ROD REDUCING APPARATUS

Carl F. Mead, Cleveland, Ohio, assignor to Alice F. Mead, Cleveland, Ohio

Application June 9, 1930. Serial No. 450,879

5 Claims. (Cl. 80—11)

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This invention relates to method and apparatus for the continuous rolling of rods, tubes, bars, sheets or other shapes by subjecting the work to one pass or transit successively to the reducing effect of a series of reducing mills, two or more of which may be effective simultaneously upon the same piece of material, all for the purpose of avoiding reheating, reducing oxidation, speeding up the operation, reducing the cost, and generally improving the reducing effects. The object of the invention is to provide improved method and apparatus of the character stated which secures the reducing effect by high speed combined forging or swaging and rolling action and therefore can produce at each reducer relatively heavy reduction in minimum time, wherein due allowance is made for elongation due to reduction, thereby enabling two or more reducers to operate simultaneously upon the same work; and wherein control of the amount and rate of reduction within reasonable limits may be readily secured by very simple devices or operations.

Further objects of the invention are in part obvious and in part will appear more in detail hereinafter.

In the drawings Fig. 1 represents, somewhat diagrammatically, one suitable embodiment of apparatus embodying the invention; Fig. 2 is a sectional elevation on the line 2—2, Fig. 1; Fig. 3 is a detail section, on a larger scale, through one of the hammer rollers; Fig. 3A is a detail sectional elevation of an over-running clutch device; Fig. 4 is an end elevation of one of said rolls, partly broken out and in section to expose interior parts; Fig. 5 is a detail sectional elevation, corresponding to the section in Fig. 4, and showing a modified arrangement; Fig. 6 is a detail section on the line 6—6, Fig. 5; Fig. 7 is a view corresponding to Fig. 5 and illustrating still another modification; and Fig. 8 is a section on the line 8—8, Fig. 7.

While the invention may be utilized for forging or rolling any cross sectional shape, such as for the rolling of sheets, bars or rods of rectangular cross section, it may also be employed upon any other shape, such as for tubes, round bars or rods and the like. In the rolling of tubes, a mandrel might be employed, although not necessarily. The drawings illustrate the invention employed for the reducing of a round rod A, which is led from the left in Fig. 1 over suitable guide rolls 1 to a pass between a hammer member 2 and a cooperating anvil member 3, from which pass the rod reduced therein is guided to and travels through one, two, three or more succeeding passes, one being illustrated as including a hammer member 2a and an anvil member 3a, each similar in all respects to the hammer and anvil members 2, 3 before referred to, so that the description of one set of said members will suffice for all succeeding sets.

The pass between the upper and lower rolls 2, 3 is, of course, properly shaped to produce the desired reduction and in the case of a round rod, the pass would be more or less oval, as shown in Fig. 3, where the bar A lies between the upper and lower hammer and anvil members. Each hammer member includes a series of small or individual roll or hammer members distributed around the circumference of the hammer roll.

Because when a bar lying on an anvil is struck with a hammer, the reduction below is equal to that above, the anvil member may be more or less plain, and in the drawings the anvil member is shown as a simple plain roll grooved at 4 to form the lower half of the pass. The hammer roll, shown in detail in Fig. 5, comprises suitable means for supporting and driving a series, twenty being shown, of small roll members 5, each grooved along its middle at 6 to form its portion of the working pass, and each of said roll members being provided with pins or trunnions 7 at its ends journalled in side plates 8 bolted or otherwise secured to the hub 9 of a body member having a sleeve portion 10 keyed to the driving shaft 11. To back up and support each of the several rolls 5, there may be interposed suitable supporting means between said rolls and the hub 9, for which purpose I provide, for example, a series of pins or rolls 12, like the rolls of roller bearings, distributed in close relation to each other around the periphery of the hub 9 and on which collectively is supported an annulus or ring 13, the outer surface of which backs up and supports the rolls 5, closely adjacent the pass grooves.

Suitable driving means for the roll may be provided, such as an electric motor 33 whose shaft is provided with a driving pinion 14 meshing with a pinion 15 on the shaft 11, and to control and limit the speed of the anvil member 10 it may be in timed or driving relation with the hammer roll, such as by interconnecting the hammer shaft 11 and the anvil shaft 16 by the intermeshing gears 17, 18.

