April 14, 1959 B. F. WARE 2,881,908

MULTIPLE-DRAW WIRE DRAWER

Filed May 3, 1954 3 Sheets-Sheet 1

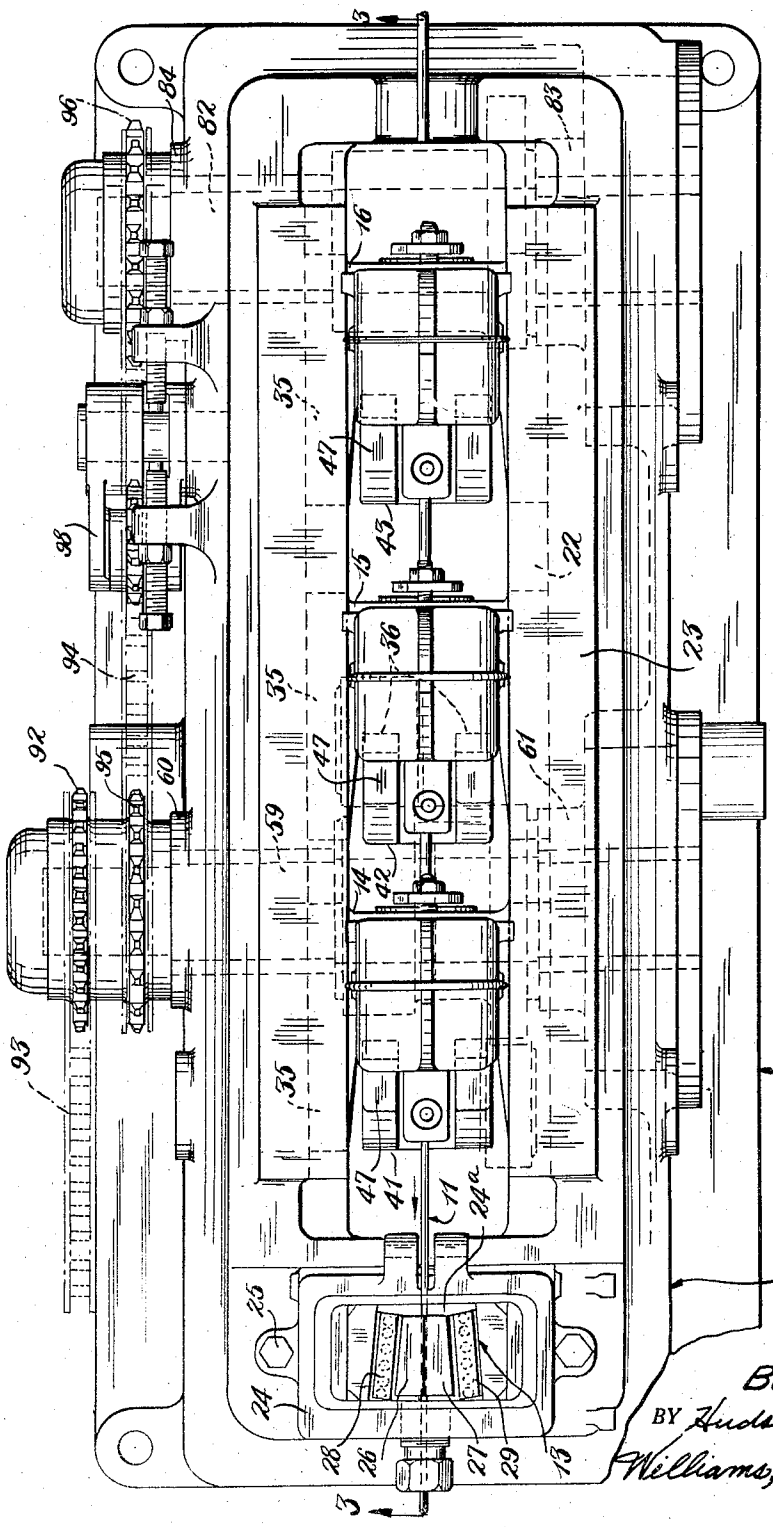

FIG. 1

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MULTIPLE-DRAW WIRE DRAWER

Filed May 3, 1954 3 Sheets-Sheet 2

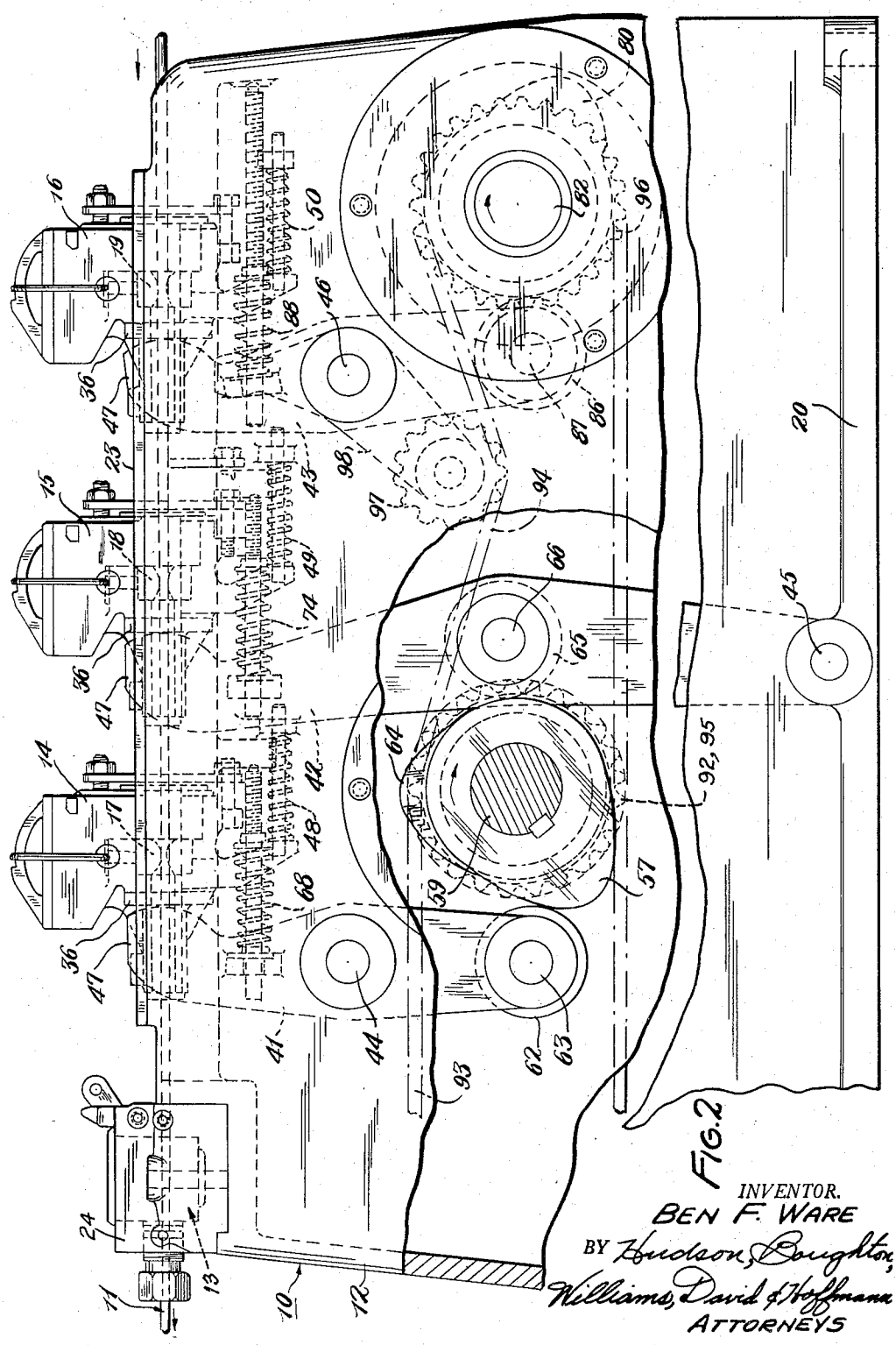

FIG. 2

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MULTIPLE-DRAW WIRE DRAWER

Filed May 3, 1954 3 Sheets-Sheet 3

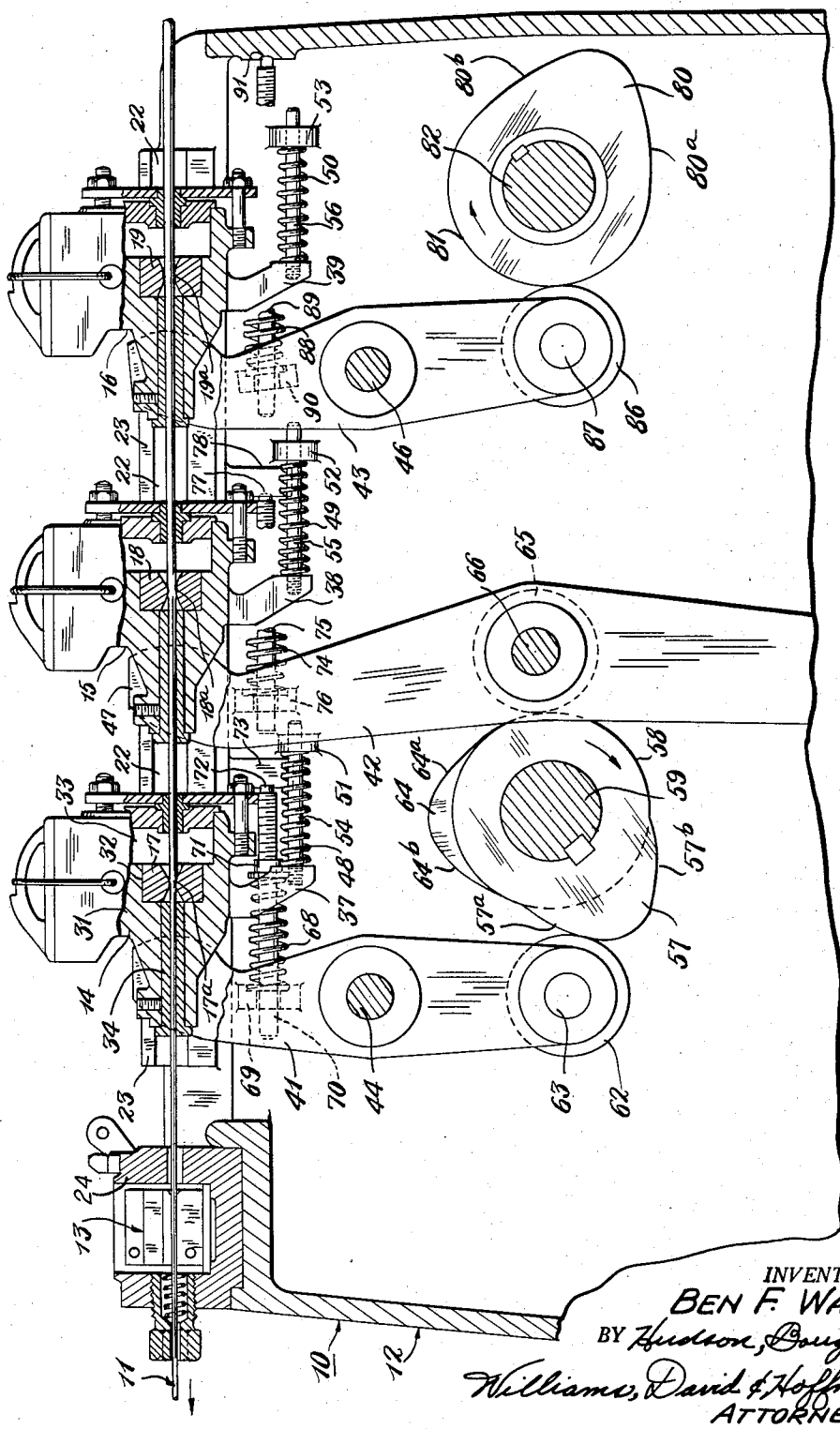

FIG. 3

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United States Patent Office 2,881,908 Patented Apr. 14, 1959

2,881,908

MULTIPLE-DRAW WIRE DRAWER

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Application May 3, 1954, Serial No. 427,211

13 Claims. (Cl. 205—14)

This invention relates to wire drawers of the kind in which the wire being drawn passes through a series of drawing dies in successsion, and more particularly, to a novel form of wire drawer of this kind.

An object of this invention is to provide a novel wire drawer of the kind having a series of drawing dies performing multiple draws on a wire and in which the drawing operations of the dies are performed in succession in a drawing cycle, such that the load on the drawer will be a distributed load and the maximum applied force during the drawing operation will be only the maximum force required by some one of the dies of the series.

Another object is to provide such a multiple-draw wire drawer in which the drawing dies are reciprocably movable relative to a wire gripping means, and in which the drawing stroke of one die starts substantially simultaneously with the end of the drawing stroke of the preceding die of the series.

Still another object is to provied a novel multiple-draw wire drawer in which a plurality of drawing dies are carried by reciprocable die carriers disposed in a series and actuated by thrust applying devices, and in which the die carriers are movable relative to their associated thrust applying devices to accommodate the elongation produced in the wire.

