

July 27, 1937.

A. SIMONS ET AL

2,088,040

METHOD OF AND APPARATUS FOR WIRE DRAWING

Filed Aug. 7, 1936

2 Sheets-Sheet 1

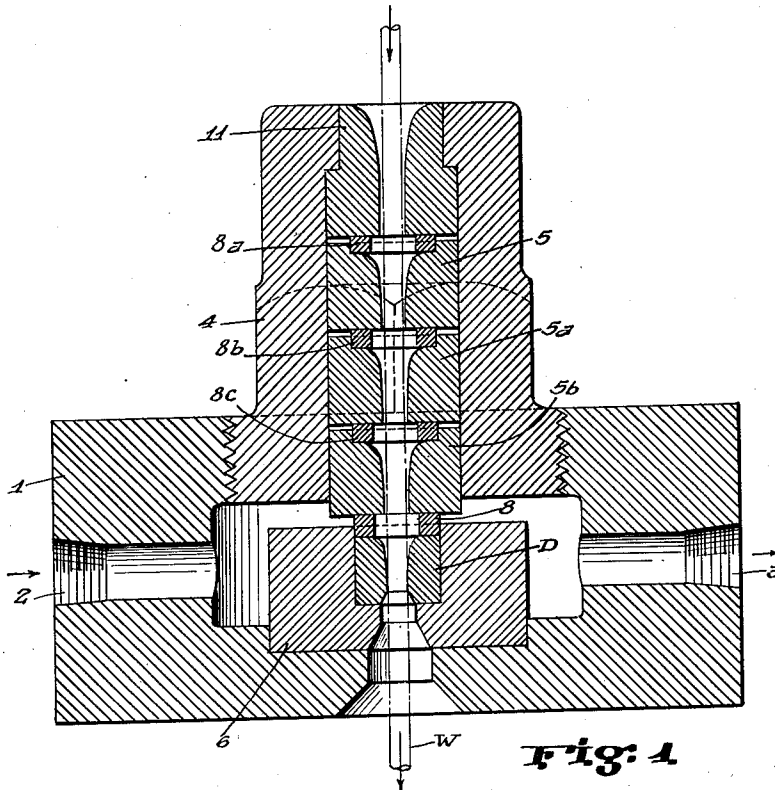


Fig. 1

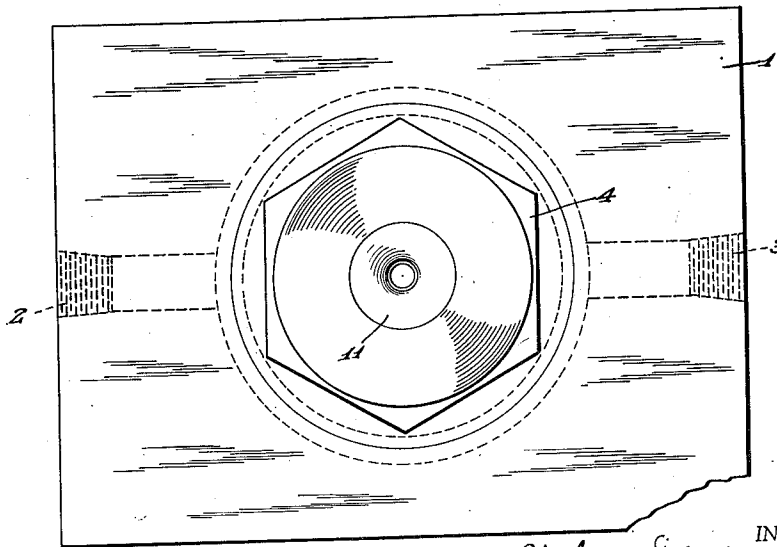


Fig. 2

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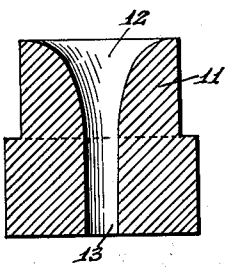


