New high-capacity circular jig recovers fine minerals

A new circular placer jig developed in Malaysia for recovering fine cassiterite on connected bucket line dredges, and proven successful for recovering very fine diamonds on a dredge in Brazil, is now being marketed on a world-wide scale.

In a cooperative program, the inventor of the jig, Norman Cleaveland, well known placer engineer, and the Dutch firm I. H. C. Holland have improved the jig. It is now available in standard sizes from eight to 25 feet in diameter, having capacities from 25 to 460 cubic yards per hour, depending on material being jigged.

The Rotterdam engineering firm has added its hydraulic membrane drive to the jig to impart a saw tooth shaped time-stroke pulsating pattern to the oscillating bed. Recovery of fine cassiterite, minus-100 to plus-150-mesh, has been increased 15 percent in this jig.

The new I. H. C. drive produces a reciprocating motion with a rapid inward stroke followed by a gradual outward stroke which eliminates the necessity for back water and prevents silting of the jig bed by overload surges. Backwater is added to many types of jigs to minimize the suction on the bed caused by the suction stroke of plunger. This tends to keep the bed loose to permit settling of heavy particles (concentrate) through the bed. Also, the horizontal transport of feed over the jig bed progresses more satisfactorily.

Many types and shapes of jigs have been developed, the rectangular and trapezoidal being the most commonly used.

In the 1940's, Lockhorst built a circular jig for the Billiton Company's gravel pump mines. This consisted basically of a number of trapezoidal jigs arranged to form a circle. This development served to reduce the area occupied by the jig and to permit it to be transported on a smaller trailer. Another feature of the plant was that the diaphragms were driven on one side only.

With its diameter of 13 feet, Lockhorst's circular jig had to be fed at the center. Difficulties were encountered in maintaining an even distribution of the feed over the jig bed and sanding of the bed frequently occurred. To combat this, the feed was more diluted and large quantities of back water were required, thus defeating the original purpose.

