No. 856,044. PATENTED JUNE 4, 1907.

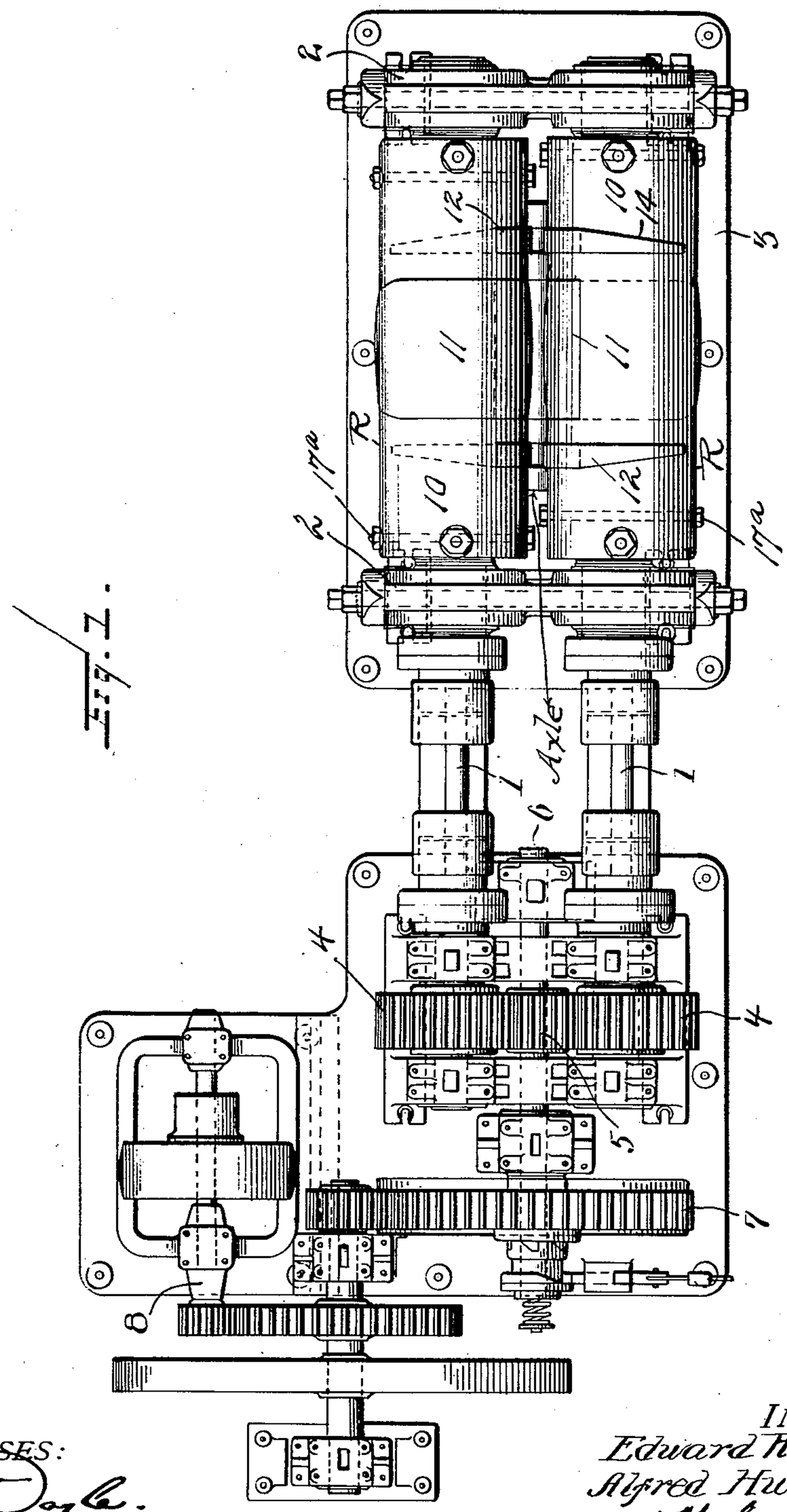
E. R. FELLOWS & A. HUBBARD.

ROLLING MILL.

APPLICATION FILED NOV. 14, 1905.

3 SHEETS—SHEET 1.

Fig. 1.



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3 SHEETS—SHEET 2.

Fig. 2.

