OPERATION AND MAINTENANCE MANUAL FOR FKC SLUDGE DEWATERING EQUIPMENT

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SECTION 1

GENERAL PRINCIPLES

SECTION 1A

SCREW PRESS INTRODUCTION

FKC screw presses have been in use in Pulp & Paper, food, chemical, and industrial applications since 1958. Uses include primary and secondary sludge dewatering, wood pulp dewatering, rejects dewatering, fruit juices, imitation crab meat (surimi) production and oil recovery.

The function of the screw press is to remove liquid from a solid/liquid mixture. This is accomplished by squeezing the solid/liquid mixture and allowing the liquid to escape through perforated screens surrounding the screw while retaining the solids inside the press.

As shown in Figure 1A, the solid/liquid mixture enters the screw press by way of the headbox at the inlet end. The mixture is conveyed from the inlet end to the outlet end of the press by the rotating screw. As the material is conveyed along the length of the press it is squeezed between the tapered screw shell and the screen drums. The dry solids exit the press at the discharge end and fall down the discharge box. The liquid (pressate) that was forced out through the screens is collected in the pressate pan and flows to the pressate discharge flange.

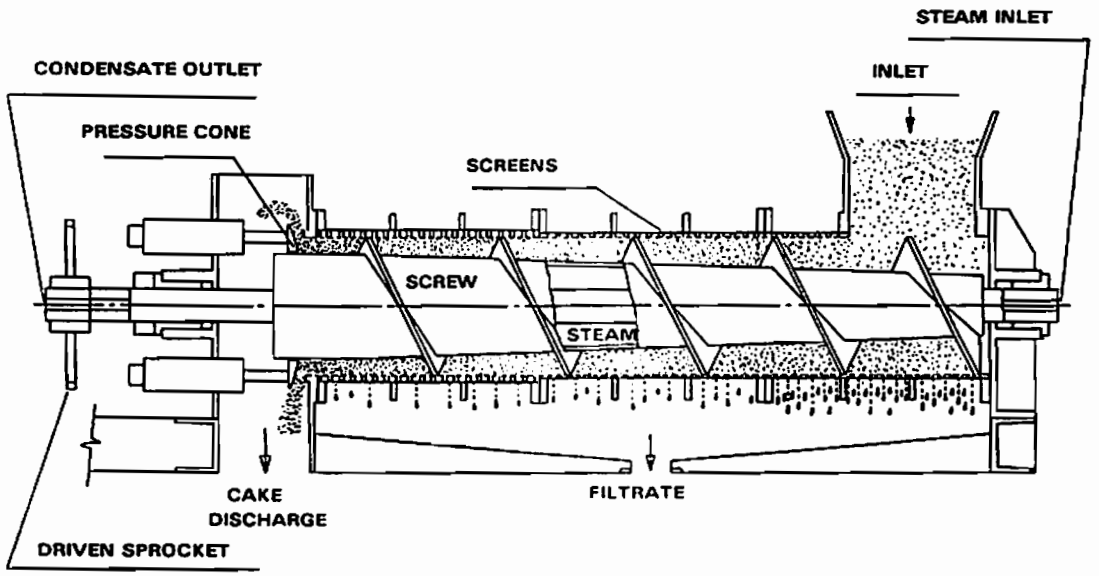


FIGURE 1A - SCREW PRESS CROSS SECTION

SECTION 1B

GENERAL MECHANICAL CONSTRUCTION

The key component of the screw press is the screw. As Figure 1B shows, the screw consists of a tapered shell to which a helical flight is attached. The outside diameter of the flight is constant. The tapered shell is smallest at the inlet end and largest at the discharge end. The screw rotates inside a series of drums lined with replaceable, perforated, stainless steel screens.

The screw is supported by four bearings; three radial bearings and one thrust bearing. The screw and bearings can be accessed by lifting the top half of the drums and bearing stands as shown in Figure 1B.

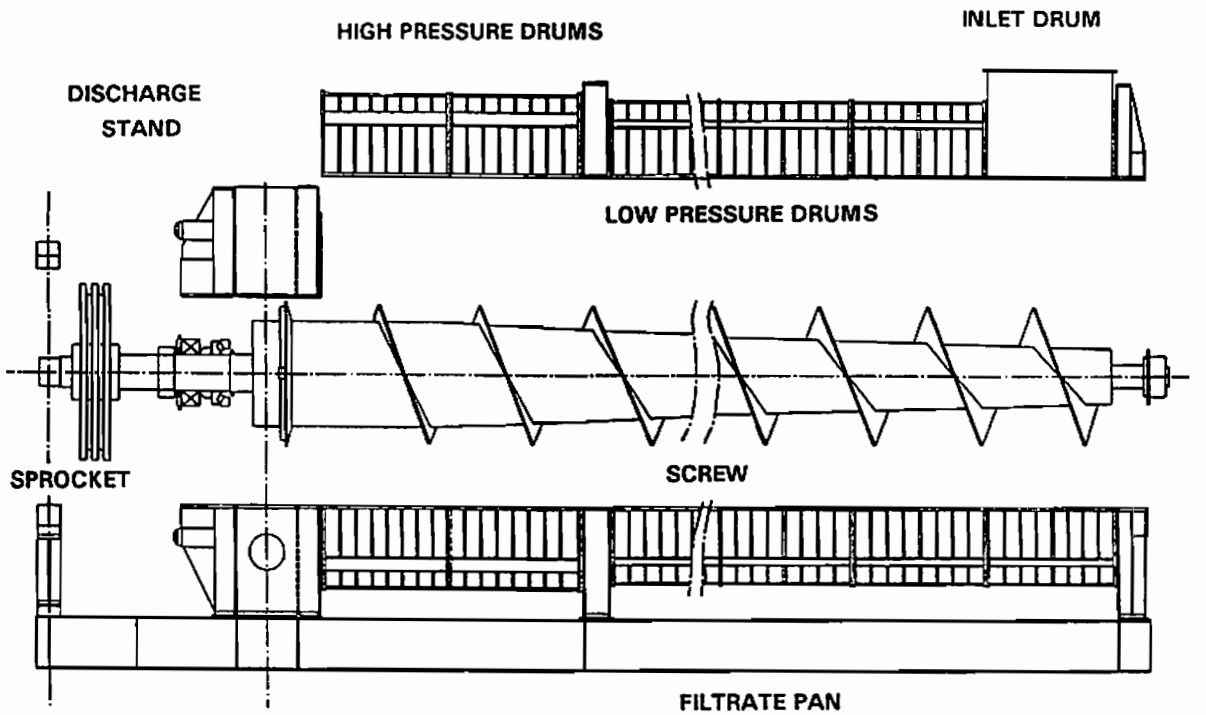


FIGURE 1B - SCREW PRESS EXPLODED VIEW

SECTION 1C

OPERATING WITH STEAM

The SHX model screw presses have screws that can be steam heated. SHX models are common in the pulp and paper industry for dewatering sludge and pulp.

As Figure 1C shows, saturated steam enters the inlet end of the screw through a rotary joint. The steam travels a short distance through a passage in the screw shaft and then into the space between the screw shaft and the tapered screw shell.

The steam does not come in contact with the material to be dewatered. Heat from the steam is transferred through the screw shell to the material being dewatered in the press. The steam condenses due to the heat loss and the condensate collects at the discharge end of the screw shell.

The condensate is intermittently removed as the screw rotates. The condensate is blown out through the condensate removal siphon as the siphon pipe dips into and rotates through the condensate during each revolution of the screw.

The condensate exits the press through the rotary joint at the discharge end of the screw shaft and is passed through the steam trap. As the siphon rotates out of the condensate, steam fills the line and closes the steam trap.

The condensate removal process repeats with the next revolution of the screw.

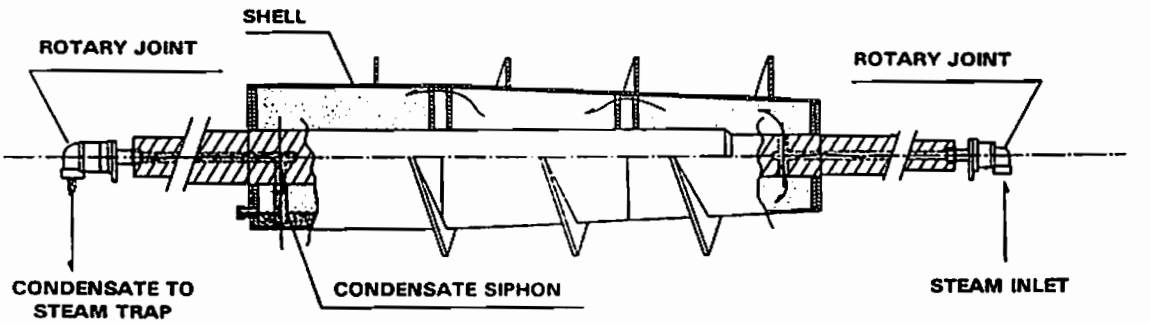


FIGURE 1C - STEAM FLOW DIAGRAM

SECTION 1D

GENERAL OPERATIONAL PRINCIPLES

Screw Press throughput and discharge cake consistency are determined by many factors including screw speed, headbox level, sludge feed rate, back pressure, heat addition, sludge inlet consistency, sludge conditioning, and other sludge properties. To thoroughly understand overall Screw Press performance, the effect each factor has on throughput and discharge cake consistency must be understood.

The chart below summarizes the effects on screw press performance of varying screw speed, headbox level, backpressure, and RST outlet consistency. Detailed explanations can be found on the following pages.

a) QUICK REFERENCE DIAGRAM / FUNDAMENTAL OPERATING RELATIONSHIPS

		DISCHARGE CAKE CONSISTENCY	THROUGHPUT CAPACITY	MOTOR LOAD
SCREW SPEED	UP	DOWN	UP	UP
	DOWN	UP	DOWN	DOWN
HEADBOX LEVEL	UP	UP	UP	UP
	DOWN	DOWN	DOWN	DOWN
BACK PRESSURE	UP	UP	DOWN	UP
	DOWN	DOWN	UP	DOWN
RST OUTLET	UP	UP	UP	UP
	DOWN	DOWN	DOWN	DOWN

Assuming sludge pump speed is controlled by headbox level and all other factors remain constant, adjustments to the operational parameters listed will have the effects noted on the chart above.

Note: (1) The impact of backpressure on discharge cake solids should be minimal compared with the resulting impact on motor amps.

SECTION 1D

GENERAL OPERATIONAL PRINCIPLES

b) SCREW SPEED

Screw speed is directly related to throughput and inversely related to discharge cake consistency, assuming all other factors remain constant.

Throughput will increase if screw speed is increased and will decrease if screw speed is decreased. The Screw Press works similar to a screw conveyor in that the faster it turns, the more material it conveys.

Discharge cake consistency will decrease if screw speed is increased and will increase if screw speed is decreased. A faster screw speed reduces retention time of the sludge in the press resulting in less dewatering or lower discharge cake consistency. A slower screw speed allows for a longer retention time of the sludge in the press which results in more dewatering and a higher discharge cake consistency.

The screw speed or throughput rate at which a given discharge cake consistency can be achieved/maintained will vary as sludge characteristics change.

c) HEADBOX LEVEL

Headbox level is directly related to both throughput and discharge cake consistency, assuming all other factors remain constant.

If headbox level is increased (i.e. sludge flow is increased), throughput, discharge cake consistency, and motor amps will increase. This is because the higher head level promotes increased dewatering in the "gravity drainage" section (first section at the inlet end of the press) resulting in a higher consistency material (more solids per volume) being fed into the press.

Conversely, if head level is decreased (i.e. sludge flow is decreased) both throughput and discharge cake consistency will decrease. This is because less gravity drainage occurs at the inlet end of the press resulting in a lower consistency material (less solids per volume) being fed into the press.

d) FEED RATE

Feed rate (sludge flow & consistency) and headbox level are interrelated. If the screw speed is kept constant, then an increase in feed rate will result in an increase in headbox level. The increase in headbox level will promote gravity drainage at the inlet end of the press and result in increases in throughput and discharge cake dryness. Conversely, if the feed rate decreases (with screw speed remaining constant), the headbox level will decrease and less gravity drainage will occur resulting in decreased throughput and discharge cake consistency.

e) PRESSURE CONE SETTING

The pressure cone applies back pressure on the cake in the high pressure section of the press. The pressure is adjusted by turning the spring arbor nuts to change the spring force on the pressure cone. Generally, as back pressure is increased, the discharge cake consistency of fiberous materials increases and the throughput remains constant or may decrease. The adverse effects of increasing back pressure are accelerated wear, higher motor load, increased chance of plugging, and decreased capture efficiency for low fiber sludges.

f) HEAT ADDITION

Heat is added by injecting steam through a short passage way in the screw shaft into the open space between the screw shaft and the tapered screw shell. Generally, heat addition increases discharge cake consistency by making the sludge easier to dewater. Heat addition reduces the friction between the screw and the sludge resulting in less wear and less energy consumption. Heat addition can indirectly increase throughput by lowering motor amps so that the press can be run at a higher headbox level.

g) INLET CONSISTENCY

Inlet consistency has a direct relationship to throughput capacity. As the inlet consistency of the sludge increases, the throughput capacity of the press increases and in many cases the discharge cake consistency increases also.

As inlet consistency increases, more solids are fed to the press per given volume of sludge and throughput increases assuming all other factors remain constant. It is for this reason that a prethickener, such as the FKC Rotary Screen Thickener, is recommended. A prethickener may result in increased capacity for an existing press or may allow the use of a smaller and more economical press in new installations.

As inlet consistency decreases, the throughput, discharge cake consistency, and capture efficiency also decrease.

h) CHEMICAL CONDITIONING (FLOCCULATION)

Various types of pulp and some simple settled sludge containing long fibers can be dewatered efficiently without chemical conditioning. Most sludges, however, require flocculation prior to being dewatered.

In order to minimize polymer consumption (i.e. maximize polymer efficiency) and improve dewaterability it is important to choose the chemical or combination of chemicals (e.g. coagulant and/or flocculant) best suited for the specific sludge to be dewatered.

Poor conditioning results in decreased capture efficiency for the press and reduces dewaterability of the sludge yielding lower throughput capacity and discharge cake consistency.

i) SLUDGE PROPERTIES

The most important, and the least controllable, factor in sludge dewatering is the sludge itself. Dewaterability depends upon the type, freeness, fiber content, ash content, pH level, etc. of the sludge.

Although it is generally not possible to control sludge properties it is important to understand the effects of sludge characteristics on sludge dewaterability.

Freeness (the rate at which water/liquid will drain from a material) is the most commonly used test for sludge/pulp dewaterability. Higher freeness values mean easier dewatering. Freeness is dependent upon sludge properties such as fiber content, fiber length, ash content, chemical conditioning, etc.

Primary sludges are easier to dewater than secondary sludges. As the ratio of primary to secondary sludge varies in a blended sludge, the dewaterability of the sludge blend will vary accordingly.

As fiber content increases, dewaterability increases. As fiber length increases, dewaterability increases. As ash content increases, discharge cake consistency generally increases, however, capture efficiency can decrease and wear due to abrasion can increase.

Changes in the pH level of the sludge indirectly effects dewaterability. Generally, chemical Conditioners (polymers) added to flocculate the sludge work best within a certain pH range. If the pH level of the sludge swings outside the functional range of the polymer, then poor conditioning results. Poor conditioning results in reduced dewaterability, throughput, discharge cake consistency, and capture efficiency.

j) CONCLUSION

A screw press operator needs to understand the various factors involved in press performance to be able to operate the Screw Press efficiently and safely.

In ideal situations, sludge conditions do not change so that the operational settings of the Screw Press (screw speed, headbox level, etc,) remain constant. In the real world, sludge conditions change on a day-to-day and sometimes hour-to-hour basis.

As sludge conditions (flow rate, inlet consistency, fiber content, etc.) vary, appropriate changes need to be made to Screw Press operational settings to optimize performance or to avoid overload situations. Since every sludge is different and each mill experiences unique periodic variations in their sludge, it is not possible to itemize specific operational changes for each change in sludge characteristics.

Initial Screw Press operation should be based on operational settings determined by FKC during start-up. If significant changes occur in the sludge properties after start-up, contact FKC for revised operational settings.

Contact your FKC representative if you have any questions or concerns about FKC Screw Press operations.

