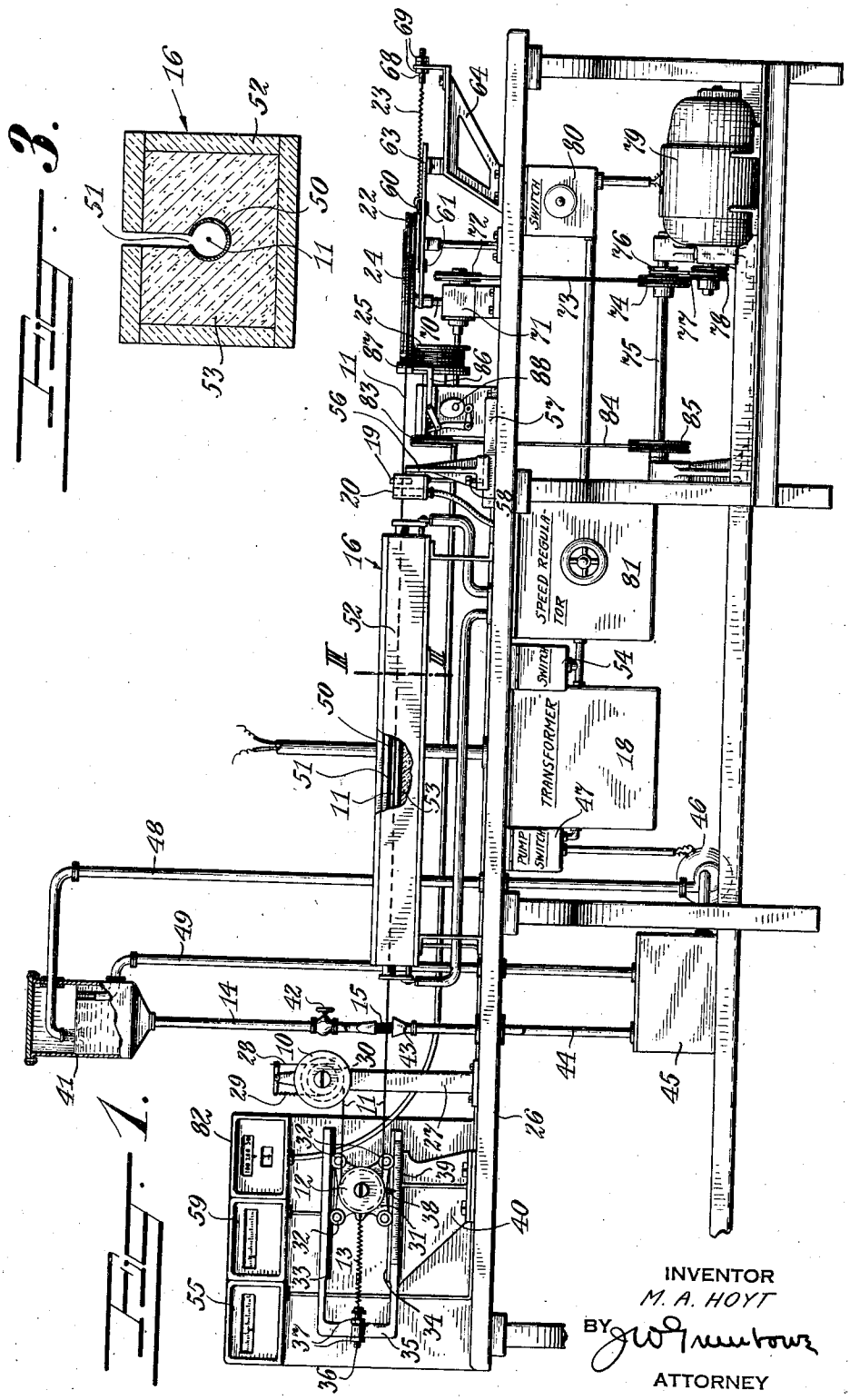
Jan. 23, 1940. M. A. HOYT 2,187,785

WIRE DRAWING METHOD AND MACHINE

Filed Nov. 28, 1936 2 Sheets-Sheet 1



Jan. 23, 1940. M. A. HOYT 2,187,785

