
BUCYRUS-ERIE
CCM

BUCYRUS-ERIE COMPANY

SPECIFICATIONS OF 1850-B SHOVEL

ELECTRICALLY DRIVEN

This specification describes a revolving shovel designed to operate on an alternating current source of power with motor-generator sets furnishing direct current power to the hoist swing and crowd motors. The machine uses a Ward-Leonard Static Regulating type control.

CRAWLER MOUNTING

The machine is supported on four crawler units located at the corners of the base frame. The loads from the base are transmitted to the trucks through hydraulic jacks, having ball shaped ends resting and held securely in renewable socket seats in the crawler frame.

Each unit is made from alloy steel plates and castings welded into a strong rigid frame. Major structural members are of low alloy high tensile steel. A driving tumbler is located at one end of the frame and at the other end is an adjustable take-up tumbler. Along the bottom of the frame is a series of large diameter, equally spaced rollers. The take-up tumblers are slide mounted in the crawler unit and are separately adjusted by hydraulic jacks. The tension of each tread belt can then be altered without affecting the alignment of the other belt in the unit. The hydraulic jacks provide clearance necessary to insert plate blocks. The take-up tumbler shaft is then held in position by the blocks after the jacks are removed. Smaller diameter rollers are located along the top of the crawler frame to prevent the slack side of the tread belt from rubbing the frame. All shafts for the driving tumblers, take-up tumblers, and lower and upper rollers are mounted in bronze bushings.

The four crawler mountings are individually powered by an AC wound rotor motor connected to a multiple reduction gear train. The gear train is protected from damage by being located midway between the two crawler belts at the outside end of the crawler frame. Machine cut, spur gears used throughout the propel gear train are totally enclosed in an oil tight gear case. The gears are oil bath lubricated. All shafts in the gear train are mounted on bronze bushings. Each propel motor is equipped with a spring set, air-released brake which sets when the master controller is in neutral or if power fails.

The eight tread belts are composed of wide face, long pitch, cast steel, heat-treated pads which are connected by large diameter special steel pins.

The tumblers of each crawler unit ride a single path along the center of the pad. This design permits the machine to negotiate uneven ground without causing undue stresses in the crawler frames. Each pad has two off-set driving lugs which engage the driving tumbler at different intervals of time, thereby providing a smooth and jolt-free motion.

LEVELING EQUIPMENT

Four large diameter hydraulic pistons support the weight of the machine and provide a leveling feature for operating on irregular ground and on grades. Both the pistons and the cylinders are forged steel. The cylinder fits up into the corner of the base frame and can be easily removed without damaging the corner of the base frame. The lower ends of the pistons are ball-shaped and bear in sockets located in the center of the crawler units. Packing for the cylinders is accessible and is relieved of distortion thus preventing leakage and reduction of pressure. Four piston rings are located near the top of each piston where they are most effective. By locating the piston rings at the top of the piston, packing maintenance is reduced. Also any damage to the lower exposed piston will not cause serious packing problems. Oil for the system is not furnished. A hydraulic pump system supplies the pistons and is capable of providing pressure to the pistons under operating conditions.

Two of the pistons are interconnected by a pipe line which allows a flow of oil between two cylinders. This design causes the two pistons to act as one, thereby making a three point plane when propelling. Frame distortion when moving over uneven ground is thus eliminated. A valve in this pipe line is operated in conjunction with the propel motor control. The leveling equipment is automatically controlled so the machine stays level at all times.

BASE

The machine is supported on a base frame upon which are mounted the center pintle, swing rack and roller circle rail. The four outside members of the base frame are solid box girders braced and reinforced with heavy gusset plates at the ends where they connect to the diagonal members. The diagonal members of the frame are heavy box section girders extending through the corners formed by the side girders. The box type design of the diagonal members gives the effect of continuous diagonal girders. One girder does not tie into the other.

The base frame sections are bolted together with high strength, finished bolts fitted in holes held to close tolerances. After bolting, the flanges of the box girders are welded at the joints to form continuous plates.

The swing rack is made of alloy steel segments with machined teeth. These segments are bolted to each other and to the base girders which support them. The roller circle rail is supported by and bolted and chocked to a machined seat on the base members.

