

(16) pound - 453g

1. PLASTIC SHAPING OF METALS

Before metals can be mechanically worked, they must first be cast into ingot moulds of suitable form. The moulds may be rectangular, square, or round in cross-section, the final castings varying in size from a few hundred pounds to several tons.

Steel remains in ingot moulds until solidification is about complete, at this time the moulds are stripped from ingots. While hot, the ingots are placed in gas-fired furnaces called soaking-pits, where they remain until they have attained a uniform working temperature (around 1225°C) throughout. Then they are taken to the rolling-mill. Because of the large variety of finished shapes to be made, ingots are first rolled into such intermediate forms as blooms, billets, or slabs.

The process of plastically deforming metal by passing it between rolls is known as rolling and is the most widely used hot-working method. Steel in the form of an ingot is a relatively weak mass of non-uniform crystals or grains. Rolling process is used to break these crystals down and to elongate them. This breaking up of the cast structure, or "refining the grain", is important because it makes the steel stronger and more ductile and gives it greater shock resistance.

Basically, the rolling processes of steel industry consist of passing the material between two rolls revolving at the same speed but in opposite directions. During its passage through a rolling mill, the metal is compressed to a thinner section, elongated proportionally in length, but spread laterally only slightly. Metal is drawn into the rolls by the frictional force. The rolls themselves may be either of steel or cast iron, consisting of a body or barrel on which the rolling is done, the neck on which the roll revolves in the bearing, and a star-shaped coupling or "wobbler" through which the roll is driven. The body of the roll may be a simple cylinder for flat rolling, or it may be grooved if a piece is to be rolled to a definite shape.

Words and combinations to be remembered:

- barrel - бочка, полотно прокатного вала
- bearing - опора, подшипник
- billet - билет, сутунка
- bloom - bloom, крупная заготовка

нормирован

расширен

вращ

звезда

body - тело, корпус; roll body - бочка валька
to break down (up) (broke, broken) - ломать, разрушать
cross-section - поперечное сечение
coupling - соединение, муфта
to draw (drew, drawn) - тянуть; - down - уменьшать в поперечном сечении
to elongate - удлинять(ся); растягивать(ся)
to finish - окончательно отработать, отделять
grain - зерно (кристалла)
groove - ручей на вальке; to groove - калибровать
ingot - слиток
mill - стан; rolling mill - прокатный стан
mould - форма; to mould - формовать
pass - ход, калибр, ручей; to pass - проходить, пропускать
pit - колодец; soaking pit - нагревательный колодец
rectangular - прямоугольный
shape - форма, профиль; to shape - придавать форму
shaping - (здесь) деформация
slab - сляб
to solidify - затвердевать
uniform - однородный
wobbler - трещ
square; round; final casting; to strip; to remain; intermediate forms; shock resistance; ductile; frictional force; flat rolling; piece.

EXERCISES

- I. While reading and translating the text pay attention to the underlined auxiliary words. Make up six sentences using these words.
- II. Look through the text and find all the sentences with Absolute Participle Construction, write them out and translate into Russian.
- III. a) Give the nouns corresponding to the following verbs and translate them:
to deform, to elongate, to finish, to groove, to mould, to pass, to shape, to solidify, to cast, to vary, to resist, to revolve, to process, to compress, to place, to use.

size the as-cast state,²⁾ welds up small internal cavities, and generally produces sounder fine-grained material than a casting. These effects improve the physical properties of the metal to a considerable degree; but hot working does not result in any great increase in strength and hardness.

Hot rolling and forging are very widely used in the fabrication of metal shapes, and, even when the finishing operation is to be cold working, the preliminary shaping is done by hot working.

The temperature of the metal for hot working depends on the metal or alloy, and there is a best temperature range and a best finishing temperature in each case. Steel requires a higher temperature than most of non-ferrous metals and alloys, but in every case an attempt is made to have a finishing temperature that will produce a fine-grained structure.