WIRE DRAWING METHOD AND MACHINE

Filed Nov. 28, 1936 2 Sheets-Sheet 2

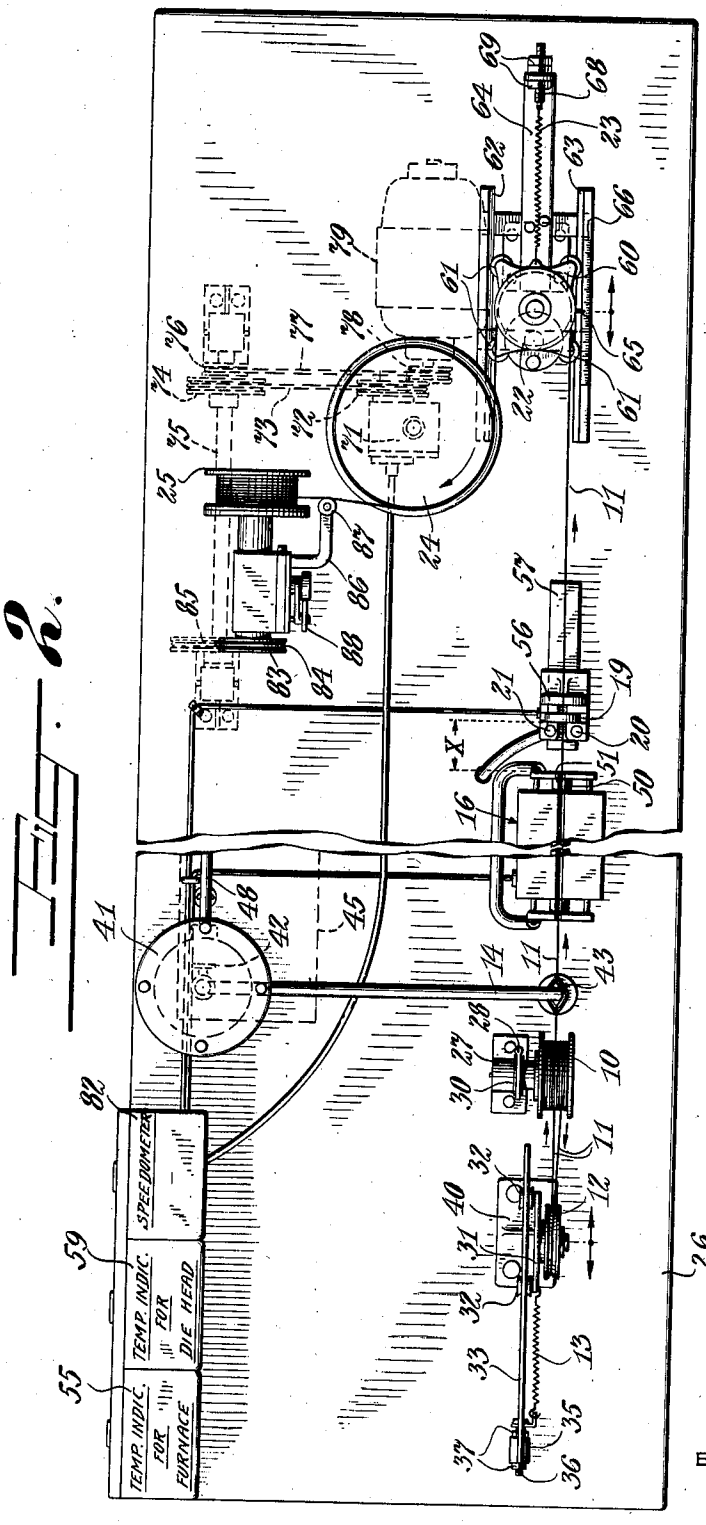


Fig. 2.

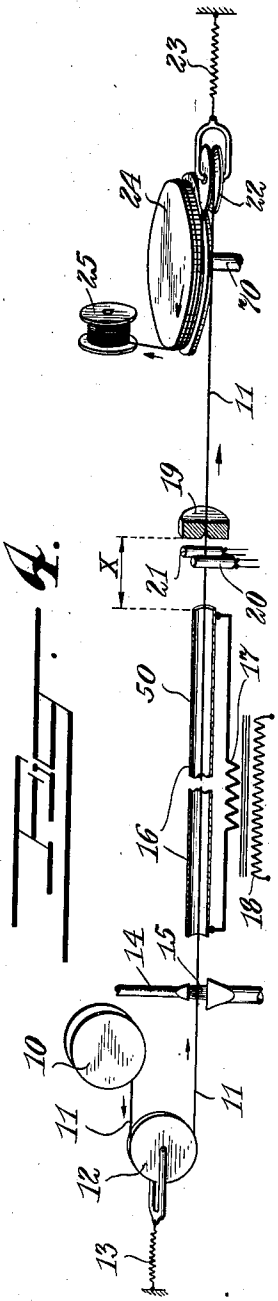


Fig. 4.

