

Dec. 16, 1941.

M. E. EVANS

2,266,418

METALWORKING APPARATUS

Filed Aug. 9, 1937

2 Sheets-Sheet 1

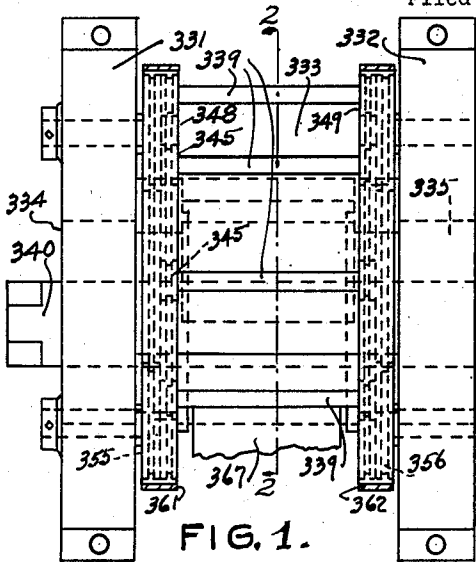


FIG. 1.

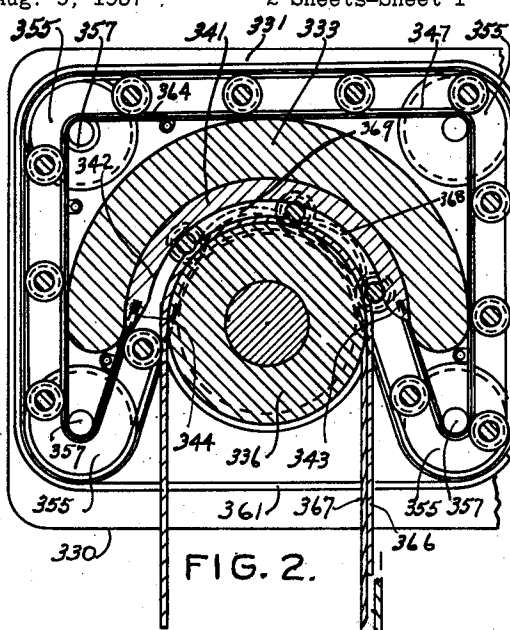


FIG. 2.

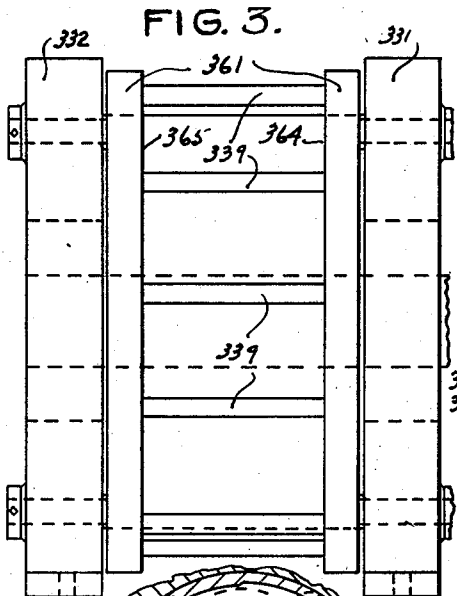


FIG. 3.

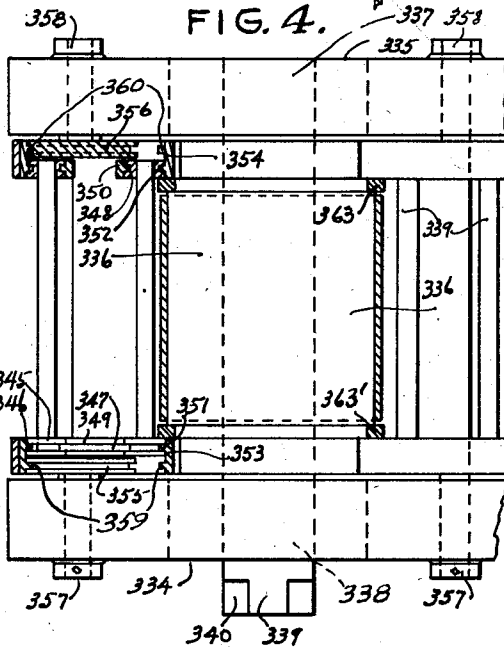


FIG. 4.