Notes:

- 1) coarse crystals - крупнозернистые кристаллы
- 2) as-cast state - в литом виде (металл в слитке)
- 3) shaping - обработка давлением
- 4) fine-grained structure - мелкозернистая структура

2. ROLLING MILLS

Rolling mills are of several different design, the choice depending upon the type of rolling to be done. For initial rolling operations on cast ingots, a two-high reversing mill, or a three-high mill is commonly used.

On a two-high mill rolls may be revolved both clockwise and counterclockwise. They grip the metal and pull it between themselves reducing its thickness and lengthening it proportionally. By reversing the direction of the rolls the steel is pulled back and forth perhaps twenty times. After every two or four passes between the rolls the metal is turned on its side, all four sides being thoroughly worked.

Rolls of a three-high mill are not reversible in direction. Instead, the metal is first pulled forward by the bottom and middle rolls, then lifted mechanically so that it can be re-turned between the top and middle rolls. These operations are repeated until the bloom is rolled to the desired size; manipulators, guiding devices, heating furnaces, etc., being used in

them.

Both two-high and three-high mills are employed for finishing the material down to its required size and shape, specially grooved rolls being used for this purpose.

Where large reductions are required per pass in hot or cold rolling, the four-high mills are now extensively applied. The mill houses two small rolls in the middle which do the actual rolling and two large backing rolls which serve to give support to the smaller ones. The drive is taken directly to the smaller rolls and the backing rolls are driven by friction as the rolling pressure is transmitted through them. In modern practice most of the four-high mills are intended for rolling plate.

Words and combinations to be remembered:

- back and forth - туда и обратно
- backing roll - опорный валок
- clockwise - по часовой стрелке
- counter-clockwise - против часовой стрелки
- to drive (drove, driven) - двигать, приводить в движение;
- drive (n.) - передача, привод
- to grip - захватывать
- guiding device - направляющее устройство
- mill - прокатный стан
 - two-high mill - двухвалковый стан
 - three-high mill - трёхвалковый стан
- per pass - за один ход
- to reduce - обжимать; reduction - обжатие
- to reverse - давать задний или обратный ход, менять направление
- reversible - с передним и задним ходом, реверсивный
- initial, commonly, friction, to lengthen, to turn, instead, thoroughly, furnace, to employ, purpose, to give support, to transmit, to intend.

EXERCISES

I. Look through the text once more and find equivalents for:

- 1. обычно используются; туда и обратно; требуемый размер; для этой цели; в зависимости от того; широко применяются; так что; доводка металла; большое обжатие; за один ход; направляющее

устройство; трёхвалковый стан, опорные валки; давление прокатки; в настоящее время на практике.

II. Give the verbs corresponding to the nouns and translate them into Russian:

choice, rolling, operation, reduction, pass, work, application, house, support, pressure.

III. a) Look through the text, find all the Passive Constructions and analyse them.

b) Translate them into Russian.

IV. Translate the sentences and substitute the modal verbs with corresponding combinations.

1. Before metals can be mechanically worked, they must first be cast into ingot moulds of suitable form.
2. The moulds may be rectangular, square, or round in cross-section, the final castings varying in size from a few hundred pounds to several tons.
3. The rolls themselves may be either of steel or cast iron, consisting of a body or barrel on which the rolling is done.
4. The body of the roll may be a simple cylinder for flat rolling, or it may be grooved. ~~It's~~ pieces must be rolled to a definite shape.
5. The metal is first pulled forward by the bottom and middle rolls, then lifted mechanically so that it can be returned between the top and middle rolls.

V. Answer the questions.

1. What types of rolling mills are commonly used for the first rolling operations?
2. In what way is the metal treated on a two-high mill?
3. Are the rolls of a three-high mill reversible in direction?
4. How is the metal pulled between the rolls of a three-high mill?
5. How long are these operations repeated?
6. What kind of equipment is used in these operations?
7. For what purpose are two- and three-high mills used?
8. What kind of rolls are used for finishing material?
9. What mills are extensively applied for large reductions in hot and cold rolling?

