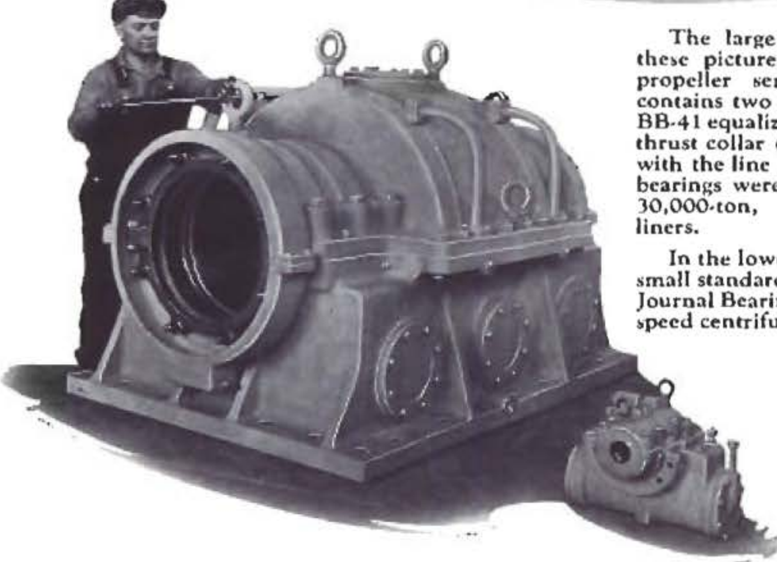
KINGSBURY BULLETIN HV

Dimensions, Capacities and Typical Mountings of Self-Aligning Equalizing Types of Kingsbury Thrust Bearings

1931

KINGSBURY



The large Kingsbury Bearing in these pictures was built for marine propeller service. The mounting contains two journal bearings and a BB-41 equalizing thrust bearing. The thrust collar (not shown) is integral with the line shafting. Four of these bearings were built for two 20-knot, 30,000-ton, 705-foot transatlantic liners.

In the lower view is shown also a small standard Kingsbury Thrust and Journal Bearing Mounting for a high-speed centrifugal pump.

Dimensions, Capacities and Typical Mountings of Self-Aligning Equalizing Types of

KINGSBURY THRUST BEARINGS

Horizontal and Vertical

BULLETIN HV

1931

Kingsbury Machine Works, Inc.
Main Office and Works
Frankford, Philadelphia, Pa.

Western Representative
Western Engineering Co.
San Francisco, Calif.

Canadian Representative
Canadian Westinghouse Co.
Hamilton, Ont.

Printed in U. S. A.

Some of the Uses for Kingsbury Thrust Bearings

MUNICIPAL SERVICE

Centrifugal Pumps for Water Supply and Other Purposes.

LARGE AND HIGH-PRESSURE STEAM STATIONS

Steam Turbines, Boiler Feed Pumps, Condenser Water Circulating Pumps, Coal Pulverizers, Condensate Pumps, Blowers, Deep-Well Pumps.

HYDRO-ELECTRIC STATIONS

Main Generators, Exciters, Governor Pumps, House Generators.

ELECTRIC SUB-STATIONS

Frequency Changers, Rotary Condensers.

IRRIGATING SYSTEMS

Deep-Well Pumps, Hydro-Electric Units.

MARINE SERVICE

Propellers, Steam Turbines, Boiler Feed Pumps, Blowers, Stabilizers.

OIL REFINERIES

High-Pressure Process Pumps, Deep-Well Pumps.

OIL PIPE LINES

Booster Pumps.

SUCTION DREDGES

Main Pumps, Ladder Shafts, Steam Turbines, Propellers.

PLATE GLASS MANUFACTURE

Grinding Machines, Polishing Machines.

KINGSBURY

Self-Aligning Equalizing Thrust Bearings

Where Kingsbury Bearings Are Used

Kingsbury Thrust Bearings are used to sustain the heaviest rotating loads used in industry, and also the heaviest high-speed loads. In the former class are included the rotors of the largest hydro-electric generators, weighing more than 1,000,000 pounds, also the screw propeller thrust of great ocean liners. In the latter class are included the powerful steam turbines used in modern central stations. In heavy hydro-electric and steam turbine service, Kingsbury Bearings entail the least possible loss of power. On propeller shafts they have far less friction than the horseshoe collars formerly used. In all classes of service they are kept cool without difficulty.

Holtwood Station of the Pennsylvania Water & Power Company. Kingsbury Thrust Bearings are 48 and 56 inches diameter. They are of the separately-adjustable (not equalizing) type. One of them is shown in the inset, with one shoe removed and one-half of split runner turned up on edge.

In smaller sizes Kingsbury Thrust Bearings are used in marine steam turbines, in Diesel engine driven vessels, in yachts and tug boats, in vertical electric motors, and in centrifugal pumps, both vertical and horizontal. They are used in suction dredges, in plate glass grinders, in large speed-reducing gears, and in a wide variety of miscellaneous applications. Their extremely low coefficient of friction, and their ability to endure heavy loads and high speeds for indefinite periods without measurable wear, are important factors in their favor.

One of the earliest commercial installations of the Kingsbury Thrust Bearing was made in 1912 in a hydro-electric unit at the Holtwood Station of the Pennsylvania Water & Power Co., on the Susquehanna River. The success of this bearing led to the adoption of Kingsbury Bearings for all ten units at that plant and to the rapid acceptance of Kingsbury Bearings among hydro-electric engineers. In similar manner the use of Kingsbury Bearings spread through the steam turbine field and then through the marine field; and they are now recognized as standard for those and similar duties.

The purpose of this bulletin is to set forth some of the standards which have been developed, both in the internal parts of the Kingsbury Bearing itself and in the mountings by which it is applied to various classes of service. All the thrust bearings here shown are *self-aligning*, and the thrust load is automatically *equalized* among the pivoted segments by which the thrust collar is supported. The mountings include a wide variety of applications, using either horizontal or vertical shafts and employing thrust bearings in sizes from 5 to 45 inches diameter of thrust collar.

The mountings are here shown only briefly. For more detailed information consult the appropriate bulletins listed on Page 39.

Basic Principle—the Wedge-Shaped Oil Film

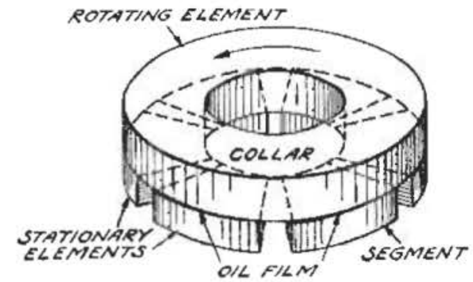


Figure 1: Basic elements of Kingsbury Thrust Bearing, showing wedge-shaped oil films.

The principle of Kingsbury Thrust Bearings is that of the wedge-shaped film. An oil film between two sliding surfaces (for example, a journal in a bearing) tends to assume a tapering form, with the thick end at the entering side. When the film is constantly supplied with fresh oil, there is a complete separation of the surfaces and hence no wear. The actual difference between the thick and thin ends may be no more than one or two thousandths of an inch; yet it is essential for proper functioning of the bearing.

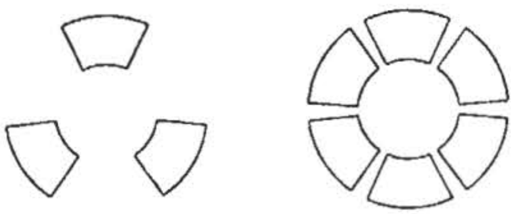


Figure 2: Standard Kingsbury Bearings described herein have either three or six shoes.

The film is under maximum pressure near the center of the loaded area, and the sum of the unit pressures is equal to the load carried.

The Kingsbury Bearing makes possible the automatic formation of wedge-shaped oil films under a thrust load, thus accomplishing in thrust bearings what a well-designed journal bearing does in the case of radial loads. This result is secured by dividing one of the bearing elements into segments, usually three or six in number. These segments are so supported and pivoted that they are free to tilt slightly. Thus the oil films assume automatically whatever taper is required by the speed, load and oil viscosity.

The coefficient of friction of Kingsbury Thrust Bearings is approximately from .001 to .005, depending on unit load, speed and viscosity of the oil. It is least under the heaviest loads and lowest speeds. A Kingsbury Bearing will easily sustain loads of 300 pounds per square inch of segment area, and higher pressures are frequently carried, especially in the larger bearings or when heavy oils are used.

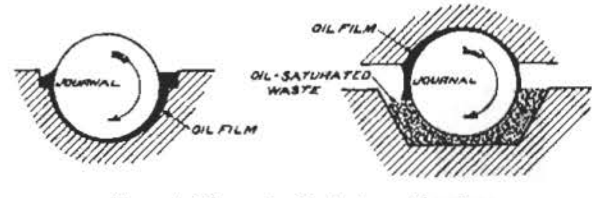


Figure 3: The wedge film in journal bearings.

Figure 4: The pivoted shoes (a fourth shoe is inverted to show the hardened steel bearing button set into its base).

Figure 5: Standard runner for bearings with vertical shaft.

Figure 6: Standard collar for bearings with horizontal shaft.

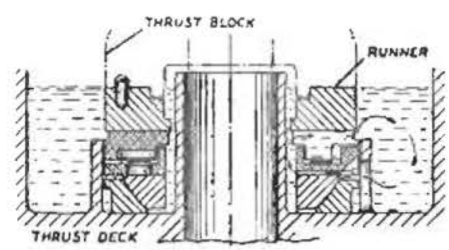


Figure 7: Section of three-shoe vertical thrust bearing, showing oil circulation and main features of mounting.

Mechanical Elements

The essential elements of Kingsbury Thrust Bearings are: the thrust collar or "runner," which is made of cast iron or steel and commonly turns with the shaft; the tilting segments or "shoes," made of bronze or faced with babbitt; the shoe-supporting member, called the "base ring;" and means for aligning the bearing and for equalizing the load among the shoes. Vertical bearings usually come with "runner" included and horizontal bearings with the "collar" included, the latter being adapted for clamping to the shaft. For all bearings in this bulletin the equalizing means consist of either a spherically-seated pair of washers or a set of sensitive rocking levers called "leveling plates." See Figures 7 and 8. The spherically-seated washers are used with 3-shoe bearings, the leveling plates with 6-shoe bearings.

Figure 10: Style N thrust bearing. For use with vertical or horizontal shaft.

Figure 11: With vertical runner added, Style N becomes Style NV. The arrows show direction of oil flow.

The "shoes" have large hardened steel buttons set into their backs. These bear either on similar buttons set into the shoe cage, if the bearing is of 3-shoe type, or on the hardened surfaces of the steel "leveling plates," if the bearing is of 6-shoe type. The shoe insets are usually placed to permit the shaft to rotate in either direction.

The spherical washers and shoe cage of the 3-shoe bearings must be assembled over the end of the shaft. The base rings of the 6-shoe bearings are split, as shown in Figure 18. This is often a great advantage for assembling. The base ring of the 6-shoe Style KV bearing is, however, made in one piece. See Figure 17. For a vertical bearing, as a special feature, the "runner" may be made in halves without change of size; but a "collar" used with a horizontal bearing requires, when split, to be made about twice its standard solid thickness. See Figures 56 and 58.

Figure 12: Style J thrust bearing. For use with vertical or horizontal shaft.

Figure 13: With vertical runner added, Style J becomes Style JV. The arrows show direction of oil flow.

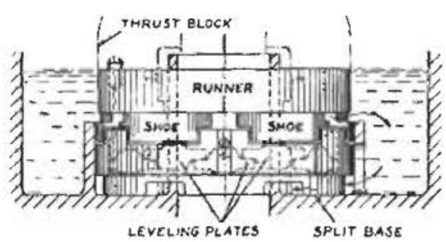


Figure 8: Section of six-shoe vertical thrust bearing, showing oil circulation and main features of mounting.

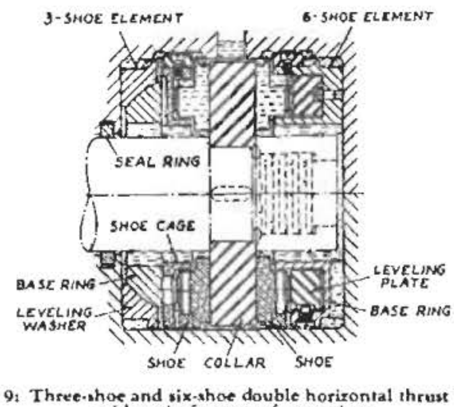


Figure 9: Three-shoe and six-shoe double horizontal thrust bearing, with main features of mounting.

Lubrication—the Oil Bath

Since a continuous flow of oil between the shoes and runner is essential, the oil circulation of Kingsbury Thrust Bearings has been very carefully worked out. The oil enters from the surrounding space through passages provided in the stationary part of the bearing, and on reaching the inner edges of the shoes flows radially outward between them. This movement is stimulated by the rotation of the thrust collar.

In vertical mountings the bearing is permanently submerged in an oil bath to a point above the bearing surfaces. Oil circulation within the bath is automatic, and no pump is needed except when external cooling is used. In horizontal mountings, however, only the lower part is ordinarily submerged when the shaft is at rest, and some form of pump is necessary to keep the bearing cavity full of oil when the shaft is turning. However, there is very little internal pressure to be overcome by such a pump.

Shoe cages of the N, J and B series are keyed to register their oil passages with the oil circulating holes in the vertical retaining flanges, or with the oil inlet in the casing if the bearing is horizontal.

In most vertical bearings there is an oil retainer between the shaft and the bearing to prevent escape of the oil downward along the shaft. This is a flanged sleeve, fitted into the mounting. It must come well above the oil level. See Figure 14.

The oil circulation in horizontal bearings follows the same direction as in vertical bearings. Similar provision for inflow and outflow is necessary. Figures 43 and following show the use of oil seal rings and drains at the ends of the bearings.

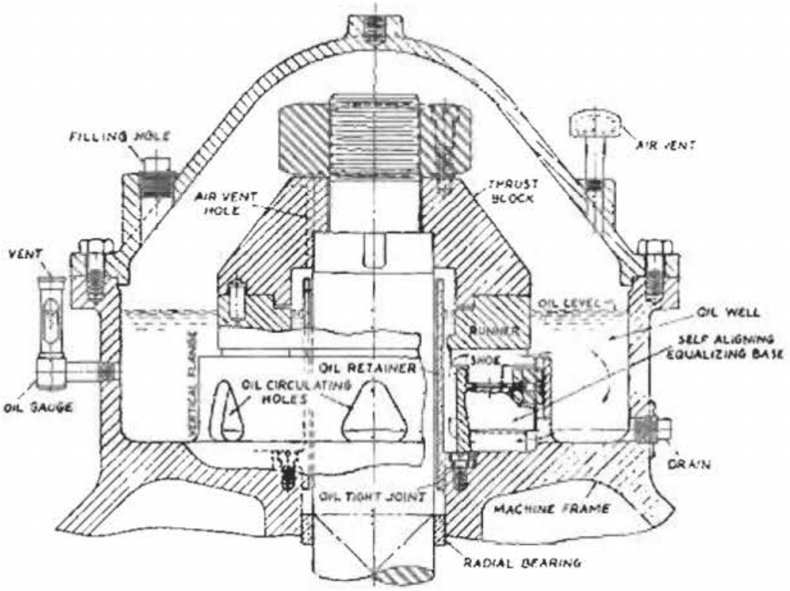


Figure 14: Simple mounting for vertical thrust bearing. Arrows show direction of oil flow.

NOTE: For clearness the bearing is shown as of Style NV, JV or BV, and the shoe-retaining flange is integral with the base mounting. A better design is to omit the shoe-retaining flange and use a Style LV or KV bearing, in which the base ring is extended upward to retain the shoes. See Figures 16 and 17. Customers preferring to build a shoe-retaining flange integral with the base should consult us regarding the size and spacing of the oil holes shown

Figure 15: Style N bearing with shoes removed, showing hardened steel support buttons in shoe cage.

Left — Figure 16: Style LV thrust bearing for vertical shaft. Runner is shown in phantom. For vertical uses this is the most convenient form of three-shoe Kingsbury Thrust Bearing, as it does not require a separate shoe-retaining flange.

Right — Figure 17: Style KV thrust bearing for vertical shaft. Runner is shown in phantom. For vertical uses in its size range this is the most convenient form of six-shoe bearing, as it does not require a separate shoe-retaining flange. Style KBV (see Page 19) offers the same advantage in the larger sizes.

For the most-used applications of Kingsbury Bearings we have developed certain standard mountings, which are completely self-contained as to bearing and cooling arrangements. In the horizontal mountings circulation is maintained by a device called a pumping ring, operating on the viscosity principle. It delivers a large volume of oil, which floods the

Figure 18: Style J bearing, with shoes removed to show leveling plates; also one separate leveling plate. Style J or B must be used where split construction is necessary for assembling. In vertical bearings a shoe-retaining flange is required either as an integral part of the thrust deck (see Figure 14) or as a separate ring (see Figure 32).

Figure 21: Style JHN double thrust bearing for horizontal shaft.

Figure 22: Style NHN double thrust bearing for horizontal shaft.

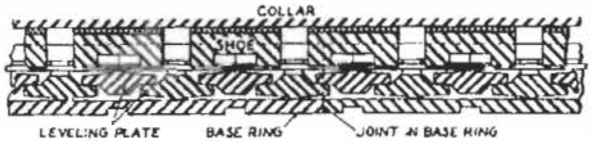


Figure 19: Developed section, showing how the leveling plates of Style J and B thrust bearings distribute the load equally among the six shoes.

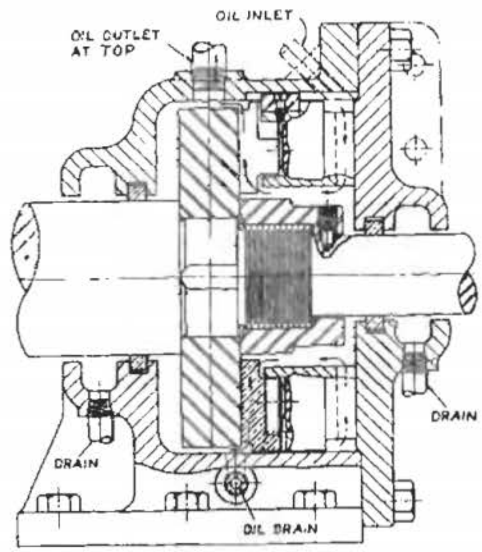


Figure 20: Simple mounting for a single horizontal thrust bearing. Arrows show direction of oil flow. See also Figure 44, Page 34.

bearing quickly at the start and maintains a rapid circulation. For mountings constructed by the customer, a gear pump is recommended. In all mountings designed for forced lubrication with external cooling, the oil inlet and outlet must be located as shown in the drawings.

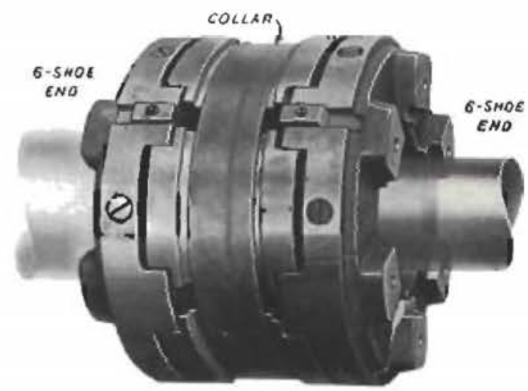


Figure 23: Style JHJ or BHB double thrust bearing for horizontal shaft.

General Information

Figure 24: Combined thrust and radial bearing with cooling coil. (Compare Figure 37 on Page 31.)

Cooling

As Kingsbury Bearings are used for relatively heavy loads, and often for high speeds, the heat generated in them requires attention. At moderate speeds and loads simple radiation, aided by the oil bath circulation, is often sufficient. A fan may be added when needed. Heavy loads and high speeds require water cooling.

