

the main shaft, rotate in a perfectly regular manner, so that the paper be reversed and pass from one cylinder to the other without sliding or other derangement of its motion, the form travels irregularly, and consequently the slurring action thus produced between the form and the paper at certain points greatly interferes with the sharpness and clearness of the impression, a result which is inevitable from the defective construction of the machine. M. Normand remedies this defect in a simple and effective manner. For this purpose he varies the length of the radii of the pinion precisely in an inverse ratio to the speed of the shaft or spindle; by making the pinion oval, whilst the rack is of an undulated form a perfect uniformity in the rectilinear motion of the table is obtained. The correctness of this theory is practically established by the model, in which oval and circular pinions act upon separate racks; in the one case the result is a perfect impression, and in the other a defective one. M. Normand's discovery is undoubtedly one of the greatest importance in typography.

ZOLLVEREIN.—We find some well-made hand presses (which have obtained a medal) exhibited by Dingler & Wolff (172) in the Bavarian department. These presses are fitted with double and single tumblers. Heim Brothers (514), Hesse Darmstadt, have also a well made double tumbler hand press.

In concluding our notice of the typographical printing machinery at the Exhibition of 1862, we cannot but express our surprise at the little that has really been done in this most important class of mechanism since the first Exhibition, eleven years ago. Viewed as a whole, the display is poor in the extreme, especially as regards English machines; indeed, the English makers, with one or two exceptions, have evidently been slumbering. If they do not bestir themselves, France, who is already a-head of us, will keep the lead.

2.—TYPE-FOUNDING.

Until the commencement of the present century, the art of casting types in metal moulds made little or no progress from the period of its first discovery by Peter Schoeffer. The Americans appear to have been the first to apply any material improvements to the metal hand mould as used by Schoeffer. By the addition of a small lever to the side of the mould its manipulation was greatly facilitated, and its powers of production were increased from about 4000 types per diem to 6000. It is to America also that we are indebted for the application of the pump for filling, the mould, and for the combination of the pump and lever mould as a type of which Besley's is a good example. The Germans have also for a long period devoted a considerable amount of attention to the appliances for casting types. Indeed it is difficult to determine the real origin of some of the improvements, but it is admitted generally that America and Germany have done more for the type founders' art than any other nation up to the period of 1851.

The lever type-mould, known also as the *American mould*, and which is now being rapidly superseded by mechanical type-founding machines driven by steam power, was introduced into this country about sixty years ago, and owes its origin to Messrs. Binney & Ronaldson, who first employed it in their foundry in Philadelphia. Although this ingenious little contrivance was a great improvement upon the old method of casting, both in point of economy and rapidity of production, yet it has long been found to be inadequate to supply the increasing demands of the press. By means of the hand mould a good caster could not turn out more than from 3000 to 5000 types per diem, and these had then to pass through the several hand processes of breaking off, rubbing, setting up, cutting out, and dressing. Attention was consequently directed to the discovery of some more rapid means of produc-

tion, which should at the same time combine accuracy of work with comparatively easy supervision, and the result was that several type-founding machines, intended to be driven by power, were patented both in America and this country by different inventors, with more or less success. Attempts have been made at casting several types at one operation, but these were not found to give entire satisfaction, and have been superseded by a return to single-letter casting, assisted by mechanical combinations and steam power.

The most notable examples of type-founding machinery at the Exhibition, are the machines shown in operation in the Western Annexé by R. Besley & Company (1556), and Messrs. Johnson & Atkinson (1632).

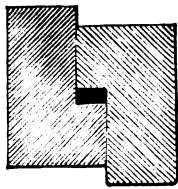
BESLEY.—This machine consists of a type mould made in two parts, on the principle of the well-known hand mould; but in place of being filled and opened and closed by hand, these operations are effected by a simple and ingenious mechanical contrivance. The mould is carried on the upper end of a vertical vibrating lever, which brings it against a feeding nozzle in connection with a pump for the purpose of allowing of the filling of the mould with molten type metal, supplied from a small reservoir on the table of the machine. The mechanism is so arranged and timed that, during the instant the back of the mould is in contact with the nozzle, a jet of type-metal is forced into the cavity by means of a plunger, which is capable of adjustment so as to force more or less metal into the mould according to the size of the type to be cast. The charged mould immediately recedes from the nozzle, and is opened by a cam action for the purpose of discharging the type. This machine, although very productive, requires, however, a considerable amount of experience on the part of the attendant to insure its proper working. All type moulds constructed on the principle of the hand mould, are liable to derangement by the presence of minute particles of metal or dirt, which will occasionally intrude themselves between the two faces of the mould, preventing the mould from closing properly and causing a distortion in the shape of the type body. In casting by hand the caster by dint of long training can detect instantly by the "click," or sound in closing the mould, and by the feel of the mould when he brings the parts together, whether the surfaces are perfectly clean, and if not he carefully brushes them over before proceeding further. Now, in Besley's machine the same care and attention is required on the part of the attendant; and hence, although the casting of the type is carried on at a greatly increased rate, or about twenty-five thousand per diem, skilled labour must be employed, which of course detracts to a certain extent from economy of production. The types, on leaving Besley's machine, are in the same state as those made by the hand mould, and consequently have to undergo all the subsequent finishing processes above alluded to.