Fig. 3

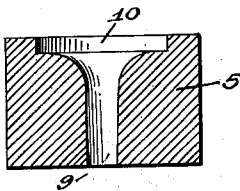


Fig. 5

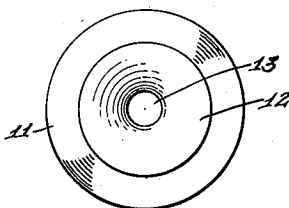


Fig. 4

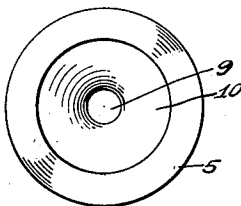


Fig. 6

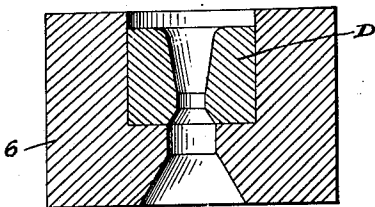


Fig. 7

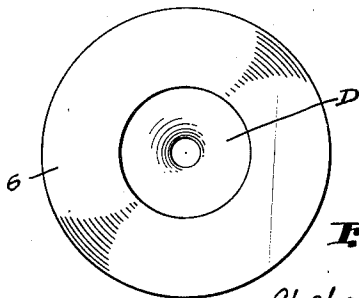


Fig. 8

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## UNITED STATES PATENT OFFICE

2,088,040

## METHOD OF AND APPARATUS FOR WIRE-DRAWING

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Application August 7, 1936, Serial No. 94,740

7 Claims. (Cl. 205—22)

Our invention relates to a new and improved method of wire-drawing, and to a new and improved apparatus for wire-drawing. The invention generally applies to the drawing of any material, of any size or shape, through a die or dies, so that it is not necessarily limited to wire-drawing. It relates generally to every type of drawing operation, as distinguished from a rolling operation.

One of the objects of our invention is to provide a method of drawing wire and other material, whereby a back or retarding force is imposed upon the wire or other article, as the same is pulled through the die or dies, and said back pull or retarding pull is above a predetermined limit. The invention is particularly valuable in the drawing of wire which is used for making wire rope. In the best embodiment of the invention, the back pull or retarding pull is close to the elastic limit of the reduced wire, at the respective pass.

Another object of our invention is to impose a sufficiently high back pull or retarding force upon the wire or the like, so as materially to lessen the wear upon the die.

Another object of our invention is to provide a method which will be suitable for drawing wire or the like, which is made of stainless steel, so as to make it possible to produce a completed and bright wire, as the result of direct drawing, and by eliminating or lessening the necessity of subsequent polishing operations.

Another object of our invention is to eliminate the effect of the die, either substantially or wholly, in shaping the wire or other member, in the operation of reducing the thickness or diameter of the wire or other member.

Another object of our invention is to surround the wire or other member, anterior to the die or dies (if said die or dies are utilized) with a material or materials other than the material of the rigid guide means through which the wire or other member is led, said surrounding material providing a layer of sufficient length and under sufficient pressure and having a sufficient frictional effect under said condition of pressure, so as to impose a retarding force upon the movement of the wire or other member, which retarding force is sufficient to affect the drawing of the wire or other member.

Other objects of our invention will be set forth in the following description and drawings which illustrate a preferred embodiment of one form of mechanism which may be utilized for carrying out the invention, it being understood that the above statement of the objects of our invention is intended generally to explain the same without limiting it in any manner.

Fig. 1 is a central sectional view of the apparatus, this being drawn to scale. The scale of Fig. 1

is sixty-six and two-thirds (66⅔%) per cent greater than the actual size of a device which has been used in the first pass for cold drawing high-carbon steel wire.

Fig. 2 is a top plan view of Fig. 1.

Fig. 3 is a central sectional view of the top or entering member which is shown in Fig. 1, the scale of Fig. 3 being larger than the scale of Fig. 1. The scale of Fig. 3 is twice the actual size.

Fig. 4 is a top plan view of Fig. 3.

Fig. 5 is a central sectional view of one of the members which succeeds the top or entering member, this also being drawn to double scale size.

Fig. 6 is a top plan view of Fig. 5.

Fig. 7 is a central sectional view showing the die and the holder thereof, this also being drawn to double scale.

Fig. 8 is a top plan view of Fig. 7.

While we have shown an actual working device and given the scale thereof, in order to give a single complete and practical example of our invention, we do not wish to be limited to the dimensions or to the relative proportions of the parts specified herein.

Heretofore, the drawing of wire or the like depended largely upon the use of a die, through which the wire or the like was pulled. These dies wore out more or less rapidly, depending upon the material of the die and the material of the wire, and the efficiency of the lubrication of the wire, and the speed of drawing.

It has been proposed to provide the die with means for supplying lubricant under pressure to the die, as shown for example in U. S. Patent No. 1,582,434, issued on April 27, 1926.

