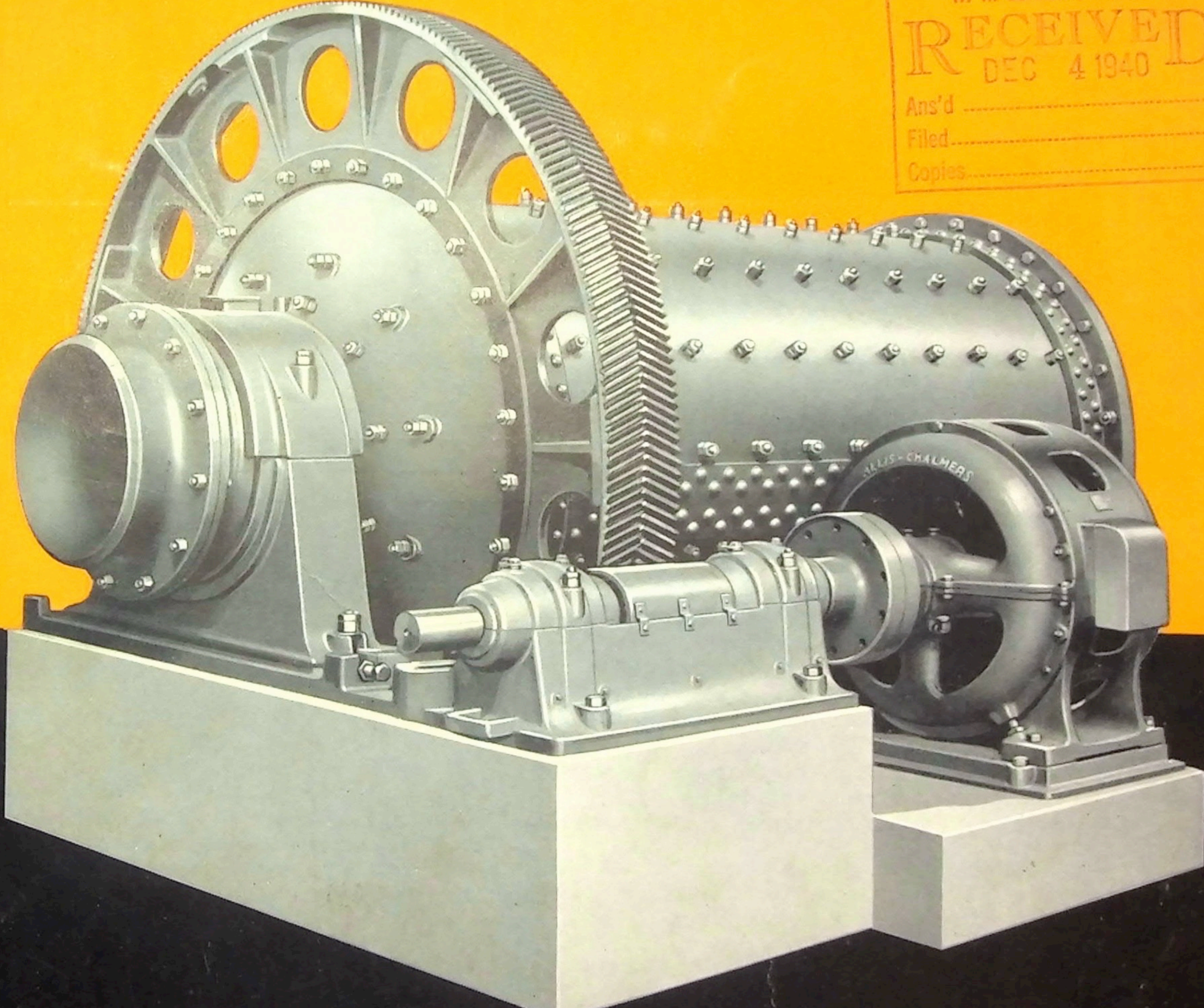
Rod Mills

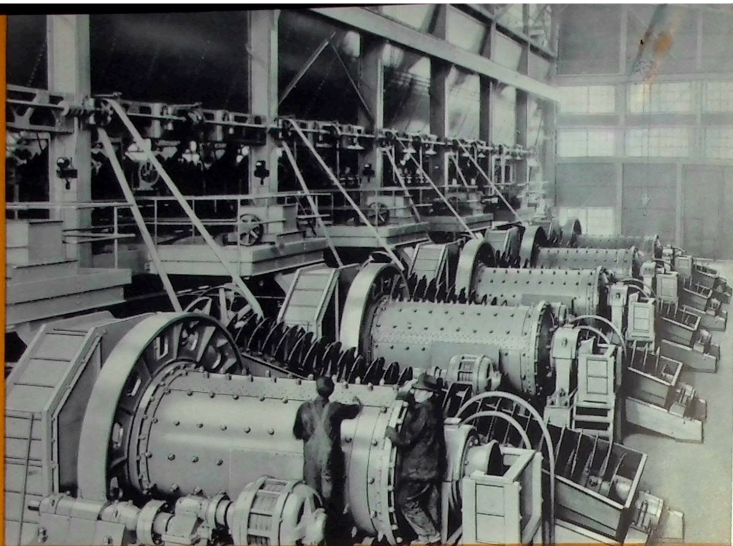
BULLETIN 1821-D



MINING DIVISION

ALLIS-CHALMERS

MILWAUKEE · WISCONSIN



Battery of Five 5′x 10′ Rod Mills at the Midvale, Utah, Plant of United States Smelting, Refining and Mining Company.

Rod Mills

LOW COST GRINDING WITH MINIMUM FINES

THE Rod Mill for grinding ore has received considerable attention from engineers and operators in recent years. Its high efficiency together with the low grinding costs shown with its use have demonstrated the modern rod mill to be an important step in advance in grinding equipment. It has been found particularly applicable where a uniform product containing a minimum of oversize and undersize is advantageous in connection with concentration of low grade ore.

Actual experience has shown that the best results are obtained from rod mills working on feed finer than 1″ and preferably finer than ¾″ making a product from 20 to 48 mesh in one pass.

In the treatment of ores by some processes the product of the rod mill is found to be preferable to that obtained from the ball mill. We say this without prejudice, as we build both machines. Within certain limits the rod mill has been found capable of doing more grinding per unit of power with less consumption of steel than the ball mill. Another point in favor of the rod mill is the low price of steel rods as compared with forged steel balls. The consumption of steel per ton of ore ground is no greater in a rod mill than in a ball mill.

In designing rod mills Allis-Chalmers engineers have the benefit of the broad experience gained in connection with the development of the ball granulator and other types of mills. It has been the general practice to make rod mills in lengths about twice the diameter and the rods which make up the grinding charge are about the same length as the internal working length between the end liners.

The principle of rod grinding action as compared to the grinding action in ball mills can better be understood by making a comparison of the grinding media. Rods making up a charge are parallel and contact upon one another in lines which tend to increase the effective grinding area per unit of steel. The rods tend to bear only on the largest particles of pulp, thereby expending most of their crushing force on the oversize and allowing the

fine particles a free passage between the rods without being ground to objectionable fineness. The balls making up a grinding charge contact at points and the particles of pulp at the point of contact are crushed to a very fine state. This concentration of crushing force at points accounts for the ball mill being more effective when feed larger than 1″ is to be reduced.

During the early stages in the development of the rod mill when rods of 1″ to 1½″ diameter were used, it was thought necessary to remove rods when worn down to ½″ diameter or less at frequent intervals to prevent their becoming bent and tangled, thereby reducing the crushing efficiency of the mill. In order to facilitate the removal of these worn rods, mills with large openings in the heads and supported by tires and rollers were adopted.

Upon experimenting with rods up to 3″ and 4″ diameter, of high carbon steel, it was found that the worn rods did not bend and become tangled, but that they were broken into short pieces and discharged with the pulp, thereby making it unnecessary to open the mill at frequent intervals to remove them. It also was found that by the use of heavier rods the crushing capacity of the mill was greatly increased. The trunnion supported type mill was then adopted by us on account of its simplicity and lower first cost, as well as the advantage of being able to operate this type of mill with a lower moisture content in the pulp, thereby reducing the wear on liners and rods with consequent lower operating costs.