10. For what purpose are the four-high mills used in modern practice ?

VI. Retell the text.

VII. a) Translate the text and find out what types of mills are described here (time-limit - 3 minutes).

b) Translate the text without a dictionary.

Blooming and slabbing mills are heavy primary mills with rolls from 800 to 1.400 mm in diameter. They are designed for rolling ingots from 2 to 30 tons in weight into blooms, slabs and shaped billets of large size. The most extensively used are two-high reversing blooming and slabbing mills with rolls from 1.100 to 1.500 mm in diameter.

Slabbing mills, which are specially designed to roll slabs, differ from blooming mills which roll both blooms and slabs. In addition to horizontal rolls slabbing mills have two vertical rolls which reduce the ingot from the sides without turning.

Billet mills with a roll diameter from 450 to 850 mm are designed for the further rolling of blooms into smaller billets (from 50x50 to 150x150 mm in cross-section). Such billets are employed as the initial material in rolling sections. The most modern billet mills are installed directly following the blooming mills in the rolling department.

Rail mills have rolls from 750 to 900 mm in diameter and designed, generally, for rolling railroad rails and other sections.

3. HOT AND COLD ROLLING

The process of hot rolling is characterized not only by the temperature at which the deformation takes place, but by the presence of the crystallization process. For example, when rolling steel at a temperature of 500°C, the process is still basically cold rolling while if copper is rolled at the same temperature it would be termed as hot rolling.

A material like lead may be hot rolled at temperatures as low as the normal room temperature. In the process of deformation the grain is distorted. If the temperature, during deformation is higher than the recrystallization temperature, deformation process is followed immediately by the recrystallization

process. If the temperature is high enough and there is enough time, recrystallization can be complete.

When rolling in several passes, the change of metal structure can be rather complex, particularly if the temperature is gradually lowered. The character of the course of the process in hot state depends on the temperature and the rate of deformation. The metals possess the highest plasticity in the interval between the recrystallization temperature and the melting point.

Rate of deformation has considerable influence on hot working. If the rate of deformation exceeds the rate of recrystallization, cold working of metal will take place even at relatively high temperatures. /

Hot deformation brings about an improvement in the structure of the metal. When cast metal is subjected to deformation, we obtain fine-grained structure. Thereby the mechanical properties of the metal subjected to hot deformation are vastly improved.

Notwithstanding the process of recrystallization taking place in hot deformation, the texture of the metal is usually fibrous; this being the result of a directed distribution of impurities. Fibrous structure should not be mixed up with elongated structure, obtained in cold deformation. Unlike the fibrous, the elongated structure can be eliminated by heating up to the temperature of recrystallization.

Production and utilization of cold rolled steel has gone up tremendously in recent years. (It is because of the direct result of the vastly improved properties that a cold rolled metal possesses over those obtained by other processes of hot rolling.) It is the cold rolling process that makes it possible to produce sheets meeting the following specifications:

1. Less than 1.0 to 1.5 mm thick, which are almost impossible to be produced by hot rolling.
2. With a uniform thickness with very close tolerances.
3. With a very good quality of the surface.
4. With high mechanical and technological properties (fitness for stamping, etc.).

By cold rolling it is possible to produce sheets and strips from 0.002 mm (or even less) to 2.0 mm thick. Cold rolled sheets

with smooth surface are widely used in mechanical engineering. The sheets with slightly coarse surface (fine-grained structure) are used for stamping.

Words and word combinations to be remembered:

to bring about - осуществлять, вызывать

fiber - волокно, fibrous - волокнистый

impurity - примесь

specification - спецификация, технические условия, характеристика, техническое описание

to meet specification - соответствовать технической характеристике (условиям)

texture - структура, строение, расположение кристаллов

tolerance - допуск

to term, to stamp, to distort, to lower, to exceed, to subject (to), notwithstanding, tremendously, gradually, particularly, relatively, slightly, influence.