However, in all previously known methods, the necessary pressure for reducing the thickness of the wire was exerted substantially wholly by the inner wall of the die, thus causing the die to wear out more or less rapidly, even though the action of the device shown in said U. S. Patent No. 1,582,434 increased the life of the die.

According to the invention, means are provided anterior to the die for supplying a retarding force which retards the movement of the wire frictionally, so that the wire is subjected to sufficiently high tension as it is pulled through the die, by means of a force which is imposed upon the wire anterior to the die. Said retarding force may be almost equal to, or even equal to, or even greater than, the elastic limit of the reduced wire.

In order to state a single practical example of the use of the apparatus and the operation of the method shown herein, without limitation to the details specified, the following may be given.

High carbon steel wire of the kind which is used extensively in making wire rope, was pulled through a die which was made of the well known material, consisting essentially of tungsten carbide alloy having cobalt or nickel as the binding

material. The wire which entered said die had a circular cross section and said entering wire had a diameter of ninety-eight thousandths (0.098) of an inch. The bearing of the die had a diameter of eighty-thousandths (0.080) of an inch so that the wire which was pulled out of the die was reduced in diameter from ninety-eight thousandths (0.098) of an inch to eighty thousandths (0.080) of an inch. The die was a tungsten carbide die.

The wire which was pulled through the die in making said test was supplied with dry powdered lubricant in the ordinary manner by pulling the wire through a box which contained a lubricant of the well known type in dry and powdered form. Said lubricant is made according to various formulas but it consists essentially of a mixture of soap, tallow and lime.

The total pull which was required in order to draw the wire through said die, without any back pull on the wire, was measured and it averaged about four hundred pounds.

Another test was made by using the apparatus shown in Fig. 1, with the use of a die having a bearing whose diameter was substantially ninety-eight thousandths (0.098) of an inch. Hence the wire was pulled through the apparatus without reducing its thickness. The only purpose of using the die in making this test was to prevent the lubricant from escaping out of that part of the device which was anterior to the die.

As the wire entered the inlet of the apparatus, namely, the member 11, the wire was caused to pass through a box containing the same dry powdered lubricant. The force which was required to pull the wire through the apparatus shown in Fig. 1, and without reducing the thickness of the wire was measured and it was found that said pull could be varied from zero up to five hundred pounds and even more, depending upon the number of pressure units which were used anterior to the die, and without reducing the wire.

This test showed that the use of the apparatus shown in Fig. 1, and which is anterior to the die D, could produce a retarding effect or back pull of five hundred pounds and more, as desired, so that the wire was under a total tension which could be regulated as desired, before it was reduced in the bearing portion of the drawing die.

The third test was made by assembling the apparatus shown in Fig. 1, using an entering wire having a thickness of ninety-eight thousandths (0.098) of an inch, and using a reducing die D whose bearing had a diameter of eighty thousandths (0.080) of an inch.

When the back-pull was zero, it required a front pull of four hundred pounds to pull the wire through the reducing die. When the back-pull was fifty pounds, no substantial change in the front pull was noted. When the back pull was one hundred pounds, the front pull was four hundred twenty-five (425) pounds, which was less than the sum of the original front pull and of the back pull which was used in this test. The back pull was supplied by the retarding effect of the pressure units. When the back pull was five hundred pounds (500 lbs.) the front pull was only six hundred and twenty (620) lbs., which was much less than the sum of the original front pull of 400 lbs. and said back pull of 500 lbs. This shows that the force required to pull the wire through the die was only one hundred and twenty pounds (120 lbs.), thus materially reducing the load on the die and the wear of the die.

This was due to the fact that the tension on

the wire anterior to the die was sufficiently high so as to tend to reduce the cross section of the wire, thereby lowering the load upon the die and decreasing the force required to reduce or form the wire as it was pulled through the bearing of the die.

While the back tension which was imposed upon the wire anterior to the die was lower than the elastic limit of the wire, said tension nevertheless tended to elongate the wire and therefore tended to reduce its thickness so as to greatly facilitate the reducing operation of the die.

Referring to Fig. 1, this shows a casing 1 which may be made of tool steel or any other suitable material.

A die holder 6 is located within said casing 1, and in a recess of the inner wall of said casing 1. The holder 6 may fit loosely or tightly in said recess, as desired.

The holder 6 is provided with a die D of any suitable material. This may be a diamond die for example, although we prefer to use the alloy die previously mentioned.

