THE PRODUCTION OF METALLIC BARS OF ANY SECTION BY EXTRUSION AT HIGH TEMPERATURES.*

The author in his opening remarks drew attention to the fact that so rapid are the strides sometimes made by invention that it frequently overtakes the means at disposal for giving practicable form to otherwise practical ideas. A case in point is afforded by the invention of Mr. Alexander Dick, which deals with all kinds of metallic sections, by forcing metal heated to plasticity through a die under hydraulic pressure. The principle is the same as that employed in the manufacture of bricks, drain pipes, and similar articles.

It is true the principle of extrusion has been applied to the production of continuous lengths of leaden pipe and wire, and of leaden rods for the manufacture of small arm projectiles; but in the present case the metal is operated upon at a very high temperature, that of plasticity, or about 1,000° F.

The process of manufacture consists in placing the heated metal in a cylindrical chamber, at one end of which is a die. Upon pressure being applied at the opposite end, the plastic metal is forced through the die, issuing therefrom as rods or bars of the required section and of a length governed by the quantity of metal placed in the receiver. This pressure chamber has not only to withstand the high temperature of the contained metal, but has likewise, while under the influence of that temperature, to meet the severe strain brought upon the interior by the resistance of the metal to the pressure of the hydraulic ram in forcing it out through the contracted area of the die. Hence the first and most important point to be settled was the design of the cylinder and the material of which it should be constructed.

Several cylinders were made, some of cast and some of wrought steel, the chamber being 24 inches long and 6 inches internal diameter, and the walls from 3 to 6 inches thick. The cylinder was surrounded by an annular chamber, which was heated by a coke fire, the object being to maintain the plasticity of the metal during the operation of pressing. The cylinders, however, cracked badly as the result of expansion and contraction strains, and for a long time the progress of a promising invention was retarded.

The difficulty respecting the pressure chamber, or container, was eventually overcome by dividing up the container into sections composed of concentric steel tubes alternating with annular spaces packed with a dense non-conducting material. This arrangement is based upon the principle that steel, if heated only to moderate temperatures, will retain its full power to resist pressure; so that a cylindrical chamber formed of several conparatively thin walls, and protected from extreme heat, will resist pressure better than a chamber having a thick solid wall heated to a higher temperature.

By this compound system of construction, the liner, which is exposed to the extreme heat of the metal, may be made with a comparatively thin wall, and will not be liable to be fractured by unequal heating and cooling, and consequent expansion and contraction. Further, in order that it may be capable of successfully resisting pressure, it is re-enforced by means of the surrounding steel tubes, which, although of themselves thin, are insulated and supported by a dense packing of non-conducting material, and are therefore kept at a comparatively low temperature and in a condition to offer the greatest resistance, which condition is further mechanically influenced by a stout steel outer casing.

Another problem which took some time to solve was the selection of an efficient non-conducting material. After experimenting with a variety of substances, Mr. Dick found that the best results were obtained from crushed granite mixed with a small proportion of borax. This compound satisfactorily fulfilled all the necessary conditions, and was therefore adopted as a non-conductor.

The apparatus consists mainly of the compressing cylinder or container and the hydraulic ram. A longitudinal section of the container is shown at Fig. 1, a transverse section at Fig. 2, and an end view at Fig. 3. The container, which is 2 feet long and 2 feet diameter externally, has an inner liner of cast steel. The internal diameter of the liner varies in different containers from 5 inches to 8 inches, according to whether it is wanted for pressing a small or a large charge, the container being changed as required. The liner is inclosed within a series of cylinders of ordinary mild steel spaced about ¼ inch apart, the annular spaces being filled in with the non-conducting material. The container is mounted on trunnions and fitted with worm gearing for

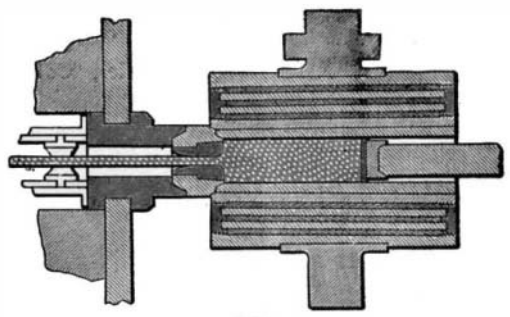


FIG. 1.

