head to one end of cylinder; now set the valve so as to cover the port, leaving not more than 1-44th of an inch from the introdnction of steam, when the crank is on its center, and see that the valve stands in the same position; if not, it may be adjusted by the length of connecting cut-off rod, until the valve stands in the same position at each central point When this is done see that the exhaust port is clear, to relieve the cylinder of the steam at the proper time. I have seen engines set up with the valve of a length not to admit of a free exhaust, which caused the engine to work heavy.

Another important point in the arrangement of an engine is the steam feed and exhaust pipes. The rule generally adopted is, to have the exhaust pipe ½ inch larger than the feed pipe, but I find by experience that the exhaust should be 1 inch larger, which will cause the machine to run much freer, causing less strain than when a smaller pipe is used.

Another important point is the setting of the piston packing rings; these should be set very carefully, taking great care that the piston head is exactly in the center of the cylinder, using a pair of calipers in adjusting it.

As regards care and management of an engine, after being put in order according to the above named points, but little work is required, but it must be constantly watched and kept well lubricated in all its parts, the cylinder receiving special care. It should have a lubricator attached to the feed pipe just before it enters the cylinder, emitting two or three drops per minute, according to the load the machine is carrying, and great care must be taken with the packing rings to keep them just tight enough to prevent any leakage of steam, and not tight enough to cause any great friction.

I have found that one good qualification in an engineer is to know enough to let his machine alone when it is working well, and to know when it is doing well. I have known men in charge of machines to be constantly at work at them, and often getting them out of order instead of benefiting them.

Great care should be taken to keep all of the bearings just tight enough to run easy without any slack motion, which causes them to thump or pound at each revolution.

In setting up the keys I find it best to use a soft metal hammer, which will not bruise the end of the key. In using, hit it one blow on the point, which will give it a little back motion, just to give the bearings a free working motion.

It is the custom of many engineers to oil the cylinder three or four times per day with about one gill of oil, but this is not the proper way. A cylinder needs oil the same as any other bearing, in very small quantities and often.

Another important matter is in starting the machine. All drips should be opened and the water drained out, by letting a little steam in to warm up the cylinder before it is started, and then slow for one minute, giving it time to work off all water which has settled in it, getting it well warmed up before running at full speed.

The great point in managemnt is to keep close watch and to know when the machine is not running right; then, if wrong, learn just what the trouble is before any changes are made, as the machine may be injured by not doing the right thing. An engineer should be a good machinist as well as a careful man, possessing good judgement, never doing repairs or making changes until he knows what is necessary to be done. If the above rules are strictly observed, very little repairs will be needed, except in case of breaks, and as to directions about repairs, no mechanic can tell just what to do until he sees just what the break is and determines its cause. Any other plan for repairs would be much like "ideal farming;" practical knowledge is the best.

*Prize article by B. Taylor, in the *Sawmill Gazette*.

Underground Pumping.

The mode of dealing with the large quantity of water often met with in sinking pits has always been a matter of great importance, because of the following obstacles which have to be overcome: First, having constantly to lower the pumps, together with a consequent lengthening of the spears or rods; second, the difficulty of keeping the valves and working barrels in order, in consequence of the quantity of solid matter which is necessarily raised with the water; and third, the difficulty of carrying on sinking work with pumping plant always at the bottom of the pit. A special form of sinking pump, recently designed by Messrs. Bailey & Co., of Salford, is now successfully at work at the Cadeby mine in South Yorkshire, and contends with the above difficulties in a very satisfactory manner. The pumps are hung in the shaft by wire cables from the surface and are easily lowered by means of powerful capstans as the sinking progresses. The special feature of this steam pump is that, instead of having an engine with foundations, connecting rod, quadrant and spears, all liable to wear and tear and mishap, the combined engine and pump is the only thing to be dealt with. Eye-bolts are provided at the top, by which it is suspended from chains or wire ropes, and lowered to follow the falling water. The pump consists of three hollow plungers. The upper pair are stationery, and over them are sliding barrels which are connected to the steam piston. From the lower end of these barrels projects the bottom plunger, working into the third barrel, which is secured by means of connecting rods to the steam cylinder. Thus there are two smaller barrels in connection with the larger ram.

There is a group of valves in the junction between the smaller barrels and the larger ram, constituting the delivery valves; and another group of valves at the bottom of the large barrels, constituting the suction valves. The action of the pump is as follows: As the bottom plunger rises, the water follows it into the lower barrel; at the same time the water in the upper hollow plungers is forced into the rising main. In the down stroke, the water in the lower barrel is forced through the lower plunger and valves into the upper barrels and plungers, and thence into the rising main. Thus there is a continuous delivery in the up and down strokes. One of the upper plungers is open on the top and forms the discharge orifice for the water; and the other is closed, forming an air vessel, which is continuously charged with air through a suitable snifting valve fitted to the side of the pump nearest to that plunger, and below the dischaige valves; this snifting valve permits a small quantity of air to be drawn in with every upstroke of the pump. The steam cylinder is fitted with the Davidson slide valve.

