

another in said horizontal positions, and means yieldingly resisting swinging of the bars horizontally toward one another about the vertical axes.

2. An exercising device to be mounted on a vertical support comprising a pair of bars, means supporting the bars from their inner ends to project divergently forward from the support and for swinging movement about substantially vertical axes, and means for yieldingly resisting movement of the bars comprising lever elements connected with the bars, resilient means associated with the lever elements, and means for adjusting the lever elements to vary the resistance to swinging of the bars.

3. An exercising device to be mounted on a vertical support comprising a body, means for mounting the body for vertical adjustment on the support, a pair of bars, horizontally spaced means supporting the bars on the body from their ends for free swinging movement about substantially horizontal axes and for swinging movement about substantially vertical axes, handles on the outer ends of the bars to be grasped by the operator when his arms are extended horizontally, each means comprising a member supported on the body for movement about a substantially vertical axis and carrying the bar for movement about a substantially horizontal axis and a spring in connection with each member for resisting movement of the bars toward the operator in a horizontal plane.

4. An exercising device comprising a body having a pair of spaced openings, pivotally mounted members received in said openings, bars carried by said members to be swingable toward and away from one another, and means in the body associated with said members for yieldingly resisting swinging of the bars.

5. An exercising device comprising a body having a pair of spaced openings, members pivoted to the body, bars carried by said members to be swingable toward and away from one another, adjusting screws carried by said members to extend into the body through the openings, spring elements in the body, and means associating the spring elements with the screws to yieldingly resist swinging of the bars in one direction and to have their movement resisting action varied by rotation of the screws.

6. An exercising device comprising a body forming a housing having a pair of spaced openings, members pivotally carried in the body, bars carried by said members at the exterior of the body to be swingable toward and away from one another, screws adjustably threaded through the members to extend into the body through the openings, springs in the body, and means connecting the springs with the screws to yieldingly resist swinging of the bars in one direction and to be adjusted by the screws to offer varying degrees of resistance to swinging of the bars.

7. An exercising device comprising a body, a pair of bars, members pivoted to the body to turn about substantially vertical axes, fittings on the inner ends of the bars, the members and fittings having registering openings, pins in said openings holding the bars for swinging about substantially horizontal axes, means yieldingly resisting swinging of the bars toward one another about said vertical axes and urging the bars and members outwardly away from one another, and means limiting said outward swinging of the bars and members.

8. An exercising device comprising a body, a pair of bars, members pivoted to the body to turn

about substantially vertical axes, fittings on the inner ends of the bars, the members and fittings having registering openings, pins in said openings having the bars to swing about substantially horizontal axes, means yieldingly resisting swinging of the bars toward one another about said vertical axes and urging the bars and members outwardly away from one another, and shock-absorbing means on the body limiting outward swinging of the bars.

9. An exercising device for mounting on a vertical support comprising a body to be mounted on the support and forming a housing the interior of which is accessible only from the support side of the body when the body is removed from the support, a pair of bars, members mounting the bars on the body to normally depend therefrom and operate to project therefrom and swing horizontally toward and away from one another, and means housed in the body connected with the members to yieldingly resist swinging of the bars in one direction.