The casing 1 is provided with an inlet opening 2 and with an outlet opening 3, so that water or other cooling medium, such as any suitable liquid or gas, can be forced through the casing 1, and around the holder 6, so as to cool the same and the die and also to cool the apparatus anterior to casing 1, by conduction. A washer 8, made of any suitable metal, such as soft steel, is located in the inlet end of the holder 6.

An inlet member 4, made of tool steel or other suitable material, has a threaded wall at its inner end, and this threaded wall can be screwed into the corresponding threaded wall of the inlet end of the casing 1, so as to provide a liquid-tight fit.

The portion of the outer wall of the member 4, which is adjacent the casing 1, may have a hexagonal or other suitable shape, so that this part of the member 4 can be engaged by a suitable tool, so as to screw the member 4 under considerable force into the casing 1, and thus compress washer 8 and the other washers 8a, 8b, 8c, so as to provide a liquid-tight device.

The member 4 is provided with a bore, in which a suitable series or plurality of identical members 5 and 5a and 5b may be located. Said members 5 and 5a and 5b fit snugly but slidably within the inlet member 4. If desired, said members 5 and 5a and 5b may have a drive fit within the member 4.

The members 5 and 5a and 5b may be designated as pressure members, and they can be made of tool steel or any other suitable material.

Said members 5 and 5a and 5b preferably have an initial sliding fit within the member 4, so that the assembly can be made readily, and without using substantial force.

The inlet end of the member 4 is provided with an inlet member 11, which is also made of tool steel or any other suitable material. Said inlet member 11 has a shoulder which abuts a corresponding shoulder of the bore of the member 4, so that the member 11 is held in the position shown in Fig. 1.

The metal washers 8a and 8b and 8c, also preferably made of soft steel, space the inlet member 11 from the adjacent pressure member 5, and also space the pressure members 5 and 5a and 5b from each other.

We can have any desired number of pressure members, so as to provide any desired number of pressure chambers.

The members 11 and 5 and 5a and 5b may have

a certain slight frictional fit within the member 4, so that the members 11 and 5 and 5a and 5b can be inserted into the member 4 while the member 4 is held inverted and they will not fall out of member 4. The washer 8 can then be located in the position shown in Fig. 1.

The member 4 can then be screwed into the casing 1 under considerable pressure, so as to compress the washers 8, 8c, 8b and 8a.

10 The shoulder of member 11 and of the bore of member 4 have a sufficiently close and liquid-tight fit, to prevent the cooling liquid from leaking out of the device.

The wire W is pulled through the apparatus 15 in the direction indicated by the arrows in Fig. 1.

For convenience the parts have been shown in superposed vertical relation, but the assembly may be held in any desired position.

As the wire W is pulled through the apparatus, 20 said wire is caused to contact with a suitable lubricant anterior to the member 11, so that the wire picks up a surface coating of said lubricant. Said lubricant may be of any type, either liquid or solid. We prefer to use a solid lubricant 25 powder of the type previously mentioned. These lubricating compositions are very well known to the trade and they therefore do not require any special disclosure.

The lubricant may be a paste instead of being 30 a loose powder and it also may be a liquid or it may be any viscous material.

As shown in Fig. 3, the member 11 is provided with a relatively long bore 13, which is substantially cylindrical and which is provided with a 35 tapered inlet 12. We do not wish to be limited to the use of a cylindrical bore 13, as said bore may have a slight taper, as shown in U. S. Patent No. 1,582,434.

As shown in Fig. 5, the pressure member 5 is 40 also provided with a relatively long cylindrical bore 9, which has a tapered inlet and an annular enlargement 10, in which the corresponding washer 8a is seated. Since the members 5 and 5a and 5b are identical, it is sufficient to state that 45 the bores 9 thereof need not be cylindrical, and they may be slightly tapered, as shown in U. S. Patent No. 1,582,434.

The wire W is pulled through the apparatus at normal ordinary speed.

50 Assuming that a dry powdered lubricant is used, this is carried along as a surface layer of powder by the wire, into the bore 13 of the member 11, in which the wire has a close fit. Likewise the wire has a close fit within the bores 9 of the 55 members 5 and 5a and 5b.

The method and apparatus specified herein are particularly adapted to the cold drawing of wire. In this process, the wire is ordinarily supplied to the cold drawing mill in the form of rod in coil 60 form, and this rod has a maximum diameter of about 0.240 inch. This rod is not accurately shaped as it comes from the hot mill, so that said diameter may vary from 0.27 inch to 0.240 inch.

