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DATE: 1993-06-01 UPDATE:

NEW FLOW SORT X-RAY DIAMOND RECOVERY MACHINES

A.) BACKGROUND:

X-RAY diamond recovery machines have been in use in South Africa since 1968. X-RAY DIAMOND RECOVERY MACHINES were originally supplied by a South African company **"GUNSON SORTEX (Pty)** Ltd. and are known throughout the industry as **"SORTEX MACHINES"**
The basic concept of operation of such X-RAY sorting machines is utilizing the fact that **diamonds fluoresce** and to some degree phosphoresce **when exposed to X-Ray** radiation. Light emitted from diamonds, which have been excited by X-Ray's is detected and converted into electrical signals. Such signals (after suitable amplification and processing) in turn are used to trigger an ejection device which physically separates the diamond from the rest of material fed through such a sorting machine.

A.1.) X-RAY DIAMOND RECOVERY MACHINES generally consist of **4 BASIC COMPONENTS:**

A.1.a.) **a MATERIAL HANDLING PART** consisting of a vibratory feeder, a conveyor belt or a feed chute arrangement and a tailings and concentrate outlet chute.

A.1.b.) a **RADIATION SOURCE**, generally in form of an X-RAY TUBE. (Other radiation sources such as isotopes emitting GAMMA radiation have been tried).

A.1.c.) a **LIGHT DETECTION DEVICE** generally consisting of PHOTO-MULTIPLIERS (P.M.TUBES)
Note: Items A.1.b.) and A.1.c.) make up the DETECTION ZONE of a sorter

A.1.d.) an **EJECTION DEVICE** (EJECTOR) consisting of high-speed air-solenoid valves fitted with suitable nozzles. Water jet based ejectors and mechanical ejection mechanisms, although tried, have never come out of their experimental stage.

Note: The location of the EJECTION DEVICE is referred to as the EJECTION ZONE which is down stream, adjacent to the DETECTION ZONE.

B.) THE BASIC OPERATION OF AN X-RAY DIAMOND RECOVERY MACHINE IS:

B.1.) Diamondiferous material (sized in a ratio of typically 2:1) is drawn, at a controlled rate, from a bin via a **VIBRATING FEEDER**.

B.1.a.) THE MAIN PURPOSE OF THIS STAGE IS TO GENERATE A CONSTANT STABLE FLOW OF DIAMONDIFEROUS MATERIAL i.e. A **CONSTANT FEED RATE** TO THE SORTER!

B.2.) The vibrating feeder then deposits the material onto either a **CONVEYOR BELT (FIG.2)** or a FEED **CHUTE**.

B.2.a.) In both cases the material is being accelerated during this stage causing the material to be spread out. i.e. the space between individual particles increases!

B.2.b.) If a **CONVEYOR BELT** is used as material transport media the material is accelerated by gravity whilst it passes from the vibrating feeder trough to the conveyor belt (in free fall or via a short transfer chute) and by means of friction between the conveyor belt surface and the feed particle surface which exists as long as there is a difference in speed between conveyor belt and feed particles.

B.2.c.) If a **FEED CHUTE** arrangement is used, particles are accelerated by gravity as they slide and / or roll down the inclined FEED CHUTE.

B.2.d.) For the sake of completeness it should be mentioned that in some sorters the feed material is dropped straight from the vibrating feeder pan through the DETECTION ZONE and EJECTION ZONE. We named this type of feed system a **GRAVITY "CURTAIN" FEED**.

B.2.e.) IT IS THE OBJECTIVE OF THIS STAGE TO **PRESENT THE FEED MATERIAL** TO BE SORTED, TO THE DETECTION ZONE OF THE SORTER, IN A STABLE **MONO-LAYER** WITH INDIVIDUAL FEED PARTICLES SPACED EVENLY APART FROM ONE ANOTHER, AND TO MAINTAIN THIS FEED STABILITY FROM THE POINT OF DIAMOND DETECTION (DETECTION ZONE) TO THE POINT WHERE THE DETECTED DIAMONDS ARE SEPARATED (EJECTED) FROM THE FEED MATERIAL.

THERE IS A VERY TRUE SAYING IN THE "ELECTRONIC SORTING WORLD";

THE PERFORMANCE OF A SORTER IS ONLY AS GOOD AS THE FEED PRESENTATION TO THE SORTER!