In the arrangement shown, the gear ratio is between the shafts 11, 16 is about one to five, and the anvil roll 3 is twice the size of the hammer roll 2, as the result of which the rolls 2 and 3 rotate in the relation of ten to one, or, in other words, roll 2 rotates ten times as fast as roll 110.
3. During each revolution of roll 2, twenty of the individual or unit rolls 5 engage and travel over the work, so that during one complete rotation of the anvil roll, two hundred blows are imparted to a length of the stock or work equal approximately to the circumference of the anvil roll. The anvil roll serves as a controller to limit the travel of the work through the first pass. Its speed is governed by the gearing ratio between the hammer and anvil shafts, and said ratio may be made capable of variation in any suitable manner so as to secure any desired effect. In any event, with a given gear ratio, the work will be subjected to rapidly repeated blows of the series of individual rolls 5. The action, however, is a sort of combined swaging and rolling action, because each of the rolls 5 rotates individually in its bearings in the plates 3 and when the mill is in operation all of the rolls 5 continue to rotate with the ring 13 turning beneath them and rolling upon the bearing pins or rolls 12. If desired, for the purpose of initiating rolling action at the beginning of an operation, a strap driver, such as conventionally indicated at 26, may be mounted on the back side of the hammer member so as to contact with several of the rolls 5 at a point where they are out of action, the fractional drag producing and maintaining rotation thereof, but the tendency of the rotating ring 13 is always to maintain roll rotation.

Of course, as the material travels through a pass of the kind described, considerable reduction in cross section may be secured, particularly in view of the repeated combined rolling and hammer action, and as a result the material elongates. Also, the quality of the material is improved by the repeated more or less inelastic effect of the surface metal as the result of the hammering or forging action. In the present apparatus and method the material being operated upon may be either hot or cold. In either case, as it leaves the first reducer described, it is immediately and by the same motion passed through one or more succeeding reducers uniting. When the material is passed in a rectangular bar, succeeding passes will be at right angles; when it is triangular, succeeding passes may be at 120°; and when it is round, succeeding passes may be at any desired angular relationship to each other. The drawings conventionally show the second pass at 90° to the first, but obviously a series of twelve passes at angles of 90° to each other might be employed if desirable. The second pass is identical with the first except that it is formed and adjusted to a smaller cross section. Its hammer may be driven in timed rotation or in any other relation with the first hammer roll 2 and indeed may be driven by the same motor, and the drawings conventionally show the mechanism so arranged. As illustrated, the shaft 11 of the first hammer roll is extended and provided with a bevel gear 21 meshing with a bevel gear 22 on 24, 25 to the shaft 11a of the second hammer roll and as the diameters of the two hammer rolls are the same, they rotate at the same speed, although this is not essential.

As before stated, the anvil roll at the first pass is positively driven, not so much for the purpose of feeding the work through the mill as for the purpose of holding it back or limiting its speed. If at least one of the anvil rolls is not restrained or some other means is not employed for holding back the work, it will pass through the mill at approximately the peripheral speed of the hammer roll, and by limiting the speed of the first anvil roll, the rate of movement at that pass is limited to the peripheral speed of the anvil roll.

Of course, at each pass there is a reduction in cross section and a consequent elongation of the work. Therefore, since the same piece of work is being simultaneously operated upon at a plurality of points, one at each pass, with reduction and elongation at each pass, it is desirable to permit more or less free advance or travel of the work at each successive pass, so that the mill will be self-accommodating to the amount of elongation. Therefore, when the anvil roll is restrained or held back at the first pass, the anvil roll at the second may be freely rotate, and when the anvil roll at the second pass is held back, the anvil roll at the third pass may be freely rotate, etc. The present apparatus provides means whereby the anvil roll at the last pass which at any time may be effective upon the trailing end of a piece of work travelling through the mill serves to restrain and limit its advance, all other anvil rolls rotating freely. In the arrangement shown the shaft 1a of the anvil roll of the second pass is restrained when necessary by means of an over-running clutch indicated. The clutch is a simple said clutch being driven by a shaft 27 operatively connected to a suitable source of power, which may be one of the driving shafts of a preceding pass, but is shown as a separate electric motor 28. The over-running clutch 30 may be of any suitable type of bevel clutch, but as illustrated, it comprises two relatively rotatable members a, b, one carrying one or more paws 29 and the other a cooperating ratchet 30. As illustrated, the motor drives the shaft 27 to which is attached the over-running member a, carrying the paws 29, and the shaft b is attached to the shaft 1a.