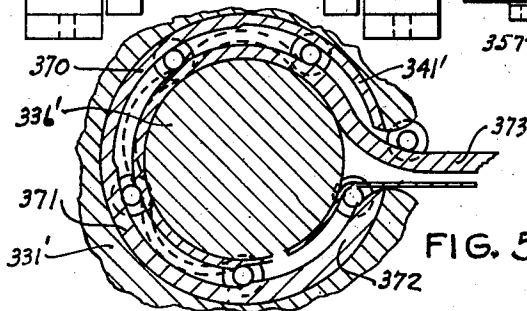


FIG. 5.

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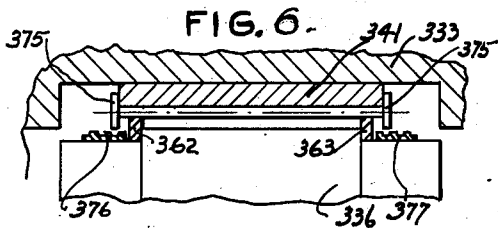
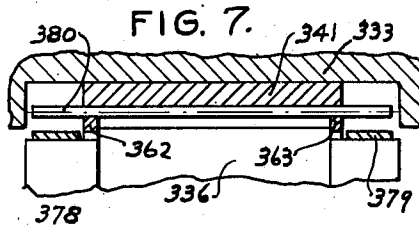
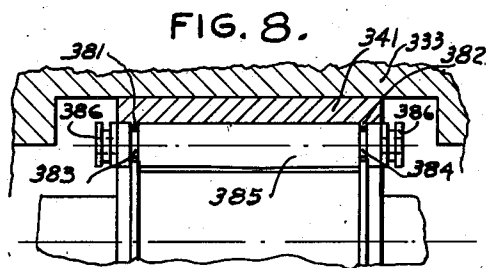
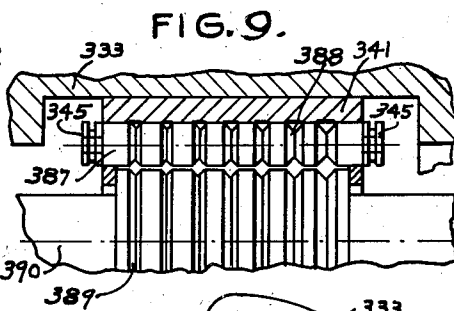
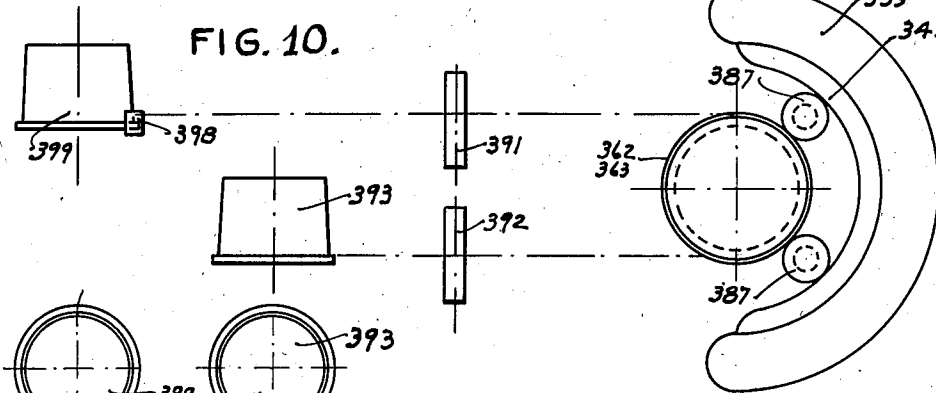
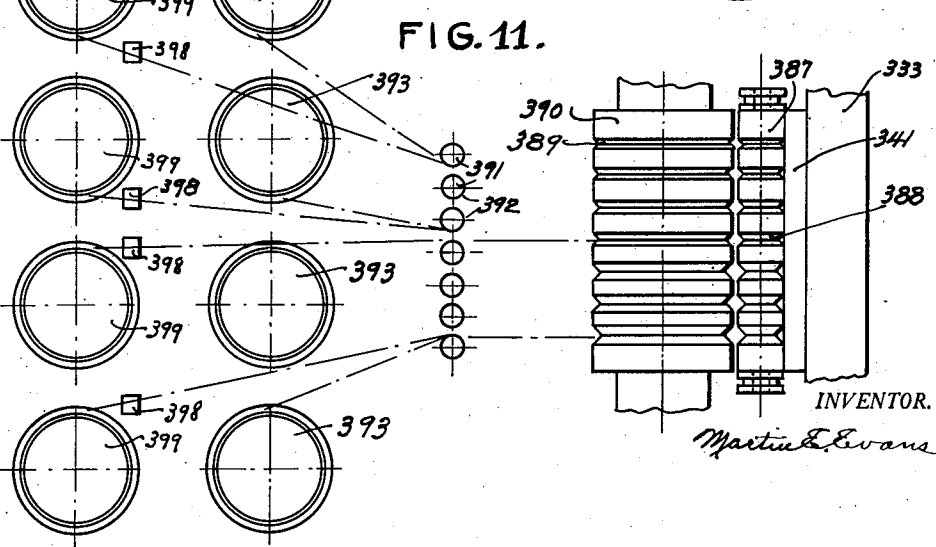
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2 Sheets-Sheet 2