B.2.f.) In the **DETECTION ZONE** of a diamond sorter, which is a completely enclosed area, (such enclosure preventing any harmful radiation from escaping and any "ambient" light from entering) one finds two basic components, a radiation source, an X-RAY tube, which excites the diamonds, causing them to fluoresce and phosphoresce (to emit light!) and a highly sensitive light detection device, usually PHOTO-MULTIPLIER tubes (P.M.-TUBES) are used, which can detect the fluorescence and phosphorescence of the exited diamonds (i.e. detect the light emitted from the excited diamond).

B.2.g.) THE AIM IS TO ENSURE THAT **ALL DIAMONDS** ARE **DETECTED** PRECISELY AT THE TIME AS THEY CROSS AN IMAGINARY LINE DRAWN TRANSVERSE ACROSS THE FEED PASSAGE. IT IS FURTHER DESIRABLE **NOT** TO DETECT **ANY OTHER PARTICLES** WHICH ARE ALSO EXCITED BY X-RAY RADIATION CAUSING THEM TO FLUORESCE AND / OR PHOSPHORESCE.

B.2.h.) The next stage downstream from the detection zone and adjacent to it, is the **EJECTION ZONE** (the diamond separation stage) (FIG.1). In this area it is the task of the **EJECTOR** to remove (eject) all light emitting particles (which have been detected by the P.M.-tubes whilst passing through the **DETECTION ZONE**). These particles are ejected from the feed stream into the **CONCENTRATE CHUTE** whereas the remaining (sorted) feed stream reports to the **TAILINGS CHUTE**.

B.2.i.) IT IS OF PRIME IMPORTANCE TO **RECOVER (EJECT) ALL DIAMONDS** THAT HAVE BEEN DETECTED, REGARDLESS OF THEIR SPEED, SHAPE, SIZE AND TRANSVERSE POSITION WITHIN THE FEED PARTICLE STREAM.

B.2.j.) IT IS ALSO VERY DESIRABLE TO REMOVE AS FEW "OTHER" FEED PARTICLES WITH THE DIAMOND, WHICH HAPPEN TO BE IN THE VICINITY OF THE EJECTED DIAMOND (FLUORESCENT PARTICLE).

C.) SOME IMPORTANT FACTS AND FEATURES OF "DRY-FEED" AND "WET- FEED" DIAMOND RECOVERY MACHINES

C.1.) **"DRY FEED" X-RAY DIAMOND RECOVERY (SORTING)** is commercially in use in South African Diamond Mines since 1967/1968.

C.1.a.) The feed transport media is normally a **CONVEYOR BELT** although some other concepts such as chute feed and free fall "curtain" have been tried as well.

C.1.b.) **Conveyor belt speeds** of these sorters vary from about 1.5 m/sec to 3.5 m/sec.

C.1.c.) **Conveyor belt widths** vary from narrow "V" grooved belts (designed to present diamondiferous gravel in a "pearl-string-formation" to the detection zone, as for instance used in re-concentrating diamond sorting machines), up to about 800mm width. Wide conveyor belts find application in large capacity "bulk" diamond recovery machines.

C.1.d.) **Gravel sizes** treated by DRY FEED, CONVEYOR TYPE, and DIAMOND RECOVERY MACHINES range from 0.5mm up to 31mm.

C.1.e.) For gravel sizes below 10mm the **gravel size range** to be sorted in one pass, should not exceed a ratio of 2:1 (i.e. +2mm -4mm, +4mm -8mm etc.) above 10mm a wider range such as 2,5: 1 or in same cases 3:1 is permissible.

C.1.f.) <u>Exceeding the maximum permissible particle size ratio results in reduced diamond recovery efficiency mainly due to large particles travelling (coming to rest) on top of small diamonds. This means that the light emitted from a small diamond, lying under a larger feed particle, cannot reach the optical detector.</u>

C.1.g.) X-RAY SOURCE and OPTICAL DETECTORS are traditionally located at the same side of the feed particle stream (above the feed particle stream)! (SEE FIG.5)

C.1.h.) It is important to realize that a diamond, lying under another feed particle, does still get exited by the X-RAY radiation. X-RAY radiation penetrates through the particle lying on top of a diamond, causing the diamond to fluoresce and phosphoresce. The light emitted from the diamond however can not pass through an opaque particle masking it!

C.1.i.) **POSITIVE features of DRY FEED BELT DIAMOND RECOVERY MACHINES are:**

C.1.i.1.) It is relatively easy to achieve a **stable, monolayer feed** stream through the detection zone and the ejection zone.

