OVERHEAD CRANES

1. Main definitions

Crane is a materials handling equipment for lifting or lowering a load by a hook and moving (transferring) it horizontally, in which the hoisting mechanism is an integral part of the equipment. A crane may be driven manually or by power and may be fixed or mobile. Equipment like stackers, lift trucks, power shovels, backhoes, excavators and other hoisting equipment not discussed in this chapter are not included in the category of crane.

A crane essentially consists of (*i*) a steel structure, (*ii*) a hoisting mechanism or a winch mechanism with its pulley and pulley system, (*iii*) suitable load handling attachment /s and (*iv*) drive and controls.

The major classification of cranes is based on whether they are stationary or mobile. However, it is to be noted that, even for the stationary cranes, some structural component of the crane is capable of movement

for transferring the load within reach of its movement. Movements of components of these stationary cranes may be linear, revolving or combination of both.

Revolving cranes: The characteristic feature of these cranes is presence of a structural arm called **boom**, which can be rotated through 360° about a vertical axis. These cranes are also called **rotary crane** or **slewing crane**. Boom may be strut or struss type. The lower end of the boom is affixed to a mast, base, carriage or support against which it can be pivoted and moved up and down which is called

luffing or **booming**. The upper end of the boom supports a hook or other end attachments for lifting of load. Different types of cranes are grouped under this classification.

Mechanism employed for rotating the boom is called **slewing mechanism**. Usually three different types of slewing mechanisms are used which are:

(*i*) Crane superstructure revolves together with the pillar or column which is mounted on bearings.

Jib cranes generally fall under this category.

(*ii*) The boom rotates about a pillar fixed on a foundation or in the crane truck.

(*iii*) The entire crane superstructure is mounted on **turntable** which rotates about and secured to its non revolving part. The turntable of the crane rests on a number of rollers running or a circular rail erected on the foundation or on the crane truck. Rack and pinion or cogwheel drives are generally employed for rotating the turntable.

Luffing is another important motion of the boom of a crane. It is the up and down motion of the boom about a pivot joint at the inner (base) end of the boom. Luffing motion of the boom can be imparted by applying various mechanism like (*i*) rack and pinion, (*ii*) nut and screw, (*iii*) segment gears, (*iv*) crank and link, (*v*) hydraulic cylinder and (*vi*) hoist drum and rope reeving system. Luffing motion is very important to reach loads lying at different distances from a stationery crane. It is to be noted that the capacity of a crane varies at different boom angles, which are indicated by the crane manufacturers.

Go to the outline

2. Types of cranes

There are different types of cranes under each classification, based on their constructional features and specific uses. Some of the common types are:

Stationary Cranes

(*i*) Jib crane

(*ii*) Overhead Travelling crane (also called Bridge crane)

(*iii*) Gantry crane

Stationary Revolving Cranes

(*i*) Wharf crane

(*ii*) Pillar crane

(*iii*) Tower crane

Mobile Cranes

(*i*) Truck/wagon mounted crane

(*ii*) Crawler crane

(*iii*) Railway/Locomotive crane

(*iv*) Floating crane

Definition, descriptive specifications, characteristics, features & uses and some of the design variations of the above types of cranes are discussed below.

Go to the outline

3. Bridge Crane Definition & descriptive specifications

These cranes essentially consists of one or more hoisting devices mounted on a bridge consisting of one or two horizontal girders, which are supported at each end by trucks riding on elevated runways installed at right angles to the bridge. Runways are installed on building columns, overhead strusses or frames, much above floor level. The hoisting device moves along the bridge while the bridge moves along the runway.

Depending on the lifting capacity of these cranes, the hoisting device may be a hand operated trolley type hoist, an electric hoist or a drum-type **crane trolley or crab**. Crane trolley is an independent machine consisting of the drum-type hoisting

equipment built on a framework, which is fitted with runner wheels, and driven by a motor through gearings. The hoisting motion is also motorised. Fig. 1 is a line diagram of crane trolley. The long travel of a bridge may also be manual through chain operation or motorised.

