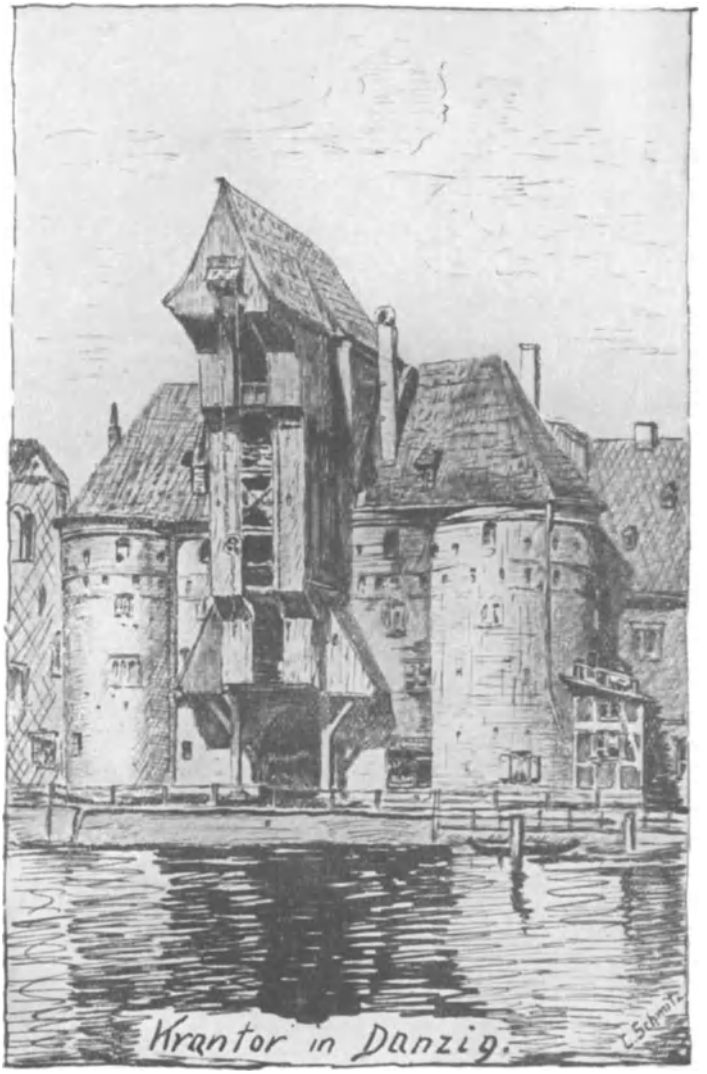

Oldest German Crane now in Service

The
German Crane Industry

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Preface.

Of the German industries, which before the war shipped a considerable part of their manufacture overseas, the German crane industry ranks foremost. The exports not only covered the simple hoisting gear and transport devices, which were produced by mass production methods and could be used everywhere with equal advantage, but also all the special apparatus and plants, which were designed to meet local requirements, i. e. the most situable and appropriate equipments for given conditions. —

This industry was not idle during and after the war and continued to improve its manufactures, to simplify its methods and thus to achieve a reduction in prices. It is, therefore, in a position to supply the most appropiate hoisting gear for any given purpose.

This pamphlet is intended to give a survey of the present standing of the German crane industry. Our old friends abroad may gather from its contents, that in the meantime the crane industry has made further progress.

Those would-be customers, however, who have not yet become acquainted with German manufactures, may find useful hints in this booklet, which may persuade them to pass on an enquiry to some German firm. It was thought advisable to include a number of rules and regulations in this book, which have been found necessary in the operation of modern crane plants in order to prolong the life of such plants and to minimize the natural wear of the single apparatus and mechanisms.

May this booklet contribute its mite to re-establish the former good feelings, which existed between the German crane industry and the foreign customers and to convince them of the high standing of this industry.

Crane Equipment.

The choice of crane and hoisting gear in general depends on the work to be done and the site where the plant is to be erected.

I. The Crane and Hoisting Gear on the Building Sites

The saving of wages on a building site plays a very important part. Then again, it is freqently nessessary to cut down the work time with all available means in order to turn to best advantage special local conditions, which are propitous for the work in hand. We need only mention work, which is dependent on certain conditions of the weather, or where the tides are a decisive factor for the progress of work. In all such cases it is essential to have high-class and efficient hoisting tackle available, and doubtless the successful termination of many a job depends on the presence and correct utilization of such hoisting gear.

The following description will only deal with the most important modern appliances and devices.

The winch, is the simplest lifting tackle to raise heavy objects and is designed for lifting and pulling work in many different types. The driving gear is generally covered by a sheet-steel cover provided with the necessary openings for inspection and lubrication. The winches are manufactured for a carrying capacity of 2 to 3 tons, and are stocked.

The Hydraulic lifting Jacks are appropriately used where heavy loads are to be raised with a minimum expenditure of power, for instance, to raise, transpose and lower bridges and other heavy iron structures.

The portable rope winch is an appliance, which can be put to manifold uses; by means of hemp or steel wire rope its lifts and moves heavy loads. Its performance may be improved by interposing a pulley block, so that loads up to 30 tons can be mastered. The winch is usually mounted in a steel frame, which protects it during transport and against the rough handling by unskilled workmen. The ratchet gear and hand brake safeguard the operators and sustain the load at any desired height.

The electricial rope winch. When electric current is available on a building site, an electrical rope winch provided with motor may be employed. In principle this winch is the same as the hand winch, but is designed for much higher speeds and contains all the apparatus and safety gear required for electric operation. The winch is also supplied with two separate rope drums, one of which is destined for the hoisting rope, the other for the moving derrick (where derrick cranes are concerned). —

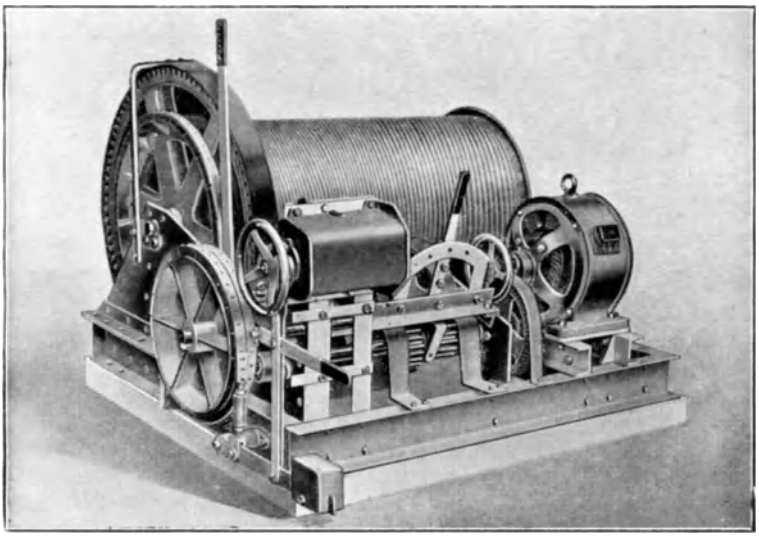


Fig. 1. Electrical rope winch

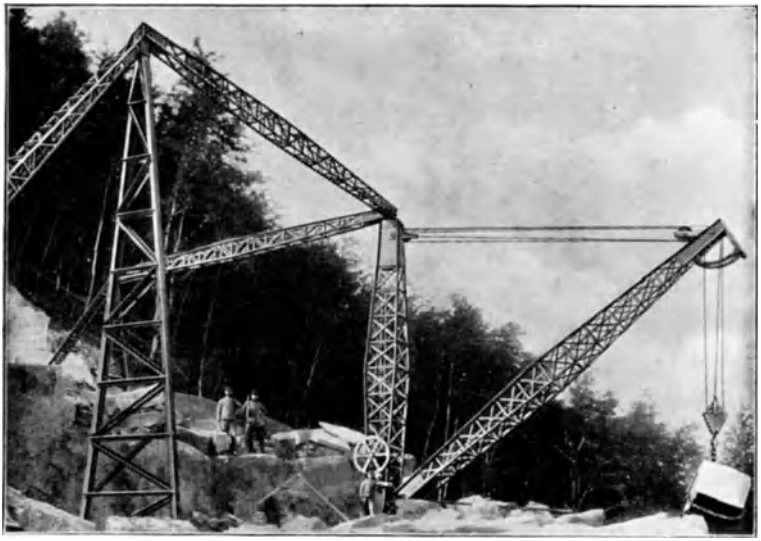


Fig. 2. Derrick pole crane in a quarry

The electro-magnetic brakes for both movements act automatically when the motor is switched off and hold the load. Special brakes are provided to lower the load, which are mostly operated by the foot and permit the slow descent of the load.

The steam rope winch. Where an electric supply is not available, a steam engine may be used as prime mover.

Derrick pole cranes. A very important appliance, which is indispensable for the above described hoisting gear; with its aid the tractive force of the different winches may be utilised to their full extent. It is unnecessary to describe the simple designs of these derrick pole cranes with their fittings, pulley, blocks etc. as these designs are common knowledge.

However, the steel trellice work designs, as shown in Fig. 2, are worthy of mention.

These poles consist of several single sections, which are rivetted together, and are, therefore easily transported. By

bolting together the individual sections, the total length of approximately 117 feet can be obtained at a carrying capacity of 30 tons.

Such apparatus must be held in position by wire rope stays; the derrick is fastened to the lower end of the pole by means of a strong journal pin and is provided with the requisite hoisting tackle. This pole crane rotates easily on a ball bearing about an angle of 360^0 and commands an area of approximately 135 to 165 feet diameter. The slewing action may be performed by means of steel wire ropes or toothed wheels.

All kinds of rope winches and especially the electrically driven ones are suitable for operating such derrick pole cranes, because they usually have to deal with heavy loads and considerable heights.

The steam locomotive slewing crane. The introduction of electrical drives gradually ousted the steam crane. Never-

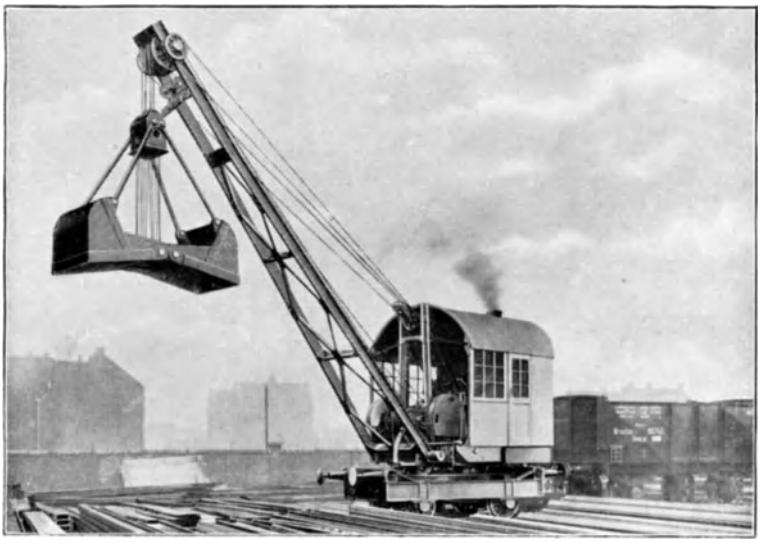


Fig. 3. Steam slewing crane

theless, the steam crane will always hold its own, where electricity is not available. In many cases the steam crane may cooperate advantageously with the electric crane; its great advantage lies in the self-contained source of power.

The prensent day improved designs of steam cranes have been standardized by most firms, so that the types manufactured by different firms have standard parts, which are turned out in series, and kept in stock to meet the large demand.

These cranes are manufactured as "standard steam cranes" for a carrying capacity of approximately 2 to 6 tons with a lifting speed of 60 feet per minute and a travelling speed with full load of about 150 to 180 feet per minute. The maximum wheel pressure of the crane being approximately 15 tons.

The crane illustrated in Fig. 3 consists of the bogie and the rotary part, which includes the upper frame and the jib. The latter is usually designed for variable radius. The steel platform of the upper frame carries the boiler steam, engine and driving gear: these parts are enclosed in a cabin to protect them against the influences of the weather. The front side is left open so as not to impede the outlook; the two sides are provided with large windows, so that all parts of the driving gear are well-lit.

The steam boiler for 114/lbs./sq. in. pressure is generally of the vertical type with horizontal tubes, which is protected by a shell to guard against heat losses by radiation. The shell is made in sections and is easily removed. The boiler is generally coal fired, but other fuel, such as wood, peat and lignite and even oil may be used. A feed water reservoir is situated underneath the platform of the upper frame. An injector is provided to feed the boiler, a hand driven pump serving as a stand-by. A reversible duplex engine is frequently used to drive the crane. The engine and the driving gear are mounted on a common frame; the former drives a counter shaft from which all movements for hoisting, slewing and travelling are controlled.

A powerful foot-operated brake serves to hold and lower the load, whilst all other movements are controlled by hand levers, which are arranged side by side.

With these levers the driver can perform the following movements simultaneously:

1. Hoisting or lowering *and* slewing.
2. Hoisting or lowering *and* travelling.
3. Hoisting or lowering *and* luffing the jib.
4. Slewing *and* luffing the jib.
5. Slewing *and* travelling.

Fig. 4. Steam crane with extended jib for erection of iron shop

A special advantage of the locomotive steam slewing crane is its freedom of movement and that it is also suitable for shunting loaded and empty railway trucks, the total weight of the latter amounting up to 90 tons.

The crane can enter works and large shops and can pass under bridges, pipes and crane tracks. The height of the jib when completely drawn in and lowered, does not exceed the permissible profile.

For standard conditions, the rope drum is designed to take up the rope for a lifting height of 40 feet. However, this dimension may be increased to 60 feet by employing a rope of smaller diameter and greater mechanical strength, no further modification being necessary. The area covered by the crane, or the lifting height may be increased by simply extending the length of the jib. Fig. 4 shows how simple it is to adapt an ordinary steam crane to a special task.

The electric pulley block. The latest types of this device compare very favorably with the steam crane as far as the multiplicity of uses is compared. It has substituted the simple hand-operated block in all those cases, where heavy loads must be raised quickly and reliably, where time and wages must be saved, and where the purchase of larger cranes are not warranted owing to economical reasons.

This interesting tackle, which is designed for loads from 0·5 to 10 tons, is driven by a totally enclosed motor, which may be wound for either direct or three-phase current, up to 500 volts. The complete mechanism is protected against rain and dust, but all parts requiring inspection or lubrication are easily accessible and can be readily exchanged. Therefore, this tackle is admirably suited for outdoor work and dusty localities. A special advantage lies in the appropriate arrangement of the hoisting ropes, which permit moving the load without lateral displacement. This is very important for the assembly of the machines and other structures, where vertical hoisting and lowering of the load is conditional.

Electric pulley blocks are generally operated by controllers and only the small three-phase types are switched on by a simple switch. The controllers are operated from the ground by chains and are provided with springs, which bring the contact fingers back into their initial position as soon as the chains are released, and thus cutting out the motor. The simplicity of this arrangement permits entrusting the device to any unskilled workman.

In the case of electric pulley blocks with suspension hooks, the controllers are generally fixed separately within easy reach of the operator handling the tackle.

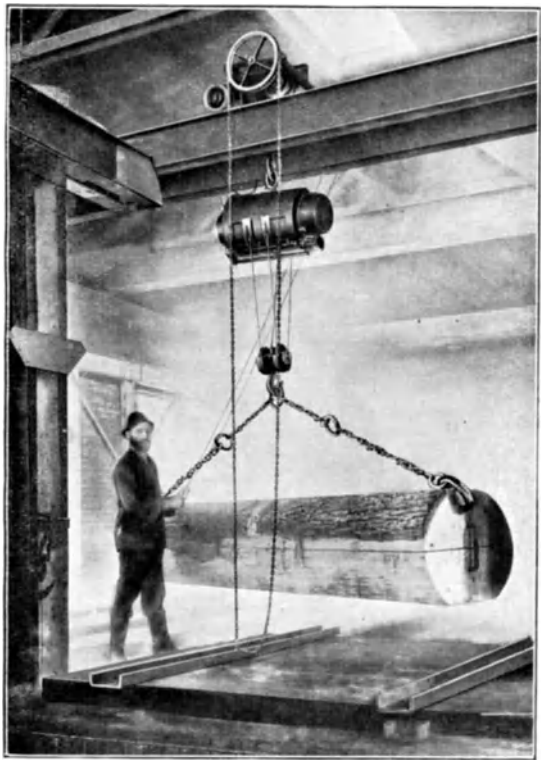


Fig. 5. Electric block pulley

Fig. 6. Travelling electric block

In Fig. 5 the electric block is shown hung on to a crab by means of its suspension hook. It can also be built into small crabs of very compact design, which run on the lower flanges of girders, Fig. 6. The crab is either moved by hand, by pulling a chain, or by a special motor.

