THE CLEVELAND-CLIFFS IRON CO.
ISHPeming, Mich.

O

MASTER MECHANIC'S REPORT
NOVEMBER 30th, 1901.
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THE CLEVELAND-CLIFFS IRON CO.

Mr. M. M. Duncan, Agent,
Ishpeming, Mich.,

Dear Sir:—

Following is the annual report of your Master Mechanic on the mechanical equipment, work done, repairs and general condition for the year 1901, embracing months from December 1st 1900 to November 30th 1901. I submit herewith monthly summaries of our Engineer's logs, showing the work done by the various plants, fuel and oils used. I will say in this connection that I find the Engineer's logs a very great convenience in accounting for the fuel used.

During the months that show an increase or decrease in fuel, our logs show with almost mathematical accuracy to what cause to ascribe the increase or decrease and the amount.

CLIFF SHAFT MINE.

There has been no change in the equipment at this mine during the past year. The repairs required have not been as heavy on some of the machinery, while on others it has greatly exceeded that of the year previous. Considering the age and condition of the machinery, I think we have been very fortunate at this mine in having had but one shut down of importance, due to failure of machinery.
HOISTING ENGINE.

The hoisting engine is running without any changes as it has been for a number of years past. The gears with cracked hubs are still in service, but the pinion, driving "A" shaft drum, will very shortly have to be replaced as the teeth are beginning to crumble away, due I presume to crystallization from the heavy loads handled on them. The gearing on this hoist has been in use about fourteen years and has handled very heavy loads, so that taken altogether, we should not complain of its giving out now. We had one delay from break down of the hoisting engine, caused by the crank pin breaking at 5:30 P. M. on Wednesday April 3rd, but the pin in giving way, attracted attention in time for the Engineer to shut the engine down without any further damage. This caused the mine to lose five shifts, the engine being started again at 7:00 A. M. April 6th. We have had several crank pins break in various machines during the year, causing great delay and inconvenience, the principal trouble being caused by a piece of poor steel, used in making crank pins but we did not discover the poor quality of this steel until a number of pins had been put in. When this was discovered, we at once ordered some special steel for this purpose since which time we have had no trouble from the pins breaking. I may add that the breaking of the crank pin in the hoisting engine did not entirely stop the mine, though it did stop hoisting, a number of the miners being kept at work.

We have had three cases of delay of from one to four hours due to trouble with the hoisting ropes two of which occurred in "B" shaft and one in "A" shaft, no damage, however, resulting in either case as the safety stops used on both these cages are very effective. We are still handling the same loads as formerly viz,

17500 on "A" Shaft and about 150,000 on "B" Shaft.

these loads being very heavy. This mine gets very good service from the hoisting ropes in use, the present rope being an inch and one-half in. These ropes have been in service since the mine was reopened and are still good for considerable service.
PUMPING ENGINE.

The pumping engine and Cornish pumps have given us very little trouble this year, the only repairs to the engine being a half new gear wheel. The pumps in connection have had but very slight repairs for the year. However, this pump is very badly out of balance as the original design intended the weight of rods in "B" shaft to counterbalance those in "A" shaft but the "B" shaft rods were never run lower than one lift, while the "A" shaft rods have been run to the bottom of the mine thus leaving a load very much heavier in "A" shaft which increased weight has not been counterbalanced. We have, however, ordered the material for the construction of the hydraulic balance, similar to the ones installed at the Moro and Salisbury mines which have proven very satisfactory. The amount of water handled by this pump amounts to almost one million gallons per day, the quantity showing but little variation during the various seas of the quantity also showing about the same as during 1900. Below is a table showing the precipitation by months from Dec. 1900 to Nov. 1901, both inclusive.

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<tbody>
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<td>Dec. 1900</td>
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<td>Nov. 1900</td>
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<td>27.84</td>
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It is noticed the rain fall for the year just past is only about three-fourths the amount for 1900. The past has been a very dry year in this vicinity. We have also been free from heavy rains.

The main gear of the pumping engine is still running with one tooth broken out and replaced with pins. The old cross head is still in service. We are also still using the same metallic piston rod packing, installed on this engine when it was first started.
COMPRESSORS.

The compressors have given us quite a little trouble during the last year, the principal cause of which, however, has been the breaking of crank pins, partly due to the design of the machine, and partly to the use of poor steel for renewing the pins.

As noted in the annual report for 1900, the air pressure was raised to seventy-five pounds until the 1st of July, when we reduced the pressure to seventy pounds. It was thought by the captain that we were using more air at the higher pressure than we were at a somewhat lower pressure. Our logs have not proven this, as there has been a pump, worked by air in the bottom of "A" shaft, taking the air from the winze, and there has also been considerable hoisting from the winze, necessitating the operation of the small puffer with air.

