(No Model.)

3 Sheets—Sheet 1.

C. B. BEACH.

ROLLING MILL.

No. 370,520. Patented Sept. 27, 1887.

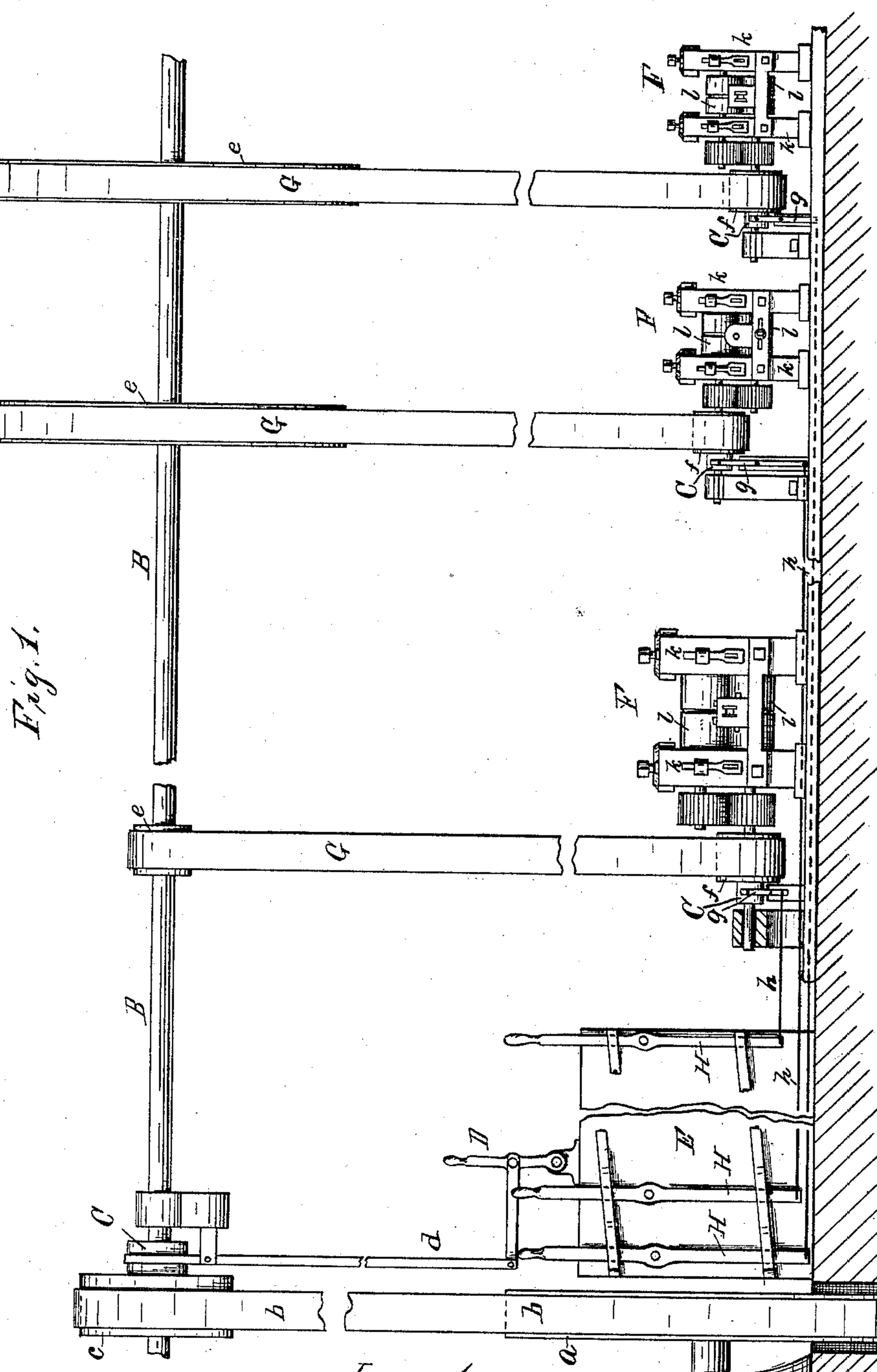

Fig. 1.

Attest:

C. B. Nash.

J. D. Fay

Inventor:

C. B. Beach

By Thos. B. Hall Jr.