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METALWORKING APPARATUS

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Application August 9, 1937, Serial No. 158,182

22 Claims. (Cl. 80—32)

This invention relates to metal working apparatus and particularly to metal rolling apparatus provided with migratory rolls.

It is a further object of this invention to eliminate roll bearings in a rolling mill, to reduce the arc of contact between the workpiece and the roll for a given reduction, to reduce the heat of reduction work.

It is an object of this invention to provide migrating rolls adapted to reduce the cross section of a metal workpiece, to utilize needle rolls in contact with the workpiece for its reduction.

It is another object of this invention to provide an arrangement of parts adapted to hold migratory rolls in definite relation to each other suitable to reduction of a metal workpiece.

It is another object of this invention to provide powerful tensioning means for structural elements being rolled with back tension.

It is another object of this invention to provide a plurality of migratory rolls adapted to operate simultaneously along the length of a metal workpiece, to arrange for the successive engagement of said rolls with the workpiece, and the control of the space between cooperating migratory rolls.

It is another object of this invention to adapt the shape and movement of migratory rolls to the character of the metal workpiece to be reduced in sectional thickness.

It is another object of this invention to adapt the shape and movement of migratory rolls to the character of metal workpiece to be elongated and reduced in sectional thickness.

It is another object of this invention to heat treat a workpiece and subject it to migratory roll operation.

Another object of this invention is to reduce the hardening effect of cold rolling on a metal workpiece.

Another object of this invention is to increase the tensile strength of hot rolled angular and tubular metal pieces.

The analyses A to G inclusive provide the threefold combination of high strength, light section and maximum corrosion resistance. The corrosion resistance appears to be due to the formation of a characteristic surface film provided by cold rolling with migratory rolls. The surface passivity induced by the presence of chromium and nickel in combination with the physical or mechanical properties of these cold worked analyses give the various structural elements novel individuality. Well cleaned surfaces provide the continuity of surface film nec-

essary for the full effectiveness of the analysis provided. The cold working with migratory rolls and the workpiece under tension provides structural elements of high tensile strength and high corrosion resistance from hot rolled sections the equivalent of which has been available heretofore only by a shot welded built up structure.

