

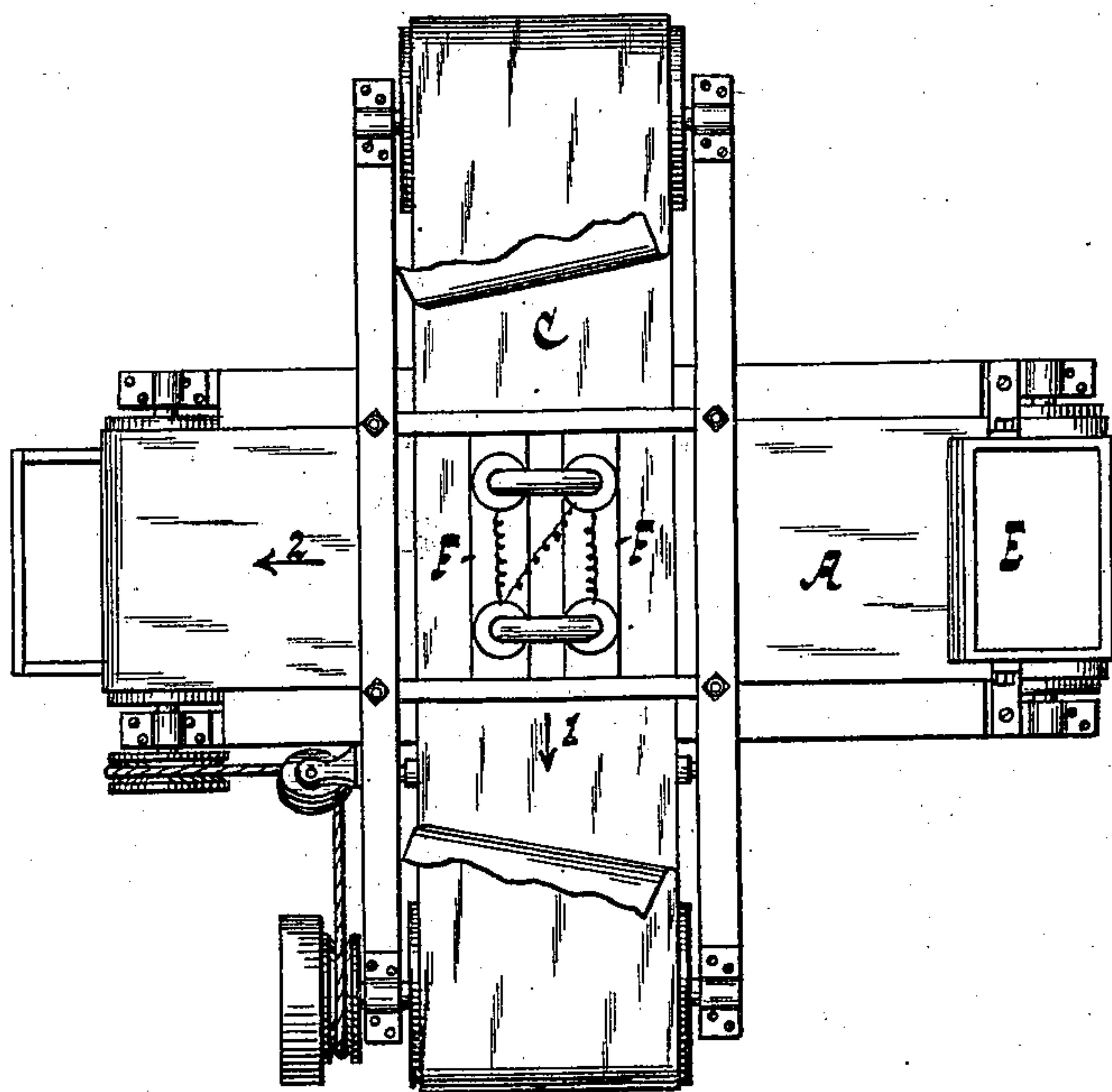
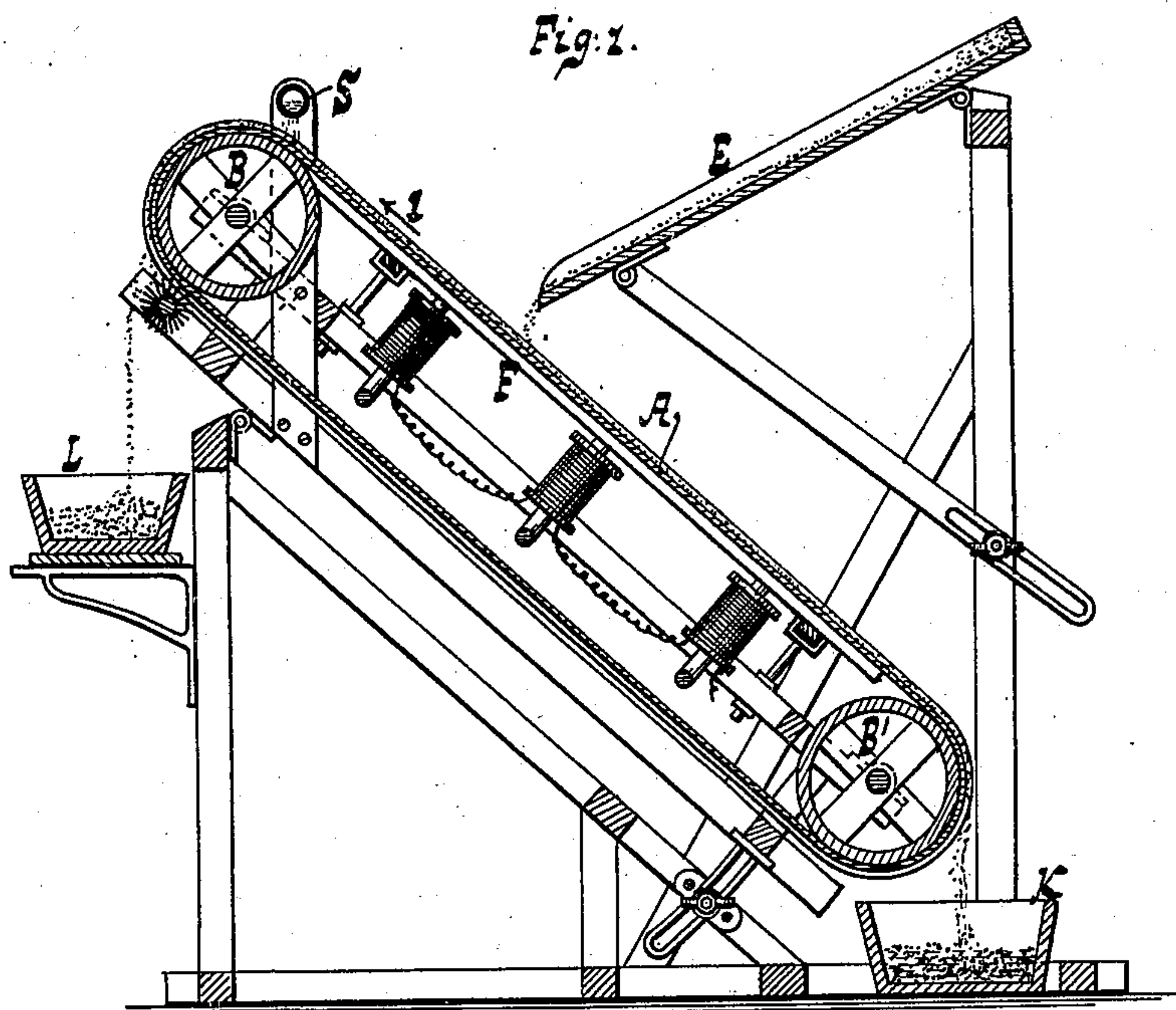
(No Model.)