Atty.

(No Model.)

3 Sheets—Sheet 2.

C. B. BEACH.

ROLLING MILL.

No. 370,520.

Patented Sept. 27, 1887.

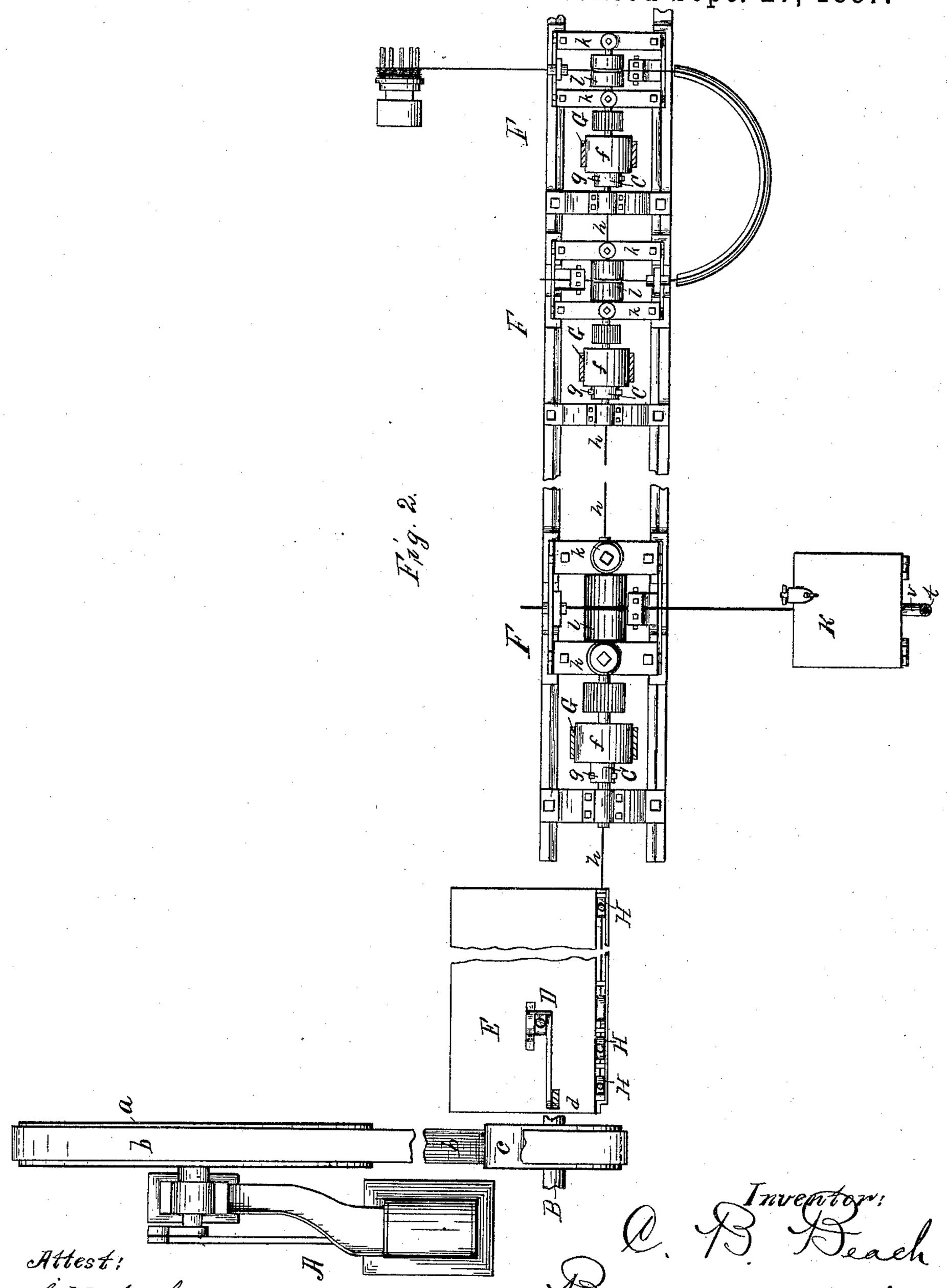

Fig. 2.

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(No Model.) 3 Sheets—Sheet 3.

C. B. BEACH.

ROLLING MILL.