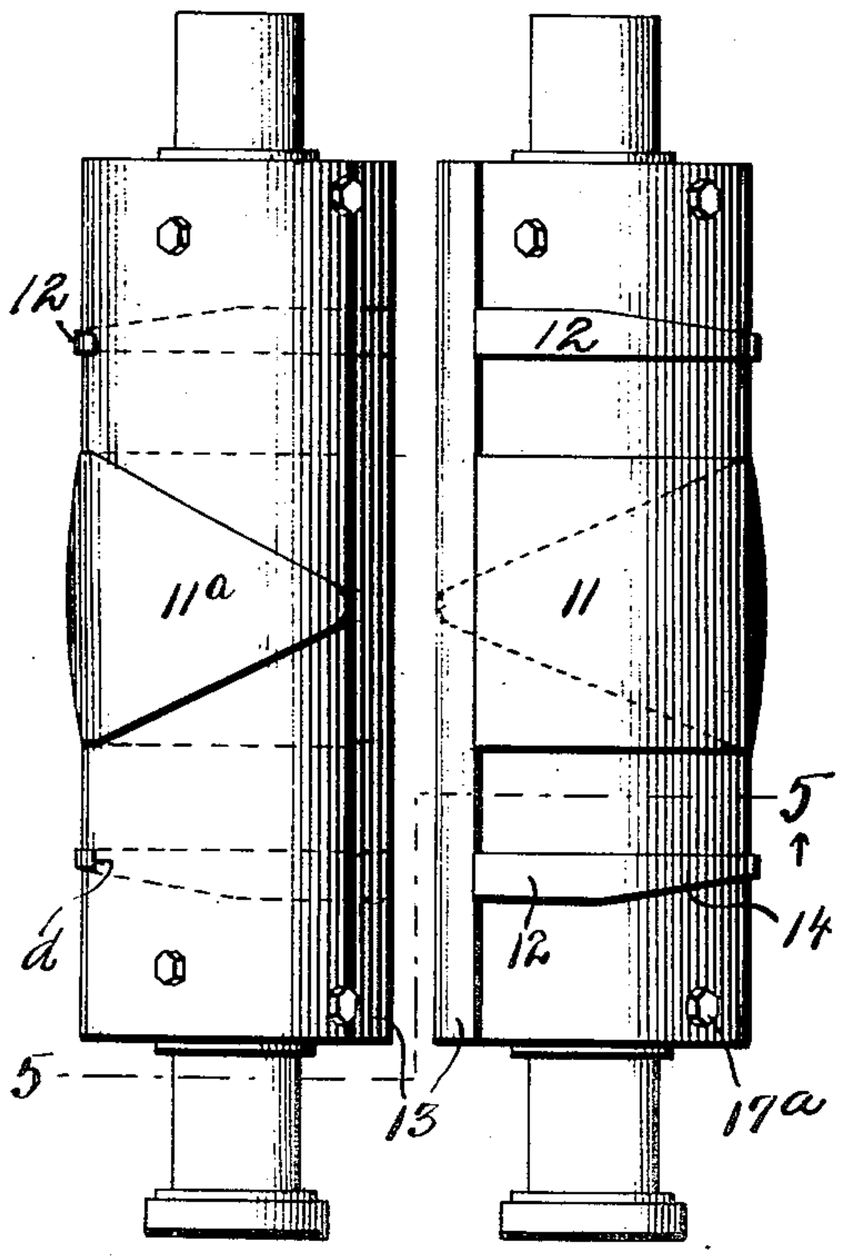


Fig. 4.