Norman Cleaveland

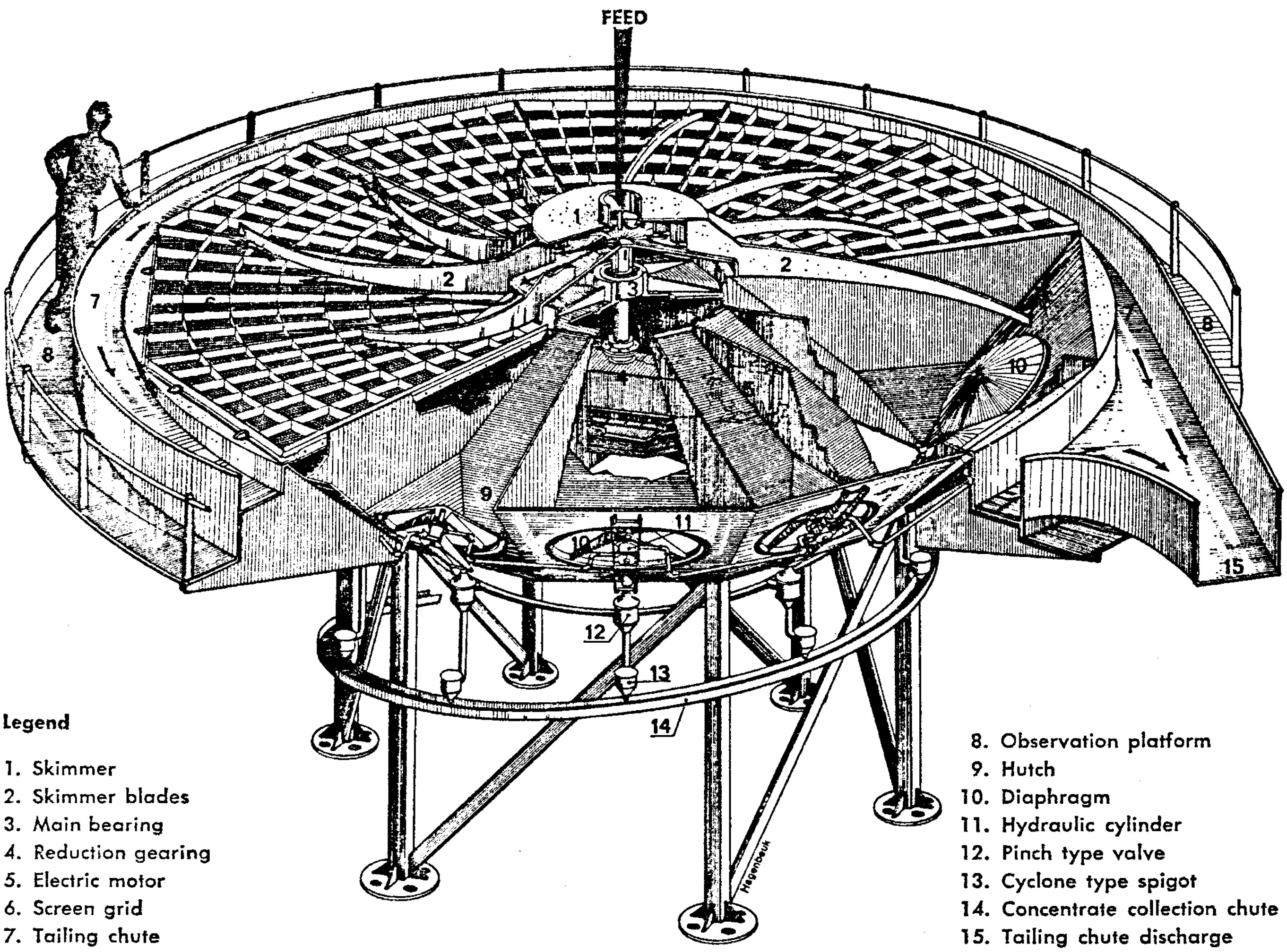
Began his dredging career in 1921 at Nome, Alaska, where he worked on construction of a connected bucket line gold dredge. From 1924 to 1930 he worked for Yuba Manufacturing Company. He first dredged for tin from 1930 through 1932 in Malaya, Siam, and Burma. He then dredged for gold in the United States until World War II. From 1946 until 1966 he headquartered in Malaya, now Malaysia, where he was president of Pacific Tin Consolidated Corporation. There he developed the Cleaveland jig.

New developments

Despite the apparent uniformity in regard to the types of jig employed in alluvial mining, two significant developments have taken place at widely separated points on the globe.

While working for Pacific Tin in Malaysia, Norman Cleaveland continued his efforts to perfect the Lockhorst jig, the underlying principle of which is undeniably sound. The most significant improvement he achieved was the addition of a rotating skimmer, the effect of which was to contour the surface to assume a uniform depth of bed, to distribute the feed evenly over the jig bed, and to move the lighter fractions of the feed, particularly sand, towards the discharge lip with the result that jig capacity was practically doubled over conventional jigs on a basis of jig bed area. He also developed a levelling arrangement which permits the jig to be kept in a horizontal position in spite of trim variations of the boat on which it is mounted. This jig was thoroughly tested in Malaysia under field conditions and in direct comparison with conventional jigs. The results obtained exceeded expectations.

Another significant advantage of



SCHEMATIC diagram to show the construction details and operating parts of the new I. H. C.-Cleaveland jig originally for Malaysian tin recovery.

arrangements employing a few circular jigs with their high capacity is that the distribution of the feed over the individual jigs is greatly simplified.