No. 370,520. Patented Sept. 27, 1887.

Fig. 5

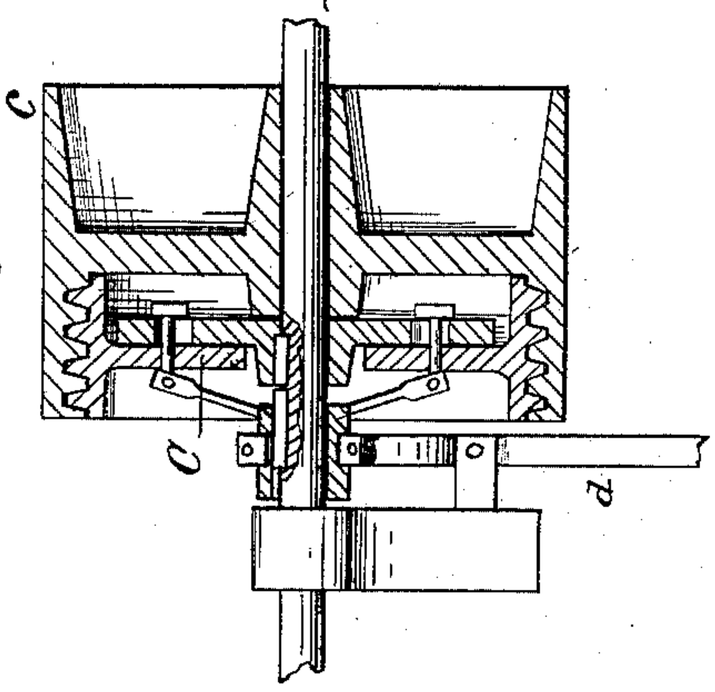


Fig. 4

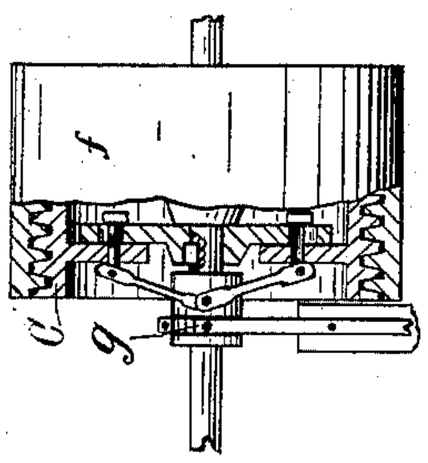


Fig. 6.