SECTION 2

DRAWINGS & PARTS LISTS

ITT

GRAYS HARBOR

PARTS LIST

SHX-1000×9000L

FUKOKU KOGYO CO., LTD

NO.	I T E M	DIMENSION	Q'TY	M A T E R I A L	REMARKS
1	ROTARY JOINT	OPML 50A (Left Screw)	1		SHOWA GIKEN
2	BEARING CASE	710×172×460	1	SS304-CS	
3	SPROCKET	RS-240-3-NT51	1	S45C-CS41	
4	OUTLET STAND	1712×1052×1550	1	SS304-CS	
5	DRUM KEY	70×50×46	2	SS304	
6	HIGH PRESSURE DRUM	1210$^{\phi}$ ×1000	2	SS304	
7	STRAINER	4$^{\phi}$ ×3^{t} ×LP	8	SS304	
8	DRUM KEY	50×50×50	2	SS304	
9	SCREW with SHAFT	1000$^{\phi}$ ×11767	1	SS304-CS-S35C	
10	DRUM KEY A	125×100×95	8	SS304	
	DRUM KEY B	160×100×95	8	SS304	
11	MIDDLE STAND	1700×200×1550	1	SS304	
12	LOW PRESSURE DRUM	1190$^{\phi}$ ×1000	6	SS304	
13	STRAINER A	4$^{\phi}$ ×3^{t} ×LP	16	SS304	
	STRAINER B	3$^{\phi}$ ×2.5^{t} ×LP	8	SS304	
14	INLET DRUM	1276×1036×1393	1	SS304	
15	STRAINER	3$^{\phi}$ ×2.5^{t} ×LP	2	SS304	
16	INLET HOPPER	1276×1036×1000	1	SS304	
17	INLET STAND	1700×227×1500	1	SS304-CS	
18	BEARING CASE	(550-280)$^{\phi}$ ×223	1	CS	
19	ROTARY JOINT	OPML 40A (Right Screw)	1		SHOWA GIKEN
20	DRUM SUPORT	1690×125×410	1	SS304	
21	FILTRATE FLANGE	10 inches ASA 150lbs	1	SS304	
22	BED No.1	11530×1795×466	1	SS304-CS	
23	BEARING CASE	680×160×403	2	SS304-CS	
24	SPROCKET	RS-240-3-NT17	1	S45C	
25	GEAR COUPLING	GC-SSM-400	1		OSAKA SEISA
26	CYCLO REDUCER	H-939B 1/731	1		SUMITOMO
27	CHAIN COUPLING	CR-6022	1		TSUBAKIMOTO
28	BEIER VARIATOR	20BK	1		SUMITOMO
29	MOTOR COUPLING	200$^{\phi}$ ×150	1	FC	SUMITOMO
30	BED No.2	4070×1220×716	1	SS304-CS	
31	SPRING ADJUST NUT	102$^{\phi}$ ×200	4	SS304	
32	SPRING CASE	114.3$^{\phi}$ ×374	4	CS	
33	SPRING	12$^{\phi}$ ×64$^{\phi}$ ×350	8	SUP	
34	SPRING COLLAR	(77-45)$^{\phi}$ ×12	4	CS	
35	SPRING SHAFT	45$^{\phi}$ ×827	4	SS304	

NO.	I T E M	DIMENSION	Q'TY	M A T E R I A L	REMARKS
36	SPRING CONE	(1050-825)$^{\prime}$ ×90	1	SS304	
37	OIL SEAL	T 240×280×19	1		NOK
38	BEARING COVER	(420-250)$^{\prime}$ ×25	1	CS	
39	BEARING	23048BC$_3$	1		NTN
40	OIL SEAL	T 260×320×25	1		NOK
41	KEY	63×32×430	2	S45C	
42	THRUST NUT	(400×298)$^{\prime}$ ×120	1	CS	
43	BEARING COLLAR	(330-300)$^{\prime}$ ×60	1	CS	
44	OIL SEAL	T 330×390×28	1		NOK
45	BEARING COVER	(560-360)$^{\prime}$ ×45	1	CS	
46	BEARING	23160BC$_3$D$_1$	1		NTN
47	BEARING COLLAR	(400-300)$^{\prime}$ ×88	1	CS	
48	BEARING	29360	1		NTN
49	OIL SEAL	T 310×370×28	1		NOK
50	GRAND PACKING	9.5$^{\square}$	1		
51	GRAND HOLDER	(340-261)$^{\prime}$ ×42	1	SS304	
52	OIL SEAL	TB 260×320×25	1		NOK
53	BEARING	23048C$_3$	1		NTN
54	NUT and WASHER	AN48+AL44	1		NTN
55	BEARING COVER	(420-210)$^{\prime}$ ×20	1	CS	
56	OIL SEAL	TB 200×240×22	1		NOK
57	CHAIN ROLLER	(190-85)$^{\prime}$ ×276	1	CS	
58	BEARING	6012Z	2		NTN
59	SNAP RING	H-95	2		
60	ROLLER SHAFT	60$^{\prime}$ ×520	1	CS	
61	CHAIN	RS-240-3 (78Links)	1		TSUBAKIMOTO
62	BEARING COVER	360$^{\prime}$ ×24	1	CS	
63	PINION SHAFT	195$^{\prime}$ ×1038	1	S35C	
64	BEARING COVER	(360-200)$^{\prime}$ ×24	1	CS	
65	OIL SEAL	T 190×225×16	1		NOK
66	END PLATE	210$^{\prime}$ ×13	1	CS	
67	BEARING	23038	2		NTN
68	BEARING COLLAR A	(210-190)$^{\prime}$ ×99	1	CS	
	BEARING COLLAR B	(210-190)$^{\prime}$ ×97	1	CS	
69	KEY	45×25×390	1	S45C	
70	BEARING COLLAR	(290-264)$^{\prime}$ ×34	1	CS	
71	KEY	45×25×223	1	S45C	

NO.	I T E M	DIMENSION	Q'TY	MATERIAL	REMARKS
72	END PLATE	$(70-18)^{\phi} \times 10$	1	CS	

SECTION 3

ASSEMBLY & INSTALLATION INSTRUCTIONS

SECTION 3A

ASSEMBLY & INSTALLATION INSTRUCTIONS

Note: The numbers preceding the various instructions correspond to the numbers shown on the following screw press assembly diagram.

1. a) Set screw press main body in place. Use a spreader bar and the recommended lift points when setting in place.

   b) Set screw press drive section in place. Use a spreader bar and the recommended lift points when setting in place.

   c) Bolt sections together using taper pins and machine bolts.

   d) Level bases to +/- 0.030 inch. Tighten anchor bolts.

   e) Grout under all base pads. Grout under base channel at screw press main body only. **Do not grout under base channel at drive skid or at drive end of screw press (by drive sprocket).** Grouting under the base channel at the drive skid or at the drive end of the press will cause water to pool in the foundation at these points

   f) Install gasket and bolt the headbox extension in place.

   g) Verify alignment of drive sprocket with driven sprocket.

   h) Verify alignment between speed reducer and drive sprocket shaft.
   -see SECTION 8C for reducer coupling alignment specifications

   i) Verify alignment of mechanical speed variator if applicable (some models use variable speed motors rather than mechanical speed variators).
   -see SECTION 8D for speed variator coupling alignment specifications

   j) Bore out motor side of motor coupling to match customer supplied motor.

   k) Install and align motor.
   -see SECTION 8E for motor coupling alignment specifications

2. Install chain tensioner frame.

3. Install chain.

4. Install lower center chain cover.

5. Install lower left half chain cover.

6. Install left chain cover support.

7. Install lower right half chain cover.

8. Install right chain cover support.

9. Install upper chain cover.

10. Install chain roller.

11. Install roller shaft.

12. Install adjusting bolts (2 each).

13. Install roller shaft set screws (2 each).

14. Install chain tensioner top brace.

15. Bolt headbox to top of inlet drum.
    Verify headbox gasket is installed between inlet drum and headbox.

16. Install drum covers.
    -See SECTION 3C for details on screw press drum cover installation.

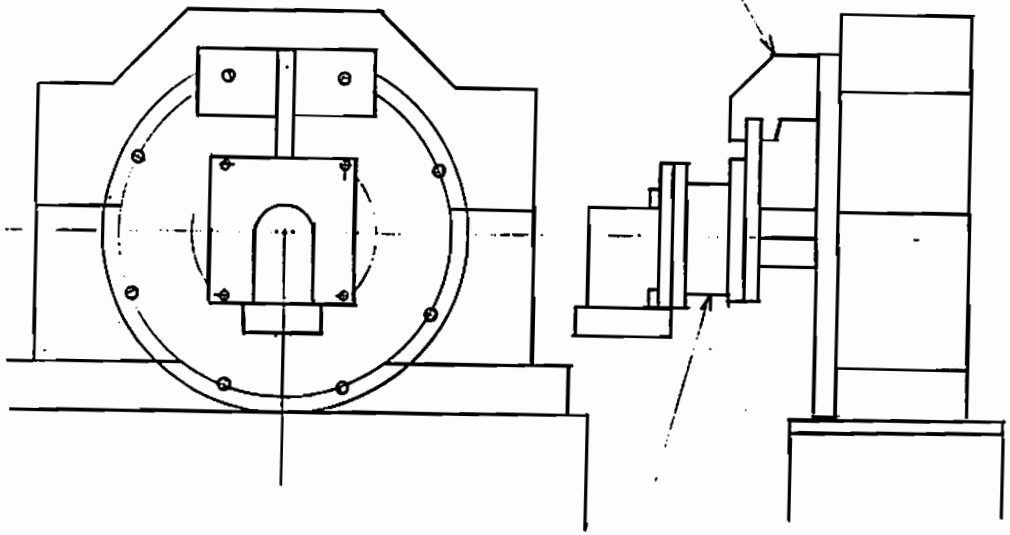
17. Connect drain piping to flange on bottom of screw press filtrate pan.

18. Connect the steam supply and condensate piping to the screw press.
    -See SECTION 3D for steam piping diagram. See Section 3E for flex hose installation instructions.

19. Complete required electrical and instrumentation connections.

OUTLET STAND SIDE

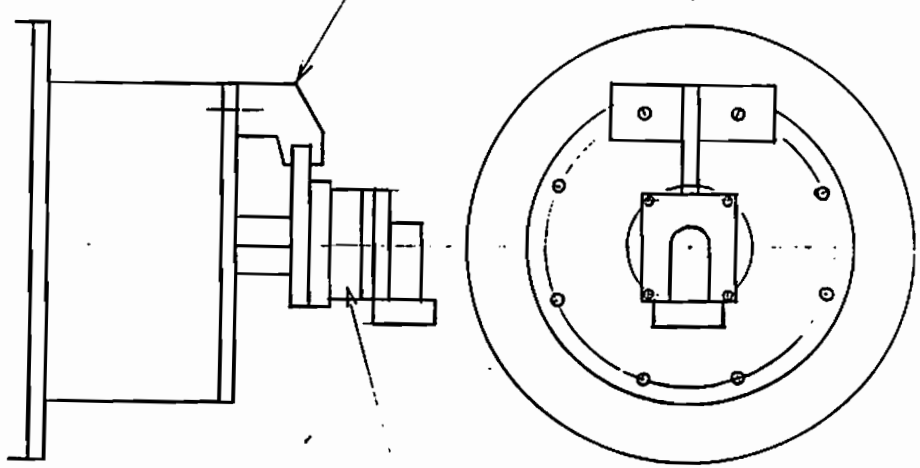
HOLDER



ROTARY JOINT
OPML-50A (LEFT SCREW)

INLET STAND SIDE

HOLDER



ROTARY JOINT
OPML-40A (RIGHT SCREW

ROTARY JOINTS IS IN WOODEN BOX (Case No. 6)

SHX-1000 × 9000L I.T.T (GRAYS HABAR)

Setting of ROTARY JOINTS

SECTION 3C

SCREW PRESS DRUM COVERS

a) DRUM COVER INSTALLATION INSTRUCTIONS

The lightweight drum covers are designed to be installed and removed easily by one person without the use of tools.

> Note that there are two types of covers; top covers and side covers. All of the covers are numbered.
>
> Note that half of the side covers have dots over the numbers. All of the side covers with dots go on the side of the press with the "0 with the dot" on the discharge box.
>
> Note that the draw latches which attach the side covers to the top covers have a **LOCK BUTTON** on the side of the latch. The **LOCK BUTTON** must be pressed before the latch can be opened. If the latch is forced open then it will be permanently damaged.

For simple installation and removal, refer to the following instructions and drawings:

1. Hang drum holders on the drums as shown on DRUM COVER ASSEMBLY DIAGRAM (2/2). Note that the holders should be positioned about 7 inches from the drum ends.

2. Install all **EVEN NUMBERED** (2,4,6, etc.) top covers.
   Note that the dots over the numbers on the top covers should be on the same side of the press as the "zero with the dot".

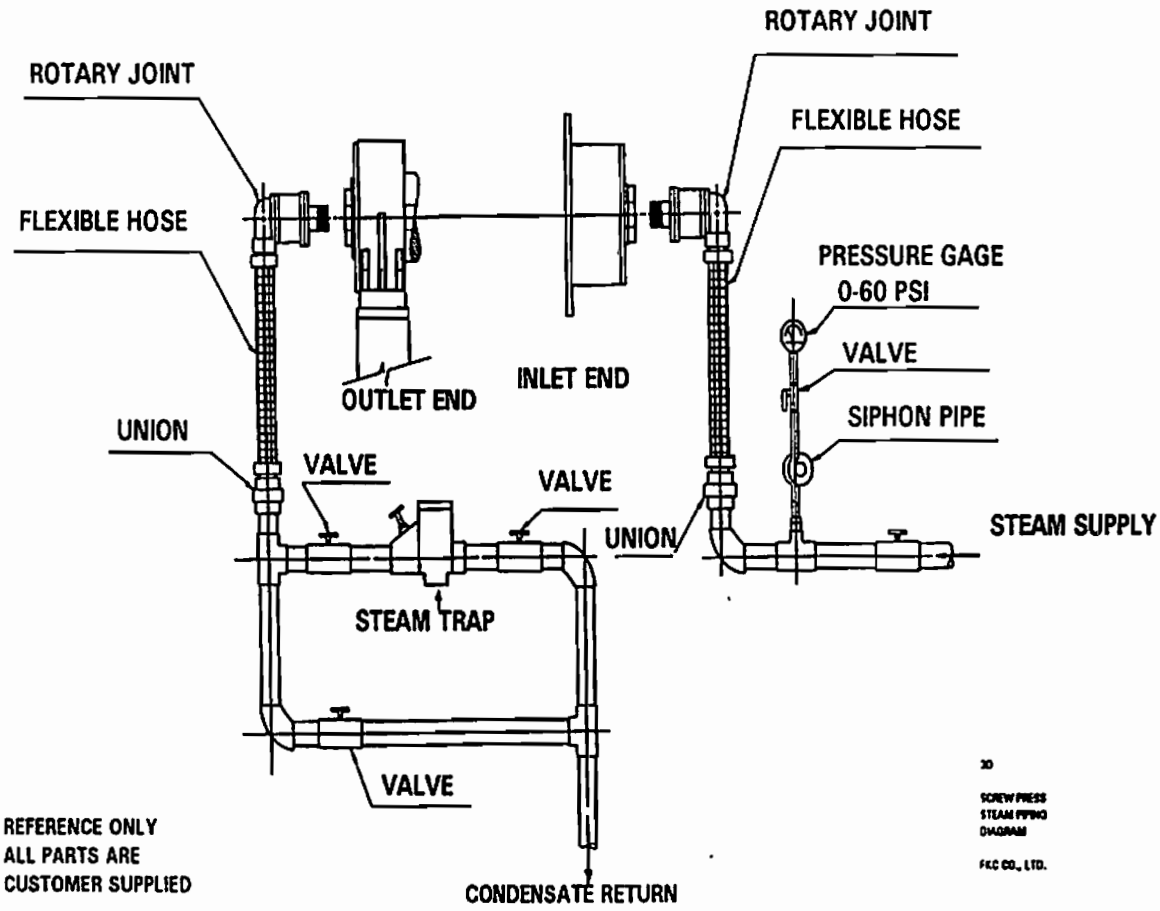
3. Install all **ODD NUMBERED** (1,3,5, etc.) top covers.
   Note that the odd numbered covers overlap the even numbered covers.

4. Install all **EVEN NUMBERED** side covers. Remember, all covers with "dots" go on the side of the press with the "zero with a dot" on one side of the discharge box.

5. Install all **ODD NUMBERED** side covers. Use the draw latches to attach the side covers to the top covers.

SECTION 3D

STEAM PIPING REFERENCE DIAGRAM



NOTES:

- The steam trap and all condensate piping must be the same size as the rotary joint. For example, a 2" rotary joint requires 2" piping and a 2" steam trap. The condensate is removed only 1/4 of each revolution so the condensate discharge flow rate is 4 times the steam inlet flow rate. Undersized condensate piping or an undersized steam trap can prevent the screw press from operating properly.
- The condensate must discharge to a non-pressurized system. Excessive backpressure in the condensate piping can prevent the screw press from operating properly.

SECTION 3E

TIGHTENING TORQUES FOR RIGID SCREWS

TIGHTENING TORQUES & PRE-STRESSING FORCES FOR RIGID SCREWS (NORMAL THREADS)

	Pre-stressing forces (kN)					Tightening Torques (Nm)				
Class (Mat. no.)	5.6	8.8	A4-50	A4-70	C3-80	5.6	8.8	A4-50	A4-70	C3-80
Thread M16	28	60	20	42	60	75	160	53	115	160
M20	44	94	31	66	94	145	315	105	220	315
M24	64	436	44	53	436	255	545	180	210	545
M30	101	215	71	84	215	505	1080	355	420	1080
M36	147	314	103	123	314	885	1890	620	735	1890
M42	202	430	-	-	430	1420	3020	-	-	3020
M48	265	566	-	-	566	2130	5430	-	-	4530

At a friction coefficient of μ = 0.25 in the thread and in the screw head the pre-stressing forces shown in the table result in approximately 73% utilization of the screw yield point $R_{po,2}$ by the equivalient stress formed by tension and torsion.

Torque-controlled tightening at a factor of α = 1.6 (VDI 2230) - Which is equivalent to a tolerance range of ±23% - will ensure that 90% of the screw yield point is not exceeded. The thread and screw head should be lubricated with an appropriate lubricant (for example Molyslide Plus by Loctite) in order to obtain the required friction coefficient. This applies in particular to stainless and adic-resistant screws since the friction coefficient for these two materials can be much higher without lubricant.