C.1.i.2.) It is possible **to move the ejector** which is generally of pneumatic design, further **downstream** from the optical detectors. Pneumatic ejectors generate a lot of dust when operated, the optical detectors however must be kept dust free at all times!

C.1.i.3.) The **ejector trigger signals**, generated by the optical detectors are simply **delayed** for exactly the same time that it takes feed particles to travel from the point of detection to the point of ejection.

C.1.i.4.) Note once again that delayed ejection is possible because all feed particles take substantially the same time to cover the distance from the point of detection to the point of ejection! <u>It follows that the point of detection must be well defined</u> in order for the above statement to hold true!

C.1.j.) **PROBLEM areas of "DRY FEED " X-RAY DIAMOND RECOVERY MACHINES are:**

C.1.j.1.) Removing dust from the sorter which is stirred up during the transfer of the feed material from the vibrating feeder onto the conveyor belt, during the feed materials acceleration to the conveyor belts speed.

C.1.j.2.) Most importantly coping with the dust being generated by the bursts of compressed air released by the pneumatic ejector commonly used in such sorters every time it ejects a particle which has been detected whilst passing through the sorters detection zone.

C.1.j.3.) Stopping the ejected particles from bouncing so that they are safely discharged through the sorters concentrate chute.

C.2.) **X-RAY DIAMOND RECOVERY MACHINES** designed to handle **WET** diamondiferous materials of sizes less than 10mm have been successfully implemented in 1978.

The first worldwide South African CHUTE FEED X-RAY DIAMOND RECOVERY MACHINE is known as the **"WET SORTEX MACHINE"**(SEE FIG.3) In Russia wet diamond recovery machines have been in use prior to 1978. However little is known about these "early" Russian made sorters, rumors have it that these machine are rather crude in design and inefficient in diamond recovery!

C.2.a.) In WET FEED DIAMOND RECOVERY MACHINES the feed transport media is normally a chute although some other concepts such as mesh belts and free fall feed straight from a vibrating feeder trough have been tried.

C.2.b.) Note that gravel sizes above approx 10mm can be sorted by means of "BELT FEED SORTING MACHINES" much in the same way as described above in chapter C.1.) "DRY FEED SORTING". However instead of dust problems, one has to then deal with water, grit and mud problems!

C.2.c.) Wet feed material of less than about 10mm in size cannot be treated with a conventional conveyor belt based sorter as:

C.2.c.1.) Firstly individual feed particles start forming particle clusters held together by the surface tension of free water present in wet gravel, causing many particles to be masked by others!

C.2.c.2.) Secondly it is water surface tension that "binds" the wet gravel to the conveyor belt surface which causes feed particles to be flung (to a varying degree) around the conveyor belt pulley causing particles to leave the conveyor belt at different angles (and speeds) thus making ejecting individual particles very inaccurate!

C.2.d.) Average **feed particle speeds** of "chute-feed" sorters vary from about 1.0 m/sec to 2.5 m/sec.

C.2.e.) Feed **chute widths** vary from 75mm up to about 250mm.

C.2.f.) **Gravel sizes** treated by WET FEED - sorters range from 1.5mm up to 25mm. For gravel sizes below 10mm the size range to be sorted should not exceed a ratio of 2:1 (i.e. +2mm -4mm, +4mm -8mm etc.) above 10mm a wider range is permissible i.e. 2.5: 1 or even 3: 1.

C.2.g.) <u>Exceeding the maximum permissible particle size ratio results in reduced diamond recovery efficiency mainly due to large particles traveling (coming to rest) on top of small diamonds. This means that the light emitted from a small diamond, lying under a larger feed particle, cannot reach the optical detector.</u>

C.2.h.) IN WET FEED DIAMOND RECOVERY MACHINES X-RAY SOURCE and OPTICAL DETECTORS are traditionally located at the same side of the feed particle stream! (SEE FIG.3)

C.2.i.) It is important to realize that a diamond, lying under another feed particle, does still get exited by the X-RAY radiation. X-RAY radiation penetrates through the particle lying on top of a diamond, causing the diamond to fluoresce and phosphoresce. The light emitted from the diamond however can not pass through an opaque particle masking it!

Critical areas of such WET DIAMOND SORTERS are:

C.2.i.1.) Getting all feed particles to settle on the feed chute in a monolayer without bouncing, bunching or forming clusters.