Yet another object is to provide such a multiple-draw wire drawer in which the die carriers are slides movable along a common guideway by swingable draw levers and are urged toward engagement with such draw levers by spring means which also produces a return-stroke movement of the slides.

Additionally, this invention provides a multiple-draw wire drawer of the character above indicated in which the draw levers are actuated by rotary cams of an arcuate spacing and throw, such that the drawing strokes of the dies are in a direction away from the grip means and occur in succession in a drawing cycle, starting with the drawing die nearest the grip means.

The invention can be further briefly summarized as consisting in certain novel combinations and arrangements of parts hereinafter described and particularly set out in the claims hereof.

In the accompanying sheets of drawings forming a part of this specification:

Fig. 1 is a plan view of a wire drawer embodying this invention;

Fig. 2 is a partial side elevation of the drawer, but showing the same with portions thereof broken away; and

Fig. 3 is a partial longitudinal vertical section taken through the drawer substantially as indicated by section line 3—3 of Fig. 1.

As representing a preferred embodiment of the invention, the drawings show this novel multiple-draw wire drawer **10** as being of the kind adapted to be used in advance of a fabricating machine, such as a cold-header, for supplying drawn wire **11** to the feed rolls (not shown)

of such machine or header. The wire drawer **10** comprises, in general, a frame **12** having thereon a grip device **13** adapted to grip the wire **11** for preventing backward movement thereof, and a plurality of die carriers or slides, in this instance, three such slides **14, 15** and **16** having thereon the respective wire drawing dies **17, 18** and **19**.

The frame **12** is an upright hollow longitudinal frame having a base portion **20** upon which the wire drawer is adapted to stand and is provided adjacent the top thereof with a longitudinal guideway **22** extending substantially in the direction of the axis of the wire **11** and in a direction away from the grip device **13**. The guideway **22** is also defined, in part, by longitudinal cover plates **23** which are suitably secured to the frame **12** in inwardly overhanging relation to the sides of the guideway.

The grip device **13** is of a conventional form comprising a grip box **24** secured to the frame **12** by screws **25**, and a pair of tapered grip blocks **26** and **27** located in the chamber **24a** of the grip box and having limited longitudinal shifting therein for gripping the wire **11** therebetween. The grip device **13** also comprises a pair of roller bearing assemblies **28** and **29** disposed in a relatively inclined relation in the grip box **24** and engaged by the grip blocks **26** and **27** for facilitating the longitudinal shifting of the latter. The action of the grip device **13** is such that upon any tendency of the wire **11** to be moved in a backward direction, that is in a direction toward the right as seen in the drawings, the grip blocks **26** and **27** will close against the wire and tightly grip the same.

The die-carrying slides **14, 15** and **16** are disposed in a longitudinal series extending away from the grip device **13** and are reciprocably movable in the guideway **22**. The slides **14, 15** and **16** are substantially identical in construction and are of a conventional form comprising a slide body **31** having a die recess or pocket **32** therein adapted to receive and hold the drawing die. The slide body **31** is provided on one side of the die with a powder chamber **33** adapted to receive a suitable drawing compound, and on the opposite side of the drawing die with a guide tube or bushing **34** through which the drawn wire extends in leaving the die box.

The die slides **14, 15** and **16** are each provided with a pair of laterally extending guide portions **35** which are slidable in the guideway **22** and retained therein by the cover plates **23**. The slides are also provided with thrust surfaces **36** on the end thereof facing the grip device **13** and which thrust surfaces are substantially flat vertical surfaces located on opposite sides of the portion of the slide body containing the guide bushing **34**. The slides **14, 15** and **16** are also provided with depending thrust brackets **37, 38** and **39**. The purpose of the thrust faces **36** and of the thrust brackets **37, 38** and **39** will be explained hereinafter.

The drawing dies **17, 18** and **19** are seated in the die pockets **32** of the respective slides **14, 15** and **16** so as to constitute a longitudinally extending series of dies and are suitably retained in such pockets. These drawing dies have draw orifices **17a, 18a** and **19a** of a progressively varying size and which produce the multiple-draw drawing operation on the wire **11**. The die **17** produces the smallest wire size for the wire **11** and represents the final draw performed on the wire prior to its passing through the grip device **13**. For convenience of analysis of the cycle of drawing operations, the die **17** can be regarded as producing its draw first in point of time in the sequence of draws and can therefore be referred to as the first die. The draw orifice **17a** of this first die is, therefore, of the smallest transverse dimension or diameter of all of the dies of the series.