The controllers of these travelling electric blocks are generally fixed to the frame of the crab, however, they can be separately mounted in special cases. The motors then receive the current from a bare contact line running alongside of the track. Where hand operated crabs and short travelling distances are concerned, a flexible cable suffices to connect the motor to the supply.

The electrical-driven jib-crane. The details and outputs of this crane will be discussed in the chapter on storage and Harbor cranes, it is also a very useful adjunct on the building site and for erection work. Wherever electric current is available, it can perform the work of the before mentioned steam jib crane. In districts lacking appropriate fuel and feed water, the electric jib crane has a decided advantage over the steam crane.

Fig. 7 illustrates such a crane working on a quay, where it handles and sets large blocks of stone or concrete up to 80 tons in weight, without requiring any auxiliary tackle.

Fig. 7. Electrically driven jib-crane

Cranes for building houses. The limited space of streets has made special designs of cranes for building houses, stores, etc. necessary. These cranes hoist blocks of stones, bricks and other building materials on to the scaffolding. Fig. 8 illustrates such a crane which is employed in very narrow streets. The lower end of the crane runs on a rail and is guided by a second wheel running on a rail at half the height of the crane.

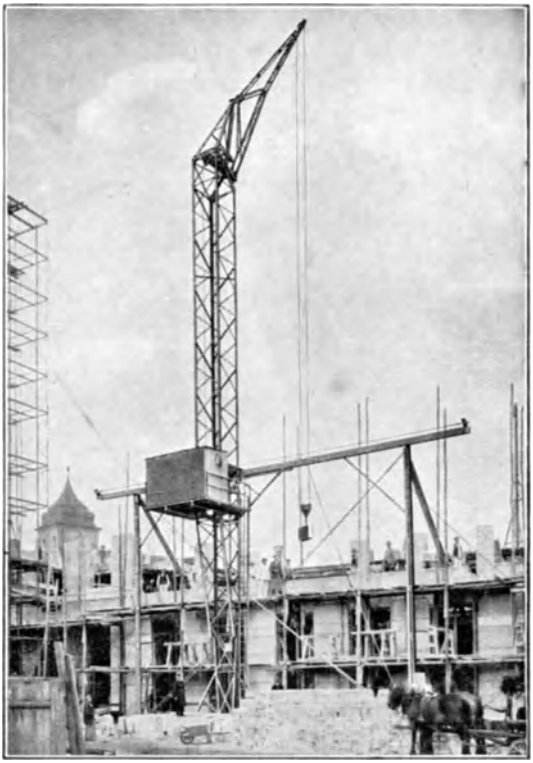


Fig. 8. Crane for building houses

Where sufficient room is available both rails are placed on the ground, in which case the supporting rail in the upper part of the scaffolding is dispensed with.

II. Cranes for Workshops and Factory yards.

The prompt execution of orders largely depends on the adequate equipment of the works with appropriate hoisting gear and transport equipment. Therefore, most of the modern works have a variety of cranes, each of which is designed to perform a certain duty.

To meet the high cost of labour and the demands of the buyers for higher output of the cranes, the designers increased the speeds of the individual crane movements and simplified the mechanism as far as possible in order to reduce the expenses for spare parts. On the other hand certain of these parts were improved to render them suitable for manifold uses and for special cases. Likewise the safety devices were further developed and the cranes equipped with modern grabs. Then again, cranes were designed which united the work of several different crane types, for instance such, which combined the duties of a travelling crane with those of a slewing crane.

According to the conditions under which a crane has to work, two main groups may be distingsuished, viz.: cranes which operate with a maximum, uniform and continuous load at high speeds, and cranes operating with medium speeds, the maximum load not frequently occurring. The cranes and hoisting tackle described in this chapter belong to the latter class.

The standard overhead travelling crane is the best known type of the class. The girders consist of a special structure of rolled sections, provided with railings and the platforms for the attendance. The structure is reinforced by diagonal struts in all planes to ensure rigidity and steady running at the high speeds of the crane and crab. The two main girders of ample dimensions, generally form the runway for the crab, if special rail girders are not provided for practical reasons.

Modern cranes are equipped with separate motors for each motion of the crane, i. e. for the travelling, traverse, and hoisting motions, and are, therefore, styled three-movement cranes. In some cases, however, the crab has to raise smaller loads at correspondingly higher speeds and is then provided with an auxiliary lifting gear equipped with a special motor, so that such cranes have four motors in all.

The travelling motion of the crane is effected by the crane travelling motor situated in the middle of the crane

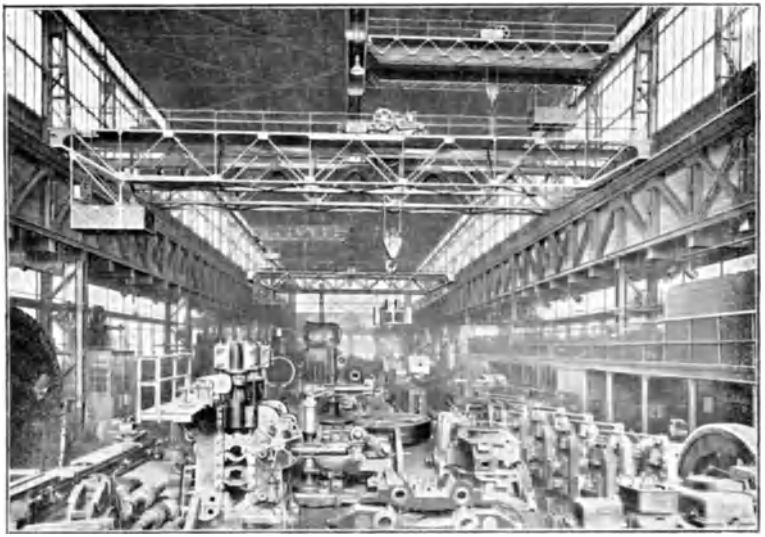


Fig. 9. Travelling cranes for the work shop running one above the other

structure. The wheels on both sides of the crane are simultaneously and uniformly driven by a strong shaft and spur wheels, so that jamming of the crane on the track is avoided. The crab, a structure of strong girders and steel sheet, is equipped with the motors and driving gear for raising and traversing.

The current is supplied to the crab by means of bare conductors situated between the main girders and protected against accidental touch.

All movements of the crane are controlled from the cab. In small or medium sized cranes this cab is mostly rigidly fixed underneath the crane girders, so as to ensure a complete survey over the load to be handled and the surroundings. The cab contains all devices and apparatus required for the proper control of the crane. In outdoor cranes this cab is closed in with boards. In very large cranes spanning more than 80 feet, the cab is mounted on the crab and performs

all the movements of the latter, so that the driver is always in close proximity to the load and has a better control of it.

The controllers, operated either by handwheels or levers, are arranged in the cab in such a manner, that the driver can control at least two movements simultaneously. An experienced driver soon learns to control the three movements, viz.: crane-travelling, traversing and hoisting or lowering movement, *simultaneously*.

As regards the kind of current to be used, it may be mentioned, that small loads can be raised more quickly employing direct current and series motors, because their speed increases with decreasing load.

The direct-current and three-phase controllers are provided with an ample number of resistance steps, which regulate the current supply so that the raising of the load and the travelling of the crane may be performed without jerks.

Fig. 9 illustrates an overhead travelling crane for 50 tons lifting capacity, which is built on the lines described above.

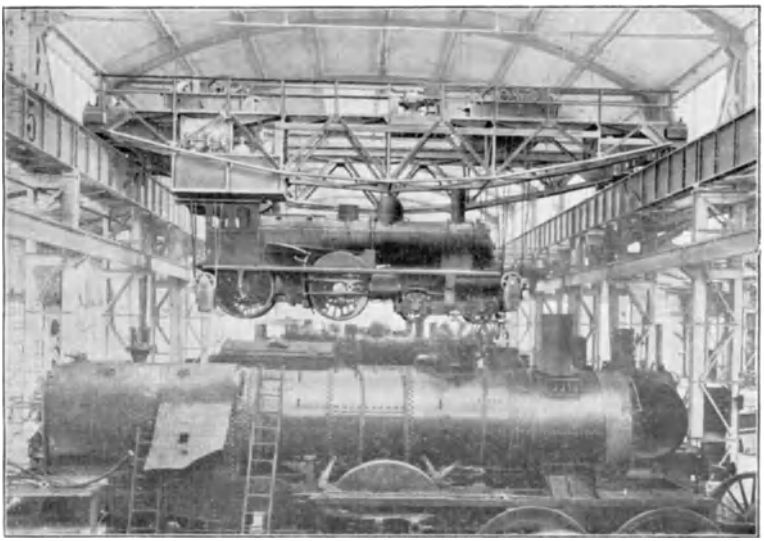


Fig. 10. Transporting locomotives by a travelling crane with two crabs

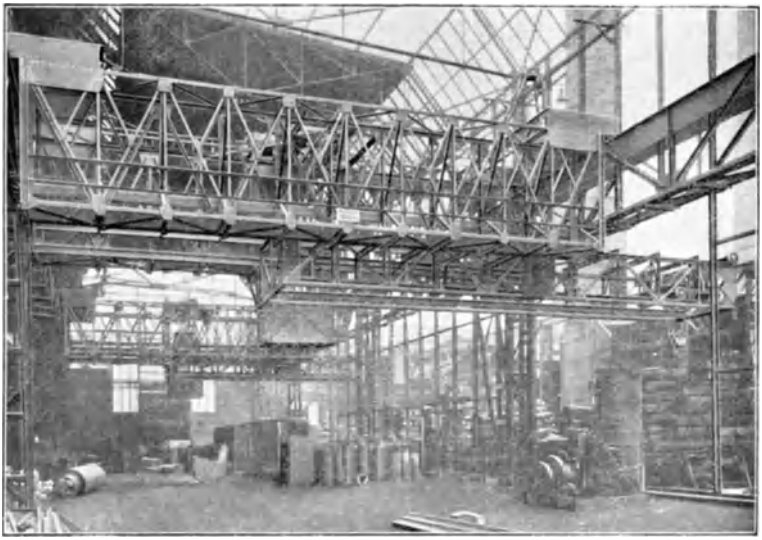


Fig. 11. Crane with sliding jib

In very long shops provided with several cranes, very frequently one crane must carry loads from one end of the shop to the other, without hindering the other cranes. This may be achieved by placing one of the cranes on a higher track, so that this crane with the load raised can travel clear of the remaining cranes. This crane thus commands the whole length of the shop and does not interfere with the perfomance of the other cranes. This arrangement is likewise shown in Fig. 9. However, there are *two* upper cranes instead of *one*, each of which spans one half of the shop, and thus render all cranes still more independent of each other.

In certain cases it is desirable to lift the load at *several* points to ensure its steady transport. The crane is then provided with two crabs or two fixed hoisting gears. Fig. 10 illustrates such a crane working in a locomotive shop; the load is hung on two strong girders and gripped at four points, so that it is impossible for it to swing or turn.

In *smithies*, and to feed *presses*, it is very important, that the driver can observe the load closely without hindrance. This is achieved by hanging the driver's cab at a lower level; the cab can also be designed to be raised or lowered, so that the pieces to be forged can always be observed from the most favourable height. These cranes generally are also provided with a special turning gear, by means of which the peice in hand can be turned at will.

The transverse transport from one shop into a neighbouring one is freqently performed with small trucks running on rails and is, therefore restricted to certain parts of the shops. To avoid these space wasting transverse rails, a special type of crane, Fig. 11, has been designed, the crab of which runs on *a sliding jib* and can enter of the adjoining shop. This jib forms the track for a second crab, and is attached to the winch in such a manner, that it just clears the girder of the crane track. There the crab takes up the load, travels back with it on the jib, whereupon the latter is drawn in

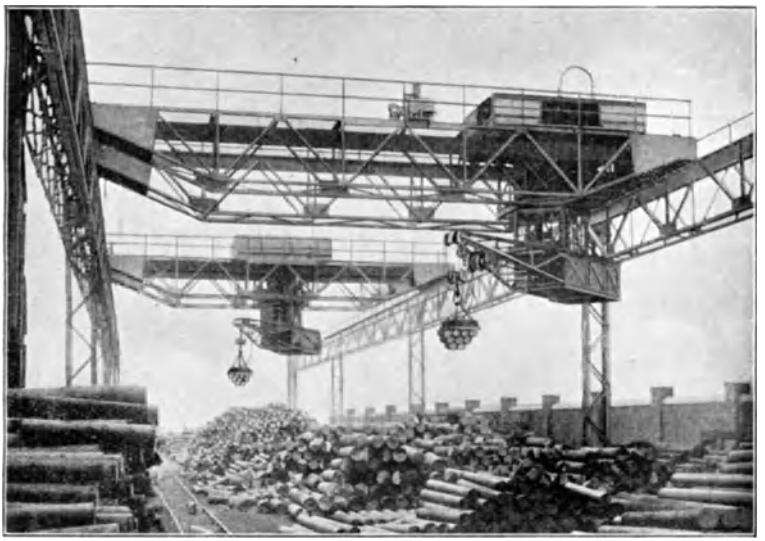


Fig. 12. Crane with slewing crab

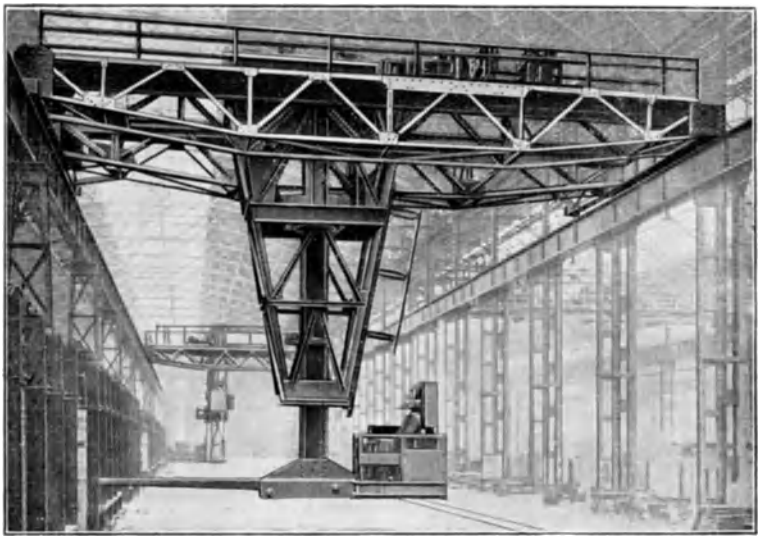


Fig. 13. Charging crane

and the crane pursues its course in its own bay. The cranes with *slewing crabs*, illustrated in Fig. 12, serve the same purpose. The rotating jibs pass under the runway and can thus manoeuvre in adjoining yards or shops.

In connection herewith a number of cranes must be mentioned, which are designed for rough service in steel works and forges. These types are very strongly built and the electrical equipment is also designed to meet the severe conditions.

The limited scope of this book does not permit of giving a detailed description of this vast section of cranes. The special catalogues published by different firms contain all necessary information.

The charging crane, the chief duty of which is to fill the furnaces with scrap, is now generally designed as shown in Fig. 13. A stong structure connected with the crab, is provided with a rotary pillar, the lower end of which is equipped with the driver's stand and all control apparatus. The tongs,

which are the actual grabbing element of the crane are so designed, that they can rotate about their axis and if necessary, can be tilted vertically. These tongs grip the filler troughs in a very simple and reliable manner, and push them through the furnace doors, where they are tilted by a rotary movement of the tongs. Owing to the manifold movements of this crane, the trough can be taken from any point of the shop and even from points situated outside the shops or from the transport trucks.

The charging crane is generally provided with an auxiliary crab for other transport duties, especially for the work in connection with the building or repair of furnaces.

A crane of very similar design is employed to place the ingots into the heating ovens; in this case the tongs are designed to grip the ingots.