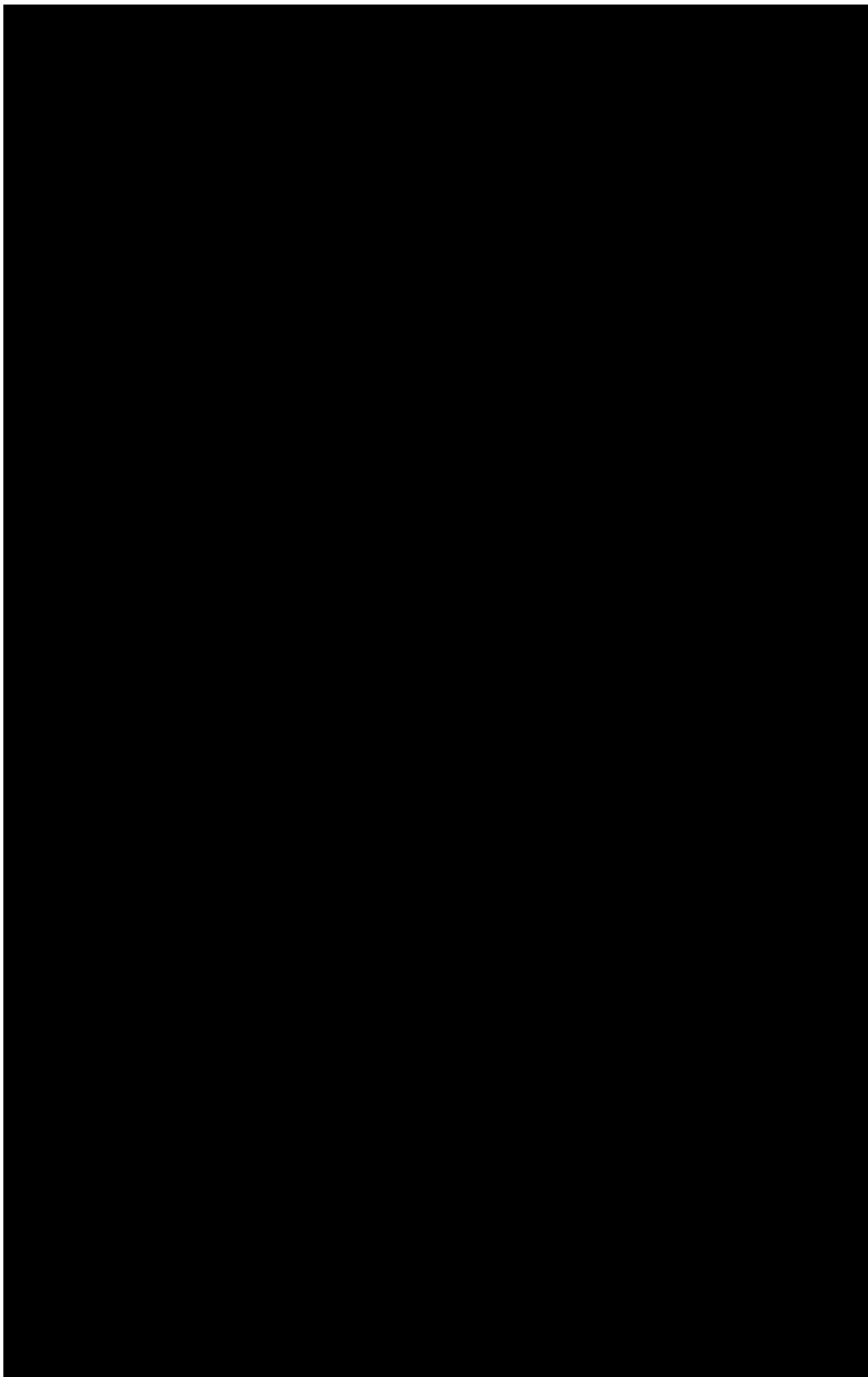
10. An exercising device for mounting on a vertical support comprising a body to be mounted on the support and forming a housing the interior of which is accessible only from the support side of the body when the body is removed from the support, the body having openings in its front, exercising bars, members obstructing the openings supporting the bars at the exterior of the body to normally depend therefrom and for swinging movement horizontally toward and away from one another, and means in the body operatively connected with the members to yieldingly resist swinging of the bars toward one another.

11. An exercising device for mounting on a vertical support comprising a body to be mounted on the support and forming a housing the interior of which is accessible only from the support side of the body when the body is removed from the support, the body having a pair of openings in its front, exercising bars, members mounted in the openings supporting the bars at the exterior of the body to normally depend therefrom and for horizontal swinging movement toward and away from one another, spring means housed in the body, parts on the members at the interior of the body, and connections in the body between the spring means and said parts whereby the spring means resist swinging of the bars toward one another.

12. In an exercising device, a single elongate bar having a portion extending laterally and forwardly and a portion joining the outer end of the first named portion and extending transversely of the longitudinal axis of the bar, said portions being integral with the bar, means supporting the bar at its inner end for swinging movement and against rotation on its own axis, and handle means on the second named portion.

13. An exercising device comprising a body, a pair of bars, means for connecting the inner ends of the bars with the body to be swingable inwardly and outwardly toward and away from one another, means on the body for limiting swinging of the bars in the outward direction, and means for adjusting the last named means to vary the extreme outward positions of the bars.