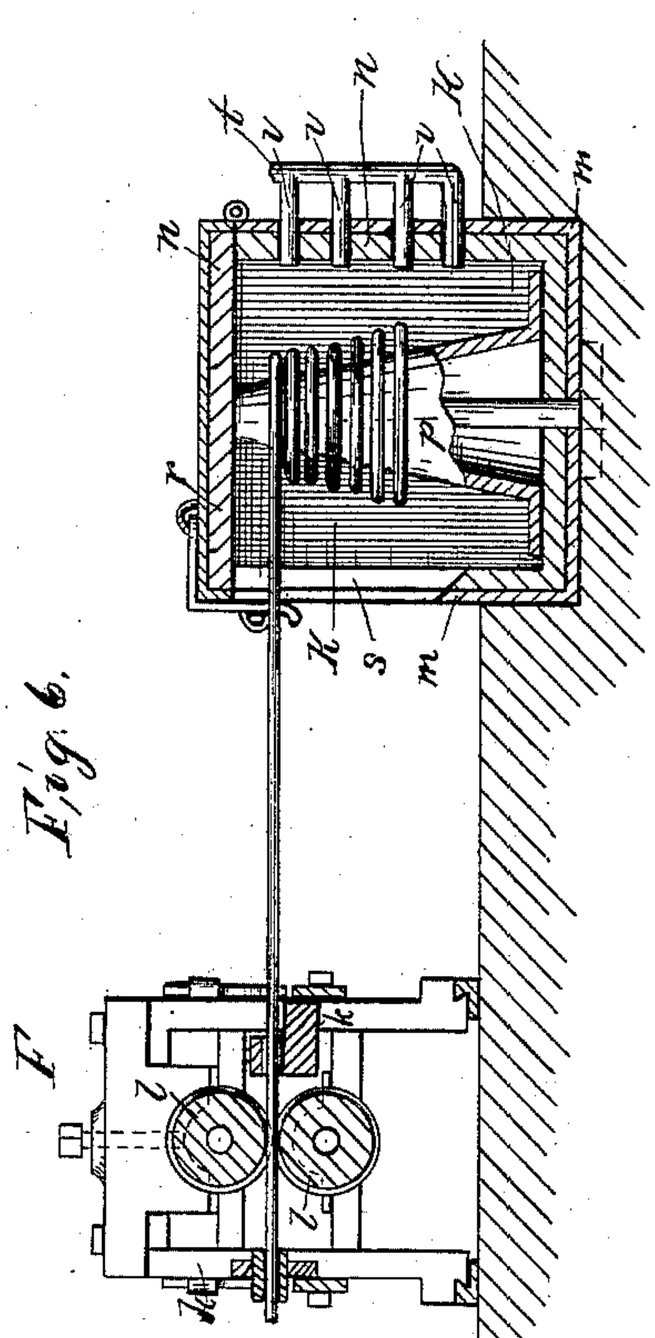
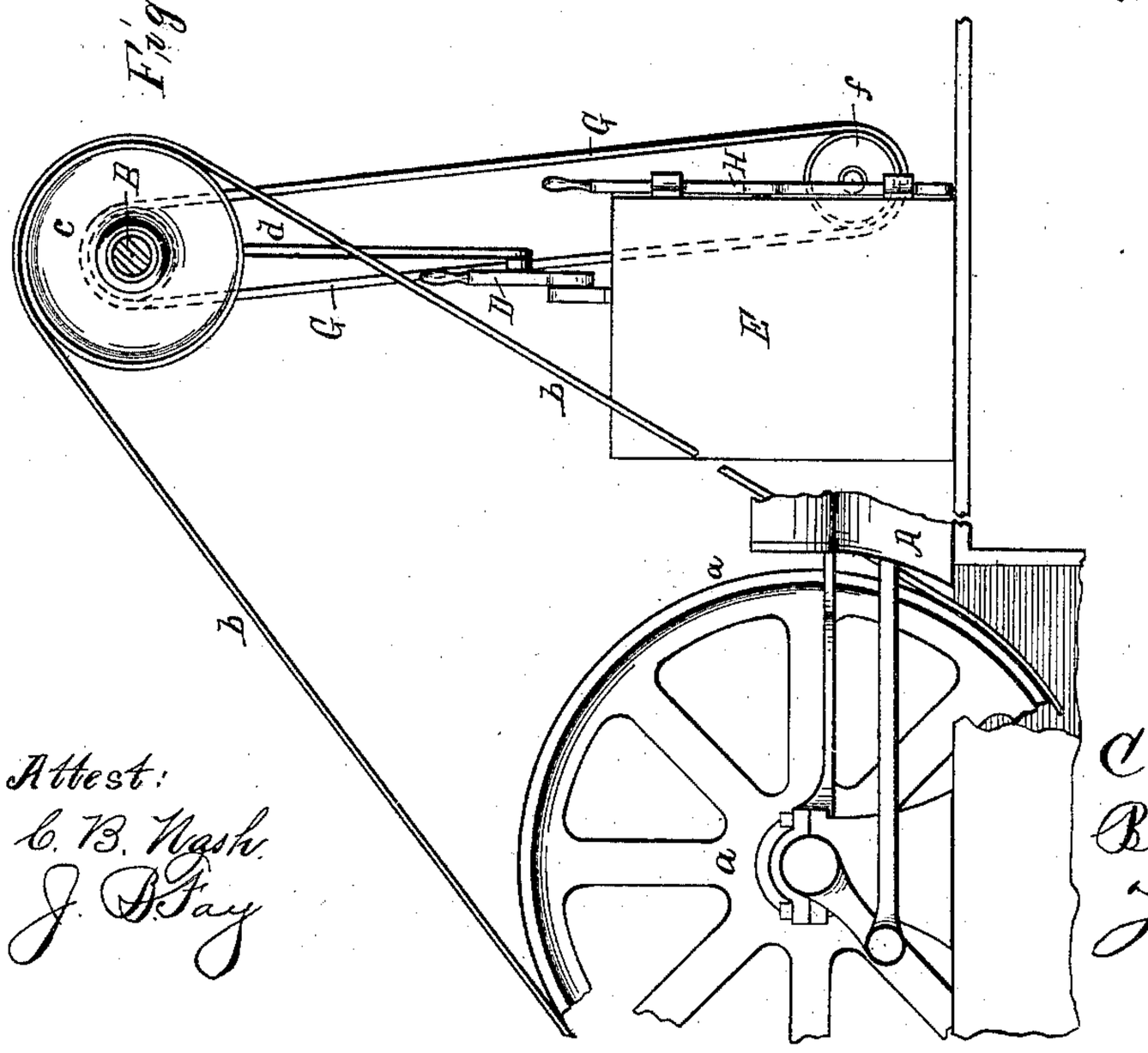