We have had several accidents with the compressors, the first being a broken crank pin on No. 1 compressor, the pin breaking March 8th and replaced and the compressor put in operation again March 6th. On July 25th the crank pin broke on the right hand side of the No. 1 compressor, causing a general smash up, as the crank on its next revolution, caught on the end of the connecting rod, bending the rod and key, breaking the strap gib and brasses and driving the air piston down against the cylinder head with such force as to break one of the foundation feet from the cylinder and also the lug on top of cylinder which held the tie rod between the steam and air cylinders. Both pistons were also driven on to their rods and the piston rod was also driven into the cross head. These called for such extensive repairs that they were not completed for six days, the compressor being able to run again at noon on July 31st. On October 4th the piston rod broke on the right hand side of the No. 2 machine, necessitating the making of a complete new rod, and owing to the very poor lathe for doing this very long work, this was not repaired until October 14th, a stop of ten days. I may add that these accidents to one side of one of these compressors does not disable the entire machine as we simply disconnect the disabled side and run the side which is all right so that we have three-fourths the capacity that we ordinarily have. I do not anticipate as much trouble the coming year from broken crank pins as we have had in the past, owing to the use of better steel and to the
fact that the pins put in from poor steel have about all been replaced.

The total amount of air made at this mine runs approximately 27,250,000 cu. ft. of air per month. This amount of air, however, is not all used for drilling as it is customary at this mine to run one compressor from six to seven in the evening and from six to seven in the morning at about its maximum speed, maintaining about twenty pounds air pressure for blowing out smoke from some close stopes.

These compressors are a nuisance to steam as ever but we are still hoping to some day be able to replace them with a more economical type of machine.

**CLIFF SHAFT CRUSHER PLANT.**

The crusher plant is running about as it was last year with the exception of new shafts. We have returned to the use of Manganese steel jaw and face plates and are now getting Manganese plates that give us excellent service; the first set installed have not worn out. The Manganese side liners run about two years without renewal. In March the Hodge crusher broke a shaft, necessitating the making of a complete new shaft. At that time, however, we had orders in the mill for two rough forgings for crack shafts, one for either crusher which arrived later and were finished in our own shops. The eccentricity of the shaft in the Holly crusher was changed to five-eighths of an inch instead of three-fourths, thereby reducing the throw to one and one-fourth where it had been previously one and one-half. Since this shaft was installed we have had almost no trouble at all with this crusher blocking with fine ore or dirt, or wearing out of the babbitt so that now we have almost no trouble at all with this machine. One of the greatest troubles with these crushers is from the chunks of ore so large that they do not drop into the jaws far enough for the crusher to get hold of them, so that it is often necessary to lift these chunks out again and sledge them up.
It would certainly save a great deal of sledged and probably a considerable expense at this mine if there was a larger crusher installed so that a great deal of the sledged and block holing could be dispensed with. At noon Wednesday, July 31st, fire started on the crusher floor and was soon burning fiercely. All the siding on the crusher house above this floor, as well as the roof burned almost entirely off so that it all had to be replaced, while the frame of the building was also considerably charred and damaged. Our belts were all destroyed and the babbitt melted out of some of the bearings on the shaft, but the crushers were but little injured. If it had not been for the fire pump and hose at this mine which is always ready for immediate service, this building would undoubtedly have burned to the ground, completely destroying the plant as there is considerable oil about the timbers below the crushers and the pressure from the city mains was not sufficient to throw water up to the floor on which the fire started. Notwithstanding the damage done to belts and buildings, by the energetic action on the part of our carpenters and the fortunate securing of new belts, we were able to start this plant almost as good as new on Monday morning, August 5th, thus losing but six and one-half shifts. We think it is a matter of congratulation that we came out so fortunate as we did. The cause of this fire could not be definitely determined but it is presumed it was from spontaneous combustion in the cupboard where the boiler kept his supplies. The operating cost of this plant usually runs from four to four and one-half cents while the maintenance cost is from one to two cents per ton and this, in view of the fact that we are ordinarily crushing from 17,000 to 20,000 tons per month. In view of the performance of the Michigamme crusher plant and to the small tonnage handled there it would appear that reorganization of this plant with the view of saving in labor would be profitable.

**CLIFF SHAFT AUXILIARIES.**

There has been no change in the auxiliary service in this mine during the past year with the exception of the installation of the
of steam
Webster Vacuum System Heating. This was started in February, since which
time we have used only exhaust steam from the No. 1 compressor for all
our heating, except during noon hour and from Saturday evening until
Monday morning when the mine is idle. This has undoubtedly saved us
considerable fuel and we think will continue to do so as long as we work
this mine, as the system works very satisfactorily aside from some poor pipe
which we got in hold of, has given us little trouble.