If *air cooling* is employed, the size, design and location of the housing will affect the radiation. Mountings are available having vertical outside fins and special internal fins. A nearby moving part, such as a flywheel or armature, may give sufficient air movement; or a fan may be mounted on the shaft. Figure 36 on Page 31 shows one arrangement which we can furnish for transferring heat rapidly from the oil to the surrounding air.

Table IV on Page 13 shows speed limits permissible for air-cooled bearings under average conditions, using plain mountings (not ribbed). It is based on a room temperature of 80 degrees F. and oil having a viscosity of 300 to 400 Saybolt at 100 degrees F., with free circulation of the air. With ribbed mountings and good air circulation, the speed may be increased 25 per cent or more. For adverse conditions it should be reduced 25 per cent. For higher speeds the oil may be cooled by pumping it through an external coil placed in the path of moving air. See Figure 40 for oil circulator.

Water cooling may be accomplished by a cooling coil in the oil bath itself, or by pumping the oil through a coil of pipe in an outside water bath. (See Figure 40.) In the self-contained mountings mentioned on the preceding page, the cooling coil is contained in an oil reservoir built into the mounting. Water cooling is used for the highest speed service. See "Typical Mountings," Pages 28 to 38.

Single and Double Thrust

Kingsbury Bearings may be arranged to take thrust in either or both directions. Sometimes the normal thrust is in one direction, and the reverse thrust is considerably smaller. In such cases a 6-shoe bearing can be used for the normal thrust and a 3-shoe bearing of the same diameter, having half the capacity of the 6-shoe bearing, for the reverse thrust.

Self-Contained Kingsbury Bearings

Included in Pages 28 to 38 are a number of Kingsbury Bearing units which are completely self-contained, including radial bearing, automatic oil

Figure 25: Split type equalizing double thrust bearing, Style BB, together with split facing collar of Type A. See also Figure 58, Page 38. This bearing is shown on Page 38 in the mounting, Figure 57.

circulation and coolers where required. We can furnish such self-contained units for both vertical and horizontal shafts, and a number of them are standardized in sizes up to 45 inches diameter of thrust collar. They are arranged to be readily attached to a flange or deck of the customer's machine, and their load-carrying capacity at stated speeds is guaranteed. As they have automatic oil circulation, they do not require any external pump. These and other mountings shown on Pages 28 to 38 are more fully described in Bulletins Nos. G-1 and S for horizontal shafts, and Bulletin M for vertical shafts. See Page 39 for full description of our publications.

Electrically Insulated Thrust Bearings

In electrical machinery, especially for high speeds and heavy loads, it is frequently necessary to insulate the bearings to protect them from injury by stray electric current. Bearings with insulated sub-bases are furnished when specially ordered. See Figure 33, Page 30. The extra heights required by such bases for the larger bearings are listed with their dimensions.

Installation and Operation

For minimum heating it is necessary to use oil of viscosity suited to the speed and load. We specify the proper oil viscosity with every bearing, and mark it on the nameplate.

General instructions are packed with each bearing and in every box of spare parts. Copies are sent also to the purchaser's engineering department.

Patents

Kingsbury Thrust Bearings, their lubrication, cooling and mountings, are protected by many patents in the United States and in Canada.

Inquiries and Orders

Kindly apply to our nearest office for prices and delivery. The internal parts whose dimensions are tabulated herein are in stock for a wide range of the smaller sizes. Sometimes special runners or collars are required, but standard bases and shoes should always be used if possible. Certain of the mountings shown on Pages 28 to 38 are standarized in the smaller sizes, and can be furnished complete at short notice. See captions on those pages marked "STANDARDIZED." Other bearing sizes and mountings can be furnished on reasonable notice. Those required to meet special conditions are built to order, and sufficient time should be allowed.

All inquiries and orders should be accompanied by full information as to service intended, space available, shaft diameter through thrust bearing, thrust load, shaft speed, type of mounting and preferred method of cooling.

Thrust Capacity

The safe load for a Kingsbury Bearing depends chiefly upon three factors: bearing size, shaft speed and oil viscosity. An increase in any of these factors increases the permissible load without changing the thickness of the oil film. Kingsbury Bearings carry heavier loads at high than at low speeds. The coefficient of friction is least when the bearing is well loaded.

Tables I, II and III show rated capacities of 6-shoe and 3-shoe standard Kingsbury Bearings respectively at various speeds. These tables apply to both vertical and horizontal bearings. They are based on a viscosity of 150 seconds Saybolt at the operating temperature. These capacities may be safely exceeded by

Figure 26: Split type equalizing double thrust bearing, Style BB. Used when thrust collar is integral with shaft. Style JJ is similar. This bearing is shown on page 35 in Figures 49 and 50.

10 per cent and even by 25 per cent if the oil viscosity is increased in the same proportion. However, the bearing pressure should not exceed 400 pounds per square inch of segment area, which is the safe limit of mechanical strength for the bearings listed in this bulletin. Consult us freely about special conditions, such as loads, speeds and proportions outside the range given, and overloads exceeding 25 per cent.

Table I Rated Thrust Capacities: Sizes 5 to 17 inches

(In Pounds)

SIX-SHOE BEARINGS

Size	Area Sq. In.	Revolutions per Minute							
		100	200	400	800	1200	1800	2500	3600
5	12.5	1,440	1,700	2,000	2,400	2,600	2,900	3,200	3,500
6	18.0	2,300	2,700	3,200	3,800	4,200	4,600	5,000	5,500
7	24.5	3,300	3,900	4,700	5,600	6,200	6,800	7,400	8,000
8	32.0	4,600	5,500	6,600	7,800	8,600	9,600	10,400	11,400
9	40.5	6,200	7,400	8,800	10,400	11,400	13,000	14,000	15,000
10½	55.1	9,200	10,800	13,000	15,400	17,000	19,000	21,000	22,000
12	72.0	12,800	15,200	18,000	21,000	24,000	26,000	28,000	29,000
13½	91.1	17,200	20,000	24,000	29,000	32,000	35,000	36,000	36,000
15	112.5	22,000	26,000	32,000	37,000	41,000	45,000	45,000	.....
17	144.5	30,000	36,000	43,000	51,000	57,000	58,000	58,000	.....

Table II Rated Thrust Capacities: Sizes 19 to 45 inches

(In Pounds)

SIX-SHOE BEARINGS

Size	Area Sq. In.	Revolutions per Minute							
		70	100	150	200	300	500	700	900
19	180	37,000	40,000	44,000	48,000	53,000	60,000	65,000	69,000
21	220	47,000	51,000	57,000	61,000	68,000	77,000	84,000	89,000
23	264	59,000	65,000	72,000	77,000	85,000	97,000	105,000	106,000
25	312	73,000	80,000	88,000	95,000	105,000	119,000	123,000	123,000
27	364	88,000	97,000	107,000	115,000	127,000	144,000	146,000	146,000
29	420	106,000	116,000	128,000	137,000	152,000	168,000	168,000	......
31	480	125,000	137,000	151,000	162,000	180,000	192,000	192,000	......
33	544	146,000	160,000	177,000	189,000	210,000	220,000	220,000	......
37	684	195,000	215,000	235,000	250,000	275,000	275,000	......	......
41	840	250,000	275,000	305,000	325,000	335,000	335,000	......	......
45	1,012	315,000	345,000	385,000	405,000	405,000	......	......	......

NOTE: For bearings of larger sizes and greater capacities, consult us, and also refer to our lines of Adjustable Bearings and Spherical Bearings. See Page 39.

Rated Thrust Capacities: Sizes 5 to 17 inches — Table III

(In Pounds)

THREE-SHOE BEARINGS

Size	Area Sq. In.	Revolutions per Minute							
		100	200	400	800	1200	1800	2500	3600
5	6.3	720	850	1,000	1,200	1,300	1,450	1,600	1,750
6	9.0	1,150	1,350	1,600	1,900	2,100	2,300	2,500	2,750
7	12.3	1,650	1,950	2,350	2,800	3,100	3,400	3,700	4,000
8	16.0	2,300	2,750	3,300	3,900	4,300	4,800	5,200	5,700
9	20.3	3,100	3,700	4,400	5,200	5,700	6,500	7,000	7,500
10½	27.6	4,600	5,400	6,500	7,700	8,500	9,500	10,500	11,000
12	36.0	6,400	7,600	9,000	10,500	12,000	13,000	14,000	14,500
13½	45.6	8,600	10,000	12,000	14,500	16,000	17,500	18,000	18,000
15	56.3	11,000	13,000	16,000	18,500	20,500	22,500	22,500	.....
17	72.3	15,000	18,000	21,500	25,500	28,500	29,000	29,000	

Maximum Speeds for Air-Cooled Operation — Table IV

Average Air Conditions (*See Notes Below*)

Thrust Load (Lbs.)	Revolutions per Minute							
	6-Shoe Bearings for Vertical or Horizontal Service				3-Shoe Bearings for Vertical or Horizontal Service			
	Single		Double		Single		Double	
	A	B	A	B	A	B	A	B
2,000	450	320	385	295	565	330	485	305
4,000	360	265	310	240	455	275	390	255
8,000	285	220	245	195	360	230	310	210
12,000	250	195	215	170	315	205	270	190
20,000	210	165	180	145	265	180	230	165
30,000	180	145	155	130	...	...	...	...
40,000	165	135	140	120	...	...	...	...
60,000	145	120	125	105	...	...	...	...
80,000	130	110	115	97	...	...	...	.
120,000	115	96	99	86	...	...	...	..
200,000	97	84	84	75	...	...	...	
Typical Mounting	Fig. No. 28 Fig. No. 46	Fig. No. 34	Fig. No. 31 Fig. No. 47	Fig. No. 51	Fig. No. 28 Fig. No. 46	Fig. No. 34	Fig. No. 31 Fig. No. 47	Fig. No. 51

Assumptions: Surrounding air can pass freely over vertical walls of mounting. Maximum air temperature about 80 degrees F. Viscosity of oil about 400 Saybolt at 100 degrees F.

Vertical Service: Use column A when radial bearing is omitted, or when it is placed below the thrust and cooled by machine frame. Use column B when radial bearing is above the thrust bearing.

Horizontal Service: Use Column A when thrust mounting contains no radial bearing or when mounting is enlarged proportionately because of the addition of a radial bearing.

Use Column B for very compact mountings with a radial bearing. For compact mountings containing two radial bearings use 90 per cent of speed in Column B.

Where "Typical Mounting" shows water cooling coil or external oil circulation, such cooling device is assumed to be omitted.

Air view of Sun Oil Company Refinery, Marcus Hook, Pa. Kingsbury Thrust Bearings are used in the multi-stage centrifugal pumps by which hot oil, under high pressure, is moved through the refining processes. They are used also on the propeller shafts of the ocean and river tankers, some of which are seen in the foreground.

STANDARD INTERNAL PARTS

The internal parts of self-aligning equalizing Kingsbury Bearings are standardized in sizes from 5 to 45 inches diameter of runner or collar. Larger sizes are also furnished when required. They may be bought either with or without the runner or collar. On Pages 16 to 25 they are listed in detail.

To customers ordering frequently, the following notes will be helpful:

Runners and Collars: The "runner" for a vertical shaft differs in shape from the "collar" for a horizontal shaft. In the bearing style identification the letter V indicates that the bearing referred to includes a separate *runner* for vertical service. H indicates a separate *collar* for horizontal service.

Three-Shoe Bearings with Vertical Runners: These are regularly made only in sizes up to 17 inches, and are identified by the letters LV and NV. They are characterized by the use of spherical leveling washers, as shown in Figure 7. Oil enters the recesses in the bottom of the shoe cage, as shown by arrows in the photograph, Figure 11, and flows radially inward to the shaft and then to the shoes. Thence it passes outward between the shoes. The shoe cage restrains the shoes against rotation with the shaft, but not against outward displacement. The various base elements of these bearings are solid rings.

Bearings LV have a raised rim to retain the shoes against radial displacement, hence they do not require separate shoe-retaining flanges in the mountings. Holes for the entry of oil are drilled in this rim, and must not be covered by any surrounding structure. See Figure 16, Page 8. This is the most generally useful type of vertical 3-shoe bearing.

Bearings NV require that the equivalent of the raised rim in the LV bearing be included in the customer's construction in order to retain the shoes. See dotted lines on Page 16, also alternate construction with separate shoe-retaining ring, Figure 32. Openings for the entry of oil are essential, and we should be consulted about them. See Figures 14 and 27. The shoe cage is keyed, so that the oil passages in it will register with the openings in the customer's construction. These bearings are useful also where the space is very restricted, as where the housing is just large enough to receive the runner and shoes.

Six-Shoe Vertical Bearings: In 6-shoe bearings the leveling plates are set into the base ring, and the latter has raised lugs which hold the shoes against rotation. See Figures 18 and 19, Page 9.

In all 6-shoe bearings oil enters slots under the base ring, and thence follows the same paths as already described. The oil passages must be kept open.

One 6-shoe bearing is made, for vertical shafts only, with a raised rim integral with the base ring. It is designated Style KV, and is furnished only in sizes up to 17 inches. See Figure 17, Page 8. The base ring of this bearing is not split. Where split construction is not required for assembling, Style KV is the most convenient vertical 6-shoe bearing within its size range.

Styles JV and BV have no raised rim on the base ring, and the latter is made in halves. They require a retaining rim to be furnished in the customer's construction, as shown by dotted lines, Pages 18-19, for holding the shoes in place radially. Cored oil holes must be provided, leading to the oil slots in the base ring, and the base ring must be keyed so that the holes and slots will register. We should be consulted regarding this. Styles JV and BV, like Style NV, are useful also in restricted spaces.

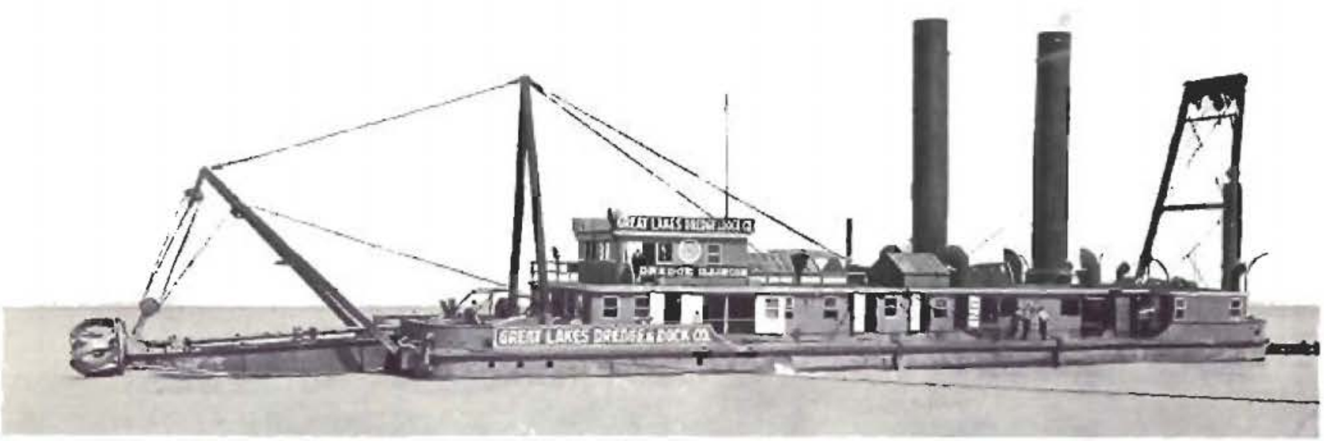
Style JV is made in sizes up to 17 inches. From 19 inches upward Style BV replaces it. The two are identical except that the base ring in Style B is more shallow, hence the oil slots in it must be supplemented by corresponding oil slots in the customer's construction. See dotted lines in the details marked Oil Slots, on Page 19.

In Style KBV a shoe-retaining band is clamped around the upper part of the base ring; hence the base ring requires locating only by dowels. This style is built in sizes 19 inch and upward; see Page 19. Its base ring is made in halves, with bolted joints.

Bearings Without Collars: Without "runner" or "collar," the 3-shoe bearing is designated simply N, and the 6-shoe bearing simply J or B. They are employed with integral thrust collars, and may be mounted either vertically or horizontally. Examples of their use are shown in Figure 30, Page 29, and Figure 48, Page 35. Double bearings made up of two such single units, for use with a shaft having an integral collar, are designated Style NN, JJ or BB. See Figures 31 and 49. In all cases our recommendations regarding oil passages, keying, and so on, must be carefully followed. Three-shoe bearings are regularly furnished only up to 17-inch size.

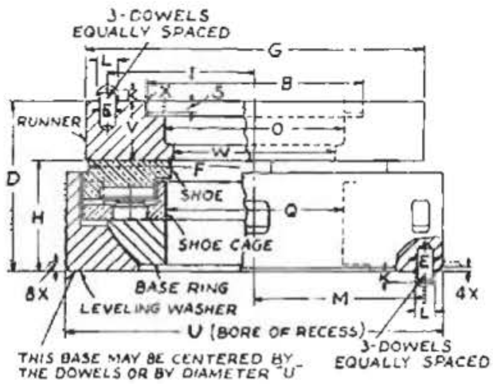
Horizontal Bearings: With a separate collar of the type used with horizontal bearings, the single 3-shoe bearing becomes Style NH. The double 3-shoe bearing with one collar becomes Style NHN. Styles JH and BH are single-thrust bearings of Styles J and B with collar added for a horizontal shaft. Styles JHN, JHJ and BHB are the double bearings of their respective types, Style JHN having 6 and 3 shoes, and the others 6 shoes on each side.

In horizontal mountings, when running, the entire bearing to the top of the housing is flooded with oil, circulation being maintained either by the viscosity pumping ring forming part of our self-contained bearings or by other adequate means.

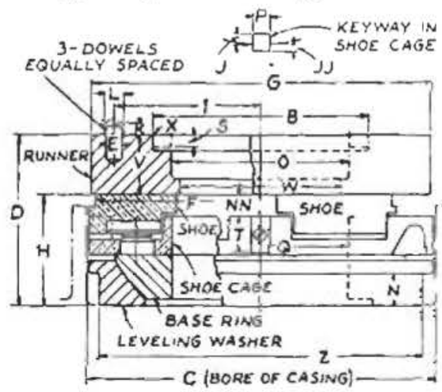


Hydraulic Dredge "Illinois," Great Lakes Dredge & Dock Company, Chicago. Heavy duty Kingsbury Thrust Bearing and independent Kingsbury Journal Bearing used on the pump shaft.

3-Shoe Self-Aligning Equalizing



STYLE LV



STYLE NV

NOTE: See Figure 14 for oil circulating holes in dotted flange surrounding Style NV bearing with automatic lubrication. See Figures 30 and 44 for location of oil inlet with forced lubrication.