The trough transport crane. In modern steel works, the troughs filled with scrap are fetched from the yards by a crane specially designed for the purpose, see Fig. 14. The

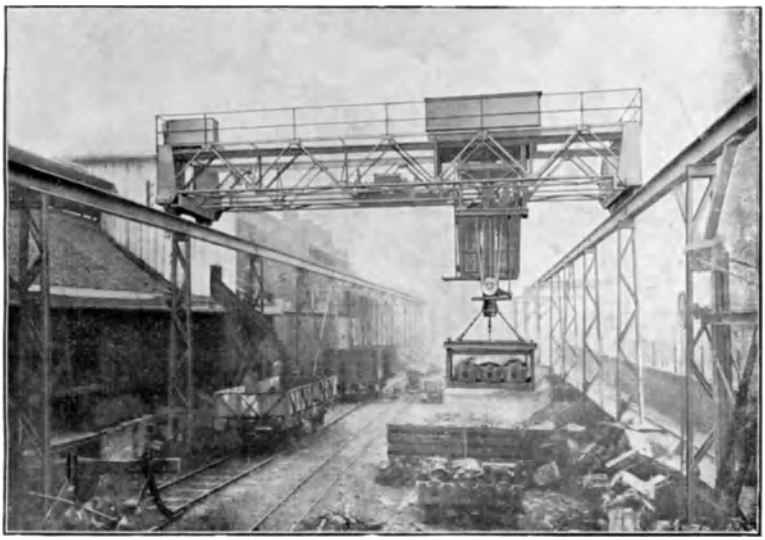


Fig. 14. Trough transport crane

Fig. 15 Scrap hoisting by means of cranes with magnets attached to them

grabbing mechanism is a special feature of this crane, it consists of two hoops, which can be vertically tilted and may be lowered to the required height by means of a rigid hoisting tackle. The hoops, normally turned upwards, are then turned downwards and lift simultaneously several troughs, and deposit them on a platform in the furnace room where they are released by turning the hoops to their original position.

Electro-magnets are frequently employed *to fill the troughs* with scrap iron; the magnets are attached to the crane hooks, as shown in Fig. 15. Special movable arms hold the scrap attracted by the magnet (especially when dealing with turnings) and thus increases the lifting capacity of the apparatus. As soon as the current is interrupted, the magnet releases the load.

The Ladle Crane. When an overhead travelling crane is principally employed for the transport and teeming of molten metal, steel, bronze or glass, it is generally constructed as shown in Fig. 16. The ladle containing the molten metal is

gripped by two hooks attached to a bridle. A second hoisting gear is situated on the same crab, the hook of which is hung into an eyelet of the ladle, and controls the pouring out of the contents of the ladle. When both hoisting gears are simultaneously lifted at different speeds, the ladle turns about its spout and thus discharges the contents very quietly and uniformly. A rigid structure is frequently provided on the crab, which holds the ladle so, that it cannot swing when the crane travels.

The Stripper Crane. This is doubtless the most remarkable crane of its kind used in steel works. Its duty is to strip the moulds of the ingots after the molten metal has solidified. This method is applicable only when very strong moulds without bottom are used, which are united in groups placed on a heavy iron plate, and by their weight prevent the molten steel escaping. The stripping of the moulds requires very considerable power and, therefore, all parts of the crab are designed very massively and made of the most resistable materials.

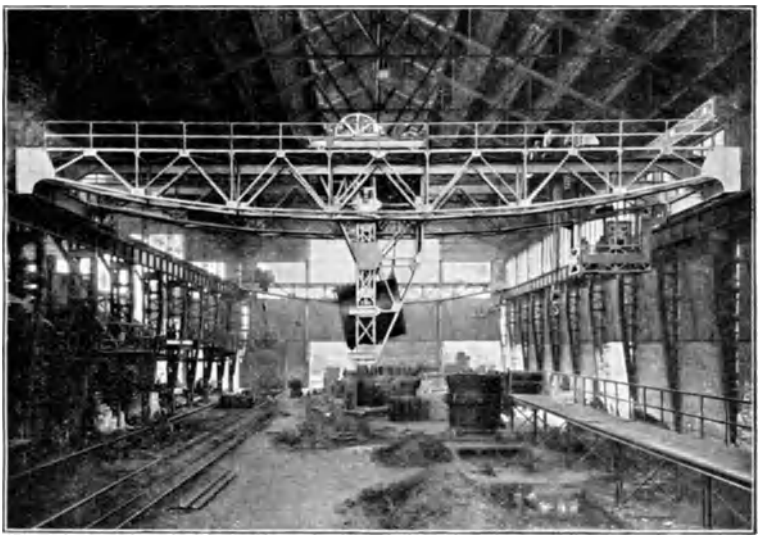


Fig. 16. Ladle Crane

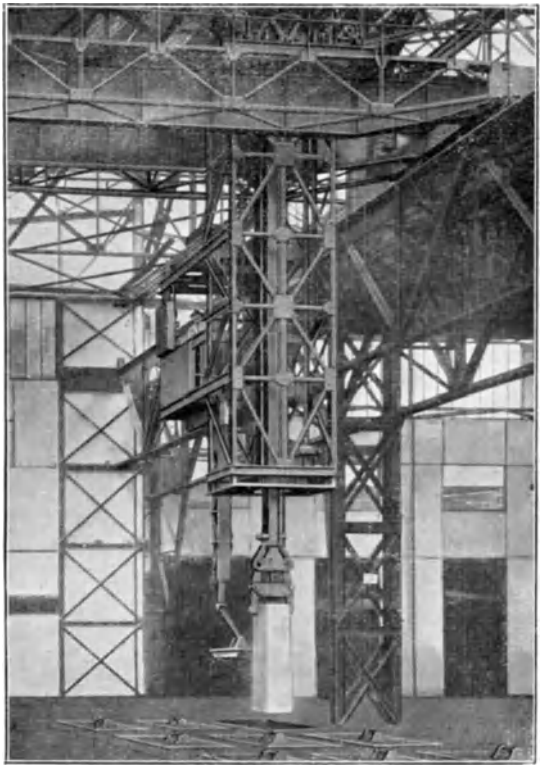


Fig. 17. Stripper Crane

A high pillar is so fixed in the guides of the structure suspended from the crab, that it may be turned, lifted and lowered. The tongs for grapping the ingots are fixed to the lower end of this pillar and their movements are controlled by the driver.

The tongs are lowered onto the ingot moulds placed on small trucks, grip them by the lateral loops and slightly raise them. A ram situated between the tongs then descends and forces the ingot out of the mould. Thereupon the empty mould is lifted by the tongs and deposited at any suitable place. The same tongs now grip the ingot and convey it to the heating furnace, whence it is taken to the rolling mill.

Bracket and Wall Cranes. The travelling bracket crane is another type used for workshop transport. This crane is chiefly employed to assist machine tools placed side by side along one side of a workshop. The jib with the lifting gear, which latter may be either stationary or movable, therefore, only covers a part of the breadth of the shop, its runway consisting of two superposed rails. The jib may also be made either stationary or movable. In the latter case it may be slewed round and thus clears the way for the transport of goods, which are being handled by a travelling crane passing over it. In large shops, several such cranes may be found on each side of the shops, which assist their groups of machine tools independently of each other.

It is also possible to enter the adjoining shops with a bracket crane, if suitable curved runways are provided; this facilitates the cross transport of the goods.

When only a limited area has to be dealt with, so that the travelling movement of the crane may be dispensed with,

Fig. 18. Travelling bracket crane

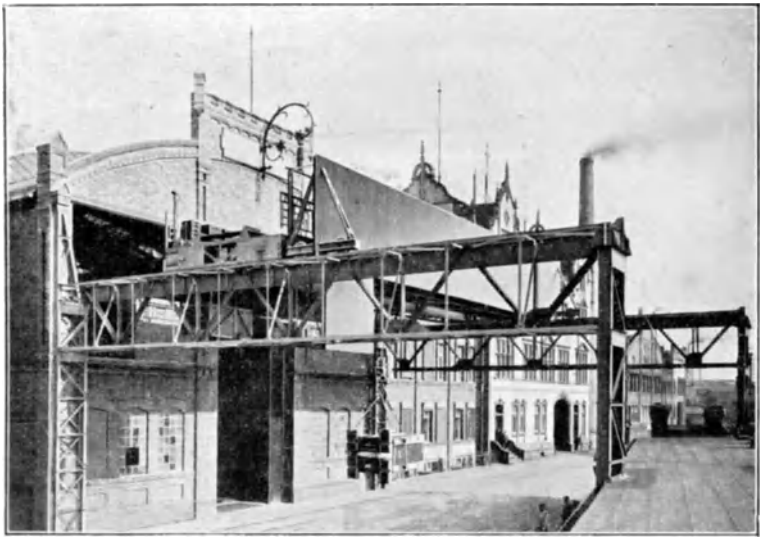


Fig. 19. Travelling crane on extended runway

a stationary bracket or wall crane is employed, the smaller tvpes of which are operated by hand, the larger ones electrically. The crane can be made to slew, and thus covers an area, which suffices for many purposes.

Travelling cranes are chiefly used for *factory yards*. The runway is mounted on pillars, so that the rails which are so often a hindrance to traffic, may be dispensed with and more ground area is available for storage purpose. Special advantages may be obtained for the transport of goods from the yard to the shops and vice versa, by extending the runway of the shops out into the yard, so that the crane may travel through a corresponding opening in the wall to and from the yard, as shown in Fig. 19.

This arrangement is very advantageous for ship yards and steel construction works, because the materials are frequently stored in the yards.

The claw crane. When long cumbersome pieces have to be handled, which must be gripped at several points, the

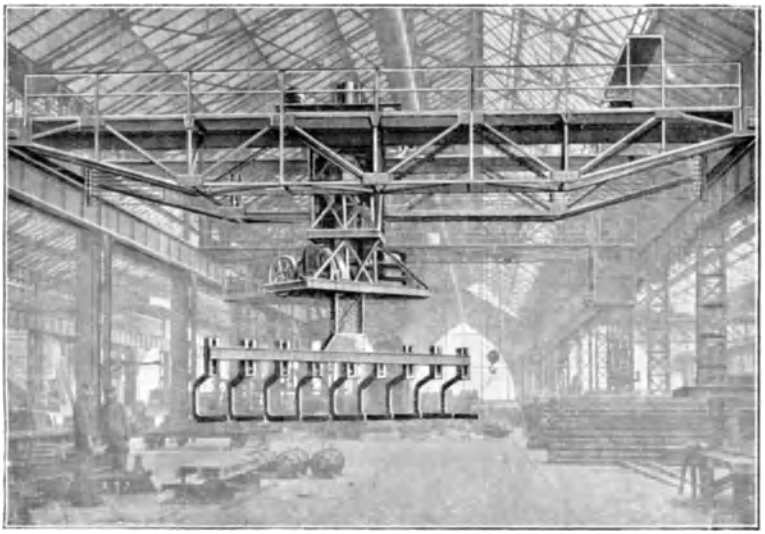


Fig. 20. Claw crane

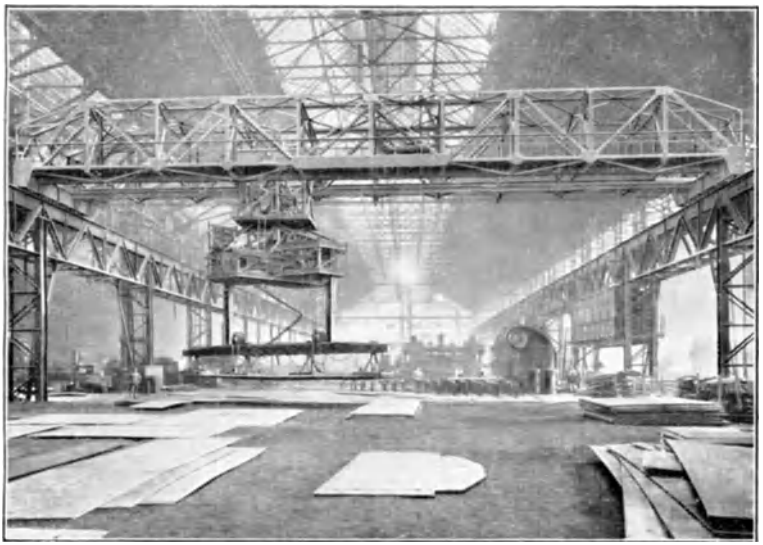


Fig. 21. Claw crane with magnets for hoisting metal sheets

hook is replaced by a hoisting bridle guided in a rigid frame and provided with a number of hooks. Cranes for high capacities have hoisting bridles with a number of rotary claws instead of the hooks. These claws are operated from the driver's stand. The crane lifts bunches of the material stored in layers by means of these claws and on tilting the latter, the material is deposited at its destination. This method of transport is very suitable for long rails, iron bars, thin iron rods etc.

These claws are substituted by magnets when large metal plates sheets have to be handled, Fig. 21.

III. Cranes for Depots and Harbours to deal with Goods in Bulk.

Coal, coke, ores, sand, and gravel, and even timber are goods which can be stored in the open. Most of these can be handled with the tipping buckets or better still with graphs as illustrated in Fig. 22.

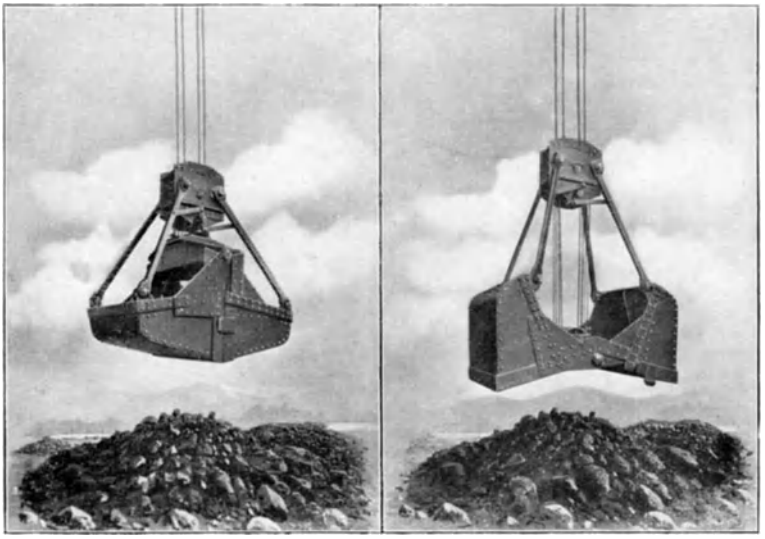


Fig. 22. Grab-crane, closed and opened

Fig. 23. Grab for transporting lumber

The grab. The design of a grab is common knowledge, therefore the following description is restricted to a few remarks on certain modifications. According to the material to be handled, the grab is designed light or heavy. A certain weight is necessary and facilitates the grabbing operation. The chief parts, viz.: the head, the lower beam, the scoops and the draw bars are made of best steel. The grab is suspended either by steel wire ropes of the best crucible steel, or by chains. The hoisting winch on the crane can be so arranged, that when the ropes are tightened, the grab is closed first and then raised with its contents. Two discharge ropes are fixed to the head, and permit of the discharge of the grab at any required height, or to lower the open grab on to the material. The grabs are manufactured for a capacity up to 10 cubic metres (13·08 cubic yards).

A modification of the above mentioned grab is employed for the transport of lumber and is illustrated in Fig. 23.

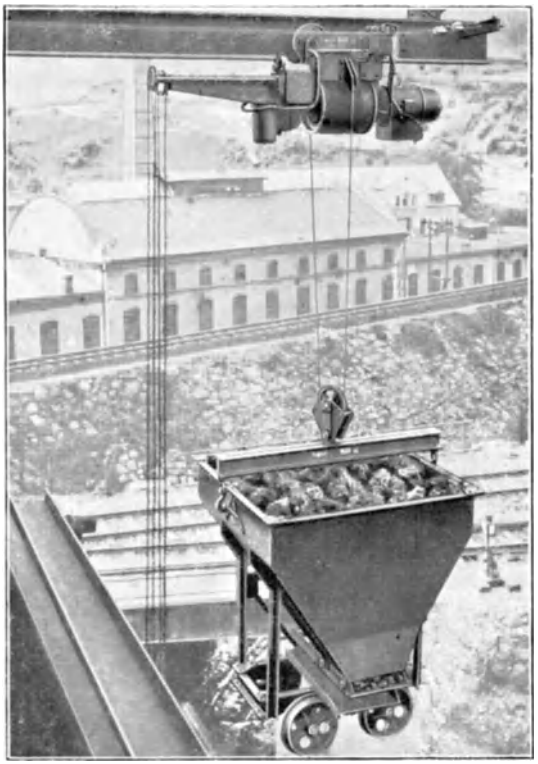


Fig. 24. Electric block transporting coal trucks

The scoops are substituted by 2 pairs of grab tongs, which grip the lumber without damaging it.