The above pre-stressing figures are standard bolt connections.

SECTION 4

INITIAL PRESTART INSPECTION

SECTION 4

INITIAL PRESTART INSPECTION

Prior to FKC arriving on-site for screw press start-up, confirm the following items:

		✓
A)	Verify screw press is mounted on rigid foundation, installed with the specified anchor bolts, and leveled per FKC requirements (see Section 3A for leveling specifications).	
B)	Verify that all anchor bolts are tight.	
C)	Retorque all bolts on screw press prior to startup.	
D)	Verify that the press is completely assembled including safety guards.	
E)	Verify screw press covers are properly installed.	
F)	Verify that the owner supplied motor matches the motor specified by FKC.	
G)	Verify that the motor and speed reducer have been properly aligned. Send copies of alignment records to FKC.	
H)	Verify lubrication of: - Speed Reducer - Chain & Sprockets - Speed Reducer Gear Coupling - Main Screw Shaft Bearings (4 each) - Jack Shaft Bearings (2 each) - Spring Cone Arbor Shafts	
I)	Verify electrical connections are complete.	
J)	Verify control headbox level / flow control system is complete including flow meter.	
K)	Verify calibration of headbox level transmitter and flow meter.	
L)	Verify that % motor load and % headbox level are displayed in the control room.	
M)	Verify high motor load alarm set-point and high-high motor trip set-points are set per FKC recommendations.	
N)	Program DCS/PLC to stop sludge flow to screw press when the actual % motor load exceeds high motor load alarm set-point.	
O)	Program DCS/PLC to stop the screw press motor when the actual % motor load exceeds high-high motor load trip set-point.	
P)	For SHX model screw presses: - Verify that the steam supply piping is flushed prior to connecting to screw press - Verify that the steam inlet piping is properly installed and complete with rotary joint, flex hose and pressure gage. - Verify that condensate removal piping is properly installed and complete with rotary joint, flex hose, steam trap, and blowdown line.	
Q)	Verify polymer delivery system is complete and functional.	
R)	Verify that the rotary screen thickener shower supply piping is flushed prior to connecting to the rotary screen (if applicable)	
S)	Verify that the rotary screen thickener shower water quality is sufficient to avoid pluggage of the RST shower nozzles (if applicable)	
T)	Verify clearance between screw flight and inner screen surface along entire screw. Clearance is adjusted at factory however drums occasionally shift during shipment. See Section 7C for instructions on checking clearances. This item will be completed by FKC personnel prior to start-up. Retorque all drum bolts after checking clearances.	

SECTION 5

OPERATING INSTRUCTIONS

SECTION 5A

STARTING THE SCREW PRESS

1. Verify that the press is empty, that is, the press was emptied of sludge/stock during previous shutdown. Note that since the screw flight does not extend all of the way to the discharge end, there will normally be some material visible at the discharge end although the rest of the press is empty.

2. Verify that the screw drain and condensate siphon are pointed down.

   Refer to FIGURE 5B for screw drain / condensate siphon location.

3. Open the steam trap bypass valve.

4. Turn on steam and allow the screw shaft to pre-heat (approximately 10 minutes).

5. Close the steam trap bypass valve.

6. Start the screw press.

7. Set screw press speed according to operating parameters defined during start-up.

8. Start sludge flow to press using manual control.

9. Manually adjust flow so the headbox level stabilizes near the desired headbox level setpoint.

10. Switch from manual flow control to automatic headbox level control.

11. Once the press operation has stabilized, verify that headbox level and motor load level are acceptable.

    Note: Ignore steps 2-5 with "HX" models

SECTION 5B

STOPPING THE SCREW PRESS

1. After sludge flow to the press has been stopped, continue to operate the press until the material inside the press has completely discharged.

   Note: Some material will remain in the flightless section at the discharge end of the screw.

2. Stop the screw press when the screw drain and condensate siphon are pointing down.

   Refer to FIGURE 5B for screw drain / condensate siphon location.

3. Open the steam trap bypass valve.

4. Turn off the steam.

5. Remove screw press covers and wash off screw press drums & screens if equipment will be shut down for more than a couple days. If sludge/pulp is allowed to dry on the outside of the drums screens then screens holes may become plugged resulting in degraded screw press performance.

   Note: Ignore steps 2-4 with the "HX" Models.

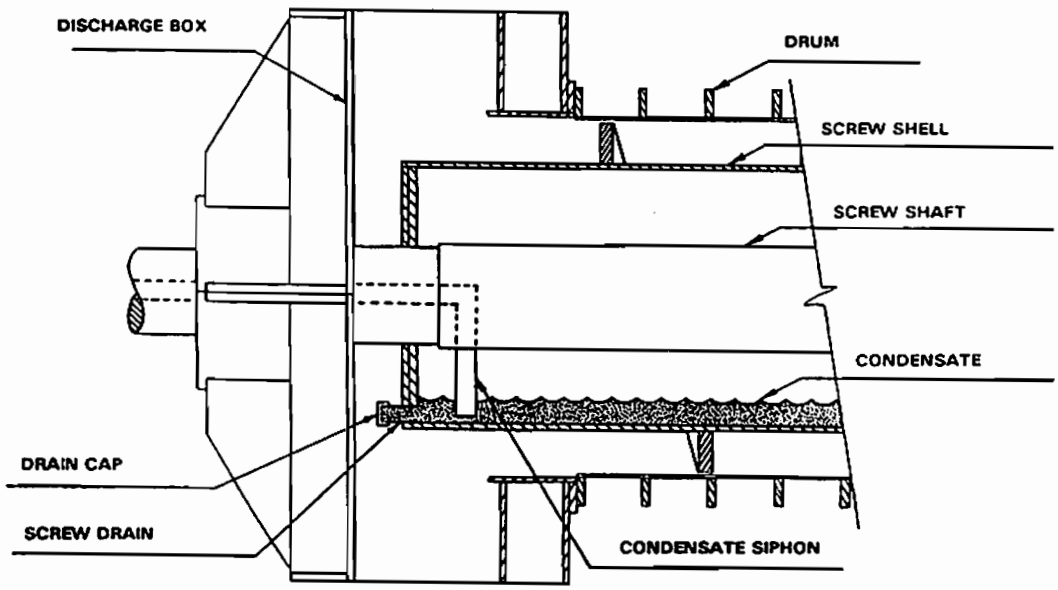


FIGURE 5B - SCREW DRAIN LOCATION

SECTION 5C

WARNING: FREEZING CONDITIONS

Do not allow sludge/pulp or condensate to freeze in the equipment!

Please note the following guidelines for operating the FKC screw press under freezing conditions.

1. Completely discharge the sludge/pulp from the screw press prior to stopping the equipment.

2. If the screw press will be shut down for an extended period in freezing temperatures, the screw must be drained of condensate on "SHX" models. To drain the screw, remove the drain cap on the discharge end of the screw shell and rotate the screw until the drain is at the bottom. This will prevent damage from condensate freezing inside the screw shell.

   Refer to FIGURE 5B for drain cap location.

3. If the sludge/pulp becomes frozen in the equipment it must be thawed prior to starting. Equipment overload and damage will occur if the equipment is started without thawing the frozen sludge/pulp.

SECTION 5D

WARNING: OVERLOADING

Overloading (plugging) of the screw press and drive train should be avoided at all times. However, FKC realizes that at times overload situations occur which can cause the screw press to trip out and stop operating. When an overload situation arises the recommended procedure for restarting/returning to service an overloaded or plugged press is as follows:

1. Inspect the screw press outlet cake. If the material is compressed/compacted to an extremely high consistency and is very hard or if knots, chips, or very long fiber are present, do not attempt to restart the press. Digging out the plugged area of the press must by completed, as described in Section 5E, before restarting. The high pressure drums should be removed, as described in Section 7B, and the compacted material removed. With the top high pressure drums removed the press can be restarted to assist with unplugging.

2. If the outlet cake is is soft and has normal fiber and ash content then the press can be restarted as follows:

    a. Back out the arbor nuts to their maximum setting.

    b. If steam is available then allow the steam to preheat the sludge/pulp for 15 to 20 minutes.

    c. For a VFD unit set speed at 25% and restart only once. If the press trips out on overload again **DO NOT RESTART**, unplugging the press must be completed as described in Section 5E.

    d. If the press remains running after restarting at 25% speed then as the motor load drops the speed can be increased slowly until the normal operating speed is achieved.

    e. For a screw press with a Beier Variator, procedures A &B above should be followed (NOTE: The speed setting of the Beier should only be adjusted when the unit is operating). Restart the screw press only once, do not adjust the Beier. If the screw press does not overload during the restart then let it clear before returning flow to the unit. If the press overloads again during the restart then the press must be unplugged as described in Section 5E.

SECTION 5E

UNPLUGGING THE SCREW PRESS

To unplug a screw press, the following procedure should be followed.

1. Remove the covers on the high pressure section of the press and remove the upper half of the high pressure drums as described in Section 7B, a.

2. Dig out as much compacted material as possible. With the upper High Pressure drums removed start the press. Starting the press will allow the compacted material in the lower portion of the High Pressure drums to rotate out of the press.

3. Once the press is clear of compacted material then reassemble the High Pressure drums as described in Section 7B, b.

4. Replace the covers and restart the press. Increase the screw speed to a faster RPM than normal. Reestablish flow with a low headbox level. Let the system run until it stabilizes and then fine tune operation by adjusting headbox level, RPM, polymer and arbor nuts.

SECTION 5F

WARNING: MECHANICAL WARRANTY

Repetitive restarts (jogging) of the screw press should never be attempted. Failure to follow the above recommendations will result in damage to the screw and/or drive train components. Damage to the screw and drive train components caused by overload and jogging is **not covered** by the Mechanical Equipment Warranty.

SECTION 6

TROUBLESHOOTING

SECTION 6

TROUBLESHOOTING

6A PROBLEM: Low Cake Discharge Dryness	
POSSIBLE CAUSES:	REMEDY / ACTION REQUIRED:
- Screw Speed Too Fast	Reduce Screw Press Speed
- Too Much Secondary Sludge	Verify Mix Ratio / Reset flow rates
- Poor Conditioning	Adjust Polymer Flow & Agitation
- Changing Sludge Properties	Adjust Polymer/Screw speed/Headbox
- Low Headbox Level	Raise Headbox Level Setpoint
- Plugged Screens	Remove Covers and Wash Press
- Clearance Problems	Readjust Clearances
- Steam System Problems	Check Steam Pressure/Condensate Flow
- Low Feed Consistency	Check Sludge Properties/Conditioning and Check RST Showers/Drum Speed

6B PROBLEM: High Screw Press Motor Load	
POSSIBLE CAUSES:	REMEDY / ACTION REQUIRED:
- Too High Headbox Level	Lower Headbox Setpoint
- Too Slow Screw Speed	Increase Screw Speed
- Stock/Knot Spill	Reduce Headbox Lvl/Increase Screw Speed
- Low Secondary Sludge Flow	Check Mix Ratio & Reset Flow Rates
- Increased Fiber Content	Reduce Headbox Lvl/Increase Screw Speed
- Too Much Backpressure	Back Off Spring Cone Arbor Nuts
- Low Steam Pressure	Check Steam Pressure/Condensate Flow

6C PROBLEM: Low Screw Press Throughput Capacity	
POSSIBLE CAUSES:	REMEDY / ACTION REQUIRED:
- Low Headbox Level	Raise Headbox Level Setpoint
- Low Feed Consistency	Check Sludge Properties/Conditioning and Check RST Showers/Drum Speed
- Low Screw Speed	Increase Screw Speed
- Poor Conditioning	Adjust Polymer Flow & Agitation
- Spiraling of Sludge	Increase Steam Pressure and Decrease backpressure
- Clearance Problems	Readjust Clearances
- Low Sludge Flow	Increase Sludge Flow/Headbox Level

SECTION 6

TROUBLESHOOTING

6D PROBLEM: Poor Capture Rate	
POSSIBLE CAUSES:	REMEDY / ACTION REQUIRED:
- Poor Conditioning	Adjust Polymer Flow, Adjust Agitator
- Too Much Backpressure	Back Off Spring Cone Arbor Nuts
- Screw Speed Too Fast	Reduce Screw Press Speed
- Too Much Secondary Sludge	Verify Mix Ratio / Reset flow rates
- Screen Damage	Inspect/Replace Damaged Screens

6E PROBLEM: Headbox Level Too High	
POSSIBLE CAUSES:	REMEDY / ACTION REQUIRED:
- Conditioning Problem	Adjust Polymer Flow, Adjust Agitator
- RST Screens Blinded	Check RST Showers/Drum Speed
- Flow Rate Too High	Reduce Flow Rate
- Plugged Overflow	Unplug Overflow

6F PROBLEM: Unusual Vibration	
POSSIBLE CAUSES:	REMEDY / ACTION REQUIRED:
- Lack of Chain Lubrication	Lubricate Chain/Sprockets
- Motor Coupling	Inspect for Wear
- Loss of Steam Pressure	Increase Steam Pressure/Temperature
- Screw & Screen Contact	Readjust Clearances
- High Motor Load	Lower Headbox Lvl,Increase Screw Speed
- Stock Spill/ Wood Chips	Lower Headbox Lvl,Increase Screw Speed
- Drive Misalignment	Realign Drive Train

SECTION 6

TROUBLESHOOTING

6G PROBLEM: Covers Difficult to Install	
POSSIBLE CAUSES:	REMEDY / ACTION REQUIRED:
- Missing Clips/Holders	Install New Clips/Holders
- Bent Covers	Rebend Covers to Proper Radius
- Installed in Wrong Order	See SECTION 3C for Instructions
- Latches Damaged	Remove and straighten LOCK BUTTON

6H PROBLEM: Uneven Spring Cone Movement	
POSSIBLE CAUSES:	REMEDY / ACTION REQUIRED:
- Broken Spring	Replace Spring
- Stuck Spring Cone Shaft	Disassemble, Clean, & Lubricate

SECTION 7

MAINTENANCE INSTRUCTIONS

SECTION 7A

LUBRICATION (SEE SECTION 7F FOR LUBRICATION DIAGRAM)

a) SPEED VARIATOR

Please refer to the respective maintenance manual for recommended schedules and lubricant specifications.

b) SPEED REDUCER

Please refer to the respective maintenance manual for recommended schedules and lubricant specifications.

c) CHAIN/SPROCKETS

Oil Bath Type: Inspect biweekly. Maintain oil at level shown on sight glass. Change oil when contamination is obvious.

Grease Type: Inspect biweekly. Apply grease directly to chain as required to maintain lubrication.

d) INLET STAND BEARING
e) OUTLET STAND BEARINGS
f) SCREW SPROCKET BEARING
g) DRIVE SHAFT BEARINGS

Lubricate bearings weekly using a high quality EP 2 grease suitable for high temperature, low speed service. All main bearings on the Screw Press are fitted with grease nipples and spring loaded relief valves. Grease should be injected until it begins to come out the pressure relief valve.

h) DRIVE SHAFT GEAR COUPLING
i) CHAIN COUPLING

Disassemble the gear coupling and chain coupling about three months after initial operation, clean thoroughly, add fresh grease and reassemble. Repeat approximately every six months thereafter.

j) SPRING CONE ARBORS

Disassemble the spring cone arbors about six months after initial operation, clean thoroughly, coat arbor nut threads with anti-seize compound, grease arbor shaft, and reassemble. Check for free movement of the spring arbor shaft. Repeat approximately every six months thereafter.

SECTION 7B

OPENING THE SCREW DRUM

a) DISASSEMBLY, HIGH PRESSURE DRUMS

Note: Numbers in parenthesis correspond to items shown on the maintenance diagram in Section 7H. The High Pressure key blocks are not shown on this diagram.

Occasionally it is necessary to open the Screw Press for inspection, repair, etc.. Often removal of only the upper half of a drum is required. The procedure to remove a complete drum is as follows:

1. Remove all of the bolts from the circumferential flanges of the upper drum half to be removed (#3).

2. Remove all of the bolts from the horizontal flange of the drum to be removed (#2).

3. Remove the bolts that hold the 3 upper key blocks that stabilize the upper H.P. drums and remove blocks.

4. Lift off the upper drum slowly using a cable and chain block or crane as shown (#5).

5. Record the number of shims (#1) between the upper and lower sections and set these shims aside for reinstallation.

6. Remove the bolts that hold the 3 lower key blocks that stablize the lower key H.P. drums and remove blocks.

7. Brace the lower drum half to prevent it from falling. Remove all of the bolts from the circumferential flanges (#3).

8. Remove the lower drum from the bottom. If it is tight then use a lead hammer (or the equivalent) to tap it downward. Use caution when removing a bound drum half. Excessive force can cause damage to the drums and fixed supports.

SECTION 7B

OPENING THE SCREW DRUM

b) REASSEMBLY, HIGH PRESSURE DRUMS

Note: Numbers in parenthesis correspond to items shown on the maintenance diagram in Section 7H.

1. Install the lower drum half from the bottom. Slowly pull the lower drum half in place until the inner screen slightly touches the screw flight (#6).

