H. R. KEITHLEY.

PROCESS OF MANUFACTURING CAR WHEEL BLANKS.

APPLICATION FILED AUG. 19, 1909.

975,383. Patented Nov. 8, 1910.

Fig. 1.

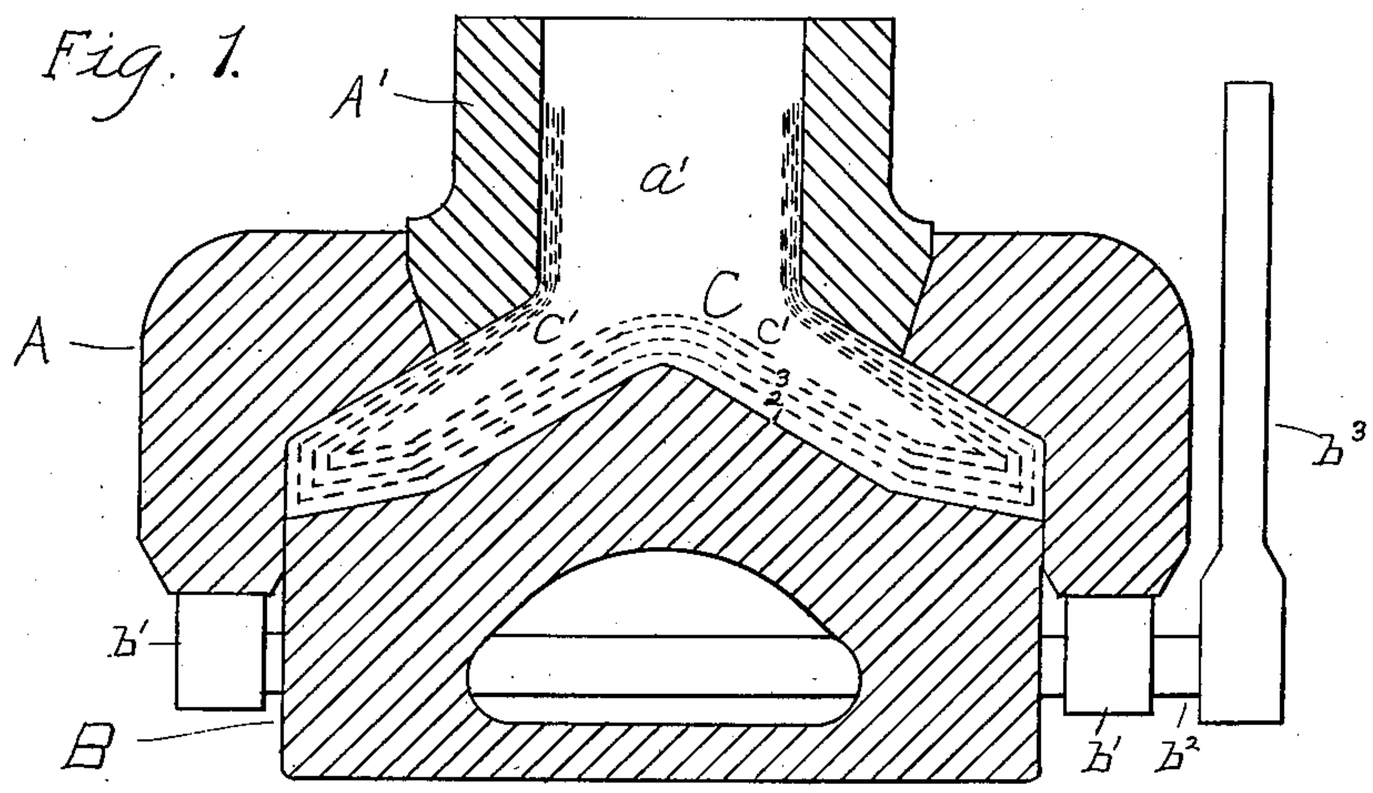


Fig. 2.