EXERCISES

I. Translate the following international words without a dictionary:

to characterize, to produce, temperature, deformation, process, material, normal, structure, production, utilization, mechanical, character, plasticity, interval.

II. Look through the text and find all the Conditional Sentences, write them out and translate into Russian.

III. Look through the text once more and find equivalents for:

происходит деформация; наличием процесса рекристаллизации; он бы назывался горячей прокаткой; материал подобный свинцу; при температуре столь низкой ...; при прокатке за несколько ходов; характер прохождения процесса; степень деформации; при сравнительно высоких температурах; вызывает улучшение структуры несмотря на то, что процесс рекристаллизации происходит ...; именно процесс холодной прокатки.

IV. a) Give the adverbs corresponding to the adjectives and translate them into Russian:

basic, immediate, complete, particular, gradual, considerable, relative, tremendous, mechanical, partial.

b) Give the nouns corresponding to the verbs and translate them into Russian:

to deform, to characterize, to roll, to term, to possess, to influence, to mix.

V. State the function of "it" and translate the sentences into Russian:

1. It is hot rolling process that is characterized not only by the temperature, but by the process of recrystallization.
2. It is known that hot deformation brings about an improvement in the structure of metal.
3. That the rate of deformation has considerable influence on hot working is well known to metallurgists.
4. It is necessary to subject metal to hot deformation to improve its mechanical properties.
5. That the production and utilization of cold rolled steel has gone up tremendously in recent years is a well known fact.
6. It is in the interval between the recrystallization temperature and the melting point that metals possess the highest plasticity.

VI. Answer the questions.

1. How is the process of hot rolling characterized ?
2. At what temperatures may a material like lead be hot rolled?
3. In what interval does the metal possess the highest plasticity ?
4. What factor has considerable influence on hot working ?
5. What quality of metal does hot deformation bring about ?
6. When do we obtain fine-grained structure ?
7. By what means can we eliminate the elongated structure ?
8. What kind of steel is produced by cold rolling ?
9. What steel product is used for stamping ?

VII. Retell the text.

VIII. a) Look through the text and find what kind of production may be rolled on a mill (time-limit - 3 min.).

b) Transl te the text without a dictionary.

Hot rolling operations are employed for the initial shaping of ingots and for further fabrication of rails, plates, pipes, etc. Sheet, strip, and some kinds of pipe may be finished hot or cold, depending upon the properties desired in

the final product.

Hot rolling of ingots is carried out in a break-down or blooming mills, which reduce the cross-sections of the ingots and improve their properties. Depending upon a particular process, a bloom may be further reduced to a billet or slab. A billet is a bloom whose length has been increased and whose cross-section has been decreased. A slab is a bloom which has been flattened and elongated. Blooms may be hot rolled directly to structural shapes and rails. Billets are formed into pipe by hot rolling and by other methods. Slabs are used for rolling of plates, strips and sheets. In the hot rolling of blooms and shapes rolls are grooved to produce cross-sections desired.

4. SPEED AND ACCURACY IN ROLLING

Speed of rolling is known to be an important parameter in the rolling process. It directly influences production where rolling time decreases with increased speed and the production is increased. Such advantages are considered to be most prominent in continuous rolling mills where as a result of increase in speed, the production is directly proportional to speed. Though, in general, an increase in speed brings about an increase in production, the effect may not be so very prominent in cases where idle time between the passes is a significant fraction of the total rolling time.

But an increase in speed of rolling results in certain other effects which are not so desirable. For example, to increase speed of rolling means to reduce permissible drafts and increase the number of passes due to the decreasing of the coefficient of friction between the rolls and the material. In case of rolling with high speed in mills, where metal to be rolled moves in one direction only, the inertia force could be advantageous in transportation or even helpful in increasing the angle of gripping as in continuous mills. But in cases where the metal has to reverse end pass through the same stand as in two-high reversing or three high mills, the inertia forces will take the metal further and would increase the idle time between passes.