All kinds of cranes and the electric blocks in connection with the tipping buckets and grabs may be employed for the *transport of goods in bulk*, see Fig. 24. The steam crane, however, ranks foremost and its advantages having been described above. A disadvantage of the crane is the limited area, which it covers. A large storage area must, therefore, be provided with a number of crane tracks, which naturally diminish the available ground area and in a still higher degree the cubic contents of the stapled materials. Doubtless the loading bridge is the best solution for large storage grounds

in order to turn the valuable ground surface to the best account, Fig. 25 illustrates such a loading bridge, a lattice work structural work of steel, which spans the entire breadth of the depot. The upper part of the structure carries the runway of a travelling slewing crane. The bridge is carried by two supports, the position of which is determined by the arrangement of the rails for the travelling motor, The bridge is generally extended beyond the supports, so that it also covers the railway siding or a quay adjoining the depot. The bridge travelling gear is driven by a motor situated in the middle of it, which actuates the wheels of the supports by means of shafts and toothed wheel gears. In special cases each support may be driven by a separate motor. When the crane has to travel round a curved track, a special gear is employed, which enables the supports to travel at different speeds in the curves.

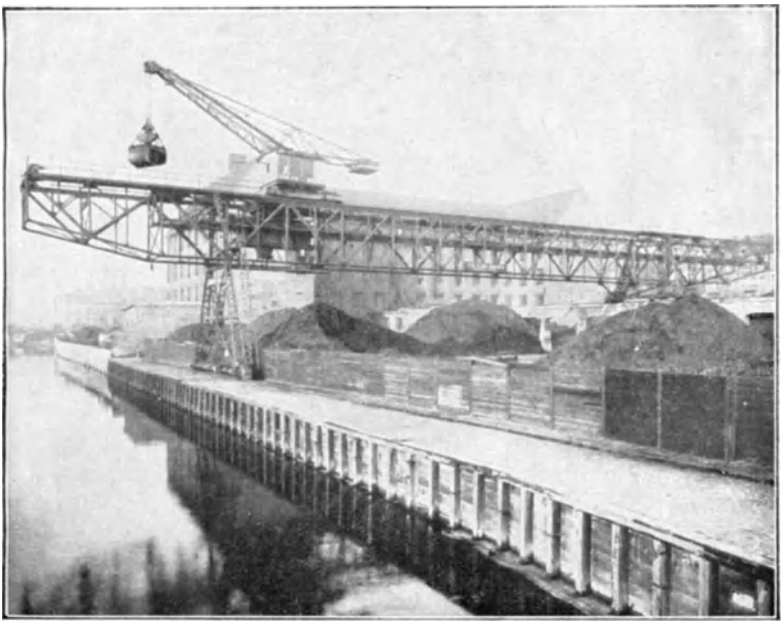


Fig. 25. Loading bridge with travelling slewing crane

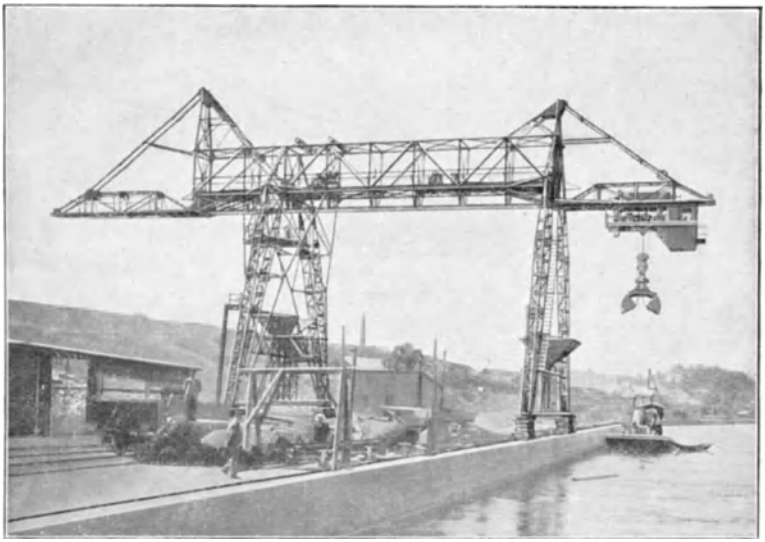


Fig. 26. Loading bridge with crab and bunkers

The bridge is frequently provided with a second crab, which either runs in the lower flange of the girders, or, as shown in the illustration, on an independent gantry. This second crab works independently of the slewing crane and distributes the material or performs other functions of which mention is made further on.

When railway trucks have to be loaded, it is advisable not to discharge the grabs direct into the trucks, but into bunkers, from which the material is conveyed to the troughs, see Fig. 26. Very frequently a weighing machine is connected with this arrangement, which automatically weighs and records the discharged material.

Special harbour cranes. When the material stored by the loading bridge is not conveyed by railway trucks, but has to be discharged from ships, or ships have to be loaded from the depot, a reliable conveyor plant is of great importance.

There is hardly another service where the rapid handling plays such an important part, as in harbour service when loading

and unloading ships. On the one hand the time during which the ships lie idle must be reduced to a minium in order to save the high harbour due and to get the vessels under way again as soon as possible, on the other hand the crane plant must be utilised to its utmost capacity with regard to the quantity of goods to be handled.

Here again the *loading bridge* ranks foremost. A characteristic feature of such cranes is, that the extending jib facing the water, can usually be drawn in or turned upwards, so as to clear the ships. The jib, is therefore, hinged to the bridge and suspended from the elevated support facing the water by means of strong tension bars or struts. A special winding gear is provided to raise the jib extension by means of blocks and wire ropes. Fig. 27 illustrates such a bridge with the raised jib, whilst the crab has travelled back to the stationary part of the bridge.

In the loading bridge illustrated, the crab runs on the lower flange of the bridge girders, an arrangement, which

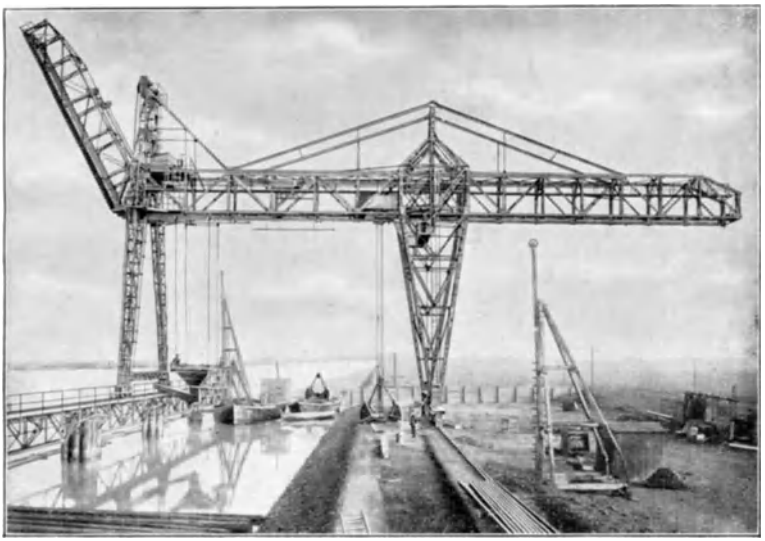


Fig. 27. Loading bridge with gear for raising the jib extension

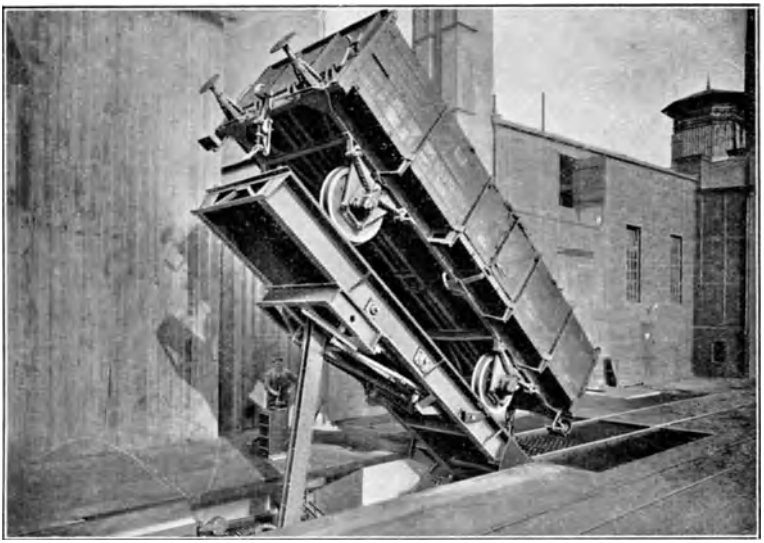


Fig. 28. Stationary tipping plants

gives the crane driver a very good outlook. The crab must be able to travel clear of the supports, therefore, the latter are arched and thus also enable the low-hanging load to pass without hindrance.

The loading bridge with its simple crab travelling underneath, covers only a comparatively narrow strip whilst the bridge stands still. To increase the radius, without moving the bridge, the latter is equipped with a *slewing jib*, see Fig. 12. This latter is the counterpart of a slewing jib crane of common design, the jib being suspended underneath the bogie truck so that it can rotate. A crab of this kind naturally covers a much greater area; it can serve a larger hatch of the ship and a broader strip of the depot without having to move the bridge or raise the jib.

The truck tipping crab. The most efficient combination designed within recent years, is doubtless the loading bridge equipped with a tipping crab.

Stationary tipping plants have been in use for many years, for instance to unload railway trucks on depots, Fig. 28. For harbour plants they can be used with advantage only when large numbers of trucks containing the same material have to be discharged regularly into ships, i. e. in transit harbours for fuel and ores. They can only discharge at one fixed spot, and, therefore, the vessel has to be warped under the tipper whilst being loaded. This trouble is avoided with a loading bridge equipped with a truck tipping crab. Fig. 29 illustrates the complete arrangement working in a coal deposit.

The crab is provided with a turntable from which a flat platform is suspended by means of ropes; this platform can be lowered down to the rails. The railway wagon is drawn on to the platform over rail guides serving as a ramp by means of a capstan and held fast by a locking mechanism. The platform is then raised and turned if necessary, so that the wagon hangs parallel to the axis of the bridge. In this position the

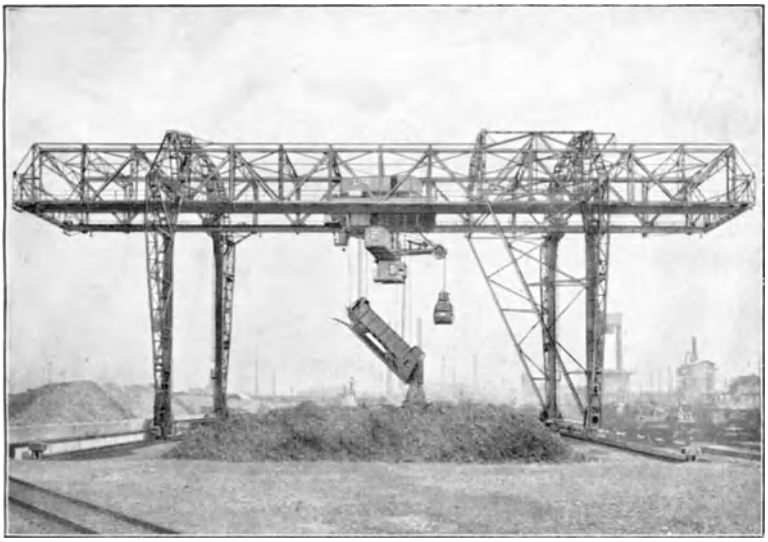


Fig. 29. Truck tipping crab emptying coal trucks

crab transports the wagon to the ship and discharges the former by tipping the platform. Finally the truck is placed on an empty siding.

This crane combination can also discharge into the depot, for instance, when there is a hitch in loading the ship.

Another very important advantage of the truck tipping crab as compared with the fixed tipper of ordinary design is, that discharging can be effected independently at the lowest position of the crab to the water level or the loading depth of the ship, thereby reducing the height of drop of the material. Consequently the material is less shattered and its value, therefore, enhanced; the wear of the bunkers and the walls of the ships is also greatly reduced.

The *electric gantry crane with slewing jib* is doubtless the most well-known and widely used of all quay and harbour cranes. It is superior to the steam crane, of the truck type in as much as it does not hinder the traffic alongside the quay, because it is mounted on a gantry. Therefore, one or more railway tracks or a road may pass underneath the crane. The gantry is mostly designed to travel, and runs on two rails the one fixed along the quay, whilst the second rail lies either in the road, or on a raised track, which is fixed to the supports of the sheds.

Such a crane is shown in Fig. 30; the gantry consists of a massive steel plate, which is stiffened out in all directions by strong bracings. The upper platform is provided with a short transverse track, which is the runway for the slewing crane. The latter can thus travel on the gantry and its radius is, therefore increased.

In many cases the slewing motion alone will suffice, especially when the jib can be made sufficiently long. The crane is then fixed near the edge of the gantry overlooking the water, and is guided and secured by a centre bearing. In both designs, the complete driving gear, motors, and the driver's stand with all control apparatus for every movement

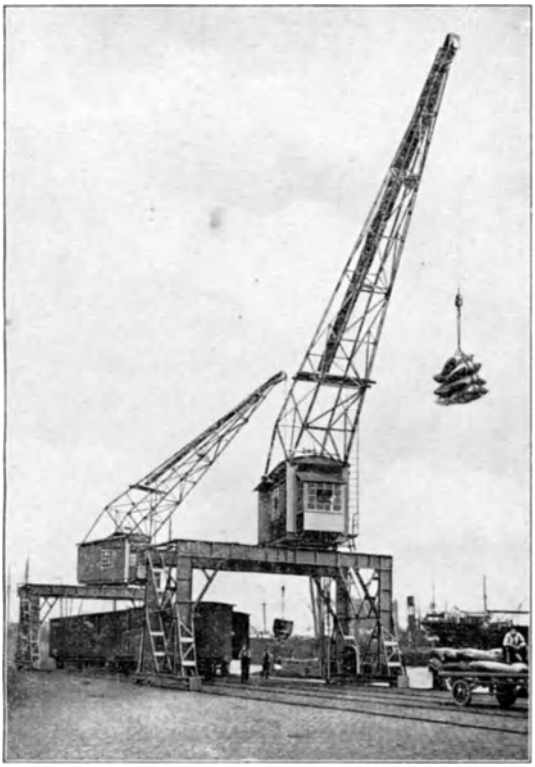


Fig. 30. Gantry crane

of the crane are mounted on the rotary part, and are protected against the influence of the weather by a spacious hut. The jib is fixed over the hut and may be luffed for certain purposes. The end of the jib is provided with pulleys; the illustration shows the jib equipped with a grab. However, the grab may easily be replaced by an ordinary hook when piece goods have to be handled.

The travelling mechanism of the gantry is generally situated on the upper platform, sometimes also on an auxiliary platform, and drives the group of wheels on each side of the crane in the manner described above.

Fig. 31. Semi-gantry crane

The semi-gantry crane. Fig. 31 illustrates a crane of this type: the slewing crane is mounted on a semi-gantry with only one rail on the grain level.

The duplex crane (patented). The above-mentioned slewing cranes of the gantry and semi-gantry type are admirably suited for the transport of piece loads or goods in bulk from the ship to the railway truck. However, the desire to increase their capacity and above all also to bring within reach of the cranes the warehouses lying behind the rail track of the quay, a new combination the so-called duplex crane, shown in Fig. 32, was designed. This construction is provided with one or two slewing cranes of the type described above, and besides with a crab, running in a jib, which may be displaced longitudinally. The jib covers the total breadth of the ship and requires much less room than a slewing jib, owing to its smaller dimensions, and does not interfere with the rigging of the ship. When the

jib is drawn back and the crab has travelled to the rear, it can deposit the load beyond the warehouses, or within the if corresponding openings in the ceilings are provided. The crab can also travel from the jib on to an adjoining fixed runway and thus distribute the goods over a still greater area. With the standard design, the rope is so arranged, that *one single* motor raises the load, draws in the jib and moves the crab.