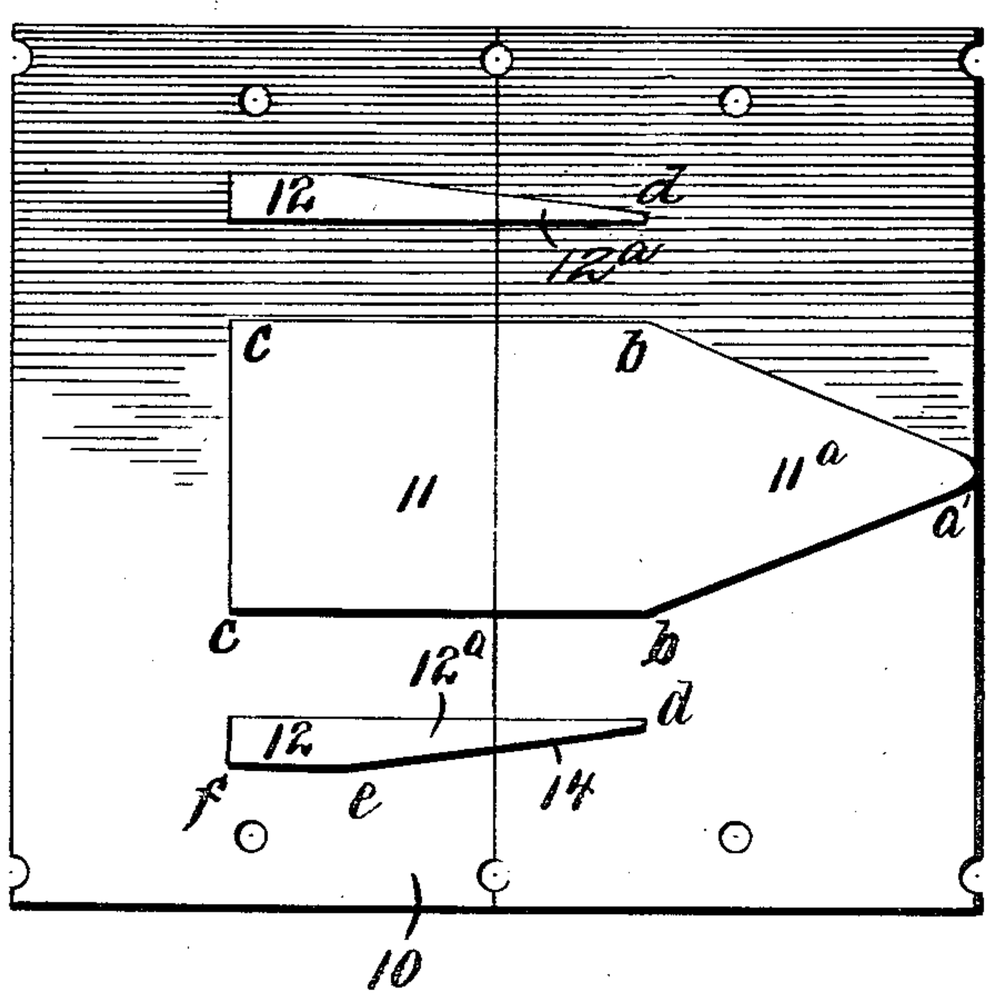
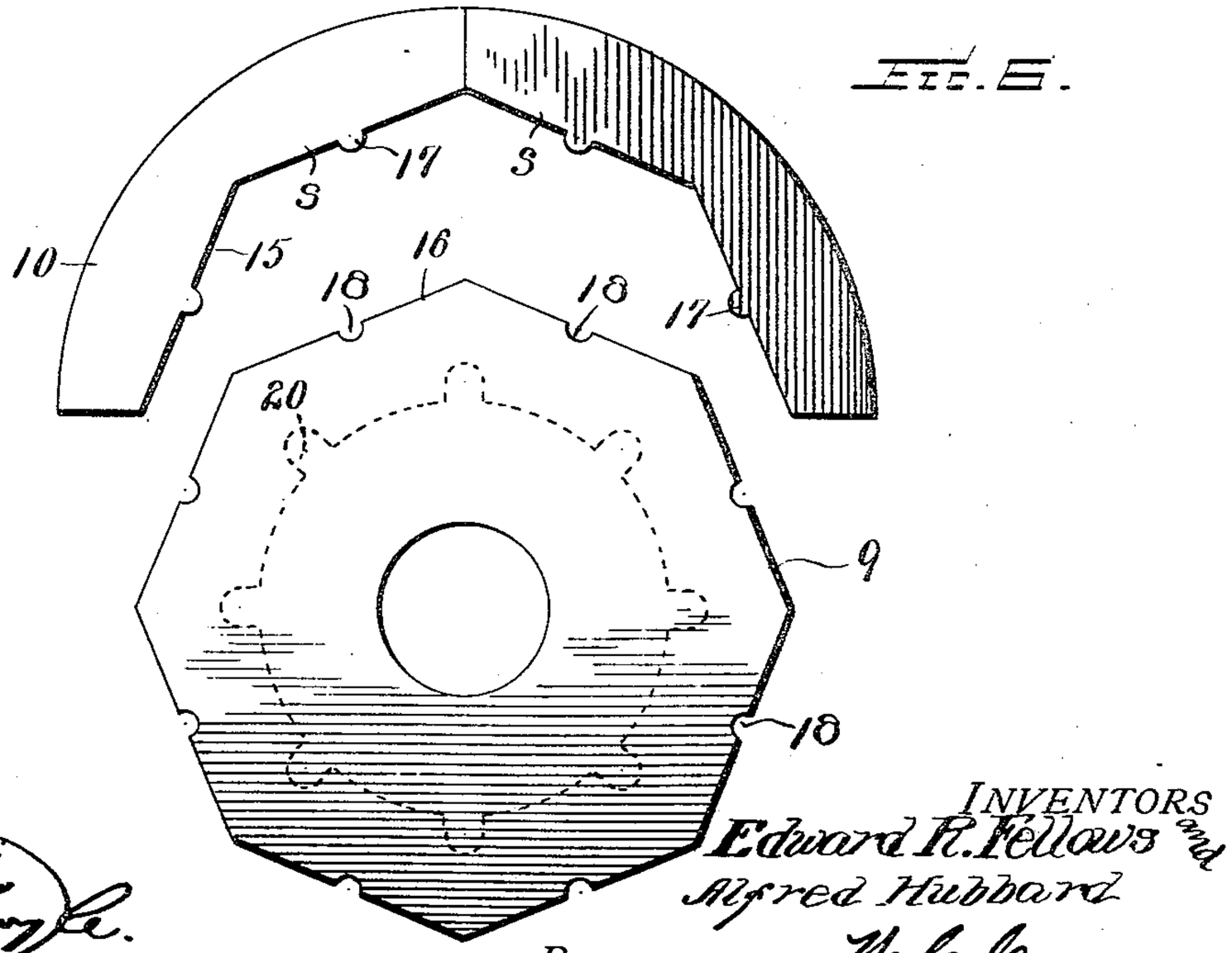