Fig. 3



Attest:
C. B. Nash.
J. B. Fay

Inventor:
C. B. Beach
By
Thos. D. Hall
Atty.

UNITED STATES PATENT OFFICE.

CLIFTON B. BEACH, OF CLEVELAND, OHIO.

ROLLING-MILL.

SPECIFICATION forming part of Letters Patent No. 370,520, dated September 27, 1887.

Application filed March 12, 1887. Serial No. 230,591. (No model.)

To all whom it may concern:

Be it known that I, CLIFTON B. BEACH, a citizen of the United States, residing at Cleveland, county of Cuyahoga, and State of Ohio, have invented certain new and useful Improvements in Rolling-Mills; and I do hereby declare the following to be a description of the same, and of the manner of constructing and using the invention, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it appertains to construct and use the same, reference being had to the accompanying drawings, forming a part of the specification, the principle of the invention being herein explained and the best mode in which I have contemplated applying that principle, so as to distinguish it from other inventions.

Although my invention relates, broadly, to rolling-mills, yet it has especial reference to a rod-mill. It constitutes a step in a line of improvements in rolling metal set forth in certain applications for United States Letters Patent filed by me. The first application which I have in mind in the above statement is an application filed by me April 6, 1887, and bearing the Serial No. 233,926. Another application is one filed by me June 2, 1886, and bearing the Serial No. 203,927. A third one is an application filed by me October 2, 1886, and bearing the Serial No. 215,131. A fourth one is an application filed by me April 6, 1887, and bearing the Serial No. 233,581. I have filed several other applications for United States Patents on rolling-mills; but I think that the four above referred to are the only ones which need be mentioned in this connection. I should, however, also refer to an application filed by John McIlvried October 29, 1886, and bearing Serial No. 217,539, this latter application being assigned by said McIlvried unto myself, being a detail improvement upon the form of apparatus shown in my said application No. 203,927, filed June 2, 1886.

The object of the improvements constituting the subject-matter of this present application is to increase, with economy in the use of fuel and the hands employed, the output of a mill, and also to produce small wire rods of great length and uniformity of gage and finish.

In the operation of this mill I prefer to use a small billet in cross-section, preferably one not over five-eighths of an inch square. This billet may be a coil-billet weighing from one hundred to two thousand pounds. The finishing-rolls are small rolls running at a very high speed. Each stand of rolls is run at an independent speed, which may be accelerated at the will of the operator during the operation of rolling. The entire mill is adapted to have its speed also, as a whole, accelerated or diminished at the will of the operator during the operation of rolling independent of the driving-engine. This feature of controlling the speed of running of the entire train of rolls without reference to the initial driving-power is the prominent point of this invention. The advantages incident thereto, and which constitute its value, will appear hereinafter.

Referring now to the drawings, I desire it to be understood that the same are intended to represent one form of apparatus for carrying out the principle of my invention, said form being shown without reference to points of mechanical construction, working proportion of parts, or like detail features, which can best be supplied by the individual mechanic who may construct any one mill.

Figure 1 is a view in side elevation of a portion of a rod-mill. Fig. 2 is a plan of the same. Fig. 3 is a detail view, in front end elevation, of the driving apparatus. Fig. 4 is a detail view, part section and part elevation, of the clutch connected with each one of the stands of rolls. Fig. 5 is a similar view to the last, showing the clutch connected with the main overhead driving-shaft. Fig. 6 is a detail view, part vertical section and part elevation, of the heat-retaining chamber and its adjacent stand of rolls.