14. An exercising device comprising a body, a pair of bars, means for connecting the inner ends of the bars with the body to be swingable about substantially vertical axes, means for yieldingly resisting swinging of the bars toward one an-



of solubility of the corrective metal in the foundation metal as well as bestowing special metallurgical properties upon the whole alloy by alloying with the corrective metal a third, fourth, or even fifth corrective metal as will appear.

When phosphorus and iron are combined under circumstances that leave unoxidized phosphorus to react upon the iron, the result is iron phosphide as expressed by the symbol  $\text{Fe}_3\text{P}$ . When the amount of phosphide is in a ratio of as much as 1.70%, to the iron, the mass of iron is said to be saturated with iron phosphide ( $\text{Fe}_3\text{P}$ ). With an increase of phosphorus up to 10.2%, a eutectic alloy comes into existence composed of the saturated solid solution of  $\text{Fe}_3\text{P}$  in iron, and thin plates of iron phosphide ( $\text{Fe}_3\text{P}$ ) distributed through the said solid solution. Further increase of the proportion of phosphorus up to 15.58% results in a body composed of the iron phosphide plates surrounded by the eutectic alloy. Further increase of the phosphorus, materially above 15.58, causes the alloy to exist as a compound of iron phosphides.

Broadly analogous to the above stated effects of phosphorus permitted to react upon iron, are compounds of phosphorus with other metals herein enumerated and referred to as corrective metals. Moreover, the phosphiding of the corrective metals will assist their entry into solution with iron and iron phosphide. For instance, in the case of copper, which normally enters into solution with iron in a very small ratio, the present process greatly increases its ratio of solubility in iron or iron phosphide by the use of sufficient phosphorus to convert the corrective metal into copper phosphide; the ratio of solubility of such copper phosphide being approximately commensurate with the percentage of phosphorus combined with the copper.

When other metals alone or phosphided, for instance, nickel, cobalt, tin, lead, etc., are permitted to enter into solid solution with the copper phosphide its ratio of solubility is still further raised.

In addition to the described method of promoting solubility of metals, generally, in iron phosphide and chemically immunizing them, the present application deals with ternary iron alloys per se using nickel and other metals as disembrittling corrective media; also those combinations of metals forming alloys of quaternary and more complex than quaternary alloys not specifically claimed in and properly divisible from my herein identified application Serial No. 140,580. That is to say the present application deals broadly with the principle of alloying whereby larger proportions of metals may be caused to enter properly into solution in the phosphide of the foundation metal and become chemically protected thereby while themselves correcting physical properties of the phosphide. It also deals with certain alloying ingredients which may be beneficially used in addition to copper and other metals in lending physical properties to high phosphorus alloys.

Even the production of alloys in general, involving, as foundation metal, iron phosphide normally having a large coarse grain but largely corrected by the introduction into solution therewith of phosphided disembrittling metal, is within the method claims of my present invention; alloys per se claimed herein being those not claimed in my antecedent applications.

The invention has for some of its objects to provide alloys which are rendered immune to

chemical reaction without sacrificing physical properties that may be required in service where chemically reactive influences are encountered; also to provide alloys which not only have the chemically resistant capacity referred to, and the physical properties, but are rendered particularly desirable by the incorporation of one or more alloying ingredients which have been found to bestow other desirable qualities; to provide alloys having the capacities described, in which the alloying ingredients may be used in a wide range of proportions and thereby correspondingly increase the range of uses to which the alloy may be put; and to provide chemically resistant alloys in which the alloying ingredients, found desirable for use for purposes within the purview of the invention but which normally enter into solution with the foundation metal only in minor proportions, may be made to correctly alloy therewith in desired larger proportions.

The invention proceeds upon the principle of incorporating with a foundation metal or alloy of metals, a proportion of phosphorus sufficient to convert the metal or alloy into chemically resistant phosphide or phosphides, with the proportion of phosphorus commensurate with the degree of resistance desired; and at the same time utilizing phosphorus for insuring the presence with the phosphide of a strengthening metal which will have the effect of neutralizing physical impairment of the phosphided metal, at least to an extent which will enable articles produced from the alloy to serve purposes for which they are intended, and particularly purposes incident to which they encounter corrosive influences against which they are rendered immune.