We are still using the same old engine in the shop and the
same pair of double 8 x 10 engines for pulling the cars back to the shaft
houses. During February of last year, the small double engine in "A"
shaft house was not looked after by the watchman one Sunday night when
the weather was very cold with the result that the engine filled with water
froze and burst both steam chests. As the steam chest, cylinder and
frame of this engine is in one piece, we did not care to go to the
expense of replacing it, but by means of very heavy bolts and chunks,
were able to pull the cracks together so that the engine is still in
service. We were not able to entirely stop the leaks.

The 8 x 10 Russell automatic engine, driving the arc light
dynamo runs with very little trouble but the dynamo gives us some
trouble occasionally from the burning of the armature connections, owing
not to the peculiar manner in which the commutator is on these machines.
This machine received one complete armature during the past year.

BOILER PLANT.

The boilers are still in service as they have been for the
last number of years and we fortunately have had little repairs on them,
during the year, excepting on boilers six and seven. In this connection
I wish to submit the reports and some correspondence from the Hartford
Steam Boiler Inspection and Insurance Company in relation to these boilers.
In the report of 1899 as well as that of 1900 your Master Mechanic took
occasion to call attention to the age and condition of these boilers,
and from the Hartford reports it is evident that we may not be able much longer to carry our present pressures on these boilers. I may add that it is under protest of the Hartford people that they permit us to carry the pressure which we now carry and from conversation with their chief inspector, I would not be surprised if they refused to give us insurance on them much longer.

EXTRACT FROM REPORT BY INSPECTOR W. T. GODFREY, HARTFORD COMPANY, GIVING INSPECTION 28th OF APRIL TO 27th OF MAY, 1901.

Eight Boilers. Cliff Shaft Mine.

No. 1, 2, 4, 5, 7, 8. Internally:— There is no excessive incrustation of scale and the care and management of these boilers is excellent, but all in this battery are now getting very old and are structurally weak for the pressure now carried, considering work, required and the manner in which they are forced, and we think it advisable to make preparations to install new boilers of higher efficiency, as it is only a matter of a short time until we will be compelled to reduce the pressure. The breeches are sound and tight. Openings to outside attachments are clear.

Externally:— Patch on fire sheet of No. 7 is cracked and leaking some; this requires attention. Heads and flanges show no serious defects. Although some of the tubes are getting very thin, there is no leakage noted. Furnace wall of No. 1 and 4 are in bad repair. Rear tube arch of No. 1 requires attention. Attachments in good order.

Nos. 3 and 6. Externally:— Boilers are in good condition as far as seen and all attachments in good working order. Safety valve free and loaded to 80 pounds; steam gauge correct, pressure observed 80 pounds.

Yours truly,

HARTFORD STEAM BOILER INSPECTION CO.

Signed H. H. Lemon, Manager.

Internally:— The flat surfaces of these hog-nose, tubular boilers in this house are becoming warped; this is being caused by an excessive hard scale which has been there for years and which it is almost impossible to remove. Therefore, the plates do not get proper protection from heat and are getting thin. These boilers are getting very old and are structurally weak for any pressure exceeding 80 pounds. The safety valves are now blowing at 85 pounds which is five pounds in excess of stipulated pressure and must be set back without delay. Boilers at this age should have pressure reduced and it is very dangerous to increase any amount. We have no doubt that three 28' x 72' boilers, H. T. type, constructed for 125 pounds pressure, will give far better results than the present battery and the saving in fuel alone would pay for the change in a few years. Steps should be taken for the improvement of this plant in the near future. Otherwise the pressure on the present boilers will have to be greatly reduced.

The attachments of these boilers are all in good working order.

Yours truly,

Hartford Steam Boiler Inspectors Co.

Signed H. H. Lemon, Manager.

From the above reports it is evident that the Hartford people will not much longer give us insurance on these boilers. I may add in this connection, that to reduce the pressure at this mine, will not only greatly reduce the economy of the engine, but it will also make it almost impossible for the machines to do their work.

The steam pipe at this plant is in very poor condition, a great many of the joints leaking badly but we cannot repair a part of this without danger of destroying the adjoining parts. This piping
This piping should all be renewed but as it will cost from $600 to $1800 your Master Mechanic does not wish to advise the expenditure, if there is any prospect of changing our power or installing new boilers until some decision is reached in relation to the above, we will try to make the old steam piping hold together.

SALISBURY MINE.

This plant is running without any change from the condition in which it was left when erected at its present location in 1899.

BOISTING ENGINE.

The engine handling the skip is in the same condition as last year. The present 18" x 48" cylinder is too small to handle the loaded skip in the present shaft, owing to the numerous turns and angles in the rope. When this engine was located at the old shaft, it would handle the present skips, loaded, at 60 pounds steam pressure very easily, the engine having comparatively early cut off; on the present incline shaft with the many angle shives, this engine will not cut off to exceed one-half the time with 90 pounds steam pressure though the shaft is on an incline of 52 degrees.