2. Install and tighten the circumferential flange bolts (#3) for the lower drum.

3. Replace the shims (#1) which were removed during disassembly.

4. Rebolt in place the 3 lower key blocks.

5. Lower the upper drum half into place. If the upper drum is tight, use a lead hammer to tap it into position.

6. Install and tighten the horizontal flange bolts (#2) then the circumferential flange bolts (#3) for the upper drum.

7. Rebolt in place the 3 upper key blocks.

8. Check to confirm that all bolts are tight.

9. Turn the screw press over at minimum speed setting to confirm no contact between the screw flight and screen surfaces.

SECTION 7B

OPENING THE SCREW DRUM

c) DISASSEMBLY, LOW PRESSURE DRUMS

Note: Numbers in parenthesis correspond to items shown on the maintenance diagram in Section 7H.

Occasionally it is necessary to open the Screw Press for inspection, repair, etc.. Often removal of only the upper half of a drum is required. The procedure to remove a complete drum is as follows:

1. Remove all of the bolts from the circumferential flanges of the upper drum half to be removed (#3).

2. Remove all of the bolts from the horizontal flange of the drum to be removed (#2).

3. Lift off the upper drum slowly using a cable and chain block or crane as shown (#5).

4. Record the number of shims (#1) between the upper and lower sections and set these shims aside for reinstallation.

5. Brace the lower drum half to prevent it from falling. Remove all of the bolts from the circumferential flanges (#3).

6 Remove the lower drum from the bottom. If it is tight then use a lead hammer (or the equivalent) to tap it downward. Use caution when removing a bound drum half. Excessive force can cause damage to the drums and fixed supports.

SECTION 7B

OPENING THE SCREW DRUM

d) REASSEMBLY, HIGH PRESSURE DRUMS

Note: Numbers in parenthesis correspond to items shown on the maintenance diagram in Section 7H.

1. Install the lower drum half from the bottom. Slowly pull the lower drum half in place until the inner screen slightly touches the screw flight (#6).

2. Install and tighten the circumferential flange bolts (#3) for the lower drum.

3. Replace the shims (#1) which were removed during disassembly.

4. Lower the upper drum half into place. If the upper drum is tight, use a lead hammer to tap it into position.

5. Install and tighten the horizontal flange bolts (#2) then the circumferential flange bolts (#3) for the upper drum.

6. Check to confirm that all bolts are tight.

7. Turn the screw press over at minimum speed setting to confirm no contact between the screw flight and screen surfaces.

SECTION 7C

CLEARANCES

a) GENERAL INFORMATION

Proper clearance between the inner surface of the screens and the screw flight is very important for optimum Screw Press performance. Check clearances every six to twelve months and adjust as required to maintain maximum Screw Press performance.

Although the screw shaft rotates very slowly, the outer edge of the screw flight may gradually wear. As the screw flight wears, the clearance slowly increases. Increased clearance can result in screen blinding, decreased dewatering ability, and decreased throughput capacity.

In most cases, the clearance between the inner surface of the screens and the screw flight should be 1.0mm to 2.5mm depending upon the location along the length of the Screw Press. The clearance along the bottom of the low pressure section of the screw should be 1.0mm to 2.0mm. A greater clearance is generally acceptable at the high pressure section.

Clearance is adjusted by moving the drums in relation to the screw. Clearances can be adjusted in two ways; by removing or inserting shims between the upper and lower halves of the drum sections and by using the jacking bolts to move the drums in relation to the screw. Removing shims is helpful to compensate for wear of the screw flight. The jacking bolts are used to center the drums around the screw. In many instances it is sufficient to adjust clearances along the bottom half of the Screw Press only.

Note that on new presses there are 1 mm and 2 mm shims totalling 10 mm per side. If removal of more than 5 mm of shims is required to bring the top & bottom clearances within tolerances then weld build up of the screw flight may be recommended.

SECTION 7C

CLEARANCES

b) CLEARANCE MEASUREMENT

A depth gage is required to measure clearances. The depth gage must have a rod/blade small enough to pass through the screen plate holes (check O&M manual for screen plate hole sizes). The depth gage must also have a base narrow enough to fit inside the 25 mm diameter holes in the screen backing plate (at the high pressure drums only). A metric vernier caliper with a depth rod is recommended. Typically the last 10 mm of the depth rod needs to be narrowed so that it will pass through the screen plate holes.

1. With the Screw Press stopped and empty, locate the screw flight by looking through the screen plate holes.

2. Measure the distance from the outer surface of the screen plate to the screw flight using a depth gage.

3. Subtract the thickness of the screen plate from the previous measurement to get the clearance between the inner surface of the screens and the screw flight.

4. Repeat steps 1-3 for the top, bottom, and both sides of each drum along the length of the Screw Press.

5. Record the clearances on a Screen Clearance Measurement Diagram similar to that shown on the following page.

SECTION 7C

CLEARANCES

c) CLEARANCE ADJUSTMENT: SHIM METHOD

Note: Numbers in parenthesis correspond to items shown on the Maintenance Diagram in Section 7H.

1. Using the clearance information recorded on the Screen Clearance Measurement Diagram, determine the number of shims (#1) to be removed (or added) to adjust the clearances at the top and/or bottom of the press to within tolerance.

2. Loosen the vertical flange bolts (#3) on the lower half of the drum section(s).

3. Loosen the horizontal flange bolts (#2) on the drum section(s) to be adjusted. Note: All of the drum halves in the low pressure section may be adjusted together as one unit rather than adjusted separately. Separate adjustment of the drum sections may be required to achieve desired tolerance.

4. Back-off on the jacking bolts (#4) to allow the lower-half of the drum section(s) to drop slightly.

5. Remove all horizontal flange bolts (#2) and remove (or insert) the appropriate number of shims between the upper and lower half of the drum section(s). Verify that the same number of shims are used on both sides of each drum section.

6. Insert and securely tighten all horizontal flange bolts (#2) to draw the lower half of the drum section(s) up to the upper half drum section(s).

7. Securely tighten all vertical flange bolts (#3) on the lower half of the drum section(s).

8. Tighten the jacking bolts (#4) up against the lower drum halves and lock in place with the jam nuts.

9. Recheck clearances to confirm that the proper screw flight to inside screen clearance has been achieved. If the screw is not centered side to side in the drums and the top and bottom clearances are not within tolerance then use the jacking bolts (#4) for the final adjustment.

10. After clearances are rechecked, rotate the screw at minimum speed setting to confirm no contact between the screw flight and inside screen surfaces along the entire length of the Screw Press.

Warning: If the screw is touching the screen at any point, do not operate the press until the proper clearance is achieved. Failure to do so may result in serious mechanical damage.

SECTION 7C

CLEARANCES

d) CLEARANCE ADJUSTMENT: JACKING BOLT METHOD

Note: Numbers in parenthesis correspond to items shown on the Maintenance Diagram in Appendix D.

1. Loosen the vertical flange bolts (#3) on the drum(s) to be adjusted.

2. Turn the jacking bolts (#4) to adjust the position of the drum(s). Adjust the drum position to achieve the clearances required.

3. Securely tighten the vertical flange bolts (#3) on the upper and lower drum halves.

4. Recheck clearances to confirm that the proper screw flight to inside screen clearance has been achieved.

5. After clearances are rechecked, rotate the screw at minimum speed setting to confirm no contact between the screw flight and inside screen surfaces along the entire length of the Screw Press.

Warning: If the screw is touching the screen at any point, do not operate the press until the proper clearance is achieved. Failure to do so may result in serious mechanical damage.

SECTION 7D

SCREEN REPLACEMENT

a) GENERAL

The screens lining the screw press drums can become damaged by several means. Depending on the abrasiveness of the sludge, they can wear over the years until they weaken and break. Screen damage can also occur during severe overload conditions or if foreign objects (pipe wrenches, etc.) are introduced into the press.

b) DRUM REMOVAL

Numbers in parenthesis correspond to items shown on the Maintenance Diagram in Appendix D.

Note: remove only the drum half with the damaged screen. Removal of both upper and lower sections at the same time will make reinstalling more difficult.

1. Remove the bolts (#3) from the vertical annular joint between the damaged drum half and the adjacent drum or fixed stand.

2. Remove the bolts (#2) from the horizontal joint joining the upper and lower halves. Note, if the lower drum half is being removed brace the lower drum so it does not fall when the bolts are removed.

3. Remove the drum half from the press. Record the number of shims between the upper and lower sections and set these shims aside for reinstallation.

SECTION 7D

SCREEN REPLACEMENT

c) SCREEN REMOVAL

The screens can be removed by several means. Since the screens are welded in place, removal of the weld is necessary. Grinding is the recommended method of weld removal since other means are more likely to damage the drum in the process.

1. Remove the weld material by grinding.

2. After the welds are broken/weakened, use a hammer to knock the damaged screen from the drum.

3. Grind the inside of the drum free of remaining weld material and burrs.

d) SCREEN INSTALLATION

The objective is to install the screen with zero clearance between the screen and the drum. Any gap between the screen and drum results in difficulties when adjusting the clearance between the screw flight and screen surfaces and may result in physical damage to the screen and/or screw.

1. Verify that the inner surfaces of the drum are smooth and undamaged.

2. Position the new screen in the drum. Adjust the screen so that the distance from the rolled edge of the screen is 5 mm from the drum end flange face on each end of the drum. Adjust the screen so that the dimension from the straight edge of the screen to the horizontal drum flange face is equal at both ends of the screen, approximately 10 mm on each side. Note that drums are 1000 mm long and the screens are available in 990 mm and 490 mm widths. Install the 490 mm screens with a 10 mm gap between them at the drum center to allow for the 5 mm gap required at the drum ends.

3. The screen must be pressed firmly against the drum prior to welding. This can be accomplished best with the use of a tool designed for this purpose. See Figure 7D - Screen Replacement Diagram for a drawing of a screen installation tool that can be fabricated by the maintenance workers performing the screen changeout.

4. With the screen pressed firmly against the drum, begin tack welding the screen to the drum at 2 inches on center, around the perimeter of the screen. Start tack welding at the center of the rolled edges of the screen and work outward toward the horizontal drum flanges. Tack weld both rolled edges of the screen simultaneously. After the rolled edges are complete, tack weld the straight edges of the screen to the drum.

5. Verify that the screen is seated tightly in the drum. If the screen is not tight then tap on the screen with a hammer to reduce the clearance between the screen and drum to zero.

6. Proceed with welding the screens in place once they are tight. On the low pressure drums, skip weld around the perimeter of the screens using 2 inch long welds, 5 inches on center. On high pressure drums, continuous seam weld around the perimeter of each screen.

7. Grind off all excess weld material and weld spatter. Make sure that the interior of the screen and the drum flange faces are smooth.

8. Recheck the clearance between the screen and drum. If the screen is not tight then tap on the screen with a hammer until the clearance between the screen and drum is reduced to zero. If 490 mm wide screens are being used, repeat the installation procedures for each screen.

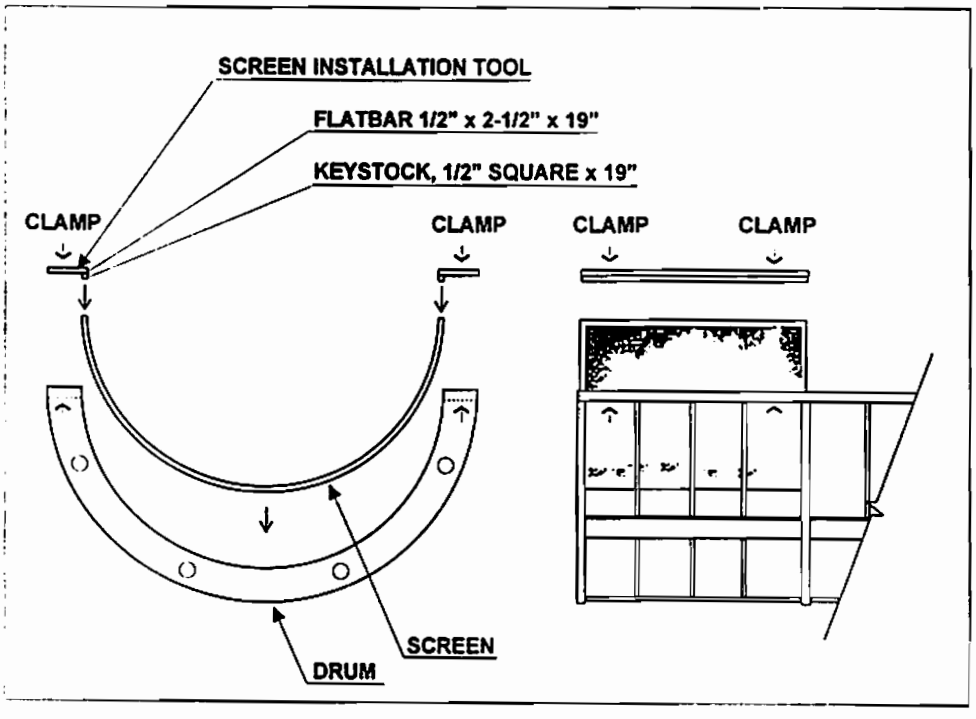


FIGURE 7D - SCREEN REPLACEMENT DIAGRAM

SECTION 7D

SCREEN REPLACEMENT

e) DRUM REINSTALLATION

Reinstall the drum half on the press using the same number of shims that existed when the drum half was removed. Note that when assembled at the factory, a total of 10 mm of shims are normally installed using a combination of 2 mm and 1 mm thick shims.

FOR AN UPPER DRUM HALF:

1. Replace the shims (#1) which were removed during disassembly.

2. Lower the upper drum half into place. If the upper drum is tight, use a lead hammer to tap it into position.

3. Align the reinstalled drum half with the adjacent drums.

4. Install and tighten the horizontal flange bolts (#2) then the vertical flange bolts (#3).

5. Check and adjust clearances as described in Maintenance Instruction TOPIC: CLEARANCES.

FOR A LOWER DRUM HALF:

1. Slowly pull the lower drum half in place. If the drum is tight, use a lead hammer to tap it into position.

2. Replace the shims (#1) which were removed during disassembly.

3. Install and tighten the horizontal flange bolts (#2) then the vertical flange bolts (#3).

4. Check and adjust clearances as described in Section 7C b) CLEARANCES.

Warning: If the screw is touching the screen at any point, do not operate the press until the proper clearance is achieved. Failure to do so may result in serious mechanical damage. If the clearance between the inner surface of the screen and the screw is not within acceptable tolerances then the clearance must be adjusted.

SECTION 7E

FLIGHT REPAIR

The flight at the high pressure end of the screw will slowly wear. The rate of wear is dependent upon two main factors; The abrasiveness of the sludge and the screw speed. As the abrasiveness and screw speed increase, the rate of wear will also increase.

As the screw flight wears, the performance of the screw press declines and the wear of the high pressure screens accelerates.

FKC recommends inspecting the high pressure screw flight on an annual basis and repairing the worn flight as required.

a) FLIGHT BUILD-UP

Figure 7E shows two methods for weld build-up of the screw flight depending upon the extent of flight wear.

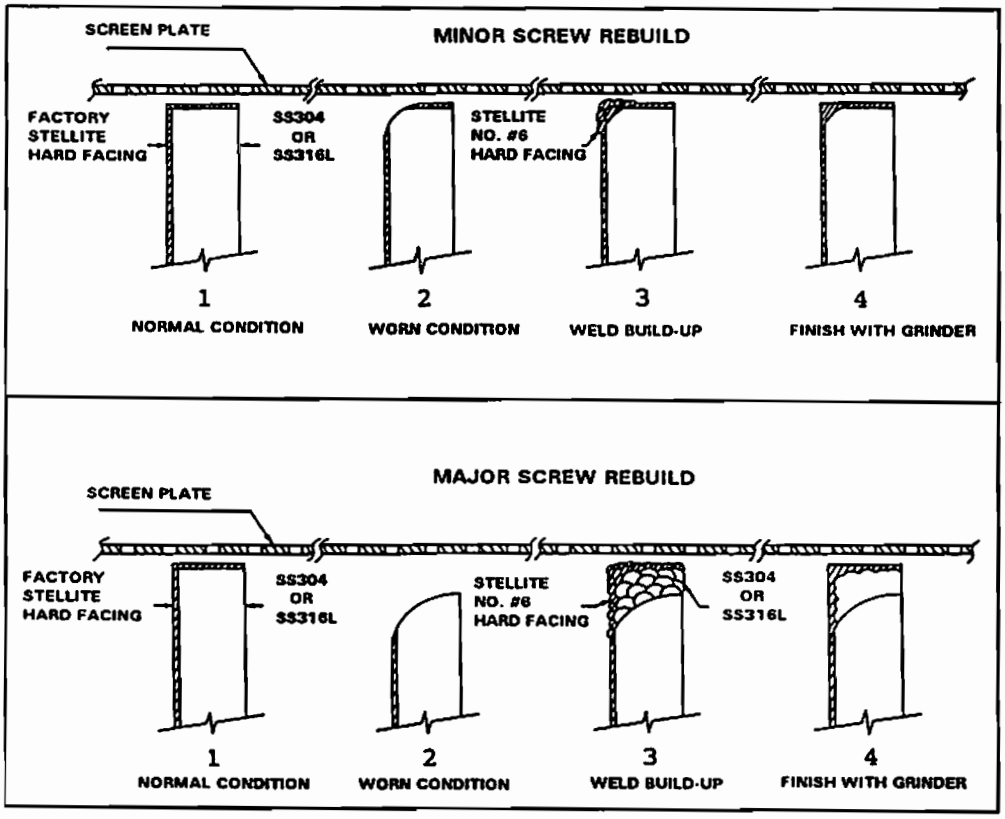


FIGURE 7E - FLIGHT BUILD-UP DIAGRAM

SECTION 7E

FLIGHT REPAIR

b) WEAR PLATE REPLACEMENT

Some of the newer FKC screw presses are fitted with replaceable wear plates at the end of the high pressure flight. Figure 7F shows how the replaceable wear plates are fitted to the screw flight. The screw flight has pockets machined in the leading face to accept the individual wear plates.