STEERING

With the two forward and two rear crawler units tied together so as to work in pairs, the machine can be steered straight forward or backward, along a curved path in either direction, or at an oblique angle. A steering arm support is welded at the inside end of each crawler unit. This support provides a means for connecting a strut between two crawler units tying them together as a pair. Two large diameter hydraulic rams used for steering each pair of crawler units connect between the steering arm support on the crawler unit and a support built into the bottom of the base frame. As one ram extends, the other retracts. Only one ram per pair of crawler units is powered, thereby making use of the connecting strut to steer the opporsite crawler unit and to keep both units working in parallel. Both the strut and the rams are connected at their ends by universal joints. When not in use, the hydraulic steering is relieved of pressure and loads imposed while digging are not transmitted through the hydraulic cylinders. Also, change in machine elevation through use of leveling jacks, imposes no strain on the steering mechanism.

ROLLER CIRCLE

The roller circle consists of a large number of forged, heat treated, steel flanged, tapered rollers revolving between two heat treated alloy steel forged rail circles. One rail is attached to the bottom of the revolving frame and the other to the top of base. The roller frame is composed of a channel on the outside and a heavy bar on the inside, both being rolled to circular form, and separated by large diameter pins on which the rollers are spaced. In this construction the pins and frame act only as spacers for the rollers. Means are provided in the roller pins for lubricating each roller independently.

REVOLVING FRAME

The revolving frame consists of a series of welded box sections, which, when bolted and welded together, form a rigid multi-cell structure. Each section contains vertical bulkheads and stiffeners. The mating surfaces of the individual sections are machined to assure that each section fits accurately to the next. The front cross beam carries the boom foot lugs and the lugs for the front legs of the A-Frame. The longitudinal beams support the hoist, drag and swing machinery while the rear mast boxes support the M-G sets and provide space for the ballast.

HOIST MACHINERY

The double twin hoist ropes pass in a single lead from the drum over large diameter boom point sheaves to the dipper. Both ends of each rope are attached to the drum and the bights are passed around equalizing sheaves, one attached at each side of the dipper. This arrangement steadies the dipper in the bank when digging. An exceptionally efficient hoist motion is provided by using the single part double twin reeving over only one large diameter roller bearing mounted sheave. The power of the hoist motors can then be applied to do useful work rather than being used to overcome friction from additional sheaves.

The two twin hoist ropes are clamped to a flange at the center of the large diameter hoist drum. Double right and left hand grooving extends from the central flange to each end of the drum to hold the ropes. Two large diameter, helical tooth gears are bolted to each end of the hoist drum.

Each hoist motor drives through a flexible coupling to its own enclosed herringbone tooth reduction unit to a helical pinion meshing with one of the gears on the hoist drum. The use of reduction gearing reduces gear tooth loading and the size of the individual parts.

Each of the gear reducer units is provided with a spring set, air released brake which sets manually from a switch in the operator's cab or automatically in the event of a power failure.

CROWD MACHINERY

The dipper handle is extended or retracted by a positive rope crowd. Crowd power is supplied by two separate crowd units located at the forward end of the revolving frame. The double twin crowd ropes pass from the crowd drums over large diameter sheaves at the saddle block. Both ends of each rope are attached to the drums. The bight of each rope passes around equalizer sheaves located on each side of the handle at the rear end.

Two retract ropes are used. One end of each rope is tied to the crowd drum and the other end is tied to an electrically operated worm driven take-up device which is located on the forward end of the handle. Both ropes pass over large sheaves at the saddle block. Each retract rope take-up is independently operated from the operator's cab. The rope pulls from the two drums are equalized electrically.

The crowd units are driven by DC mill type motors through multiple gear reductions. The first reduction has herringbone gears while the second and third reductions have helical cut gears. Each unit is separately mounted on the revolving frame. Each motor has a spring set, air-released brake which can be set manually from the operator's cab or automatically in the event of a power failure.

SWING MACHINERY

Swing power is provided through multiple swing units securely fastened to the revolving frame deck. Each unit has multiple gear reductions. The first reduction uses a herringbone tooth design while the second reduction has helical teeth. Power is supplied to each unit through a vertically mounted DC mill Type motor.

Each gear reduction is separated by a horizontal divider. This construction allows each reduction to have a separate oil bath lube supply. Two different weighs of oil may be used to meet the desired lubrication requirements. No oil pumping system is required for circulation.

The second reduction gear is straddle mounted between two anti-friction bearings thus assuring it of perfect alignment. All shafts, gears, and pinions are all made of high alloy heat-treated material.

A-FRAME

The A-Frame provides the support for the boom and is pin connected to the revolving frame in both the front and the back. The front A-Frame legs are of box design and are braced near the midpoint with a cross girder also of box construction. A second cross brace is located near the apex. The rear legs are of box design and pin to the front legs at the top and to the revolving frame at the bottom. Two safety cables are provided for each rear leg.

