both mechanical and electrical interlock means. The electrical interlock means prevents the energization of the mechanical interlocking means until the ends of the respective cranes are properly aligned with each other at a predetermined interlocking station.

I also provide in the mechanical interlocking means of my invention cam means for drawing the ends of the respective cranes into more intimate engagement and trolley blocking means operatively associated with said movable interlocking means to prevent inadvertent movement of the trolleys of the respective cranes beyond the ends thereof before the movable interlocking means has engaged receiver means associated with the end of a crane.

Also provided by my invention is visual indicating means which serves to indicate to the operator of the cranes when the cranes are properly aligned with respect to each other at the interlocking station and means for the de-energization of the drive motors of the cranes at the initiation of the interlocking process and while the interlock between the ends of the cranes exists.

I claim as my invention:

1. An interlock system for maintaining the ends of
9 juxtaposed, trolley-supporting, overhead travelling cranes in operative relationship with each other at a predetermined station to permit the trolleys of said cranes to move from one crane to another, the combination of: movable interlocking means mounted on one of said cranes; receiver means on the other of said cranes engageable by said interlocking means to lock the ends of said cranes in operative relationship; motor means for energizing said interlocking means; and mechanical interlock means fixedly supported at said station and engageable by said movable interlocking means on said one crane to prevent movement of the interlocked cranes when said movable interlocking means is engaged therewith.

2. In an interlock system for maintaining the ends of juxtaposed, trolley-supporting, overhead travelling cranes in operative relationship with each other at a predetermined station to permit the trolleys of said cranes to move from one crane to another, the combination of: movable interlocking means mounted on one of said cranes; motor means for said interlocking means operatively connected thereto; receiver means on the other of said cranes engageable by said interlocking means; motor means on said cranes for driving the same; and resilient means on the end of one of said cranes for spacing the ends of said cranes as they move into said station but compressible by engagement of said movable interlocking means with said receiver means to permit the ends of said cranes to be drawn toward each other by said movable interlocking means.

3. In an overhead traveling crane interlock system for securing the ends of juxtaposed cranes in operative relationship with each other at a predetermined station to facilitate free movement of the trolleys of said cranes between said cranes, the combination of: movable interlocking means mounted on one of said cranes and including cam means for longitudinally drawing the ends of said cranes into operative engagement with each other; means operatively connected to said interlocking means for energizing the same; and receiver means on the other of said cranes engageable by said interlocking means and the cam means thereof to lock said cranes in operative relationship with each other.

4. In an overhead travelling crane interlock system for securing the ends of juxtaposed cranes in operative relationship with each other at a predetermined station to facilitate free movement of the trolleys of said cranes between said cranes, the combination of: movable interlocking means mounted on the end of one of said cranes constituted by a pair of laterally spaced hook members; means for rotating said hook members; and receiver means mounted on the other of said cranes engageable by said hook members for locking the ends of said cranes to each other.

5. In an overhead traveling crane interlocking system for securing the ends of juxtaposed cranes to each other at a predetermined station to permit movement of the crane trolleys upon the rails of the juxtaposed cranes, the combination of: motor driven interlocking means on one of said cranes; receiver means on the other of said cranes engageable by said interlocking means; motor means for driving said cranes; alignment means mounted at said station, said alignment means being positioned to extend between said interlocking and receiver means and preventing engagement therebetween unless each of said cranes is positioned in registry with said alignment means; and electrical interlock means at said station engageable by said cranes for permitting the energization of the motor driven interlocking means when each of said cranes is in registry with said alignment means.

6. In an overhead travelling crane interlocking system for securing the ends of juxtaposed cranes to each other at a predetermined station to permit movement of the crane trolleys upon the rails of the juxtaposed cranes, the combination of: motor driven interlocking means on one of said cranes; receiver means on the other of said cranes engageable by said interlocking means; motor means for driving said cranes; alignment means mounted at said station, said alignment means being positioned to extend between said interlocking and receiver means and preventing engagement therebetween unless each of said cranes is positioned in registry with said alignment means; and co-operating detector means on said cranes and at said station for indicating when said cranes are properly registered with said alignment means.

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