This shaft is also very expensive in the wear of ropes as the best record we have had in it was from a band lay, six strand, nineteen wire Roebling rope which ran two hundred eighty-three days. We have had ropes give out in this shaft in six weeks' time. This may not be altogether the fault of the shaft, but a very great proportion of it, probably, is chargeable to the many small angle shives necessary. If this shaft was vertical from the shaft house down, until it intersects the incline part of the shaft, I believe we could hoist more economically and I do not believe we would have so much difficulty with our ropes. If there
are to be no changes in our power, I would at least advise the changing of the present cylinder for a larger one.

The engine, running the cage gives very satisfactory service as the load is light and we would not suggest any changes in this machine at present.

CORNISH PUMP.

This is an 18" x 60" Allis Corliss engine which has been in service at this mine for a number of years. The pump is 14" diameter by 8 ft. stroke. The concrete foundation, placed under this pump when it was erected in its present location was unfortunately divided into five parts where it should have been two. The main part of the foundation should have been one monolith but was unfortunately divided by ear paper into three large, concrete blocks. This gave us considerable trouble during the early part of the year as the foundation sat on clay and as the mine had been increased in depth, longer rods were added to the bottom and as it had not been properly balanced, the pull on the crank when these rods were coming up was very heavy, probably near seventy-five tons. This excessive strain caused these blocks to tilt and work from the ground up, throwing considerable strain on the connections and excessive strain on the bed plate of the engine. During July we started work on the foundation with the view to repairing same if possible but while this work was in progress, one Sunday morning the frame of the pump cracked from the bottom almost to the top. We could not stop this pump to make repairs, so removed a brace from the Neco engine which is a duplicate and put it on with a heavy bend with two inch bolts with railroad iron across the ends and pulled these up as tight as we could possibly get them. In addition to this original plan of repairs, carried out which consisted of cutting notches three feet long into the foundation
across the vertical cracks or parting planes into which we set a three foot section of sixty pound rail, wedging it tightly with steel wedges, filling the surrounding space with cement mortar and allowing it to set about twelve hours. Two rails were inserted across each crack in such a way that it would be necessary for the foundation to crumble away or shear the rails in two before the separate parts could move. These repairs have left this foundation apparently as rigid as it would ever have been, had it been in one piece and we do not anticipate any further trouble.

A great deal of the strain was taken off the connections and the pump put in very fair balance by the installation of the hydraulic balance which consists simply of an ordinary pole without valves with a longer run of pipe, extended up the shaft to give a sufficient head of water on the pole to secure the desired balance. This construction runs with practically no attention and is a great deal cheaper to install than it would be to install a balance bob with the necessary blasting in the shaft and delay the hoisting. This hydraulic balance has proven very satisfactory both here and at the Moro and as stated before we will shortly install one on the cliff shaft pump.

The auxiliary pumping plant has proven very satisfactory in taking care of any surplus water, thus keeping it out of the mine. For this reason, we have seldom run this pump at any considerable speed during the entire year.

AIR COMPRESSOR.

The air compressor at this mine has had some repairs during the year, consisting principally of two new crank pins, a new cross head pin, new crank and cross head brasses, new strap gib and key and new brass shoe on the cross head. This machine has worked very hard it having but 16" x 50" air cylinder. It makes an average of about 15,000,000 cu. ft. of free air per month which is considerable less than it was required to do last year, which we suppose is due to the use
of air for ventilation, being more carefully looked after. This is a matter which has tended to regulate itself as they have been sinking a new shaft and drifting in rock most of the year, necessitating the use of rock drills which would not have been possible with the low air pressure, carried last year. The average air pressure is now about fifty-four pounds which will do fairly good work with the rock drill but not as efficient work as the machines could do. In addition to the use of air for ventilation and the small amount of drilling, we have been operating a No. 5 Cameron pump, together with small hoist for sinking the shaft and also run a small puffer in the shaft house for pulling in the tram car from the stock piles.

The reduction in the amount of air used at the Salisbury Mine is an indication of what may be accomplished by the shift bosses and mining captain in cutting down the amount of air blown away when it is absolutely necessary that it be done. We had informed the mining captain that if they wish to keep the pressure up, they must not blow the air away; and when the amount used for ventilation became so great that we could not maintain the pressure, the Engineers were instructed to slow the compressor down, thus allowing the pressure to fall until nothing could be done with air when the shift bosses would immediately find the place that was blowing air too freely and close it off and the pressure could then be maintained fairly slow for a considerable time.

**BOILER PLANT.**

There has been no changes in the boiler plant or steam pipe and we are still using the 34" x 18 ft. Reynolds hydraulic boilers together with the 16' x 60" horizontal tubular boiler, removed from the old engine house three years ago. We carry 90 pounds on these boilers and should have at least 110 if we are to continue the use of our present...