The die **18** is the intermediate die of the series and produces its draw as the second draw of the sequence. The draw orifice **18a** of this second die is of a transverse dimension or diameter somewhat larger than the orifice of the first die **17**.

The die **19** is the die of the series which is encountered first by the wire **11** since this die is relatively more remote from the grip device **13** than the first and intermediate dies **17** and **18**, but produces its draw last in the sequence of draws and is therefore referred to as the last die of the series. The draw orifice of this last die is somewhat larger in transverse dimension or diameter than the orifice of the next preceding die **18**.

Thus, during relative axial forward movement of the wire **11** through the drawing dies of the series, it will be subjected to a progressive decrease in size as the drawing operations are performed thereon by the respective dies of the series.

Working or drawing strokes of the dies **17**, **18** and **19** are produced by movement of the slides **14**, **15** and **16** toward the right along the guideway **22**, as seen in Fig. 3. These drawing strokes of the dies **14** and **15** and **16** are produced by suitable mechanism such as that illustrated in the drawings and which includes actuating members here shown as draw levers **41**, **42** and **43** associated with the respective slides and swingably mounted in the hollow frame **12** by transverse pivot pins **44**, **45** and **46**. These draw levers have a forked upper end **47** in engagement with the pairs of thrust surfaces **36** of the respective die slides, such that a clockwise swinging movement imparted to the levers will cause drawing strokes of the slides **14**, **15** and **16** and of the drawing dies carried thereby.

Return movement is imparted to the slides **14**, **15** and **16** by compression springs **48**, **49** and **50** engaging the thrust brackets **37**, **38** and **39** of the respective slides. These springs also urge the slides toward engagement with the forked upper ends **47** of their respective draw levers. The springs **48**, **49** and **50** have their rear or remote ends in engagement with spring seats **51**, **52** and **53** formed by lug projections of the frame **12** and are disposed in surrounding relation to guide rods **54**, **55** and **56** which are threadedly connected with the thrust brackets **37**, **38** and **39** and slidably extend through the spring seats **51**, **52** and **53**.

The clockwise drawing stroke of the first slide **14** is produced by a suitable actuating means for the draw lever **41** and which, in this instance, is a rotary cam **57** carried by a transverse drive shaft **59** rotatably mounted in suitable bearings **60** and **61** of the frame **12**. The cam **57** is engaged by a cam follower provided on the lower end of the draw lever **41** and which is in the form of a roller **62** mounted on a pivot shaft **63**.

The drawing stroke of the lever **41** takes place as the roller **62** traverses the rise portion **57a** of the cam and the return stroke occurs as the roller traverses the fall portion **57b**. After traversing the fall portion **57b**, the roller **62** operates on the cylindrical dwell portion or hub **58** until it is again engaged by the rise portion **57a** at the start of the next drawing cycle. The lift or throw of the cam **57** is of a suitable value to provide a drawing stroke of the desired length for the slide **14**.

The draw lever **42** for the second slide **15** is actuated by a second cam **64** carried by the shaft **59** and which engages a roller **65** forming a cam follower for this lever by being mounted on a pivot shaft **66**. The clockwise drawing stroke of the lever **42** is produced as the roller **65** traverses the rise portion **64a** of the cam and the return stroke occurs as the roller traverses the fall portion **64b** of the cam. After traversing the fall portion **64b**, the roller **65** operates on the cylindrical dwell portion or hub **58** until it is again engaged by the rise portion **64a** during the next drawing cycle.

The cam **64** has a lift or throw of a suitable value to provide a drawing stroke of the desired length for the slide **15**. The cam **64** is located on the shaft **59** in an arcuately spaced relation to the actuating cam **57** for the slide **14**. The arcuate spacing of the cam **64** relative to the cam **57** can be of any desired value, but is preferably such that the drawing stroke of the slide **15** will be started substantially simultaneously with the completion of the drawing stroke of the slide **14**.

The roller **62** of the draw lever **41** is maintained in engagement with the cam **57** by the action of a compression spring **68** having one end thereof in engagement with a spring seat **69** provided on this draw lever. The spring **68** is disposed in surrounding relation to a guide rod **70**, and its opposite end is in engagement with a threadedly adjustable spring seat **71** provided on such rod. One end of the guide rod **70** is engaged in a socket recess **72** provided in a thrust lug **73** of the frame **12**, and its opposite end slidably extends through an opening of the spring seat **69**.