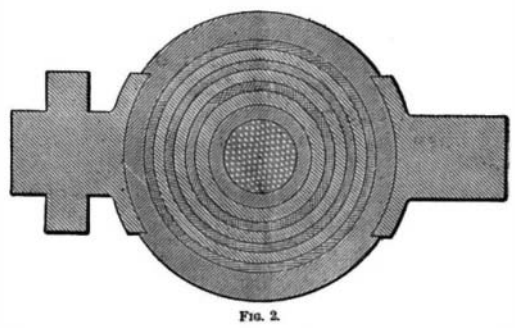


FIG. 2.

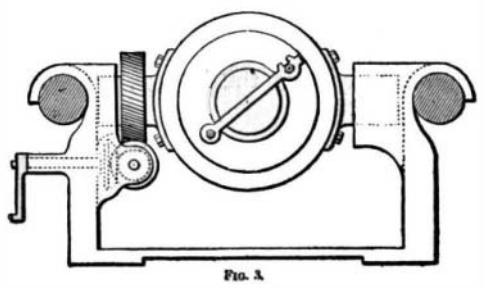


FIG. 3.

PRODUCING METALLIC BARS BY EXTRUSION.

bringing it to a vertical position for being charged with metal and restoring it to the horizontal for the operation of pressing, as shown in Fig. 3.

Great care has to be exercised in making the die plates, the material of which is tungsten steel. They are formed with either one or several openings, each opening being of the section required to be given to the article to be produced. The edges of the openings in the dies are beveled, so as to give free access to the metal under pressure and to more perfectly condense it. The metal is forced out of the container through the die by an 18 inch hydraulic ram, working under a pressure of 4,480 pounds per square inch.

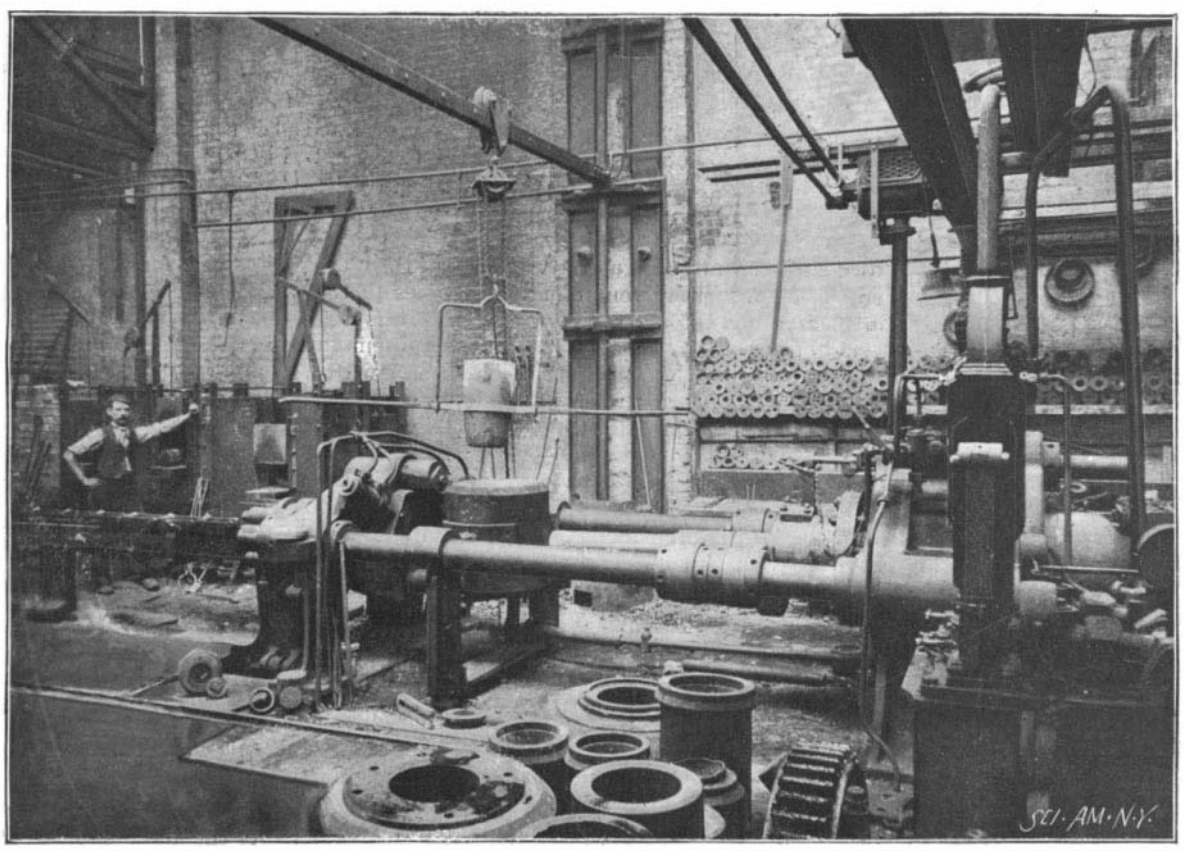
Upon the occasion of a visit of the author to the Delta Metal Works, New Cross, London, where this machine is in operation, it was producing Delta metal rods 1 inch in diameter and 12 feet long. The die used for them had four openings, thus producing four lengths, or an aggregate of 48 feet of rod at the same time. The container was turned into a vertical position and 168 pounds of molten metal was poured into it. It was then allowed to stand for six minutes so as to acquire a plastic condition. In order to prevent a back flow of the plastic metal taking place, a dished steel check disk, which is less plastic and more rigid than the heated metal at the working temperature, is first placed on the top of the charge, and when the pressure is brought on, the disk is expanded and completely fills the bore of the liner, thus effectually preventing the back flow of the metal.