Identification	LV-5 NV-5	LV-6 NV-6	LV-7 NV-7	LV-8 NV-8	LV-9 NV-9	LV-10½ NV-10½	LV-12 NV-12	LV-13½ NV-13½	LV-15 NV-15	LV-17 NV-17
Area (Net Sq. In.)	6.3	9.0	12.3	16.0	20.3	27.6	36.0	45.6	56.3	72.3
Cap. at 150 lbs. 1 sq. in.	945	1,350	1,845	2,400	3,045	4,140	5,400	6,840	8,445	10,845
Cap. at 250 lbs. 1 sq. in.	1,575	2,250	3,075	4,000	5,075	6,900	9,000	11,400	14,075	18,075
(Capacity varies with speed. Consult Table III on Page 13.)										
Weights (Lbs. Net) LV Bearing, complete	10	17	27	39	54	84	125	175	230	325
Weights (Lbs. Net) NV Bearing, complete	8	14	21	29	42	65	98	140	185	270
Weights (Lbs. Net) Spare Runner	3¼	5½	8	12	16	26	43	61	81	117
Weights (Lbs. Net) 3 Spare Shoes	1	1¾	3	4½	6	10	13	17½	22½	31
ALL DIMENSIONS ARE IN INCHES										
B (Bore)	3.375	4.000	4.625	5.250	6.000	7.000	8.000	9.000	10.000	11.250
C	5.375	6.375	7.375	8.375	9.375	11.000	12.500	14.000	15.500	17.625
D	2 5/8	3 1/16	3 5/8	4 1/16	4 1/2	5 1/8	5 3/4	6 1/2	7 1/8	8
E	5/16	3/8	3/8	7/16	7/16	1/2	9/16	5/8	11/16	3/4
F (Nominal Size)	5	6	7	8	9	10 1/2	12	13 1/2	15	17
G	5 1/8	6 1/8	7 1/8	8 1/8	9 1/8	10 11/16	12 3/16	13 11/16	15 3/16	17 1/4
H	1 3/4	2 1/16	2 3/8	2 11/16	3	3 3/8	3 3/4	4 1/4	4 5/8	5 1/4
I	2 3/16	2 5/8	3 1/8	3 9/16	4 1/16	4 3/4	5 7/16	6 1/8	6 13/16	7 3/4
J	5/32	3/16	1/4	5/16	5/16	11/32	13/32	1/2	9/16	9/16
JJ	5/32	3/16	3/16	3/16	3/16	7/32	7/32	1/4	3/16	5/16
K	1/4	1/4	1/4	9/32	9/32	5/16	11/32	7/16	15/32	1/2
L	3/8	7/16	7/16	1/2	1/2	9/16	5/8	3/4	13/16	7/8
M	2 11/16	3 1/8	3 5/8	4 1/16	4 9/16	5 5/16	6	6 3/4	7 9/16	8 1/2
N	1/2	9/16	5/8	3/4	7/8	1	1 1/8	1 1/4	1 3/8	1 1/2
NN	5/16	3/8	7/16	1/2	9/16	5/8	11/16	3/4	13/16	15/16
O	2 11/16	3 3/16	3 3/4	4 1/4	4 7/8	5 9/16	6 7/16	7 1/4	8	9
P	5/16	3/8	3/8	7/16	7/16	1/2	9/16	5/8	11/16	3/4
Q	2 3/4	3 1/4	3 3/4	4 5/16	4 7/8	5 11/16	6 1/2	7 5/16	8 1/8	9 3/16
S	7/32	1/4	1/4	9/32	9/32	5/16	11/32	7/16	15/32	1/2
T	9/16	11/16	13/16	15/16	1	1 1/8	1 3/16	1 3/8	1 1/2	1 5/8
U	6.000	7.000	8.000	9.125	10.125	11.750	13.375	14.875	16.500	18.625
V	7/8	1	1 1/4	1 3/8	1 1/2	1 3/4	2	2 1/4	2 1/2	2 3/4
W	2 3/8	2 7/8	3 3/8	3 7/8	4 3/8	5 1/16	5 13/16	6 9/16	7 5/16	8 1/4
X (Chamfer)	1/32	1/32	1/32	1/32	1/32	3/64	3/64	3/64	3/64	1/16
Z	5 1/16	6	6 7/8	7 3/4	8 3/4	10 1/4	11 9/16	13	14 1/2	16 1/2

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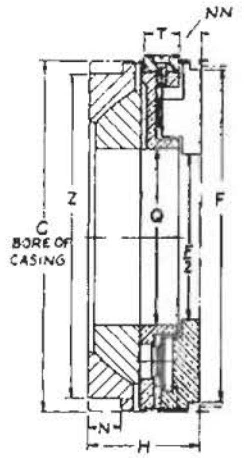
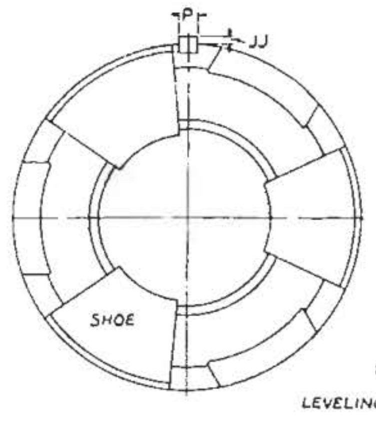
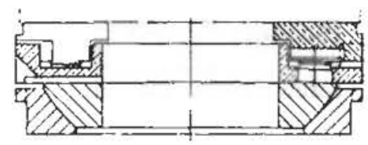
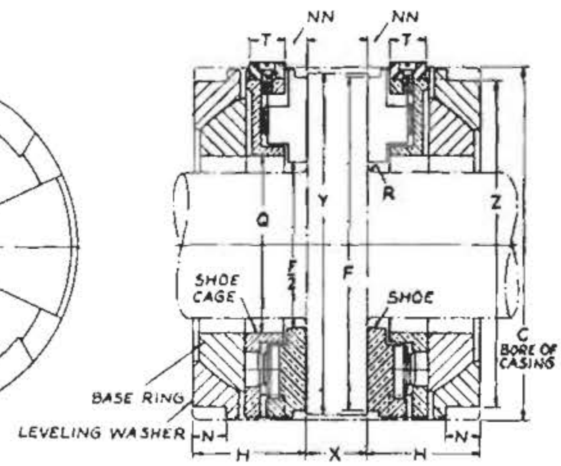
3-Shoe Self-Aligning Equalizing



STYLE N
(Single)
Vertical or Horizontal





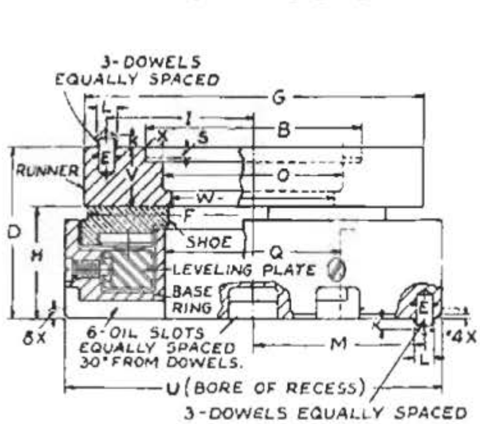


STYLE NN
(Double)
Vertical or Horizontal

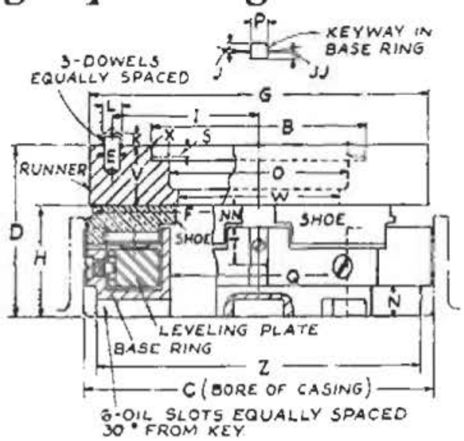
NOTE: Openings opposite oil slots must be provided in surrounding ring if automatic lubrication is used. See Figures 30 and 44 for oil inlet with forced lubrication.

Identification	N-5 NN-5	N-6 NN-6	N-7 NN-7	N-8 NN-8	N-9 NN-9	N-10 1/2 NN-10 1/2	N-12 NN-12	N-13 1/2 NN-13 1/2	N-15 NN-15	N-17 NN-17
Area (Net Sq. In.)	6.3	9.0	12.3	16.0	20.3	27.6	36.0	45.6	56.3	72.3
Cap. at 150 lbs. 1 sq. in.	945	1,350	1,845	2,400	3,045	4,140	5,400	6,840	8,445	10,845
Cap. at 250 lbs. 1 sq. in.	1,575	2,250	3,075	4,000	5,075	6,900	9,000	11,400	14,075	18,075
(Capacity varies with speed. Consult Table III on Page 13.)										
Weights (Lbs. Net) N Bearing, complete	4 3/4	8 1/2	13	17	26	39	55	79	104	153
Weights (Lbs. Net) NN Bearing, complete	9 1/2	17	26	34	52	78	110	158	208	306
Weights (Lbs. Net) 3 Spare Shoes	1	1 3/4	3	4 1/2	6	10	13	17 1/2	22 1/2	31
ALL DIMENSIONS ARE IN INCHES										
C	5.375	6.375	7.375	8.375	9.375	11.000	12.500	14.000	15.500	17.625
F (Nominal Size)	5	6	7	8	9	10 1/2	12	13 1/2	15	17
H	1 3/4	2 1/16	2 3/8	2 11/16	3	3 3/8	3 3/4	4 1/4	4 5/8	5 1/4
JJ	5/32	3/16	3/16	3/16	3/16	7/32	7/32	1/4	5/16	5/16
N	1/2	9/16	5/8	3/4	7/8	1	1 1/8	1 1/4	1 3/8	1 1/2
NN	5/16	3/8	7/16	1/2	9/16	5/8	11/16	3/4	13/16	15/16
P	5/16	3/8	3/8	7/16	7/16	1/2	9/16	5/8	11/16	3/4
Q	2 3/4	3 1/4	3 3/4	4 5/16	4 7/8	5 11/16	6 1/2	7 5/16	8 1/8	9 3/16
R (Rad.)	3/32	3/32	3/32	3/32	3/32	1/8	1/8	1/8	5/32	5/32
T	9/16	11/16	13/16	15/16	1	1 1/8	1 3/16	1 3/8	1 1/2	1 5/8
X	7/8	1	1 1/4	1 3/8	1 1/2	1 3/4	2	2 1/4	2 1/2	2 7/8
Y	5 1/8	6 1/8	7 1/8	8 1/8	9 1/8	10 11/16	12 3/16	13 11/16	15 3/16	17 1/4
Z	5 1/16	6	6 7/8	7 3/4	8 3/4	10 1/4	11 9/16	13	14 1/2	16 1/2

6-Shoe Self-Aligning Equalizing



STYLE KV



STYLE JV

NOTE: Openings opposite oil slots must be provided in surrounding ring if automatic lubrication is used. See Figures 30 and 44 for oil inlet with forced lubrication.

Identification	KV-5 JV-5	KV-6 JV-6	KV-7 JV-7	KV-8 JV-8	KV-9 JV-9	KV-10½ JV-10½	KV-12 JV-12	KV-13½ JV-13½	KV-15 JV-15	KV-17 JV-17
Area (Net Sq. In.)	12.5	18.0	24.5	32.0	40.5	55.1	72.0	91.1	112.5	144.5
Cap. at 150 lbs. 1 sq. in.	1,875	2,700	3,675	4,800	6,075	8,265	10,800	13,665	16,875	21,675
Cap. at 250 lbs. 1 sq. in.	3,125	4,500	6,125	8,000	10,125	13,775	18,000	22,775	28,125	36,125
(Capacity varies with speed. Consult Table I on Page 12)										
Weights (Lbs. Net) KV Bearing, complete	13	21	31	44	60	93	134	185	252	380
Weights (Lbs. Net) JV Bearing, complete	9½	16	25	35	48	76	126	156	213	220
Weights (Lbs. Net) Spare Runner	3¼	5½	8	12	16	26	43	61	81	117
Weights (Lbs. Net) 6 Spare Shoes	2	3½	6	9	12	20	26	35	45	62
ALL DIMENSIONS ARE IN INCHES										
B (Bore)	3.375	4.000	4.625	5.250	6.000	7.000	8.000	9.000	10.000	11.250
C	5.375	6.375	7.375	8.375	9.375	11.000	12.500	14.000	15.500	17.625
D	2 5/8	3 1/16	3 3/8	4 1/16	4 1/2	5 1/8	5 3/4	6 1/2	7 1/8	8
E	5/16	3/8	3/8	7/16	7/16	1/2	9/16	5/8	11/16	3/4
F (Nominal Size)	5	6	7	8	9	10 1/2	12	13 1/2	15	17
G	5 1/8	6 1/8	7 1/8	8 1/8	9 1/8	10 11/16	12 3/16	13 11/16	15 3/16	17 1/4
H	1 3/4	2 1/16	2 3/8	2 11/16	3	3 3/8	3 3/4	4 1/4	4 5/8	5 1/4
I	2 3/16	2 5/8	3 1/8	3 9/16	4 1/16	4 3/4	5 7/16	6 1/8	6 13/16	7 3/4
J	5/32	3/16	1/4	5/16	5/16	11/32	13/32	1/2	9/16	9/16
JJ	5/32	3/16	3/16	3/16	3/16	7/32	7/32	1/4	5/16	3/16
K	1/4	1/4	1/4	9/32	9/32	5/16	11/32	7/16	15/32	1/2
L	3/8	7/16	7/16	1/2	1/2	9/16	5/8	3/4	13/16	7/8
M	2 11/16	3 1/8	3 5/8	4 1/16	4 9/16	5 5/16	6	6 3/4	7 9/16	8 1/2
N	1/2	1/2	5/8	3/4	7/8	1	1 3/16	1 3/8	1 1/2	1 3/4
NN	5/16	3/8	7/16	1/2	9/16	5/8	11/16	3/4	13/16	15/16
O	2 11/16	3 3/16	3 3/4	4 1/4	4 7/8	5 9/16	6 7/16	7 1/4	8	9
P	5/16	3/8	3/8	7/16	7/16	1/2	9/16	5/8	11/16	3/4
Q	2.750	3.250	3.750	4.313	4.875	5.688	6.500	7.313	8.125	9.188
S	7/32	1/4	1/4	9/32	9/32	5/16	11/32	7/16	15/32	1/2
T	9/16	11/16	13/16	15/16	1	1 1/8	1 3/16	1 3/8	1 1/2	1 5/8
U (Bore of Recess)	6.000	7.000	8.000	9.125	10.125	11.750	13.375	14.875	16 500	18.625
V	7/8	1	1 1/4	1 3/8	1 1/2	1 3/4	2	2 1/4	2 1/2	2 3/4
W	2 3/8	2 7/8	3 3/8	3 7/8	4 3/8	5 1/16	5 13/16	6 9/16	7 5/16	8 1/4
X (Chamfer)	1/32	1/32	1/32	1/32	1/32	3/64	3/64	3/64	3/64	1/16
Z	5 1/16	6	6 7/8	7 3/4	8 3/4	10 1/4	11 9/16	13	14 1/2	16 1/2

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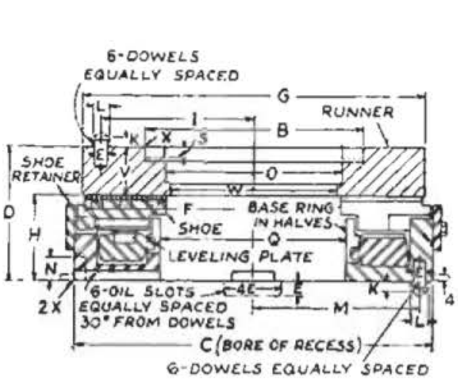
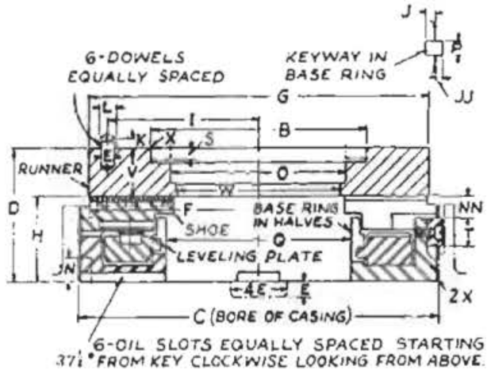
NOTE: Thrust block should be a free fit in bore "B" of runner.

6-Shoe Self-Aligning Equalizing



STYLE KBV



STYLE BV

NOTE: Openings opposite oil slots must be provided in surrounding ring if automatic lubrication is used. See Figures 30 and 44 for oil inlet with forced lubrication.

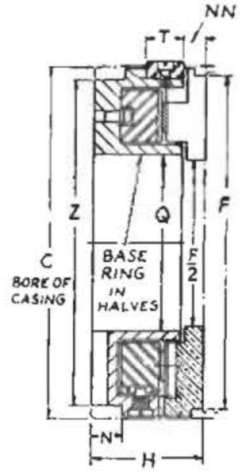
Identification	KBV-19 BV-19	KBV-21 BV-21	KBV-23 BV-23	KBV-25 BV-25	KBV-27 BV-27	KBV-29 BV-29	KBV-31 BV-31	KBV-33 BV-33	KBV-37 BV-37	KBV-41 BV-41	KBV-45 BV-45
Area (Net Sq. In.)	180	220	264	312	364	420	480	545	684	840	1012
Cap. at 200 lbs. 1 sq. in.	36,000	44,000	52,800	62,400	72,800	84,000	96,000	109,000	136,800	168,000	202,400
Cap. at 350 lbs. 1 sq. in.	63,000	77,000	92,400	109,200	127,400	147,000	168,000	190,800	239,400	294,000	354,200
(Capacity varies with speed. Consult Table II on Page 12.)											
Weights (Lbs. Net) KBV Bearing, complete	399	512	635	826	1,020	1,218	1,475	1,875	2,478	3,260	4,310
Weights (Lbs. Net) BV Bearing, complete	396	507	629	818	1,007	1,203	1,457	1,850	2,458	3,237	4,285
Weights (Lbs. Net) Spare Runner	159	195	223	312	364	426	497	600	795	1,027	1,275
Weights (Lbs. Net) 6 Spare Shoes	91	122	165	227	242	305	388	550	666	818	1,150
ALL DIMENSIONS ARE IN INCHES											
B (Bore)	12.625	13.750	14.625	16.000	17.125	18.000	18.875	20.500	22.375	24.500	26.750
C	20.250	22.250	24.500	26.500	28.750	30.750	33.000	35.000	40.000	43.750	48.000
D	7 3/4	8 1/4	8 11/16	9 9/16	10 1/16	10 1/2	11	11 7/8	12 3/4	14	15 1/8
E	7/8	1	1	1	1 1/4	1 1/4	1 1/4	1 1/4	1 1/2	1 1/2	1 1/2
F (Nominal Size)	19	21	23	25	27	29	31	33	37	41	45
G	19 1/4	21 1/4	23 1/4	25 1/4	27 1/4	29 3/8	31 3/8	33 3/8	37 1/2	41 1/2	45 1/2
H	4 3/4	5 1/4	5 11/16	6 3/16	6 11/16	7 1/8	7 5/8	8 1/8	9	10	11
I	8 5/8	9 1/2	10 1/2	11 1/2	12 1/4	13 1/4	14 1/4	15 1/4	17	19	21
J	17/32	1/2	1/2	3/4	3/4	3/4	15/16	15/16	1 3/16	1 1/8	1 1/4
JJ	11/32	3/8	3/8	1/2	1/2	1/2	9/16	9/16	9/16	5/8	3/4
K	9/16	5/8	5/8	5/8	3/4	3/4	3/4	3/4	7/8	7/8	7/8
L	1	1 1/8	1 1/8	1 1/8	1 3/8	1 3/8	1 3/8	1 3/8	1 5/8	1 5/8	1 5/8
M	9 1/4	10 3/16	11 5/16	12 5/16	13 5/16	14 1/8	15 1/8	16 1/8	18 1/4	20 1/8	22 1/16
N	7/8	1	1	1 1/8	1 3/16	1 1/4	1 3/8	1 7/16	1 9/16	1 1/4	1 15/16
NN	1	1 1/8	1 5/16	1 3/8	1 7/16	1 1/2	1 5/8	1 3/4	1 13/16	2 1/8	2 5/16
O	10 1/8	11 1/8	12 1/8	13 1/4	14 1/4	15 1/8	16 1/8	17 1/4	19 1/8	21 1/8	23 1/8
P	7/8	1	1	1 1/4	1 1/4	1 1/4	1 1/2	1 1/2	1 1/2	1 3/4	2
Q	10 5/8	11 3/4	12 3/4	14	15	16 1/4	17 1/4	18 1/2	20 3/4	23	25
S	19/32	11/16	11/16	11/16	13/16	13/16	13/16	13/16	1	1	1
T	1 3/4	1 3/4	2 1/8	2 1/4	2 3/8	2 1/2	2 5/8	2 3/4	3	3 1/4	3 9/16
V	3	3	3	3 3/8	3 3/8	3 3/8	3 3/8	3 3/4	3 3/4	4	4 1/8
W	9 1/4	10 1/4	11 1/4	12 1/4	13 1/4	14 1/8	15 1/8	16 1/8	18	20	22
X (Chamfer)	1/16	1/16	1/16	1/16	1/16	1/16	1/16	3/32	3/32	3/32	3/32
Add to Height (D) for Ins. Sub-Base	1 3/4	2	2	2	2 1/2	2 1/2	2 1/2	2 1/2	3	3	3

2712

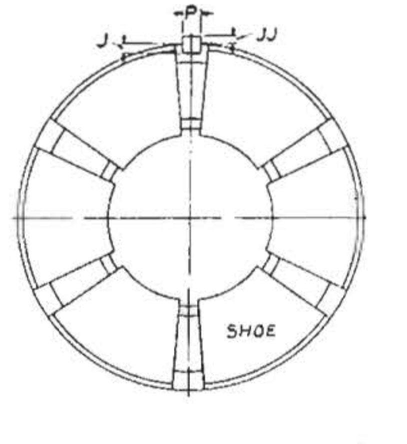
KINGSBURY

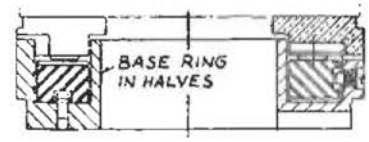
NOTE: Thrust block should be a free fit in bore "B" of runner.