Fig. 5.



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3 SHEETS—SHEET 3.

Fig. 2.

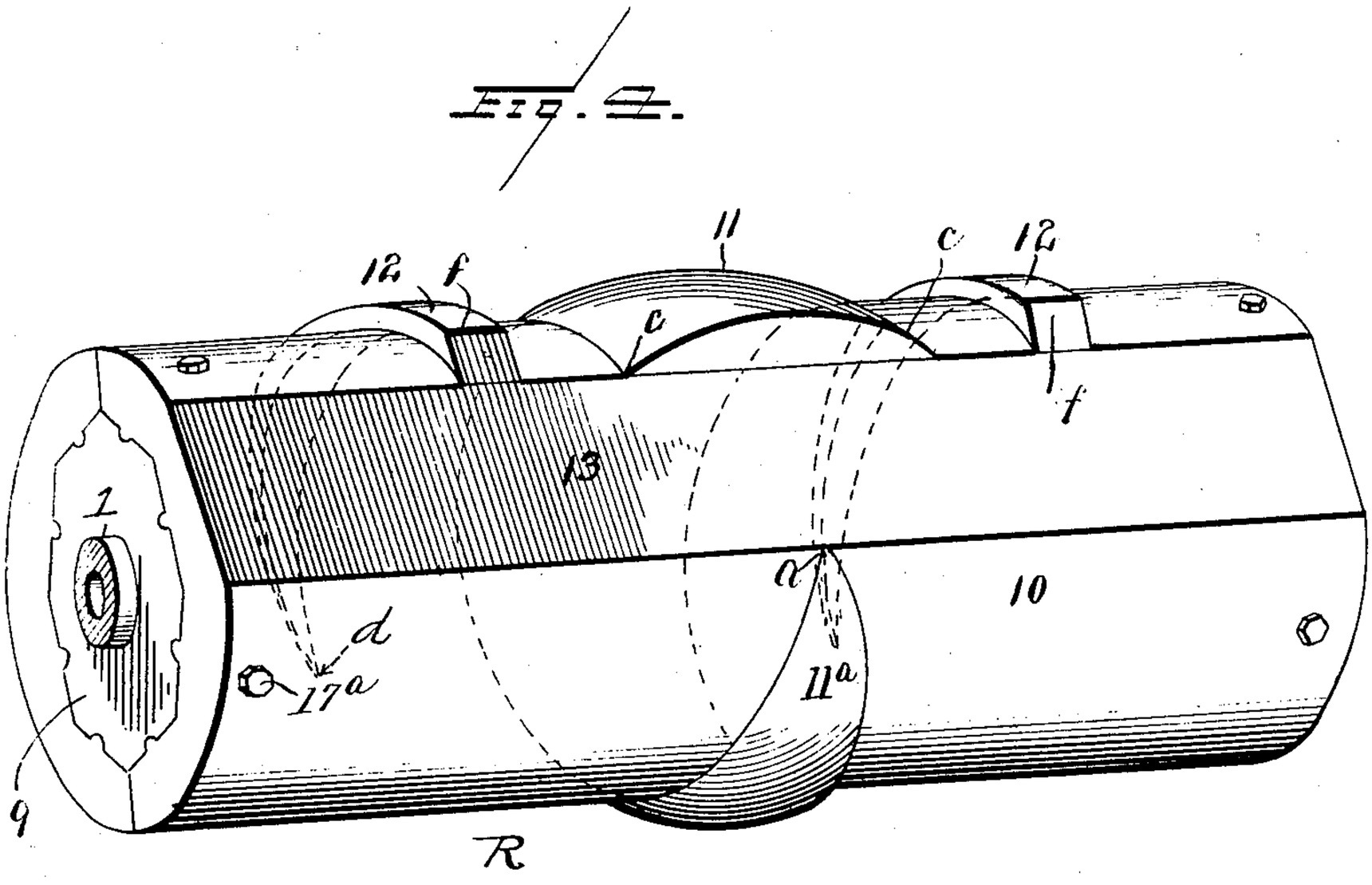
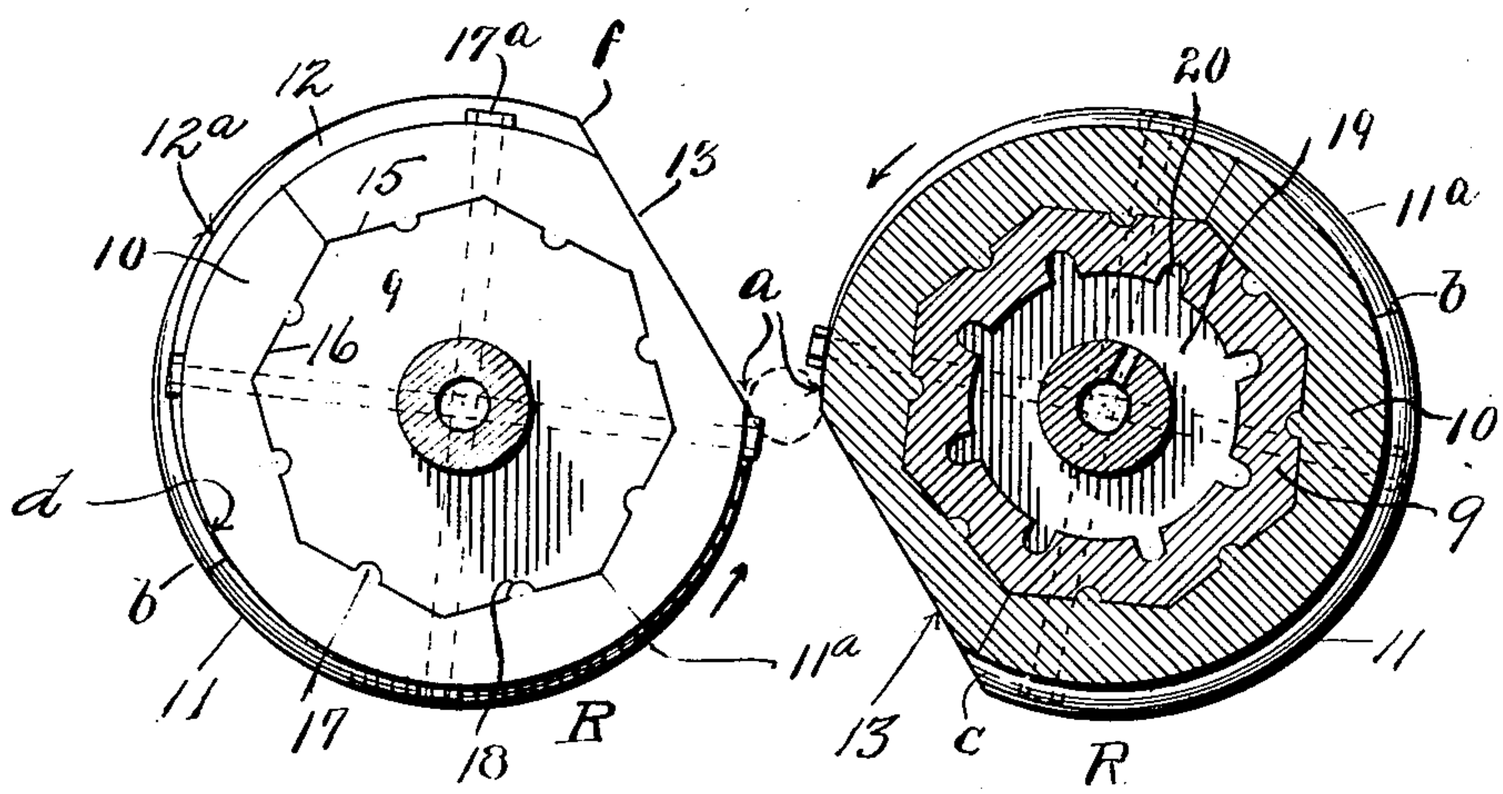