Similarly, the roller **65** of the draw lever **42** is maintained in engagement with the cam **64** by a compression spring **74** disposed around a guide rod **75** and having one end thereof engaging a spring seat **76** provided on this draw lever. One end of the guide rod **75** slidably extends through the spring seat **76**, and its other end is rockably engaged in a socket recess **77** of a thrust lug **78**. The action of the springs **68** and **74** is such as to hold the rollers **62** and **65** against their associated cams **57** and **64** or against the cylindrical dwell portion **58**.

The draw lever **43** for the third slide **16** is actuated by a rotary cam **80** secured to a transverse drive shaft **82** rotatably mounted in the frame **12** by suitable bearings **83** and **84**. The cam **80** has a lift or throw of a suitable value to provide a drawing stroke of the desired length for the slide **16** and is engageable by a roller **86** mounted on a pivot shaft **87** of the draw lever **43**. The clockwise drawing stroke of the lever **43** is produced as roller **86** traverses the rise portion **80a** of the cam and the return stroke occurs as the roller traverses the fall portion **80b** of the cam. After traversing the fall portion **80b**, the roller **86** operates on the cylindrical dwell portion **81** until it is again engaged by the rise portion **80a** during the next drawing cycle.

The lift portion of the cam **80** is located in arcuately spaced relation to the cams **57** and **64**, such that the drawing stroke of the slide **16** will occur in timed sequence with the drawing stroke of the slides **14** and **15**. When the series of drawing dies comprises three dies, as in the wire drawer **10**, the cams **57**, **64** and **80** are spaced approximately 120 degrees apart, such that the load of the drawing strokes will be distributed relatively evenly around the full 360 degrees of arcuate extent of the drive shaft **59**.

The roller **86** is held in engagement with the face of the cam **80** by the action of a compression spring **88** disposed around a guide rod **89** and engaging a spring seat **90** of the lever **43**. The opposite end of the spring **88** engages a spring seat provided on this guide rod similar to the spring seat **71** of the guide rod **70**. One end of the guide rod **89** slidably extends through the spring seat **90** of the lever **43** and its opposite end is rockably engaged in a socket recess **91** of the frame **12**.

The drive shaft **59** is suitably driven from an available source of power, such as the fabricating machine or header with which the wire drawer **10** is being used. For this purpose, this shaft is provided with a drive sprocket **92** engaged by a drive chain **93**. The shaft **82** is driven from the shaft **59** by means of a chain **94** extending around sprockets **95** and **96**. An idler sprocket **97** carried by a swingable arm **98** engages the chain **94** and forms a tightener for this chain.

From the construction above described for the wire drawer **10**, and with the parts of the machine occupying the relative positions shown in the drawings, it will be seen that the lift portion **57a** of the cam **57** is imparting

a drawing stroke to the first slide **14** by which the drawing die **17** is being pushed over the wire **11** while this wire is being held against backward movement by the grip device **13**. The elongation which is produced in the wire **11** by the drawing stroke of the die **17** will occur in the portion of the wire extending between this die and the grip device **13**. This elongation in the wire will be accommodated in the machine by a movement of the second slide **15** toward the right away from its draw lever **42** and by a similar movement of the third slide **16** away from its draw lever **43**. This movement of the slides **15** and **16** away from their draw levers is permitted by, and is in opposition to, the compression springs **49** and **50**.

Substantially simultaneously with the completion of the drawing stroke of the die **17**, that is to say, substantially simultaneously with the crest of the cam **57** leaving the roller **62**, the lift portion **64a** of the cam **64** will begin to actuate the lever **42** to cause the drawing stroke of the die **18**, during which this die is pushed over the wire **11** while the latter is held against backward movement by the grip device **13**. The elongation produced in the wire by this drawing stroke of the die **18** will be accommodated in the machine by a further movement of the slide **16** away from its draw lever **43**.

Substantially simultaneously with the completion of the drawing stroke of the die **18**, that is to say, substantially simultaneously with the crest of the cam **64** leaving the roller **65**, the lift portion **80a** of the cam **80** will actuate the draw lever **43** to cause a drawing stroke of the die **19** during which the latter will be pushed over the wire **11**. During the initial portion of the swinging movement imparted to the draw levers **42** and **43** by the cams **64** and **80**, these levers will move through and take up the space by which the slides **15** and **16** were shifted away from these levers by the drawing elongation previously produced in the wire by the preceding die or dies of the series. As soon as this intervening space has been taken up, the draw levers will engage the slides **15** and **16** and produce the drawing strokes thereof.