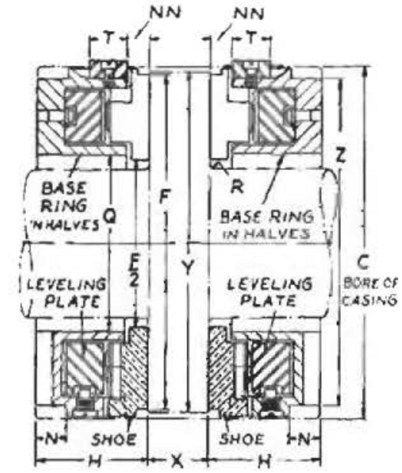
6-Shoe Self-Aligning Equalizing



STYLE J
(Single)
Vertical or Horizontal







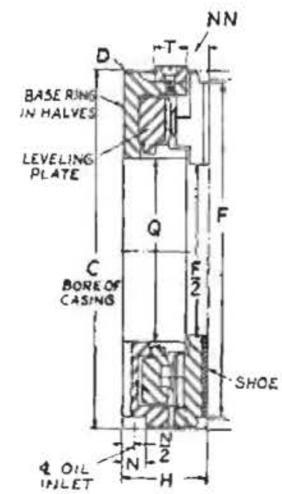
STYLE JJ
(Double)
Vertical or Horizontal

NOTE: Openings opposite oil slots must be provided in surrounding ring if automatic lubrication is used. See Figure 14. See opposite page for oil inlets with forced lubrication.

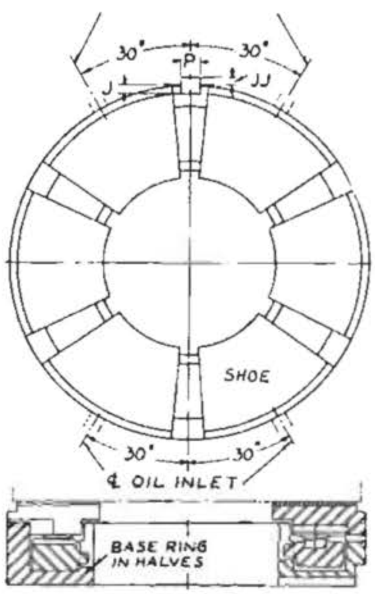
Identification	J-5 JJ-5	J-6 JJ-6	J-7 JJ-7	J-8 JJ-8	J-9 JJ-9	J-10 1/2 JJ-10 1/2	J-12 JJ-12	J-13 1/2 JJ-13 1/2	J-15 JJ-15	J-17 JJ-17
Area (Net Sq. In.)	12.5	18.0	24.5	32.0	40.5	55.1	72.0	91.1	112.5	144.5
Cap. at 150 lbs. 1 sq. in.	1,875	2,700	3,675	4,800	6,075	8,265	10,800	13,665	16,875	21,675
Cap. at 250 lbs. 1 sq. in.	3,125	4,500	6,125	8,000	10,125	13,775	18,000	22,775	28,125	36,125
(Capacity varies with speed. Consult Table I on Page 12)										
Weights (Lbs. Net) J Bearing, complete	6	10 1/2	17	23	32	50	83	95	132	203
Weights (Lbs. Net) JJ Bearing, complete	12	21	34	46	64	100	166	190	264	406
Weights (Lbs. Net) 6 Spare Shoes	2	3 1/2	6	9	12	20	26	35	45	62
ALL DIMENSIONS ARE IN INCHES										
C	5.375	6.375	7.375	8.375	9.375	11.000	12.500	14.000	15.500	17.625
F (Nominal Size)	5	6	7	8	9	10 1/2	12	13 1/2	15	17
H	1 3/4	2 1/16	2 3/8	2 11/16	3	3 3/8	3 3/4	4 1/4	4 5/8	5 1/4
J	5/32	3/16	1/4	5/16	5/16	11/32	13/32	1/2	9/16	9/16
JJ	5/32	3/16	3/16	3/16	3/16	7/32	7/32	1/4	5/16	5/16
N	1/2	9/16	5/8	3/4	7/8	1	1 1/8	1 1/4	1 3/8	1 1/2
NN	5/16	3/8	7/16	1/2	9/16	5/8	11/16	3/4	13/16	15/16
P	5/16	3/8	3/8	7/16	7/16	1/2	9/16	5/8	11/16	3/4
Q	2 3/4	3 1/4	3 3/4	4 5/16	4 7/8	5 11/16	6 1/2	7 5/16	8 1/8	9 3/16
R (Rad.)	3/32	3/32	3/32	3/32	3/32	1/8	1/8	1/8	5/32	5/32
T	9/16	11/16	13/16	15/16	1	1 1/8	1 3/16	1 3/8	1 1/2	1 5/8
X	7/8	1	1 1/4	1 3/8	1 1/2	1 3/4	2	2 1/4	2 1/2	2 7/8
Y	5 1/8	6 1/8	7 1/8	8 1/8	9 1/8	10 11/16	12 3/16	13 11/16	15 3/16	17 1/4
Z	5 1/16	6	6 7/8	7 3/4	8 3/4	10 1/4	11 9/16	13	14 1/2	16 1/2

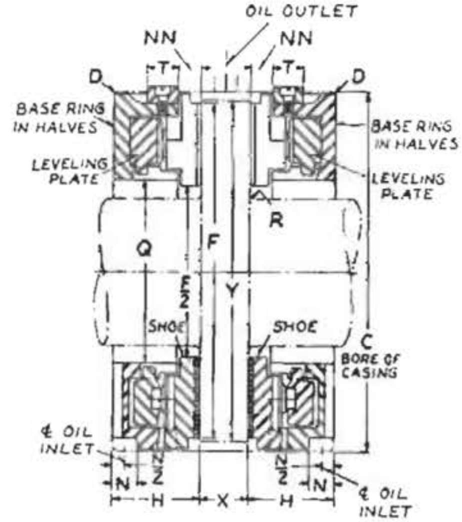
2716

6-Shoe Self-Aligning Equalizing



STYLE B
(Single)
Vertical or Horizontal





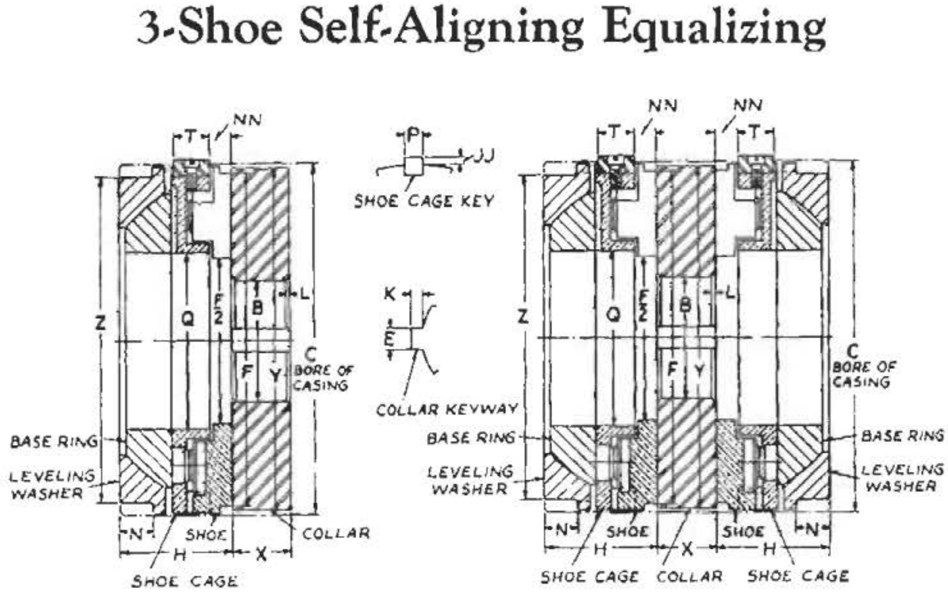
STYLE BB
(Double)
Vertical or Horizontal

NOTE: Openings opposite oil slots must be provided in surrounding ring if automatic lubrication is used. See Figure 14. Above are shown alternative locations of oil inlets with forced lubrication.

Identification	B-19 BB-19	B-21 BB-21	B-23 BB-23	B-25 BB-25	B-27 BB-27	B-29 BB-29	B-31 BB-31	B-33 BB-33	B-37 BB-37	B-41 BB-41	B-45 BB-45
Area (Net Sq. In.)	180	220	264	312	364	420	480	545	684	840	1012
Cap. at 200 lbs. 1 sq. in.	36,000	44,000	52,800	62,400	72,800	84,000	96,000	109,000	136,800	168,000	202,400
Cap. at 350 lbs. 1 sq. in.	63,000	77,000	92,400	109,200	127,400	147,000	168,000	190,800	239,400	294,000	354,200
(Capacity varies with speed. Consult Table II on Page 12.)											
Weights (Lbs. Net) B Bearing, complete	237	312	406	506	643	777	960	1,250	1,663	2,210	3,010
Weights (Lbs. Net) BB Bearing, complete	474	624	812	1,012	1,286	1,554	1,920	2,425	3,326	4,420	6,020
Weights (Lbs. Net) 6 Spare Shoes	91	122	165	227	242	305	388	550	666	818	1,150
ALL DIMENSIONS ARE IN INCHES											
C	20.250	22.250	24.500	26.500	28.750	30.750	33.000	35.000	40.000	43.750	48.000
D (Chamfer)	1/8	1/8	1/8	1/8	1/8	1/8	1/8	3/16	3/16	3/16	3/16
F (Nominal Size)	19	21	23	25	27	29	31	33	37	41	45
H	4 3/4	5 1/4	5 11/16	6 3/16	6 11/16	7 1/8	7 5/8	8 1/8	9	10	11
J	17/32	1/2	1/2	3/4	3/4	3/4	15/16	15/16	1 3/16	1 1/8	1 1/4
JJ	11/32	3/8	3/8	1/2	1/2	1/2	9/16	9/16	9/16	5/8	3/4
N	7/8	1	1	1 1/8	1 3/16	1 1/4	1 3/8	1 7/16	1 9/16	1 3/4	1 15/16
NN	1	1 1/8	1 5/16	1 3/8	1 7/16	1 1/2	1 5/8	1 3/4	1 15/16	2 1/8	2 5/16
P	7/8	1	1	1 1/4	1 1/4	1 1/4	1 1/2	1 1/2	1 1/2	1 3/4	2
Q	10 5/8	11 3/4	12 3/4	14	15	16 1/4	17 1/4	18 1/2	20 3/4	23	25
R (Rad.)	3/16	3/16	1/4	1/4	5/16	3/8	3/8	7/16	1/2	9/16	5/8
T	1 3/4	1 3/4	2 1/8	2 1/4	2 3/8	2 1/2	2 5/8	2 3/4	3	3 1/4	3 9/16
X	3 1/4	3 3/8	3 7/8	4 1/4	4 3/8	5	5 1/4	5 5/8	6 3/8	7	7 5/8
Y	19 1/4	21 1/4	23 1/4	25 1/4	27 1/4	29 3/8	31 3/8	33 3/8	37 1/2	41 1/2	45 1/2

2717

3-Shoe Self-Aligning Equalizing



STYLE NH
(Single)

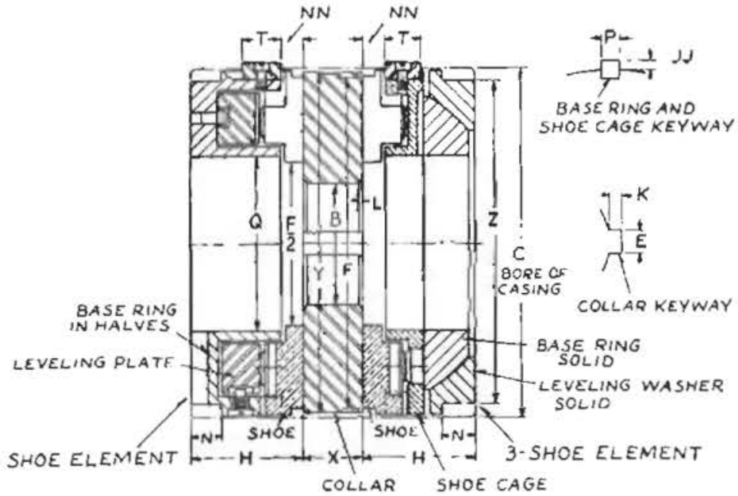
STYLE NHN
(Double)

NOTE: See Figures 30, 44 and 47 for location of oil inlets with forced lubrication.

Identification	NH-5 NHN-5	NH-6 NHN-6	NH-7 NHN-7	NH-8 NHN-8	NH-9 NHN-9	NH-10½ NHN-10½	NH-12 NHN-12	NH-13½ NHN-13½	NH-15 NHN-15	NH-17 NHN-17
Area (Net Sq. In.)	6.3	9.0	12.3	16.0	20.3	27.6	36.0	45.6	56.3	72.3
Cap. at 150 lbs. 1 sq. in.	945	1,350	1,845	2,400	3,045	4,140	5,400	6,840	8,445	10,845
Cap. at 250 lbs. 1 sq. in.	1,575	2,250	3,075	4,000	5,075	6,900	9,000	11,400	14,075	18,075
(Capacity varies with speed. Consult Table III on Page 13.)										
Weights (Lbs. Net) NH Bearing, complete	9	16	25	35	50	77	112	169	212	316
NHN Bearing, complete	14	24½	39	52	76	116	167	248	316	469
Spare Collar	4½	7½	12½	17½	24	38	57	80	108	163
3 Spare Shoes	1	1¾	3	4½	6	10	13	17½	22½	31
ALL DIMENSIONS ARE IN INCHES										
B (Bore)	1.750	2.125	2.500	3.000	3.500	4.125	4.750	5.375	6.000	6.625
C	5.375	6.375	7.375	8.375	9.375	11.000	12.500	14.000	15.500	17.625
E	3/8	3/8	1/2	5/8	5/8	3/4	3/4	7/8	1	1
F (Nominal Size)	5	6	7	8	9	10½	12	13½	15	17
H	1 3/4	2 1/16	2 3/8	2 11/16	3	3 3/8	3 3/4	4 1/4	4 5/8	5 1/4
JJ	5/32	3/16	3/16	3/16	3/16	7/32	7/32	1/4	5/16	5/16
K	3/16	3/16	1/4	5/16	5/16	3/8	3/8	7/16	1/2	1/2
L (Chamfer)	1/16	1/16	1/16	1/16	1/16	3/32	3/32	3/32	3/32	1/8
N	1/2	9/16	5/8	3/4	7/8	1	1 1/8	1 1/4	1 3/8	1 1/2
NN	5/16	3/8	7/16	1/2	9/16	5/8	11/16	3/4	13/16	15/16
P	5/16	3/8	3/8	7/16	7/16	1/2	9/16	5/8	11/16	3/4
Q	2 3/4	3 1/4	3 3/4	4 3/16	4 7/8	5 11/16	6 1/2	7 5/16	8 1/8	9 3/16
T	9/16	11/16	13/16	15/16	1	1 1/8	1 3/16	1 3/8	1 1/2	1 5/8
X	7/8	1	1 1/4	1 3/8	1 1/2	1 3/4	2	2 1/4	2 1/2	2 7/8
Y	5 1/8	6 1/8	7 1/8	8 1/8	9 1/8	10 11/16	12 3/16	13 11/16	15 3/16	17 1/4
Z	5 1/16	6	6 1/8	7 3/4	8 3/4	10 1/4	11 9/16	13	14 1/2	16 1/2

2714

6 and 3-Shoe Self-Aligning Equalizing



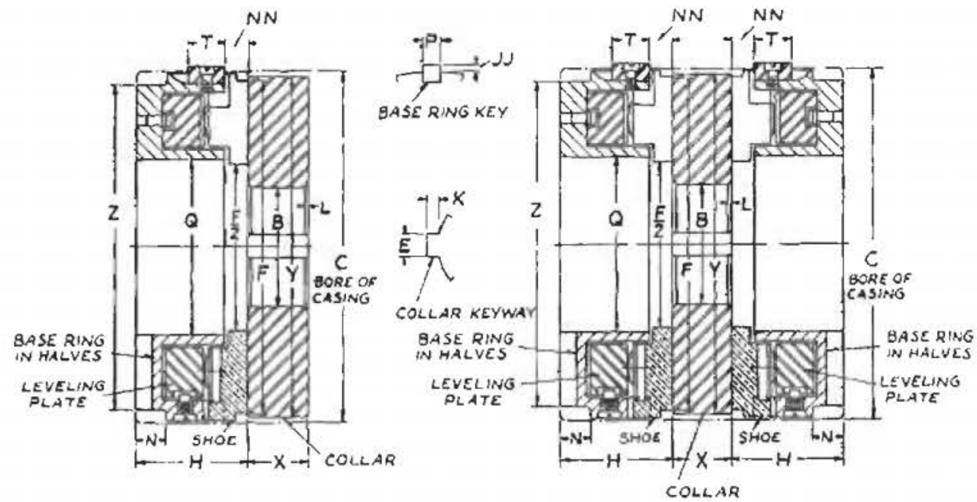
STYLE JHN

NOTE: See Figures 30, 44 and 47 for location of oil inlets with forced lubrication.