The speed of motor 28 is such that while the work is engaged in both passes shown, and particularly while its rate of advance is still controlled by the first anvil roll 3, the over-running member a travels faster than member b in the direction of the arrow c. Consequently, the second anvil roll rotates freely with no braking or restraining upon it with full opportunity for any such variation in speed as is necessary on account of variations in elongation. As soon as the trailing end of the work piece leaves the first of the last three to a total emergency for the member b of the over-running clutch to speed up until the peripheral speed of the second hammer roll is reached, but before that speed is reached member b overtakes the normally over-running member a and the cooperating paws 29 and ratchet 30 become effective and begin to limit the rate of rotation of the second anvil roll by applying the brake or restraining effect of the motor, which thereby limits the rate of advance of the work in the second pass.

Similar connections may be made at the third and any preceding passes, as will be readily understood.

In Fig. 3 the hammer roll is a wheel with a series of small individual rolling members distributed around its periphery. In Fig. 5 a modification is illustrated, the active or work moving member that view being small rollers 30 carried on the outer arms of levers 31 whose inner arms are provided with idle rollers 32 traveling upon the hub 9a of the hammer roll. With this arrangement, the active rolls 30 form the heavy ends of the levers and all of them are normally held outwardly by centrifugal force. As each of 145
the active rolls reaches work engaging position it
imparts a rolling and forging blow to the work
and then rebounds to the dotted line position.
In Fig. 5, the work being struck a second blow by
the succeeding roller, etc.

In Fig. 7 the active rolls are eccentrically
mounted between the flanges of the hammer roll,
each striking its forging and rolling blow upon the
work as it comes into active position and rebound-
ing to the limiting dotted line position, Fig. 7.

With all arrangements, the work, which may be
either cold or hot, and which may also be of sheet
or bar form, is subjected simultaneously at dif-
ferent points throughout its length to a combined
rolling and forging action with consequent reduc-
tion in cross section and elongation, but without
any necessity of turning the work around its own
axis. Nevertheless, there is no buckling or
stretching of the material between passes. As a
consequence, in one pass of the work through the
mill a very considerable reduction and elongation
may be effected with consequent reduction in cost
and time over preceding methods and apparatus
for the purpose. Furthermore, successive units
may be placed very close together so that not only
is the mill itself quite compact, but the time from
pass to pass is reduced, and when the work is hot
one heat is sufficient for all usual methods.

What I claim is:
1. Rolling mechanism, comprising a plurality
of pairs of cooperating hammer and anvil rolls
arranged to simultaneously engage the work,
means for driving the hammer rolls, independent
drives for the anvil rolls, and means for limiting
the speed of the last one of the anvil rolls en-
gaged by the work at any time.
2. Rolling mechanism, comprising successive
pairs of opposed hammer and anvil rolls, means
for driving the hammer rolls, means for limiting
the peripheral speed of one anvil roll to a rate
less than that of its hammer roll, the succeeding
anvil roll being mounted for free rotation but
being restrained by the effect of the first anvil
roll while the latter is effective upon the work,
and means for applying a braking effect to the
second anvil roll when the work passes beyond
the first anvil roll.
3. Rolling mechanism, including an anvil mem-
ber, a hammer roll member cooperating there-
with, said member comprising a rotatable hub, a
series of roll members distributed peripherally
about the axis thereof, and an annulus freely
rotatable about the center axis of the hub in-
wardly of said roll members and forming a
backing for all of said roll members.
4. Rolling mechanism, comprising cooperating
opposed hammer and anvil rolls, the former hav-
ing a series of like reducing members and the
latter having an uninterrupted surface, means
for driving the hammer roll, separate driving
means for the anvil roll, and means for con-
trolling the speed of the anvil roll independently
of that of the hammer roll to thereby regulate
the rate of advance of the work through the
rolls.
5. Rolling mechanism, comprising a plurality
of pairs of opposed hammer and anvil rolls hav-
ing aligned passes, driving means for said rolls,
and an over-running clutch in the drive of the
anvil roll of the second pair, whereby said anvil
roll can rotate faster than its drive to accom-
modate itself to elongation of the work at the
first pass, but said anvil roll is restrained by its
drive when the work moves wholly beyond the
first pass.

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