Upon this check disk was then placed the loose steel block just referred to, which, having been previously heated, prevents the cold end of the plunger chilling the charge of metal. The plunger being of smaller diameter than the liner, there is no fear of the latter becoming chilled by the former. To preclude the possibility of such an occurrence, the back of the loose block is recessed to receive a corresponding projection on the front end of the plunger, which is thus kept horizontal in its forward travel and prevented from coming in contact with the liner.

The loose block having been inserted, the container was brought into a horizontal position, the stop plate removed, and the container run up to the die block, which, with the die, had been previously heated. The hydraulic pumps were then started, and in four minutes the charge was expelled and had become converted into four 1 inch rods, each measuring over 12 feet in length. The clips were then released and the ram continued its forward travel, pushing out the remaining metal, or stump, together with the die and its holder, as well as the check disk and the loose block, leaving the container perfectly clear for a fresh charge.

With regard to the physical characteristics of the bars thus produced, it is obvious that, owing to the great pressure put upon the metal, its quality must necessarily be greatly improved, in the same way that Whitworth steel is improved by compression. In the first place, it is found to be perfectly homogeneous. The actual increase of strength in extruded bars over that of hot rolled bars of the same metal varies with the nature and composition of the metal or alloy. Taking ordinary yellow metal, the increase in tensile strength is 24 per cent, with a proportionate increase in elongation. Some tests made at Woolwich Arsenal with Delta metal bars produced by extrusion show a tensile strength of 107.520 pounds per square inch, with 32·5 per cent elongation on 2 inches, against 85,120 pounds per square inch tensile strength and 20 per cent elongation of rolled bars of the same metal. The samples shown by the author of the paper were of a perfectly smooth surface, and they ranged from light sections, such as wire weighing about $\frac{1}{100}$ of a pound per foot, to heavy rounds, hexagons and squares weighing forty pounds and more per foot.

It will thus be seen that we have, if not a new industry, at any rate a new industrial process of far-reaching importance. It is not outside the bounds of possibility that, given an improved description of steel or other metal for the dies, other metals, such as iron and steel, which are less ductile and less expensive than those to which the system is at present applicable, may be used for the production of a still wider range of articles by extrusion.



PRODUCING METALLIC BARS BY EXTRUSION.

* Abstract of paper read before the Iron and Steel Institute of Great Britain at the Spring meeting, May, 1896. By Perry F. Nursey.

Acetylene in Use.