Identification	JHN-5	JHN-6	JHN-7	JHN-8	JHN-9	JHN-10 1/2	JHN-12	JHN-13 1/2	JHN-15	JHN-17
3-Shoe Element										
Area (Net Sq. In.)	6.3	9.0	12.3	16.0	20.3	27.6	36.0	45.6	56.3	72.3
Cap. at 150 lbs. 1 sq. in.	945	1,350	1,845	2,400	3,045	4,140	5,400	6,840	8,445	10,845
Cap. at 250 lbs. 1 sq. in.	1,575	2,250	3,075	4,000	5,075	6,900	9,000	11,400	14,075	18,075
6-Shoe Element										
Area (Net Sq. In.)	12.5	18.0	24.5	32.0	40.5	55.1	72.0	91.1	112.5	144.5
Cap. at 150 lbs. 1 sq. in.	1,875	2,700	3,675	4,800	6,075	8,265	10,800	13,665	16,875	21,675
Cap. at 250 lbs. 1 sq. in.	3,125	4,500	6,125	8,000	10,125	13,775	18,000	22,775	28,125	36,125
(Capacity varies with speed. Consult Tables I and II on Pages 12 and 13.)										
Weights (Lbs. Net) JHN Bearing, complete	16	27	43	58	82	127	195	254	344	519
Spare Collar	4 1/2	7 1/2	12 1/2	17 1/2	24	38	57	80	108	163
6 Spare Shoes	2	3 1/2	6	9	12	20	26	35	45	62
ALL DIMENSIONS ARE IN INCHES										
B (Bore)	1.750	2.125	2.500	3.000	3.500	4.125	4.750	5.375	6.000	6.625
C (Bore Casing)	5.375	6.375	7.375	8.375	9.375	11.000	12.500	14.000	15.500	17.625
E	3/8	3/8	1/2	5/8	5/8	3/4	3/4	7/8	1	1
F (Nominal Size)	5	6	7	8	9	10 1/2	12	13 1/2	15	17
H	1 3/4	2 1/16	2 3/8	2 11/16	3	3 3/8	3 3/4	4 1/4	4 5/8	5 1/4
JJ	5/32	3/16	3/16	3/16	3/16	7/32	7/32	1/4	5/16	5/16
K	3/16	3/16	1/4	5/16	5/16	3/8	3/8	7/16	1/2	1/2
L (Chamfer)	1/16	1/16	1/16	1/16	1/16	3/32	3/32	3/32	3/32	1/8
N	1/2	9/16	5/8	3/4	7/8	1	1 1/8	1 1/4	1 3/8	1 1/2
NN	5/16	3/8	7/16	1/2	9/16	5/8	11/16	3/4	13/16	13/16
P	5/16	3/8	3/8	7/16	7/16	1/2	9/16	5/8	11/16	3/4
Q	2 3/4	3 1/4	3 3/4	4 3/16	4 7/8	5 11/16	6 1/2	7 5/16	8 1/8	9 3/16
T	9/16	11/16	13/16	15/16	1	1 1/8	1 3/16	1 3/8	1 1/2	1 5/8
X	7/8	1	1 1/4	1 3/8	1 1/2	1 3/4	2	2 1/4	2 1/2	2 7/8
Y	5 1/8	6 1/8	7 1/8	8 1/8	9 1/8	10 11/16	12 3/16	13 11/16	15 3/16	17 1/4
Z	5 1/16	6	6 7/8	7 3/4	8 3/4	10 1/4	11 3/16	13	14 1/2	16 1/2

2715

6-Shoe Self-Aligning Equalizing



STYLE JH
(Single)

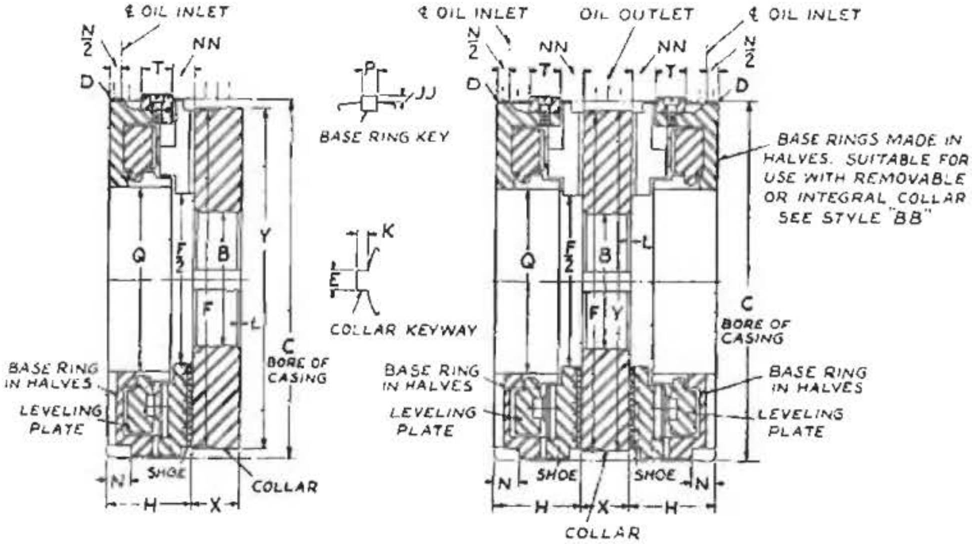
STYLE JHJ
(Double)

NOTE: See Figures 30, 44 and 47 for location of oil inlets with forced lubrication.

Identification	JH-5 JHJ-5	JH-6 JHJ-6	JH-7 JHJ-7	JH-8 JHJ-8	JH-9 JHJ-9	JH-10½ JHJ-10½	JH-12 JHJ-12	JH-13½ JHJ-13½	JH-15 JHJ-15	JH-17 JHJ-17
Area (Net Sq. In.)	12.5	18.0	24.5	32.0	40.5	55.1	72.0	91.1	112.5	144.5
Cap. at 150 lbs. 1 sq. in.	1,875	2,700	3,675	4,800	6,075	8,265	10,800	13,665	16,875	21,675
Cap. at 250 lbs. 1 sq. in.	3,125	4,500	6,125	8,000	10,125	13,775	18,000	22,775	28,125	36,125
(Capacity varies with speed. Consult Table I on Page 12.)										
Weights (Lbs. Net) JH Bearing, complete	11	18	30	41	56	88	140	175	240	366
Weights (Lbs. Net) JHJ Bearing, complete	17	29	47	64	88	138	223	270	372	569
Weights (Lbs. Net) Spare Collar	4½	7½	12½	17½	24	38	57	80	108	163
Weights (Lbs. Net) 6 Spare Shoes	2	3½	6	9	12	20	26	35	45	62
ALL DIMENSIONS ARE IN INCHES										
B (Bore)	1.750	2.125	2.500	3.000	3.500	4.125	4.750	5.375	6.000	6.625
C	5.375	6.375	7.375	8.375	9.375	11.000	12.500	14.000	15.500	17.625
E	3/8	3/8	1/2	5/8	5/8	3/4	3/4	7/8	1	1
F (Nominal Size)	5	6	7	8	9	10½	12	13½	15	17
H	1 3/4	2 1/16	2 3/8	2 11/16	3	3 3/8	3 3/4	4 1/4	4 5/8	5 1/4
JJ	5/32	3/16	3/16	3/16	3/16	7/32	7/32	1/4	5/16	5/16
K	3/16	3/16	1/4	5/16	5/16	3/8	3/8	7/16	1/2	1/2
L (Chamfer)	1/16	1/16	1/16	1/16	1/16	3/32	3/32	3/32	3/32	1/8
N	1/2	9/16	5/8	3/4	7/8	1	1 1/8	1 1/4	1 3/8	1 1/2
NN	5/16	3/8	7/16	1/2	9/16	5/8	11/16	3/4	13/16	15/16
P	5/16	3/8	3/8	7/16	7/16	1/2	9/16	5/8	11/16	3/4
Q	2 3/4	3 1/4	3 3/4	4 5/16	4 7/8	5 11/16	6 1/2	7 5/16	8 1/8	9 3/16
T	9/16	11/16	13/16	15/16	1	1 1/8	1 3/16	1 3/8	1 1/2	1 5/8
X	7/8	1	1 1/4	1 3/8	1 1/2	1 3/4	2	2 1/4	2 1/2	2 7/8
Y	5 1/8	6 1/8	7 1/8	8 1/8	9 1/8	10 11/16	12 3/16	13 11/16	15 3/16	17 1/4
Z	5 1/16	6	6 7/8	7 3/4	8 3/4	10 1/4	11 9/16	13	14 1/2	16 1/2

2718

6-Shoe Self-Aligning Equalizing



STYLE BH
(Single)

STYLE BHB
(Double)

NOTE: See Figures 30, 44 and 47 for location of oil inlets with forced lubrication.

Identification	BH-19 BHB-19	BH-21 BHB-21	BH-23 BHB-23	BH-25 BHB-25	BH-27 BHB-27	BH-29 BHB-29	BH-31 BHB-31	BH-33 BHB-33	BH-37 BHB-37	BH-41 BHB-41	BH-45 BHB-45
Area (Net Sq. In.)	180	220	264	312	364	420	480	545	684	840	1012
Cap. at 200 lbs. 1 sq. in.	36,000	44,000	52,800	62,400	72,800	84,000	96,000	109,000	136,800	168,000	202,400
Cap. at 350 lbs. 1 sq. in.	63,000	77,000	92,400	109,200	127,400	147,000	168,000	190,800	239,400	294,000	354,200
(Capacity varies with speed Consult Table II on Page 12.)											
Weights (Lbs. Net.) BH Bearing, complete	465	620	800	1,020	1,288	1,590	1,935	2,450	3,350	4,475	5,970
Weights (Lbs. Net.) BHB Bearing, complete	700	930	1,210	1,525	1,931	2,360	2,905	3,625	5,010	6,685	8,970
Weights (Lbs. Net.) Spare Collar	228	308	394	514	645	813	975	1,200	1,687	2,265	2,960
Weights (Lbs. Net.) 6 Spare Shoes	91	122	165	227	242	305	388	550	666	818	1,150
ALL DIMENSIONS ARE IN INCHES											
B (Bore)	7.500	8.500	9.375	10.000	11.000	11.750	12.500	13.375	15.000	16.750	18.500
C	20.250	22.250	24.500	26.500	28.750	30.750	33.000	35.000	40.000	43.750	48.000
D (Chamfer)	1/8	1/8	1/8	1/8	1/8	1/8	1/8	3/16	3/16	3/16	3/16
E	1 1/8	1 1/4	1 1/4	1 1/2	1 1/2	1 3/4	1 3/4	2	2 1/4	2 1/4	2 1/2
F (Nominal Size)	19	21	23	25	27	29	31	33	37	41	45
H	4 3/4	5 1/4	5 11/16	6 3/16	6 11/16	7 1/8	7 5/8	8 1/8	9	10	11
JJ	11/32	3/8	3/8	1/2	1/2	1/2	9/16	9/16	9/16	5/8	3/4
K	9/16	5/8	5/8	3/4	3/4	7/8	7/8	1	1 1/8	1 1/8	1 1/4
L (Chamfer)	1/8	1/8	5/32	5/32	5/32	3/16	3/16	3/16	1/4	1/4	1/4
N	7/8	1	1	1 1/8	1 3/16	1 1/4	1 3/8	1 7/16	1 9/16	1 3/4	1 15/16
NN	1	1 1/8	1 5/16	1 3/8	1 7/16	1 1/2	1 5/8	1 3/4	1 15/16	2 1/8	2 3/16
P	7/8	1	1	1 1/4	1 1/4	1 1/4	1 1/2	1 1/2	1 1/2	1 3/4	2
Q	10 5/8	11 3/4	12 3/4	14	15	16 1/4	17 1/4	18 1/2	20 3/4	23	25
T	1 3/4	1 3/4	2 1/8	2 1/4	2 3/8	2 1/2	2 5/8	2 3/4	3	3 1/4	3 3/16
X	3 1/4	3 3/8	3 7/8	4 1/4	4 5/8	5	5 1/4	5 5/8	6 3/8	7	7 5/8
Y	19 1/4	21 1/4	23 1/4	25 1/4	27 1/4	29 3/8	31 3/4	33 3/8	37 1/2	41 1/2	45 1/2

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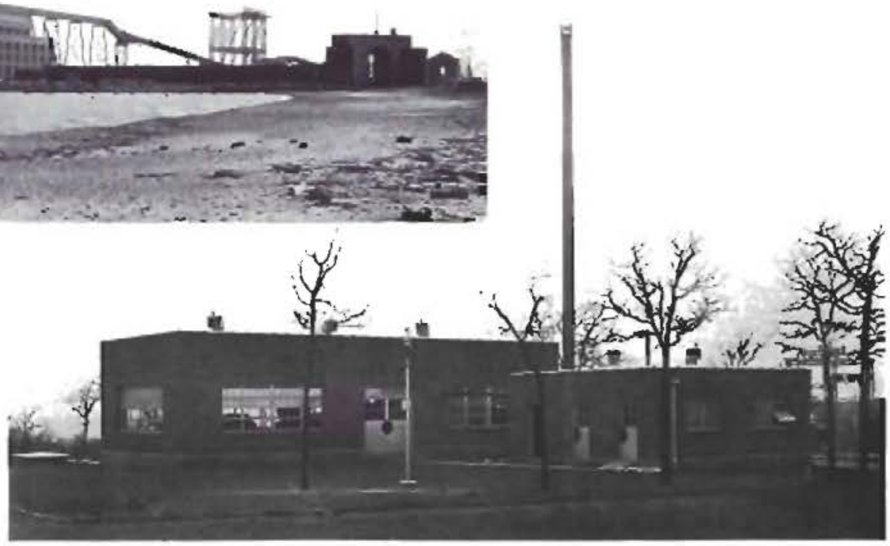
Above: Hydro-electric Station, Kern No. 3, Southern California Edison Company. The main generators have equalizing self-aligning Kingsbury Thrust Bearings.

Right: Villa Street Pumping Plant, Pasadena Water Department, Pasadena, Calif. The deep well centrifugal pumps use Kingsbury Thrust Bearings.

Above: State Line Generating Station, Hammond, Indiana. Steam pressure 650 pounds. Kingsbury Thrust Bearings used with boiler feed pumps and condenser water circulating pumps.

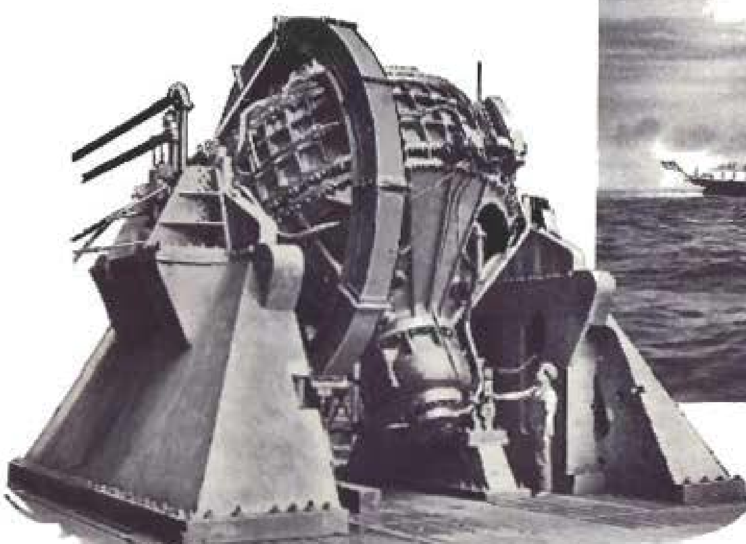


Right: Sand Springs Station, The Texas-Empire Pipe Line Company. Kingsbury Bearings used in the centrifugal booster pumps.

Above: S. S. "FLORIDA" of Peninsular and Occidental Steamship Company. 9,500 total shaft horsepower, twin-screw, geared turbine drive. Kingsbury Thrust Bearings used for propellers and turbines.

Below: U. S. Cruiser, type of "HOUSTON," "NORTHAMPTON," "SALT LAKE CITY," and "PENSACOLA," equipped with Kingsbury Thrust Bearings for propellers and turbines.

Below: This large ship stabilizer, built by Sperry Gyroscope Company, uses Kingsbury Thrust Bearing to carry rotor weight of 230,000 pounds at 800 r. p. m.



Above: S. S. "EXCALIBUR" of Export Lines. 8,000 shaft horsepower, single-screw, geared turbine drive. Kingsbury Thrust Bearings used for propeller and turbines.

TYPICAL MOUNTINGS FOR GENERAL USE

The drawings on Pages 28 to 38 show typical mountings covering many of the conditions encountered in service. We can furnish some of the mountings as complete units, standardized in the smaller sizes, and these are designated by the words "STANDARDIZED" in the captions under the cuts. Dimension lists will be furnished for them on request. Designs not so designated are apt to be special; we are prepared to build them, but it is sometimes better that they be constructed by the customer, to fit standard Kingsbury internal parts.

Where mountings are built by the customer, certain details may be changed, but we should be consulted in all such cases.

The reader is advised to study carefully Figure 27, which is the simplest form of vertical mounting, and Figure 43, which is similarly typical of horizontal mountings.

Vertical Mountings

Figure 27 shows a simple form of vertical thrust bearing for a suspended shaft. The housing is integral with the machine frame, and provision is made for a radial bearing just below. The thrust bearing shown is Style LV or KV. This makes a simpler construction than the somewhat similar mounting shown in Figure 14, which requires a vertical shoe-retaining flange with holes cored in it for oil circulation.

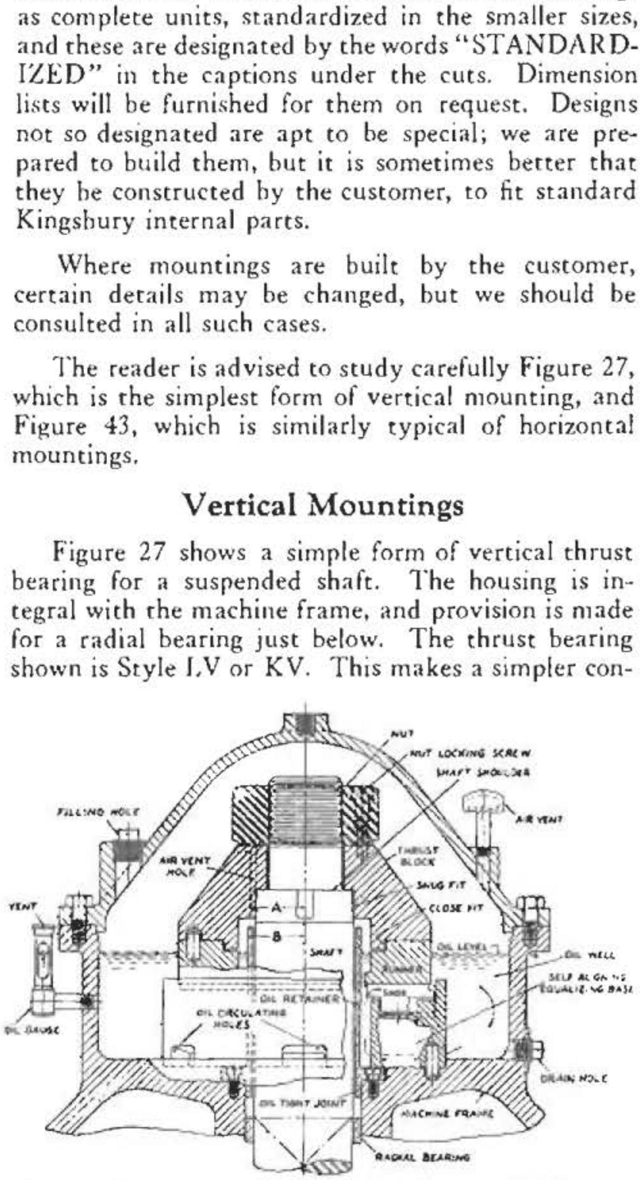


Figure 27: Simple mounting for vertical thrust bearing, Style LV or KV.

The thrust block must have a snug cylindrical fit on the shaft and must be tightly clamped against the shoulder, and all its contact surfaces must be true. An air vent hole is required in the thrust block; it must be so placed that its outer radius A is less than radius B.

This mounting has no cooling coil and no provision for external circulation. It is suitable for moderate speeds.