The latter is often caused by water holding several feed particles together!

Feed particle speeds vary from 2:1 up to 4:1 depending on particle shape, size, surface properties and mass, the amount of feed (free) water moving with the feed material as well as the angle, surface characteristics and shape (curvature etc.) of the feed chute itself.

C.2.i.2.) Coping with the spray of water, grit and mud being generated by the bursts of compressed air released by the pneumatic ejectors which are commonly used in such wet diamond sorters. Every time a particle is ejected the free water moving with the feed stream (usually contaminated with micro particles) is virtually atomized. And to make matters worse this messy process takes place in close vicinity of the optical detector which must be kept clean at all times!

NOTE: As feed particles, passing down an inclined chute, travel at substantially different speeds it is important to eject diamonds as close as possible to the point where they have been detected!

C.2.i.3.) Stopping the ejected particles (some of them being accelerated by the air blast to speeds in excess of 50 meters per second!) from bouncing so that they are safely discharged through the sorters concentrate chute.

C.2.j.) **The advantages of sorting wet diamondiferous material:**

C.2.j.1.) These advantages are obvious when one considers that the gravel is treated by a wet process prior to sorting.

Be it H.M.S. concentrate, PAN concentrate or R.O.M. material that has passed over a "wet" sizing screen!

C.2.j.2.) If a dry sorting process is to be used the feed material to the sorter must first be dried, which means extra equipment is required and, at ever increasing energy prices, the treatment costs are increased, making final diamond recovery more complicated and more costly!

D.) THE NEW GENERATION OF DIAMOND RECOVERY MACHINES (FIG.4)

D.1.) FLOW SORT DESIGNERS TOOK A NEW, UNBIASED LOOK AT WHAT IS REQUIRED OF TODAY'S DIAMOND RECOVERY MACHINES. NONE OF THE CURRENT PRACTICES, REGARDLESS OF HOW OLD OR HOW WELL ESTABLISHED THEY MIGHT HAVE BEEN WERE TAKEN FOR GRANTED! THE MAIN OBJECTIVE THROUGHOUT THIS DESIGN PHASE HAS BEEN TO PRODUCE A SORTER THAT IS SUITABLE FOR **ALL DIAMOND RECOVERY OPERATORS**. SUITABLE FOR LARGE DIAMOND MINES AND SUITABLE AS WELL AS AFFORDABLE FOR SMALL DIAMOND DIGGINGS. SUITABLE FOR SOPHISTICATED FULLY AUTOMATED RECOVERY PLANTS AS WELL AS SIMPLE GREASE OR PAN BASED OPERATIONS. SUITABLE FOR PERMANENT RECOVERY INSTALLATIONS AS WELL AS PORTABLE PLANTS AS NEEDED FOR PROSPECTING WORK AND TAILINGS DUMP EVALUATION. AND ALL THIS WITH UNSURPASSED DIAMOND RECOVERY EFFICIENCY.

D.2.) The sorter has been designed to handle **WET** diamondiferous material and with little changes it can be converted to handle **DRY** diamondiferous material.

D.2.a.) AS FEED TRANSPORT MEDIA WE USED A **STRAIGHT CHUTE** FEED ARRANGEMENT WITH SPECIAL FEED MATERIAL **STABILIZING CURTAINS**. (SA PATENT APPLICATION 93/3667 REFERS)

D.2.a.1.) WET FEED MATERIAL IS MIXED WITH WATER TO HELP IT SLIDING DOWN THE FEED CHUTE.

D.2.a.2.) DRY FEED MATERIAL SLIDING DOWN THE FEED CHUTE WITH THE HELP OF A MEDIUM VELOCITY AIRFLOW, GENERATED BY MEANS OF AN EXTRACTION FAN WHICH DRAWS AIR DOWN THE ENCLOSED FEED CHUTE!

D.3.) The sorter is **physically smaller**, and substantially **lighter** than the current generation of X-Ray diamond recovery machines making it easy to transport.