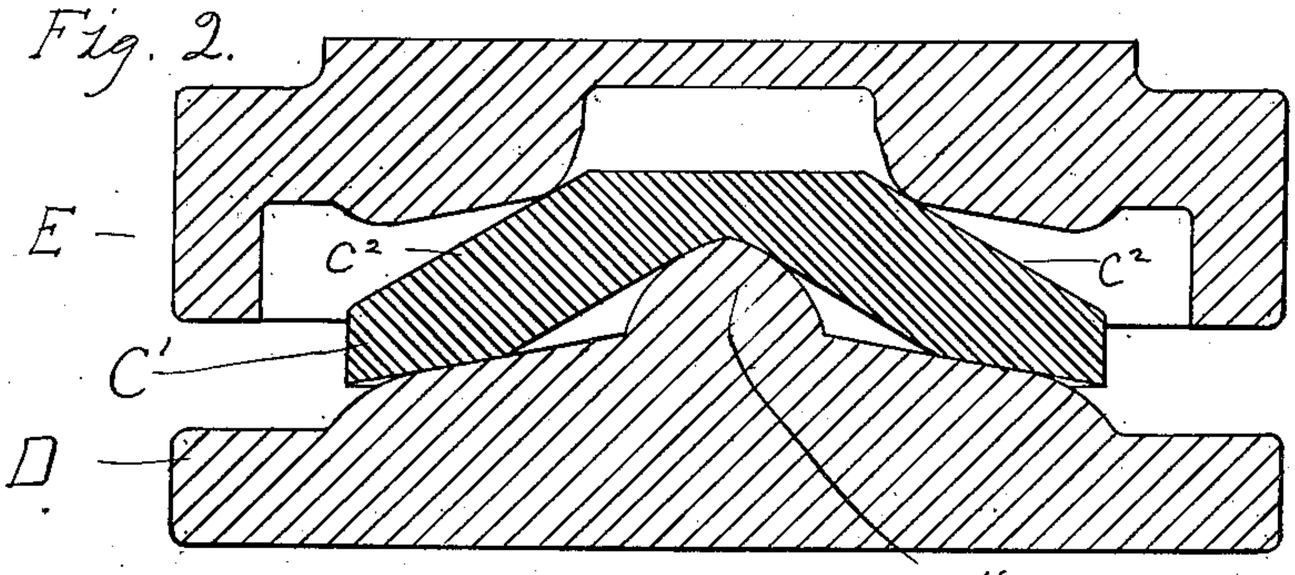


Fig. 3.

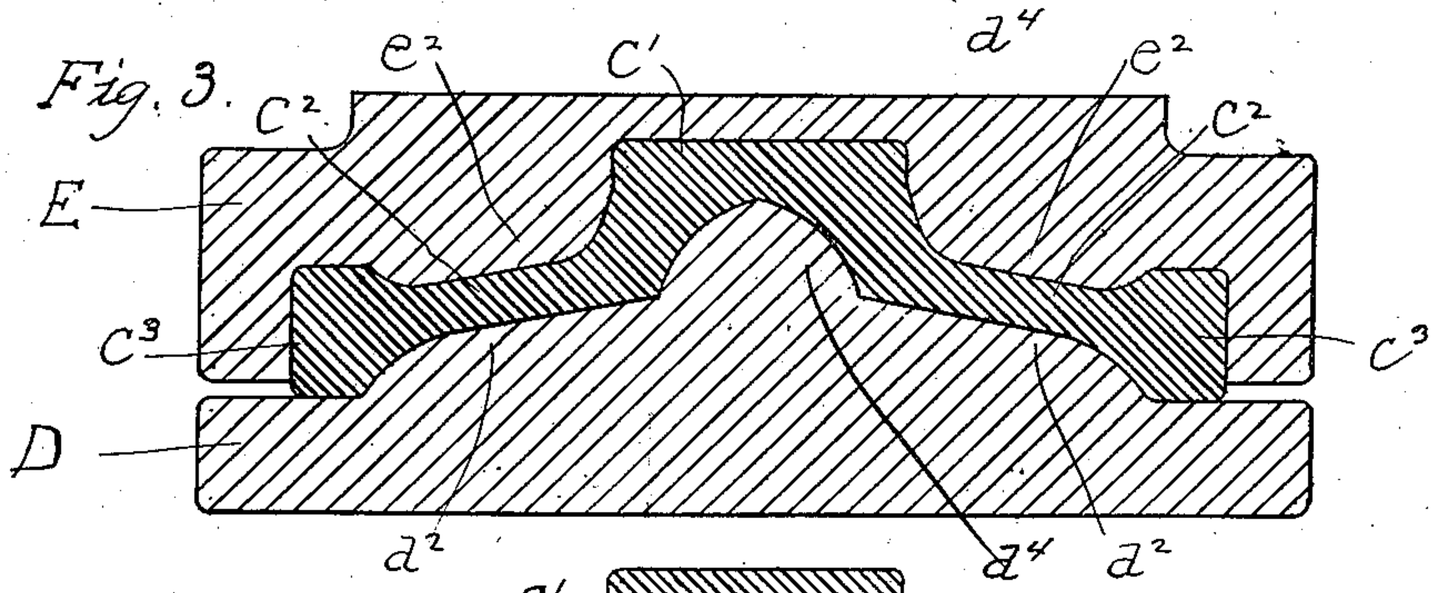
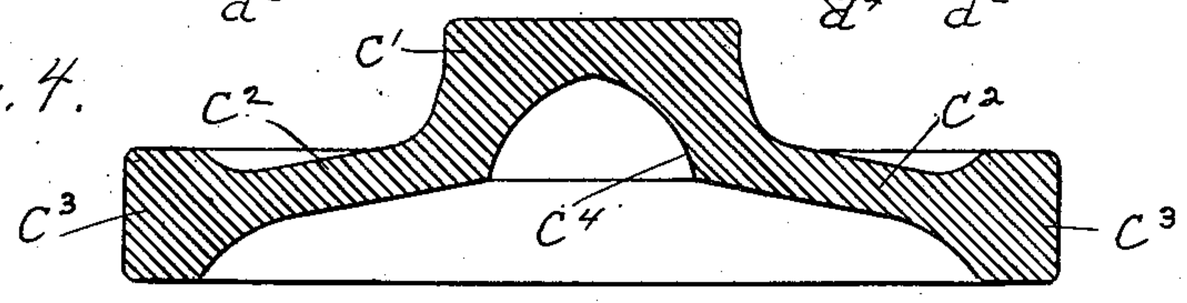