It is stated that acetylene is being tried in some of the tram cars in Paris, and with promising success. The generator, containing the calcium carbide and water, weighs under thirty pounds, and is placed beneath the steps of the vehicle, and it contains sufficient material for generating thirty-five feet of gas. As the lighting power of acetylene gas is something like fifteen times that of coal gas, the cost is stated to be less than that of illuminating the cars by petroleum. Doubtless, after this, we shall have a practical and safe application of acetylene for lantern purposes next season.—The British Journal of Photography.

As the exact year of Gutenberg's birth is not definitely known, the year 1900 has been selected by the authorities of Mayence to celebrate his five hundredth birthday.

Science Notes.

The fourth Congress of Criminal Anthropology is to be held at Geneva, Switzerland, under the auspices of the Swiss government, from August 4 to 29 of the present year.

An International Exhibition will be held at Brisbane, Queensland, Australia, during June, July and August, 1897. Special attention will be given to labor saving appliances of all kinds.

The instruments used in the observation of the British Association's committee on earth tremors are so delicate that an angle can be detected which corresponds with that subtended by a chord an inch long of a circle 1,000 miles in radius.

It is recorded that a fully equipped expedition will shortly start for the exploration of the remaining two-thirds of the interior of Australia which the Elder expedition left unfinished. Mr. Albert E. Calvert provided the funds for the expedition.

An aluminum quadrant has been devised to measure the actinic power of the Roentgen rays. The aluminum is arranged in concentric layers varying from one to ten millimeters in thickness. Measurements are made by holding the quadrant between the excited Crookes tubes and a phosphorescent screen or a sensitized plate.

Arrangements are now being perfected in Limoges to celebrate this year the centenary of the introduction of porcelain into France, by means of a retrospective exposition in which the history of porcelain manufacture will be traced. The exposition is being organized by the Société Gay-Lussac, working in conjunction with representatives of the town of Limoges.

A seismological department has been established at the Athens Observatory. It has been placed under the direction of Dr. Papavasilon, who is well known for his investigation regarding the Locris earthquake in 1894. Earthquakes are very frequent in Greece; 34 were recorded in January alone. A monthly bulletin will be published and regular observations will be made over the disturbed area.

Mr. E. D. Fridlander, B.Sc., recently gave an account of some observations of the amount of dust in the atmosphere made at various places during a voyage round the world in 1894-95. The experiments, which were made with a form of Aitken's pocket dust counter, showed that there are often considerable variations in the number of dust particles in a very short space of time. Dust was found up to an altitude of 6,000 feet or 7,000 feet among the Alps, and also in the open ocean so far away from any land as to preclude the possibility of artificial pollution.

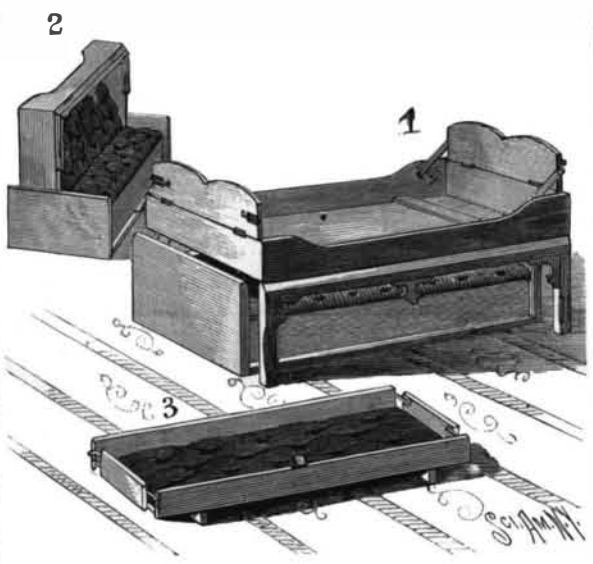
Columbia University will send a party of naturalists under the leadership of Prof. Bashford Dean, to explore Puget Sound. Three zoologists and one botanist will accompany the party. The deep sea work will be done with the Albatross. The region is almost unexplored. The region around Puget Sound is exceedingly rich and promising in its marine and botanical life. The expedition hopes to make extensive additions to the teachers' collections of the university, to add new types to the herbarium and zoological museum, and to collect unique material for research for staff and graduate students and for training in independent marine research. The party will return about the first of September.