D.3.a.) WE HAVE REPLACED THE TRADITIONAL STEEL CABINET USED IN CONVENTIONAL DIAMOND RECOVERY MACHINES AS ENCLOSURE FOR SORTER COMPONENTS SUCH AS THE FEED CHUTE, X-RAY TUBE, P.M.-BOX (A BOX CONTAINING THE LIGHT SENSITIVE DETECTORS SUCH AS PHOTO-MULTIPLIERS) AND THE EJECTORS, WITH **A SELF SUPPORTING FEED CHUTE STRUCTURE** TO WHICH ALL OTHER COMPONENTS ARE ATTACHED AS SELF-CONTAINED SUB-ASSEMBLIES. (SA PATENT APPLICATION 93/3664 REFERS)

D.4.) The sorter is of **modular design** making it easy to dismantle, transporting the sorter broken down into its sub-assemblies and to reassemble the machine at a new location within an hour!

D.4.a.) THE MACHINE CAN BE QUICKLY BROKEN DOWN INTO THE FOLLOWING SUB-ASSEMBLIES:

* FEED CHUTE SUPPORT STAND (COMPLETE WITH FEED-WATER AND X-RAY COOLING WATER CIRCUITS)
* FEED CHUTE ASSEMBLY (COMPLETE WITH INLET, TAILINGS AND CONCENTRATE CHUTES)
* X-RAY TUBE ASSEMBLY
* PHOTO-MULTIPLIER TUBE BOX (P.M. BOX) (COMPLETE WITH P.M.-TUBE, H.T.-SUPPLY AND SIGNAL AMPLIFIERS)
* EJECTOR ASSEMBLY (COMPLETE WITH ALL EJECTOR ASSOCIATED ELECTRONICS)

* HIGH VOLTAGE GENERATOR (FOR X-RAY TUBE)

* ELECTRIC CONTROL PANEL

D.5.) To eliminate problems associated with a pneumatic ejection device (described above in detail) such as generating dust in dry-sorters, spraying "dirty" feed water onto sensitive devices such as X-Ray tube window and optic box windows in wet-sorters etc, as well as avoiding the need of a costly compressed air supply system (high speed ejectors need almost instrument air quality to operate!) we replaced the traditional pneumatic ejector with an **ELECTRO-MECHANICAL EJECTION DEVICE** which works fast, accurate and "clean". (SA PATENT APPLICATION 93/3666 REFERS)

D.5.a.) The idea to use in electronic sorting machines mechanical ejectors instead of pneumatic ones is not new at all. Several sorting machine designers have made attempts in this direction, none of these attempts however have been successful in the X-RAY diamond recovery field. And even today one finds sorting machine designers and manufacturers quickly ending a discussion about using mechanical ejectors in diamond recovery machines with the comment:"It will never work"

D.5.b.) AFTER SEVERAL MONTHS OF CONCENTRATED R&D-WORK FLOW SORT DESIGNERS HAVE HOWEVER SUCCEEDED TO DESIGN AND MANUFACTURE A MECHANICAL EJECTOR IN THE FORM OF AN EJECTOR GATE, DRIVEN VIA A COMPUTER CONTROLLED STEPPER-MOTOR.

D.5.c.) OUR EJECTOR DESIGN COMPRISES OF:

D.5.c.1.) A **LIGHT-WEIGHT** rubberized **TITANIUM EJECTOR-GATE** (TO KEEP THE INERTIA OF THE MOVING PART LOW)

D.5.c.2.) A SPECIALLY **DAMPENED EJECTOR GATE SHAFT** TO ELIMINATE MECHANICAL OSCILLATIONS OF THE EJECTOR SYSTEM WHICH OCCUR DURING STEPPING AND PARTICULAR AFTER STOPPING THE GATE IN EITHER ITS OPEN OR ITS CLOSED POSITION.

CORRECT DAMPENING OF THE EJECTOR DEVICE IS OF UTMOST IMPORTANCE AS MECHANICAL OSCILLATIONS MAKE THE SYSTEM AT HIGH ACCELERATION AND DECELERATION PHASES, WHICH ARE IN THIS APPLICATION ESSENTIAL, UNSTABLE.

D.5.c.3.) THE OPTIMUM ACCELERATION / DECELERATION PROFILE FOR THE STEPPER MOTOR PLUS EJECTOR GATE ARE SOFTWARE **CONTROLLED**.

D.5.c.4.) WITH OUR SYSTEM WE OBTAIN TYPICAL OPENING AND CLOSING TIMES, FOR A 35 DEGREE ANGULAR EJECTOR GATE MOVEMENT (EITHER WAY), OF LESS THAN 25 MILLISECONDS. IN OTHER WORDS THE MECHANICAL EJECTOR GATE CAN PERFORM 20 COMPLETE **EJECTION CYCLES PER SECOND**, A PERFORMANCE WHICH IS COMPARABLE TO PNEUMATIC EJECTORS!