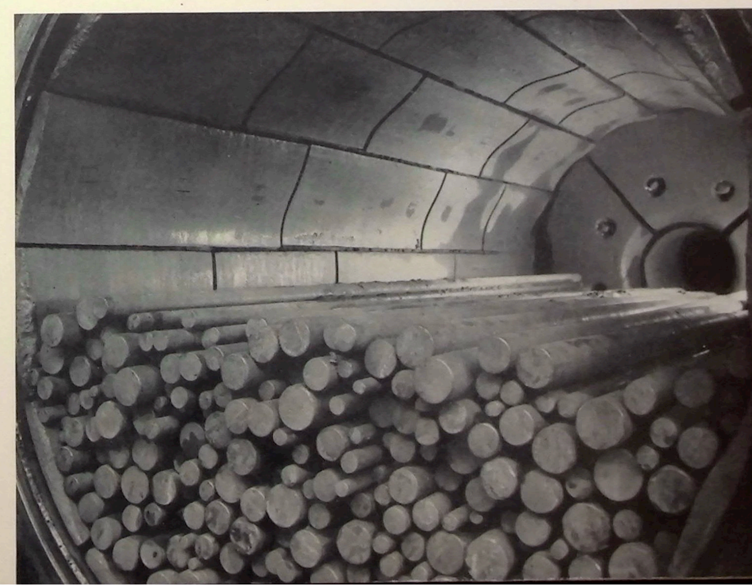
WET GRINDING ROD MILLS

The outstanding features of this mill are, (1) both ends supported in trunnion bearings of generous proportions, insuring low bearing pressure, (2) extra large opening in the feed end trunnion to facilitate feeding the large tonnage reduced in a rod mill, (3) opening in the discharge trunnion sufficiently large to permit a man entering the mill to inspect the interior, making a manhole in the shell unnecessary on the standard 5′ and larger diameter mills; also giving a hydraulic gradient sufficient to induce a rapid flow of pulp through the mill but not enough to cause uneven wear of the rods.

Standard practice is to reline our 5′ and larger diameter mills through the opening in the trunnion, while a manhole is provided in the 3′ and 4′ diameter mills for relining and inspection.

Some mill operators prefer to reline their mills by removing the head of the mill. This can be done by either blocking the mill in place with cribbing or by the use of supporting rollers, which can be furnished if so desired.

The trunnion bearing of the discharge head is so constructed that it is possible to remove the head from the mill without first completely dismantling the bearing. These features all aid in increasing the operating efficiency of the rod mills.



Rod Mill with head removed to show rods.

WET GRINDING ROD MILLS — CAPACITIES, ETC.

Size of Mill	Weight of 45% Rod Charge	Approximate Capacity In Tons per 24 Hours. Medium Hard Quartz.		H.P. to Run Mill	H.P. of Motor Recom-mended	Speed of Mill, R.P.M.	Speed of Countershaft		Size of Pulley
		1″ to 20 Mesh	½″ to 65 Mesh				Pulley Drive, R.P.M.	Direct Motor Drive, R.P.M.	
3′x 6′	4900	77	34	14.7	20	34	177	575	40″x12″
3′x 8′	6500	102	45	19.5	25	34	177	575	40″x12″
4′x 8′	13000	210	92	38	40	26	140	495	64″x12″
4′x10′	16000	258	113	46.7	50	26	140	495	64″x12″
5′x10′	26500	435	190	75	100	20	122	390	84″x19″
5′x12′	32000	525	230	90.5	125	20	122	390	84″x19″
6′x10′	40000	670	294	110	125	18	110	350	84″x25″
6′x12′	48000	800	350	132	150	18	110	350	84″x25″
7′x12′	67000	1150	505	179	200	15½	....	290	....
7′x15′	84500	1450	635	226	250	15½	....	290	....
8′x12′	90000	1575	690	232	250	14	....	290	....
8′x15′	112000	1960	860	290	300	14	....	290	....
9′x12′	113000	2040	900	282	300	12½	....	290	....
9′x15′	142000	2560	1140	355	400	12½	....	290	....

Capacities of Dry Grinding Rod Mills are approximately one-third less than for Wet Grinding Mills.

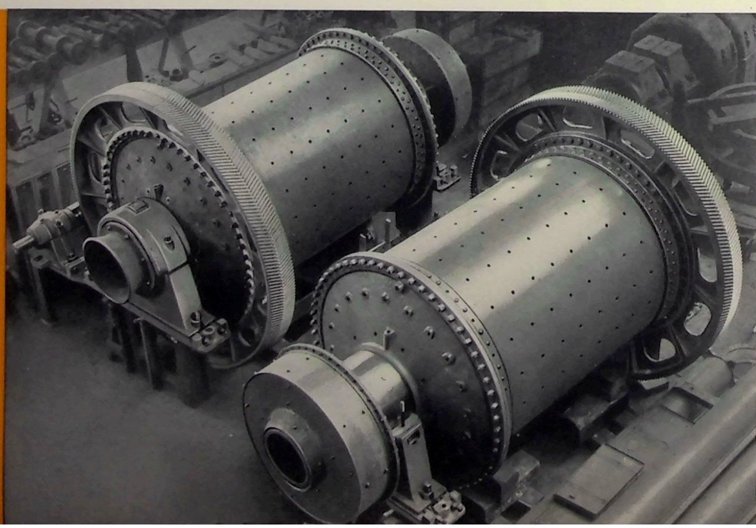
DRY GRINDING ROD MILLS

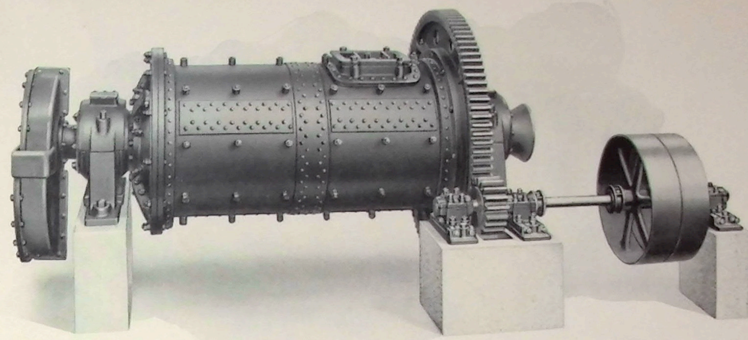
The dry grinding rod mill is of similar construction to the wet grinding mill. The main difference is in the trunnion bearings. In the dry grinding mill these are cooled by means of water circulating through coils placed in the babbitt. It is necessary to cool these main bearings due to the heat involved in the process of dry grinding of materials.

Dry grinding mills are equipped with drum type feeders, enabling the feed to enter the mill by means of an internal spiral. Whenever a dust-proof arrangement is required a screw type feeder enclosed in a dust-proof housing can be furnished.

The dry grinding rod mill is applicable to various industries where in the grinding of materials the addition of water is neither necessary nor required, such as the manufacture of sand line brick, crushed stone, and in sand plants, graphite plants, bauxite plants, etc.

7′x10′ Rod Mills Showing Feed and Discharge Ends; Plate Steel Drum Feeders.





3′x6′ Rod Mill, Sectionalized for Muleback Transportation in Bolivia, S. A.

The Allis-Chalmers Manufacturing Company maintains a corps of engineers who are ready at all times to work out your problems and recommend the proper grinding equipment.

For capacities of dry grinding mill see note below table on previous page.

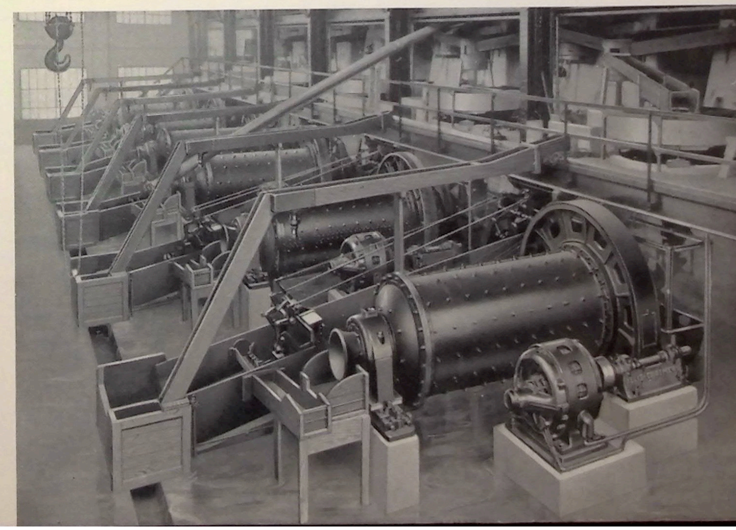
PLATE STEEL SHELLS

The shell is made of heavy steel plate of riveted or welded construction, with heavy steel flanges for bolting to heads. These flanges are machined true and parallel with each other to insure proper alignment of trunnions.