Fig. 4.



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PROCESS OF MANUFACTURING CAR-WHEEL BLANKS.

975,383. Specification of Letters Patent. Patented Nov. 8, 1910.

Application filed August 19, 1909. Serial No. 513,701.

To all whom it may concern:

Be it known that I, HERBERT R. KEITHLEY, a citizen of the United States, residing at Kansas City, in the county of Jackson and State of Missouri, have invented certain new and useful Improvements in Processes of Manufacturing Car-Wheel Blanks, of which the following is a full, clear, and exact description.

In the present state of the art, it is impracticable to produce economically, sound and efficient car-wheels from steel castings or cast blanks, on account of the great difficulty of securing a homogeneous and solid structure in the cast blank. As a consequence the blank from which the car-wheel is made must be subjected to a previous rolling or forging operation before being subjected to the pressure of the dies which give the blank the rudimentary form of a car-wheel, and therefore the initial heat of the blank, due to casting, cannot be retained until the initial die forging operation is performed and the blank is required to be re-heated. This necessity of re-heating the blank after it has lost its initial heat due to casting, limits the carbon content and consequently the hardness of the steel which can be used in present methods of producing car-wheels, to such an extent that comparatively soft steel is used. This is principally due to the fact that the harder steel must not, on account of its higher carbon content, be heated as highly and must therefore be forged at a lower temperature. At such lower temperature the resistance of the harder steel to forging pressures increases more rapidly with declining temperatures than it does with mild steel. As a consequence if harder steel were used in order to give it the degree of plasticity required for the heavy forging pressures of the initial die forging operation, it would have to be heated to a high temperature at which there would be danger of over-heating or "burning" the steel. In my improved process this difficulty is obviated by my method of producing a sound homogeneous steel cast blank which may be removed from the mold to the dies and subjected to the initial die forging operation while it retains its initial heat due to casting, and while it retains a high degree of plasticity which could not be attained by re-heating the blank without danger of over-heating and burning hard steels having high carbon content or hard steel alloys.

The more especial object of my invention is to provide new and improved processes of manufacture which will make hard steel and its alloys, and preferably manganese steel, available and their use practicable and economical for producing car-wheels for railroad cars.

Manganese steel containing from 6 to 12 per cent. or more, of manganese possesses properties of intense hardness and great resistance to abrasion and wear. These qualities are essential in the wearing body portion of the rim and flange of a car-wheel for railroad cars.