D.5.c.5.) THE EJECTOR CONTROL SOFTWARE (RUNNING ON A MICROPROCESSOR) DECIDES WHEN THE GATE MUST OPEN, CLOSE, STAY-OPEN OR REMAIN CLOSED DEPENDING ON THE OPTICAL DETECTION SIGNAL AMPLITUDE, SEQUENCE AND DURATION.

D.5.c.6.) THE NEW FLOW SORT EJECTOR SYSTEM HAS RECENTLY BEEN SUBJECTED TO A TWO WEEKS R.O.M. SORTING TEST, PERFORMING IN

EXCESS OF 13 000 EJECTIONS, WITHOUT LOOSING A SINGLE DIAMOND!

D.5.c.7.) IT GOES WITHOUT SAYING THAT SUCH A MECHANICAL EJECTION DEVICE WOULD ALSO BE OF GREAT BENEFIT TO ANY CONVEYOR BELT BASED SORTER.

D.6.) With a revolutionary new design of the diamond sorters **DETECTION ZONE** SEE FIG.6 (SA PATENT APPLICATION 93/3665 REFERS) we made another major break through in the areas of: increased sensitivity, precise physical detection point of fluorescent feed particles, keeping the P.M.-BOX window clean (self cleaning) and, most importantly, positive detection of diamonds which are covered, whilst the move through the detection zone, by other feed particles (as described in Para's C.1.f..to C.1.h. above) Diamonds, which would be lost by conventional diamond recovery machines! (SEE FIG.5)

D.6.a.) WE DECIDED TO PLACE THE OPTICAL DETECTORS (LOCATED IN THE P.M.-BOX) UNDER THE FEED STREAM, IN FACT WE MADE THE P.M.- BOX WINDOW PART OF THE FEED CHUTE! (SEE FIG.4 & FIG.6). THIS HAS THE FOLLOWING ADVANTAGES:

D.6.a.1.) FEED PARTICLES PASS AT VERY CLOSE DISTANCE IN FRONT OF THE P.M.- TUBES. FURTHER, AT THE MOMENT WHEN A FLUORESCENT PARTICLE PASSES IN FRONT OF THE P.M.- BOX WINDOW THE P.M.-TUBE IS EXPOSED TO A LARGE SPHERICAL LIGHT EMISSION ANGLE FROM THIS PARTICLE.

D.6.a.2.) THE INTENSITY OF LIGHT DIMINISHES WITH THE INVERSE SQUARE OF THE DISTANCE FROM THE LIGHT SOURCE. THE TYPICAL DISTANCE BETWEEN FLUORESCENT DIAMONDS AND P.M.-TUBES IS NOW APPROXIMATELY ONE THIRD OF THAT COMPARED TO A CONVENTIONAL DIAMOND RECOVERY MACHINE. THIS GAIN OF LIGHT INTENSITY COMBINED WITH THE CAPTURE OF A LARGER SPHERICAL ANGLE OF THE EMITTED LIGHT, MEANS THAT OUR NEW SORTER IS OVER A MAGNITUDE MORE SENSITIVE THAN COMPARABLE CONVENTIONAL DIAMOND SORTERS!

D.6.b.3 THIS INCREASED SYSTEM SENSITIVITY CAN BE PRACTICALLY UTILIZED IN MANY WAYS:

* LOWER SENSITIVITY P.M. TUBES CAN BE USED WHICH ARE SUBSTANTIALLY CHEAPER

* P.M.- TUBES CAN BE OPERATED AT A LOWER VOLTAGE WHICH MEANS THEY WILL LAST LONGER

* IN SOME APPLICATIONS, SOLID STATE LIGHT SENSORS (WHICH CAN NOT MATCH THE HIGH SENSITIVITY OF P.M.-TUBES) CAN BE USED INSTEAD OF P.M.-TUBES

* LOWER DIAMOND FLUORESCENCE (PHOSPHORESCENCE) LEVELS CAN BE DETECTED

* LOWER X-RAY RADIATION LEVELS ARE SUFFICIENT TO EXCITE DIAMONDS WHICH IN TURN MEANS THAT A LARGER FEED CHUTE WIDTH CAN BE COVERED PER X-RAY TUBE (HIGHER THROUGHPUT)

D.6.c.) THE FACT THAT THE LIGHT SENSORS (P.M.- TUBES) ARE NOW POSITIONED ON THE OPPOSITE SIDE OF THE X-RAY RADIATION SOURCE (X-RAY TUBE) ALSO

MEANS THAT THE LIGHT EMITTED BY DIAMONDS WHICH ARE MASKED BY OTHER PARTICLES (LYING, MOVING ON TOP OF THEM) WHICH ARE HOWEVER EXCITED BY X-RAYS WHICH HAVE PENETRATED THROUGH THE COVERING PARTICLE, CAN ALSO BE DETECTED!