The duplex crane thus permits arranging a maximum number of hoisting devices on a maximum quay surface operating independnntly of one another.

Fig. 32. Double crane with crab and slewing crane

Fig. 33. Luffing crane with lowered jib

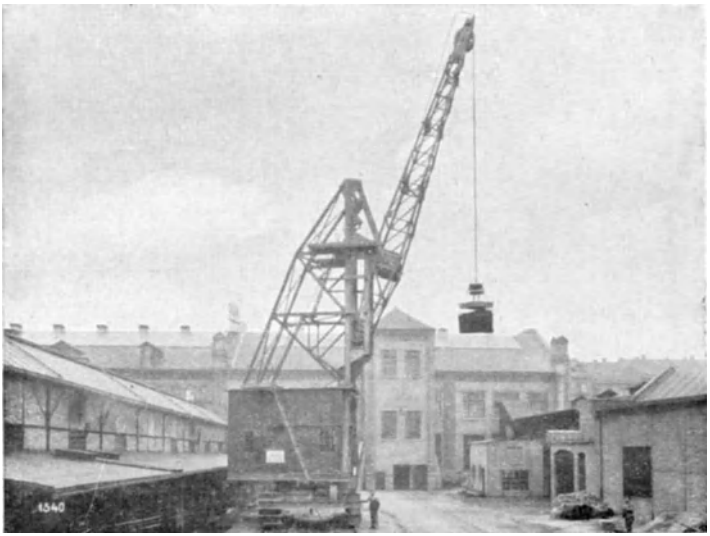


Fig. 34. Luffing crane with raised jib

The luffing crane. Another interesting speciality are the gantry cranes with luffing jibs. The advantage of this design is that whilst the jib is drawn in with great speed, the load moves horizontally.

This type of crane will render good service wherever slewing of a standard crane is hindered by the rigging, masts and chimneys of the boats.

IV. Ship yard cranes.

The steam crane. The steam crane plays a very important role in ship yards, especially in smaller ones, and such devoted to the construction of river steamers, where large crane plants would not pay. When equipped with the jib described above, it can approach the vessel under construction within a very short distance. The steam crane thereby covers a considerable breadth of the vessel, and with raised

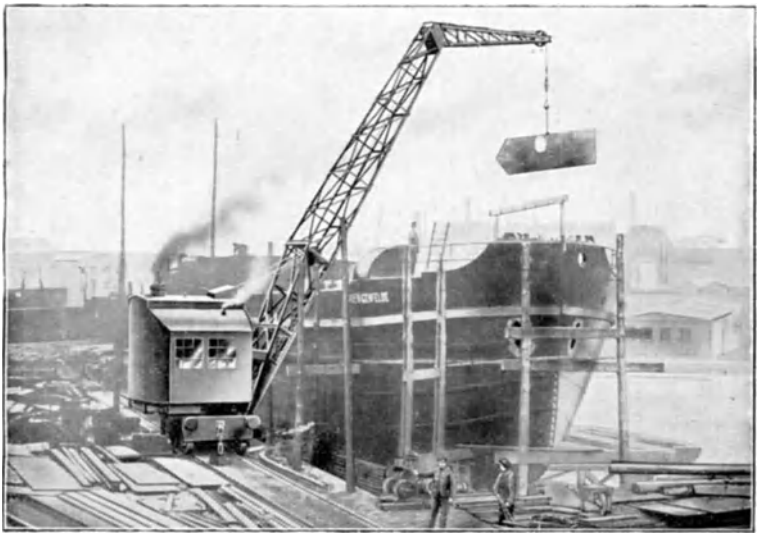


Fig. 35. Steam crane in ship yards

jib may even be used to fix the beams and the plating of larger ships, as shown in Fig. 35.

The travelling turret slewing crane. This type of crane is employed to erect the body of the vessel on the slips and to fit light pieces into vessel, which have already left the slips and are moored alongside a quay. A slim turret structure carries a long horizontal rotary jib, which is generally supported by a bell-shaped construction, possessing advantages in regard of the stability and easy movement of the jib. The lower end of the turret is designed as gantry and, therefore, does not interfere with the traffic on the vessel or quay.

Fig. 36. Travelling turret slewing crane

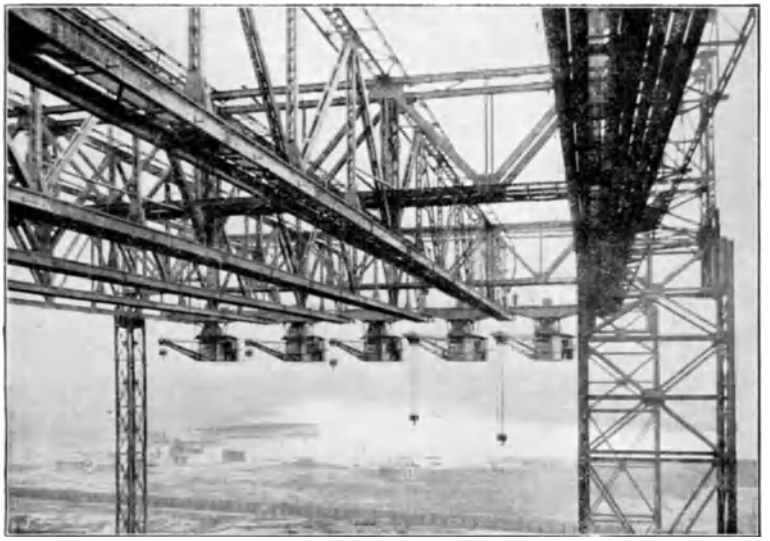


Fig. 37. Five slewing cranes suspended from overhead runways

The turret rests on wheels, which are grouped in pairs and driven in the manner described above. The long arm of the jib forms the runway for the crab, which latter is equipped either with its own hoisting and travelling gear, or is driven by a winch situated on the rear end of the jib. This winch with a special counterweight constitutes the compensation of the tilting movement of the load.

Fig. 36 illustrates such a crane working on the slips. Owing to the height of the jib, the crane can lift the loads clear off the scaffolding, which would otherwise be a hindrance. The driver's cage containing the control apparatus is situated underneath the jib and permits a clear outlook for the driver.

Travelling slewing crane. The steam crane and the turret slewing crane are restricted to running on tracks alongside of the slips. Recently strong steel structures covering 2 or 3 ship building bays have been erected. The runways for several small quick-travelling slewing cranes are suspended from these structures. Fig. 37 illustrates such a plant with

five slewing cranes of 5 tons carrying capacity each working alongside of each other, whereby in certain cases they can lift much greater loads by united efford. The rotary jib of these cranes is fixed in the centre of the crane girder and not only covers its own radius, but also part of the radius of the adjoining crane, and can therefore, take over the load of the latter. Thus the single cranes can cooperate and work alone without hindering each other. They generally take over the materials arriving from the workhops in trucks or auxiliary cranes at the upper end of the slips.

When only one bay of the slips is used, or the work on one part of the slips is to be forced, several slewing cranes can be placed on the same runways. This is achieved by a special crane, running above the structure of the slips on a transverse runway. These cranes can hoist a complete slewing crane off its track and place it on to another desired runway.

Giant cranes. As soon as the construction of a ship has advanced so far that it can be launched, it is towed to the equipping quay, where it is provided with the inner

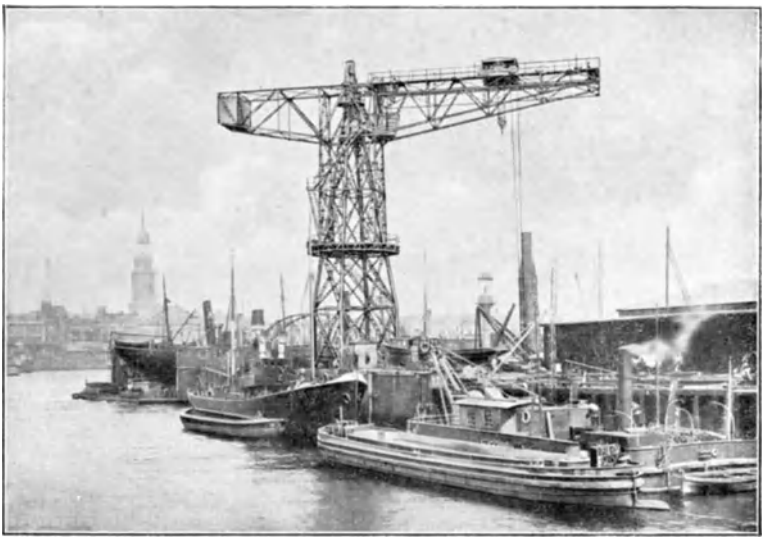


Fig. 38. Hammer head crane with crab

Fig. 39. Hammer head crane with slewing crane, crab and luffable jib

equipment. This latter consist of very heavy parts, such as the boilers, main engine, armour plates, guns and the like for the placement of which, cranes of unusual capacity are required. These cranes are stationary and it is generally not recommendable to equip them for travelling as the runway evolved would necessitate very high expenses for foundation. However, cranes of the F type have already been constructed up to a carrying capacity of 150 tons.

The stationary type of such a giant crane is mostly erected as near as possible to the edge of the water on a strong foundation, on which the fixed column forming the rotary axis is reliably anchored. To keep the road clear for communication, the lower part of this column may be designed as a gantry. Fig. 38 shows such a crane, the hook of which carries 40 tons at a maximum radius of 13·5 metres (44′). An auxiliary hook is provided, which can carry 6 tons at a radius of 22 metres (72′). This crane is generally termed hammer head crane, on account of its characteristic form.

Its jib is rigidly connected to a bell-shaped structure and supported by the center column, whilst the lower end of the bell forms a guide ring and is supported by corresponding guide rollers on the column. The crab runs on the upper girder of the front jib, the rear arm of which is provided with a counter-weight. All movements are performed by single motors.

Fig. 39 illustrates a hammer head crane of similar design for a carrying capacity up to 250 tons.

This crane is likewise stationary and situated on the edge of the quay. It differs from the preceding crane inasmuch as the jib is connected to the bell by means of a joint and may, therefore, be luffed vertically. In this position the outer end of the jib attains a height of 104 meters (340') above water level and can slew the load clear of the highest masts. A slewing crane of 20 tons capacity runs on the upper frame throughout the length of the jib and transports small loads within a radius of 35 metres, (115') it being unnecessary for the hammer head crane to rotate in this case. A standard crab is provided for heavy loads, the runway of which lies inside the jib and reaches nearly to the joint of same. When the jib has to be raised, this crab is fixed at its extreme position by strong bolts, whilst the slewing crane travels back along the fixed arm of the jib. The desired radius of the crane is then attained by a corresponding adjustment of the jib.

The floating crane. This type of crane can be put to the most manifold uses in ship yards and possesses a number of advantages over the ordinary stationary and travelling cranes, which fully justify the higher capital outlay. The crane may be employed for equipping purposes and for building on harbour basins, quay walls, piers and breakwaters, to raise sunken ships and to assist in the construction of large buildings on shore. Then again, where a floating crane is available, it is not necessary for a ship requiring repair of a few days' or hours' duration, to be moored close the pier under a stationary crane. In this case the floating crane, which generally

Fig. 40. Floating crane

has greater freedom of movement than the ship, will approach the latter and can therefore be utilized to the best advantage.

Another possibility is, that several ship yards share the expenses of a floating crane and utilize it to its utmost capacity. A stationary crane seldom can be used to its full capacity on a shipyard and, therefore, the invested capital is not turned to full account.

Fig. 40 and 41 illustrate recent designs, which embody all the advantages and improvements which the ever-increasing demands have developed. Fig. 40 represents a floating crane of 5 tons capacity; maximum radius 14 metres (46′) height of pulley above water level 19 metres (62′). All movements

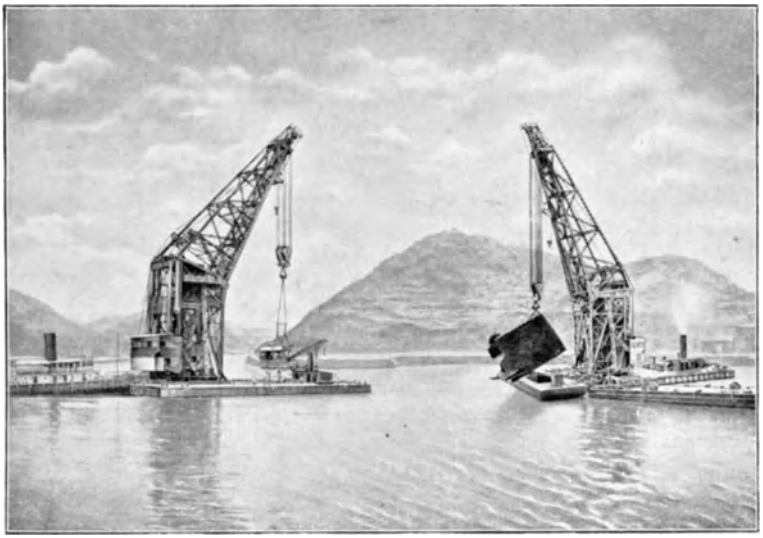


Fig. 41. Giant floating crane employed in the Panama Canal

are performed by a steam engine. The supporting structure is turretshaped and mounted on a circular rail track on a steel pontoon. It carries at its top the luffable jib which may be raised or lowered by means of strong spindles. The weight of the jib with the suspended load is partially balanced by a corresponding counter weight. The height of the rotary structure permits the crane to be anchored close to the ship and the jib to clear even high-decked ships.

The two floating cranes illustrated in Fig. 41, built by order of the United States Government for the upkeep of the Panama canal, have a lifting capacity of 250 tons each. With these crane, the jib is also pivoted to a bell-shaped structure so that it can be luffed. This structure is in turn mounted rotary on a structure column. The latter is rigidly connected with the frame of the pontoon, and is now generally so placed towards one end of the pontoon, that the jib can cover three sides of the pontoon at equal radius. Therefore, the crane may be moored either parallel to the

ship or end on. The luffing movement of the jib slews the load in or out much more precisely than it would be possible with a horizontally travelling crab. The rotary movement of the jib permits to deposit the load at any desired spot of the pontoon or the vessel to be dealt with. The lower end of the bell shaped structure forms a strong ring supported by a number of steel rollers fixed at the foot of the stationary column.. This device lies high enough over the deck of the pontoon not to hinder the traffic on board. The prime mover is mostly a steam engine which also propels the pontoon by means of a screw or two if local conditons are not more in favour of towing the crane by a tug or capstan. The steam engine also drives the hoisting gear and hauls in the jib, when the latter is not rotary. With rotary jibs electrical drive is preferable, owing to the better control of the different mechanisms. For such cases a dynamo is coupled with the steam engine, or the floating crane is connected by means of a cable to a source of electricity on land or on the ship under repair. Two hooks, each for half of the full load are suspended, from the jib and may be connected by a cross-beam, to lift heavy goods. To raise light loads at corresponding higher speeds, auxiliary hoisting gear with separate hooks is mostly supplied. Sometimes the jib is also equipped with a crab, which travels on a girder fixed under the jib.

Design.

I. Equipment.

The following description gives a short survey of the qualities of a modern well-designed crane plant and of the provisions for the personal safety of the attendants.

The carrying capacity of the hoisting tackle or crane is always marked in conspicuous figures, so that mistakes are avoided.

The accessibility of all movable parts for inspection and lubrication is facilitated by corresponding platforms, pathways and ladders protected by railings, so that all parts to be inspected can be reached by the attendants without risk. Due consideration is also given to the possibility of dismounting single machine parts and exchanging them. The platforms are also mostly provided with a raised edge to prevent tools and other objects falling to the ground.

Safety measures. The end position of travelling crabs and cranes are protected by buffers, in very heavy designs by *spring buffers*, which prevent overrunning the end positions and deaden the shocks. The same holds for the hoisting gear of the winches. By providing for wooden brakes or *electrical end switches* the hoisting movement can be interrupted automatically in the highest position. This prevents the load being raised too high or damage to the hoisting gear due to inattention of the driver.