The analyses A to G with the usual physical characteristics are set forth as produced under licenses of the Chemical Foundation Inc., New York, and Fried. Krupp, A. G. of Germany by United States Steel Corp. The analyses H-K inclusive are by the same producer. The manipulations of these chosen analyses by the processes and agencies of this invention provides the structural elements of novel individual characteristics later to be described in detail.

Needle rolls

With migratory rolls operative upon a workpiece, the rolls travel with the workpiece but at a lower rate. With a short housing for the rolls to travel on, a succession of roll arrangements is provided such that the forward roll grips and enters upon the product of the immediately following roll thereby maintaining the continuity of uniform thickness of workpiece emerging from the operation. With a long housing one roll group may travel the length of the housing and the length of the workpiece. The diameter of a migrating roll may be materially reduced compared to that of backed up and end-bearing rolls. Whether a single group or a succession of roll groups traverse the workpiece, the reduction of the workpiece by the rolls results in a uniform cross section of the workpiece between the grips on the piece. Relative movement of the workpiece is provided by either a stress longitudinally of the workpiece or a movement of the housing or both in combination. Migratory needle rolls for cold metal working in a pre-stressed housing because of their small area of contact with the workpiece give relatively small reaction stresses per unit of needle roll length. Because of their backing by a pre-stressed housing and their freedom from bending stresses and their possession of smaller diameter than backed up rolls, these migratory rolls may be of lengths accommodating exceptional widths of workpieces, widths which exceed by far any that may be accommodated in the previous art.

Fig. 1 shows a plan view of an embodiment of the invention adapted to convey the migratory needle work rolls in their cycle of travel.

Fig. 2 shows a vertical sectional view along line 2—2 of Fig. 1.

Fig. 3 shows a front end elevation of Fig. 1.

Fig. 4 shows a front partial sectional view in elevation of Fig. 1.

Fig. 5 shows a partial vertical sectional elevation illustrating a modification of the roll guides.

Fig. 6 shows a view in partial section of a needle roll with end guides for the embodiment shown in Fig. 1.

Fig. 7 shows a partial sectional view of a plain needle roll applied to the embodiment of Fig. 1.

Fig. 8 shows double grooved guides on the ends of a needle roll applied to the embodiment of Fig. 1.

Fig. 9 shows grooved needle and supporting rolls for the embodiment of Fig. 1 adapting the mechanism to rod rolling.

Fig. 10 shows in addition to the embodiment of Fig. 1 in side elevation rod winding drums and guides.

Fig. 11 shows in plan view the arrangement of Fig. 10.

Embodiments of the invention adapted to handling strip metal sufficiently thin to be coiled is set forth in the Figures 1-11 inclusive. Referring to Figs. 1-4 inclusive, an integral frame 330 comprising end pieces 331 and 332 with a semicylindrical cross member 333 is provided with end bearings 334 and 335 of an external diameter large enough to accommodate the passage through the bearing openings in the endpieces of a roll 336 and having necks 337 and 338 fitting the end bearings 334 and 335 respectively. An extension 339 of roll neck 338 is provided with a driving connection 340. Between the roll 336 and the semicylindrical cross member 333 and contacting the latter a semicylindrical cross anvil 341 has a roll supporting surface 342 parallel to the surface of the large roll 336 and concentric therewith, the latter being carried on a shaft the projecting ends of which provide the roll necks 337 and 338. The space between the anvil surface 342 and the roll 336 accommodates the passage of reducing rolls 339 and a workpiece. Inclined ends 343 and 344 on the anvil 341 guide the rolls 339 as they enter and leave the anvil contact area. On the ends of the rolls 339 are rollers 345 with circumferential tapered grooves 346 adapted to grip tongues 347 and 348 on stationary tracks 349 and 350 providing an exterior closed circuit from the exit side of the anvil to the entry side thereof. The grooved rollers are pressed onto their respective stationary tongues by moving tongues 351 and 352 on endless belts 353 and 354 respectively supported on grooved pulleys 355 and 356 respectively on shafts 357 and 358 respectively. The belts 353 and 354 carry second tongues 359 and 360 respectively riding in the grooved supporting pulleys. These belts are reversely wound around the large roll 336 and receive therefrom traction sufficient to cause the rollers 345 and their rolls 339 to migrate around the circuit of the stationary track 349. The transmission belts 353 and 354 are circumscribed by pressure belts 361 and 362 respectively adapted to sustain the weights of the migrating rolls and rollers in certain parts of their travel. The transmission belts 353 and 354 maintain continuous contact with the rollers 345. The rollers as they leave the stationary tracks 349 and 350 at the contact point of the rolls 339 with the workpiece 366 and the anvil approach surface 343 travel in spaces between the ends of the anvil 341 and the frame ends 331 and 332.