Control of all the movements (hoisting, cross travel of hoisting devices and long travel of the bridge) of an electric overhead travelling (abbreviated as EOT) crane can be through pendant from floor, or may be remote operated through radio or other devices. Many of these cranes are provided with a cab fixed to the bridge, from which an operator controls the crane. Electrical power is fed to the crane by means of festooning cable or from bare conductors running along the runway through collectors connected with the bridge structure.

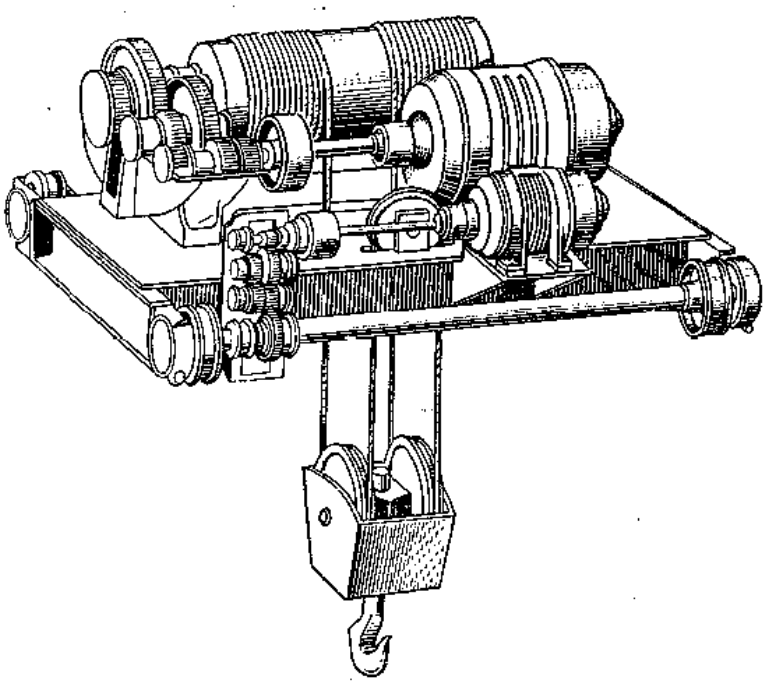

Fig. 1. Crane trolley

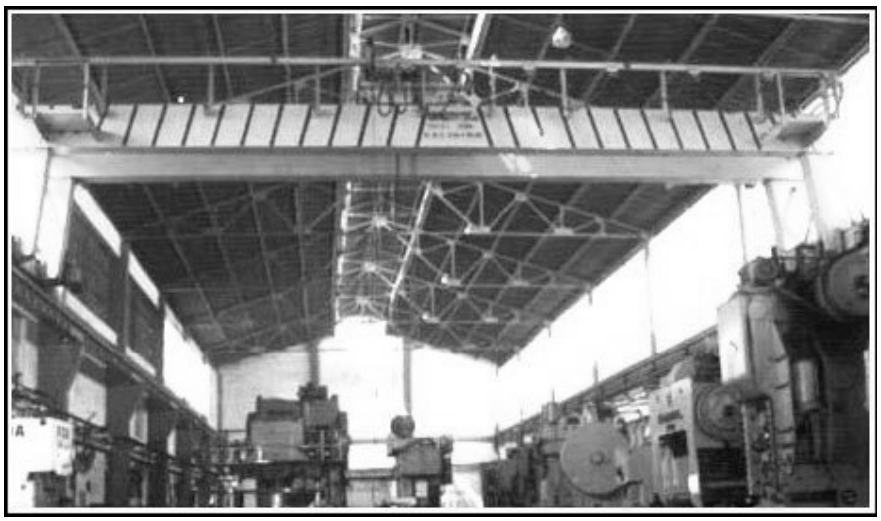

Fig. 2. View of an overhead travelling crane

Go to the outline

4. Characteristics and uses

The major advantage of overhead travelling bridge crane is that it does not interfere with work on floor. It can move materials over the working zone. Other characteristics are:

(*i*) It can reach the entire rectangular area bounded by the bridge length and runway length.

(*ii*) Runways can extend beyond the building, supported by columns erected suitably.

(*iii*) Capacities may vary from small value (1 ton) to up to 1000 tons.