Fig. 5.



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UNITED STATES PATENT OFFICE.

EDWARD R. FELLOWS AND ALFRED HUBBARD, OF YOUNGSTOWN, OHIO.

ROLLING-MILL.

No. 856,044. Specification of Letters Patent. Patented June 4, 1907.

Application filed November 14, 1905. Serial No. 287,298.

To all whom it may concern:

Be it known that we, EDWARD R. FELLOWS and ALFRED HUBBARD, citizens of the United States, and residing at Youngstown, in the county of Mahoning and State of Ohio, have invented certain new and useful Improvements in Rolling-Mills, of which the following is a specification.

This invention relates to that type of rolling mills designed specially for rolling a car axle into the desired shape from a heated blank or billet.

To this end the invention has in view a novel construction of rolling die presenting a die formation which secures a true rolling process or action by constantly compressing and reducing the metal toward the center, and embodying means whereby the spreading action of the metal is effected entirely by compressing and reducing the blank throughout the entire length or portion upon which the die is being operated. In this connection, the improved die possesses special utility in a car axle mill structure, inasmuch as said die, by its rolling process or action, gradually and uniformly compresses the metal throughout the entire operation of spreading or elongation.

With these and other objects in view, which will more readily appear as the nature of the invention is better understood, the same consists in the novel construction, combination and arrangement of parts hereinafter more fully described, illustrated and claimed.

The essential features of the invention involved in carrying out the general object above indicated are necessarily susceptible to structural change without departing from the scope of the invention, but a preferred embodiment thereof is shown in the accompanying drawings, in which:

Figure 1 is a general plan view of a complete car axle mill embodying the present invention; Fig. 2 is a plan view of the complemental rolls; Fig. 3 is a plane projection of one of the rolling dies; Fig. 4 is a perspective view of one of the rolls; Fig. 5 is a cross sectional view on the line 5—5 of Fig. 2. Fig. 6 is a detail end view of a roll body and section of a detachable rolling die.

Like references designate corresponding parts in the several figures of the drawings.