All driving gearings are protected with *cases* against accidental contact; all brake and counter weights and other easily detachable parts are so secured that they cannot fall to the ground even when they become loose.

To prevent the crane or crab from falling when the wheels should happen to break or the crane runs off the rails, strong *supports* are provided near the wheels, so that the frame of the crab or crane almost immediately settles on the rails.

Large loading bridges are furnished with *rail grips* to prevent them from being blown away by a gale. A few manipulations suffice to firmly fasten the crane. Great care is taken with the design of the *brakes*, which, according to their employment, are constructed as band or block brakes, operated either electrically, or by hand or foot. The electromagnetic brake is so designed, that when the current is cut off, the brake is automatically applied. This type of brake is not supplied with hand driven cranes or generally not with cranes driven by self-locking worm gears.

The ropes and chains are so dimensioned, that they have a sufficient margin of safety against rupture. All drums and pulleys have ample diameters and thus minimize the wear of the ropes or chains. Where within the reach of the crane open fires are used (smithies, foundries, etc.) special protection devices are provided for ropes, chains, blocks, etc. Where shocks occur, for instance in cranes for smithies where they are invitable, the hoisting gear is protected by flexible suspension of the hook or upper pulley block.

The driver's stand. The operator's stand is always so arranged that the driver can reach and leave it quickly without risk, that he has a clear outlook over the total area covered by the crane and that the driver and all the gear and control apparatus are protected against the influence of the weather and in cases of fire against radiation, smoke and gases. In the latter cases, the driver's stand is frequently lined with uninflamable material.

When the driver's stand is movable, for instance with travelling crabs, arrangements are made, that the driver can leave his stand in any position of the crab.

The electrical equipment. The standards of the Association of German Electrical Engineers are binding for all electrically driven cranes. Besides these, the many years experience gained by the different firms with the design of

special crane types is turned to the best account. The stretching devices for the contact wires are always so arranged, that when the current is cut off, repairs can be made without risk. For the same reason all metal parts of the crane and driver's stand and especially the rails of the runways are earthed. In cranes provided with several motors, the connections are so made, that the main current and each circuit can be cut off separately.

All control apparatus are so designed, that the momentary position of all levers is clearly visible and the zero position is distinctly felt.

II. The material.

The good performance af all parts depends on the correct choice of the material. The German crane industry nowadays disposes of all materials required for the construction of cranes, due to the highly developed German steel industry, and the many years' experience of the individual firms as regards the most suitable material to be used in each case.

Of the multitude of materials employed, only the most important shall be mentioned.

Soft cast iron is used for all bearings, bearing covers, rosettes, oil and gear cases, motor supports, rope drums, engine frames, small steam cylinders, rope pulleys, bearing bushes.

Medium hard cast-iron is chiefly employed for the wheels.

Hard cast iron is used for the capstan bushes and certain castings for which a very hard surface is indispensable.

Malleable cast-iron is employed for small parts, especially when manufactured in series, for which cast-iron or cast steel is not suitable; for Stauffer lubricators, conical washers etc.

Soft steel, which is very flexible and can be welded, is especially used for the chains and such parts which have to be welded.

Thomas steel of standard strength and expansion is chiefly used for the crane structures, girders and bridges in the shape of sheets and plates, bars and profile irons.

A steel (quality I) of the same strength, but higher expansion is employed for the driving gears, which are not subjected to great stresses, for instance for the fixed axles drums and rope pulleys, pins, small beams, control levers, small spindles and all hooks.

A steel (quality II) of much greater strength but less expansion is used for all shafts and axles subjected to greater stresses, for instance such exposed to combined torsional and bending stresses.

Large and important forged pieces and most worms are also made of this material.

A steel (quality III) of very high mechanical strength, the manufacture of which entails heavy expenses is employed exclusively for parts subjected to very heavy stresses, for instance pinions and similar parts, which frequently have to withstand heavy shocks.

Crucible steel is an exellent but expensive material and is employed only where extraordinary stresses have to be dealt with, i. e. balls, ball races, bearing supports, steel wire ropes and springs.

Moulded cast steel is produced in several degrees of hardness and employed for bearings, bearing covers, winch frames, toothed wheels, wheel rims, racks and brake discs and in hard quality for wheels tyres and slide surfaces for large roller bearings and other cast steel parts which require a greater degree of hardness.

Gun metal is likewise manufactured in different degrees of hardness and is employed for bearing liners and bushes.

Phosphor bronze is the most appropriate material for worm gears, friction discs, valve bodies and bearing liners. All parts exposed to salt water are likewise made of this material.

III. The drawing office.

The quality and correct choice of the materials used for the construction of cranes no doubt play an important part, but the activity of the designing engineer is not less important. An excellent theoretical training at the German Technical High Schools combined with several years' practical working in the shops or outdoors enables him to tackle practical problems from a scientific point of view and to find the best solution of a problem with the least expenditure of material and labour.

A well-directed and well-equipped workshop with skilled workmen is indispensable to carry our the ideas and plans of the drawing office. Great progress has been made in this direction within recent yeas. Many firms have enlarged and re-equipped their shops; increased, improved and cheapened their manufactures, so that many of them have real model shops. It is beyond the scope of this book to enter into details, which alone would suffice to fill a book.

Operation and Maintenance of a Crane Plant.

A good crane plant costs money. The capital expenditure for the crane plant may under certain conditions involve a considerable part of the total money investment in a works or harbour plant, or other machine driven plant. It is, therefore, in the interest of the owners to give their special attention to the maintenance of the crane plant. If a crane is properly treated by skilled hands its life and efficiency is almost unlimited. The expense for maintenance and exchange of worn parts are a minimum as compared with the complete overhauling of a neglected and worn out crane plant.

In a neglected crane, the resistance in the gears increases; consequently the current consumption rises and likewise the working expenses. However, the monetary losses, accruing from an important crane being thrown out of action are much more serious. If small repairs had been made in time, the break down of such a crane would not necessitate the summoning of skilled workmen and specialists, or entail the loss of valuable time. Then again, a faulty crane is a constant source of danger for the attendants and the loads to be handled. The following lines deal with those points to which the works manager should direct his special attention during the operation, inspection and maintenance of the crane. The conscientious control of these items is the surest means to enforce the proper handling of the crane even by unskilled workmen.

The following hints are generally in accordance with the crane regulations in force in Germany. They have been compiled in part by the Standards Committee of the German Industry in cooperation with the Crane Association.

I. General Remarks

The entrance to the crane plant is prohibited to everybody but the crane drivers and specially authorized persons, who are cognisant of the existing dangers. This also holds for all repair work. Before stepping on the crane track, the crane driver in question must be informed in an unequivokal manner. All stairs must be provided with boards warning unauthorized persons not to step on the crane. The maneuvring of cranes may be entrusted only to reliable persons, who are acquainted with the dangers of the service; for electrically driven cranes a knowledge of electrical engineering is indispensable. For large plants comprising several cranes it is advisable to keep a very reliable person preferably a skilled lock smith, to supervise all cranes and to make him responsible for all work in connection herewith.

Each driver's stand must be provided with a complete list of driver's regulations.

Access to cranes is only permitted over the existing stairs. Stepping over from one crane to the other is forbidden.

When leaving the crane, the crane driver must hand over the crane to his succesor, to whom he is compelled to report any irregularities.

In case of a break down, and when repairs have to be made on the electrical equipment, the main switch of the crane plant must always be switched off. Before switching on or off the main switch, or when the fuses have blown, or the current supply is interrupted, all control apparatus must be switched into the zero position. It must be borne in mind that the contact wires for the travelling motions of the crab are alive even when the main switch of a crane in the driver's cage has been switched off. Therefore, the switch behind the main current collector must also be cut out.

The driver must always have in stock in his cage a number of fuses, spare springs and carbon brushes. All tools required in the crane must be deposited in the boxes provided

for the purpose; they should not be left lying on the crane. When using the tools, care must be taken not to let them drop down.

Only a small amount of combustible matter (cotton waste oil) may be kept on the crane and must be stored in the fire-proof boxes provided for the purpose. Benzene for cleaning purposes is strictly forbidden on the crane. The crane driver is responsible, that the inscription showing the lifting capacity of the crane is clearly vissible. On no account the maximum capacity may be surpassed. In dubious cases, the crane driver must insist on a control of the weight of the load.

Only the heating devices provided on the crane for this purpose shall be used. It is strictly forbidden to use the electrical equipment for heating purposes. Reading or occupations diverting the attention of the crane driver are forbidden in the cage or on the crane track.

The crane driver is responsible for the maintenance of the crane in accordance with his regulations. All parts subject to wear must be regulary examined and if undue wear is observed, this must immediately be reported. The driver is especially held to report damage of the ropes slipping off the drums into the gears, or knotting and looping of the ropes. The driver is likewise responsible for the sufficient and careful lubrication of all driving gears, ropes and wheels.

All safety devices and brakes must be tested daily by the driver (in the case of cranes not frequently used) each time before using the crane to see that they operate correctly. The renewal of brake shoes or bands must be reported by the driver betime. Should a brake fail, the crane service must be stopped immediately. Automatic switches may on no account be hindered in their performance by tying or clamping their parts together.

The cranes must be inspected at the end of each week, detailed rules for this inspection are given further on. The results of the inspection must be entered in a book so that the condition of the crane at any period can be ascertained.

The handling of the crane. Before using the crane, the driver must convince himself, that the track is clear, no obstacles obstruct the gears or conductors, and that rail grips or other fixing devices (if provided) are released. Then he must see that all controllers are set to the off position and finally cut in the main switch and the automatic excess current switches, if such are provided.

When switching on the controllers, this must be done by jerks from contact to contact. Too rapid switching on is not permissible and must be avoided. On the other hand, resting too long on the first steps of the controller is also not permissible. Switching off should be performed rapidly in one uninterrupted action. When the crane is equipped with brake connections for the lowering operation, the controllers must be switched off step by step.

A very important matter for the crane driver is to ascertain the *inertia* of the single movements, i. e. to ascertain the space the hook travels *after the motor has been switched off* when raising or lowering it; with or without load, owing tho the inertia of the rotating masses. From this observation, the driver soon learns to cut off the current at the appropriate moment, so that the load stops precisely at the desired height.

When cutting out the controller, care must be taken not to pass beyond the zero position, as otherwise the motors and controllers suffer. This rule must be especially observed with direct current supply.

In cranes provided with a hand or foot operated brake, care must be taken not to operate the brake before the controller is set to zero, so that the motor does not have to work against the closed brake. Likewise the *sudden* application of the brake should be avoided as far as possible, otherwise all parts of the crane suffer.

Special care must be taken, that the lower pulley block is not raised too high, and that the crab and crane are not run with a shock against the stop-blocks of the track. If the driver does not pay attention to this, breakage of the

driving gear and damage to the crane structure results. The presence of automatic switches does not ensure absolute safety, because the performace may fail. And besides, these switches are not provided to terminate the normal movement, but only to limit it, when in spite of the care of the driver, a movement cannot be interrupted in time owing to the defect of some mechanism, such as a brake or controller. The driver should, therefore, not depend solely on these switches, but stop all movements in good time.

Before stopping the crane, all control apparatus must be set to zero. All mechanical brakes must be applied and the main switch must be cut out. When longer stoppage of the crane is concerned, especially in the case of loading bridges, the rail grips or other fixing devices should be applied, so that the crane cannot be moved by the wind or otherwise.

Cranes may only be used to convey loads; it is forbidden to shunt wagonns with a crane except when especially built for this purpose.

Generally one or more assistants are required besides the driver for the operation of a crane. It will, therefore, not be amiss to make a few remarks concerning the regulations governing their work.

The rope men. All ropes and chains must be chosen sufficiently strong for the loads to be handled. The rope man must convince himself of the good condrition of all hooks, shackles, wedges, ropes and chains he intends using, and should reject all defective ones with a corresponding report to the works manager.

The rope man may not select the ropes and chains by simply guessing the weight of the piece to be carried, but should apply to his foreman if he is in doubt as to the weight. It is recommendable to mark the weight on the piece either with chalk or oil colour. The tables hung up in the shops should be studied to ascertain the carrying capacity of the ropes and chains.

It is not advisable to spread the sling ropes or chains too far apart, because the resulting stresses by the inclined pull greatly exceed the weight of the load. Longer sling ropes should be used if necessary.

All sling ropes must be protected against dampness and should be hung up in the rope box along or on special hooks. It is also advisable to slightly heat the chains when they have not been used for some time, in order to expell the hardness resulting from frequent bending of the chains. Only the hooks supplied with the chains and marked with the carrying capacity may be employed. Shaped hooks are only admissible for small loads. Double ramshorns for heavy loads should be loaded on both sides, so that they do not hang askew.

The load must be slung on to the hook vertically under the crab in such a manner, that it is well balanced and the sling ropes or chains do not shift or edge out of the hook. The load may not be attached to the points of the hooks. Loose parts of the load must be removed, or so fixed, that they cannot fall down. When superposing several pieces, so that material does not lie on material, pieces of wood must be placed on sharp edges or corners to protect the ropes and chains. When chains are used, care must be taken, that the links lie correctly on the edges of the load.

It is strictly forbidden to balance the load by boarding it, or by the rope man hanging on to the ropes.

After fixing the load to the crane hook, the rope man preceeds the crane to the spot where the load is to be deposited. He stops there in a position, in which he can be easily seen by the crane driver so that undue hanging of the load is avoided.

When long unwiedly pieces are to be transported, guide ropes must be used, to avoid the pieces losing their balance or tipping. In this case the rope man takes the guide rope at the rear end of the piece and walks along side of it, whilst the foreman takes over the duties of the rope man and gives the driver the necessary instructions.

All ropes may be removed only after the load has been safely deposited.

The crane driver. The crane driver is only entitled to perform those movements of the crane for which the rope man has given him instructions. When the cranes are required to transport a heavy load, an engineer should be present to give the necessary instructions and to take over the responsibility for the transport.

Whilst travelling, the crane driver must keep an eye on the load. If he has received notice that persons are on the crane track, he must operate very carefully and give the prescribed alarm signals before starting the travelling movement.

The crane driver should avoid travelling with the load over the heads of persons. Unnecessary loitering about underneath the raised load, especially in the case of magnetically lifted loads, should be forbidden.

The crane hook should only be lowered so far, that at least 1 1/2 turns of the rope remain on the drum. Whilst transporting the load, the latter should not be raised higher than necessary. It should be avoided to raise the load slantingly. This is permissible only in exceptional cases, in the presence and with the permission of a responsible works engineer. This regulation does not apply to cranes specially designed for such purposes. It is strictly forbidden to haul off tightly jammed loads with the crane. The cranes specially designed for the purpose and used in steel works and rolling mills are excepted from this rule.

The crane driver is not allowed to leave the cage as long as the load is slung to the crane hook, and he must see, that the empty hook is raised.

II. Special regulations for electric crane maintenance.

This comprises the following current work: Adjustment of the Stauffer lubricators, filling of the oil-ring bearings, tightening all screws, cleaning all lubricators and driving gears, control of the electrical apparatus.

Lubrication. All lubricators of high-speed shafts should be inspected daily, those of low speed shafts at least once a week, and be filled with fresh lubricants if necessary. All Stauffer lubricators must be adjusted daily before each performance of the crane, and the driver should convince himself that the grease is forced well through.

A sure sign that lubrication is efficient is that all bearings and bearing surfaces remain cool.

Friction coupling must be lubricated with good thick cylinder oil. The coupling should be able to be inserted with minute exertion. When new coupling parts are provided, the insertion of the coupling is somewhat difficult until the cone has worn away uniformly.

Levers, which do not move much, and which are not provided with special lubricators, should be lubricated with oil at intervals. Those bearings, which have wick lubricators, should be examined to see that the wick is long enough to suck the oil out of the lubricator.

Once a year all lubricators must be thoroughly cleaned. All oil and grease must be removed from the bearings and the latter should be rinsed with petroleum simultaneously turning the shafts and pins. The Stauffer lubricators and oil containers must then be refilled, new wicks must be provided and the grease must be forced through on to the bearing surfaces.