In two-high reversing blooming mills an accelerating, constant speed, and decelerating period has to be provided to get

на выходе *облегчить*
a low speed at discharge to facilitate stopping the bloom and its feeding back. In such a case increase of speed does not play as useful role as in continuous processes.

Production of sections with dimensions to be required is a rather fundamental problem affecting the selection of various technological factors. It is practically impossible to produce a shape of exact dimensions and certain deviations are inevitable. These deviations may be due to technological factors like temperature and the length of the piece to be worked, equipment factors as wear of grooves, elastic deflections, or material factors. The aim in production of sections is to restrict the influence of factors mentioned above and produce a shape with minimum deviations by accurately controlling these factors and at the same time produce them economically.

Words and combinations to be remembered:

to accelerate - ускорять(ся)
accuracy - точность; accurate - точный
angle - угол; angle of gripping - угол захвата
bar - пруток, брусок
deflection - прогиб
dimension - размер, габарит
discharge - разгрузка; at discharge - на выходе
draft - обжатие прокатываемого материала
to feed - подвзвать
fraction - доля, часть (здесь)
mill - стан; continuous rolling mill - непрерывный стан
production - (здесь) производительность
stand - клеть

to facilitate, idle time, wear, constant speed, to restrict, to play a useful role, wear, elastic deflection, exact dimensions, permissible, desirable, to affect.

EXERCISES

I. Analyze the underlined Infinitives and translate the sentences:

II. Give the nouns corresponding to the adjectives and translate them.

important, proportional, desirable, advantageous, helpful, technological, useful, permissible, direct, significant.

III. Look through the text once more and find equivalents for:
/ непосредственно влияет; прямо пропорциональна скорости; приводит к увеличению производительности; всего времени прокатки; только в одном направлении; вследствие уменьшения коэффициента трения; время простоя; износ ручьев; ограничить влияние (факторов); должен изменить направление.

IV. State the function of the Infinitive in the following sentences and translate them into Russian:

1. To acquire a better understanding of the advantages of a modern rolling mill it is necessary to start with the principles and types of traditional ones.
2. To increase the production means to decrease the rolling time in continuous rolling mills.
3. We know the inertia force to be advantageous in transportation or even helpful in increasing the angle of gripping in continuous mills.
4. Production of sections with dimensions to be required is known to be a rather fundamental problem affecting the selection of various technological factors.
5. The ingots to be rolled should be preliminarily preheated in soaking pits to acquire temperature necessary for hot rolling.

V. Answer the questions.

1. What important parameters in the rolling process do you know?
2. What is its most direct influence on production?
3. What is the main advantage of increased speed in the rolling process?
4. What undesirable effects does an increase in speed result in?
5. Is it practically possible to produce sections with dimensions to be desired?
6. What are the main factors influencing these deviations?
7. What is the aim in production of sections?

VI. Retell the text.

VII. Translate the text using a dictionary.

The modern method of production of hot strip (thin sheets) is by rolling in continuous mills, which consist of two groups

of working stands. Such mills are provided with five-zone continuous re-heating furnaces of capacity 250 tons/hour each. Water under a high pressure of 90 to 100 atmospheres is extensively used for removal of scale from the surface of slab. The first roughing group of mills usually consists of four roughing stands, one scale breaker and occasionally a press for pressing the side edges. If the width of sheets is more than that of the slab, a four-high spreading stand is used for increasing the width. After this the slab is turned through 90° by turning rollers (Figure 5-5) and then fed to the subsequent stands in the roughing group. The rest of the roughing stands are four-high universal stands. All working rolls of four-high stands run in roller bearings. The stands of the roughing group are arranged at such a distance from each other that the strip enters the following stand only when the back end has come out of the previous stand (open continuous arrangements).