To remove the worn wear plates, simply remove the nuts/washers (3 sets for each wear plate) from the backside of the screw flight using a metric socket & ratchet wrench. The worn wear plate w/ threaded studs can then be removed from the face of the flight. A thread locking compound is applied to the threads prior to assembly so localized heat may be required for disassembly.

To install new wear plates, first apply a thread locking compound (such as Loctite No. 262) to the threaded studs on the wear plate. Insert the threaded studs on the backside of the wear plate through the holes in the screw flight. Place washers and nuts on the threaded studs and tighten nuts evenly to aviod warpage.

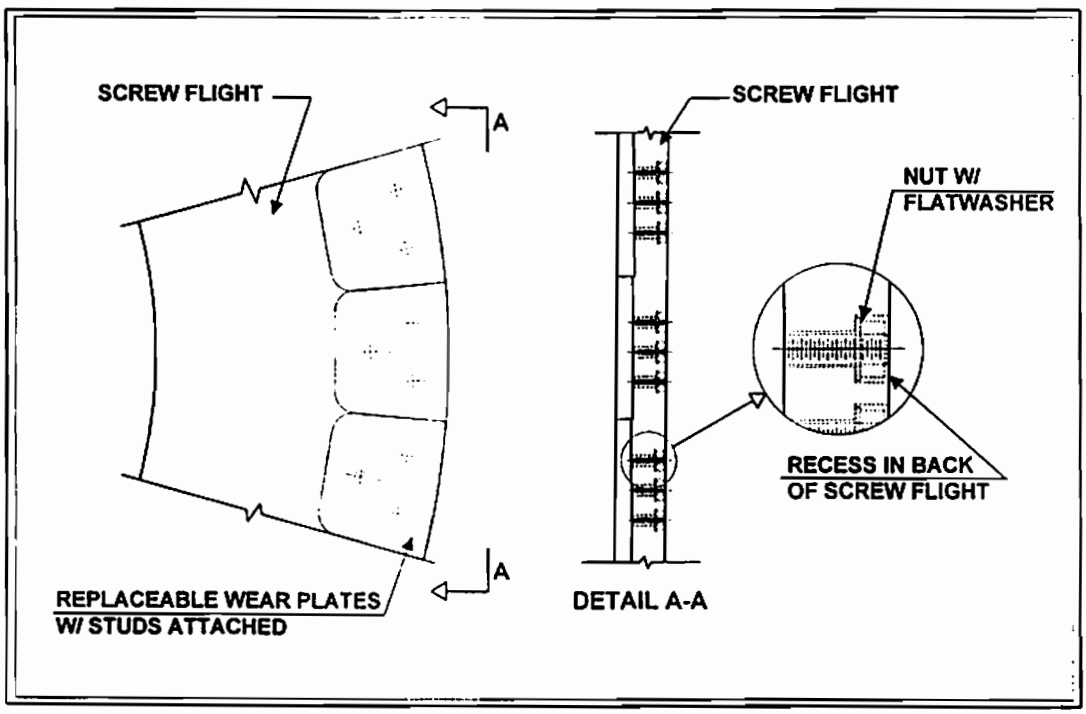
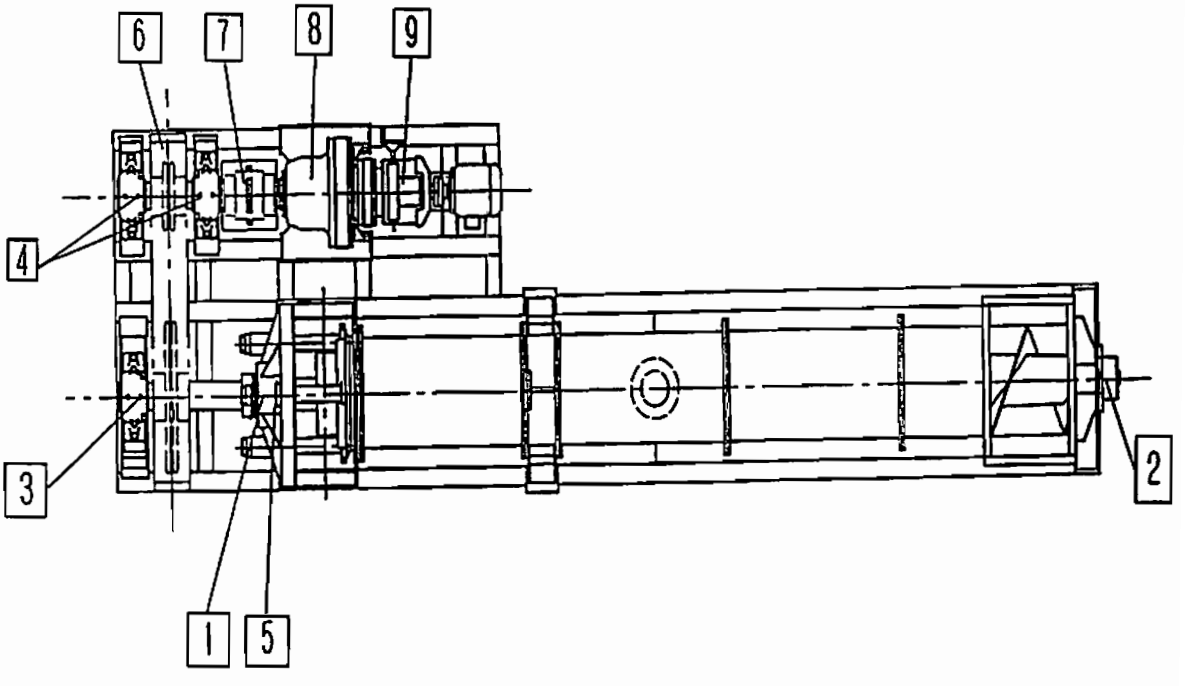


FIGURE 7F - WEAR PLATE REPLACEMENT DIAGRAM

SECTION 7F

LUBRICATION DIAGRAM

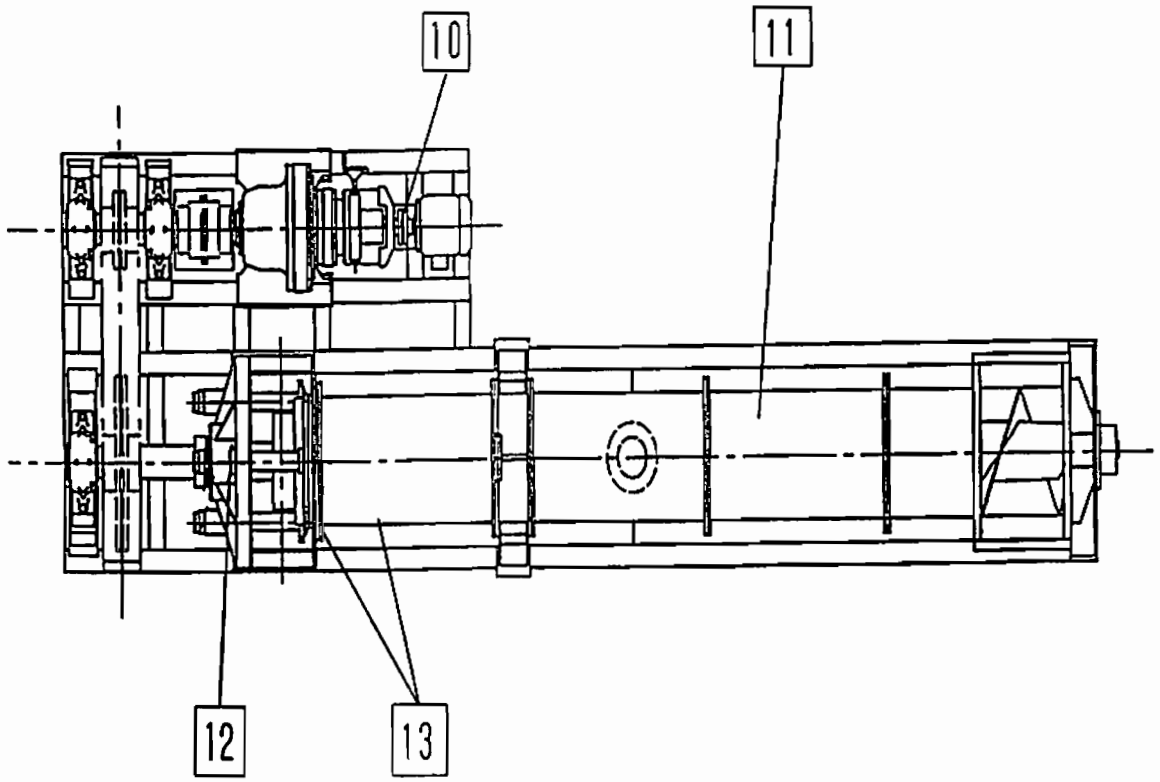
PART #	PARTS	INSPECTION INTERVAL	LUBRICATION INTERVAL	LUBRICATION SPECIFICATION
1	BEARING	1 WEEK	1 WEEK	SHELL DARINA EP 2
2	BEARING	1 WEEK	1 WEEK	SHELL DARINA EP 2
3	BEARING	1 WEEK	1 WEEK	SHELL DARINA EP 2
4	BEARING	1 WEEK	1 WEEK	SHELL DARINA EP 2
5	ARBOR	1 WEEK	1 WEEK	SHELL DARINA EP 2
6	CHAIN	2 WEEK	3 MONTHS	SHELL TELLUS C150
7	COUPLING	1 MONTH	6 MONTHS	SHELLARBANIA EP 1
8	REDUCER	1 MONTH	3 MONTHS	SEE SECTION 8A
9	VARIATOR	1 MONTH	3 MONTHS	(IF APPLICABLE)SEE SEC.8



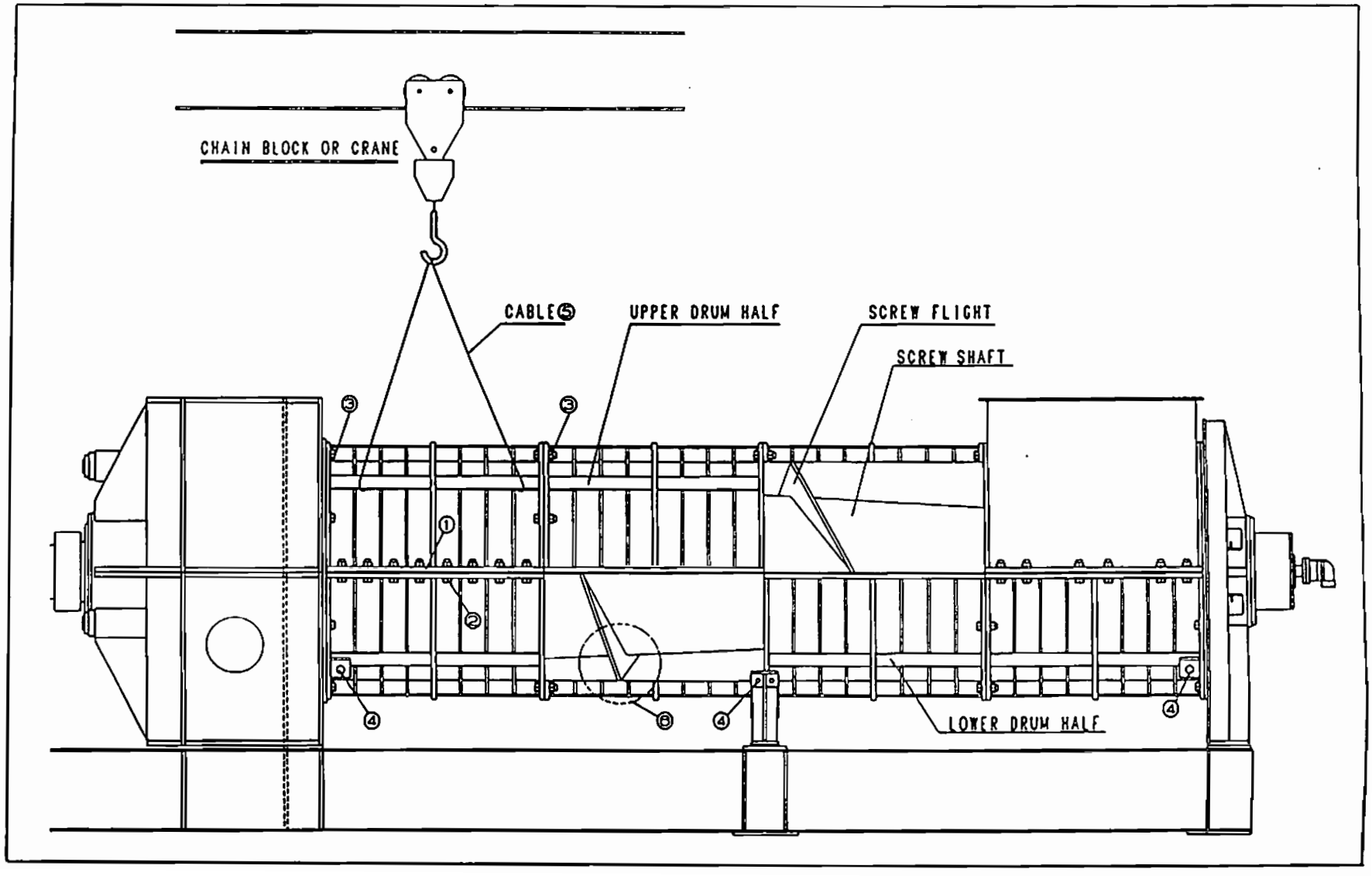
SECTION 7G

INSPECTION DIAGRAM

PART #	PART	INSPECTION INTERVAL	INSPECTION NOTES
10	COUPLING	6 MONTHS	CHECK FOR EXCESSIVE WEAR CHECK FOR EXCESSIVE VIBRATION
11	CLEARANCES	6-12 MONTHS	CHECK SCREW FLIGHT CLEARANCES CHECK DRAINAGE PATTERN
12	SPRING ARBOR	6 MONTHS	CHECK SPRING ARBORS FOR FREE MOVEMENT
13	BOLTS	3-4 WEEKS	CHECK TORQUES AT HIGH PRESSURE DRUMS



SECTION 7H MAINTENANCE DIAGRAM



SECTION 8

COMMERCIAL PARTS LITERATURE

SECTION 9

ANNUAL INSPECTION

SECTION 9

ANNUAL INSPECTION

9A GENERAL INSPECTION

FKC recommends that the screw press be thoroughly inspected on an annual basis in order to:

1. Optimize screw press performance
2. Maximize equipment life
3. Minimize the chance of unscheduled maintenance shutdowns.

For optimum discharge cake dryness and maximum capacity, the clearance between the screw flight and interior of the screens needs to be properly set. Clearances can change over time due to flight wear or drum shifting. Checking clearances annually and adjusting if necessary can keep the press performing optimally.

To maximize equipment life, a detailed annual inspection helps in uncovering minor problems that if caught soon enough can be corrected before becoming major problems. Since the rotational speed of the FKC Screw Press is very low, wear on sprockets, couplings, screw flight, etc. occurs very slowly. By catching wear in the early stages, lubrication procedures or operational procedures may be modified to slow the rate of wear thereby extending equipment life.

An annual inspection is a good time to check screen wear and lubrication procedures. If significant screen thinning or damage is found then screens should be changed before they fail completely. Changing damaged screens during a scheduled shutdown is generally more economical than waiting until they completely fail and changing them during an unscheduled shutdown.

The Screw Press Inspection Checklist on the following page can be used a general guide during annual inspection.