The engine A has its band-wheel *a* connecting by belt *b* with the pulley *c*. Said pulley is loosely fitted on the main overhead driving-shaft B, being adapted at will of the operator to be made fast with said shaft by the clutch C, the operating-lever *d* of said clutch being connected with hand-lever D, located at the elevated stand E. By this means the operator standing on his elevated station may control the speed of rotation of said main driving-shaft B without reference to the speed of the initial power of the mill. The form of clutch C is in duplicate of the form set forth in the said assigned application of McIlvried, hereinbefore referred to. This form is herein shown,

because it is at the present time my preferred form; but it is evident that any other clutch may be used in substitution therefor adapted to accomplish the same purpose. The stands of rolls shown in the drawings represent severally the first stand of rolls and the last two stands of rolls in a train. Each of the several stands of rolls F is connected by an independent belt, G, to its appropiate pulleys *e*, said pulleys *e* all being fast on the overhead driving-shaft B. The connection of these belts G with their respective stands of rolls is by a clutch apparatus in duplicate of the clutch shown in connection with the loose pulley heretofore referred to on the overhead driving-shaft, the lever *g* of each roll-clutch being connected by a link, *h*, with a vertical hand-lever, H, located at the elevated station E, whereby any one stand of rolls may have its speed increased or diminished independently of the other rolls and also of the initial driving-power during the running of the mill by throwing the appropriate roll-clutch in or out of engagement with the appropriate pulley *f*.

The housings *k* of the different stands of rolls are made much smaller and lighter than those usually employed in rod-mills. This is permissible because of the fact that the stands of rolls are not coupled together, but, on the contrary, each stand of rolls being a separate and independent rolling-machine, and accurately constructed and adjusted with a view to running at a high speed and using only sufficient horse-power to perform its own individual work, this independency of operation resulting necessarily in a strain upon each stand of rolls incident to the work of said stand. The rolls *l* of the several stands are only about half as long between the housings as in ordinary rod-rolls, and they have their one end, respectively, provided with longer necks on which to carry the pinion, or pinion and pulley, as the case may be. These rolls are made of wrought-steel tempered, and have unusually small necks in proportion to their diameters. The several pulleys *e* on the overhead driving-shaft are graduated in diameter, progressively increasing from the head of the train to the finishing end. This gradation in the diameter of the said pulleys *e* is not made for the purpose of preventing the growing of the loops between the roll-passes, although if the relation of diameters be carefully determined this latter result will in a measure be attained; but the object thereof is to be able to transmit to the rolls toward the finishing end without the intervention of gears a very high rate of speed while the main driving-shaft is running at a moderate speed. The relative size of the main driving-shaft pulleys should be determined with a view to giving to the rolls a higher rate of speed than is ever to be employed, thereby permitting of using up the rolls as they wear and are refitted for use at the expense of their diameter. This point is of advantage peculiarly incident to the method of rolling by stands of rolls running independently of one another, inasmuch as the diameter of the roll is immaterial, providing only that the rolls be of small diameter for finishing.

In front of the first stand of rolls I locate my heat-retaining chamber K. Said chamber is constructed of plate or cast iron, *m*, for its outer wall, and provided with an interior lining, *n*, of fire-brick or other refractory substance.

Within the chamber is centrally located an upright conical drum, *p*, said drum being adapted to rotate about its vertical axis as the coiled billet placed thereon is uncoiled in the rolling of the same. This chamber is provided with a lid, *r*, constructed similarly to the body of the chamber, and the side of the chamber facing the said first stand of rolls is provided with a feeding-opening, *s*. The chamber is provided with a gas-pipe, *t*, having a series of jet-orifices, *v*, communicating with the interior of said chamber.