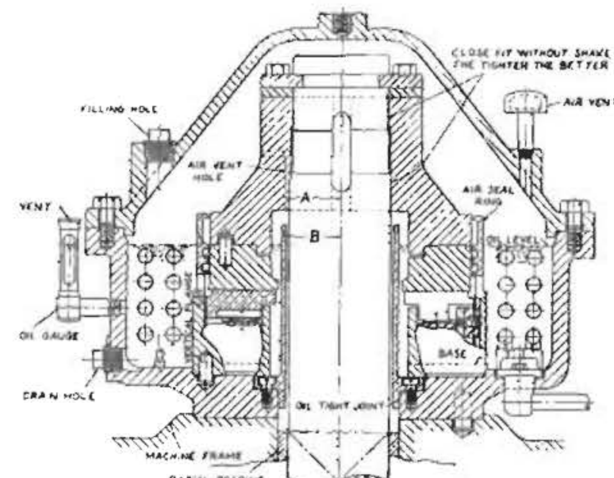


Figure 28: Simple vertical mounting with cooling coil and air seal ring. Thrust bearing may be Style LV or KV. STANDARDIZED.

In Figure 28 a cooling coil is added, with bottom water connections; and the housing is separate from the frame of the machine. The thrust bearing shown is Style KV. It has a base ring with integral raised rim and oil slots underneath its base. The shaft is suspended by a split ring key; by inserting shims under ring key, the shaft may be adjusted slightly up or down. The thrust block must have a long close fit on the shaft, and the lower face must be accurately squared. As this arrangement is intended for high speed, an air seal ring is shown surrounding the thrust collar and lower end of the thrust block. We can furnish the internal parts as listed herein or the complete unit of bearing and housing in standard sizes as listed in Bulletin M.

In addition to the oil circulation shown by the arrows in Figures 7 and 8, there is a circular movement of the oil in the bath, due to rotation of the runner. At high speeds this may tend to cause frothing. To confine this froth where it can do no harm, an air seal ring is provided for high-speed bearings in certain mountings; see Figures 28 and 33. We will advise the customer when conditions require its use. It is not part of the standard bearing, but is furnished when needed at an additional cost.

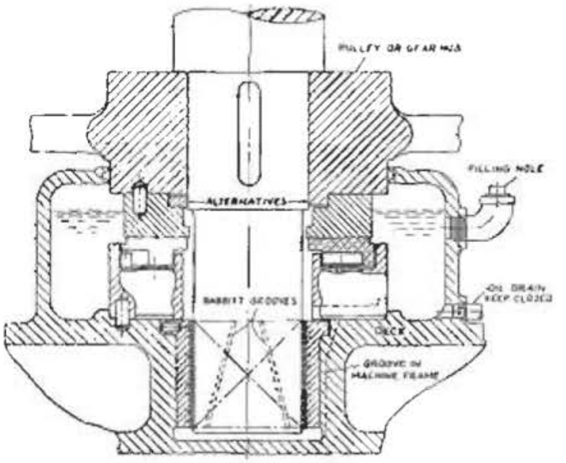


Figure 29: Mounting for supporting heavy gear or pulley. Bearing shown may be Style KV or LV.

Figure 29 is arranged for a Kingsbury Bearing with a radial journal bearing at the bottom of a shaft, and gear or pulley just above. The housing forms part of the machine frame. The bearing is Style KV. Two methods of centering the runner on the shaft are shown. A shaft of this type is not likely to run fast enough to require special cooling.

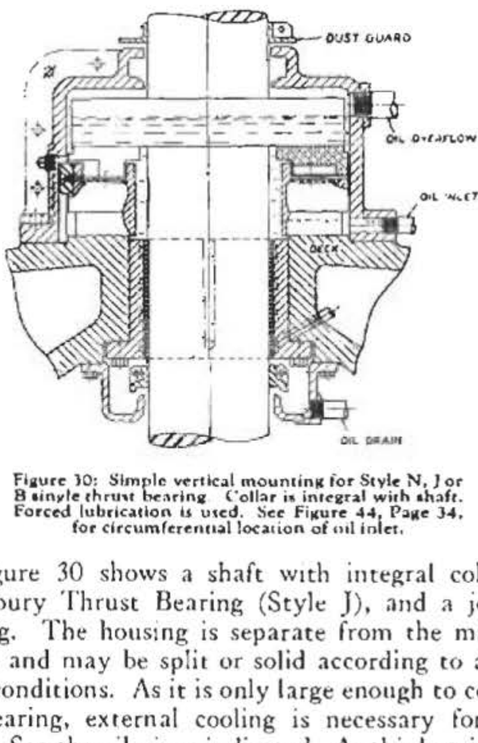


Figure 30: Simple vertical mounting for Style N, J or B single thrust bearing. Collar is integral with shaft. Forced lubrication is used. See Figure 44, Page 34, for circumferential location of oil inlet.

Figure 30 shows a shaft with integral collar, a Kingsbury Thrust Bearing (Style J), and a journal bearing. The housing is separate from the machine frame, and may be split or solid according to assembling conditions. As it is only large enough to contain the bearing, external cooling is necessary for high speed. See the oil pipes indicated. As this bearing has no oil retaining sleeve (compare Figures 27 and 28), enough oil will run down to the journal to lubricate it at low speeds. If the speed is high, the journal should be lubricated by the small pipe shown. This pipe leads to the lower end of a vertical groove in the babbitt liner, hence the tendency of the oil is to work upward. An oil thrower, pan and drain are provided.

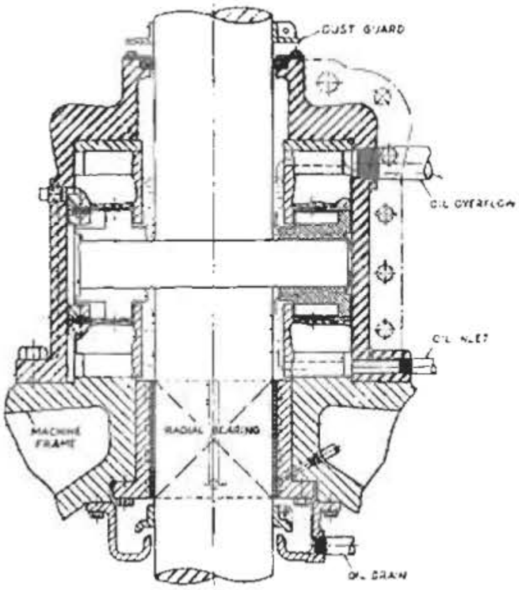


Figure 31: Simple vertical mounting for Style NN, JJ or BB double thrust bearing. Collar is integral with shaft. Forced lubrication is used. See also Figure 44.

Figure 31 shows a double vertical bearing, Style JJ, with integral shaft collar and journal bearing below. The housing above the journal bearing is separate, and split for convenient assembling. It must be strong enough to carry the upward thrust. If clearance permits it to be raised clear of the bearing, it may be made in one piece. If split, short keyways may be used instead of one long keyway. Oil circulation is by external pump, and a cooler may be used when the speed requires it. Internal oil circulation follows the course of the arrows. When the overflow pipe is large enough to avoid accumulation of pressure in the housing, a felt washer or equivalent may be used at the top. Otherwise a seal ring with drain above it should be placed around the shaft just above the bearing.

Figure 32 shows a thrust bearing below a split coupling, arranged to support a long vertical shaft. No journal bearing is shown. The thrust bearing is Style JV; the ring surrounding it is separate from the base piece and doweled in place. It has slots to admit oil. The thrust block is integral with the lower end of the coupling, hence the middle pair of bolts in the coupling must be fitted. The runner is also split; this is special, and must be ordered if wanted, but it has

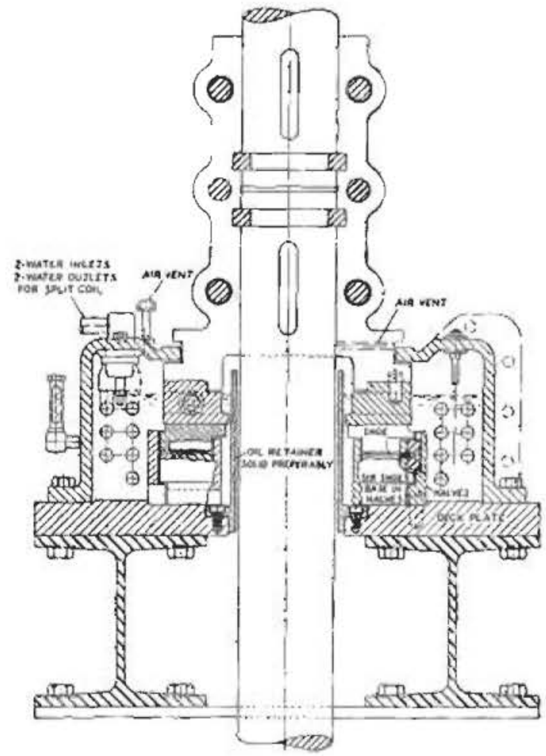


Figure 32: Full split thrust bearing and mounting designed for vertical shaft. Casing and coil are split. Deck plate and oil retainer should preferably be solid. Note use of separate shoe-retaining ring with Style J or B thrust bearing. This can be used in other mountings also, in preference to a cored vertical flange integral with the thrust deck as in Figure 14.

the same dimensions as the standard solid runner. The base ring, of course, is split; but the oil retainer should if possible be in one piece for tightness. A special two-piece design may be used for the cooling

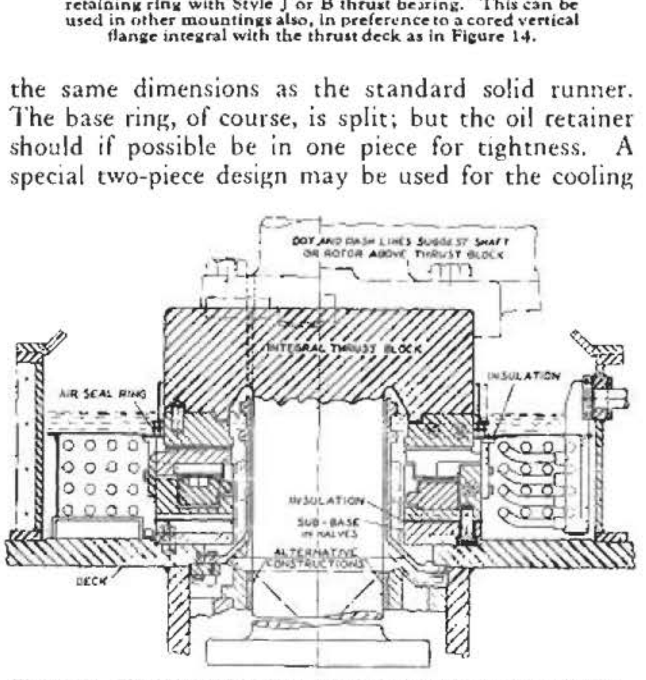


Figure 33: Kingsbury Thrust Bearing arranged for high-speed hydro-electric service. Alternative constructions allow the split oil seal ring to be dismounted from top or bottom, or from bottom only. See also text on Electrically Insulated Thrust Bearings, Page 11.

coil. The housing may be split or solid, according to requirements for assembling, but the deck plate should if possible be solid. An air vent hole may be placed at the lower end of the coupling when required, as shown by dotted lines. We can furnish internal parts only or the complete unit below the coupling, including deck plate.

Figure 33 shows an application of the KBV bearing to a high-speed hydro-electric unit. Note the large housed cooling coil, with headers of the manifold type used for low-pressure cooling water. Note also the air seal ring and the insulated sub-base. This base can be made to standard thickness shown in the dimension lists, or of special height to make this bearing interchangeable with the corresponding adjustable vertical bearing covered by our Bulletin E-1.

The thrust block illustrated is integral with the shaft and makes desirable the use of a full split thrust bearing. Whether the water coil and oil housing be split will depend on the superstructure not illustrated.

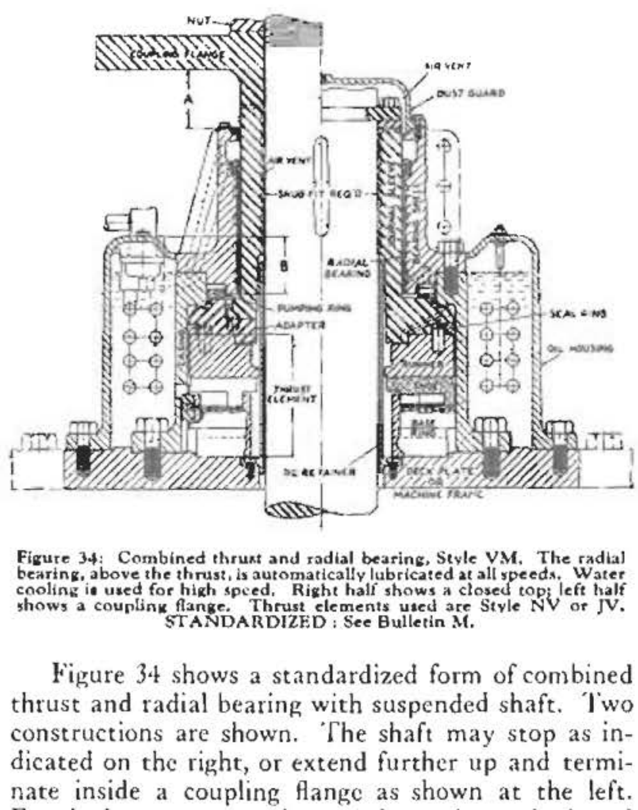


Figure 34: Combined thrust and radial bearing, Style VM. The radial bearing, above the thrust, is automatically lubricated at all speeds. Water cooling is used for high speed. Right half shows a closed top; left half shows a coupling flange. Thrust elements used are Style NV or JV. STANDARDIZED : See Bulletin M.

Figure 34 shows a standardized form of combined thrust and radial bearing with suspended shaft. Two constructions are shown. The shaft may stop as indicated on the right, or extend further up and terminate inside a coupling flange as shown at the left. For the latter construction an adapter is required, and clearance *A* must be greater than *B* for disassembling the bearing shell. For high speeds the radial bearing is lubricated centrifugally by oil rising inside the runner and passing to the periphery of the flange on the adapter sleeve. For lower speeds a special form of pumping ring, working on the viscosity principle, is used to force oil to the top of the radial bearing. Capillary oiling is also present, due to immersion of the lower end of that bearing. From the top of the bearing shell the oil returns to the bath. A seal ring prevents oil from returning directly to the bath. The pumping ring, although required only at low speeds, is sometimes needed for high-speed hydro-electric units, which may float along at very low speeds when not working. It operates regardless of the direction of rotation. If the working speed is low, the cooling coil may be omitted. This unit may also be fitted with an efficient air-cooled oil housing such as shown in Figure 36. We build complete units of this design (including deck plate if desired), in standard sizes from 9 inches to 17 inches, thrust collar diameter, and have dimension lists available. We build them larger when required. They are called Type VM bearings, and are fully described, with standard dimensions, in Bulletin M.

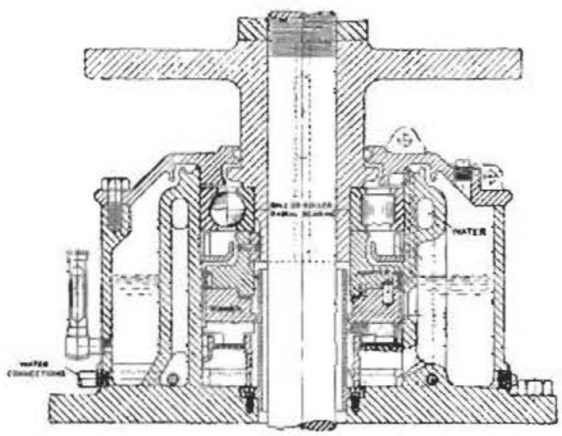


Figure 35: Kingsbury Thrust Bearing combined with ball or roller radial bearing. Water circulation in cored jacket permits high speed. STANDARDIZED : See Bulletin M.

Figure 35 shows a standardized mounting for the Kingsbury Thrust Bearing as used in conjunction with a ball or roller radial bearing. This combination is usual in deep well pumps, where running speeds are commonly from 850 r.p.m. to 1,800 r.p.m., and in small hydro-electric units at lower speeds. In our mounting the ball or roller bearing is supplied with a limited amount of oil which flows downward through it. This lubricates adequately, yet avoids power waste from unnecessary churning of oil. After passing through the radial bearing, the oil runs back to the bath through a pan that is placed under the radial bearing to catch any worn particles. This makes a nearly trouble-proof design. Cooling is accomplished very simply by means of an inner water jacket with which oil is actively in contact on both sides. We furnish this assembly complete in small standard sizes from 5 inches diameter upward, with either a radial ball or a radial roller bearing.

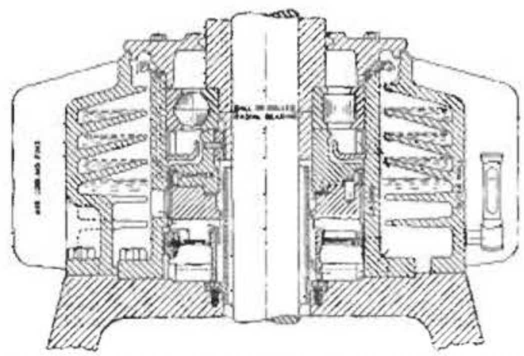


Figure 36: Kingsbury Thrust Bearing combined with ball or roller radial bearing. Special air-cooled mounting.

Figure 36 shows a combination of Kingsbury Thrust Bearing and ball or roller radial bearing similar to that shown in Figure 35, except that cooling is accomplished without water. A system of internal heat-absorbing flanges is used, over which the hot oil spreads as it flows down from the top of the housing, and of external radiating fins over which the surrounding air passes.

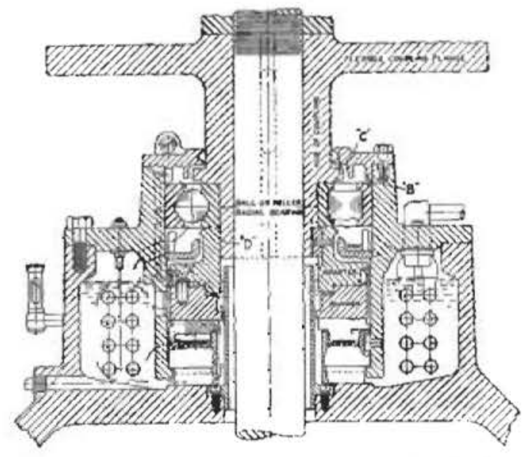


Figure 37: Kingsbury Thrust Bearing combined with ball or roller radial bearing. Water cooling coil permits high speed. STANDARDIZED : See Bulletin M.

In Figure 37 the assembly of Kingsbury Thrust Bearing and ball or roller radial bearing is completely independent of the oil reservoir, which forms part of the machine frame. The bearing assembly, with cooling coil attached, is simply bolted to the top of the reservoir. Part of the oil goes up inside the runner and past the oil seal ring *A* to the top of the housing, as in Figures 35-36; thence through the radial bearing back to the bath. Clearances *B* and *C* are small so that the adapter cannot lift clear of the dowel pins. Two constructions are available for the adapter: the fit marked *D* on the left side may be sliding as shown, or the adapter may be threaded on the hub of the coupling. Standardized mountings of this design are available in small sizes. This is made also with an inner water jacket instead of a coil.

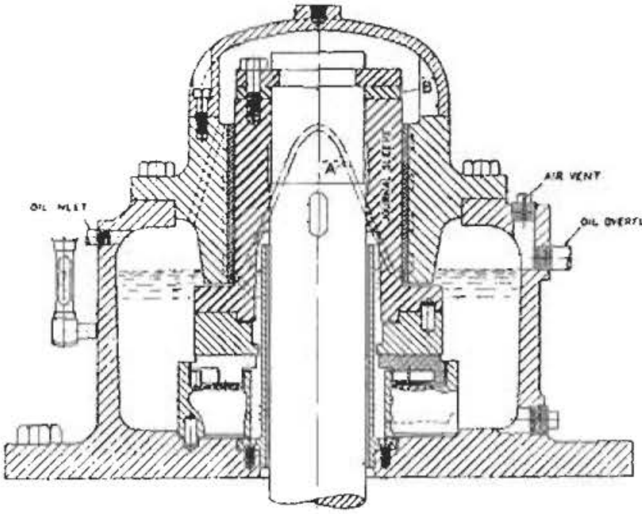


Figure 38: Combined thrust and radial bearing for heavy loads and slow speeds. Thrust bearing shown is Style KV or LV.