In adapting the invention to a car axle mill, the dies are so shaped and related as to provide means for, first, subjecting the central portion of the axle blank to a rolling compression while the ends of the blank are entirely relieved from any compression and therefore free to expand longitudinally, hence, permitting the blank or billet to expand longitudinally toward both ends as the metal is displaced in the operation of reducing the center; and, then, placing the ends under rolling compression to form the journals when the maximum compression is reached on the central portion of the axle blank or billet. In this connection, it is also the purpose of the invention to provide, through the medium of the dies, means for maintaining or holding the central portion of the blank under a uniform or constant compression during the reduction of the ends and the formation of the journal portions. The preferable embodiment of the invention for securing this rolling action is shown in the drawings and consists primarily in the employment of a pair of revoluble die carrying rolls, each of which is designated in its entirety by the reference character R. These rolls are shown arranged side by side in the same horizontal plane to permit of the convenient handling of the finished and unfinished axle blanks, and the same are rotated at a uniform speed and in the same direction, whereby their contiguous opposing surfaces move in opposite directions. Any suitable means for mounting and operating the rolls may be resorted to without affecting the invention, but for illustrative purposes there is shown in Fig. 1 of the drawings a complete mill embodying rolls constructed in accordance with the present invention, and comprising means for rotating the same at the proper speed and in the proper direction. As illustrated in this figure of the drawings, the opposite rolls are shown mounted on the parallel roll shafts 1 journaled in suitable bearings and supported within the end housings or stands 2 arranged at the ends of the rolls and surmounting a suitable base 3. Also the roll shafts 1 are equipped at one end with the gears 4 meshing with an intermediate pinion 5 common to both of the roll shafts and the gears therefor, which pinion is carried by a counter-shaft 6 also carrying a spur wheel 7 suitably geared with a motor shaft 8. In connection with these instrumentalities any suitable starting and stopping mechanism may be employed to provide for temporarily arresting the action of the rolls when the axle blank has been completely reduced, and to

start the same again upon the introduction of a new blank or billet.

An important feature of the invention resides in the form and disposition of the reducing and spreading die elements carried by the complemental or matching rolls R. Each of these rolls primarily consists of a roll body 9 rigidly secured to the shaft 1 therefor and carrying thereon a cylindrical rolling die designated in its entirety by the reference numeral 10. Irrespective of the method employed for securing the rolling die 10 to the roll body 9, the same includes, as the active members or parts thereof, a central die element or projection 11, and the oppositely located end die elements or projections 12 arranged respectively at opposite sides of the central die element or projection and disposed in spaced relation thereto. These die elements 11 and 12 consist of elevated portions or lands raised above the surface or face of the die body so as to exert a reducing and spreading action on the axle blank or billet during the rolling operation. Referring particularly to the shape and disposition of these die elements or lands 11 and 12, it is to be observed, in the first place, that the cylindrical rolling die 10 is provided with a blank or mutilated section 13 extending lengthwise from end to end thereof and occupying a small segment of the cylindrical body to provide for the convenient introduction and removal of the axle blank, as may be best seen from Fig. 5 of the drawings. With relation to this blank section 13 of the die or roll, the central die projection or land 11 extends circumferentially about the central portion of the die or roll for the full distance of the active portion of the rolling die; that is, the starting point *a* of said central die projection or land commences at one side of the blank section 13 of the die, and the ending terminal or point *c* is arranged to terminate at the opposite side of the said blank portion 13. The circumferential extent of this central die projection or land is sufficient to impart the necessary number of turns to the axle blank or billet to accomplish the complete reduction and spreading of the metal within the central portion of the blank or billet by the time the same has been rolled between the complemental die projections or lands 11 of the adjacent rolls, from their starting points *a* to their intermediate points *b*. It is to be further noted that the central die element or land 11 is not of uniform width and projection throughout. For approximately one-half its extent the said element or land is eccentric to the roll and die body from which it projects; that is from the starting point *a* to an intermediate point *b*, the same is of a progressively tapering projection from the die body, commencing practically flush with the surface of the die body and increasing in thickness or projection until the maximum projection is reached at the intermediate point *b*. Also, from the point *a* to the intermediate point *b* the eccentric portion (11^a) of the die element or land 11 is of a flaring width, thus producing a divergent or wedge-shaped die portion, which subserves the function not only of reducing the central portion of the axle blank, but also simultaneously spreading the metal longitudinally toward the ends of the blank.

From the intermediate point *b* to the ending terminal *c* the die element or land 11 is of uniform width and projection.

As already indicated the end die elements or lands 12 are arranged at opposite sides of the central die element or land 11, and the best results are believed to be obtained by having the starting points *d* of the end elements 12 begin in a longitudinal plane on the roll which intersects the central die element at the point *b* where it reaches its greatest width and projection. Furthermore, the said end die elements or lands 12 are preferably co-extensive in length with the uniform portion *b*—*c* of the central die element 11 and the inner edges of the end die elements are arranged parallel with the adjacent outer edges of the central die element or land.