Brakes. The brake bands and blocks must firmly grip the brake disc under pressure of the counter-weight when the brake is applied, and care must be taken, that the weight lever hangs free in its lowest position. All movable parts of the brake gear must be well lubricated. The brake band must be adjusted by means of the screws in such a manner, that when the brake is not applied, the distance between the band and disc is uniformly 1·5 millimetres. The pressure screws must be secured by the counter nuts provided for that purpose. To ensure smooth and uniform lowering of the load by means of the brake, it is well to moisten the total periphery of the brake disc with oil diluted with petroleum.

Excessive lubrication of the brake disc would cause the load to skid, whilst the disc is too dry, the lowering of the load would be jerky. Wooden brake blocks and the lining of brake bands should be carefully examined to ascertain their state of wear and to renew them betimes.

Ropes. Ropes must be non galvanised and lubricated with non-acid grease. They must always be kept stretched, so that they cannot kink, or jump out of the pulleys or into gears. All ropes must be permanently controlled, so that the may be renewed when worn to far. When single wires of a rope tear, the protruding ends should be cut off with sharp nippers. New ropes should be uncoiled on the floor, to eliminate the twist. They should then be fixed in position and subjected to the maximum load for some time. On depositng the load, the rope should be loosened, so that the newly-formed twist can disappear.

Hoisting Chains. The chains and chain wheels must be kept very clean and should be frequently overhauled with brushes and oil. Good oil should also be used to lubricate the holes provided for this purpose.

All whistling or grating sounds in the joints when the chains run over the chain wheels, are a sure sign of deficient lubrication which must be remedied at once. New chains should be carefully rid of sand and dirt before being fixed in position.

Inspection.

All cranes should be inspected at the week's end after knocking off work, if possible in the presence of a responsible employee of the works, who must personally convince himself of the condition of the cranes and make a corresponding entry in the inspection book. In case of serious damage, he must decide on the steps to be taken.

Besides the different items enumerated under the heading maintenance, inspection comprises the following points.

The structure. The steel structure must be inspected to see if any rivets are loose, which must be removed and

temporarily substituted by well-fitting screws. Defective parts of the coating of paint must be renewed, otherwise such parts give rise to rusting.

This inspection should be repeated quarterly. All connections of the horizontal and diagonal struts must be carefully examined, because loosening sets in first here, due to overtaxing the crane, running on the end buffers, counter-current braking and in general careless, jerky mowements. When rivets have become loose on the main girders, this is generally a sign, that the permissible load has been greatly exceded.

If great wear of the rails for the crab or crane of the wheels is noticeable, this may be due to horizontal depression caused by shocks. This generally leads to deformation of the crab track, which causes jamming of the wheels with consequent increased wear. In such cases it is best to consult an expert.

Defective parts of the coating of paint must be thoroughly rid of dirt, oil and rust, if needs be with steel wire brushes, before they are repainted. The first coating should consist of red lead which should not be applied too thickly. When the coating has thoroughly dried, the coating of oil color can be given.

When rusting is due to the atmospheric moisture or is produced by climatic conditions, this repair should be undertaken frequenly. Some experts advocate the application of a thin layer of pure linseed oil immediately after the metal has been freed from rust and is bright. When this coating has dried, two coatings of red lead should be applied and care must be taken, that no moisture is deposited on the film of paint before it hardens, i. e. this treatment should be performed in dry weather only, or in a sheltered locality.

The electrical plant.

First of all the supply must be cut off by switching out the main switch. The covers of the controllers must be renewed and the fingers must be examined to see that they give good contact. Loose fingers must be adjusted and burnt fingers renewed. Each individual contact segment

must be rubbed with a dry cloth and all parts should be rid of dust. When cotton waste is used for cleaning, care should be taken that particles of the waste do not adhere to the contact fingers. Burnt spots or beads of molten metal must be removed and all surfaces carefully emeried.

Finally all contact surfaces must be slightly greased after they have been cleaned; vaseline is best suited fot this purpose: *The controllers are such an important item of the electrical equipment, that their upkeep is conditional.*

As to the motors, the commutator covers must be removed to see that the carbon brushes are not worn down too far and are pressed against the commutator with the right pressure. Then the commutators must be cleaned and treated in the same manner as the controller segments. At intervals (about every three months) the armatures of the motors must be removed, the dust blown out and all oil adhering to the parts of the motor wiped off. If necessary, the commutators must be ground with fine emery cloth.

Gears. The inspection for the gears comprises all the operations mentioned under the heading maintenance.

Then the wheels, their bushes and faces must be examined; these are subject to rapid wear if not properly attended to. Renewal should not be unduly postponed.

In slewing cranes, the jib of which is drawn in by a spindle, the control of the latter and its lubricators is very important, because damage or undue wear of the spindles or nuts easily leads to fracture.

Likewise all worm gears must be most carefully controlled and the ball thrust bearing of the worm axle readjusted, so that its play is a minimum and no shocks occur when the motor is started.

Extensive Repairs. Should the inspection disclose defects necessitating extensive repairs, the latter must be performed on the following lines: —

Extensive repairs may only be carried out by the person especially authorized to do so. The crane drivers of the adjoining cranes must be informed of such repairs before entering the crane plant.

During the stay on the crane plant and the movements of the crane, the workmen carrying out the repairs must obey the instructions given by the responsible foreman.

The crane to be repaired must, if possible, be moved to a ladder. Otherwise steps must be taken, that the repair men can safely enter and leave the crane.

The gangways and platforms provided on the crane should be used as far as possible. When special emergency scaffolding has to be erected, care should be taken, that this is sufficiently strong and reliable.

When repairs of longer duration are involved, the cranes must be providet with boards marked "Caution- crane repair" or the space underneath the crane must be closed for traffic. If several cranes run on the same track steps must be taken that the crane under repair is not jolted.

Trial runs after the repairs are terminated, may be carried out by the crane driver only.

Spare parts.

An unbiased judgment of the suggestions given in the above lines will certainly lead to the conclusion that even the most conscientious treatment of the crane only may minimize the natural wear of single, highly-exerted parts, but cannot altogether prevent this. To avoid serious damage ensuing by the wear or breakage of such parts, which would lead to a longer standstill of the crane, it is advisable to keep in stock a number of spare parts. These spare parts are best supplied by the manufacturers along with the cranes.

The following is a list of such spare parts:

1 complete set of coupling bolts,
1 complete set of bearing liners and bushings,
the pinions on the rotor shaft,

brake bands and blocks,
a number of wheels with and without toothed rims,
one hoisting rope or chain;
one complete armature (rotor) for each motor,
contact parts for the controllers.

III. Treatment of steam cranes.

The rules given in the preceeding chapters regarding the handling, maintenance and control of electric cranes, also hold for steam cranes, the more so, as their gears and mechanisms consist of the same unit parts as those of electric cranes.

Starting the crane. Before starting the crane, all valves and cocks must be closed to see that they are tight and not stopped up. The boiler must be filled up to the mean water level with pure, soft water, likewise a cistern underneath the platform. They chimney cover closed during the standstill of the crane, must be opened and the boiler slowly heated. All manholes and flanges must be examined to see that they are tight. All lubricators of the engine and all Stauffer lubrications of the winding gear must be filled and adjusted before each operation of the crane.

When the steam in the boiler has reached the working pressure, the main steam valve on the boiler is opened and the engine heated by slightly opening the steam admission valve. The condensed water produced must be blown off through the cocks provided on the cylinders. After the engine has been sufficiently heated, it may be started by means of the admission valve.

After stoppinp the crane. The jib must be slewed in the direction of travel, the pinion for the hoisting gear inserted and likewise the coupling for the travelling gear. The brake for the travelling gear must be applied by means of the foot lever, to prevent accidental travelling of the crane. The main steam valve must be closed, the fire extinguished and the chimney cover closed. In frosty weather, the boiler

and cistern must be emptied, likewise the cylinders, to avoid the water freezing.

Attendance. Only good mineral oil should be used to lubricate the steam cylinders. The stuffing boxes for the piston rod and plying rods must be well tightened; however, care must be taken, that the plying rod does not jam owing to unequal tightening of the screws. Steam does not escape through the stuffing boxes. The wick lubricators should always be full of oil.

The driver must take care, that the water level of the boiler is always higher than the lowest level admitted. It is advisable to feed the boiler at frequent intervals to avoid feeding too much cold water at a time.

All cocks and valves must be carefully reseated if they drip or steam escapes. Packings, which have become defective, must be renewed. The cones of the feed valves must be reground at intervals. When the cones and seats of the stop and check valves have become leaky this must be reported at once, so that the boiler is not discharged during the intervals of rest.

The safety valve must be controlled to see that it really blows off at the indicated maximum steam pressure, and the steam gauge that it indicates the actual steam pressure of the boiler. The drain cocks should be frequently examined to see that they open and close easily. The cleaning of the boiler should not be restrictet to simply rinsing it; the fire box and the water tube should also be thoroughly cleaned and all dirt and scale removed.

When much scale has deposited on the water tube and fire box, the boiler must be shut down and all scale removed; any sediment, which may have deposited at the bottom of the boiler, must be removed by way of the cocks or holes provided for the purpose.

The feed water tank should be refilled during each interval of rest.

Coal, briquettes, lignite and wood may be used to heat the boiler, however, when pure fuel is used, the fire must be attended to oftener, so that the required amount of steam is permanently produced.

The grate should be evenly covered with coal, and the driver must see that the layer of fuel is uniform throughout. Clinkers must be removed regularly, however, the driver must avoid that too much cold air enters the furnace. Large pieces of coal should be broken up before being thrown on the grate.

Jib Indicator. An indicator is placed near the driver, which indicates the different positions of the jib and the admissable load. It is necessary to frequently control the readings of this indicator as to its accuracy. The indicated load should on no account be exceeded.

When grabs are employed the load is understood to be the weight of the grab including its charge.

Some Rules
for Drawing up an Inquiry
for Cranes.

Enquiries for cranes

For new buildings. Before a building is erected, the choice of a crane for a certain purpose, or of the complete crane equipment of the building is a comparatively easy matter. When the manufacturing process, the necessary machine tools with the space they require and the contemplated crane plant have been decided upon, the tables on page 89 contain all the data required to ascertain the section of the building, which should be adhered to, so that the crane has room to move freely in all directions and may be utilized to its full capacity. The tables also contain the maximum values for the crane bridge, which are necessary to dimension the girders of the crane track and their supports.

For existing buildings. In old buildings of limited height, it is not always possible to erect a *standard crane* as a glance at the tables would prove. In such a case it is advisable to leave the design of the crane to the manufacturers, giving them all necessary data pertaining to the local conditions. It is a well-known fact, however, that when these data are given by a layman, they do not contain all items, required to work out a sensible scheme. Frequently apparantly unimportant dimensions and data are missing, which, however, may be decisive for the choice of the type of crane to be adopted. Then either time-robbing and expensive inquiries are necessary or the crane does not turn out to the satisfaction of the buyer. All alterations, which have to be made, are very expensive, and generally only minimize the fault without completely eliminating it.

The following schedule is intended to aid prospective customers in formulating their inquiries. The questions should be answered as explicitly as possible and sketches of dimensions be attached.

1. For which purpose is the crane to be used? A short description of the working conditions will be the best means to form an opinion as to the properties of the crane. Above all the maximum carrying capacity (in tons) and the span (in feet) should be mentioned. The latter is measured fram center to center of the rails.

2. It is of importance to know if the crane has to operate permanently with the maximum load, or only temporarily, as this influences the choice of the material and the electrical equipment. Then the velocities of the crane (in feet per min.) should always be mentioned, viz: for hoisting the load, travelling of the grab and crane. When no special wishes are expressed, the speeds mentioned in the table are taken.

3. The kind of current available, i. e. direct or three phase current, the pressure and frequency of the supply must be stated. These data decide the choice of the motors, control apparatus and magnets. If any special make of the electrical equipment is preferred, this must be especially mentioned in the inquiry.

4. The dimensions marked with a ? in the sketch Fig. II are very important for the design of the crane. These dimensions are: the span; the height of the track above floor level (assuming a perfectly level floor, otherwise from the *highest* point of the floor) measured to the top of the rails to the lowest point of the roof structure; the outline of the walls or columns flanking the rails.

   The highest and lowest position of the crane hook, the minimum distance of the hook from both rails, and in some cases also the distance of the hook from the

walls of the building, if the crane has to serve a machine tool or rail track near these latter, these must be mentioned.

5. If the shop contains platforms, large machine tools, shafting, piping, etc. over which the crane must pass, or raise the loads, or under which it must run, exhaustive data concerning the dimensions should be sent. Frequently these data are overlooked, and then the performance of the crane is handicapped.

6. It is also essential to know if the crane is to be manoeuvred from the ground, and if so, where the control chains may hang down. If, however, the crane is to be provided with a driver's cage, it must be decided whether this cage is to be fixed to the crane girders or to the crab.

   The required position of the cage should be marked in the plan of the sketch.

   The access to the cage should also be considered, it may be advisable to provide a gangway alogside of the crane track so that the driver can reach and leave the cage without risk.

7. It is advantageous to decide at once where the current supply is to be arranged and to fix the position by definite measures marked in the plan. This also localises the crane in the shop beyond all doubt. The position of the driver's cage, the travel of the crab, etc. may be referred to the position of the supply, either on the same side or opposite to the main supply.

8. Finally it should be stated if the crane works in a completely closed shop, or if it also has to work outdoors, so that the cage, crab and travelling gear may be protected against the influence of the weather. Likewise it should be notified if the crane when working outdoors has to contend with a certain velocity of the wind (generally taken at 50 kilos per square meter), as this decides the power of the motors to be used for the travelling gear.

Enquiries for loading plants.

The above date also hold for a loading crane. Exhaustive details should be given concerning the electric supply on the lines mentioned under point 3. It is also important to know if the current can be transmitted *overhead* by means of poles, or if local conditions make it necessary to run the conductors in *underground* concrete channels. This latter is not recommended where the ground water level lies high, or where there is danger of flooding caused by heavy rains or tides.

The following remarks should be especially observed when planning a local plant:

1. If no scheme of the contemplated plant has been worked out a detailed description of the requirements and a schedule of the performance of the plant must be given from which an idea of the functions of the crane may be formed. It is a well known fact, that a layman is inclined to scheme the plant for its maximum capacity, which naturally makes it unduly expensive. The average daily output should be taken as a basis for the calculations, the temporary higher outputs being a secondary consideration.

   In both cases the required output should be stated in *tons per working hour.*

   Other important points influencing the design are to know if the plant is to be employed chiefly to charge or to discharge, or for both purposes; if the goods arriving are simply to be transhiped, or stored, etc. and how they are to be conveyed from the depots. Sometimes it is essential to know from which side the goods arrive and on which side they are conveyed further on.

2. A situation plan of the yard with all buildings and existing railway sidings marked is a valuable adjunct and should contain all important dimensions. As for the railway lines, it should be noted, that a loading plant can frequently be designed more advantageously both as regards its output

and construction if single tracks can be shifted. Therefore it is advisable to mark those tracks in the plan which can be shifted, stating the distances.

A *section* through the area, on which the different objects are shown in elevation, and the heights marked is likewise very valuable, especially so, when the crane bridge has to convey the goods over an existing building. This drawing should also contain the gradients of the area, and details concerning the condition of the ground and its carrying capacity.

Where the loading and unloading of ships is concerned, i. e. where a quay crane has to be provided, a sectional drawing of the quay with dimensions must be given, also data as to what load the quay can stand, because frequently the out board rail of the crane is run on this quay. This drawing should also contain the figures for the highest and lowest water level, because the lift of the crane depends on these figures; likewise the dimensions of the ships (breadth, length, and draught) and their hatches should be mentioned, because the radius of the jib and the dimensions of the conveying devices is influenced by these dimensions. If local conditions, however, call for a jib of a certain length, the radius should be calculated from the edge of the quay, i. e. the distance from the centre of the rope to the outside edge of the quay should be mentioned. —

For stationary loading plants requiring larger foundations, it is essential to know at what depth firm ground is struck and how high it may be taxed (in tons per square meter).

3. *The material to be handled.* Very exhaustive information should be given concerning the nature of the materials to be handled, which should be classified as follows: —

Piece goods; the weight of the heaviest pieces in tons suffices.

Girders and rails: dimensions and lengths should be mentined.

Lumber: diameters and lengths of the stems must be stated.

Grain and cereals: kind of grain and weight of same per cubic meter.

Coal, coke and ores: mention the mean diameter the pieces in centimeters. For ores a remark should also be added stating if the ore is hard or soft, or in what proportion it is mixed.