In the above mentioned space the rollers act as guides on the ends of the anvil 341 to maintain the rolls in alignment. In the event that the workpiece 366 is not around the roll 336, the rolls are pushed up against the anvil surface by a pair of compressible rings 363' and 363 on the ends of the roll 336 which cause the rolls 339 to migrate along the surface 342 to the exit inclined end 344 of the anvil. As the roll starts down the exit incline 344, the rollers on the roll engage the tongues 347 and 348 on the stationary tracks 349 and 350 and the transmission belts 353 and 354 cause the rollers and rolls to exit and travel the exterior circuit provided. At the upper rear of the machine on the shafts 357 and 358 pivoted sections 364 and 365 respectively of the stationary track 349 are hinged to swing in a manner permitting the withdrawal of the rollers and the substitution of others for change of size.

To control the thickness changes of the workpiece 366, the use of a gauge sheet 367 is contemplated, made of metal having an elastic limit high enough not to be affected greatly by the rolling operation; such a sheet is shown in Fig. 2 entering between the roll 336 and the workpiece 366. In Fig. 2 the dotted 368 and 369 show the elongated sections of the workpiece between the rolls 339.

Referring to Fig. 5, a stepped anvil 341' resting on a cross-member 333' cooperates with a roll 336', the successive steps 370, 371 and 372 reducing the space between the anvil and roll 336' by successive parallel passages through which the passage of the rolls 339 with the work piece is effected. The workpiece receives successive reductions by a single roll in their passage as outlined.

Referring to Fig. 6 a partial sectional view is shown of a needle roll 374 with end flanges 375 supported on the anvil 341 by pressure members 362 and 363 on the roll 336. The roll also carries transmission belts 376 and 377 grooved to move the needle roll 374 in the exterior circuit required for repeated operation on the workpiece by the roll.

Referring to Fig. 7, a plain needle roll 380 is shown supported on the anvil 341 by pressure of expansion ring members 362 and 363 on the roll 336 and plain transmission belts 378 and 379 are positioned for moving the needle roll in its exterior circuit.

Referring to Fig. 8, the anvil 341 is provided with depending flanges 381 and 382 matching grooves 383 and 384 in a roll 385 held in contact with the anvil 341 by pressure members 362 and 363.

Rollers 386 on the roll 385 function in the manner previously described for transmission purposes while the groove and flange arrangement keep the roll in alignment. Obviously a rack and pinion arrangement may be substituted for the tongue and groove arrangement. While the illustration in Fig. 2 shows a rolling operation on a long strip, the position of the large roll 336 within the concavity of the crosspiece 333 provides a path of travel long enough for reduction of a standard short piece by a single roll if desired and when feeding and receiving mechanism not shown are substituted for the receiving and delivering reels. The symmetrical arrangement of parts facilitates reversible operation of the rolling mechanism.