D.6.d.) IT MUST BE UNDERSTOOD THAT IS NOT COMMON FOR A SMALL DIAMOND TO TRAVEL DOWN A CHUTE RIDING ON TOP OF A LARGER PARTICLE, THE OTHER WAY AROUND HOWEVER IS NOT UNCOMMON AT ALL. THE PROBABILITY OF A LARGE PARTICLE RIDING ON TOP OF A SMALLER ONE INCREASES WITH INCREASING FEED RATE AND INCREASES WITH INCREASING FEED MATERIAL SIZE RANGE.

D.6.e.) IN PRACTICE THIS MEANS THAT FEED MATERIAL SIZING IS NO LONGER OF THE SAME IMPORTANCE AS IT IS WITH CONVENTIONAL X-RAY DIAMOND RECOVERY MACHINES WHICH IRRADIATE THE FEED MATERIAL AND DETECT LIGHT EMITTING PARTICLES IN THE FEED MATERIAL FROM THE SAME SIDE!

D.6.f.) PRACTICAL TESTS WERE CONDUCTED WITH R.O.M. MATERIAL RANGING IN SIZE FROM 2mm UP TO 12mm. THIS MATERIAL HAS BEEN FED THROUGH FLOW ELECTRONICS NEW DIAMOND RECOVERY MACHINE, AT FULL FEED RATE. THE SORTER PRODUCED, IN A SINGLE PASS, (WITHOUT FURTHER SIZING) OUTSTANDING DIAMOND RECOVERY RESULTS.

E.) TO SUMMARIZE: FLOW SORT NEW STATE OF THE ART DIAMOND RECOVERY MACHINES, HAVE MANY ADVANTAGES OVER CONVENTIONAL DIAMOND RECOVERY MACHINES.

WITH ITS ECONOMICAL PRICE TAG (LESS THAN HALF THE PRICE OF A CONVENTIONAL SORTER OF SIMILAR THROUGHPUT!) AND NO REQUIREMENT OF EXPENSIVE AUXILIARY EQUIPMENT IT WILL FIND ITS WAY INTO MANY OF THE SMALLER DIAMOND MINES AND DIAMOND PROSPECTING OPERATIONS AROUND THE WORLD.

IN THESE DIAMOND MINING OPERATIONS FLOW ELECTRONICS NEW X-RAY DIAMOND RECOVERY MACHINES WILL REPLACE OLD RECOVERY METHODS SUCH AS GREASE TABLES AND PANS.

NOT ONLY IS FLOW SORT NEW X-RAY DIAMOND RECOVERY MACHINE FAR SUPERIOR IN DIAMOND RECOVERY EFFICIENCY AS COMPARED TO THESE OLD TECHNIQUES BUT ALSO OFFERS MUCH BETTER SECURITY.

THE OPERATION OF THE SORTER, WHICH ENTAILS NOT MORE THAN SWITCHING THE SORTER ON AND OFF, A SUPERVISORY COMPUTER WITH AUTOMATIC MACHINE PERFORMANCE LOGGING PRINTER AND MACHINE STATUS INDICATION PANEL TAKES CARE OF THE REST.
THE MODULAR DESIGN ALLOWS FOR EASY PART REPLACEMENT BY SEMI SKILLED PERSONNEL WITH MINIMUM DOWN TIME.

THERE IS NO AUXILIARY EQUIPMENT REQUIREMENT FOR THE NEW SORTER, NO COMPRESSOR, NO COMPRESSED AIR FILTER, NO FEED DRYING PLANT, NO SEPARATE X-RAY WATER COOLER, ETC.

ALL THE MACHINE NEEDS TO RUN IS 3 kW ELECTRIC POWER (A PORTABLE 3 kW POWER PLANT IS SUFFICIENT) AND A 15 l/min, 300kPa WATER SUPPLY!

PETER WOLF