(*iv*) Bridge cranes are designed and built as per requirement by specialist companies.

(*v*) Requires heavy frame work and are expensive.

(*vi*) Requires trained operators.

These cranes are mainly used in heavy machine shops, foundries, steel plants, assembly and repair shops, warehouses and yard storages. With appropriate hoisting attachments like slings, grabs, grab buckets, magnets etc. these crane can handle an extremely wide range of large, heavy and awkward unit loads as well as bulk load.

Go to the outline

5. Types of bridge crane

Bridge cranes are classified according to the load capacity as follows:

(*a*) Light duty—up to 5 tons. May be hand propelled.

(*b*) Medium duty—5 to 20 tons, used in factories and warehouses.

(*c*) Heavy duty—20 to 50 tons, used in foundries, heavy shops.

(*d*) Extra heavy duty—over 50 tons, used in steel plants, docks etc.

The medium and heavy duty crane bridges are essentially electrically driven.

Design wise the traveling bridge crane may be classified as.

(*a*) **Top running** or (*b*) **Bottom running** (under slung).

The bridge girders of a top running crane are carried on top of the end trolleys (Fig. 3). The girders of the bottom running crane are suspended from the end Trolleys. The hoisting device is also top running or bottom running in corresponding designs. Bottom running bridge crane are generally limited to 10 tons capacity.

Major specifications of a bridge crane are:

(*i*) Lifting capacity, (*ii*) Span of the crane, (*iii*) Hook lift, (*iv*) Hoisting speed, (*v*) Hoist travel speed and (*vi*) Long travel speed of bridge.

The specifications are generally limited to 1000 ton lifting capacity, 40 m span, 10 to 20 mpm hoisting speed, up to 30 mpm hoist travel speed, and 60 to 150 mpm bridge travel speed. Two speeds of hoisting are provided in many cranes as demanded by the application.