In my said application No. 233,926, filed April 6, 1887, I have set forth as a new article in metal-rolling a coiled billet. I therein, also, have pointed out the advantages of having a billet in coil form, and inasmuch as such a coil-billet is a feature essential to the attainment of the highest and best result in my system of rod-making I will, in illustrating the operation of my present mill, take this coil-billet as it comes from the reel and follow it through to the finish in this mill. If it is practicable the said coil-billets should go at once from the reels to the reheating-furnace in order to save all initial heat possible. I will assume that the furnace is thus charged with the said coil-billets of extraordinary weight, respectively, formed of metal pieces of great length. Upon the starting of the engine which actuates the mill the main pulley upon the overhead driving-shaft, together with the respective stand-pulleys, are loose, and the mill is at rest. The first thing to be done, and which is a matter which shall have been ascertained and determined beforehand, is to set the mill—that is to say, each set of rolls should be so connected, by means of their respective clutches, with their respective driving-belts that the speed of each succeeding stand of rolls will be adapted to cause the latter to accurately take up the work of the immediately-preceding stand, thereby substantially preventing the growing of the loop upon the floor. This is the sense in which I employ the term "set," in stating that the first thing is to set the mill. The mill having been set, the main pulley *c* is thrown into clutch sufficiently with the main driving-shaft B, so as to revolve the latter at a comparatively slow rate of speed. The mill is now in operation. A coil-billet having been brought down from the furnace and placed upon the rotary drum in the heat-retaining chamber, its loose end is passed out through the feeding-opening and stuck into the first pass, the cover of the heat-retaining chamber having been first secured in closed position before the rolling com-

mences. The heat-retaining chamber is well heated by lighting the gas of the jet-orifices *v* before placing the coil-billet within the same, and the chamber is maintained at a suitable temperature by said gas-jets during the operation of rolling the entire billet. The ordinary automatic repeater may be employed between passes, if desired. Suffice it to say that the rod is doubled and stuck into the several passes and is now being delivered. If the mill is properly set, it will be found that the loops between passes keep close to the train and do not perceptibly grow upon the floor. At this stage of operation the main pulley *c* on the overhead driving-shaft should by its clutch be gradually and closely engaged to said shaft B. The result will be the quick but gradual speeding of the entire mill, while at the same time the relative speed of the different stands of rolls will be maintained. The mill should now be run at a very high speed—a speed, in fact, whose only limit is the endurance of the necks and brasses of the rolls. The loops must, too, be closely watched by the operator, and the several roll-clutches here and there be more tightly engaged or released with their respective pulleys *f* as the exigencies of each case may require. The importance and value of the coil-billet and the heat-retaining chamber will now be appreciated. The coil-billet, being in such a compact form, would without the heat-retaining chamber keep its rolling-heat for several minutes, but with it a rolling-heat can be maintained indefinitely. The mill should continue to run at the highest possible speed until the coil-billet is about exhausted. Then it should be slowed down by gradually releasing the main pulley *c* in its clutching engagement with the overhead driving-shaft B. Another coil-billet should now be in readiness to be immediately placed in the heat-retaining chamber, and the foregoing operation is repeated. The only provision which I have made for taking care of the rod produced is to cut it on the floor and reel it in as many strands as desired.

With respect to the production of small rods, I would call attention to certain facts. It is with difficulty and varying success, as heretofore practiced, that a No. 6 rod can be produced from a four-inch square in cross-section billet, though such a rod can be produced from a one-inch square in cross-section billet weighing from forty to fifty pounds. The reason is apparent—to wit, the loss of rolling-heat by the chilling of the rod while lying in long loops upon the floor; and the heavier—that is to say, the larger—the billet is in cross-section the longer, in ordinary practice, will be these loops which expose the metal to loss of heat by radiation. An illustration is important, to wit: In the rolling of a hundred-pound four-inch-square in cross-section billet by a mill having eight stands of rolls there will be from five hundred to seven hundred feet of metal aggregated in the respective loops running exposed upon the floor of the mill, while by my method in rolling a coil-billet of one hundred pounds or two thousand pounds there should be not more than ten feet of loop between any two passes. Moreover, in the first-cited instance the metal is only traveling at a speed incident to the rate of five hundred revolutions of the rolls per minute, while by my method the metal may travel many times such speed, and as metal does not materially chill while being rolled, and as a given point of the coil-billet will pass from the first stand of rolls to the last stand of rolls in a few seconds of time, this, too, under most favorable conditions, I am enabled to roll a No. 10 rod without difficulty and without material reduction in tonnage.