After all of the dies of the series have been moved through their drawing strokes as explained above, the wire **11** is fed forward by the feed rolls and during this forward feeding movement, the slides **14**, **15** and **16** move through their return stroke by advancing with the wire under the action of the springs **48**, **49** and **50**.

From the accompanying drawings and the foregoing detailed description, it will now readily be understood that the wire drawer **10** accomplishes a multiple-draw reduction of the wire stock by actuation of the drawing dies of a series in a sequence, such that the drawing operation of one die will start substantially simultaneously with the completion of the drawing operation of a related or preceding die of the series. In this way, the maximum load to which the machine is subjected will be the maximum drawing load accompanying the actuation of some one of the dies of this series. Moreover, it will be seen that in this novel wire drawer, the provision for movement of the die slides away from their respective actuating devices accommodates the elongation produced in the wire by the preceding die or dies of the series. It will, accordingly, be understood that this multiple-draw wire drawer extends the range of usefulness of various fabricating machines and headers by producing a greater reduction in the stock diameter than has heretofore been possible in available wire drawing machines. It will also be seen that although the machine herein disclosed employs three drawing dies, a larger or smaller number of such dies could be provided within the 360 degrees of available angular extent of the drive shafts **59** and **82** and through which arcuate distance a corresponding number of actuating cams could be spaced.

From the disclosure herein made of the wire drawer **10** it will be further understood that the wire **11** is advanced intermittently in the direction indicated in the drawings, and between the successive advance movements is held against backward movement by the grip device **13** and is subjected to the above-explained multiple-draw drawing operation by the drawing dies of the series.

Although the novel wire drawer of this invention has been illustrated and described herein to a somewhat detailed extent, it will be understood, of course, that the invention is not to be regarded as being limited correspondingly in scope, but includes all changes and modifications coming within the terms of the claims hereof.

Having thus described my invention, I claim:

1. In a wire drawer, a frame, a plurality of slides disposed in a series and individually reciprocably movable on said frame in the direction of and along the axis of a wire to be drawn, a plurality of drawing dies having draw orifices of progressively different sizes, grip means on said frame and effective on said wire to prevent backward movement thereof, said dies being carried by the respective slides and being movable thereby through drawing strokes over said wire and in a direction away from said grip means, and slide actuating mechanism including devices effective on the respective slides for imparting said drawing strokes thereto in succession and in series sequence.

2. In a wire drawer, a frame, a plurality of slides disposed in a series and individually reciprocably movable on said frame in the direction of and along the axis of a wire to be drawn, a plurality of drawing dies having draw orifices of progressively different sizes, grip means on said frame and effective on said wire to prevent backward movement thereof, said dies being carried by the respective slides and being movable thereby through drawing strokes over said wire and in a direction away from said grip means, and slide actuating mechanism including actuating members engageable with the respective slides for imparting said drawing strokes thereto in succession and in series sequence, the slide relatively more remote from said grip means being movable away from its actuating member during the drawing stroke of another of said slides which is relatively closer to said grip means for accommodating elongation produced in said wire.

3. In a wire drawer, a frame having a guideway thereon, a plurality of slides individually reciprocable in said guideway and disposed in a spaced-apart series relation therealong, grip means on said frame adjacent one end of said guideway and adapted to grip the wire to be drawn to prevent backward movement thereof, a plurality of drawing dies in a series extending along said guideway and having draw orifices of sizes decreasing progressively toward said grip means, said dies being carried by the respective slides and being movable thereby through drawing strokes along said wire and in a direction away from said grip means, and slide actuating mechanism including thrust members engageable with the respective slides for imparting said drawing strokes thereto in succession and in a sequence starting with the slide nearest said grip means, the slides relatively more remote from said grip means being movable away from their thrust members by substantially the amount of the elongation produced in the wire of the drawing action of the dies of the preceding slides of the series.

4. A wire drawer as defined in claim 3 in which the thrust members are actuated in timed relation by rotary cam means.

5. A wire drawer as defined in claim 3 in which the thrust members are actuated in timed relation by rotary cams, said cams having an arcuate spacing and throw such that the drawing stroke of the die of each succeeding slide of the series starts substantially simultaneously with the end of the drawing stroke of the next preceding slide.