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WIRE DRAWING METHOD AND MACHINE

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18 Claims. (Cl. 205—13)

This invention relates to wire drawing and more particularly to an improved method and machine for making refractory metal filaments.

In the manufacture of filaments for incandescent electric lamps, it is very important that the product be of uniform diameter, resistance, and weight per unit of length. It is believed that variations in these characteristics are due to variations in the density and hardness of the stock from which the filament is drawn, as well as variations in the heat treatment, temperature of the drawing die, and speed of drawing.

In order to improve the product, it is an object of my invention to make wire, particularly for use as incandescent electric lamp filaments, by an improved method and an improved machine in which the various factors contributing to the product may be accurately adjusted and measured in order to not only determine what is the best method, but to practice that method, eliminate variation in the wire, and produce a uniform and desirable product.

Another object of my invention is the provision of a wire drawing machine in which means are provided for locating irregular spots in the wire, testing the force required to draw the wire, when employing dies of various shapes, testing the variation in drawing force when employing different lubricants, arriving at the proper temperature of the wire being drawn for getting the best results, determining the proper die temperature, and finding out if it is possible to draw wire successfully at increased speed.

A further object of my invention is the provision of an improved method of wire drawing involving the accurate control of the speed at which the wire is drawn, the tension to which it is subjected during drawing, the temperature of heat treating, and the temperature of the die, in order that a uniform and highly desirable product may be obtained.

Other objects and advantages of the invention relating to the particular arrangement and construction of various parts will become apparent as the description proceeds.

Referring to the drawings illustrating my invention—

Fig. 1 is a fragmentary elevational view, partly in vertical section, of a wire drawing machine embodying my invention;

Fig. 2 is a fragmentary plan view of the machine illustrated in Fig. 1;

Fig. 3 is a transverse sectional view on the line III—III of Fig. 1; and

Fig. 4 is a diagrammatic view illustrating the main features of my improved machine.

Referring to the drawings in detail, like parts being designated by like reference characters, and first considering Fig. 4, we find a spool 10 from which the stock or wire 11 to be drawn is unwound and passes over a pulley 12, resiliently held in place by means of a spring 13, thereby keeping the wire 11 under a desired tension.

After passing from the tensioning pulley 12, the wire is lubricated, as by means of a fountain 14 from which a bath of desired lubricating liquid 15, which may be of a type containing graphite, such as referred to in the Benbow patent No. 1,168,050, flows and wets the wire 11 just before it enters the heat treating furnace 16. This furnace is desirably electrically heated, being connected to the secondary 17 of a transformer 18, controlled by means to be subsequently described.

The furnace, as distinguished from previous wire drawing furnaces, heats the wire to only a moderate temperature thereby slowly, rather than quickly, evaporating the moisture from the aquadag or other lubricant, thus avoiding the quick formation of steam which flows off particles of the lubricant which are then burnt, and at the same time, because of its length, effecting a desired heat treatment of the wire, by bringing it to the furnace temperature, prior to its passage to the die 19.

The die 19 is maintained at a desired adjustable constant temperature, preferably by means of electric heaters 20 and 21. The distance X between the die and the outer end of the furnace may be varied, in order to suit conditions found to be best in accordance with the size and character of the wire being drawn.

The wire 11 passes from the die 19 around a bodily-movable pulley 22, actuated by an associated spring 23 for balancing the spring 13 and maintaining the wire under the desired tension. After passing from the pulley 22, the wire passes around a capstan 24, rotated at desired constant speed, and is then wound up on a reel 25.

The foregoing description is of the basic elements of the machine as they are employed in practicing my improved method. We will now consider the elements of said machine more in detail with particular reference to the Figs. 1, 2, and 3.