SCREW PRESS INSPECTION CHECKLIST

PRESS #:	DATE:	INSPECTOR:

ITEM #	CHECKPOINT DESCRIPTION	√	COMMENTS
1	SCREEN DEFORMATION/DAMAGE LOW PRESSURE DRUMS EXTERIOR SURFACE		
2	SCREEN DEFORMATION/DAMAGE HIGH PRESSURE DRUMS EXTERIOR SURFACE		
3	INSPECT FOR CORROSION OF HIGH AND LOW PRESSURE DRUM SECTIONS/BOLTS		
4	CHECK CLEARANCES BETWEEN SCREW FLIGHT AND INSIDE OF SCREEN (1-2mm @ BOTTOM)		
5	INSPECT INTERIOR SURFACE OF HIGH PRESSURE SCREENS FOR WEAR AND THINNING		
6	INSPECT INTERIOR SURFACE OF LOW PRESSURE SCREENS FOR WEAR AND THINNING		
7	INSPECT SCREW FLIGHT AT HIGH PRESSURE SECTION FOR EXCESSIVE WEAR		
8	VERIFY SPRING CONE IS FREE TO MOVE. DISASSEMBLE SPRING ARBORS AND INSPECT		
9	INSPECT DRIVE SPROCKET FOR EXCESSIVE WEAR OR DISTORTION		
10	INSPECT DRIVE CHAIN FOR EXCESSIVE WEAR AND PROPER TENSIONING		
11	INSPECT KEY/KEYWAY ON SCREW SHAFT SPROCKET FOR DISTORTION / DAMAGE		
12	INSPECT SPEED REDUCER, SPEED VARIATOR, AND ALL OIL SEALS FOR OIL LEAKAGE		
13	VERIFY PROPER LUBRICATION OF: a) SPEED REDUCER b) CHAIN/SPROCKET c) INLET STAND BEARING d) OUTLET STAND BEARING e) SCREW SPROCKET BEARING f) DRIVE SHAFT BEARINGS g) DRIVE SHAFT GEAR COUPLING h) CHAIN COUPLING i) SPRING CONE ARBORS		
14	VERIFY ALL BOLTS ARE TIGHT		
15	CALIBRATE MOTOR AMP METER AND HEADBOX LEVEL TRANSDUCER		

SECTION 10

PERFORMANCE DATA

SCREW PRESS TRIAL DATA SHEET

DATE:	PERFORMED BY:
COMPANY:	LOCATION:

1. DATE/TIME								
2. PRIMARY CONS.								
3. PRIMARY GPM								
4. PRIMARY STBD/D								
5. SECONDARY CONS.								
6.SECONDARY GPM								
7. SECONDARY STBD/D								
8. MIX RATIO P:S								
9. MIXED FEED CONS.								
10. MIXED FEED GPM								
11. MIXED FEED STBD/D								
12. HCRST DRUM NOTCH								
13. HCRST SCREW NOTCH								
14. HCRST OUTLET CONS.								
15. SCREW PRESS RPM								
16. S.P. HEAD BOX								
17. S.P. MOTOR LOAD								
18. S.P. TORQUE								
19. S.P. OUTLET CONS.								
20.								
21. STEAM PRESSURE								
22. PRI. FIBER CONTENT								
23. SEC. FIBER CONTENT								
24. MIXED FIBER CONTENT								
25. MIXED ASH CONTENT								
26. pH								
27. POLYMER DOSAGE LB/T								
28.								
29.								
30.								

SECTION 10

PERFORMANCE DATA

a) GENERAL

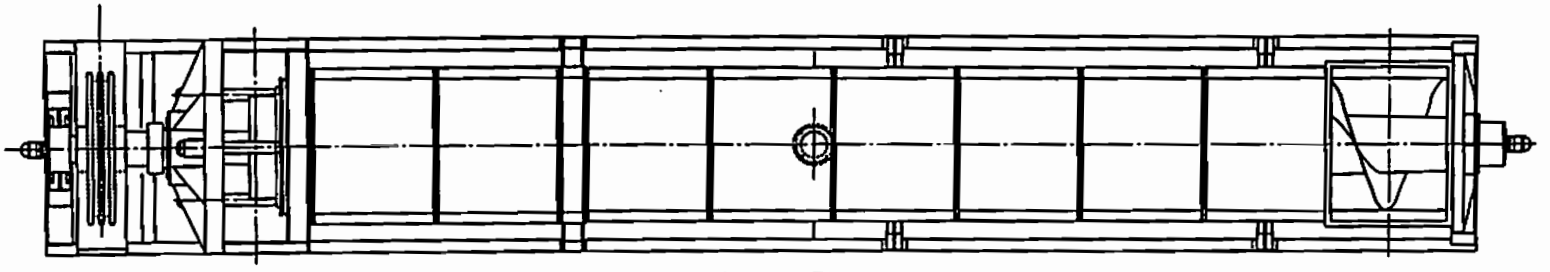
As sludge characteristics change, operating parameters may need to be re-defined. In order for FKC Co., Ltd. to provide additional operational advice and instruction, please begin to develop a performance profile for the screw press by recording the following data:

1. Inlet Sludge consistency
2. Sludge Fiber Content (150 Mesh)
3. Ash Content
4. pH level
5. Primary Sludge Flow (gpm)
6 Secondary Sludge Flow (gpm)
7. RST Discharge Consistency
8. Screw Press Speed
9. Screw Press Headbox Level
10. Screw Press Motor Load
11. Screw Press Discharge Cake Consistency

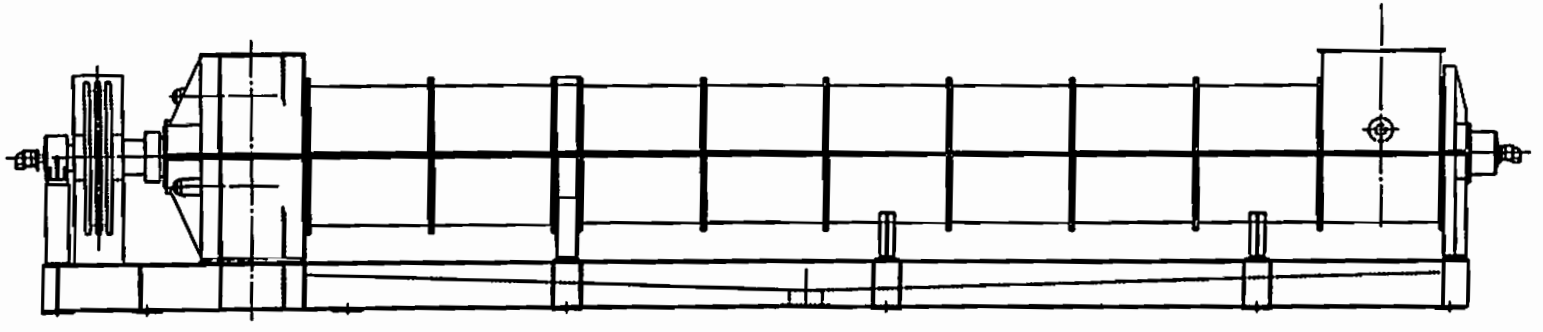
Use the attached Data Sheets or a similar form for record keeping.

SCREEN CLEARANCE MEASUREMENTS
9000L

PRESS NO. :	
DATE:	
LOCATION:	
INSPECTOR:	



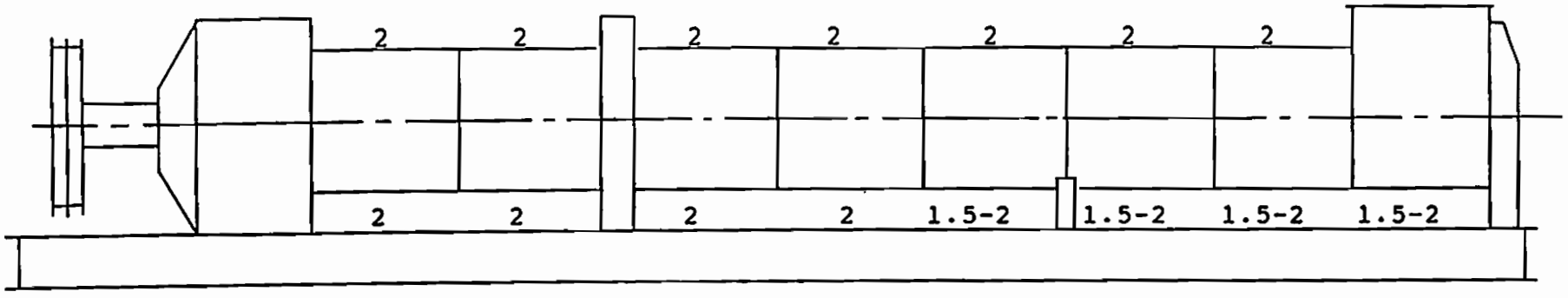
SIDE VIEW



TOP VIEW

FKC®
SCREW PRESS

RECOMMENDED SCREEN CLEARANCE MEASUREMENTS



SIDE VIEW

SCREW PRESS INSPECTION CHECKLIST

PRESS #:	DATE:	INSPECTOR:

ITEM #	CHECKPOINT DESCRIPTION	√	COMMENTS
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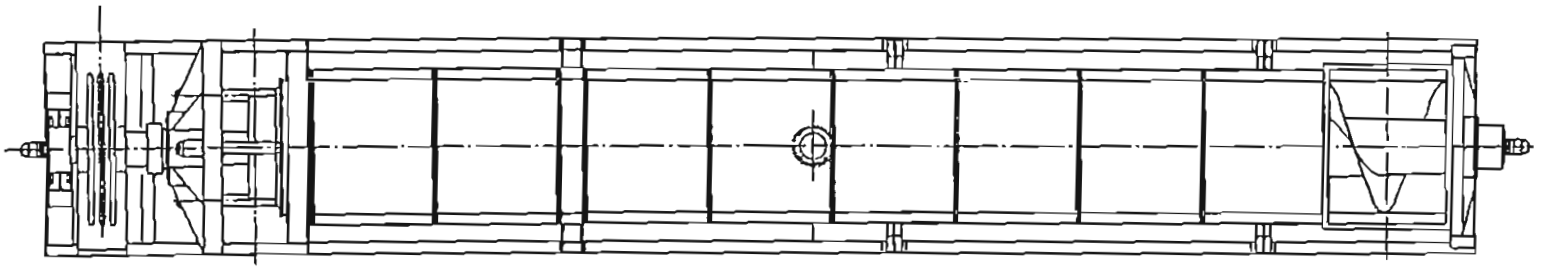
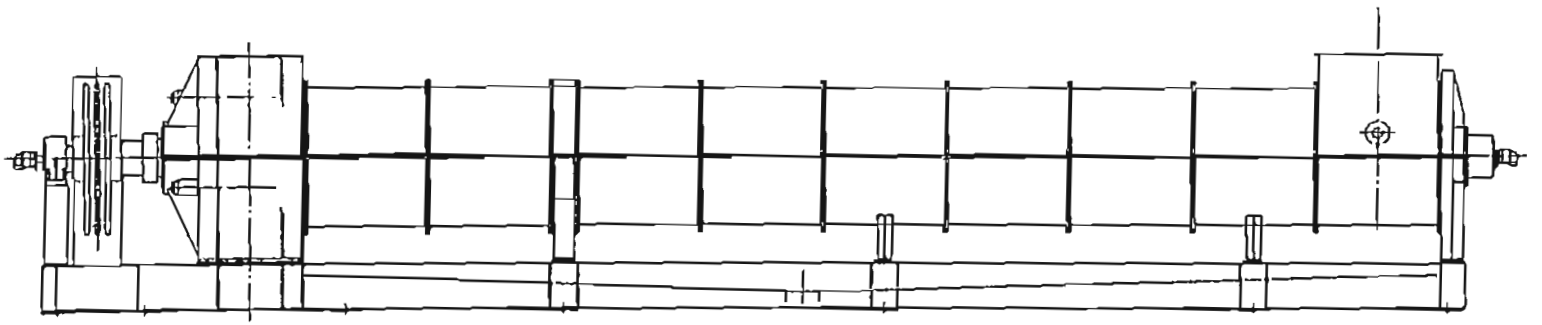
14	VERIFY ALL BOLTS ARE TIGHT		
15	CALIBRATE MOTOR AMP METER AND HEADBOX LEVEL TRANSDUCER		

SCREEN CLEARANCE MEASUREMENTS
9000L

PRESS NO. :	
DATE:	
LOCATION:	
INSPECTOR:	



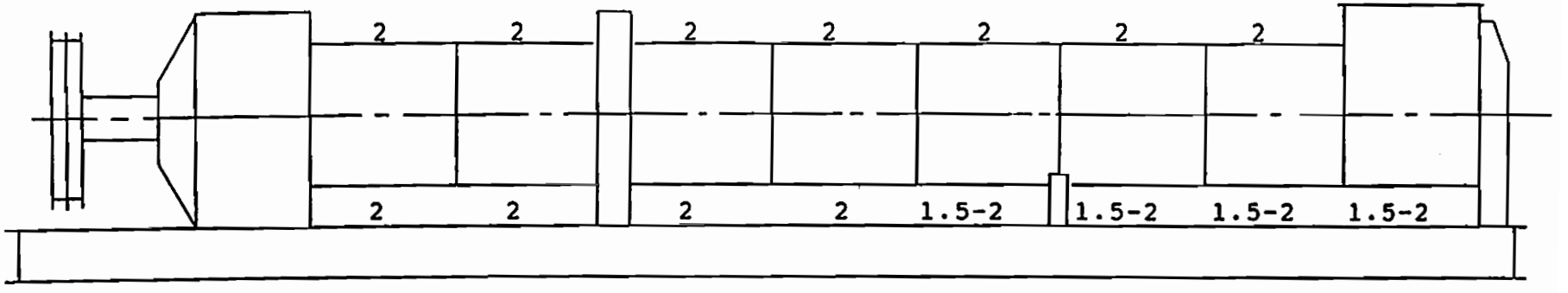
SIDE VIEW



TOP VIEW

FKC
SCREW PRESS

RECOMMENDED SCREEN CLEARANCE MEASUREMENTS



SIDE VIEW

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SCREEN CLEARANCE MEASUREMENTS
9000L

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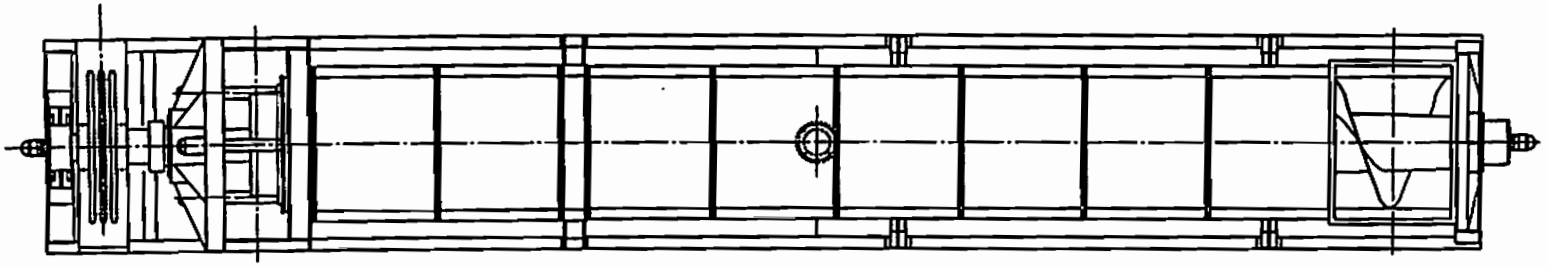
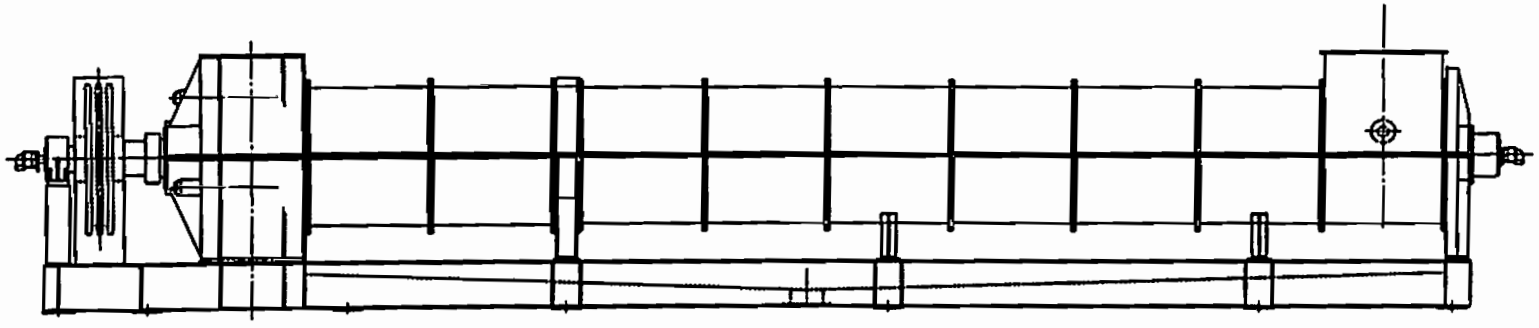


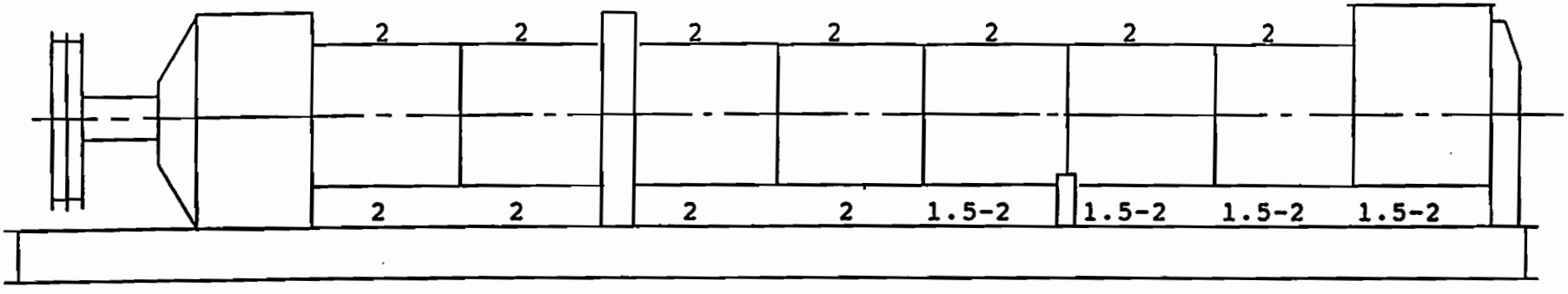
SIDE VIEW



TOP VIEW

FKC
SCREW PRESS

RECOMMENDED SCREEN CLEARANCE MEASUREMENTS



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SCREEN CLEARANCE MEASUREMENTS
9000L