Likewise the cross section of such rod is not 65 truly circular.

Hence in pulling said rod through the initial or first pass, it is not possible to have an extremely close fit between the rod and the apparatus in the first pass. Said rod is normally reduced in four successive passes until it has a cross section of about ninety-one thousandths (0.091) of an inch.

At this point the wire is usually annealed before it is subjected to any more drawing operations. 75 tions.

As the wire is reduced in successive passes through wire drawing dies, its cross section becomes more truly circular and its thickness becomes more uniform.

The method and apparatus as specified herein, 5 can be used in cold drawing the rod from the beginning of the operations previously mentioned and until the wire has been reduced to final size required for making wire rope or other article.

In successive passes, as the wire becomes more 10 truly cylindrical and of more uniform thickness, the fit of the wire within the bores of the pressure members may be made closer and smaller tolerances may be successively allowed.

The mechanical movement and the inner heat 15 which is developed when the wire passes through the members 11 and 5 and 5a and 5b and also through the die D is sufficient to transform the dry powdered lubricant into a more or less viscous and coherent mass which can withstand 20 high pressure. Likewise the soap or tallow may be carbonized, at least partially. Even though the device is cooled, the friction and inner movement of the lubricant causes it to decompose and carbonize. This is especially true of the soap. 25 Since the wire W tightly abuts the drawing portion of the inner wall of the die D (this being designated as the "bearing" in the trade), more lubricant is pulled into the apparatus than escapes from the apparatus, when the operation 30 of the device is started, although some lubricant passes through the die, as a very thin surface coating on the wire. This process goes on until the lubricant is accumulated in the interiors of the members 11 and 5 and 5a and 5b under high 35 pressure. This pressure is built up very rapidly.

The forward pull of the wire and its close fit in the bores of the pressure members and in the bore of member 11 (which is also a pressure member) prevents the lubricant from leaking 40 out backwards, because the movement of the wire tends to carry more lubricant into the device. Likewise, the lubricant can be of the type previously mentioned, which can withstand high pressure without leaking out of the device. 45 Under the conditions prevailing, said lubricant becomes a coherent packed mass which does not flow readily in a direction perpendicular to the direction of the pressure which is imposed upon the lubricant. Since the pressure which is imposed upon the lubricant is perpendicular to the axis of the wire, the lubricant will not leak substantially out of the apparatus under proper conditions, and a high pressure can be built up and maintained. The pressure is greater in the member 5b and it diminishes in the members 5a and 5 and 11. Hence by using a suitable number of 50 said pressure units, it is possible to create substantially any desired pressure within said pressure unit.

The pressure of the lubricant exerts a frictional retarding force upon the wire, anterior to the die D, and this retarding force subjects the wire to high tension anterior to the die D. This back tension may be regulated as desired, but in 65 order to be most effective for the purposes stated herein, this anterior and retarding tension should be close to and almost equal to the elastic limit of the reduced wire.

The tension on the wire, anterior to the die D, 70 facilitates the drawing operation of the die D, because said tension tends to elongate and reduce the wire, so that the wear upon the die D may be reduced to as little as ten per cent of the normal wear upon the die. 75

It is preferable to use a die D in each pass, in order to reduce the wire accurately and thus complete the reduction in thickness.

The invention is of particular utility in drawing wire or other members made of iron-chromium alloys, such as stainless steel. Stainless steel is essentially an iron-chromium alloy, relatively low in carbon. These alloys may contain from eight per cent to sixty per cent of chromium and between one-tenth per cent and one per cent of carbon.

These stainless steel compositions also include other ingredients and since they are well known in the art, a specific description thereof is unnecessary. In order to secure the anti-rusting properties of this steel, it is necessary to provide the same with a polished luster, in order to make the chromium coat the other ingredients of the alloy.

In drawing wire made of such stainless steel composition, it has hitherto been impossible to secure the desired polish or luster, after the drawing operation has been completed. It was necessary to treat the wire in a polishing machine subsequent to the drawing operation, in order to create said polish or luster, and this was a substantial additional expense.

By using the apparatus shown in Fig. 1, it is possible to draw wire of such composition directly, and to produce the desired polish or luster directly in the drawing operation. For this purpose the wire can be pulled through the apparatus in the final pass with the retarding force substantially equal to or slightly less than the elastic limit of the drawn or reduced wire. Whenever we refer to the elastic limit of the wire, we refer to the reduced wire, namely, the wire as it leaves the die of the respective pass.