JOHNSON & ATKINSON.—The type casting and finishing machine exhibited by the inventors, Messrs. Johnson & Atkinson, of the Patent Type-Founding Company (Limited), is the most complete thing of the kind ever brought out, and has well earned the prize medal awarded to it. In this machine the complete manufacture of finished type ready for the printer, after being "picked," is carried on at the rate of thirty thousand per diem. It consists in reality of two distinct machines combined upon one bed-plate. The first is a casting machine, which obtained the silver medal at the Paris exhibition in 1855 as the best type-casting machine there; and the second is a machine for finishing the cast type as fast as they are delivered from the mould. The essential feature of novelty in the casting machine is the peculiar form of the mould, which is so contrived that the "body" of the type is produced from a fixed opening, and is therefore perfectly invariable under all circumstances.

The diagrams (Figs. 526 and 527) illustrate the principle of the hand mould and of the new mould invented by Mr. Johnson, and

show at a glance the important difference between the two. In the hand mould the cavity in which the type is cast is formed by two right-angled blocks placed face to face, and sliding one over the other so

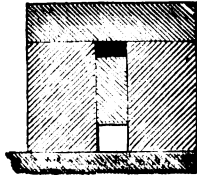
Fig. 526.



Old Hand Mould.

as to be capable of adjustment to the different "thicknesses" of type. So long as the two faces are in true contact the "body" of the type will be invariable; but should any extraneous matter intrude, the contact is no longer true and the mould will not close, the result being a long

Fig. 527.



Johnson's Improved Mould.

body or slightly distorted type. In Mr. Johnson's mould the two sides which regulate the "body" are permanent fixtures, consisting of blocks of metal firmly secured to a base plate, and hence no variation of the "body" can arise. The proper "thickness" of the type is produced by the central block, which slides vertically in perfect contact with the two inner faces of the side blocks, and by the movable top plate sliding longitudinally upon the surface, this plate being held firmly down in its place by a wedge or incline action. The height to which the central block rises, or the "thickness" of the type, is controlled by the interposition of the matrix as in the ordinary plan; but in order to avoid any irregularity in "thickness" by the lodgment of small particles on that portion of the central block which comes in contact with the matrix, the machine is made to force home the block against the side of the matrix by a positive action, and then after such contact has been established, to release the block and allow it to be held in its place by a powerful spring.

The type-metal is forced into the mould direct from the nozzle of the feeder with which the mould remains in constant contact. But in order to prevent any inconvenient heating of the mould by means of its close and constant proximity to the nozzle, provision is made for circulating a current of cold water through the principal portions of the mould. This, however, has only been found requisite when casting large-sized type. The cast type is pushed out of the mould by the rising of the central block, which carries the type with it, and brings it in such a position as to enable it to be pushed forward by the end of the top plate as it advances to close the mould. As each type is pushed forward, it enters a long horizontal groove, adjusted accurately to the proper "thickness" of the type, and the series are pressed onwards to the finishing instruments by a weight and cord. The tails are broken off by causing them to come in contact during their traverse along the groove with a fixed plate or "breaker off." Each type then passes in succession through other grooves in the bed-plate of the machine, in the sides of which are fixed steel tools which act as planes, and which successively plane the different sides of the type. When planing the "rubbed" and the "dressed" sides, each side is operated upon in succession; and whilst the first of each pair of sides is being planed the other is held against a movable edge of steel which can be adjusted so as to cause that side to be cut more or less at the head or the foot as may be required to render the type true. In planing the second of each pair of sides, that side which has been made true by the first cut is held against a fixed surface of steel, and while thus held is pushed past the second plane iron by which the second side is rendered perfectly parallel with the first. This system of dressing insures absolute equality, both in the "thickness" and "body" of the type passing through it. The grooving of the foot and the nicking of the body are both effected by special cutters, the operations being performed as the type passes along; hence by the time the type issues from the machine, nothing further is required except the operation of "picking" before they are delivered to the printer.