6. A wire drawer as defined in claim 3 in which the thrust members are swingable draw levers actuated in

timed relation by rotary cams and having cam follower means held against said cams by spring means.

7. In a wire drawer, a frame having a guideway thereon, a plurality of slides individually reciprocable in said guideway and disposed in a spaced-apart series relation therealong, grip means on said frame adjacent one end of said guideway and adapted to grip the wire to be drawn to prevent backward movement thereof, a plurality of drawing dies in a series extending along said guideway and having draw orifices of a size decreasing progressively toward said grip means, said dies being carried by the respective slides and being movable thereby through drawing strokes along said wire and in a direction away from said grip means, slide actuating mechanism including thrust members engageable with the respective slides for imparting said drawing strokes thereto in succession and in a sequence starting with the slide nearest said grip means, and spring devices effective on said slides for producing a return stroke thereof and normally urging said slides into engagement with said thrust members, the slides relatively more remote from said grip means being movable away from their thrust members and in opposition to said spring devices by substantially the amount of the elongation produced in the wire by the drawing action of the dies of the preceding slides of the series.

8. In a wire drawer, a frame having a longitudinal guideway thereon, a plurality of slides individually reciprocable in said guideway and disposed in a spaced-apart relation in a series extending therealong, grip means on said frame adjacent one end of said guideway and adapted to grip the wire to be drawn to prevent backward movement thereof, a plurality of drawing dies having draw orifices of sizes decreasing progressively toward said grip means, said dies being carried by the respective slides and being movable thereby through drawing strokes along said wire and in a direction away from said grip means, shaft means rotatable in said frame and extending transversely to said guideway, rotary cam means driven by said shaft means, draw levers swingable on said frame and having pushing engagement with the respective slides of said series, said levers being actuated by said rotary cam means in timed sequence for causing the drawing strokes of said slides in succession starting with the slide which is nearest said grip means, and spring means effective on said slides for imparting return stroke movement thereto and urging said slides toward engagement with said levers, the slides relatively more remote from said grip means being movable away from their draw levers during elongation produced in the wire by the drawing dies of the slides which are relatively closer to said grip means.

9. A wire drawer as defined in claim 8 in which said shaft means includes a first rotary shaft having a pair of said draw levers located on opposite sides thereof, and in which said rotary cam means comprises a pair of arcuately spaced cams driven by said first shaft and adapted to actuate said pair of levers.

10. In a wire drawer, a frame having a longitudinal guideway thereon, a plurality of slides individually reciprocable in said guideway and disposed in a spaced-apart relation in a series extending therealong, a grip means on said frame adjacent one end of said guideway and adapted to grip the wire to be drawn to prevent backward movement thereof, a plurality of drawing dies having draw orifices of sizes decreasing progressively toward said grip means, said dies being carried by the respective slides and being movable thereby through drawing strokes along said wire and in a direction away from said grip means, shaft means rotatable in said frame and extending transversely to said guideway, rotary cam means driven by said shaft means, and draw levers swingable on said frame and having pushing engagement with the respective slides of said series, said levers being actuated by said rotary cam means in timed sequence for causing the drawing strokes of said slides in succession during an operating cycle of 360 degrees of rotation of said shaft means, said rotary cam means comprising cams spaced arcuately of said shaft means such that the drawing stroke of one die starts substantially simultaneously with the ending of the drawing stroke of an adjacent die and such as to distribute the drawing strokes of said dies throughout said 360 degrees of rotation, the slides relatively more remote from said grip means being movable away from their draw levers during elongation produced in the wire by the drawing dies of the slides which are relatively closer to said grip means.

11. The method of drawing wire which comprises the steps of, gripping a wire for holding the same against backward movement, and pushing a series of drawing dies over and along the wire for drawing the same while the wire is being thus held against backward movement, said pushing of the dies being carried out in succession and in a series sequence starting with such pushing of an end die of the series.

12. The method of drawing wire which comprises the steps of, gripping a wire for holding the same against backward movement, pushing a series of drawing dies over and along the wire for drawing the same while the wire is being thus held against backward movement, said pushing of the dies being carried out in succession and in a series sequence starting with such pushing of an end die of the series, and advancing the wire and dies together after each such series sequence drawing actuation of the dies.

13. The method of drawing wire which comprises the steps of, gripping a wire for holding the same against backward movement, and pushing a series of drawing dies over and along the wire for drawing the same while the wire is being thus held against backward movement, said pushing of the dies being carried out in succession and in a series sequence starting with the die which is the most remote from the gripping point.

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