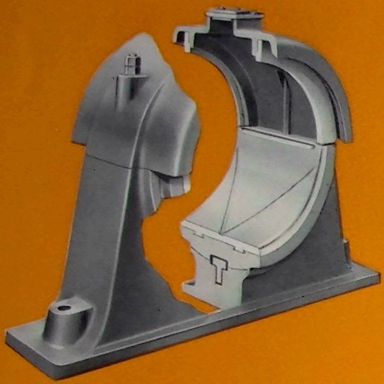
SEMI-STEEL CAST HEADS

The heads are cast of semi-steel of such proportions and designs as to amply take care of the bending stresses.

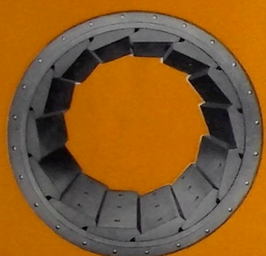
The flanges on the heads and shell are provided with male and female joints for carrying the shearing effect of the load. The heads are bolted to the shell with through-bolts; on the gear end sufficient bolts are supplied to permit removal of the gear without removing the head. The trunnions are turned true with the axis of the mill.



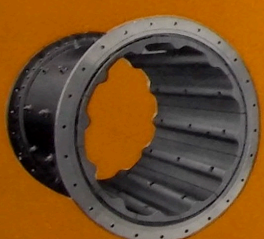
Six 5′x10′ Motor Driven Rod Mills, The Homestake Mining Co., Lead, S. D.



Trunnion Bearing.



Ship Lap Type Liner.



Wave Type Liner.

LARGE HEAVY DUTY BEARINGS

The mill is supported by two heavy cast-iron, spherical, babbitted bearings of ample size to insure low bearing pressure; both shell and saddle are machined to gauge in order that all shells may be interchangeable and also rest in the saddle conformably.

Each shell is provided with a recess in the bottom; a dowel pin in the saddle projecting into this recess prevents the shell from turning in the saddle.

The cap or upper half of the bearing has a large space for wool-waste and lubricant. It is provided with shrouds which extend out over the oil and dirt flanges of the trunnions and down to the center line of the bearing to prevent the entrance of grit and water into the bearing.

An opening in the cap large enough to admit the hand is provided. It is closed by an iron-weighted canvas cover of hinged construction designed to prevent dirt and water from entering the oil space.

In the dry grinding mill the bearings are cooled by means of water circulating through coils placed in the babbitt. It is necessary to cool them due to the heat involved in the process of dry grinding of materials.

DISCHARGE CONE CAST INTEGRAL WITH TRUNNION LINER

For the purpose of delivering the product from the mill, the discharge end trunnion is provided with a flanged discharge cone cast integral with the discharge trunnion liner.

LININGS DESIGNED FOR MAXIMUM WEAR

The feed and discharge end trunnions are provided with cast-iron removable liners.

The shell liners can be furnished of white iron, chrome or manganese steel of the latest and most approved types. These liners are made extra thick and designed so the wear will be uniform over the entire section, the ultimate result being an exceptionally long life and a minimum of scrap when the worn liner is removed. The shell is drilled to match the lining and the necessary bolts are furnished.

The feed and discharge heads can be furnished with removable liners of either white iron, chrome or manganese steel, drilled to match and provided with the necessary bolts.

All liners are removable and replaceable through the manhole.

FEEDERS — TYPES AND SIZES

These feeders are usually of the following standard types:

Plate Steel Single Scoop Feeder with . . 30″ to 72″ radius

Plate Steel Double Scoop Feeder with . . . . 30″ to 72″ radius

Cast Iron or Plate Steel Combination Feeders with . . . . 37″ and 48″ radius

Cast Iron or Plate Steel Drum Feeders.

Plate Steel Scoop Feeders can be supplied when desired in sizes of 30″, 36″, 42″, 48″, 60″ and 72″ radius. They are preferred in some classes of work and some conditions of operation.

All Scoop Feeders are made with sufficient radius for elevating and returning the oversize from a mechanical classifier. These feeders are provided with manganese steel wearing tips.

Combination Feeders handle direct feed as well as the mechanical classifier returns when the mill is operated in closed circuit. The primary feed is spouted directly into the feeder through the circular opening; it is then elevated and delivered to the mill by an interior spiral. An exterior scoop is also provided which elevates the mechanical classifier returns and delivers them to the interior spiral.

Combination feeders for the 3-foot mills are provided with 37-inch radius exterior scoop. Combination feeders for 6, 7, and 8-foot mills are provided with 48-inch radius exterior scoop.

The Cast Iron Drum Feeder is a duplicate of the combination feeder without an external scoop and is preferred where it is not necessary to elevate classifier returns. In larger sizes, Drum Feeders are built of plate steel.

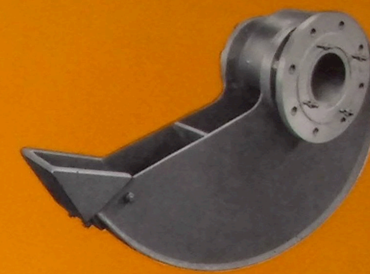
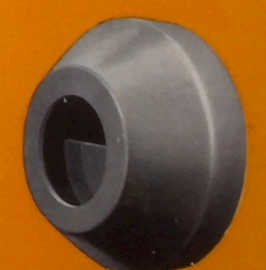
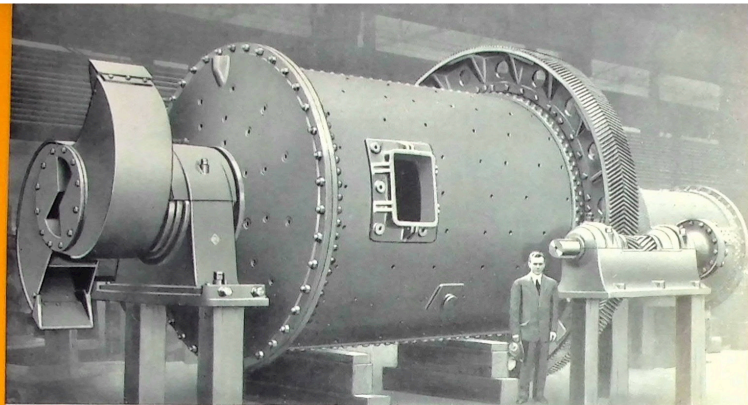


Plate Steel Single Scoop Feeder.

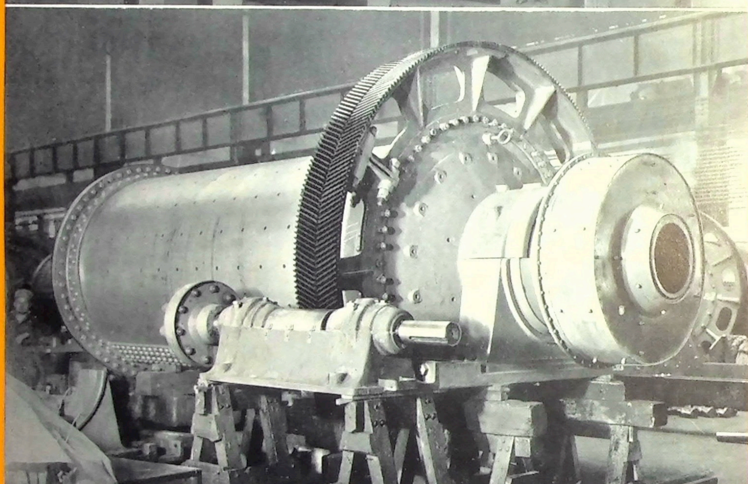
Combination Feeder.