All of the apparatus previously described is desirably mounted on and below a table 26 in order to provide for convenient inspection and control. The spool 10 from which the wire 11

is unwound is shown rotatably mounted on a standard 27 extending upward from the table 26. In order to balance the tension of spring 13, which maintains the wire 11 stretched, braking means are provided for applying a friction drag on said spool, said means in the present embodiment taking the form of a wire 28 held under tension, by means of a spring 29, around a braking drum 30 rotatable with the spool 10.

The pulley 12 is desirably rotatably mounted on a carriage 31 having wheels 32 which ride on tracks 33 and 34 on a frame 35, between which frame and said carriage is the pulley tensioning spring 13 adjusted, as by means of a bolt 36 and nuts 37, to apply the desired tension to the wire 11. The amount of tension on the wire is desirably indicated by a pointer 38, on the carriage 31, movable along a scale 39 formed on the frame 35, which is in turn supported on the table 26 by means of a base or bracket portion 40.

The means for applying the aquadag or other lubricant 15 comprises the pipe 14 running from an upper or supply reservoir 41 and controllable by a valve 42 from which pipe the lubricant flows over the wire 11. The pipe 14 discharges into a funnel 43, and through a pipe 44 to the lower reservoir 45, from whence it is drawn by means of a pump 46, controlled by a switch 47 and fed by a supply pipe 48, to the reservoir 41. A constant head of lubricating liquid is provided, and loss by flooding of the reservoir 41 avoided, by the provision of an overflow pipe 49, the upper end of which takes any liquid above the level illustrated in Fig. 1 and lets it flow directly to the lower tank 45.

The electric furnace 16 desirably comprises a resistance tube 50, relatively long in order to allow the wire to be drawn at a fairly high rate of speed and still maintain the desired length of heat treatment. The temperature in the furnace is adjusted so that it is moderate enough to avoid burning the lubricant, and thereby possibly avoid the necessity of renewal each time the wire passes to the furnace and die for reduction in section, while at the same time eliminating the water or other vehicle which carries the graphite, if such is the type of lubricant employed.

In a desirable embodiment of my invention, the tube 50 was made about forty inches long and formed with a slot 51 for receiving the wire 11. The tube 50 is enclosed in a box 52, of asbestos or other insulating means, and said box may, if desired, contain heat insulating material 53 of any desired fireproof character. The furnace is energized by means of the transformer 18 provided with a switch and control means 54, the temperature in the furnace being shown by means of the indicator 55.

The die 19 is mounted in a head which carries the electric heater elements, and supported from the table 26 by means of a standard 56, longitudinally slidable on a track 57, and adapted to be clamped in adjusted position with respect to the furnace 16 by means of a set screw 58. Energizing and controlling means for the die are provided as for the furnace, the die head temperature being shown by the indicator 59.

The pulley 22, like the pulley 12, is desirably rotatably mounted on a carriage 60 having wheels 61 riding on tracks 62 and 63 of a supporting frame 64. The frame 64 is mounted on the table 26 and the carriage has a pointer 65 movable along an indicating scale 66 for showing the tension on the wire 11. The tension is applied by means of the spring 23, one end of which is secured to the carriage 60 and the other to a screw 68 secured in adjusted position on the frame 64 by means of associated nuts 69.

The constant speed capstan 24, in the present embodiment, is mounted on a vertical shaft 70 driven by means of suitable gearing 71 and a connected pulley 72, through belt 73, from pulley 74 carried by jack shaft 75, and in turn driven by pulley 76, through belt 77, from pulley 78 carried by motor 79, controlled by switch 80 and speed regulator 81. The speed of the capstan 24 is indicated, and the number of revolutions may be counted, by the speedometer and counter 82.

After passing around the capstan 24, the wire is wound up on the reel 25 which is frictionally driven by its pulley 83 by means of the belt 84 passing over the driving pulley 85 on the jack shaft 75. Between the pulley 83 and the reel 25 is friction slip means which causes the reel 25 to wind up the wire 11 as fast as it passes off the capstan 24, but exerts no force great enough to slip the wire along the capstan. The force exerted by the reel 25, however, is great enough to hold the wire 11 in such frictional engagement with the capstan that said wire is driven at a speed corresponding with the circumferential speed of the capstan.

In order to cause the wire to be evenly wound on the reel 25, an arm 86 carrying a roller 87 is provided which is caused by mechanism 88, to push the wire across the face of the reel 25 and allow it to return periodically, in a manner which will be clear to those skilled in the art.