SWITZERLAND.— We notice also a well-made type-founding machine in the Swiss department (98), exhibited by the proprietors of the Haas Type Foundry, Basle. This machine, which obtained honourable mention, is not at work; but, judging from its general arrangement, we should say its powers of production were by no means small. The mould is constructed in two parts on the principle of the hand mould, and is therefore liable to the same deranging influences, a fact which necessitates the employment of skilled supervision. It is carried by a horizontal lever, which brings it up to the filling nozzle in connection with a reservoir of molten metal. This nozzle is provided with a plug or "jobber" for clearing it out after every jet, and for closing the rear of the same when the metal runs in. The mould is brought up to, and removed from the nozzle by a cam, and is opened and closed by a separate lever and crank motion.

A few words on the composition of the type-metal now employed will not be out of place here.

Up to the year 1851 the ordinary type-metal, consisting of about

	Parts.
Lead,	70
Tin,	5
Antimony,	25

was generally used by type-founders; but the great wear and tear of type occasioned by the general increase of periodical literature necessitated the employment of an alloy, which, though still preserving its proper printing qualities, should be of a more durable nature. In 1852 Mr. J. R. Johnson patented a hard metal type composed of zinc and its alloys; but as this metal was found to oxidize considerably in a damp atmosphere, it had to be abandoned. This gentleman again applied for a patent in 1854 for a process of making hard type by substituting tin for lead either entirely or partially in the ordinary compounds. This metal is now very generally employed, and its discovery is the first important step made in this direction. The type so made is harder, tougher, and more durable in every respect than the ordinary type. In his specification Mr. Johnson gives as the best proportions—

	Parts.
Tin,	75
Antimony,	25

but if lead be also used, it should not exceed 50 parts in 100 of the combined metals employed.

The Type Founding Company manufacture two qualities of type, viz.—"hard metal" and "extra hard metal" type. The "hard metal" consists of—

	Parts.
Lead,	50
Tin,	25
Antimony,	25

This is intended as ordinary working type, but the extra hard, which consists of 3 parts of tin to 1 part of antimony, is specially adapted for newspaper headings, and all long-standing type. It has been for some time in use at the Bank of England for printing bank notes, which are now produced by surface printing, and has given great satisfaction. Nearly fifteen months after the date of Mr. Johnson's patent, Mr. Robert Besley obtained a patent (June 28th, 1855), for a hard alloy applicable to the casting of type. In his provisional specification he sets forth the following ingredients, viz., lead, regulus of antimony, nickel, copper, zinc, and tin, as those to be employed in the making of his alloy; and further adds that "the zinc is subjected to a white heat to drive off any sulphur that it may contain!" The proportion of zinc remaining in the alloy after such a process is not stated. In the final specification we find a very different alloy is set forth as the best for the purpose contemplated. Here the zinc is omitted entirely, probably for the reason that it declined to remain after being subjected to a

white heat, and in lieu of it we find substituted cobalt and bismuth, thus materially changing the nature of the alloy. The proportions given are as follows:—

	Parts.
Good virgin lead,	100
Regulus of antimony,	30
Tin,	20
Nickel,	8
Metallic cobalt,	5
Copper,	8
Bismuth,	2

As good examples of well-made type, we may briefly direct attention to the hard metal machine made and dressed type, exhibited by the Patent Type Founding Company (5273, Class 28 C); the machine rubbed type of Caslon & Glasgow (5217); the hard metal type of Besley & Company (5208); and to the beautiful founts of V. & J. Figgins (5232); and of Miller & Richard (5265). We have seen nothing, however, to equal the elegant specimens of ornamental type and printing in colours exhibited in the French gallery, by Mons. Chas. Derriey (2739). The "setting up" of these specimens is the very perfection of the compositor's art, and reflects the highest credit on M. Derriey, under whose superintendence they have been prepared.

3.—TYPE COMPOSING AND DISTRIBUTING MACHINES.

A considerable number of inventors have for many years directed their attention to the difficult problem of constructing machinery capable of accomplishing in a more rapid and economical manner the delicate operations of the compositor. Type-composing machines are all based on the principle of selecting and liberating each letter by depressing a corresponding key on a key board, similar to the clavier of a pianoforte. One of the earliest machines of this description was introduced by M. Ballanche, a printer in Lyons, more than twenty years ago. At the Hyde Park Exhibition of 1851, and at the Paris Exposition of 1855, an ingenious type composing and distributing machine was exhibited by the inventor & maker,