Certain embodiments of the invention contemplate the further principle of incorporating with the phosphided metal or metal alloy, not merely a single metal having the capacity of counteracting the embrittling or weakening effect of the phosphorus, but still another metal or metals having the capacity of likewise lending strength to the phosphided foundation metal, or else the capacity to bestow upon the alloy some other physical property or properties appropriate to the uses to which an article made from the resultant alloy is to be put, or both of said capacities; also the principle of adding a strengthening metal or metals of the iron group, such as cobalt or nickel, either separately or jointly, which enter into solution with the foundation metal, for instance, iron, in various proportions between very wide limits; or a metal or metals of the iron group together with one or more other alloying ingredients, such, for instance, as copper, manganese, molybdenum, tin, tungsten, and vanadium, which may be selected for their influence upon the red hardness, fusing point or other physical properties of the resultant alloy; also the principle whereby, in the phosphided foundation metal or alloy, the solution of a desired large ratio of a particular strengthening metal, which normally enters into such solution only in a low ratio, may be promoted by including also a suitable proportion of one or more grain-refining metals or what I shall refer to as by-ingredients or solution-promoting ingredients. For instance, whereas nickel is a good disembrittling metal and will enter into solution in iron phosphide in any desirable proportions, copper, which is a good grain refining and therefore disembrittling metal, and also desirable for other physical properties will enter



proportions (around 10 or 12%) of copper not carried in by the phosphorus.

A high phosphorus iron alloy omitting both of the iron group conditioning metals as well as tin, but having good physical and chemical resistance responds to the formula iron 75%, molybdenum 10%, tungsten 5%, vanadium 2% and phosphorus 8%, of which the molybdenum, tungsten, and vanadium are all tough and non-brittle; have the capacity of refining the grain of and therefore disembrittling iron phosphide, and the molybdenum has the further capacity of forming with tungsten, an addition alloy that enters more readily into solution with the iron phosphide.

The term "by-ingredient" as herein employed indicates a metal or metals that has the capacity to enter into solution with one or more physically corrective metals of normally limited solubility in the foundation metal phosphide having a particular phosphorus content, and thereby produces a physically corrective alloy of desired greater solubility in the foundation metal phosphide having the said phosphorus content. For instance, in a formula employing iron as the foundation metal with 25% copper and 10% phosphorus, the phosphorus together with about 10% of the copper would pass into solution and form iron-copper-phosphide grains, while the remainder of the copper would freeze into coarse grains which would not properly alloy with the iron phosphide, but would gravitate to the bottom of the bath and remain separate from the iron phosphide alloy. If, however, a by-ingredient is used in such a heat, for instance, nickel or molybdenum in a proportion appropriate to the 15% of copper that would otherwise remain uncombined, a copper-nickel or copper-molybdenum addition alloy would be formed and the entire 25% copper would go into solution with the iron phosphide and produce the desired effect as to solution, grain-size, physical properties and protection against chemical action.

Some scrap metal has been found to offer an economical source of physically corrective alloy suitable for some embodiments of the invention. For instance, metal commercially known as brass scrap which has been found to be suitable since, in addition to the copper and zinc conventionally included in brass, such scrap has been found to contain antimony, arsenic, bismuth, cadmium and tin; some of which, even in the small proportions in which they are found in the brass, will assist the copper in entering into solution, while others of them will have their effect upon the fusing point of the resultant alloy. The use of the term "essential" in connection with the use of elements of the claims herein is intended to convey the fact that such elements are the ones that contribute to the results aimed at, and is not to indicate that there are no other elements in the claims, since the exclusion of non-essential elements may be economically impossible owing to commercial sources relied upon for the essential ingredients.

I claim:

1. A chemically resistant and physically strong alloy comprising as its foundation metal iron in a proportion of from about 29% to about 75%; said alloy also containing a disembrittling metal which is at least one of the metals nickel, cobalt, copper, molybdenum, and tungsten in a proportion of from about 5% to about 25%; grain refining corrective metal which is at least one different metal taken from the list tin, manganese, molybdenum, tungsten, and vanadium in a proportion of from about 1% to about 19%; and phosphorus from about 8% to about 25%.
2. A chemically resistant and physically strong iron phosphorous alloy comprising iron about 75%; phosphorus about 8%; molybdenum about 10%; tungsten about 5%; and vanadium about 2%.

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