BOOM

The boom is constructed in two sections. The lower boom section comprises two welded box side girders and two box section cross girders solidly welded together. The lower boom is built on a taper with widespread boom feet for connection to the revolving frame and more closely spaced lugs at the upper end to accommodate the shipper shaft bearing construction. The lower section of the boom is supported by struts which connect between the top of the A-Frame and the upper end of the lower boom section. The heavy design of the lower boom allows it to accept the torsional loads due to swing and the impact loads from digging.

The upper boom is pinned to the lower boom section just above the shipper shaft. The upper section is made from two long all-welded girders of box design, adequately stiffened along their length with K bracing. A lighter construction can be used on the upper boom section as it is designed mainly to accept compression loads from the hoist ropes. The two boom point sheaves are straddle mounted on anti-friction bearings in a swivel trunnion which allows them to follow the sideways lead of the hoist ropes. The upper boom section is supported by multiple bridge strands which connect from the top of the A-Frame to the end of the upper boom section. The boom point rope grooves are flame hardened for increased wear.

A small crane is provided at the boom point for service and maintenance work. Adequate walkways, ladders, and rails are provided for access to all parts of the boom.

BOOM MACHINERY

The boom machinery includes the saddle block and crowd rope sheaves which are located at the junction of the upper and lower boom sections. The saddle block and crowd rope sheaves pivot about the shipper shaft the bearings of which are located in the lower boom section.

The saddle block guides the tubular dipper handle and transmits lateral swing loads to the lower boom section. A series of readily replaceable steel springs are located between the saddle block liners and a support which attaches to the main saddle block box type frame. These springs cushion side loads from the handle while the long, replaceable liners with high contact area slide against the dipper handle to prevent any handle damage.

The grooves on the cast steel crowd rope sheaves are flame-hardened for increased wear and are mounted on bronze bushings.

AIR COMPRESSORS

Two air compressors are provided with one located on the revolving frame deck and the other in the base frame. The revolving frame compressor furnishes air for the hoist, swing and crowd brakes and for general use. The compressor in the base frame supplies air for the propel brakes, grease pumps and for general use. Lubrication of the crawler units is manually accomplished through a lubrication supply in the base frame. An air powered pump is installed on a grease drum and grease is pumped through a reel mounted hose which is long enough to reach all points on the crawler units.

DIPPER HANDLE

The dipper handle is a cylindrical low alloy high tensile steel tube with connections for crowd and retract ropes. The forward end of the handle is combined with the dipper connection. Both the handle and the dipper connection are welded together as a unit. The crowd sheaves attach solidly to the rear end of the handle. Anchors for the retract ropes and a bracket for the dipper trip machinery are located under the handle and back of the dipper where they are protected from damage.

DIPPER

A low alloy high tensile all-welded steel dipper of the size and type specified is provided. The dipper is equipped with renewable tooth points and is built of the highest grade material to withstand severe shock loads and abrasion.

DIPPER TRIP

The dipper door latch is tripped by a cam and chain. Power to trip the dipper is supplied from an AC motor mounted beneath the dipper handle. This design gives positive dipper trip control. The trip is actuated by a thumb lever on the crowd motion master controller.

OPERATING CONTROL - OPERATOR'S CAB

The master controllers for hoist, swing and crowd are located in the operator's cab. Propelling and steering are controlled from a panel mounted under the base with access from the ground. The cab is positioned at the forward end of the revolving frame and to the right of the boom. This position, high above the ground, gives the operator a commanding view of the work. All master controllers are conveniently grouped and arranged for operation by one man.

The cab is constructed to give maximum visibility when swinging as well as when digging. A special windshield wiper is provided for the front window. Provision is made for easy cleaning of all windows. Cab windows are tinted to minimize glare and heat.

Air for heating or cooling the insulated cab is provided by a heavy duty industrial type air conditioning unit which is thermostatically controlled.

ROPES

All ropes for the initial operation of the machine are supplied.

HOUSE

The house which covers the entire revolving frame is of all steel panel construction. Each panel is securely fastened to a steel framework which forms the support for the house. Large sliding doors and windows are provided where necessary for access to the house and for lighting.

House ventilation is provided by motor driven blower fans mounted in the ceiling. The fans draw clean air into the house through large openings in the roof. Exhaust fans mounted in the rear and at the sides of the house insure adequate circulation and eliminate hot spots.