This retarding force is so close to the tensile or elastic limit of the reduced wire W, as to reduce the work of the die D, so that the drawing operation does not destroy the polish or luster of the original material.

It is highly desirable to have two or more pressure members, so as to form an assembly having a series of spaced bores which are separated by enlarged spaces, said spaces forming pressure chambers. It is impracticable to attempt to provide too close a fit between the wire and the cylindrical or slightly tapered bore in which the wire has a close fit, since the shape of the wire and the thickness of the wire must vary to some extent throughout the operation.

If it is attempted to make the tolerance too low, sudden very high pressures may be generated which will break the apparatus even if it is made of tool steel. Likewise the wire may be broken and the sudden change in retarding force cannot be regulated equally.

Hence we prefer to use a plurality of pressure chambers, in which the pressure is built up successively, as the pressures in said chambers can be controlled and a sufficient tolerance can be allowed between the wire and the closely surrounding guide means so as to prevent the abrupt and undesirable changes in retarding force.

For example, and in order to give a single practical example which will guide persons skilled in the art, in drawing the rope wire having a diameter of ninety-one thousandths of an inch (0.091), the tolerance between said wire and the interior surfaces of the substantially cylindrical bores of the pressure members was about eight thousandths (0.008) of an inch, or substantially ten per cent of the diameter of the wire.

While this working figure may be varied, it

specifies the tolerance which is practical in order to prevent the apparatus from breaking or the wire from being ruptured.

Each pressure chamber includes the interior of the washer, and the tapered inlet of the bore of the succeeding member, up to the point where the wire has the above mentioned close fit within said bore.

In order to secure best results, the total force which is required to pull the wire through the reducing die in each pass, should be at least fifty (50%) per cent and preferably from seventy-five (75%) per cent to ninety-nine (99%) per cent of the elastic limit of the reduced wire in said pass. This tensional effect is to some extent a function of the tolerance between the wire and the closely fitting part or parts of the guide means which are located anterior to the die.

With the use of two devices of equal length, a greater tensional effect is secured by using a smaller tolerance.

By using a plurality of pressure chambers, separated by thin annular or tapered bodies of the lubricant pressure-exerting material, a difference in pressure can be built up in successive chambers, because each thin annular body can withstand back pressure.

The wire has a rough and somewhat porous surface. The first pressure chamber forces the lubricant into said pores, where the lubricant is retained while it passes through the die. The pressure in successive chambers may rise so high as to affect the original powder or other lubricant, so as to greatly increase its coefficient of friction.

Hence the desired retarding effect can be secured in two or more cumulative stages, without the necessity of using tolerances which are too low to be practical, and without danger of breaking the device or rupturing the wire.

We do not wish to be limited to the use of any particular lubricant or pressure-creating material. Likewise, the invention generally covers any means or mechanism whereby retarding forces or tensions (two or more) which increase towards the die, are imposed upon the wire anterior to the die, while permitting the continuous movement of the wire.

The pressure chambers should have greater lateral cross-sections than the thin layers of pressure-creating material between said chambers, in order to accumulate enough pressure-creating material in said chambers, in order to allow for fluctuations. The pressure or pressures may vary, due to differences in thickness and shape of the wire, and other factors which vary. Allowance should be made for such variation, in order that the retarding force should not ordinarily exceed the elastic limit of the wire, or the breaking force of the reduced wire. The retarding force may be close to, and almost equal to the elastic limit of the reduced wire. We do not wish to be limited to any particular retarding force but we prefer to use a retarding force preferably equal to from twenty-five per cent to ninety-nine (99%) per cent of said elastic limit.

The pressure is created in the device because part of the lubricant or other foreign material which is collected on the surface of the wire, is wiped off the wire. Said foreign material accumulates in the pressure chamber which is closest to the die. When this is filled up, pressure is created therein. The pressure cannot force the foreign material backwards, because the foreign material anterior to said pressure chamber is in

the form of a thin cylindrical or tapered layer which has considerable cohesion, and which has considerable adhesion to the wire and to the guide means around the wire. This cohesion and adhesion, if a powdered lubricant is used, is produced by the mechanical working of the lubricant as it is forced into the narrow clearance between the wire and said cylindrical or tapered bore. Pressure is now built up in the next chamber, so that sufficient pressure can be built up in a short time. We can use any suitable relief means in any or all of the pressure chambers, in order to relieve excessive pressures, and we can force the foreign material under suitable pressure directly into said pressure chambers, instead of relying upon the moving wire to create said pressure.