Figure 38 shows a simple combination of thrust and journal bearings, suitable for moderate speed if air cooled as illustrated, or for higher speed if the oil is externally cooled. Oil may be made to pass by

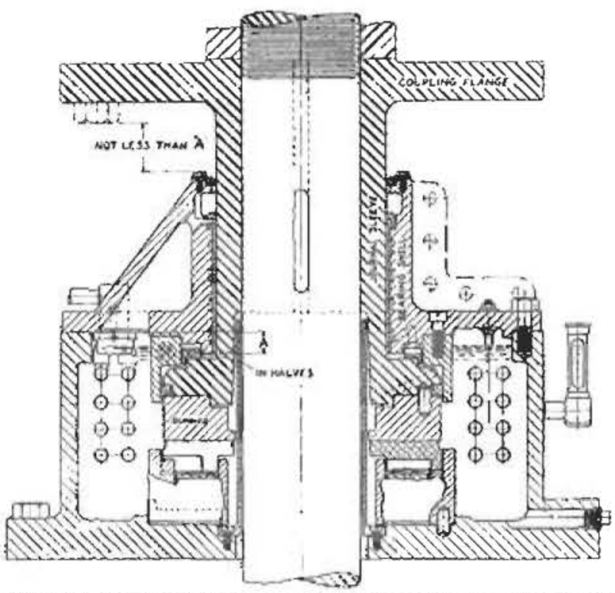


Figure 39: Combined thrust and radial bearing with automatic journal lubrication. Water cooling permits high speed. STANDARDIZED.

centrifugal force through the radial holes in the journal sleeve at its lower end, to the groove *A*. A spacing ring *B* between the journal sleeve and the split collar at the top of the shaft permits the shaft to be adjusted up or down if needed. Accurate, snug fitting and facing of the journal sleeve are necessary.

In Figure 39 the oil pot is part of the customer's construction. This arrangement resembles Figure 34 in the method of distributing oil to the bearings. An oil seal ring is used between runner and thrust block, as in Figure 34 between runner and adapter. The gap surrounding the runner encourages rapid circulation of the oil around the cooling coil in the bath. We can furnish this bearing assembly complete in standard sizes, together with coil. See Bulletin M.

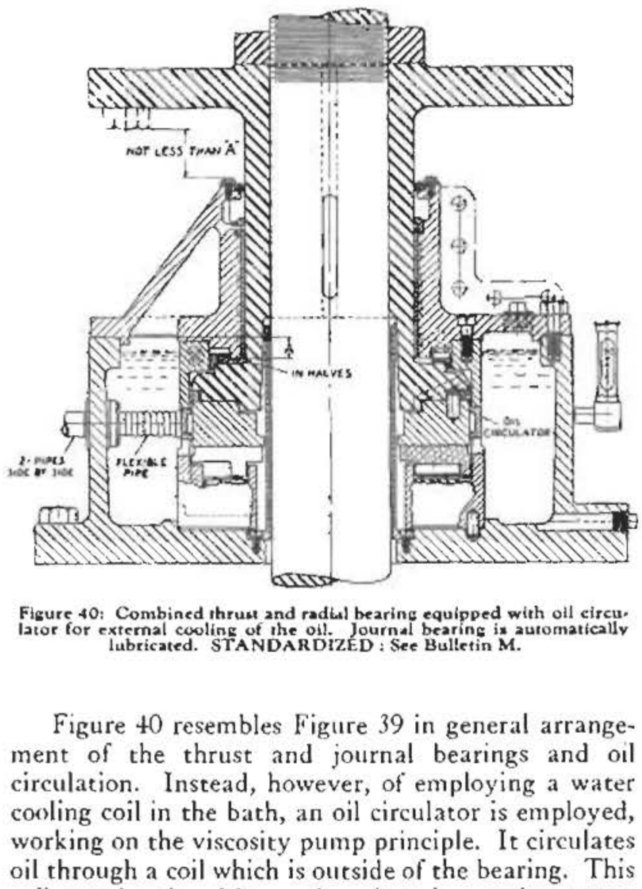


Figure 40: Combined thrust and radial bearing equipped with oil circulator for external cooling of the oil. Journal bearing is automatically lubricated. STANDARDIZED: See Bulletin M.

Figure 40 resembles Figure 39 in general arrangement of the thrust and journal bearings and oil circulation. Instead, however, of employing a water cooling coil in the bath, an oil circulator is employed, working on the viscosity pump principle. It circulates oil through a coil which is outside of the bearing. This coil may be placed in moving air or in running water, below the level of the bearings. The pumping ring, like that shown in Figures 34 and 39, operates with the shaft rotating in either direction. We can furnish this bearing assembly in standard sizes, ready to mount in the customer's oil reservoir.

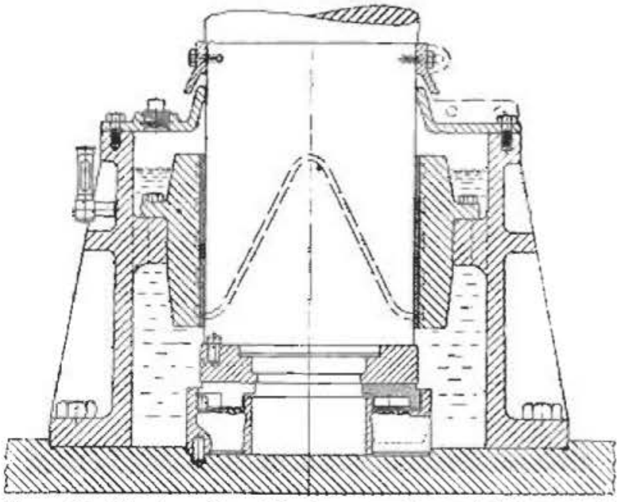


Figure 41: Kingsbury Thrust Bearing supporting end of heavy shaft. Bearing shown is Style KV or LV.

Figure 41 shows a thrust bearing and radial bearing at the lower end of a shaft. It is designed for heavy low-speed machinery. Both bearings are submerged in oil, and a dust shield is placed above the housing cover. Although the thrust bearing looks small, it will carry a load equal to the weight of a shaft of the diameter of the runner and more than fifty feet high.

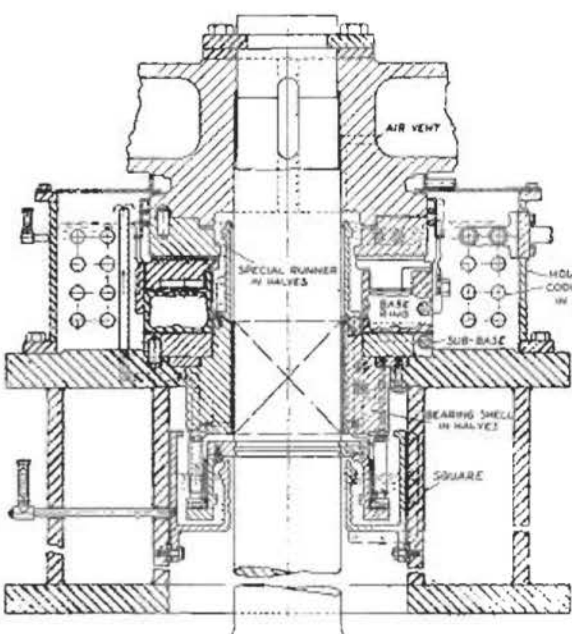


Figure 42: Kingsbury Thrust Bearing with radial bearing underneath. Compound oil reservoir. Oil circulation is automatic by means of viscosity pumping ring. With the oil pan withdrawn, all bearing parts can be lifted out with the shaft.

Figure 42 illustrates how the problem of automatic lubrication and cooling has been solved by the use of a compound reservoir when the radial bearing is below the thrust bearing. In this drawing the supporting girder is illustrated, as are also the hub and arms of a generator rotor. The viscosity pump in the lower reservoir oils the radial bearing, and at high speed changes the oil in the lower reservoir for cooler oil from above. We will adapt this design to customer's requirements and furnish such parts as best serve the purpose.

Various water cooling coils are illustrated, showing forms suited to particular mountings. That in Figure 33 is surrounded by a casing and cover which are useful, especially in high-speed bearings and in abnormally large or noncircular oil housings, for controlling the oil circulation within the well to make effective use of the water cooling surfaces. We furnish such casings and covers with the coils when necessary. Dimensions of these elements are supplied with certified drawings of the bearings with which they are to be used.

Insulated sub-bases are available for vertical bearings for electrical machinery. These are supplied as shown in Figure 33, and add to the height of the bearing as marked in the tables. They are seldom applied to bearings smaller than 19 inches runner diameter.

Horizontal Mountings

The Kingsbury Bearing elements described in this bulletin need to be submerged in oil while running. To minimize leakage of oil around a horizontal shaft, the oil level, when not running, is ordinarily kept below the shaft. This requires the use of means to raise the oil to fill the bearing cavity when running. That is done either by an external circulating oil pump or by an internal "pumping ring" working on the viscosity principle. The pumping ring is employed in certain self-contained bearing units* furnished complete by us. An external pump would be used where the mounting is furnished by the customer.

The mountings here shown, with a few exceptions, require oil to be supplied to and discharged from the bearing cavity at a rate specified by us and depending upon bearing size and shaft speed.

Oil is taken either from a reservoir under the bearing or from an external source. After passing through the bearing cavity it goes back to the source and is there cooled, refiltered if necessary, and returned to circulation.

*See Bulletins G-1 and S, described on Page 39 herein

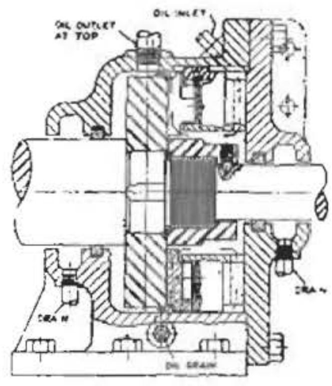


Figure 43: Simple mounting for single horizontal thrust bearing, Style JH, BH or NH. Forced lubrication is used. Base flange is provided for attachment to machine.

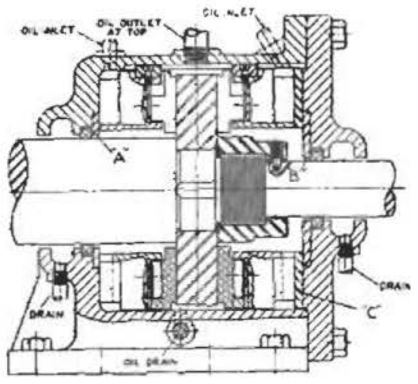


Figure 45: Simple mounting for double horizontal thrust bearing. Forced lubrication is used, with two inlets and one outlet. Base flange is provided for attachment.

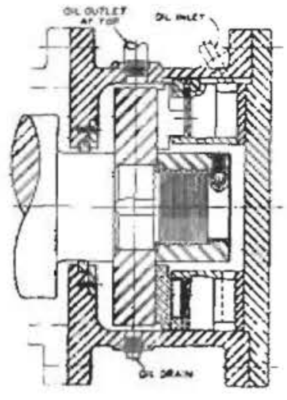


Figure 46: Simple mounting for single horizontal thrust bearing, Style JH, BH or NH. Forced lubrication is used. End flange is provided for attachment to machine.

See Figure 44 regarding dotted oil inlets in these drawings.

In all horizontal bearings the oil should travel in the same direction as in the vertical bearings. Alternative locations of oil inlets for the bearing cavity are shown in Figure 44. The oil passes through slots in the base ring, then through the annular space between the shaft and the bore of the base ring, and issues radially between the shoes, bathing the bearing surfaces of the collar as it flows. The oil discharge is at the top of the cavity, over the collar. If the oil pump starts and stops with the shaft, it must have capacity to fill the bearing cavity quickly; but only moderate force is required, as the back pressure is very small.

Horizontal mountings are usually provided with oil seal rings around the shaft, and with drain pockets outside the seal rings, by which whatever oil gets past the seal rings is returned to the source of circulation. When the machine is at rest, the oil level in the mounting or bath is just below the bottom of the shaft. Sometimes however, especially in marine work, stuffing boxes are used to prevent escape of oil, and the bearing cavity may remain completely filled with oil, as in Figure 57.

Figure 43 shows a simple form of horizontal single-thrust mounting on a low pedestal base. Oil enters from outside by the dotted inlet (which may be located in one of the lower positions shown in Figure 44, if desired, for ready removal of the cap) and flows from the contracted portion of the base ring, inward through oil slots. Thence it follows the arrows and passes out at the top. When running, the entire bearing cavity is filled with oil. An external pump and cooler are assumed. The housing and end cover are designed to be split horizontally in order to insert the oil seal rings. See Figure 45 for an alternative design by which horizontal split construction of the housing may be avoided when necessary. The collar in Figure 43 is securely clamped on the shaft by a nut with locking means. The internal parts might be Style NH, JH or BH. Style JH is shown. When desired, we can

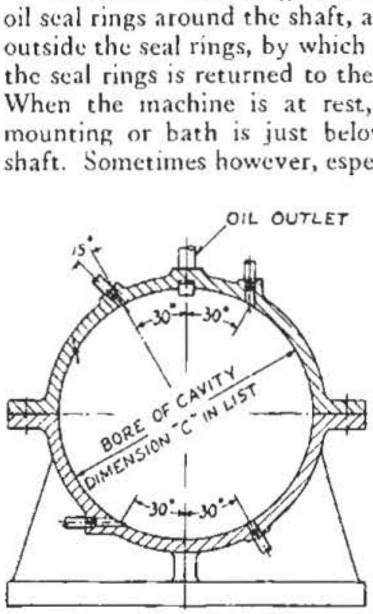
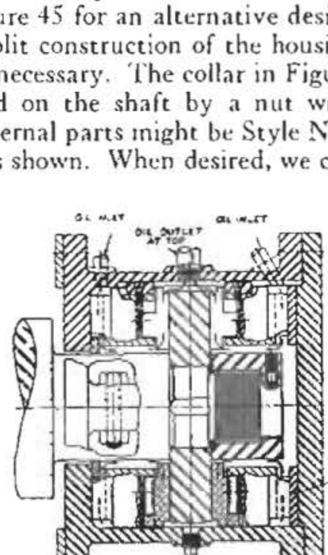


Figure 44: Cross section of mounting shown in Figure 43, showing choice of circumferential positions for oil inlet with forced lubrication. These positions with reference to the key apply also to vertical mountings in which the oil is supplied under pressure through a casing closely surrounding the bearing, as in Figures 30 and 31.

Figure 47: Simple mounting for double horizontal thrust bearing. Forced lubrication is used, with two inlets and one outlet. End flange is provided for attachment to machine.

See Figure 44 regarding dotted oil inlets.



build the complete unit, with base to suit customer's requirements.

Figure 45 is a quite similar design for a double-thrust bearing. The bearing shown is JHJ or BHB, but the N elements might be used in either or both positions. Oil enters at two points shown, and discharges at the top center. See also Figure 44. The oil seal retaining plates *A* and *B* are required with BHB bearings if the housing base and cover are combined into one piece, or if it is desired to place seal rings without lifting the shaft. When JHJ or NHN bearing parts are used, the plate *A* is not needed because of recesses in the backs of the bearings, as shown in Figure 47. Since the housing cover takes part of the thrust, the joint must be securely fastened against shearing forces. A filler plate *C* of adjustable thickness is used between cover plate and base ring to regulate end play. The lower half of the housing may be built integral with the customer's machine. We can however furnish complete separate units with bases to suit customer's requirements.

Figure 46 is similar to Figure 43, except that the shaft does not extend through the cover, and the mounting is provided with an end flange. The housing may be in one piece if the retainer plate shown is used for the oil seal ring. The housing is intended to be bolted directly to a flange on the machine, or to be built into the customer's machine frame. We are prepared to build complete separate units with flanges to suit customer's requirements.

Figure 47 shows a mounting similar to Figure 46, except that the bearing is double. A similar mounting is commonly used with marine reduction gears to take the propeller thrust. The oil circulates as in Figure 45. See Figure 44 for inlet locations. When Style J or N bearing parts are used, the oil seal rings are held in place by the bearing base itself, so that no separate retainer plate is needed. The latter should be used, however, with Style B bearings. A filler plate *A* is employed, as in Figure 45; its thickness may be adjusted when assembling to secure the right degree of end play. When required, we can build the complete mounting with flange to suit customer's requirements.

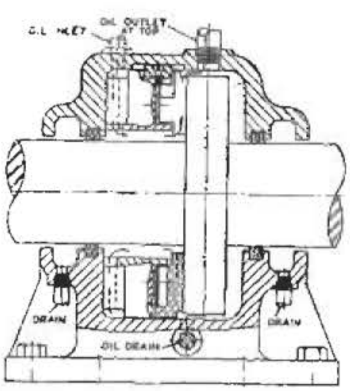


Figure 48: Simple horizontal mounting for single thrust bearing. Style J, B or N. Collar is integral with shaft. Forced lubrication is used.

See Figure 44 for oil inlets.

Figure 48 shows a shaft with integral thrust collar. The housing has a pedestal base and is split horizontally on the shaft axis. Shafts of this character frequently have integral end flanges; hence the oil seal rings are split to permit assembling. The bearings may be Style J or B, both of which have split base rings. If the mounting is not integral with customer's machine, we can build the complete unit, with base to suit his design.

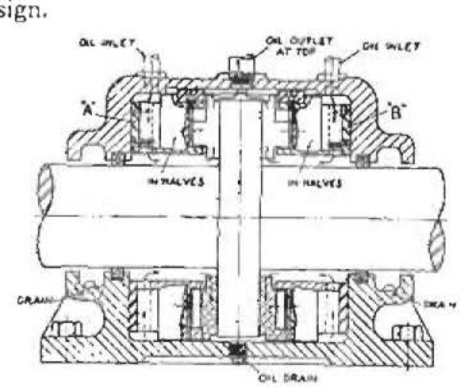


Figure 49: Simple horizontal mounting for double thrust bearing of Style JJ, BB or NN. Collar is integral with shaft. Forced lubrication is used, with two inlets and one outlet.

See Figure 44 for oil inlets.

Figure 49 shows a mounting similar to Figure 48, but arranged for a double thrust. Filler plates *A* and *B* are provided to locate the shaft endwise and limit the clearance. They are split and are doweled and screwed to the base rings. If desired, we can build the complete unit, with base to suit customer's design.

Mountings of the general types shown in Figures 43 and 45 to 49 are covered more fully in Bulletin G-1.

Horizontal Mountings With Adjacent Journal Bearings

Figure 50: Combined horizontal mounting for journal and double thrust bearing. Collar is integral with shaft. Forced lubrication is used. Base flange is provided for attachment. STANDARDIZED : See Bulletin G-1.

Figure 50 shows a double thrust bearing built in one housing with a journal bearing. This design is used for such service as ship propeller and dredge pump shafts. In dredge service the upper shell of the journal bearing should be fully babbitted when an upward load is to be carried. An oil seal ring is interposed between the journal and the double-thrust bearings, and each of the three bearings receives oil separately. Oil seal rings and drains are provided at the ends, and wipers may be used if the shaft speed is not high enough to throw off the oil. External cooling is assumed. The thrust bearings shown are Style J or B. We build the complete unit in standard sizes. Stuffing boxes are furnished when desired.