G. CONKLING.

ART OF CONCENTRATING MAGNETIC IRON ORE.

No. 504,200.

Patented Aug. 29, 1893.



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# UNITED STATES PATENT OFFICE.

GURDON CONKLING, OF GLENS FALLS, NEW YORK.

## ART OF CONCENTRATING MAGNETIC IRON ORES.

SPECIFICATION forming part of Letters Patent No. 504,200, dated August 29, 1893.

Application filed September 30, 1891. Serial No. 407,289. (No specimens.)

*To all whom it may concern:*

Be it known that I, GURDON CONKLING, a citizen of the United States, residing at Glens Falls, in the county of Warren and State of New York, have invented new and useful Improvements in the Art of Concentrating Magnetic Iron Ores, of which the following is a specification.

My invention relates to that method of concentration in which magnetic attraction is employed as the agency for separating the iron from the gangue and the object of my improvement is the attainment of a high degree of purity in the concentrated product in an economical manner.

The apparatus which may be used in carrying out my invention is illustrated in the accompanying drawings in which—

Figure 1 represents a longitudinal vertical section of a magnetic separator to be used when the crushed ore is in a wet state. Fig. 2 is a plan or top view of a magnetic separator to be used when the mass to be concentrated is in a dry state.

Two general methods of concentration have heretofore been employed in treating magnetic iron ores in one of which, known as the wet process, the ore is crushed and then concentrated in a wet state, while in the other, known as the dry process, the ore is crushed in a dry state and then concentrated while dry. By neither of these processes is it possible to obtain a substantially pure product containing say from seventy to seventy-two per cent. of metallic iron without a wasteful loss of ore.

In the crushing to which the ore has to be subjected to prepare it for concentration, a part of the rock or gangue is broken into small particles while a considerable proportion of it is reduced to a fine powder or dust.

In the process of concentrating the ore in the wet state while the gangue dust is washed away, the small particles of gangue tend to cling to the particles of ore and in order to remove such particles of gangue, the ore must be subjected to so many repeated washings and concentrations, that a large quantity of ore will be carried away with the gangue, so that while a concentrate containing say from fifty to sixty per cent. of metallic iron may be profitably obtained by this wet process, such pro-

cess cannot be carried much beyond this point without too wasteful loss of ore; it cannot therefore be profitably employed to bring magnetic iron ores containing phosphorus within the Bessemer steel limits.