roughing stand - черновая клеть

scale breaker - устройство для удаления окалины

spreading stand - плющильная клеть

5. ROLLING SLABS

3 Slabs are rolled in a reversing two-high blooming and slabbing mill or in a universal slabbing mill with horizontal and vertical rolls. The former finds application when a steel plant of medium size has on its product list both structural sections and plates or strips. The ingots may be rolled into the desired quantities of both these semi-finished products. Rolling slabs in such a mill requires that the rolls be separated wide apart when the slab is turned through 90° for edging. This increases the idle time, and reduces the production. The modern trend in the production of slabs is to make use of a reversing two-high universal stand.

Heated ingots from the soaking pits are transferred to the ingot buggy and carried to the turn table by the roll table. After turning they are transferred on to the roll table and carried to the stand with vertical rolls. The ingots are passed then through the universal rolling stand, having the vertical rolls on the soaking pit side, being thus reduced initially in width and then in height. After rolling they go to the roll

table from where they are once again reversed and fed through the two sets of rolls. The process is repeated with intermediate turning with the help of manipulator till the final section is obtained by adjusting the gaps between the vertical as well as horizontal rolls. Slabs of the required dimension are then taken through the scarfing machine to shears where the ends are cropped off and the slab is cut into pieces of desired length. The product may then pass to the store or go to the plate mill installed in line with it.

Owing to the very heavy weights of ingots the ingot buggy requires a motor of 70 kw. Placing the ingot on the roll table from the ingot buggy results in considerable impact and special devices are provided to take the shock while turning the ingot on to the roll table. A manipulator, which could be operated separately through a transmission from a 160 kw motor, is provided just before each working stand.

Words and word combinations to be remembered:

to adjust - устанавливать, регулировать
 adjustment - установка, регулировка, пригонка
 buffer - буфер; демпфер; глушитель
 to crop off - обрубать
 edging - боковое обжатие; edging pass - ход бокового обжатия
 impact - удар
 machine - машина, станок; scarfing machine - машина для скашивания кромок
 product - изделие, продукт; semi-finished product - полуфабрикат
 shears - ножницы
 table - рольганг; turn table - поворотный стол
 universal stand, gap, plate mill, store, to take the shock, to operate, to provide, in line, modern trend.

EXERCISES

I. Answer the questions.

1. What kind of mill is used for rolling slabs ?
2. What mills are installed in a plant of a medium size ?
3. Into what kind of production may the ingots be rolled ?
4. What is the modern trend in production of slabs ?
5. How are the ingots initially reduced ?

6. For what purpose is the manipulator used ?
7. What device is used for cutting the slab into pieces of the desired length ?
8. What is the further way of the product ?

II. Look through the text once more and find equivalents for:
перечень продукции; чтобы валки далеко отстояли друг от друга;
новое направление; таким образом подвергаясь обжатию сначала в
ширину, а потом в высоту; ещё раз изменяют направление и прохо-
дят через ...; чтобы принять удар; посредством передачи от мо-
тора.

III. Give the verbs corresponding to the nouns and translate them:

application, product, help, weight, result, provision, manipu-
lator, transmission, store, operation.

IV. Look through the text, find all the Gerunds and analyse them.

V. Translate the sentences, pay special attention to the Gerund.

1. By reversing the direction of the rolls the steel is pulled back and forth many times.
2. After its being turned on the other side the steel passes between the top and middle rolls of a mill.
3. Besides being important for industry oxygen is also important for medicine.
4. Before being supplied to a rolling stand the ingots are preheated in soaking pits or furnaces.
5. Inspection of the finished ingots should be carried out after each melt and marking of them should also be performed after each melt.
6. It is impossible to produce rolled sections of high quality without furnishing the rolling mills with modern and perfect equipment.

VI. Retell the text.