BALLAST

Space is provided in the revolving frame for the required amount of ballast. Punchings or pieces of pig iron are suitable for this purpose. Ballast is not furnished and will have to be provided by the purchaser.

OVERHEAD CRANE AND AUXILIARY WINCH

An electrically operated overhead traveling crane with trolley is provided within the house to assist in service, inspection and maintenance of the revolving frame machinery. The crane has sufficient longitudinal and lateral travel to allow it to service all areas of the deck. The hook has sufficient travel to lower to the ground level. Auxiliary trolley beams are provided for access to those machinery parts which cannot be reached by the main crane.

Two AC motor driven single drum winches, mounted in front of the main machinery, are provided to facilitate maintenance and to aid in reeving hoist and crowd ropes.

A jib crane with motor driven hoist is provided for hoisting lubricants and minor machinery items from the ground to the revolving frame.

ELECTRICAL EQUIPMENT - REVOLVING FRAME

The machine is equipped with two motor-generator sets. Each set is driven by a synchronous motor which in turn drives a series of generators. The generators furnish DC power for the hoist, swing and crowd motions. The M-G set units are mounted to the rear of the revolving frame and positioned laterally. Mounting the M-G sets to the rear of the revolving frame lessens the amount of ballast required while the lateral mounting position places bearings on the sets normal to the digging force. Better bearing life can be expected with a laterally mounted set.

The hoist, swing and crowd motors have separately excited main field windings, have small flywheel effect and are of a type suitable for high peak duty.

Motor shafts run on anti-friction bearings. The DC motors are force ventilated (blown) by externally mounted blowers which in turn are driven by separate squirrel cage ball bearing motors. Class H insulation is used for hoist, crowd and swing motors.

At the operator's position are master controllers which control the output of special semi-conductor amplifiers. These special amplifiers vary the intensity and direction of the exciting current which establishes the voltage of the main generators, and thereby the speed and direction of rotation of the driving motors.

The semi-conductor amplifiers operate under the principle of static regulating control which provides quick response, flexibility of machinery operation, and smooth acceleration and deceleration of the driving motors.

The hoist motors through gears and ropes are connected at all times to the dipper. The motors deliver power to the machinery when required and then act as generators when overhauled by the weight of the dipper. This regenerative feature is also utilized in the swing and crowd.

Shovel type transformers are provided to furnish power for the motor blowers, air compressors, dipper trip and other auxiliaries. An additional transformer furnishes power for lights. These transformers are constructed with special bushings and tight fit covers to prevent oil leakage.

The DC exciter generator is separately powered by an induction motor.

Each DC motor on the machine is powered by its own DC generator. The generators are so established on the M-G sets so as to balance the duty on the synchronous motors.

ELECTRICAL EQUIPMENT - BASE

A motor driven cable reel for carrying the power cable is provided and is mounted on the base frame.

Collector rings are attached underneath the revolving frame, and take power from heavy shoes mounted on the base. The rings are of ample capacity, simple design, well insulated and accessible for inspection.

Shovel type transformers are provided for furnishing power to the various motors and lights mounted on the base. Disconnecting switches are provided for the main high voltage power line, and disconnecting cutouts are provided for the transformers.

Each crawler unit is powered by a wound rotor motor which is totally enclosed. Each motor is provided with an electrically controlled brake.

The oil pump motors for steering are operated through individual controllers and are interlocked with the propelling control.

Leveling control is operated through magnetic and limit switches which automatically operate to maintain the machine in level position. Manual control of leveling through push buttons is also provided. During propelling, the automatic leveling device is inoperative but the equalizing device functions. All of these features combine to provide a machine that requires no attention or lost time for equalizing and leveling and which results in rapid move-up.

ELECTRICAL EQUIPMENT - GENERAL

Lighting equipment is provided and arranged to give suitable illumination for night work, by floodlighting the digging and dumping area, and by local lighting in the house and at the base. Portable lamps with extension cords are provided for inspection and repair work. As far as possible, all wir- on the revolving frame and base is of the multiple cable, interlocked armor type.

GENERAL

It is the policy of Bucyrus-Erie Company to improve its product continually. The right is reserved to make changes in specifications or design which, in the opinion of this Company, are in accord with this policy, or which are necessitated by the unavailability of materials. The description herein is for the purpose of identifying the type of machine, and does not limit or extend the express warranty provisions in any contract of sale.

END OF SPECIFICATION