Referring to Figs. 9, 10 and 11, an adaptation of the invention is shown suited to rolling rods. Migratory rolls 387 with a series of circumfer-

ential grooves 388 cooperating with a series of circumferential grooves 389 in a power roll 390 roll on an anvil 341 supported on a cross member 333. Rollers 345 function in the manner previously described. As shown in Figs. 10 and 11 a series of upright guides 391 and 392 direct the rods from a series of supply drums 393 to the grooves 388 and 389 then to finishing dies 398 and drawing drums 399 where the rods are accumulated.

I claim:

1. In a metal working machine, the combination comprising a frame, a relatively large roll mounted in said frame, a concave shaped frame cross member concentric with and in spaced relationship to said roll, a plurality of small rolls, means to transport said small rolls spaced successively from the exit side to the entrance side of and through the space between said large roll and said concave cross member, said small rolls contacting said concave member in said through travel with a clearance from said large roll sufficient to provide a passage for a finished workpiece, a tapered entrance to said space and means to rotate said large roll.

2. Claim 1, and means to alter said passage.

3. In a metal working machine, the combination comprising a frame having a cross member, a relatively large roll mounted in said frame substantially parallel to and in spaced relation to said cross member, a concave surface on said cross member substantially concentric with said roll and forming the frame side of said spaced relationship, a plurality of rolls relatively smaller than said large roll and of a size adapted to roll upon said concave surface between said large roll and said frame cross member with a space between said successive small rolls and said large roll adapted to accommodate a workpiece therein, means to transport said smaller rolls spaced successively from the exit side to the entrance side of and through the space between said concave surface and said large roll, means to rotate said large roll whereby a workpiece and a plurality of said small rolls are advanced through said space, and a tapered entrance to said space adapted to initiate the reduction of said workpiece between the large and small rolls which reduction is continued by said rotation.

4. Claim 3 and means therewith to change the dimension of the space for said workpiece adjacent said successive small rolls.

5. In a metal working machine, the combination comprising a frame, a relatively large grooved roll mounted in said frame, a concave shaped frame cross member concentric with and in spaced relationship to said roll, a plurality of grooved small rolls, means to transport said small rolls spaced successively from the exit side to the entrance side of and through the space between said large roll and said concave cross member, the grooves of said small rolls registering with the grooves of said large rolls while rolling on said concave member, and means to rotate said large roll.

6. Claim 5, and means to pull a workpiece in one of said pair of registered grooves in a manner to reduce the work of reduction in said pair of grooves.

7. Claim 5, and a die and means to draw a workpiece as it emerges from a pair of said registering grooves, said pair of registering grooves providing back tension for said workpiece in said die.

8. In a metal working machine, the combina-

tion of a large roll, a small roll, a backing providing a guide spacing said small roll from said large roll suitably to accommodate a workpiece between said rolls, means to rotate said large roll, and means to move said small roll in a circuit from one end to the other of and including said guide.

9. In a metal working machine, the combination of a large roll, a small roll, a backing providing a concave guide for said small roll positioned to accommodate a workpiece on said large roll, means to rotate said large roll, and means to move said small roll in a circuit including said concave guide.

10. In a metal working machine, the combination of a large roll, a small roll, a backing member providing a guide for said small roll on a workpiece on said large roll, means to rotate said large roll, and means to move said small roll in a circuit including said guide whereby said small roll may be moved from one end to the other of said guide and so positioned for cooperation with said large roll.

11. In a metal working machine, the combination of a large roll, a small roll, a backing member on which said small roll travels, conveyors engaging the end extensions of said small roll operative to move said roll in a circuit from one end to the other end of said backing member, and means to rotate said large roll and move a work piece therewith as said small roll engages said work piece and reduces its thickness.

12. In a metal rolling machine, the combination comprising a large roll, a plurality of small rolls, a backing providing a guide for said small rolls upon which they roll in proximity to said large roll, means to rotate said large roll and also said small rolls on said guide, and means to move said small roll in a circuit including said guide, the space between said small rolls and said large roll being adapted to accommodate a work-piece.