Heretofore manganese steel has had only a limited use for car-wheels for mine cars, and could only be adapted for this use by casting the manganese steel wheel with a soft steel hub portion in which the axle hole could be cored and finished by machining or could be bored out. For the manganese steel, owing to its intense hardness, is practically unmachineable and cutting or boring tools have no effect upon it. As a consequence of the difficulty of finishing this steel which can be done only by a grinding operation, it is impracticable to produce, with economy, car-wheels from manganese steel by present processes of manufacture.

In carrying out my invention I produce, by casting, a blank of preferably circular form and substantially uniform thickness and of less diameter than the finished wheel it is to form, and free from pipings, blow holes and other imperfections, and while hot the blank may then be removed from the mold and subjected to the heavy forging pressure of the initial die forging operation which produces the rudimentary hub, web and rim of a car-wheel in the blank, while it retains the initial heat due to casting.

In the accompanying drawings, illustrating my invention, in the several figures of which like parts are similarly designated, Figure 1 is a vertical sectional view showing a mold of special construction for producing steel cast blanks, according to my invention, which will be free from pipes, blow-holes, shrinkage cavities, and other defects, and from which car-wheels may be produced according to my invention. Fig. 2 is a ver-

tical sectional view of a circular steel cast blank made according to my invention in the mold Fig. 1, and placed between a pair of forging dies before said dies are closed down. Fig. 3 is a vertical sectional view showing the dies Fig. 2 closed down and the cast blank partly forged by said dies, so as to form the rudimentary hub, web and rim portions of a car-wheel according to my invention. Fig. 4 shows the partly forged steel cast blank in vertical section, when removed from the dies, Fig. 3.

Referring to the accompanying drawings in detail, the steel cast blank C^1 Fig. 2, is formed with a horizontal circular body portion and a vertical column portion having greater thickness and is preferably cast in a specially constructed mold, Fig. 1, in which the cope A and drag B are made of cast iron and the riser A^1 is preferably made of sand or fire clay or similar refractory or heat retaining material. This mold forms a circular chamber C with a wide opening, formed by the riser A^1. When the molten steel is poured into the chamber C the metal in contact with the cast iron chills A and B solidifies much more rapidly than in the central portions c^1 c^1 and the thicker column portion a^1 in the riser A^1, the layers of solidified metal formed each minute after the metal is poured are indicated by the dotted lines 1. 2. 3., Fig. 1. The outer portions of the steel cast blank are rapidly contracted by contact with the chills A and B and exert such great pressure inwardly upon the still fluid metal of the interior lower portions c^1 c^1 of the casting that no pipes or shrinkage cavities will form in the lower interior portions of the casting. The hydrostatic pressure of the fluid metal in the riser A^1 will feed the fluid metal into the interior fluid portions c^1 c^1 until the entire lower part of the casting is solidified and all pipes, shrinkage cavities and other defects will be forced into the riser A^1 and the column of metal containing these defects can be discarded by cropping off when the casting is removed from the mold, leaving the whole lower portion of the casting in the form of a circular blank, sound and free from all defects and ready for forging into a car-wheel.

The cope A is preferably supported upon two cams b^1 b^1 carried by the shaft b^2 to which the lever b^3 is attached. When the molten steel is poured into the chamber C the portion in contact with the cast iron cope A will tend to shrink down from the casting, and in order to prevent the forming of a space between the casting and the cope A in which gas bubbles might collect, the lever b^3 is operated to turn the cams b^1 b^1 on the shaft b^2 so the weight of the cope A will continue to rest directly upon the metal as it solidifies and tends to shrink away from the cast iron cope A. By this means the blank will be uniformly chilled both from the top and the bottom and the casting will be given a uniform structure.

Although the cope and drag of the mold are described above as preferably constructed of cast iron, sand, fire clay or other refractory material may be used if desired.

The steel cast blank when produced from manganese steel or similar hard steel alloy is preferably removed from the mold and the discard cropped off and then forged in the first operation forging dies, Fig. 2, while still retaining its initial heat from casting. By this method the hard steel can be subjected to the heavy pressure of the initial die forging operation at much higher temperatures and consequently when in a softer and more plastic state than would be practicable if it were necessary to re-heat the blank.