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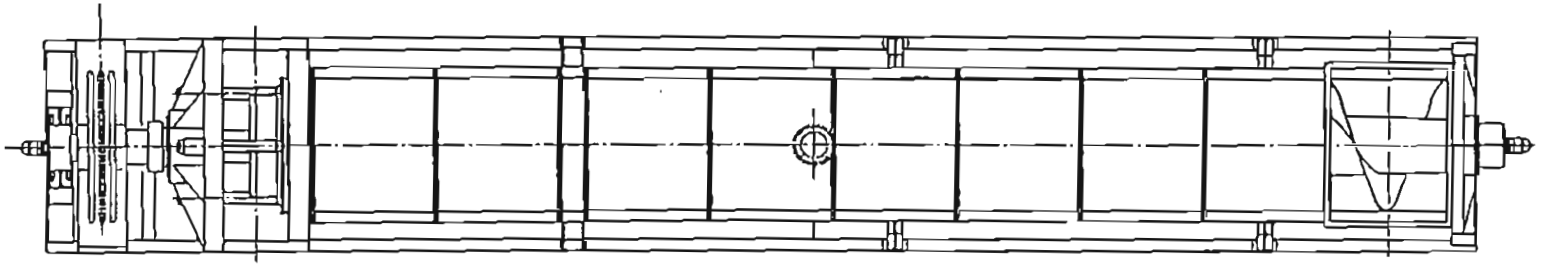
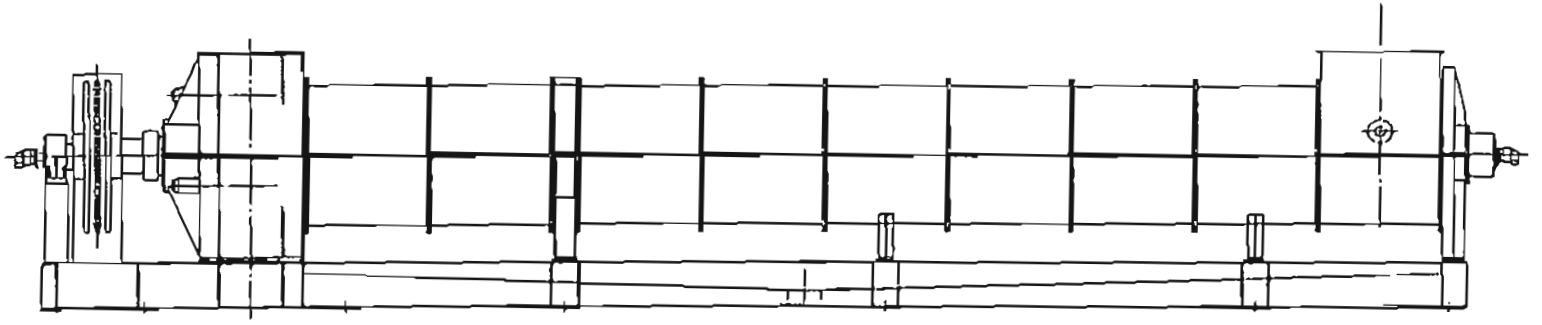


SIDE VIEW

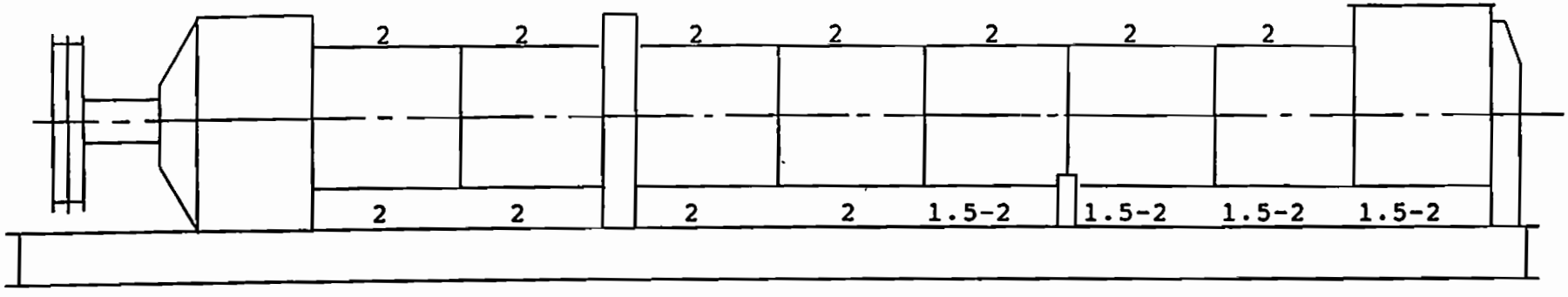


TOP VIEW

FUKOKU KOGYO CO., LTD.

FKC®
SCREW PRESS

RECOMMENDED SCREEN CLEARANCE MEASUREMENTS



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SCREEN CLEARANCE MEASUREMENTS
9000L

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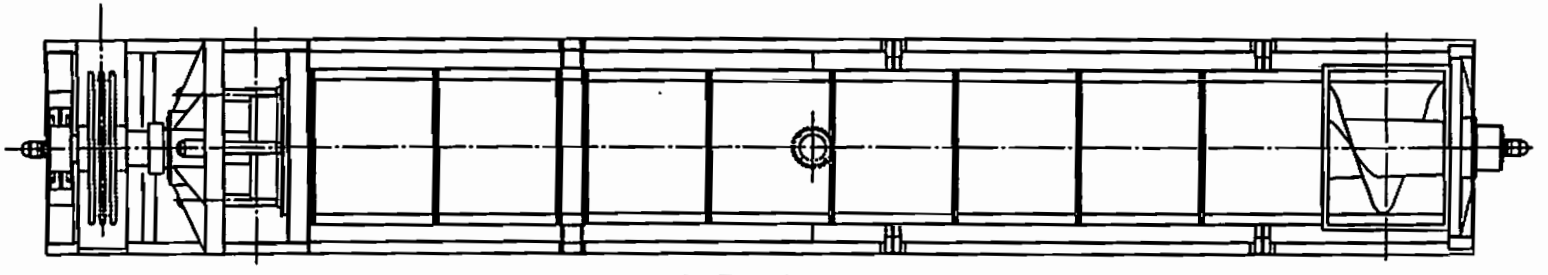

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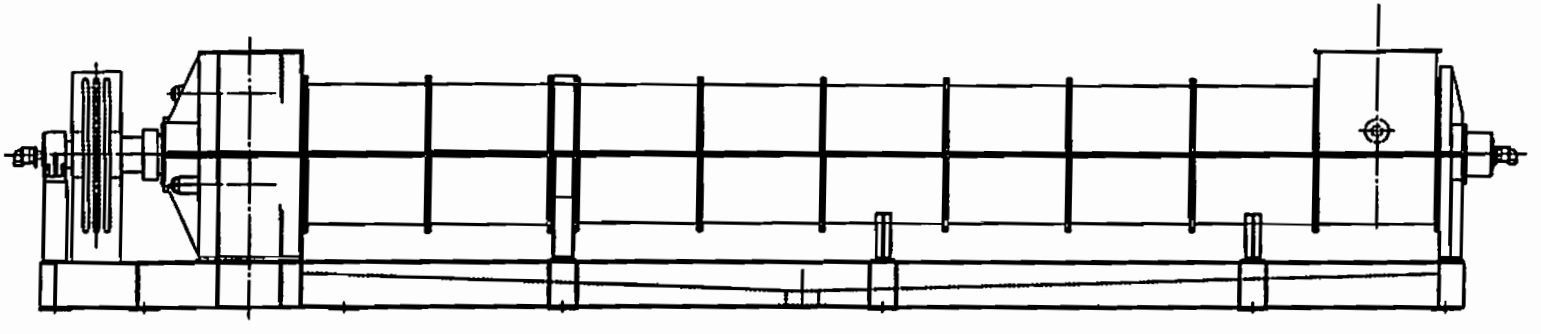
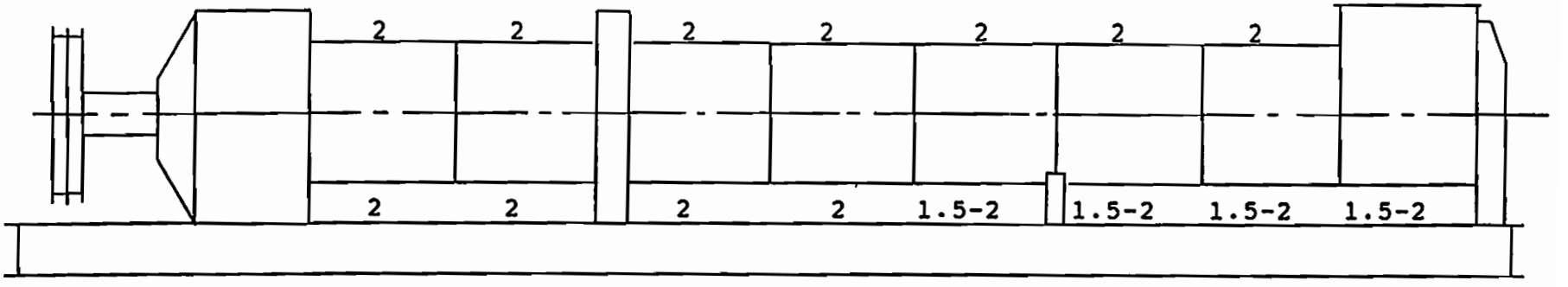


TOP VIEW

FKC®
SCREW PRESS

RECOMMENDED SCREEN CLEARANCE MEASUREMENTS



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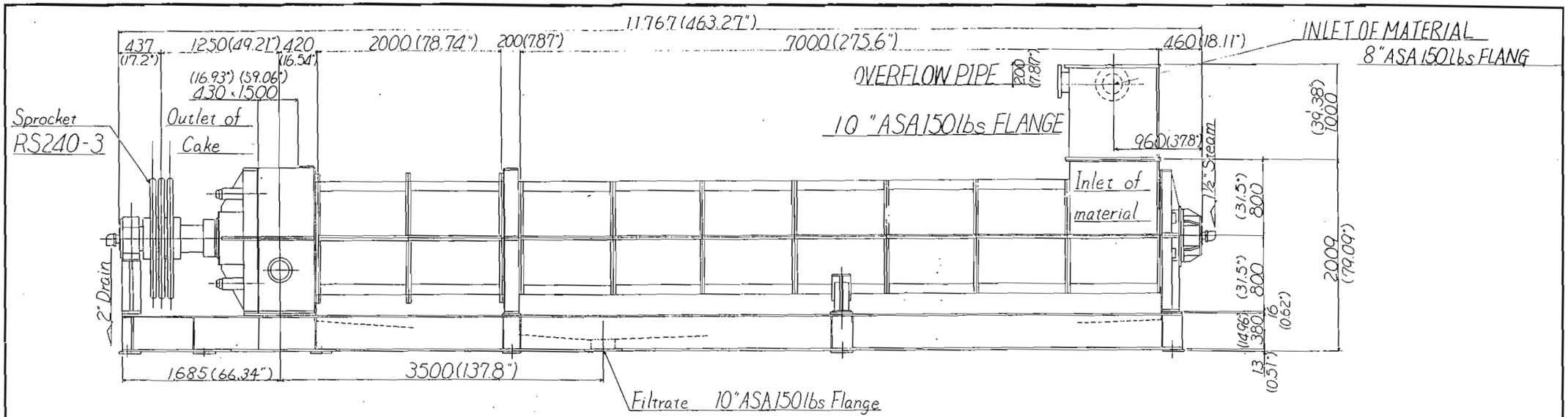


Gear Coupling GC-SSM400

Chain Coupling CR-6022J

Motor 15kw. 6P (Customers Supply)

Cyclo Reducer H-939B 1/731

Beier Variator 20 BK

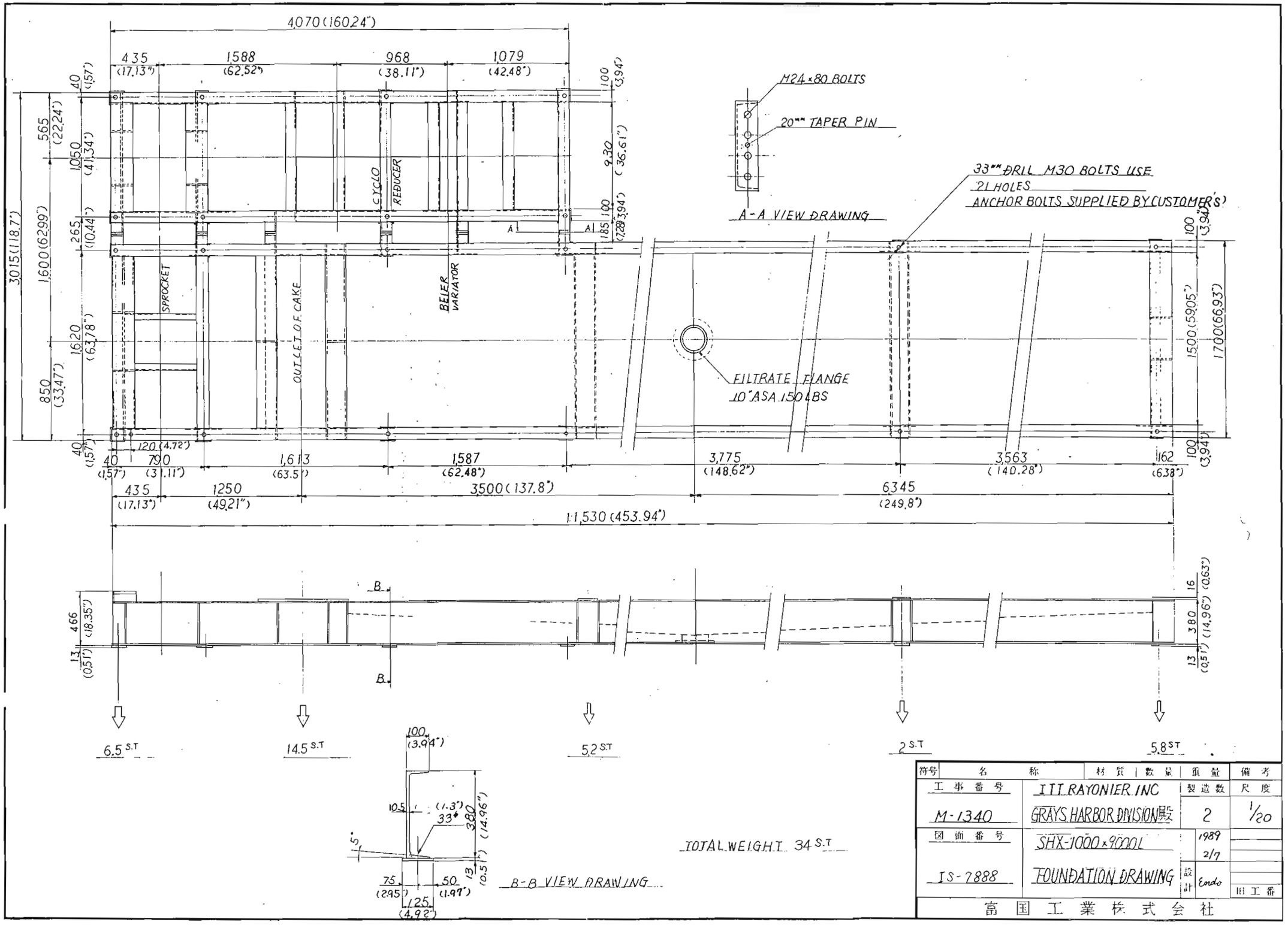
Total Weight = 34 S·T

Total Operating Weight = 39 S·T

1/9

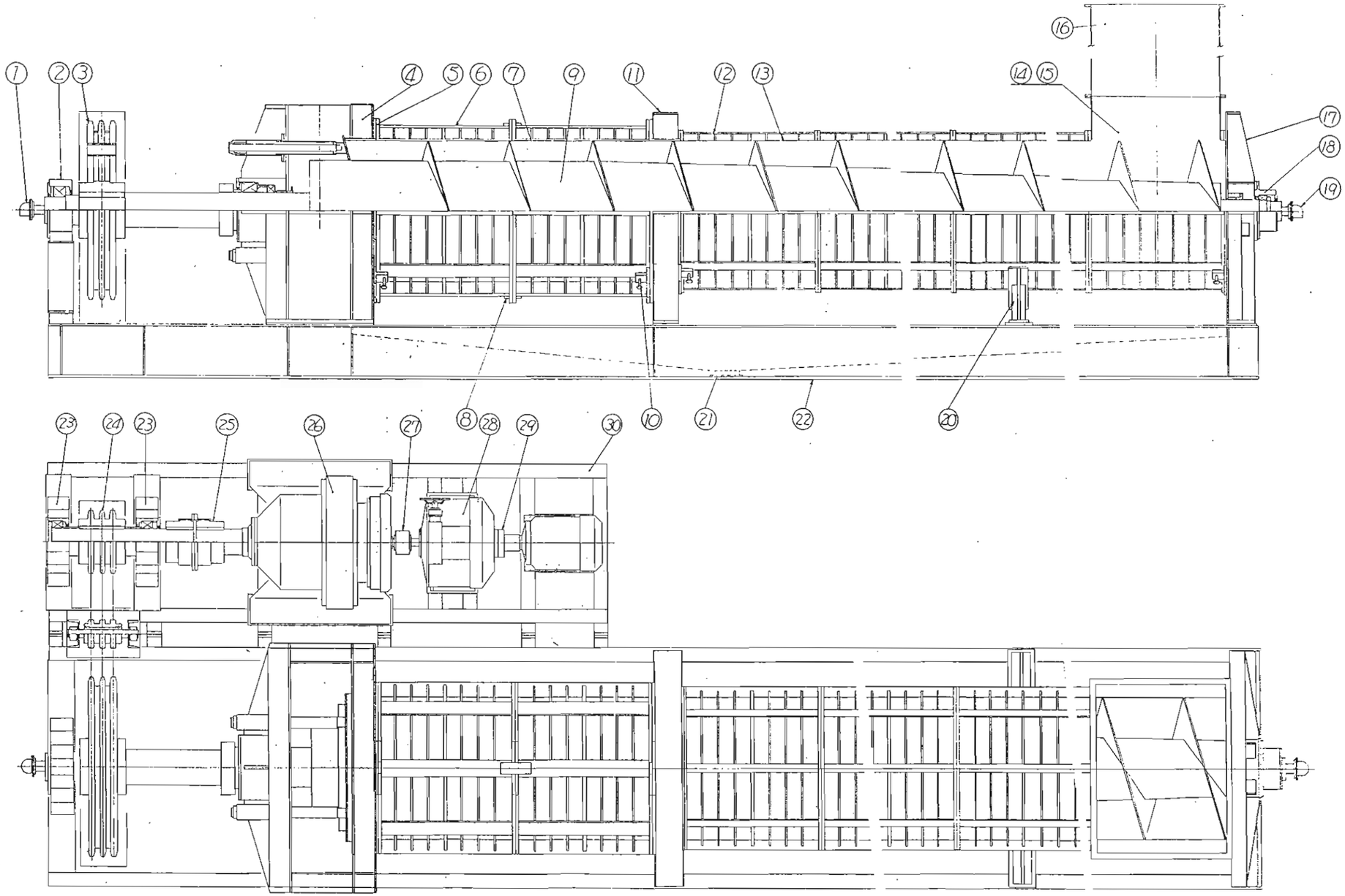
符号	名称	材質	数量	重量	備考
工事番号	ITT RAYONIER INC.		製造数		尺度
M-1340	GRAYS HARBOR DIVISION殿		2		1/30
図面番号	SHX-1000・9000L			1989 2/7	
IS-7887	ASSEMBLY		設計	Endo	出工番