4. Should a scheme of the contemplated crane plant already exist, and a tender is required, the following should be observed:

A scale drawing of the contemplated plant with all necessary dimensions and information in accordance with point 1 to 3 must be sent in.

A special note should be made of the kind of material and hourly quantity (in tons). If the type of conveyor has been decided on, a drawing of same with dimensions and a statement of its weight must be enclosed with the enquiry.

If for local reassons, a certain speed is desired, this should be stated for the single movements, viz: — hoisting, travelling of crab, travelling of crane and slewing. Otherwise the speeds are determined by the manufacturer in accordanc with the stipulated output.

If the crane is to run an existing elevated crane track, or has to cooperate with, or pass over or under an existing crane, a detailed drawing with dimensions giving all data of the situation should be forwarded.

Even when a complete scheme of the plant is to hand, it is advantageous to study the above remarks very carefully and to add the data necessary for a critical study of the contemplated plant. This will enable the firm called to

draw up an estimate, to put forward an alternative scheme, which may be more favourable as regards expenses or efficiency, because the firm can then quote modern, approved constructions, which are specially suited for the author of the first scheme.

Query sheet for crane plants. A query sheet is attached to facilitate the drawing up of an enquiry for electric travelling cranes and loading plants, when expert advice is not at hand. This query sheet can easily be answered *after reading* the above explanations. It suffices to mention the number and letter of the question in the enquiry, or to enter the dimensions in an enclosed drawing.

If some questions remain unanswered it is assumed, that the crane manufacturer is at liberty to decide as he thinks fit.

Enquiry Form

for Enquiries for Electrical Travelling Cranes, Loading Cranes and Slewing Cranes

(Please refer to the explanations on pages 78—84).

Question	Answer
A) In case a scheme of the contemplated plant has been made:	
What is the purpose and mode of operation of the plant?	Ground plan and cross-section of the contemplated arrangement, giving necessary dimensions and a description of the work to be performed and the output required
Note: Also in cases where a scheme is already drawn up, it is avisable to study the following questions and fill in the answers, as this might lead to improvements or to alternative schemes arrived at by considering the problem from a different point of view.	
B) In case the crane manufacturer is to work out the scheme:	
1. What is the purpose and mode of operation of the plant?	Purpose and work to be performed should be described in detail
2. **Outputs.**	
a) Is the service to be of severe nature?	..... Working hours per day
b) Is a maximum load to be conveyed continuously, or temporarily only? . .	..... tons
c) How great is the average load to be conveyed?	..... tons
d) or what output is required?	..... tons or cu. m per work hour
3. **Operating Power.**	
a) For steam operation:	
What type of fuel?	.....
b) For electric operation:	
Current (direct or three-phase)? .	..... current
Cycles per second?	.....
Voltage?	..... Volts
c) Is the supply line erected:	
Under ground?	.....
Above ground on poles?	..... Include dimensional sketch!
„ „ at the wall?	.....
„ „ on the ceiling? . .	.....

Question	Answer
d) Are motors and control apparatus of a special make required?	.....Name of maker
e) Are existing motors and control apparatus to be used?	.....Name of maker
H.P.?	.....
R.p.m.?	.....
4. Goods to be conveyed.	
a) Piece goods: maximum weight of piece?	.....tons
„ „ dimensions of cases? . .	..... m
b) Rolled iron: section?	.....Include dimensional sketch
„ „ greatest lengths? . . .	.....m
c) Lumber (beams etc.) diameter . . .	.....cm
„ „ greatest length?	.....m
d) Grain: type?	.....
„ weight per cu. m.?	.....t
e) Coals, coke, ores:	
medium size of piece?	.....cbm
hard, in pieces, soft, earth-like? .	.....
Proportion of mixture?	.....
f) Required type of conveying vessel:	
Cage or grab. System?	.....Include dimensional sketch
Contents?	.....tons or cu. m.
Dead weight?	.....tons
5. Workshop. (If already existing use longitudinal section table II.)	
a) Must special consideration be given to:	
temperatures above 35° C?	.....
damp rooms?	.....
dusty rooms?	.....
acid vapours or heavy flue gases? .	.....
b) Is the crane also to travel out of the shop into the open?	.....
c) Are one or several other cranes already running on the same crane track?	.....
d) Is the crane to be controlled:	
from the driver's stand on the crane?	.....
„ „ „ „ „ „ crab?	.....
„ „ hall?	..... Include ground plan

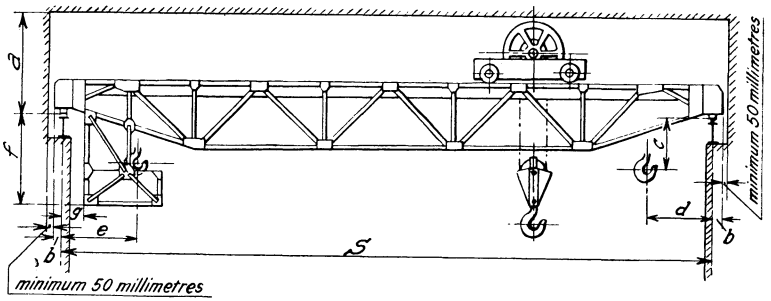
Question	Answer
e) From what place may the control chains suspend?	.....
f) What are the dimensions of the available longitudinal section?	..... Details and dimensions to be entered in table II.
g) Are there obstacles in the path of the travelling crane with suspended load which force the crane to turn aside, or over which the load must be hoisted?	..... Of special importance are the dimensions marked ▭
h) Is a crane track existing?	..... Include sketch of the cross section of crane track with dimensions of individual sections and of crane track, also of greatest span from centre of support columns or pillars?
6. Working Place.	
a) Nature of the place?	..... Ground plan and cross section giving dimensions
Level or inclined?	.....
b) Bearing capacity of ground?	..... kilos per sq.cm
In what depth?	..... m
c) Are there located on the working place:	
other buildings?	..... Include in plan under a) giving dimensions.
streets?	.....
quay-walls?	.....
cranes?	.....
crane tracks?	.....
railway tracks?	.....
d) Is it possible to dislocate existing railway tracks?	.....
e) What is the highest and lowest water level under the edge of the upper quay wall?	.....
f) Dimensions of:	
railway cars?	..... Length, breadth, depth
trucks or vehicles?	.....
ships and their hatchways?	.....
7. Special Data for Slewing Cranes.	
a) Are the slewing cranes to be	
stationary?	.....
or portable?	.....

Question	Answer
b) Distance between centre of loading rope and edge of quay?	.....m } Total radius b + c!
c) Distance from edge of quay to centre of slewing?	.....m }
d) Is jib to be luffed up?	.....
e) Is jib to be luffed horizontally? .	.....
f) At what distance from the edge of the quay is load to be deposited? .	.....m
g) Is it possible for the crane truck to travel near to the ground?	.....
h) Are one or several tracks to be spanned, and is a gantry necessary?	..... Breadth } of the gantry ..... Height }
i) Is the crane to travel on a normal railway track?	..... } Distance from edge of quay and from centre to centre of rail
k) Are special crane tracks available? .	..... }
What is the section of the rails? . .	..... Include sketch of dimensions

Table I.

Standard Electric Travelling Cranes.

Required clear section in new buildings and extreme position of crane hook.



Carrying capacity tons	Span S m	a	b	c	d	e	f	g	Wheel base	Wheel pressure in tons	Breadth of rails
5	10	1600	200	400	850	750	2800	400	2400	6,0	45
	12										
	14								2600	6,5	45
	16										
	18								2800	7,1	45
	20										
	22								3200	7,8	55
	24	1700		300			3600				
	26								3600	8,5	55
	28										
	30								4000	9,0	55
7,5	10	1700	220	400	900	800	2800	400	2600	7,5	45
	12										
	14								2600	8,1	55
	16										
	18								2800	8,8	55
	20										
	22								3200	9,5	55
	24	1800		300			3600				
	26								3600	10,3	55
	28										
	30								4000	11,3	55
10	10	1800	230	400	950	1000	2800	400	2800	9,0	55
	12										
	14								2800	9,7	55
	16										
	18								2800	10,4	55
	20										
	22								3200	11,3	65
	24	1900		300			3600				
	26								3600	12,2	65
	28										
	30								4000	13,4	65
15	10	2100	250	400	1000	1100	2900	500	3200	12,2	55
	12										
	14								3200	13,1	55
	16										
	18								3200	14,0	55
	20										
	22								3200	15,2	65
	24	2200		300			3600				
	26								3600	16,2	65
	28										
	30								4000	17,4	65

Carrying capacity tons	Span S m	a	b	c	d	e	f	g	Wheel base	Wheel pressure in tons	Breadth of rails
20	10	2150	275	500	1050	1100	2900	600	3400	15,3	65
	12										
	14								3400	16,0	65
	16										
	18								3400	17,2	65
	20										
	22								3400	18,5	65
	24										
	26	2250		400			3600		3600	19,7	65
	28										
	30								4000	20,9	75
30	10	2300	300	700	1200	1150	2900	600	4000	20,6	75
	12										
	14								4000	22,0	75
	16										
	18								4000	23,4	75
	20										
	22								4000	24,8	75
	24										
	26	2400		600			3600		4000	26,1	75
	28										
	30								4000	27,6	75
40	10	2500	325	750	1300	1400	3000	600	4000	26,4	75
	12										
	14								4000	28,0	75
	16										
	18								4000	29,6	75
	20										
	22								4000	31,2	75
	24										
	26	2600		650			3600		4000	32,7	90
	28										
	30								4000	34,3	90
50	10	2600	350	800	1400	1500	3000	600	4200	31,8	90
	12										
	14								4200	33,7	90
	16										
	18								4200	35,7	90
	20										
	22								4200	37,5	100
	24										
	26	2700		700			3600		4200	39,4	100
	28										
	30								4200	41,3	100

Carrying capacity tons	Span S m	a	b	c	d	e	f	g	Wheel base	Wheel pressure in tons	Breadth of rails
60	10	2800	375	900	1450	1550	3000	600	4400	37,3	100
	12										
	14								4400	39,5	100
	16										
	18								4400	42,9	100
	20										
	22								4400	44,3	120
	24										
	26	2900		800			3500		4400	46,5	120
	28										
	30								4400	48,8	120
75	10	3000	400	1000	1500	1600	3000	600	4600	45,0	100
	12										
	14								4600	48,4	120
	16										
	18								4600	51.3	120
	20										
	22								4600	54,0	120
	24										
	26	3100		900			3400		4600	56,7	120
	28										
	30								4600	59,7	120
100	10	3200	450	1500	1600	1800	3000	600			
	12										
	14										
	16										
	18										
	20										
	22										
	24										
	26	3400		1400			3400				
	28										
	30										

When the travelling crab is provided with a protective cover for temporary outdoor work the dimension "*a*" must be increased by about 100 millimeters.

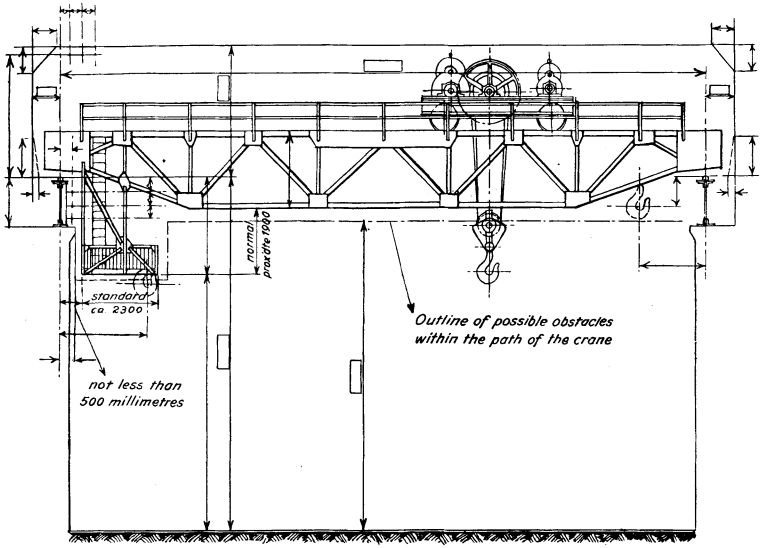
Either flat steel or special rails may be used for crane tracks.

Railroad rails should be avoided whenever possible.

Table II.

Clear Section

and desirable hook positions for travelling cranes in existing localities.



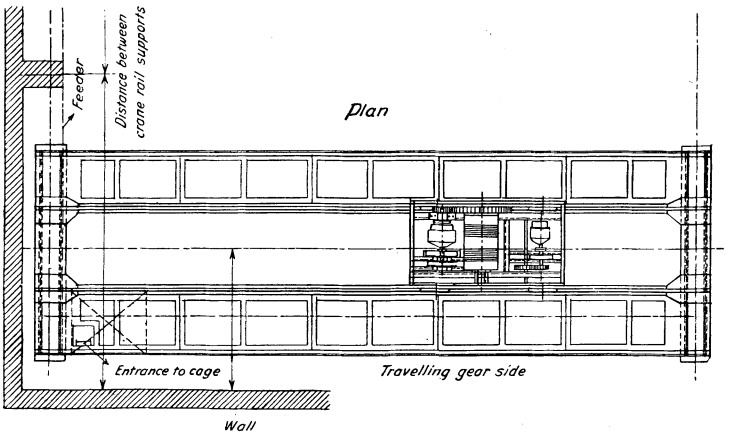
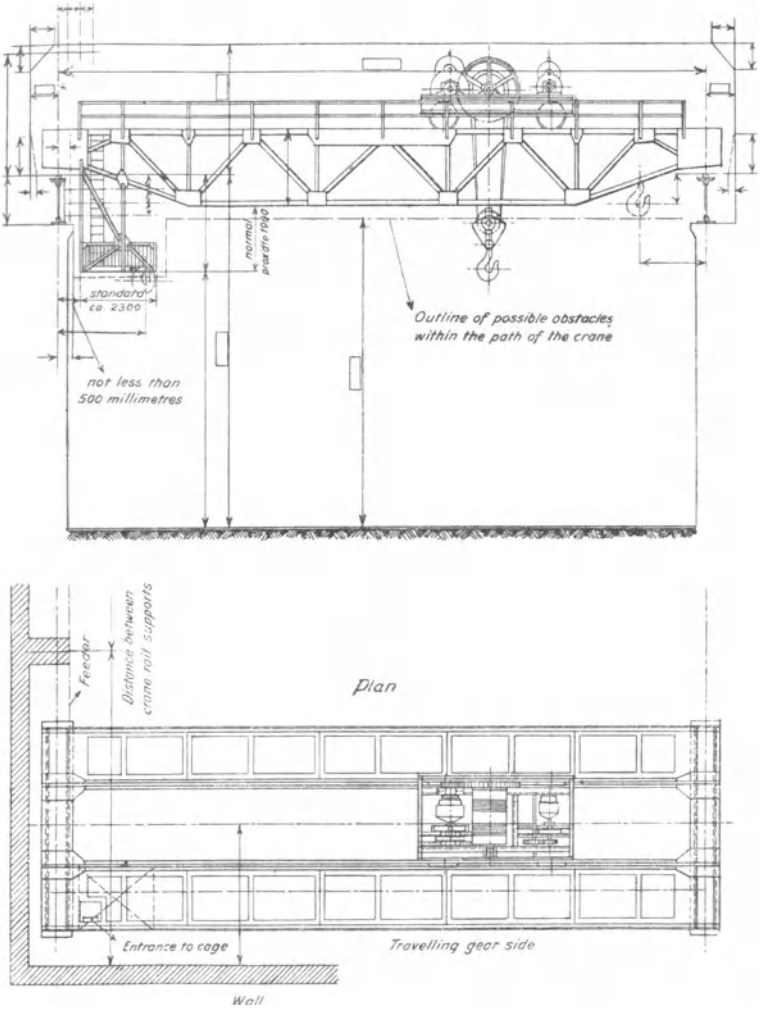


Table II.

Clear Section

and desirable hook positions for travelling cranes in existing localities.



A blue print of the above containing the necessary dimensions should be made and enclosed with every enquiry.

Deutscher Kran-Verband (E.V.)

Berlin SW 61, Wartenburgstraße 17

Telegrams: Kranverband :: Telephone: Kurfürst 1494

Acting Secretary: W. Gerlach

Members

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