In a paper published in the Astronomische Nachrichten Dr. See shows how, by a very ready method, determination may be made of the absolute dimensions of the orbits of bright and rapidly revolving binary stars by single spectroscopic measures of the motions in the line of sight of the component stars, and from the dimensions and other known data of the orbits the actual masses of the stars and their distances from the earth can be easily calculated. But perhaps the most important result claimed for this method is the means it furnishes of testing the question whether the Newtonian law of gravitation applies to stellar systems as well as to the solar system. Dr. See shows the manner in which may be calculated the motion in the line of sight in all parts of the binary orbit, these calculations being based upon the law of gravitation and a single spectroscopic measure. If such measures be continued upon a number of pairs, while the stars complete their revolutions, and the computed and observed motions in the line of sight agree throughout, within reasonable limits of error, it will be strong proof of the universality of the Newtonian law.

One of the most interesting exhibits at the Royal Society's recent conversazione was the series of photographic spectra of the Bessemer flame, as seen at the Northeastern Steel Company's works at Middlesbrough, shown by Prof. Hartley. The photographs demonstrated the presence of gallium, and subsequently this body was separated both from the metal and from the ore of the district. The discovery, in 1876, of the very rare element gallium was the great achievement of Lecoq de Boisbaudran, who obtained it in extremely minute quantities from certain Westphalian zinc blendes. Some of its properties resemble those of nickel, and others those of aluminum: but it has qualities of its own rendering it specially remarkable among the metals. It would be interesting to learn to what extent it is found in Cleveland ironstone. The Westphalian blendes used by Lecoq de Boisbaudran contained, according to Adolphe Wurtz, only one sixty-thousandth of a part of gallium. The element was predicted, with most of its properties, under the name of "ekaluminium," by the Russian chemist Mendelejeff, on the basis of the periodic law.

A COMBINED BED AND SOFA.

The object of the invention shown in the illustration, for which a patent has been granted to Mr. Thomas Langdon, of South Los Angeles, Cal., is to combine in a single article of furniture a single or double bed, a sofa, and a separate, detachable, crib or berth. The device consists of a base to which are attached two stout end pieces, which are connected by a longitudinal partition centrally located between them. The body of the bed is hinged to the top edge of this partition, so that it may be thrown up, to form the back of the couch, or lie down horizontally, when it will rest upon said partition and upon folding legs which are suitably hinged at the front and rear of the bed. A hinged head board and foot board are provided, which are held in position by pivoted braces, and provided with locking bolts, which are controlled by springs and engage suitable holes in the sides of the bed when the same is folded up, thereby holding the clothes firmly in place. The sofa is located in the front compartment of the base, and consists of a cushioned top and hinged sides and ends, which are folded down when it is to be used as a lounge or sofa, the base of the bed being likewise cushioned to form the back of said sofa. If the sofa is to be used as a crib or couch, the front board of the latter is turned upward to form a side rail; and if a second single bed is required, in addition to the large bed, it is formed by taking out the frame of the lounge, turning the end



LANGDON'S COMBINED BED AND SOFA.

and side pieces upward around the cushioned top and latching them into position, the small bed thus formed resting upon two transverse pieces secured to the bottom of the cushion.

A Polar Region Map.