From the foregoing it will be seen that I have devised an improved apparatus and method of wire drawing, whereby not only may the operations be accurately controlled, the speed momentarily decreasing if the resistance to wire drawing increases and increasing if the resistance to wire drawing decreases as the pulley 22 and its carriage moves toward and away from the pulley 12, on account of a corresponding lengthening and shortening of the springs 13 and 23, the momentary variation in speed being equal to twice the momentary speed of the pulley carriage 60 on the tracks 62 and 63, but means are provided for indicating the capstan speeds and furnace and die head temperatures, so that comparisons may be made with the object of determining the optimum conditions for drawing wires of various sizes and compositions. It will, however, be understood that my method and machine is particularly adapted for drawing tungsten wire for use as filaments for incandescent electric lamps. I have found that when drawing tungsten wire ranging in size from approximately 1 to 7 mils in diameter, the speed at which the wire travels, or the circumferential speed of the capstan 24, may be approximately 55 meters per minute, employing a forty inch furnace maintained at a temperature of approximately 600° C., when the die head is kept at a temperature of 350° C.

Although a preferred embodiment of my invention has been disclosed, it will be understood that modifications may be made within the spirit and scope of the appended claims.

I claim:

1. The method of wire drawing comprising passing wire, while subjected to a desired degree of tension, through a lubricant bath, a relatively long furnace of desired constant moderate temperature, to allow the lubricant vehicle to be

slowly evaporated therefrom while the wire is heat-treated, and through a temperature-controlled hot die spaced a desired distance from the furnace outlet at uniform speed subject, however, to temporary increases and decreases as the force of drawing the wire decreases and increases.

2. The method of wire drawing comprising passing a lubricated wire through a relatively long furnace of desired constant moderate temperature, to slowly dry the lubricant and heat-treat the wire, and then passing said wire through a temperature-controlled die spaced a desired distance from the furnace outlet, at uniform speed, subject, however, to temporary increases and decreases in accordance with the force of wire drawing.

3. The method of wire drawing comprising passing wire through a lubricating bath, a lubricant drying and heat-treating furnace, through a temperature controlled heated die, and then over a bodily-movable pulley spring-actuated to vary the tension on said wire, in accordance with the wire-drawing force, and pulling the wire beyond said pulley at uniform speed, whereby it is subject to temporary increases and decreases in drawing speed in accordance with the decreases and increases in the force of wire drawing.

4. The method of wire drawing comprising passing wire through a lubricant bath containing graphite, a relatively long furnace of desired moderate temperature to allow the lubricant vehicle to be slowly eliminated while the wire is heat-treated, and then through a temperature controlled heated die spaced a desired distance from the furnace outlet.

5. A machine for wire drawing comprising a relatively long furnace maintainable at a desired constant moderate temperature, a lubricant bath at the entering end of said furnace, a die adapted to be maintained at a desired constant temperature and spaced a desired distance from the outlet end of said furnace, a constant speed capstan for drawing wire through said bath, furnace, and die, means for resiliently holding said wire and controlled by the force required to draw said wire for varying the speed of wire drawing.

6. A machine for wire drawing comprising a relatively long furnace maintainable at a desired constant moderate temperature, a die adapted to be maintained at a desired constant temperature and spaced an adjusted distance from the outlet end of said furnace, a constant speed capstan for drawing wire through said furnace and die, means for resiliently holding said wire and controlled by the wire drawing force required for varying the speed of the wire.

7. A machine for wire drawing comprising a heat treating furnace, lubricant means at the entering end of said furnace, a die maintainable at constant temperature disposed an adjusted distance from the outer end of said furnace, a spring-controlled bodily-movable pulley, and means for drawing said wire through said lubricating means, furnace, die, and over said pulley at a desired nominal constant speed, whereby the length of the pulley spring varies in accordance with the force of wire-drawing, to momentarily change the wire-drawing speed inversely with said force.

8. A machine for wire drawing comprising a relatively long electric furnace, maintainable at an adjustable moderate temperature, lubricating means at the entering end of said furnace, an electrically heated die maintainable at an adjusted temperature and spaced a desired distance from the outlet end of said furnace, means for drawing said wire through said lubricating means, furnace, and die, and means comprising a spring-controlled bodily-movable pulley, over which said wire passes, for holding said wire under tension and controlled by the force of wire drawing for momentarily varying the drawing speed thereof inversely with said force.