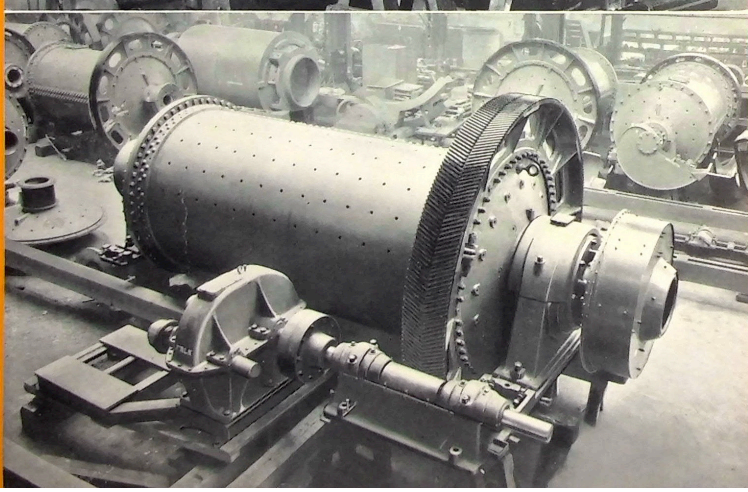
Cast Iron Drum Feeder.



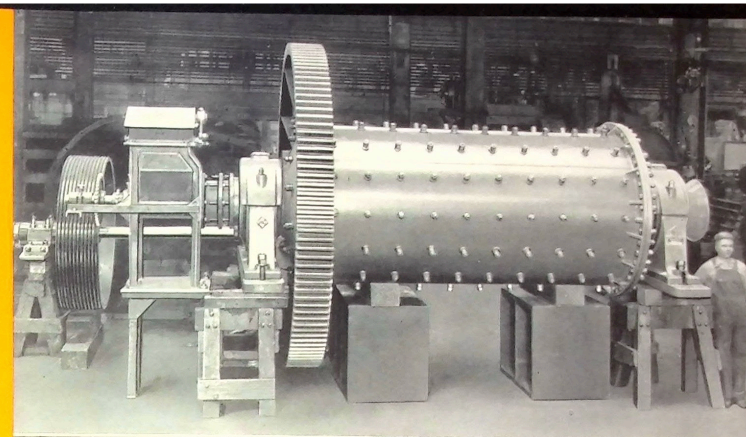
9′x12′ Rod Mill with Special Plate Steel Double Scoop Feeder, Wuest Gears.



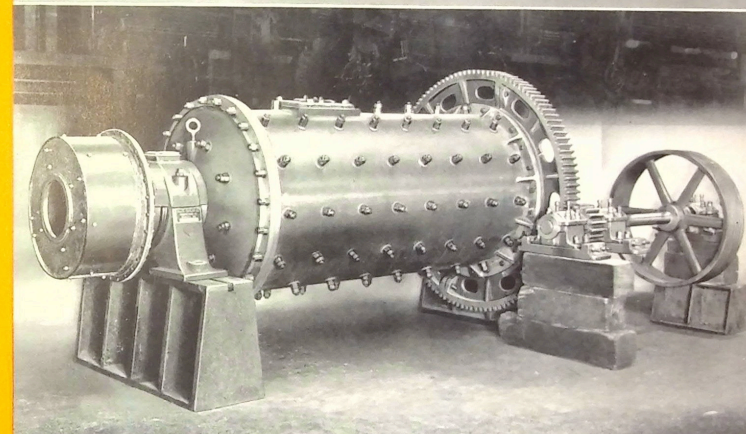
7′x15′ Rod Mill with Plate Steel Drum Feeder and Wuest Gears.



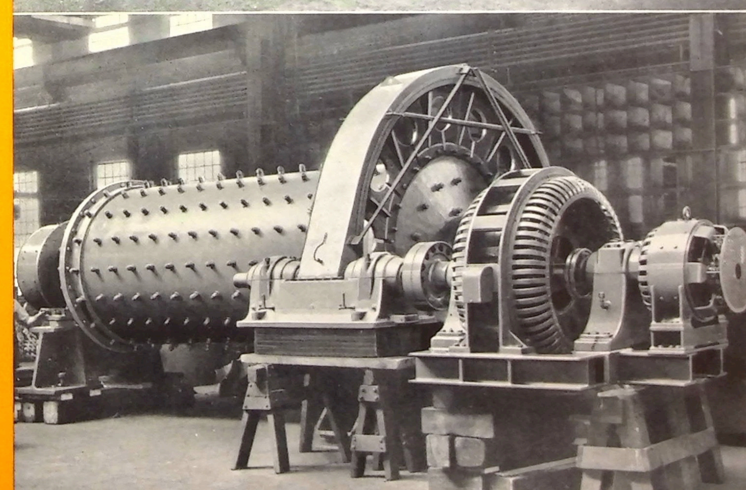
7′x15′ Rod Mill Showing Wuest Gear and Speed Reducer Drive.



5′x10′ Dry Grinding Rod Mill with Screw Feeder.

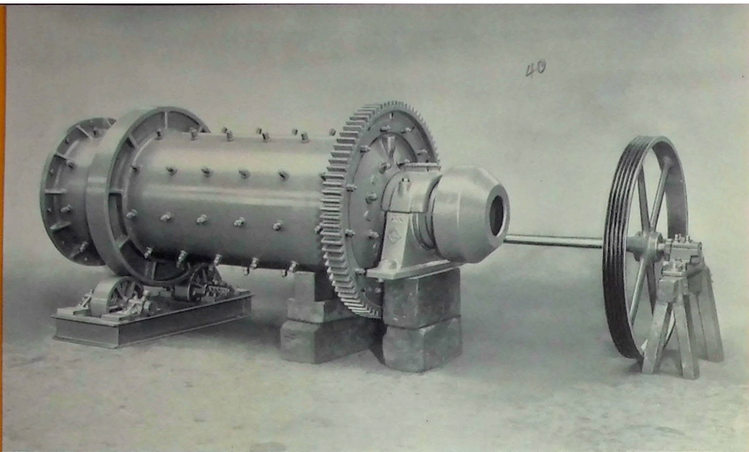


4′x8′ Rod Mill with Plate Steel Drum Feeder.

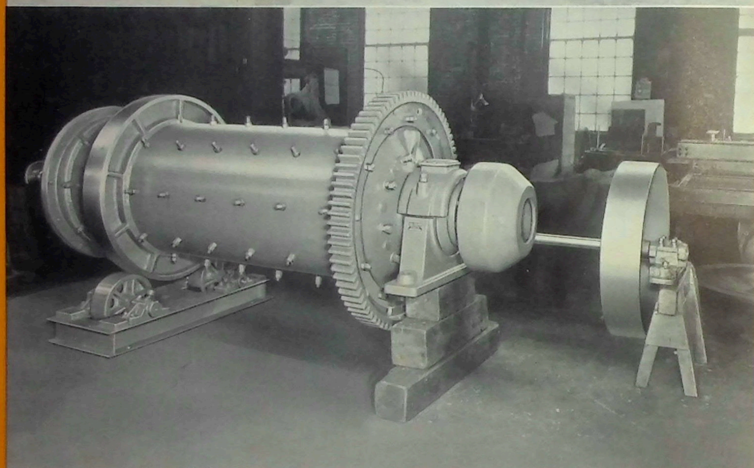


6′x15′ Dry Grinding Mill with Herringbone Gears, direct connected to Allis-Chalmers Synchronous Motor.

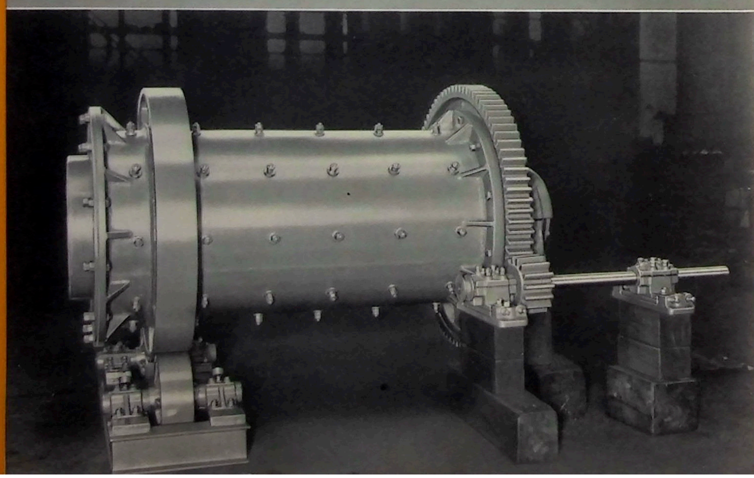
3'x8' Roller Suported Open End Rod Mill with Texrope Drive.