Six of these pumps have been supplied to the Denaby Main Colliery, which will raise 300,000 gallons per hour through 300 feet. Each pump has its own winding drum and steel wire rope, enabling each or all of the pumps to be raised or lowered at will. Two shafts are being sunk to a depth of 600 yards, and four pumps are in one shaft and two in the other. Each pump has a telescopic suction pipe, which enables a depth of nine feet to be sunk without lowering the pump.

The First American Tin Mill.

The Rapid City *Republican*, in a recent issue, gives an interesting description of the Elendale Tin Mining Company's new Tin Mill, the first of its kind established in the United States, and which is now treating the product of the Dakota Tin mines. Our contemporary states that the mill is located on Iron Creek, about 22 miles south-west of Rapid City, at the foot of the mountain on which the mines are situated. The mill proper measures 50 feet in width by 100 feet in depth, and is divided into 3 stories. It is unique in plan, compact and convenient, well built in particulars and protected from all dangers of fire, both by a system of water pipes and by having roofs, etc., covered by a thick asbestos coating. Either steam or water power may be used for running the machinery. The steam equipment consists of two 100 horse power boilers and 100 horse power high speed engine. The water power equipment consists of a flume 20 inches by 24 inches in section, bringing the water from a dam on Iron Creek, a mile and a quarter distant from the mill, giving a head 100 feet pressure at at the wheel. About 500 miner's inches of water are supplied to the Turbine wheel. The water power will be used except during short cold snaps in the winter, the engine being placed in the mill as reserve power in case of accidents. The ore is hoisted from the main shaft and dumped first into an ore bin of 200 tons capacity, located high up the mountain over the hill. From this bin it is conveyed to the mill by a wire rope bucket tramway, the lode going downhill to the mill, hauling the empty buckets back to the mine. The ore buckets mechanically deliver their contents into a 175 ton ore bin, above and back of the mill. The large lumps of ore are crushed, first by a Gates crusher, then passed through a drier to a set of Gates improved cornish rolls, thence elevated to a set of rotary sizing sieves. From the sieves the finer sizes are conveyed to a set of Paradox concentrating tables, and the coarser sizes to common Hartz jigs. The concentrates are, for the present, being shipped to Chicago to be smelted, but it is the intention of the company to erect at once a smelting plant on the hills. Assays and tests from the different workings gave an average of 3 per cent. metallic tin, while picked or specimen rock is often blasted out that will yield over 30 per cent. of the white metal.

An Electric Well Oil Driller.—Wesley Webber, o Pittsburgh, has been granted a patent for a new device for drilling oil wells by electricity. The new invention is a novelty, and if a success will revolutionize the modus operandi of drilling oil wells. The device is intended to supplant the use of heavy tools and do in a scientific way that which has heretofore been accomplished in a crude way. The device, as distinguished from the power in the derrick used at present, is an apparatus comprising a series of motors in tandem, connected to one another so as to practically make one motor. The reason for using the motor in tandem is to get the power within a six-inch diameter, so that the entire mechanism, which, to outward appearances, looks like the common boiler, can be lowered in the well and the power applied direct at the bottom, which is the true place of resistance in "making a hole." Projecting therefrom is a rod which resembles a piston-rod working in and out of the cylinder; upon said rod the drill bits are firmly fastened and the apparatus lowered in the well the usual way. The entire mechanism, with a number of improvements to adapt it to drilling, is about the same as propel the electric street car, and as a number of mechanics and electricians who have seen it say, "there is no reason why the thing won't work."

Uses of Asbestos in the Laboratory. — Asbestos in its various forms is a very useful substance, and can be employed very handily in many ways at the lecture table and in the laboratory, says Professor Markoe. Shredded or carded asbestos will serve as an excellent filtering material, used just the same as paper pulp. Asbestos twine is used in binding together parts of apparatus exposed to fire and strong acids. The professor often prevented a crack in the neck of a retort or flask from spreading by binding it with asbestos yarn or twine soaked in solution of sodium silicate, and then treated with a solution of calcium chloride, a perfectly insoluble cement being thus formed. Asbestos wool mixed with solution of silicate of sodium makes a fire-proof cement of great strength, also serves to mend cracks in stoneware. It can be made insoluble by subsequent treatment with calcium chloride, silicate of cacium being formed. Asbestos paper and card can be obtained of all degrees of thickness, and can be well employed as substitutes for wire gauze and the sand bath in small operations involving the heating of glass vessels. Asbestos paper and silicate of sodium are very useful for mending cracks in glass apparatus.