Another important and valuable result obtainable by use of the coil-billet and the heat-retaining chamber is the following: It will require a period of several minutes to roll off a heavy coil-billet, and one gang of men can conveniently run two trains by my method with less labor than has heretofore been involved in running one train by the old method. A further advantage is that the liability to make scrap and cobbles is largely in favor of my method said favor being, say, as one to five, or one to twenty, according to the weight of the coil-billet used. So, also, when not actually engaged in rolling, my mill may be instantly stopped, and remain at rest until rolling is resumed, the engine in the meantime maintaining its speed, or being slowed down or stopped, as may be desired. The entire train is subject to the will of the operator on the elevated station E, and from this position he has full view of the rolling-field and entire command of the size of the loops after the metal is once in all the passes. By skillful adjustment of the different hand-levers subject to his control at his station this managing operator can maintain the different loops of metal practically at a constant and uniform size. He can also speed up or slow down the entire train at his will and subject to his discretion during the operation of running the mill independently of the engine. By this latter feature—to wit, the adjustment of the speed of the entire train of rolls independent of the speed of the initial driving-power—this managing operator can instantaneously increase or diminish the working capacity of the mill per minute without changing the set of the mill. The relative working capacities per minute of the different stands of rolls in the train being thus preserved and maintained, while coincident therewith the mill may be slowed down for a period of time sufficient for a new piece of metal to be introduced into the different passes, and thereafter instantaneously speeded up to a very high rate of speed, enables me to throw off a quantity of work from the mill largely in excess of what would otherwise be possible.

Certain features of invention shown in this application do not constitute a part of the

latter, inasmuch as said features of invention form the subject-matter of the several other applications of mine for United States patents now pending, hereinbefore referred to, respectively, application Serial No. 203,926, filed April 6, 1887; application Serial No. 203,927, filed June 2, 1886; application Serial No. 215,131, filed October 2, 1886; application Serial No. 233,581, filed April 6, 1887; and hence all the claims upon said features of invention are rested in said other applications.

As heretofore intimated, the form of mill shown in the drawings and the method of operation described in this specification constitute but an illustration of the principle of this invention. Other forms of embodying and using the invention may therefore be substituted for this specific form, provided, only, the principles of invention respectively set forth in the following claims are retained and employed.

I therefore particularly point out and distinctly claim as my invention—

1. In a metal-rolling mill, the combination, with a train of rolls, a driving-shaft in common for the different stands of said train, and intermediate driving means between the latter and said shaft, of initial driving mechanism and a device which puts the latter in or out of engagement with said common driving-shaft, substantially as set forth.

2. In a metal-rolling mill, the combination, with a train of rolls and a driving-shaft in common for the different stands of rolls in said train, said common driving-shaft and stands of rolls being connected together, of an engine, intermediate connection between the latter and said common driving-shaft, and mechanism which throws said common driving-shaft in and out of engagement with said engine-connection, substantially as set forth.

3. In a metal-rolling mill, the combination, with a train of rolls, a driving-shaft in common to the latter and intermediate connection between said shaft and stands of rolls, of an engine, intermediate connection between the latter and said common driving-shaft, and a clutch which controls the engagement between said common driving-shaft and the engine-connection therewith, substantially as set forth.

4. In a metal-rolling mill, the combination, with a series of independent stands of rolls, a driving-shaft in common to the latter, and independent belts respectively connecting said common driving-shaft with the respective stands of rolls, of mechanism which rotates said common driving-shaft, and a device which controls the engagement of said shaft-rotating mechanism with said shaft, substantially as set forth.

5. In a metal-rolling mill, the combination, with a series of independent stands of rolls, a driving-shaft in common to the latter, and independent belts respectively connecting said shaft with the different stands of rolls, said parts being provided with independent speed-adjusting devices, of an engine, a main pulley on said driving-shaft, belt-connection between said engine and said shaft-pulley, and a clutch which connects said pulley with its shaft, substantially as set forth.

6. In a metal-rolling mill, the combination, with a series of independent stands of rolls, a driving-shaft in common to the latter, and independent speed-adjusting connections between said shaft and stands of rolls, of initial driving mechanism for said common train-driving shaft, and speed-adjusting connection between the two latter parts, all said speed-adjusting connections being provided with respective operating parts located together at a common stand of operation, substantially as set forth.

In testimony that I claim the foregoing to be my invention I have hereunto set my hand this 7th day of March, A. D. 1887.

CLIFTON B. BEACH.

Witnesses:
J. B. FAY,
C. B. NASH.