13. In a metal rolling machine, the combination of an integral frame made up of two end pieces with bearings therein and a curvilinear cross-piece joining said end pieces, a large roll mounted in said bearings and within the concave curvature of said cross-piece and having an intervening space adapted to accommodate a small roll on said cross-piece and a work-piece between said rolls, a small roll backed by said cross-piece on one side and engaging said work-piece on the other side, and means to rotate said large roll whereby said work-piece is advanced and reduced in said intervening space between said rolls.

14. In a metal rolling machine, the combination of an integral frame made up of two end pieces and a curvilinear cross-piece cast as a unit, bearings in said end pieces, a large roll mounted in said end pieces and occupying the concave curvature of said crosspiece with an intervening space, in said intervening space a plurality of small rolls backed by said cross-piece on one side and engaging on the other side a workpiece supported on said large roll, means to convey said small rolls exteriorly from the exit to the entrance of said space, and means to rotate said large roll whereby said workpiece is advanced through and reduced in cross-section in said intervening space.

15. In a metal rolling machine, the combination comprising a large roll, a plurality of small rolls, a mounting for said large roll, a member upon which said small rolls travel in a path

concentric with said large roll with a space for a workpiece between said two sizes of rolls, means to change said space for said workpiece, means to guide said small rolls spaced in a circuit including said concentric path, and means adapted to propel said small rolls around said circuit in separated relation to each other as said large roll is rotated.

16. In a metal working machine, the combination of a large roll with a first and second circumferential grooves, a first small roll with a first and a second circumferential grooves cooperating respectively with said first and said second large roll grooves, a second small roll with a first and a second circumferential grooves cooperating respectively with said first and second large roll grooves, a backing providing a guide for said small rolls to travel on, means to rotate said large roll, and means to move said small rolls in a circuit including said guide as said large roll advances the workpiece sections in said cooperating grooves.

17. In a metal working machine, the combination of a large roll grooved circumferentially, a small roll grooved circumferentially, said grooves coacting on a workpiece therein, a backing providing a guide for said small roll to travel on, a second small roll grooved circumferentially coacting with said large roll on said workpiece and travelling on said backing member, means to rotate said large roll, and means to move said separated small rolls in a circuit including said guide, the said small rolls merging their effects upon said workpiece.

18. In attenuating apparatus, the combination comprising a plurality of metal strip supply means, a plurality of metal strip takeup means, said supply and takeup means being paired and joined by a work-strip for said pair, a large roll with a first and second circumferential grooves carrying strips between said paired means, a first small roll with a first and a second circumferential grooves respectively co-

operating with said large roll first and second grooves, a second small roll with a first and a second circumferential grooves respectively cooperating with said large roll first and second grooves, a backing guide for said small rolls to travel upon, and means to move said separated small rolls in a circuit including said guide as said large roll is rotated.

19. In a metal rolling machine, the combination comprising a plurality of separated rolls, a closed circuit of travel for said separated rolls, means to move said separated rolls in said circuit, and a movable support carrying a workpiece in pressure contact with one of said separated rolls as it travels in said circuit.

20. In a metal rolling machine, the combination comprising a plurality of separated rolls, a closed circuit of travel for said separated rolls, means to move said separated rolls in said circuit, a movable support carrying a workpiece in pressure contact with one of said separated rolls as it travels in said circuit, and means to change the rolls in said circuit of travel.

21. In a metal rolling machine, the combination comprising a plurality of separated rolls, a closed circuit of travel for said rolls, means to move said separated rolls in said circuit, and a movable support carrying a workpiece in pressure contact with a succession of said separated rolls whereby the pressure effect of said rolls is merged on said workpiece.

22. In a metal rolling machine, the combination comprising a plurality of separated rolls, a closed circuit of travel for said separated rolls, means to move said separated rolls in said circuit, means to maintain a workpiece in pressure contact with a plurality of said rolls and merge their effects on said workpiece, a die, and means to draw said workpiece through said die while utilizing said pressure contact to effect a back tension on said workpiece approaching said die.

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