富国工業株式会社



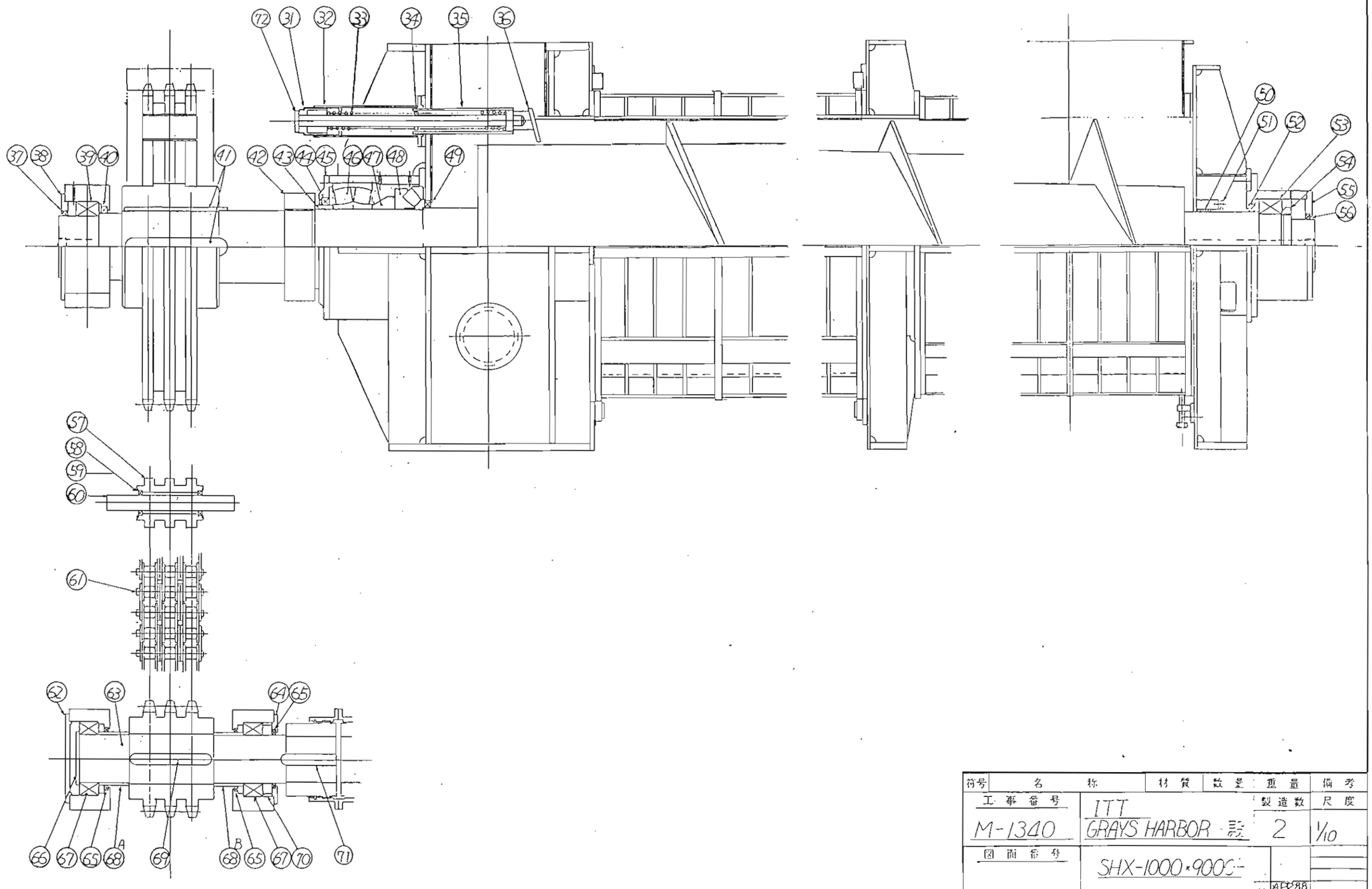
符号	名称	材質	数量	重量	備考
工事番号	ITT RAYONIER INC		製造数		尺度
M-1340	GRAYS HARBOR DIVISION殿		2		1/20
図面番号	SHX-1000×9000L			1989 2/7	
IS-7888	FOUNDATION DRAWING		設計	Endo	

富国工業株式会社



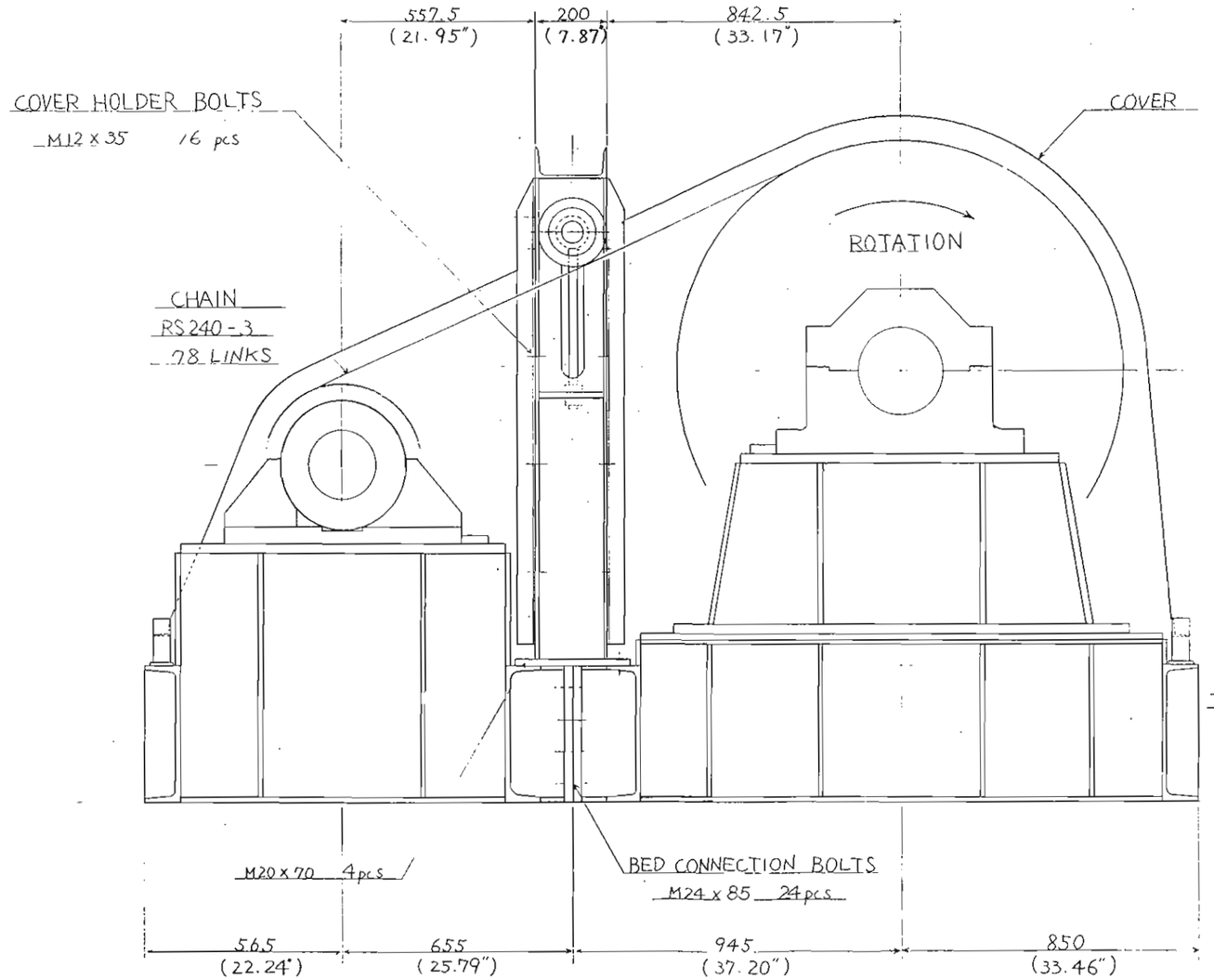
符号	名称	材質	数量	重量	備考
工事番号	ITT		製造数		尺度
M-1340	GRAYS HARBOR 殿		2		1/20
図面番号	SHX-1000×9ML SCREW PRESS				
					設計
					旧工番

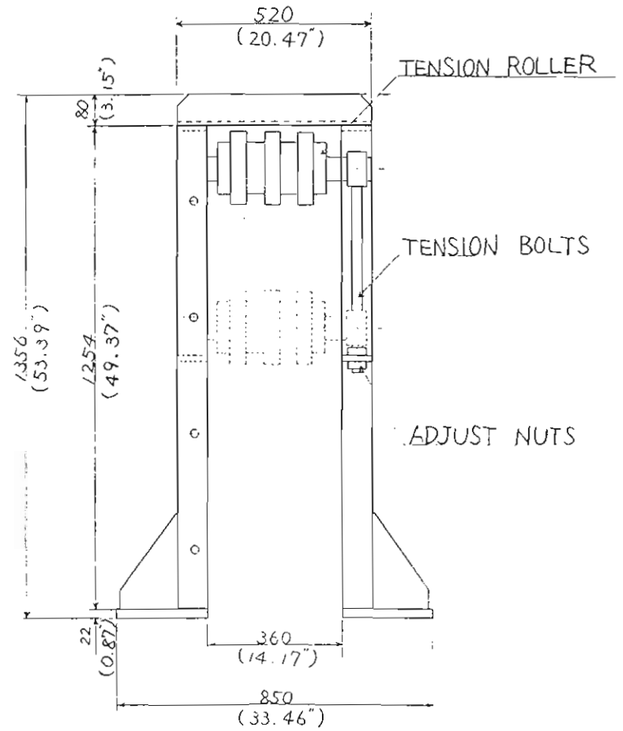
富国工業株式会社



符号	名称	材質	数量	重量	備考
工事番号	ITT		製造数		尺度
M-1340	GRAYS HARBOR 設		2		1/10
図面番号	SHX-1000×900S-				
	SCREW PRESS	設計	APR88		図番

富国工業株式会社

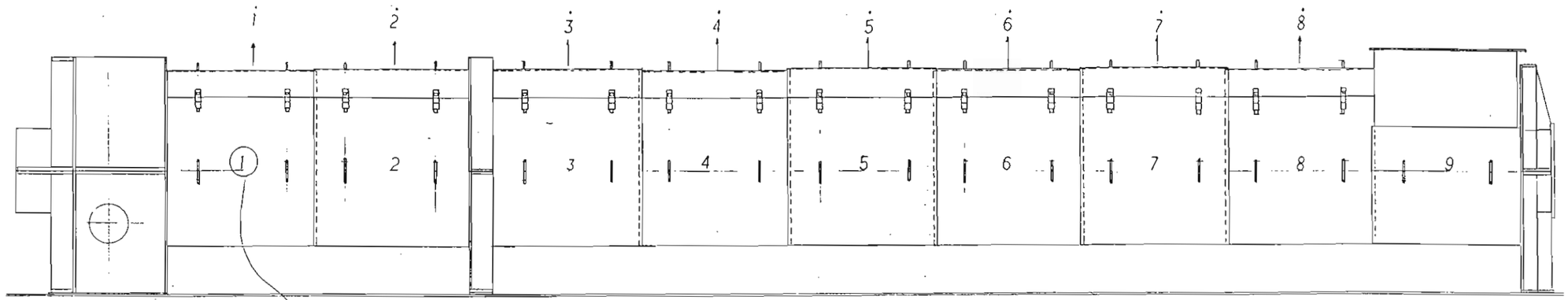




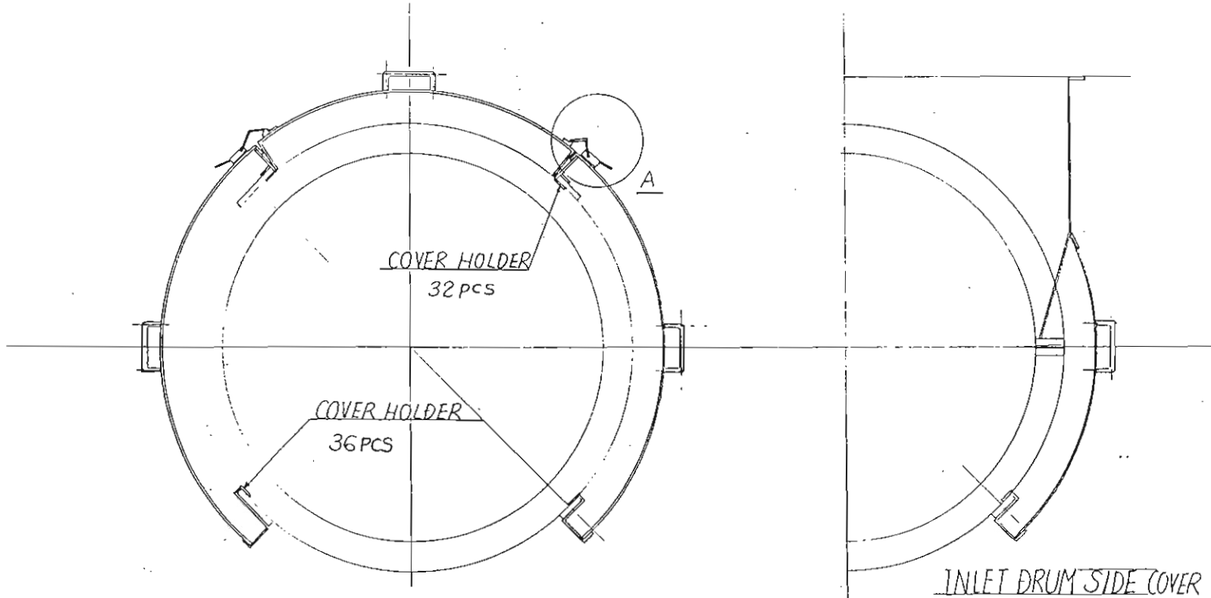
3/4

符号	名称	材質	数量	重量	備考
工事番号	ITT		製造数		尺度
M-1340	GRAYS HARBOR 殿		2		1/10
図面番号	SHX-1000/6000L			1989 3.21	
	ASSEMBLY		設計 N. Abe		図工番

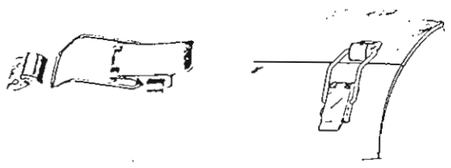
富国工業株式会社



Cover Number
Drive Section Side Course Number is "i"



INLET DRUM SIDE COVER



A

HIGH PRESSURE DRUM USE

LOW PRESSUR DRUM USE

.315

符号	名称	材質	数量	重量	備考
工事番号	ITT		製造数		尺度
M-1340	GRAYS HARBOR 殿		2		
図面番号	SHX-1000×9000L		1989 4/9		
	DRUM COVER		設計	遠藤	旧工番

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