An additional disadvantage of the wet process is found in the fact that in cold weather or in cold climates the wet concentrate when placed on a car or vehicle for transportation is liable to freeze into a solid mass and in this state it is refused by the furnace man. In the dry process, on the other hand, an almost prohibitory item of expense is found in the wear and tear of belts and machinery and injury to the health of operatives caused by the great quantity of floating dust due to the crushing, screening and concentrating of the mass in the dry state and at the same time a very considerable percentage of iron in the shape of excessively fine particles is carried away with the gangue dust into the dust collectors. When applied to ores containing iron pyrites or sulphuret of iron, the dry process is inadequate to the production of a substantially pure concentrate, since the degree of heat necessarily applied for drying the mass volatilizes a portion of the contained sulphur and thus renders the sulphuret magnetic, so that it is taken out by the magnets with the iron and remains in the concentrate as an impurity.

By means of my invention I obviate the disadvantage incident to both the wet and the dry process and am enabled to obtain a substantially pure concentrate containing from seventy to seventy-two per cent. of metallic iron without any material loss of ore.

To this end my invention consists in first comminuting the ore in the presence of water, then exposing the comminuted ore while being carried in a stream of water to the action of magnets and continuously removing the magnetic particles which have been attracted by the magnets from the magnetic field, while the non-magnetic particles are carried away by the water, then drying the magnetic particles and exposing the dried particles to the action of magnets.

In carrying my invention into effect, I first crush the ore in a damp or wet state, which may be done as the ore comes from the mine or from the dump or waste pile, to such a size



as may be most desirable according to the nature of the ore to economically break apart the particles of iron and rock or gangue. The crushed mass is then concentrated by means of magnets in the presence of a sufficient quantity of water to wash the ore thoroughly and as far as practicable float apart and separate the particles of ore from those of rock or gangue and other waste matter. I prefer to apply the water in the shape of a running stream caused to pass over and through the mass while the same is being subjected to the magnetic attraction. This concentration should be continued only so far as it may be done without removing any material proportion of the ore with the gangue. By this means all the fine non-magnetic dust and a large proportion of the small particles of non-magnetic matter will be removed from the mass which will be reduced in bulk from fifty to seventy-five per cent. Substantially all the magnetic material originally present in the crushed mass will be found in the concentrate which will contain from fifty to sixty per cent. of metallic iron entirely free from gangue dust. In carrying out this part of my process, I may use with advantage such an apparatus as is shown in Fig. 1 of the drawings, in which A designates an endless belt which extends over rollers B B' and is placed in an inclined position. F is a magnet which is situated in the interior of the belt close to its upper branch. E is a trough over which the crushed ore, mixed with water, is fed to the belt A and S is a spray pipe for washing the particles of ore which are attracted by the magnets. The belt A moves in the direction of arrow 1 and the particles which are attracted by the magnet are carried by the belt over the pulley B and they are collected in the receiver L. The particles which are not attracted by the magnet, are carried by the stream of water over the pulley B' and are collected in the receiver K. The concentrate produced as above described will still contain a considerable percentage of small particles of nonmagnetic matter which will cling to the particles of ore while wet. In order to remove these nonmagnetic particles, I next thoroughly dry the mass, thereby causing the clinging particles of ore and rock to fall apart. This drying operation is greatly facilitated by the reduction in the bulk of the mass effected by the preceding partial concentration and, furthermore, the drying can be effected at such a low temperature, that in treating ores containing

sulphurets of iron no sulphur is volatilized, thus leaving the sulphurets in their non-magnetic state. After the mass has been dried, I complete the concentration by subjecting it while still in the dry state to the action of magnets thereby separating from the ore such impurities as were left associated with it at the conclusion of the wet treatment.

Owing to the removal of the gangue dust, during the wet treatment very little if any dust is raised during the subsequent steps of drying and concentrating, thus avoiding the difficulties incident thereto in the dry process.

In carrying the dry concentration into effect, I may use the apparatus shown in Fig. 2 of the drawings in which A represents the main belt and C the secondary belt which extends at right angles over the main belt A and in the interior of which close to its lower branch are situated the magnets F.

The mass to be separated is fed to the main belt A through the hopper E and the magnetic particles which are attracted by the magnets F are carried away by the belt C in the direction of arrow 1, while the gangue which remains on the belt A, is carried away in the direction of arrow 2.

It may be remarked as a matter of commercial advantage that it may at times be economical to carry on the wet part of my process at the mine and then to transport the partially concentrated wet product to the furnace and utilize the waste furnace heat for the drying required and prior to the completion of the process.

What I claim as new, and desire to secure by Letters Patent, is—

The herein described process of concentrating magnetic iron ore which consists in first comminuting the ore in the presence of water, then exposing the comminuted ore while being carried in a stream of water to the action of magnets and continuously removing the magnetic particles which have been attracted by the magnets from the magnetic field while the non-magnetic particles are carried away by the water, then drying the magnetic particles and finally exposing the dried particles to the action of magnets.

In testimony whereof I have hereunto set my hand in the presence of two subscribing witnesses.

GURDON CONKLING.

Witnesses:

WM. C. HAUFF,  
E. F. KASTENHUBER.