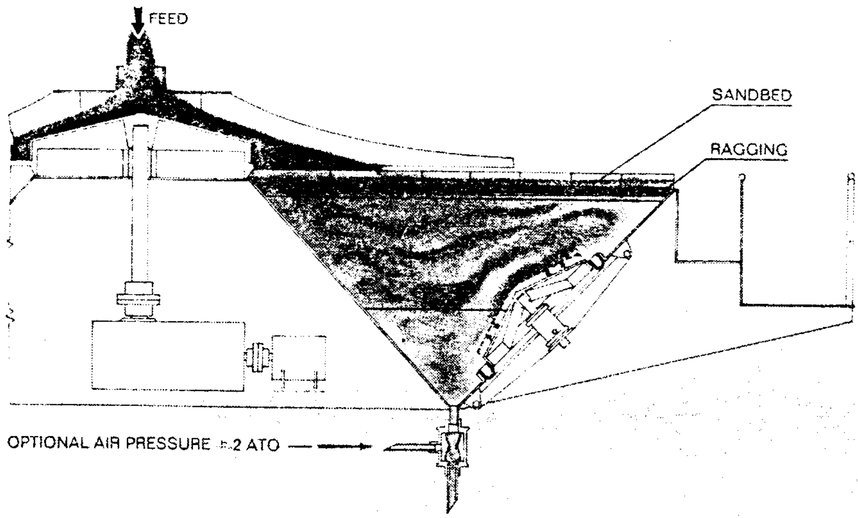
The flow of the slurry from the rotating screen on board the dredge to the jigs is preferably achieved solely by means of gravity, thereby dispensing with the need for power. Is is also very desirable to keep the distribution system as low as possible. Every foot of height increases the level at which very heavy components have to be mounted and also that to which the dredged material must be elevated. It is obvious that the problem of distribution is reduced as the number of jig feed points decreases. A tin dredge treatment plant with a capacity of 600 cubic meters per hour requires 40 3-cell jigs with 42 by 42 inch cells. This necessitates the feed being divided into 40 equal parts. Using a circular jig with a diameter of 25 feet, only two jigs are more than ample for the given output. Thus it is only necessary to split the feed into two parts. This simplification results in many savings in capital and operating costs.

While Cleaveland was busy improving the circular jig, other, quite independent developments were taking place at the I.H.C. Delft laboratory. I.H.C. Holland, long known as one of the world's foremost dredge designing and building companies, offers through its Marine Mining Division specialized services ranging from feasibility studies of off shore mining projects through to equipment design and construction. There, engineers were devising a jig drive mechanism which would eliminate the need for back water. The optimum motion of the water in the

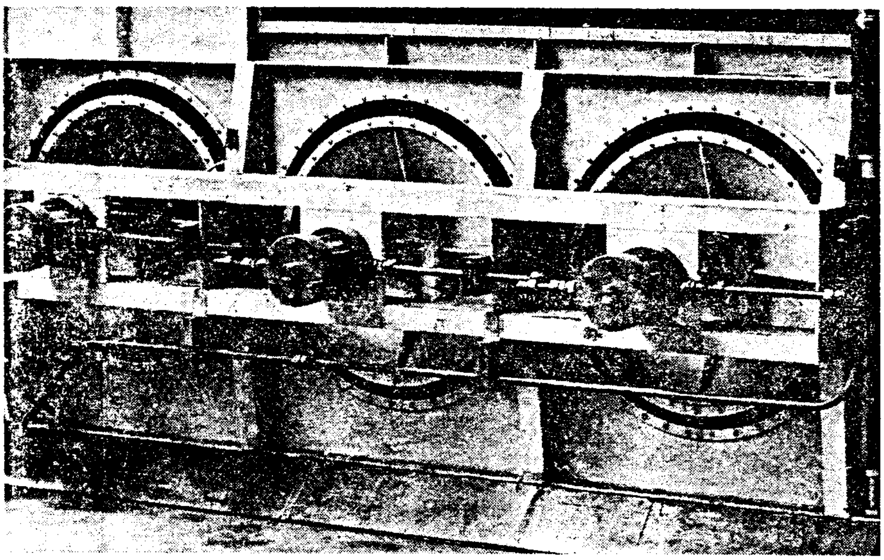
Comparison of Conventional Placer Jig with I. H. C.-Cleveland Circular Jig

	Conventional, 42 by 42 inch, Three Cells per Flow Line	*Circular, 25-foot Diameter*
Full load capacity, cubic yards per hour	800	800
Number of flow lines	40	2
Full load per flow line, cubic yard per hour	20	400
Total jig bed area, square feet	1,440	922
Full load of area, cubic yard per hour per square foot	0.56	0.87
Total width of discharge lips, feet	140	157
Full load flow of solids over lips, cubic yard per hour per foot	5.7	5.1
Total length of side walls plus discharge lips, feet	980	157
Number of diaphragms	120	24
Number of drives	60	24
Number of motors	60	3
Sand overload capacity	Less than 25%	More than 100%*
Installed horsepower	120**	80
Approximate total net weight, metric tons	88.5	40