3'x8' Special Rod Mill with Cast Iron Drum Feeder and Pulley Drive.



3'x6' Rubber Lined Rod Mill, Spur Gear Drive.



TYPES OF DRIVES

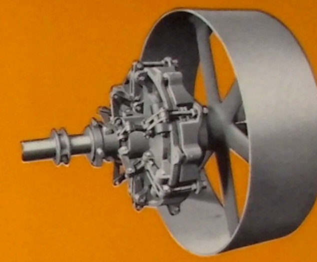
The following types of drive can be furnished:

Spur-gear, pulley-driven mills can be furnished with either plain or friction clutch pulley and either right or left hand drive with gear on discharge end.

Motor-driven mills can be furnished complete with wound rotor motors, 440 or 220 volts, 60-cycle, 3-phase, with gear on discharge end.

Texrope drives can be furnished where it is desired to use high speed motors.

Mills are designated right or left hand drive when facing the gear end.



Type "C" Friction Clutch Pulley.

SPUR GEAR AND PULLEY DRIVE

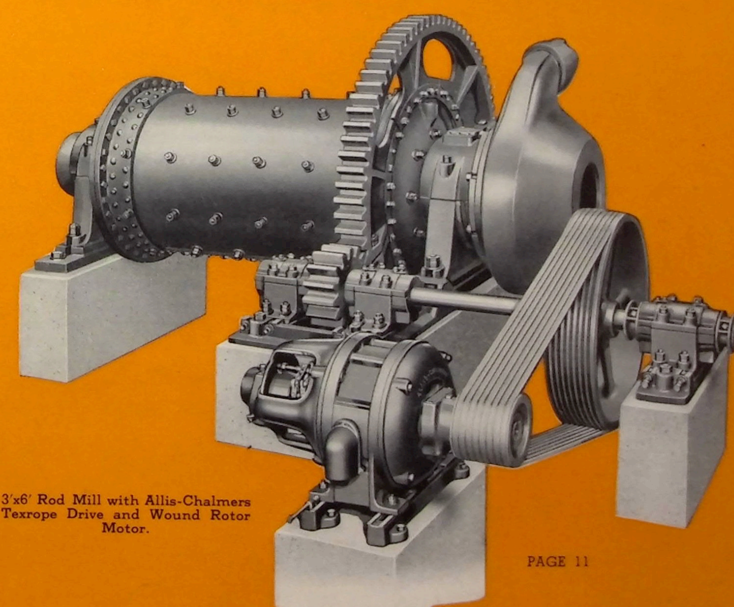
Spur gear drives are offered in three alternate combinations as follows:

1 Gear cast iron; pinion cast steel. These gears are made of the best grades of selected material. The gear teeth are accurately machine moulded and the pinion teeth accurately cut.

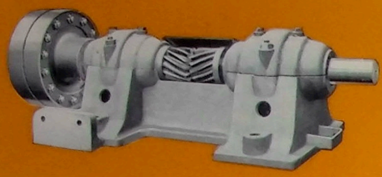
2 Gear cast iron; pinion cast steel. The gear and pinion teeth are accurately cut.

3 Gear cast steel; pinion cast steel. The gear and pinion teeth are accurately cut.

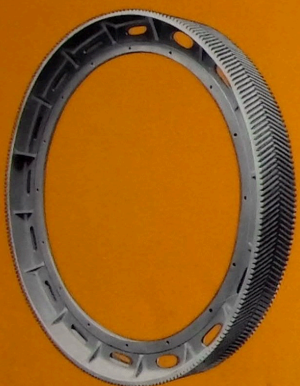
All gears are bored concentric with the axis of the mill. The web is machined on both sides and drilled to template so that when the teeth are worn



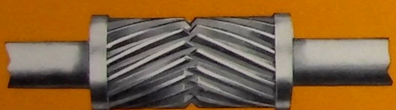
3'x6' Rod Mill with Allis-Chalmers Texrope Drive and Wound Rotor Motor.



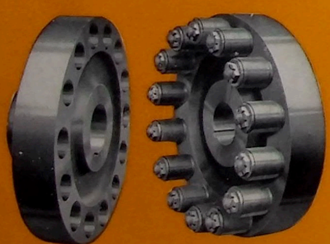
Countershaft Assembled.



Wuest Gear.



Wuest Pinion.



Bushing Type Flexible Coupling.
Split showing Construction.

on one side the gear can be reversed and a like amount of wear obtained on the other side.

All pinions are properly bored, keyseated and fitted to the countershaft.

The countershaft is of turned mild steel properly keyseated for the pinion and driving pulley and provided with two safety set collars. It is also provided with three high-grade chain-oiling bearings, each mounted on a heavy cast-iron sole plate. This sole plate is accurately planed on the top surface and provided with set-screw adjustment for the end of the bearing.

There is also provided a friction clutch driving pulley of size suited to the mill. It is properly turned, bored and keyseated, also balanced and fitted to the countershaft and is equipped with a Type "C" Allis-Chalmers 6-arm clutch with asbestos-faced block lining.

The friction clutch pulley sizes can be altered within certain limits. Plain pulleys will be supplied when ordered.

WUEST GEAR DRIVE FOR DIRECT CONNECTION

GEAR—The main driving gear is of the Wuest double helical type made of cast-steel with teeth accurately machine-cut. It is properly machined, drilled to template and bored concentric with the center line of the mill. It is also provided with necessary bolts for attaching it to the head.

PINION—The pinion is of the Wuest double helical type with teeth accurately machine-cut to match the gear. The pinion has two external shrouds made of rings turned with a slight inward taper and shrunk on the pinion ends. This gives a construction which will stand the severest operating conditions.

PINION SHAFT—The pinion shaft is made of forged steel and is forged integral with the pinion. It is properly keyseated on both ends for a flexible coupling and the length is such that either end may be used. This is done so that the pinion and gear may be reversed when the faces of the teeth on one side become worn.

The shaft is run in two special high-speed bearings of the ring-oiling type designed for this purpose. These bearings have removable babbitted shells with ball and socket seats. The lower half of these bearings is cast integral with the base plate. This base plate is arranged to be bolted to the sole plate supporting the main trunnion bearing.

With the Wuest gear drive, the main trunnion bearings are mounted on adjustable sole plates. Alignment is secured by aligning the mill axis to the countershaft axis. This does not disturb the alignment of the motor

and pinion shaft. This construction is of the latest design and the best Wuest gear drive on the market.

FLEXIBLE COUPLINGS REDUCE SHOCKS AND PROTECT THE DRIVE

A high-grade flexible coupling, designed especially for electric drive is shown in the illustration above. This coupling, which from its construction is designated as the bushing type, consists essentially of two disc castings. Projecting from the face of and rigidly attached to one of these discs are a number of pins upon which are assembled leather washers or bushings.

The bushings project into, and are finished to fit corresponding openings in the opposite disc. These bushings reduce the jar or shock incidental to starting, and thus protect the motor. This coupling freely permits the slight end play or lateral oscillation desirable for electrical drive.

ALLIS-CHALMERS MOTORS CAN BE SUPPLIED FOR ALL MILLS

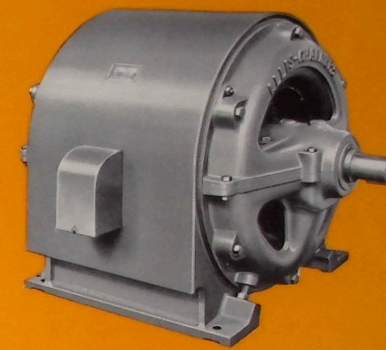
Motors of wound rotor type are furnished for direct connection to rod mills. They have a pull-out torque, not less than 200% of normal load torque with approximately 200% of normal current. This heavy-duty capacity combines with large air gap and liberally proportioned dust-proof bearings to make the motor operate for long periods with little or no repairs. The housing on the coupling end can be split to make all bearing parts accessible without removing the coupling from the shaft.