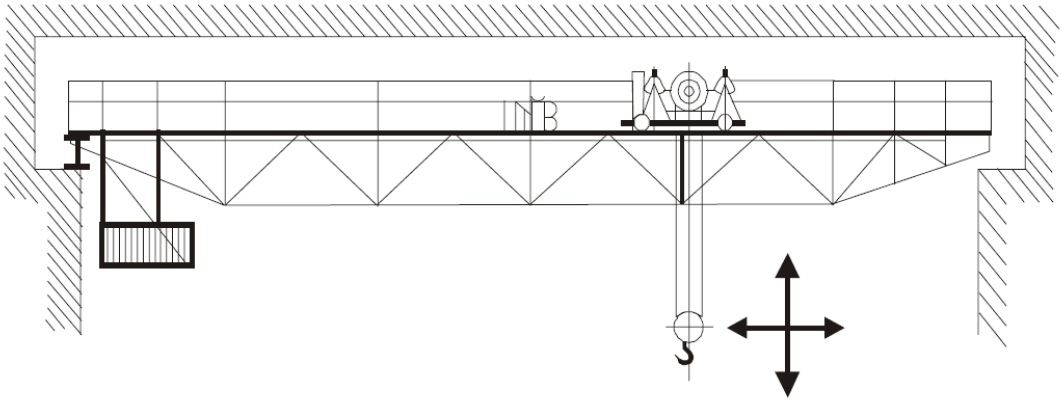

Fig. 3. Double girder top running bridge crane

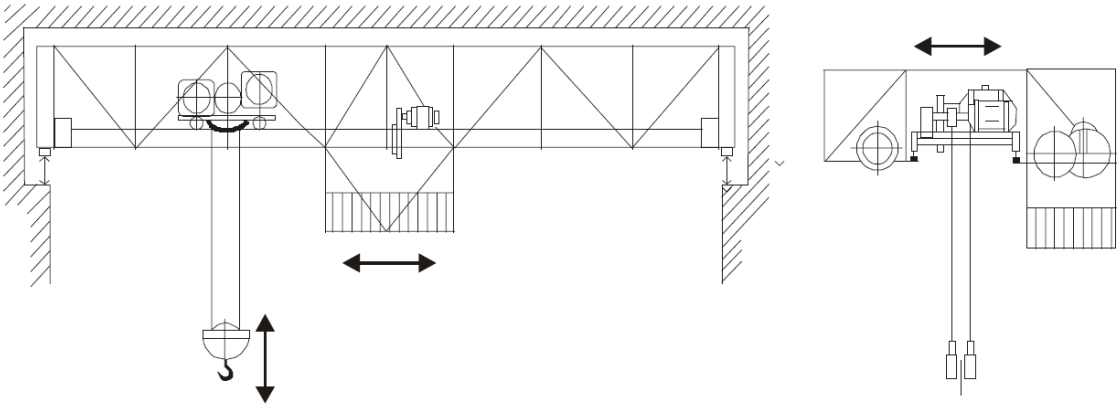

Fig. 4. Top running bridge crane with bottom running crab

Go to the outline

6. Gantry Cranes

Definition, Characteristics and Uses. Gantry cranes have a girder or bridge, on which the hoisting device/s operate, similar to an overhead travelling crane, except that the bridge is rigidly supported on two or more legs with wheels which run on fixed rails or runways at the level of the floor. The movement of the gantry crane may be done manually or through motor.

The characteristics of a gantry crane are :

(*i*) Can be used indoors or outdoors.

(*ii*) Relatively easy to change its location.

(*iii*) Simple operation.

(*iv*) Long life and low maintenance.

These crane are used for loading and unloading carriers, outdoor storage operations, for handling unit or even bulk materials where movement is short. These cranes serve purpose of a bridge crane and are used where installation of a bridge crane is not possible. Limitation of these cranes are their limited movement and capacities up to a maximum of 300 te.

Types of gantry crane. A few types of gantry cranes are possible based mainly on the design of the legs:

(*i*) **Fixed gantry crane** whose both legs are fixed on floor

(*ii*) **Portable gantry crane** in which both legs are fitted with small wheels which can travel on plain floor. These are generally of small capacity up to 3 te.

Fig. 5. Portable gantry crane

(*iii*) **Semi-gantry** or **single leg gantry crane** is a gantry crane with one end of the bridge is rigidly supported on one or more movable legs supported on fixed rail or runway, the other end of the bridge being supported by a truck running on an elevated rail or runway.

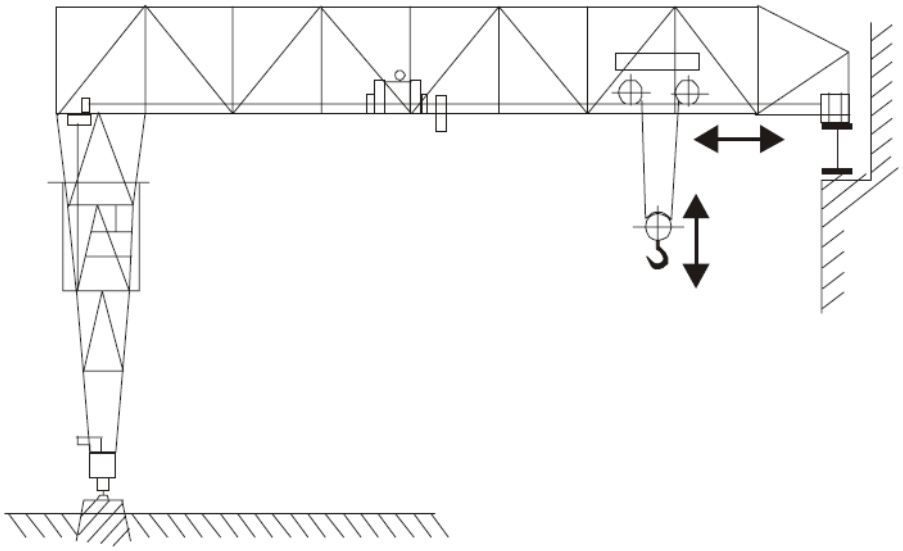

Fig. 6. Semi-gantry crane

Cantilever gantry crane in which the bridge girder is extended beyond the crane runway on one or both sides. Its runway may be either on the ground or elevated. Fig. 6 shows photograph of a large capacity outdoor gantry crane.

Fig. 7. 40 te gantry crane

Go to the outline