The cast blank C^1 is forged in the dies D. E., Fig. 2, which are operated by hydraulic pressure, thus forming the rudimentary hub portion c^1 and web c^2, Fig. 3, with the hub portion c^1 on one side of the web c^2 c^2 and the annular concave cavity c^4 is formed in the hub portion c^1 by means of the annular convex projection d^4.

The metal in the intermediate portions of c^2 c^2 of the blank C^1 is caused to flow outwardly to the periphery of the blank by the heavy pressure of the dies D. E. thereby producing the rim portion c^3 c^3 and the web portion c^2 c^2 of a car-wheel, Fig. 3, by pressure between the die portions e^2 e^2 d^2 d^2.

When the partly forged blank, Fig. 4 is removed from the first forging dies D. E., Fig. 3, it may be subjected to further forging or rolling operations to complete the wheel.

It is obvious that car-wheels may be produced according to my invention from other hard steel alloys than manganese steel, which are unmachineable, also from soft steel.

In all steel car-wheels at present produced by forging the wheel into shape in order to give the required ductility to the steel the carbon content is limited so that on account of its consequent softness it wears rapidly in service, the wheel rim is made heavy to allow for the rapid wear and for restoring the proper contour to the tread and flange by turning the wheel in a lathe. This involves greater first cost for extra metal in the rim and further expense in repairs and maintenance for wrought steel wheels of this type.

In a manganese steel car-wheel produced from a blank made according to my invention the wearing body of the wheel rim can be made as light as the rim of a chilled cast iron car-wheel with a corresponding economy in weight and cost of metal.

When the steel cast blank is removed from the mold, and before it is subjected to the first forging operation, it may be placed in a soaking pit, or heating furnace, and the initial heat from casting the metal may be retained, or raised to a higher temperature than it would be practicable to re-heat a cold blank to, for forging hard steel alloys or steels of higher carbon content than now used for producing car-wheels, and with this operation of retaining the initial heat of the metal, from casting, and raising it to a higher temperature after the removal of the blank from the mold, which is involved in my process, all danger of overheating or burning the steel will be obviated.

In a car-wheel produced from a blank made according to my invention the metal may be subjected to heat-treatment, if required, when the wheel is forged into shape by heating it to a proper temperature and then suddenly cooling the metal by quenching. However it is believed that the chilling effect of the metal forging-dies will be sufficient to give the toughness and tensile strength desired for manganese steel, without re-heating the forged wheel to temper it. If this result is attained all danger of over-heating and cracking the metal by re-heating will be obviated.

I claim as my invention and desire to secure by Letters Patent—

1. The method of producing an individual car wheel blank free from pipes and segregations which consists in casting a horizontal steel disk with a vertical column rising from the top thereof, the parts being so proportioned that the metal in the column remains fluid until the disk has solidified and the solidification of the disk progresses from the edge thereof toward the column, and then discarding the column.

2. The method of producing an individual car wheel blank free from pipes and segregations which consists in casting a horizontal steel disk with a vertical column of considerable cross-sectional area rising from the top thereof at the center, the column being so proportioned that the metal therein remains fluid until the disk has solidified and the disk being so shaped that solidification thereof progresses from the edge toward the center so as to avoid the formation of solidified portions in the disk between the fluid column and unsolidified portions of the disk, and then discarding the column.

3. The method of producing an individual car wheel blank free from pipes and segregations which consists in casting a horizontal steel disk which rises gradually toward the center and there merges into a vertical column extending directly upwardly therefrom, the parts being so proportioned that the column remains fluid until the disk has solidified, and solidification of the disk progresses from the edge thereof toward the center, and then discarding the column.

4. The method of producing an individual car wheel blank free from pipes and segregations which consists in casting a horizontal steel disk with a vertical column rising from the top thereof, the parts being so proportioned that the metal in the column remains fluid until the disk has solidified and the solidification of the disk progresses from the edge thereof toward the column, subjecting the disk to pressure while it is solidifying, and then discarding the column.

5. The method of producing an individual car wheel blank which consists in casting a horizontal shallow steel disk which rises gradually from the edge toward the center and there merges into a vertical column extending upwardly therefrom, the parts being so proportioned that the column remains fluid until the disk has solidified and solidification of the disk progressing from the edge thereof toward the center, and then discarding the column.