9. A machine for wire drawing comprising a relatively long furnace maintainable at a desired moderate temperature, lubricating means at the entering end of said furnace, heated die means spaced a desired distance from the outlet end of said furnace and maintainable at an adjusted temperature, and a constant speed captain for drawing wire through said lubricating means, furnace, and die.

10. A machine for wire drawing comprising a heat treating furnace, a die maintainable at constant temperature and disposed an adjusted distance from the outer end of said furnace, a spring-controlled bodily-movable pulley, and means for drawing said wire through said furnace and die at a desired nominal constant speed, whereby the length of the pulley spring varies in accordance with the force of wire-drawing, to momentarily change the wire-drawing speed inversely with said force.

11. A machine for wire drawing comprising a relatively long electric furnace, maintainable at an adjustable moderate temperature, an electrically heated die maintainable at an adjusted temperature and spaced a desired distance from the outlet end of said furnace, means for drawing said wire through said furnace and die, and means comprising a spring-controlled bodily-movable pulley, over which said wire passes, for holding said wire under tension and controlled by the force of wire drawing for momentarily varying the drawing speed thereof inversely with said force.

12. A machine for wire drawing comprising a relatively long furnace maintainable at a desired moderate temperature, means indicating said temperature, die means spaced a desired distance from the outlet end of said furnace and provided with heating means for keeping it at an adjusted temperature, means indicating said die temperature, a constant speed capstan for drawing wire through said furnace and die, means indicating said speed, and a spring-controlled bodily-movable pulley, over which said wire passes on its way from the die to the capstan, for momentarily varying the drawing speed inversely with the drawing force.

13. The method of wire drawing comprising passing wire, while subjected by spring-controlled means to a desired degree of tension, through a relatively long furnace of desired constant moderate temperature, to allow the wire to be heat-treated, and through a temperature-controlled hot die spaced a desired distance from the furnace outlet by pulling said wire at uniform speed, whereby said spring-controlled means moves as the force of drawing the wire decreases and increases to cause inverse changes in the wire-drawing speed.

14. The method of wire drawing comprising passing a wire through a relatively long furnace of desired constant moderate temperature, to heat-treat the wire, then through a temperature-controlled die spaced a desired distance from the furnace outlet, and then over a spring-controlled

bodily-movable pulley, pulling it at uniform speed, whereby it is subject, however, to temporary increases and decreases in drawing speed inversely with wire drawing force variations.

15. The method of wire drawing comprising passing wire through a heat-treating furnace, through a temperature controlled die, and then over a bodily-movable pulley spring-actuated to vary the tension on said wire, in accordance with the wire-drawing force, and pulling the wire beyond said pulley at uniform speed, whereby it is subject to temporary increases and decreases in drawing speed in accordance with the decreases and increases in the force of wire drawing.

16. The method of wire drawing comprising passing wire through a relatively long furnace of desired moderate temperature to allow the wire to be heat-treated, then through a temperature controlled die spaced a desired distance from the furnace outlet, and then over a bodily-movable pulley spring-actuated to vary the tension on said wire, in accordance with the wire-drawing force, and pulling the wire beyond said pulley at uniform speed, whereby the wire drawing speed varies inversely with the wire drawing force.

17. A machine for drawing tungsten wire of small size comprising an electrically heated furnace about forty inches long maintained at a substantially constant temperature of approximately 600° C., a die maintained at a substantially constant temperature of approximately 350° C., and spaced a short distance from the outlet end of said furnace, a capstan rotated at a constant speed for normally drawing wire through said furnace and die at approximately fifty-five meters per minute, and means for resiliently holding said wire under tension, controlled by the wire drawing force, for momentarily decreasing the wire drawing speed upon an increase in said force and momentarily increasing the wire drawing speed upon a decrease in said force.

18. A machine for drawing tungsten wire of small size comprising a furnace maintained at a substantially constant temperature of approximately 600° C., a die maintained at a substantially constant temperature of approximately 350° C., and spaced a short distance from the outlet end of said furnace, a capstan rotated for normally drawing wire through said furnace and die at approximately fifty-five meters per minute, and means for resiliently holding said wire under tension, controlled by the wire drawing force, for momentarily decreasing the wire drawing speed upon an increase in said force and momentarily increasing the wire drawing speed upon a decrease in said force.

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