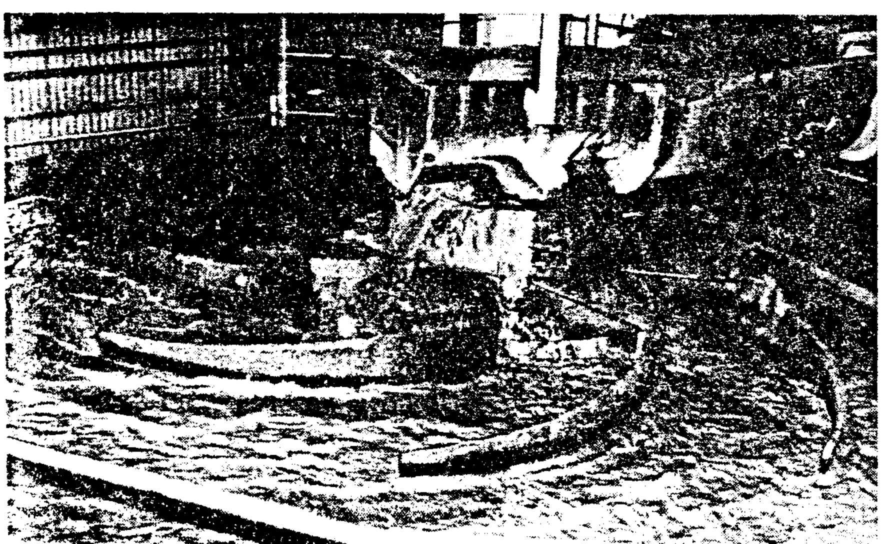
* Due to skimmer. ** Excluding back water pump motors.



CROSS SECTION of the circular jig (right side only, the left hand recovery section is identical) showing pulp flow and the compression waves formed by the reciprocating diaphragm. Note how air can be added to increase agitation.



THREE hydraulic rams connected in series actuate three diaphragms in unison. A relatively light, easily changed cam disc is used to actuate spool of the hydraulic valve. Thus, diaphragm movement can easily be controlled.



FEED to the new jig is laundered to the top center and dropped into the rotating skimmer which distributes the feed over the entire bed area to prevent plugging of a compartment by surges.

hutch was established in theory and in practice.

The advances represented by these two separate developments have now been linked, and the result is seen in the I.H.C.-Cleaveland circular jig, which emodies the solution to all the problems hitherto encountered with this type of plant. Moreover, since its inception substantial progress has been made towards the elimination of regular maintenance.

There are many advantages connected to the high capacity of the new jig. Problems of distribution are eliminated because the jig requires considerably less space, the vessel on which it is mounted can be smaller and cheaper. The compact construction of the jig and its simplified distribution system enable the overall height of the dredge which it operates to be reduced to cut weight and therefore cost.

Conclusion

The I.H.C.-Cleaveland jig represents a logical fusion of all the advances made to date in jig design and construction. It affords a solution to practically every problem which has hitherto been encountered in the treatment plants of alluvial mines. Summarizing, this jig possesses the following characteristics:

1. **Diminishes flow velocity over the jig bed.**
2. **Greatly reduces side wall effect.**
3. **Eliminates back water.**
4. **The design guarantees even distribution of pulp over the entire jig area, thereby eliminating sanding.**
5. **Absence of moving parts in areas exposed to dirt.**
6. **Easy adjustment of stroke and frequency.**
7. **Unique saw-tooth pulsating characteristic.**
8. **Are screens less susceptible to blinding.**
9. **Optional levelling arrangement for maintaining horizontal position.**

In terms of operation these features mean:

1. Higher loading per unit of surface area without loss of efficiency.
2. Improved performance under overload conditions.
3. Ability to handle coarser material.
4. Improved recovery of fine ore grains.
5. Simplified distribution system.
6. Smaller total treatment area.
7. Reduced height of dredges.
8. Minimal supervision.
9. No build up of slimes in jig tank.

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