Improvements in the starting characteristics of synchronous motors have made this type suitable for direct connection to rod mills.

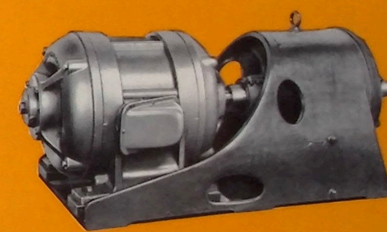
STARTING EQUIPMENT TO SUIT THE MOTOR

Starters for slip ring motors driving rod mills are designed so that the motor will deliver 150% full load torque on the first point. This usually is sufficient to start the machine, but provision is made in proportioning the grids for 200% full load torque on the second point, so that a large factor of safety is obtained over operating requirements.

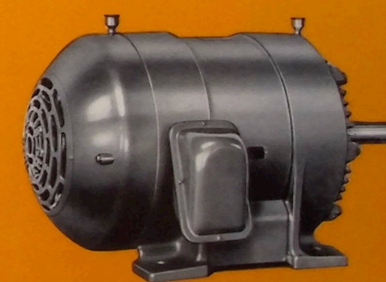
Starters are of the drum type and handle both the primary and secondary circuit of the motor. The drum structure is totally enclosed, having renewable contacts with the fingers and finger-board easily accessible. Separate resistors are provided so that the resistor banks can be located in any convenient place near the drum.



Typical Induction Motor of the larger sizes.



Gearmotor Unit for Slow Speed Drives.

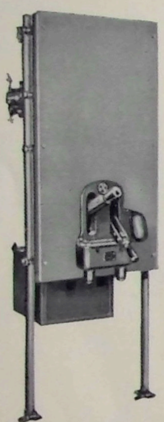


Enclosed Fan-Cooled Induction Motor.

OIL CIRCUIT BREAKER

Oil circuit breakers are not regularly included with the starting equipment, but can be furnished usually from stock. These breakers are of the wall mounting type, and have overload and no-voltage release. They can also be equipped with an ammeter mounted on the cover, and supplied with a pipe frame support. Panel mounted starters can also be furnished.

A desirable feature of this circuit breaker is the electrical interlock between the oil switch and the resistance starter whereby it is impossible to close the primary oil switch unless the resistance starter is on the first notch, that is, has full resistance in the secondary circuit of the motor, thus protecting the motor against a very suddenly applied load.



Standard Manually Operated Panel for Starting Squirrel Cage Motors of the Largest Ratings from Auto Transformers

FOUNDATION BOLTS

A complete set of foundation bolts can be supplied but are not included with mill except when ordered.

SECTIONALIZED MILLS

The Allis-Chalmers Manufacturing Company through its long association with the mining industry has furnished all types of mining machinery and many complete installations for mule-back transportation. Superior workmanship and careful fitting is of more importance in sectionalized machinery than in any other class. The extensive experience of the Allis-Chalmers Manufacturing Company in this class of work is a guarantee to the customer of practical design and satisfactory workmanship.

Allis-Chalmers sectionalized machinery is erected, bolted and marked before shipment, and all possible means and precautions are taken to insure rapid assembling and true fitting in the field.

To illustrate our special facilities for this class of work, we show on page 5 a view of a sectionalized rod mill recently built by us. The special features to be noted are that the mill is erected completely before shipment, insuring the accurate fitting of all parts in the field. Every fourth rivet hole in the shell was reamed and bolted with a fitted bolt to insure absolute alignment of shell while riveting in the field.

OPERATING INSTRUCTIONS

SIZE OF RODS

The diameter of the rods should be specified to meet the particular requirement and they should contain not less than .90 carbon, and preferably from 1.00 to 1.10 carbon, and should be machine straightened. The length of the rods should be at least 1″ shorter than the working length of the shell and to allow for the 1″ tolerance in cutting we recommend that the rods be specified 1″ less in length than actually required, viz., a mill with a working length between end liners of 10′-1″ would require rods specified as 9′-11″ long. The initial rod charge is not considered a part of the mill and is not furnished except on special order.

CARE OF WUEST GEARING

When the main gear and pinion are lined up in their bearings they should be in exactly parallel vertical and horizontal planes. The test of parallelism is to clean all grease from the gears, paint the pinion with red lead and revolve with the gear to see how the teeth bear. There should be an even bearing along the pitch line of the teeth. If the contact on one half is near the edge and on the other half near the center, and on the backs of the teeth on opposite ends, then it is pretty certain that the shafts are not lying in the same plane. In such case the mill should be moved on its adjust-

able sole plates so as to bring the axis of the mill in parallel with axis of the pinion shaft. Having ascertained that the shafts are parallel and that the gears will bear evenly along the pitch line of the teeth, it should then be made sure there is proper running clearance for the teeth to mesh without binding.

Theoretically, 2 or 3 thousandths of play on the back side of the teeth along the pitch line is sufficient. In practice, however, it must be remembered that the gears will warm up in service and that the large gear will expand in consequence. If the gears are set tight in mesh in the first place, then the expansion may cause them to bind, making them noisy and scoring the teeth. Some clearance is also desirable to leave room for lubricant between the two faces. We recommend a running clearance of from 10 to 20 thousandths depending upon the size of the gears. The clearance should be measured in the following manner: With the gears standing the pinion should be rotated until the forward sides of the teeth are in contact with the gear teeth. The running clearance will then be the distance between the back side of the pinion teeth and the gear teeth and can be measured by feelers. The clearance should be properly measured along the line of engagement which is in the same plane as the center line of the shaft. Since the teeth are helical, it is necessary to rotate the pinion a little to get the measurement along all the face.

The gear is mounted so that the edge of the rim runs true. The pinion should be perfectly free to adjust itself longitudinally into correct mesh with the gear. In other words, there should be no collars on the pinion shaft. On rod mill pinions, external shrouds are furnished which assist in positively locating the pinion teeth to the gear teeth.

The bushing coupling which connects the motor to the pinion should be mounted with at least 1/8″ clearance between the faces so that it will not impede the free end movement of the pinion which should be controlled entirely by the teeth or shrouds independent of any magnetic end play of the motor shaft under varying loads.

Wuest gears should be kept free of all dirt and grit and should be properly lubricated if best results are expected. A heavy gear grease is recommended, and the following method of application is recommended: For the first application it is very important that the gears be thoroughly cleaned with gasoline so as to remove old grease or paint. A small quantity of the grease is then melted and brushed evenly and thickly over the teeth of the gear and pinion. When the faces are clean the grease will adhere readily. Subsequent applications can be made as often as necessary by melting the grease and pouring it on the teeth in a thin stream while the gears are running.

BEARING LUBRICATION

Main trunnion bearings are best lubricated by a very heavy oil, and to retain the lubricant, wool waste is packed in the space at the top of the bearing. A semi-liquid grease can be used as an alternative for oil. When grease is used, wool waste is also recommended to retain the lubricant.

Countershaft bearings are of the ring oiling or chain type and should be lubricated with a high grade motor oil. The oil reservoirs should be drained and refilled with fresh oil at reasonable intervals.

LINERS AND REPLACEMENTS

We furnish shell liners in standard lengths of 2 and 3 feet and they should be placed so that the joints are staggered. All liners are common for either right or left hand mills, but liners of the Shiplap type must be placed so that the lifters are down. Shells with liners placed as shown in middle illustration on page 6 should revolve clockwise.