The dimensions of the apparatus, and the relative proportions of the parts, will vary with the type of foreign material which is used for creating pressure and friction.

The members 11, 5, 52, and 5b, together with the intermediate washers, may be considered as forming a chamber which has an inner wall and which is closed, save for an inlet end and an outlet end. Said chamber has longitudinally spaced pressure portions at the inlet ends of members 5, 5a, and 5b. At said pressure portions, said inner wall of said chamber is laterally spaced from the wire, more than between said pressure portions.

We have shown a preferred embodiment of our invention, but it is clear that numerous changes and omissions can be made without departing from its spirit.

We claim:

1. In the art of drawing wire or the like while said wire is moved in a predetermined path through a chamber prior to reducing the wire, that step which consists in maintaining a body of material under pressure in said chamber, and in contact with the wire, said material having a coefficient of friction which is high enough to cause said material to retard the movement of the wire by frictional force, said retarding effect being at least twenty-five per cent of the elastic limit of the reduced wire and not greater than the elastic limit.

2. In the art of drawing wire or the like while said wire is moved in a predetermined path through a chamber prior to reducing the wire, those steps which consist in applying foreign surface material to the wire anterior to the chamber, causing the wire to carry said material into the chamber, and limiting the movement of the foreign material out of said chamber so that said foreign material accumulates under pressure in said chamber and fills the chamber except that part of the chamber which is occupied by the wire, said material having a frictional retarding effect on the movement of the wire under the pressure within said chamber, said retarding effect being at least twenty-five per cent of the elastic limit of the reduced wire and less than the elastic limit.

3. In the art of drawing wire or the like, those steps which consist in moving said wire through a chamber which has an inner wall and which is closed save for an inlet end and an outlet end, prior to reducing the wire, the inner wall of said chamber having at least two pres-

sure portions comprising longitudinally-spaced portions of said inner wall which are spaced laterally more from the wire than the portion of the inner wall which is intermediate said spaced portions, and causing the wire to carry foreign material into said chamber and to subject said foreign material to pressure within said chambers while the foreign material contacts with the wire, said pressure increasing in said spaced portions from the inlet end to the outlet end, said foreign material having a frictional retarding effect upon the wire within the chamber.

4. In the art of drawing wire or the like, those steps which consist in moving the wire through a chamber which is closed save for an inlet end and an outlet end, prior to reducing the wire, causing the moving wire to carry foreign material into said chamber, and limiting the escape of the foreign material from the chamber so as to cause the moving wire to subject the material to sufficient pressure within said chamber while said material contacts with the moving wire, so that said material will retard the movement of the wire and subject it to tension prior to reducing the wire, said tension being at least twenty-five per cent of the elastic limit of the reduced wire and less than said elastic limit.

5. In the art of drawing wire or the like, that step which consists in pulling the wire continuously through a drawing die, while continuously subjecting the continuously moving wire to tension anterior to the die by passing said wire through a surrounding and abutting body of material which is maintained under pressure, and without substantially reducing the wire, said tension being at least fifty per cent of the elastic limit of the reduced wire, and not exceeding said elastic limit.

6. For use in wire drawing, a device which is closed save at the open ends thereof and through which a wire may be moved, the inner wall of said device being shaped to provide at least two longitudinally spaced chambers having an intermediate connecting bore which is of smaller mean lateral diameter than said chambers, said chambers being adapted and shaped to receive a foreign material drawn in by said wire, which foreign material is subjected to pressure by additional foreign material drawn in by the movement of the wire and said foreign material being in contact with the wire to exert a drag on the movement of the wire through the device.

7. For use in wire drawing, a device which is closed save at the open ends thereof and through which a wire may be moved, the inner wall of said device being shaped to provide at least two longitudinally spaced chambers having an intermediate connecting bore, said bore being tapered and being of smaller mean lateral diameter than said chambers and having its widest end at the chamber which is closest to the inlet end of the device, said chambers being adapted and shaped to receive a foreign material drawn in by said wire, which foreign material is subjected to pressure by additional foreign material drawn in by the movement of the wire and said foreign material being in contact with the wire to exert a drag on the movement of the wire through the device.

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