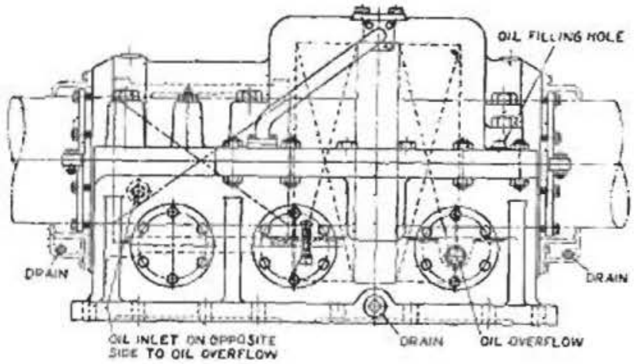


Figure 51: Style KH combined horizontal mounting for journal and double thrust bearing. Collar is integral with shaft. Lubrication is automatic. Base flange is provided. STANDARDIZED : See Bulletin G-1.

Figure 51 shows our standard KH marine mounting. It is made of cast steel and contains JJ or BB thrust bearings. The shaft has an integral collar. This mounting is similar to Figure 50 except that it usually has stuffing boxes at the ends. Internal means are provided for circulating oil to the bearing cavities from the main reservoir in the base. This internal circulation is maintained by a pumping ring similar in principle to that shown in Figure 53. At low speeds natural radiation is satisfactory, but at higher speeds external cooling is necessary. In that event the oil inlet and outlet illustrated would be used; otherwise oil would be added at filling hole as required. The large supply of oil in the mounting gives a considerable margin of safety in case the outside circulation fails temporarily. A similar bearing, Style KPH, having a two-shoe thrust element in one end, six shoes in the other, with cooler mounted on the side, is used for heavy-duty dredge service.

In Figure 52 is shown a marine bearing similar to that in Figure 50. As in that design, the thrust collar is integral with the shaft. In this design, however, there are two short journal bearings, one at each end.

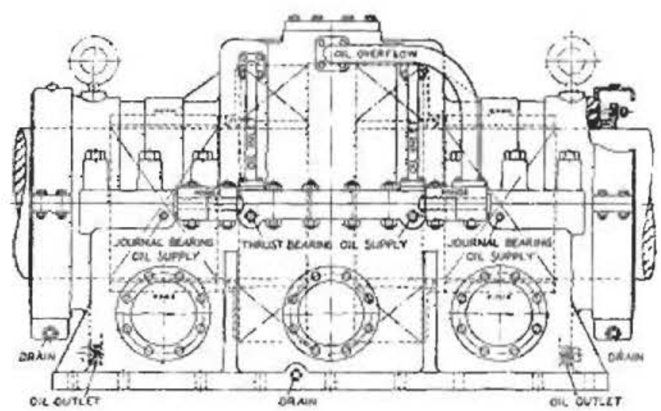


Figure 52: Marine mounting for two journal bearings and a double Kingsbury Thrust Bearing. Collar is integral with shaft. Forced lubrication is used. Designed for propeller shafts of 705-foot, 30,000-ton, twin-screw transatlantic liners. STANDARDIZED : See Bulletin G-1.

Oil is supplied separately to each bearing, and returns from all bearings into the base. One outlet, serving the entire system, leads to an external cooler. Oil for the thrust bearing cavities is usually piped directly to the top of the bearings. In large sizes, in order to minimize the labor of raising the top half of the housing, the joint is hinged.

All connections to the ship's oil piping can lead direct to the base, provided the design includes return passages from cap to base, preferably utilizing short pipe bends assembled permanently with the cap.

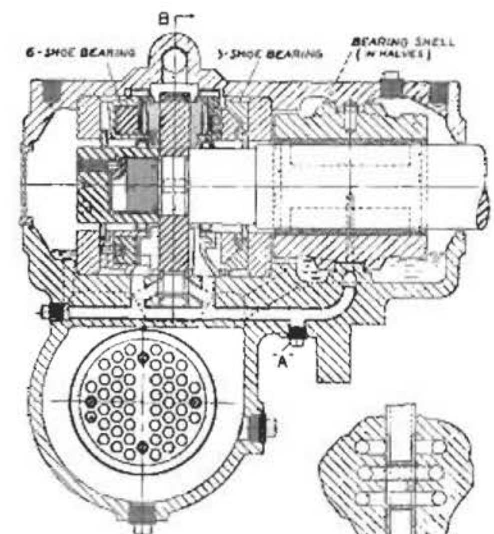


Figure 53: Self-contained, water-cooled mounting for use with centrifugal pumps. Oil is circulated automatically to double thrust and journal bearings by automatically reversible viscosity pumping ring. For alternative shaft form see Figure 55. STANDARDIZED : See Bulletin S.

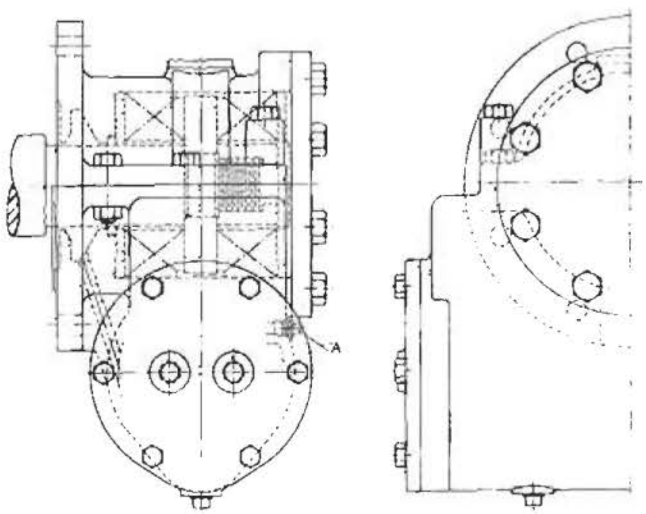


Figure 54: Self-contained mounting for double Kingsbury Thrust Bearing with automatic lubrication. End flange is provided for attachment to radial bearing housing.

With end stuffing boxes to retard leakage, the housing may fill completely with oil, which will be retained till it gradually leaks away. Circulation by oil supply and external oil pump is assumed. Large bearings of this type are provided with hoods over the stuffing boxes to catch dripping oil and return it to the sump. We build this unit complete in standard sizes.

The above marine mountings, and also Figures 56 and 57, are more fully covered in our Bulletin G-1 on Marine and Dredge Bearings, in which their installation dimensions are given.

Figure 53 shows a self-contained horizontal unit which we furnish complete as shown for use with centrifugal pumps running at speeds up to 3,600 r.p.m. The cooler is in the housing, and circulation is maintained by a pumping ring operating on the viscosity principle. The thrust bearing is double, and adjoins a sensitively self-aligning journal bearing. We furnish this unit in standard sizes from 5 to 15 inches collar diameter.

The normal oil level when this bearing is at rest is just below the shaft. When the shaft starts turning, oil from the bath at the base of the pumping ring, entering via the right and left dotted passages, travels around with the collar and is forced, via similar passages shown in full lines, to the thrust segments and to the journal bearing. The initial turns of the shaft raise oil quickly to all bearing surfaces. From the top of the thrust bearing the oil returns to the cooler underneath. The housing is split horizontally, and the end plate has a hole through which a revolution counter may be inserted.

Oil may be supplied to other journal bearings from connection *A*, if returned to the cooler housing.

The same mounting is furnished with a large, medium-sized or small cooler, for high, medium or low speed work; the last class includes bearings used in horizontal hydro-electric units, whose speeds are usually under 1,000 r.p.m. See Bulletin S for installation dimensions and further particulars.

Figure 54 shows a mounting designed in the main like that in Figure 53, and adapted to fit against a flange on the customer's machine. It does not include a journal bearing. Although not standardized, it will be furnished when required, to fit the purchaser's machine. Lubrication is automatic, as described for Figure 53, and, as in the latter, oil can be fed from this mounting at *A* to nearby journal bearings, if returned again to the thrust bearing well.

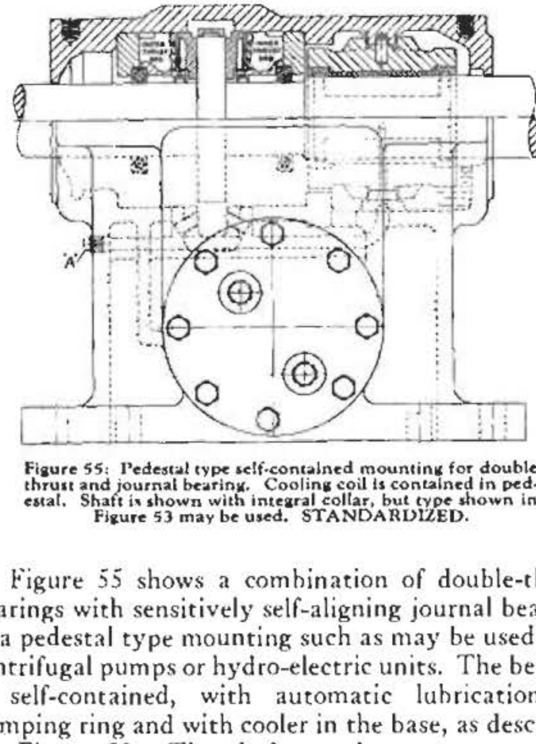


Figure 55: Pedestal type self-contained mounting for double thrust and journal bearing. Cooling coil is contained in pedestal. Shaft is shown with integral collar, but type shown in Figure 53 may be used. STANDARDIZED.

Figure 55 shows a combination of double-thrust bearings with sensitively self-aligning journal bearing, in a pedestal type mounting such as may be used with centrifugal pumps or hydro-electric units. The bearing is self-contained, with automatic lubrication by pumping ring and with cooler in the base, as described for Figure 53. The shaft, as shown, goes straight through and has an integral collar, but the nutted collar of Figure 53 is equally suitable. When parts cannot readily be assembled over the ends of the shaft, the oil seal rings, and also the pumping ring, are made in halves. The thrust elements may be Style J or B, both of which are split, or Style N if a nutted collar is used. We furnish this unit complete in standard sizes listed in Bulletin S.

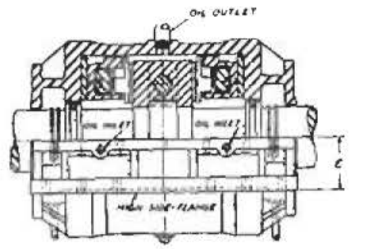


Figure 56: Kingsbury Double Thrust Bearing with thick split thrust collar of Style B, Figure 58. Medium high base flange is illustrated.

Figure 56 shows a horizontal bearing with split thrust collar of Style B; see Figure 58 and text below. This mounting was designed originally for submarines and like vessels, where the thrust housing flanges need to be higher up than usual around the housing barrel. The side flanges of this mounting can be made of unequal heights for locations near the shell of a vessel. The housing is split horizontally, and the bearings, including the oil seal rings, are likewise split, and can be removed without disturbing the shaft. As nothing has to be threaded over the shaft, the latter can be made with integral coupling flanges. Distance pieces are inserted between the ends and the bearings in order to locate the shaft accurately endwise, and provide for the proper end play. External oil pump and cooling are assumed. These mountings can be furnished complete as required.

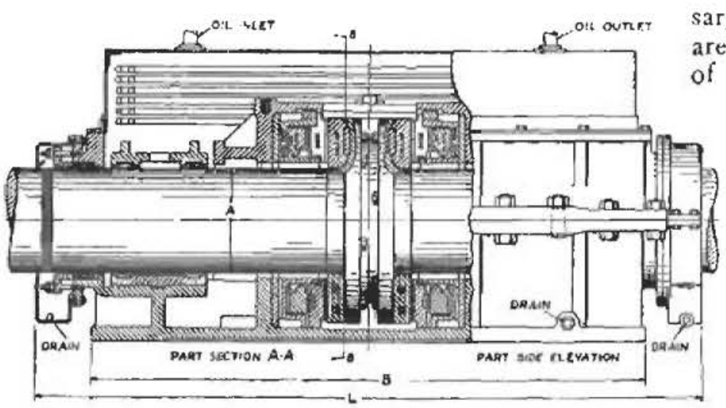


Figure 57: Special mounting for naval vessels. Two journals, and a double thrust bearing with split facing collars.

Figure 57 shows a large mounting designed for heavy warships having the thrust bearing located abaft the propelling machinery. There are forward and reverse thrust bearings, and a journal bearing at each end. A shaft collar of Style C (Figure 58) and facing collars of Style A are used. The journal bearing caps, the end caps, and the top halves of the thrust mountings are all removable. It follows that any part which might be disabled in service can be quickly replaced with the minimum weight of spares.

The casing cover is galvanized steel, and the whole housing is completely filled with oil, which is cooled by the coil or by an external system. If either the water or the oil circulation should be disabled, the bearing would still run for a considerable time in safety, because of the heat capacity of the large volume of contained oil. This construction represents the maximum precaution against serious disablement in service. Such mountings are of special design, and can be furnished complete. This and similar mountings are described more fully in Bulletin G-1.

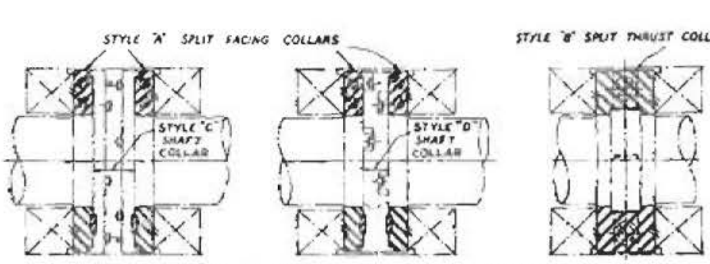


Figure 58: Two types of split facing collars. Used especially on vessels for quick replacement. See text.

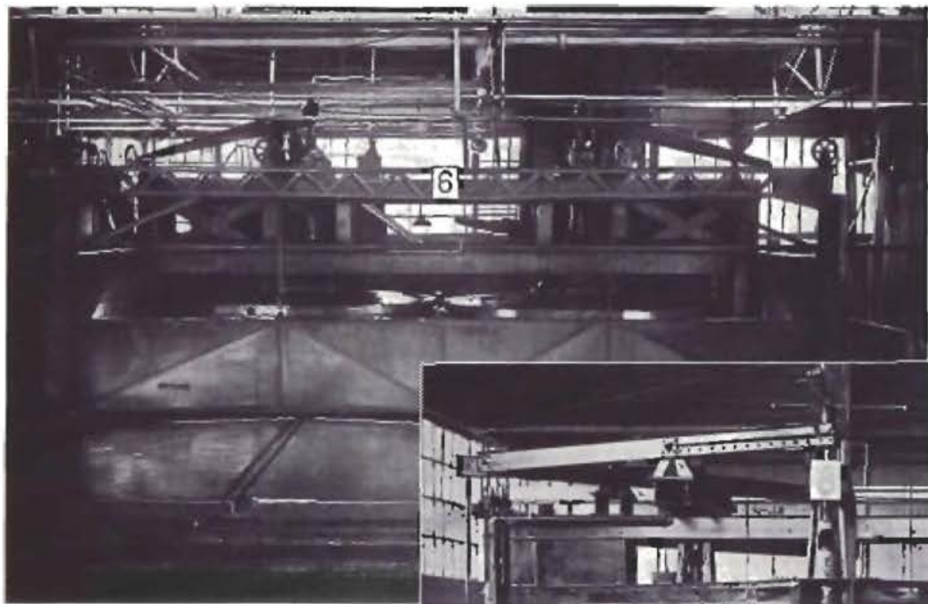
Split Thrust Collars and Runners

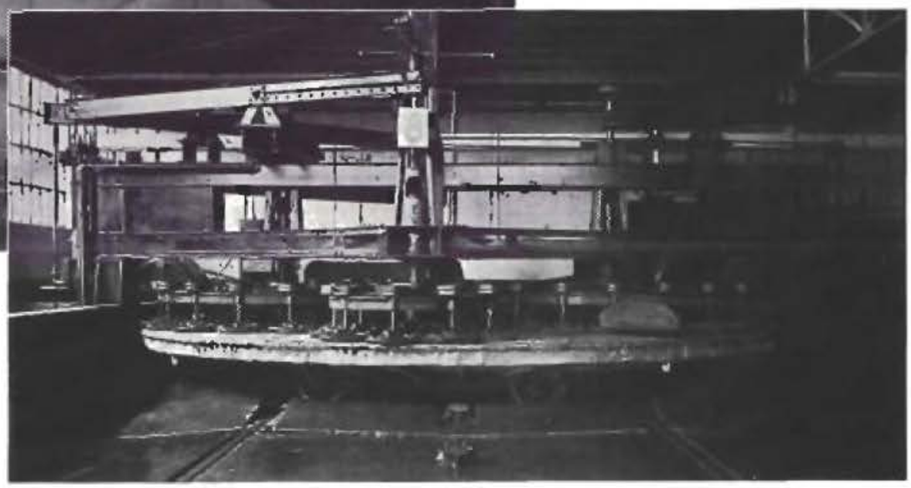
Split thrust collars may be used when necessary instead of the solid ones whose dimensions are listed in the tables. The two most useful forms of split collars, Styles A and B, are illustrated in Figure 58. Style A is a single facing collar, with a thickness about the same as the runner of a vertical bearing. It must be backed up by a solid shaft collar which is thick enough to carry the thrust load. Two such integral shaft collars, Styles C and D, are illustrated in Figure 58, each faced with two Style A thrust collars.

Style B thrust collar is about twice as thick as the standard solid thrust collar given in the dimension lists of the horizontal bearings. This Style B collar can be fitted over a shallow shaft collar, a cheaper construction than needed for Style A thrust collars.

The two halves of a split thrust collar are carefully fitted together with tongue-and-groove joints, and are securely bolted.

Split runners for vertical bearings are similarly constructed and have the same dimensions as the solid runners for such bearings.





Left and below: Kingsbury Thrust Bearings support the plate glass grinding and polishing machine tables in the Glassmere Plant of the Ford Motor Company.

OTHER KINGSBURY BULLETINS

For details of mountings here shown, and dimension lists of those standarized, write for the appropriate Bulletin listed below.

BULLETIN G-1
Marine-Type Mountings

Standard and special horizontal thrust mountings. Includes the GH line (two-shoe adjustable); KH line (housings with JJ and BB internal parts); KPH line, also separate *Journal Bearings*. For marine propeller shafting, suction dredges and similar service.

BULLETIN M
Combined Vertical Mountings

Standard and special mountings for thrust bearings from 5 to 17-inch size, also larger special sizes. Includes the VM line of combined Thrust and Journal Bearing Mountings; also combined Kingsbury Thrust and Ball or Roller Radial Bearing Mountings; Thrust Mountings only, and separate Journal Bearing Mountings.

BULLETIN R
Vertical Spherical Thrust Bearings

These bearings replace combined vertical thrust and journal bearings in certain conditions, and may be interchanged with them. Solid or split runners. Bases with large bores to pass shaft flanges. Bearings with convex runner, Style RX; with concave runner, Style RV.

BULLETIN S
Bearing Mountings for High-Speed Centrifugal Pumps

Standard mountings complete with Thrust Bearing, Journal Bearing, Oil Pump and Cooler. Special mountings. Half flange types; full flange types; pedestal types. Also includes separate journal bearing mountings and thrust bearing mountings.

BULLETIN E-1
Vertical Adjustable Thrust Bearings

Standard sizes from 17 inches to 117 inches. Used principally in hydro-electric generators. Bearings adjustable from below. Bearing bases with large bores, to pass shaft flange. Air seal rings, cooling coils, insulated sub-bases. Combined adjustable thrust and journal bearings. Separate journal bearings.

BULLETIN C-2
Engineering Aspects of the Kingsbury Thrust Bearing

The theory of lubrication and its application in Kingsbury Thrust Bearings. Relation between load, speed, temperature and oil viscosity. Frictional coefficients and horsepower absorbed in bearings. Typical designs of Kingsbury Thrust Bearings for meeting a variety of conditions. Test results. Installation and care of Kingsbury Bearings.

KINGSBURY