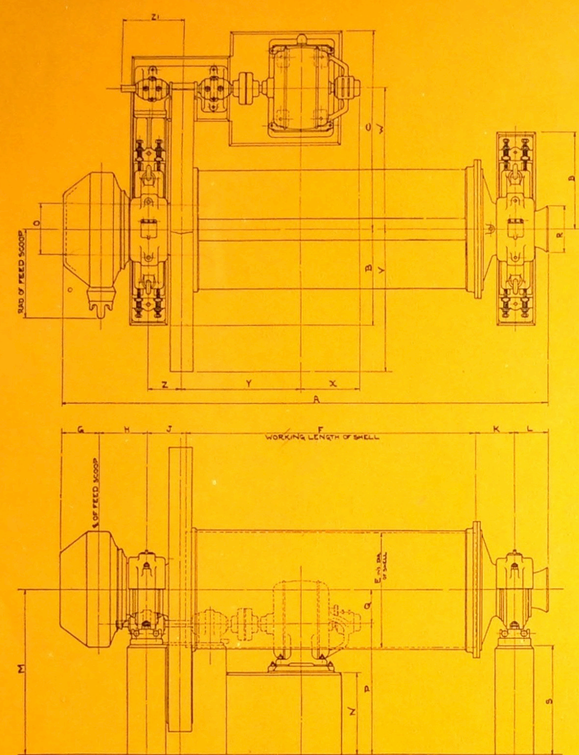
Leakage around the bolt holes can also be prevented by using washers cut from discarded rubber belting placed between the shell and the cut steel washer. When a new lining is placed in operation the mill should be stopped occasionally and bolts tightened until the heads are thoroughly seated in the liner.

STARTING NEW MILLS

A new rod mill installation should be revolved several hours without rod charge or pulp to determine whether alignment of the gears and bearings is correct. After the rod charge has been put in the mill it should again be revolved several hours before the feed is turned in. All liner bolts should be given a final tightening before the pulp is added.

WATCH THE SPEED

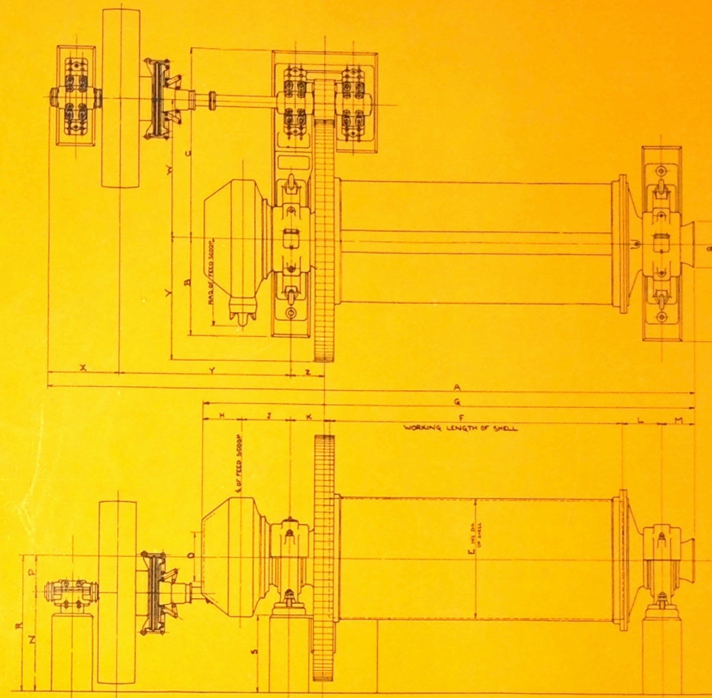
The recommended speeds are maximum and should not be exceeded. If the normal speed cannot be conveniently maintained it is preferable to reduce the speed rather than increase it.



CLEARANCE DIMENSIONS

ROD MILLS WITH WUEST GEARS AND MOTOR DRIVE

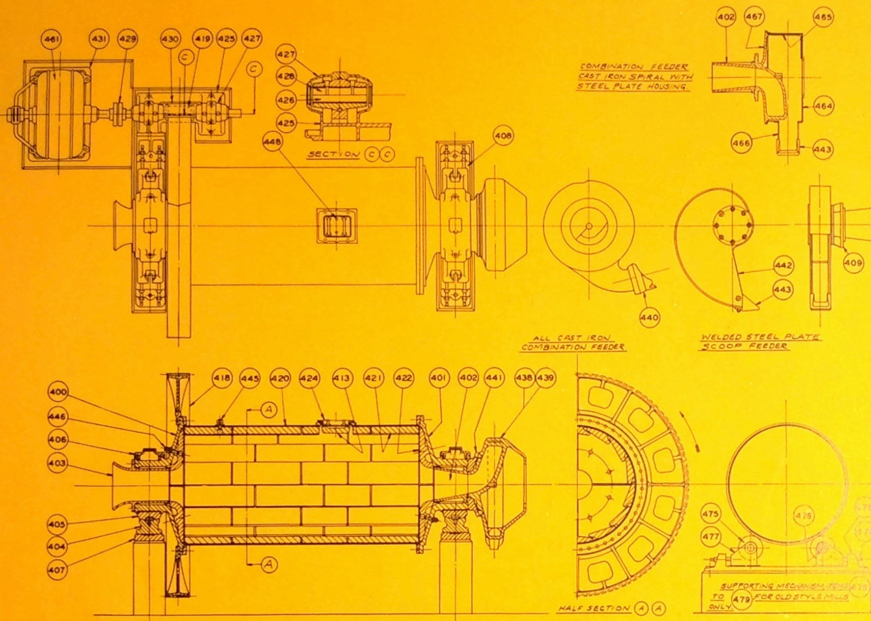
Size Dia.	Size Lgth.	A	B	C	E	F	G	H	J	K	L	M	N	O	P	Q	R	S	V	W	X	Y	Z	Z^3	Rad. of Feed Scoop
3'-0"	6'-1"	11'-5¼"	2'-8"	5'-0"	3'-0"	6'-1"	13"	15¼"	11½"	11½"	13"	3'-6"	15¼"	16"	2'-8½"	9½"	16"	22½"	3'-2⅛"	3'-3⅛"	22¼"	3'-11 13/16"	9⅜"	13¼"	35"
3'-0"	8'-1"	13'-5¼"	2'-8"	5'-0"	3'-0"	8'-1"	13"	15¼"	11½"	11½"	13"	3'-6"	15¼"	16"	2'-8½"	9½"	16"	22½"	3'-2⅛"	3'-3⅛"	23"	4'-0 11/16"	9⅜"	13¼"	35"
4'-0"	8'-1"	14'-10½"	3'-3"	6'-4 5/16"	4'-0"	8'-1"	16"	20"	16"	16"	13½"	4'-6"	20"	20"	3'-7"	11"	18¼"	2'-7"	4'-1"	4'-3 5/16"	2'-3"	4'-10"	13⅞"	2'-7"	46"
4'-0"	10'-1"	16'-10½"	3'-3"	6'-4 5/16"	4'-0"	10'-1"	16"	20"	16"	16"	13½"	4'-6"	20"	20"	3'-7"	11"	18¼"	2'-7"	4'-1"	4'-3 5/16"	2'-3"	4'-10"	13⅞"	2'-7"	46"
5'-0"	8'-1"	15'-8½"	3'-7½"	7'-4⅜"	5'-0"	8'-1"	16"	20½"	18½"	18½"	18"	5'-3"	19⅞"	20"	3'-10½"	16½"	2'-1⅝"	2'-10½"	4'-9⅞"	4'-10⅜"	2'-8¼"	5'-2⅞"	15½"	2'-8¾"	46"
5'-0"	10'1-"	17'-8½"	3'-7½"	7'-4⅜"	5'-0"	10'-1"	16"	20½"	18½"	18½"	18"	5'-3"	19⅞"	20"	3'-10½"	16½"	2'-1⅝"	2'-10½"	4'-9⅞"	4'-10⅜"	2'-8¼"	5'-2⅞"	15½"	2'-8¾"	46"
6'-0"	10'-1"	18'-1½"	4'-0"	7'-11 9/16"	6'-0"	10'-1"	16"	20½"	20"	20"	20"	6'-0"	2'-1¼"	20"	4'-6"	18"	2'-8"	3'-4"	5'-5"	5'-5 9/16"	2'-6¼"	6'-1⅛"	17"	3'-4"	46"
6'-0"	12'-1"	20'-1½"	4'-0"	7'-11 9/16"	6'-0"	12'-1"	16"	20½"	20"	20"	20"	6'-0"	2'-1¼"	20"	4'-6"	18"	2'-8"	3'-4"	5'-5"	5'-5 9/16"	2'-6¼"	6'-1⅛"	17"	3'-4"	46"