The end die projections or lands 12, for a portion of their extent, are formed with eccentric portions 12^a which are progressively tapering projections, that is, starting substantially flush with the surface of the die at *d* and progressively increasing in projection to an intermediate point *e* where each of the end dies reaches its maximum projection. From there on, that is from the intermediate point *e* to the ending point *f*, each of the end dies 12 is of uniform width and projection. A feature of importance to note in connection with the end die elements or lands 12 is that the outer edges of their eccentric portions 12^a are inclined as at 14, said inclinations being arranged in the same relative directions as the diverging side edges of the eccentric portion 11^a of the central die element or land 11.

With dies constructed as described, it will be obvious that when an axle blank or billet is interposed between the die carrying rolls R within the blank sections 13 thereof (see Fig. 5), said rolls, having their surfaces moving in opposite directions, will serve to maintain the axle blank or billet in position to impart a rolling movement thereto. In the first movement of the opposite die carrying rolls, the starting points of the central die elements 11 move into engagement with the opposite sides of the axle blank or billet, and by reason of the tapering projection of the portion 11^a of the central die element or land, the blank or billet will have the central portion thereof reduced, and the displaced metal will be compensated for by the free longitudinal expansion of the axle blank or billet, since the ends of the latter are perfectly free

from the end die elements during this operation. Furthermore, during the action of the eccentric portions 11ª the flaring or wedge-shaped form of the latter causes the spreading out of the metal toward the ends of the blank or billet. When the central die elements or lands have moved on the axle blank or billet to their points *b* of greatest projection, the central reducing action ceases and the points *d* of the end die elements or lands move into engagement with the axle and commence the end reductions which form the usual journal collars. The outer inclined edges 14 of the end die elements or lands between the points *d*—*e* continue the spreading out action of the flaring die portions 11ª of the central die, and while this action is going on the central reduced portion of the axle blank or billet is held under uniform and constant compression by the uniform portion *b*—*c* of the central die element or land. When the end die elements or lands 12 reach their points *e* of greatest projection, from there on, that is from *e* to *f*, the said end die elements or lands exert a uniform compression upon the blank or billet, which compression acts as a finishing-off operation.

Various expedients may be resorted to for attaching the dies in place, but a practical construction is shown in the drawings, and consists in constructing the die bodies 10 of a plurality of sections *s* having inner angular sides 15 registering with corresponding angular faces 16 upon the roll body 9. Fastening bolts 17ª may be utilized for securing the dies upon the roll bodies and for additional strength and security the roll bodies of the dies may be provided on their matching faces with interlocking holding tongues and recesses 17 and 18 respectively.

Another feature which may be employed in carrying out the invention is to utilize the hollow roll body 9 to form an interior cooling chamber 19 supplied with water through suitable connections and which may have formed in its wall a number of channels 20 or equivalent means for thoroughly cooling the body portion of the roll, and thereby preventing overheating.

The rolling surface of the central die element or land is convexed throughout, while that of the end die elements or lands is flat throughout.

From the foregoing it is thought that the construction and action of the rolls and their dies will be clearly understood by those skilled in the art without further description.

Having thus described the invention, what is claimed and desired to be secured by Letters Patent is:

1. A rolling die having a raised working die portion which gradually tapers in width and in thickness from its initial point and merges into a portion which is of uniform width and thickness to its termination, substantially as described.

2. A rolling die having a raised working die portion which gradually tapers in width and in thickness from its initial point and merges into a portion which is of uniform width and thickness to its termination, the tapered part of the die portion having a transversely curved working surface.

3. In a rolling mill, a die roll provided with a central raised die element which gradually tapers in width and in thickness from its initial point and merges into a portion which is of uniform width and thickness to its termination, the tapered part of said die portion having a transversely curved working surface; and raised end die elements spaced from the uniform part of the central die element and each of which end die elements tapers in width and in thickness from its initial point and merges into a portion which is of uniform width and thickness to its termination, the initial or starting points of the end die elements being arranged to engage the work after the maximum compression and spreading have been effected by the central die element.

4. A die carrying roll having an angular body, a sectional semi-cylindrical working die matching said angular body and having holding elements interlocking with complemental elements carried by the body, and supplemental fastening means engaging said die and the roll body.

In testimony whereof we affix our signatures in presence of two witnesses.

EDWARD R. FELLOWS.
ALFRED HUBBARD.

Witnesses:
H. M. KAERCHER,
ROBT. O. KIELING.