6. The method of manufacturing an individual car wheel blank which consists in casting a blank in such form as to cause solidification of the metal to take place progressively from the entire outer surface toward a common point so as to subject the progressively decreasing mass of molten metal in the interior of the blank to compression toward said point, providing a vertical column of metal at said point so as to produce a hydrostatic head of metal acting upon the molten interior of the blank, and maintaining a portion at least of the column in a fluid condition until the blank has solidified.

7. The method of manufacturing an individual car wheel blank which consists in casting a blank in such form as to cause solidification of the metal to take place progressively from the entire outer surface toward a common point so as to subject the progressively decreasing mass of molten metal in the interior of the blank to compression toward said point, providing a vertical column of metal at said point so as to produce a hydrostatic head of metal acting upon the molten interior of the blank, and causing the column to solidify more slowly than the blank.

8. The method of manufacturing an individual car wheel blank which consists in casting a blank in such form as to cause solidification of the metal to take place progressively from the entire outer surface toward a common point so as to subject the progressively decreasing mass of molten metal in the interior of the blank to compression toward said point, providing a vertical column of metal at said point so as to produce a hydrostatic head of metal acting upon the molten interior of the blank, the

column being made sufficiently large in cross section to cause the central portion thereof to remain fluid until the blank has solidified.

9. The method of producing an individual car wheel blank which consists in making a casting of molten steel having a much greater horizontal thickness than vertical thickness and provided with a vertical column rising therefrom, and then chilling the casting from the top and bottom faces so as to cause the metal to solidify progressively from the top and bottom toward the interior and subject the progressively decreasing molten mass in the interior of the casting to compression stresses which, together with the hydrostatic head of molten metal in the column, serve to compact the metal as it solidifies and at the same time permit the pipings and segregations to escape into the column.

10. The method of producing an individual car wheel blank which consists in casting a blank of substantially uniform vertical thickness and having a much greater horizontal thickness than vertical thickness, providing a vertical column which rises from the top of the blank, and chilling the blank, from the top and bottom faces so as to cause the solidification of the molten metal to take place progressively from the top and bottom faces of the blank, and causing the column to solidify more slowly than the blank.

11. The method of manufacturing an individual car wheel blank which consists in making a casting of molten metal, chilling the casting from the top and bottom faces and from the sides so as to cause the casting to solidify progressively from the entire outer surface toward a common point and thereby subject the progressively decreasing mass of molten metal in the interior of the casting to compression toward said point, providing a vertical column of metal at said point so as to produce a hydrostatic head of metal acting on the molten interior of the casting, and causing the column to solidify more slowly than the casting.

12. The method of producing an individual car wheel blank which consists in making a casting in the form of a horizontal disk having a much greater diameter than vertical thickness, subjecting the top and bottom faces and the periphery of the disk to a chilling action so as to cause the molten metal to solidify progressively from the outer surfaces of the disk toward the center of the disk and thereby subject the progressively decreasing mass of molten metal in the interior of the disk to compression toward the center, providing a vertical column of metal rising from the top of the disk at the center thereof so as to produce a hydrostatic head of metal acting upon the molten interior of the disk, and causing the metal of the column to solidify more slowly than the metal in the disk.

13. The method of producing an individual car wheel blank which consists in making a casting of molten metal, providing a vertical column extending upwardly from the top of the casting, chilling the rim portions of the casting and also portions between the rim portion and the column so as to subject the molten interior of the casting to compression stresses coöperating with the hydrostatic head of the molten metal in the column to compress the molten interior of the blank, and causing the column to solidify more slowly than the casting.

14. The method of manufacturing an individual car wheel blank which consists in casting a blank having a much greater horizontal thickness than vertical thickness, chilling the blank from the top and bottom and from the sides so as to cause the metal to solidify progressively from the outer surfaces to a common point and thereby subject the progressively-decreasing molten mass in the interior of the blank to compression toward said point, maintaining a vertical column of molten metal rising directly from the top of the blank at said point so as to subject the molten interior of the blank to a hydrostatic head of molten metal, and subjecting the blank to external pressure during cooling.

In testimony whereof I hereunto set my hand this eighth day of May, A. D. 1909.

HERBERT R. KEITHLEY.

Witnesses:
JOHN S. COOPER,
S. A. BISHOP.