CLEARANCE DIMENSIONS

ROD MILLS WITH SPUR GEARS AND PULLEY DRIVE

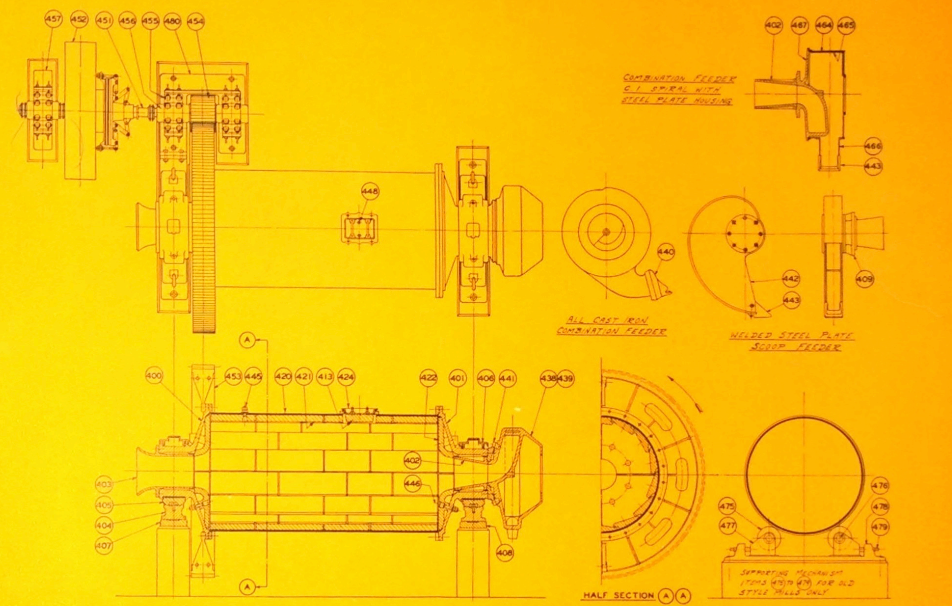
Size Dia.	Size Lgth.	A	B	C	E	F	G	H	J	K	L	M	N	O	P	Q	R	S	V	W	X	Y	Z	Rad. of Feed Scoop
3'-0"	6'-1"	14'-11⅜"	2'-8"	5'-2¼"	3'-0"	6'-1"	11'-5¼"	13"	15¼"	11½"	11½"	13"	2'-6¾"	16"	11¼"	16¼"	3'-6"	22½"	3'-2"	3'-7"	24¾"	3'-9⅝"	9⅜"	35"
3'-0"	8'-1"	16'-11⅜"	2'-8"	5'-2¼"	3'-0"	8'-1"	13'-5¼"	13"	15¼"	11½"	11½"	13"	2'-6¾"	16"	11¼"	16¼"	3'-6"	22½"	3'-2"	3'-7"	24¾"	3'-9⅝"	9⅜"	35"
4'-0"	8'-1"	20'-1⅝"	3'-4"	6'-4⅞"	4'-0"	8'-1"	14'-10½"	16"	20"	16"	16"	13½"	3'-3½"	20"	14½"	18¼"	4'-6"	2'-7"	4'-1 5/16"	4'-7⅞""	2'-5"	5'-10⅛"	13⅞"	46"
4'-0"	10'-1"	22'-1⅝"	3'-4"	6'-4⅞"	4'-0"	10'-1"	16'-10½"	16"	20"	16"	16"	13½"	3'-3½"	20"	14½"	18¼"	4'-6"	2'-7"	4'-1 5/16"	4'-7⅞"	2'-5"	5'-10⅛"	13⅞"	46"
5'-0"	8'-1"	20'-6¾"	3'-9"	7'-3½"	5'-0"	8'-1"	15'-8½"	16"	20½"	18½"	18½"	18"	4'-1½"	20"	19½"	2'-1⅝"	5'-9"	3'-4½"	4'-7⅝"	5'-0½"	2'-8¾"	5'-2"	15½"	46"
5'-0"	10'-1"	22'-6¾"	3'-9"	7'-3½"	5'-0"	10'-1"	17'-8½"	16"	20½"	18"½	18½"	18"	4'-1½"	20"	19½"	2'-1⅝"	5'-9"	3'-4½"	4'-7⅝"	5'-0½"	2'-8¾"	3'-2"	15½"	46"
6'-0"	10'-1"	24'-2½"	4'-0"	7'-3⅜"	6'-0"	10'-1"	18'-1½"	16"	20½"	20"	20"	20"	4'-1½"	20"	22½"	2'-8"	6'-0"	3'-4"	4'-7⅝"	4'-11⅜"	3'-2"	5'-11½"	17"	46"
6'-0"	12'-1"	26'-2½"	4'-0"	7'-3⅜"	6'-0"	12'-1"	20'-1½"	16"	20½"	20"	20"	20"	4'-1½"	20"	22½"	2'-8"	6'-0"	3'-4"	4'-7⅝"	4'-11 3/16"	3'-2"	5'-11½"	17"	46"



LIST OF PARTS

ROD MILLS WITH WUEST GEARS AND MOTOR DRIVE

400—Discharge Head
401—Feed Head
402—Trunnion Liner (feed end)
403—Discharge Spout and Liner
404—Main Bearing Base
405—Main Bearing Shell
406—Main Bearing Cap
407—Long Sole Plate
408—Short Sole Plate
409—Nozzle for Scoop Feeder (and trunnion liner)
413—Liner for Manhole Cover
418—Wuest Gear
419—Wuest Pinion and Shaft
420—Shell
421—Shell Liners
422—End Liners
424—Manhole Cover
425—Bearing Base
426—Bearing Shell (lower half)
427—Bearing Cap
428—Bearing Shell (upper half)
429—Flexible Coupling
430—Splash Guard
431—Motor Base Plate
438—Combination Feeder, L.H. (shown)
439—Combination Feeder, R.H.
440—Combination Feeder Protecting Nose
441—Combination Feeder Flange
442—Scoop Feeder (steel plate)
443—Feeder Nose
445—Sq. Ctsk. Hd. Bolt (shell)
446—Sq. Ctsk. Hd. Bolt (end liner)
448—Sq. Ctsk. Hd. Bolt (manhole)
461—Motor
464—Combination Feeder Housing
465—Combination Feeder Liners
466—Combination Feeder Scoop
467—Combination Feeder Spiral
475—Support Roller
476—Support Roller Shaft
477—Support Roller Bearing
478—Support Roller Sole Plate
479—Adjusting Screw



LIST OF PARTS

ROD MILLS WITH SPUR GEARS AND PULLEY DRIVE

400—Discharge Head.
401—Feed Head
402—Trunnion Liner (feed end).
403—Discharge Spout and Liner.
404—Main Bearing Base
405—Main Bearing Shell
406—Main Bearing Cap
407—Long Sole Plate
408—Short Sole Plate
409—Nozzle for Scoop Feeder (and trunnion liner).
413—Liner for Manhole Cover
420—Shell
421—Shell Liners
422—End Liners
424—Manhole Cover
438—Combination Feeder, L.H. (shown)
439—Combination Feeder, R.H.
440—Combination Feeder Protecting Nose
441—Combination Feeder Flange
442—Scoop Feeder (steel plate)
443—Feeder Nose
445—Sq. Ctsk. Hd. Bolt (shell liner)
446—Sq. Ctsk. Hd. Bolt (end liner)
448—Sq. Ctsk. Hd. Bolt (manhole liner)
451—Countershaft
452—Friction Clutch Pulley
453—Spur Gear
454—Spur Pinion
455—Chain Oiling Pillow Block Base and Babb. Shell
456—Chain Oiling Pillow Block Cap and Babb. Shell
457—Sole Plate for Countershaft Bearing
464—Combination Feeder Housing
465—Combination Feeder Liners
466—Combination Feeder Scoop
467—Combination Feeder Spiral
475—Support Roller
476—Support Roller Shaft
477—Support Roller Bearing
478—Support Roller Sole Plate
479—Adjusting Screw
480—Sole Plate (double) for Countershaft

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28 1/2			
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1 1/8
6
6 6/8
7

at 20 RPM mult	2.62
50 RPM	2
100	1.62
150	1.43
200	1.317
250	1.25
300	1.16
350	
400	1.069

200
20
40 – 50
1
40
24
960

10
300
3000

4-10
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