The United States Hydrographic Office of the Naval Bureau has just issued a map which embodies the entire history of North Polar exploration. It is published in two sheets, which divide between them the entire area included in the Arctic circle, and with a marginal belt of four degrees outside it. In other words, the map covers the entire area of North Polar exploration from latitude 62° 30′ north. It is, of course, circular, and is drawn to so large a scale that the diameter of the great circle contained on the two sheets measures forty inches. The longitudes east and west from Greenwich are marked on the Arctic circle, and the latitudes on two great meridian lines which cross the map at right angles from 75° west (nearly the latitude of Washington) and at 165° west. The great circle of Lockwood and Brainard's nearest approach to the Pole, May, 1882, is drawn at 83° 24′ north, and the point where they reached that altitude is marked at 44° 5′ west. The history of every North Polar expedition and exploration of the coasts is indicated by a series of ingenious colored lines and tracings. They can be easily followed, and tell the story with absolute accuracy and in graphic terms. The amount of skilled labor and geographic detail incorporated in the map is enormous, and is saved from being confusing only by the large scale to which the map is drawn. Seventy-six distinct explorations are traced on the map, from Sir John Franklin's, in 1845, down to Peary's, in 1895. Eight nations are represented in these explorations—Great Britain, Germany, Austria, Norway, Sweden, Netherlands, Russia and the United States. The height of the land is marked in feet and the depth of the water in fathoms. The land is colored to a light gray and the water left white. The names on the map are not crowded and are most delightfully legible. The entire lithographic execution of the work is the best. We are at a loss which to pronounce the more admirable, the high degree of perfection reached in the printing or the judgment shown in avoiding unnecessary refinements and the overloading the surface with more names than it could carry clearly, as is done in the recent editions of Stieler. It was a good stroke of practical judgment which divided the entire Arctic circle between two sheets instead of giving it all in one huge, unmanageable sheet, an arrangement whose convenience any one who wishes to consult the maps often will appreciate at once. At the bottom a complete key to all the signs or symbols employed to indicate the polar explorations and expeditions, with the names of the explorers and the dates of their expeditions, is printed out in full. We are proud to see so great a work as this bearing the imprimatur of the United States Hydrographic Office; and, more than all, we are glad to have such a condensed clew map to tell in a few words the confused and confusing story of these heroic expeditions to show what each accomplished, and what the relation of one to the other is and what remains to be done. The map is issued at the low price of one dollar, which, says the Independent, barely covers the cost of publication.

A Trolley Without Poles.

Chemnitz, Saxony, two years ago banished horses from her street cars and substituted the trolley. In a report to the State Department, Consul J. C. Monoghan says one of the principal novelties of the adopted system is that no poles are used. The method of stringing wires is by means of ornamental rosettes fastened into the woodwork or walls of houses, having projecting hooks to which the wires are attached. These hooks are firmly fastened and are tested with seven times the weight they will be called upon to bear. Owners of houses, without exception, preferred to allow the use of their houses free rather than have posts on the sidewalk. The streets through which the cars wind their way are wider than Washington Street, Boston, or Westminster Street, Providence. The railway tracks, in conformity to the law, are level with the pavement, and accidents to vehicles of any kind are rare. The gage is narrower than in America, but the cars keep the track and run as rapidly and smoothly as in the United States. In the heart of the city they run 220 yards per minute, and in the suburbs 330 yards per minute.

The increase of traffic since the introduction of electricity in Chemnitz has been 60 per cent. The cars have no conductors. The motorman is the only person on board who represents the company. By doing away with conductors the company saves 44,000 marks annually. The fare is only ten pfennigs, or a trifle less than 2½ cents, on all routes, including transfers. Should 150,000 persons evade payment in twelve months, the loss would be only 15,000 marks. It would take 450,000 evasions in fare to offset the company's savings by dispensing with conductors' salaries. Among a people who pay for food and drink in restaurants, saloons, and gardens on their honor alone, it is unlikely that the company loses much. Culprits in this regard when detected are punished by having their names advertised in the newspapers as a warning to others. Fare boxes are attached to both ends of the car, so there is no such excuse offered as "difficulty in getting forward."

Experiments are being made in Dresden with storage batteries and underground conduits with a view to replacing the overhead system of railway propulsion in Chemnitz. The overhead trolley system has been very profitable. The system has worked perfectly for the past two years, and has much to commend it to cities bent on an overhead system.

Prompt People.

Don't live a single hour of your life without doing exactly what is to be done in it, and going straight through it from beginning to end. Work, play, study—whatever it is, take hold at once, and finish it up squarely; then to the next thing, without letting any moments drop between. It is wonderful to see how many hours these prompt people contrive to make of a day; it is as if they picked up the moments which the dawdlers lost. And if ever you find yourself where you have so many things pressing upon you that you hardly know how to begin, let me tell you a secret: Take hold of the very first one that comes to hand, and you will find the rest all fall into file, and follow after, like a company of well-drilled soldiers, and though work may be hard to meet when it charges in a squad, it is easily vanquished if you can bring it into line. You may have often seen the anecdote of the man who was asked how he had accomplished so much in his life. "My father taught me," was the reply, "when I had anything to do, go and do it." There is the secret—the magic word now! Make sure, however, that what is to be done ought to be done. "Never put off till to-morrow what you can do to-day" is a good proverb, but don't do what you may regret.—Merchant Sentinel.