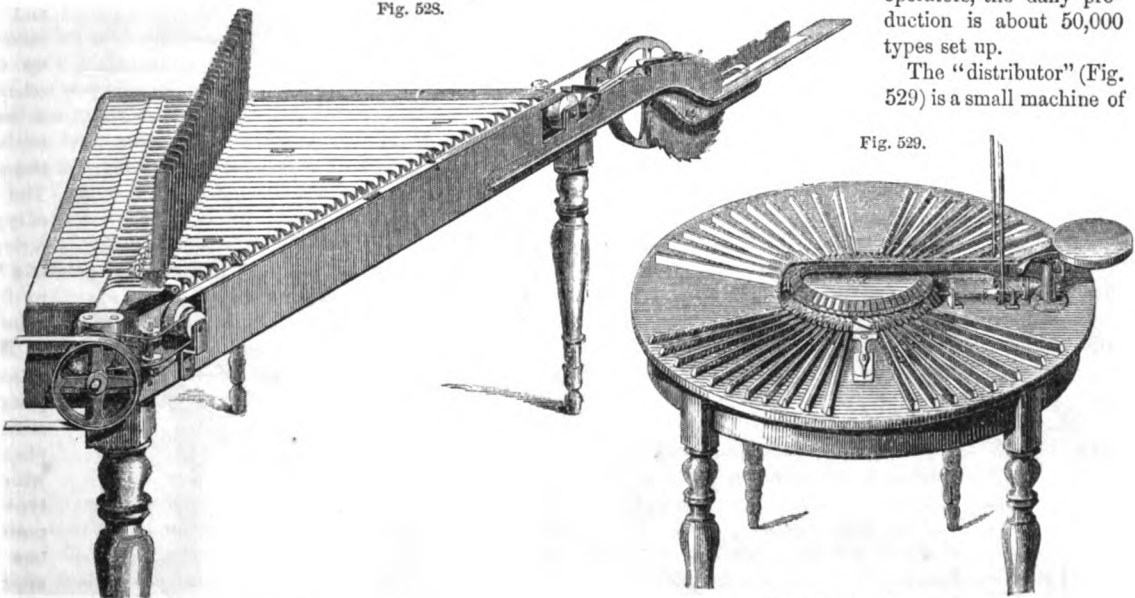
M. Sørensen, a workman of Copenhagen. This machine obtained the gold medal in 1855. It was employed for about two years in setting up and distributing the type for the *Fædreland*, one of the Copenhagen newspapers, but never came into general use. In the present Exhibition we have two examples of this class of machines, namely, Mitchell's and Young's.

MITCHELL (1662).—The composing and distributing machines exhibited at work by the inventor, Mr. W. H. Mitchell, obtained a prize medal. They are of American extraction, and are perfect specimens of mechanical ingenuity. A tolerably correct notion of the general arrangement and appearance of these machines will be

obtained from the annexed illustrations, of which Fig. 528 represents a perspective view of the "compositor," and Fig. 529 a similar view of the "distributor," the two being totally distinct from one another. The form of the "compositor" is in plan a right-angled triangle, placed horizontally, with a key board at one of the sides or base, provided with thirty-nine keys. Each key when pressed strikes out a type from one of an equal number of brass slides standing at an incline upon the machine in a row nearly parallel with the key board. The type thus liberated is conveyed upon a band, moving in a direction at right angles with the key board to another band (forming the hypotenuse of the triangle) which carries it on to its destination. On its arrival here it is placed on its foot, and pushed forward to make room for the next type, by the aid of a notched or serrated wheel, called the "setting wheel." The words are thus put together with great rapidity in a long line of about thirty inches, which is afterwards divided by the compositor into lines of the required length.

The essential principle of this machine consists in the combination of bands of such lengths, and travelling at such varied speeds as will enable the types at different distances from the wheel to reach it in the order in which the keys are struck. The "compositor" is said to be capable of setting up types at the rate of six letters per second, or 21,600 per hour; but as the human fingers cannot attain to such rapidity, and as allowance must be made for the operations of "justifying" and "correcting," the work of an average trained operator will probably not exceed 24,000 or 25,000 types per day, which is about equal to the work of two men setting up type in the ordinary mode. As each machine can employ two operators, the daily production is about 50,000 types set up.

The "distributor" (Fig. 529) is a small machine of



Mitchell's Type Composing Machine.

Mitchell's Type Distributor.

circular form. The lines of type to be distributed are placed successively in a long channel, in which they are pressed forward towards a vibrating metal "finger." By this finger each type is separated from the line, pushed aside, and dropped on to a grooved brass wheel revolving horizontally. In the grooves of this wheel pins are placed, on which the types are hung by means of nicks, the ends of the types projecting below the under surface of the wheel at distances varying according to the position of the nicks. As each letter arrives over its receptacle it is lifted off its pin, and dropped into its place, being pushed a little forward to make way for the next arrival. When the line is filled in this way, it is removed by a boy to the "compositor."

The "distributor" is self-acting, and requires only the attention of a boy. It distributes eight thousand letters per hour.

Both machines have been successfully used with type ranging in size from great primer to brevier. They have been worked for several years in America, and have been recently adopted by the following establishments:—Messrs. Bradbury & Evans; Eyre & Spottiswoode; Spottiswoode & Company; John Childs & Son, of Bungay; Mr. William Mackenzie, Glasgow; and the University Press, Oxford. As compared with the present mode of type-setting, the following advantages are claimed for these machines:—

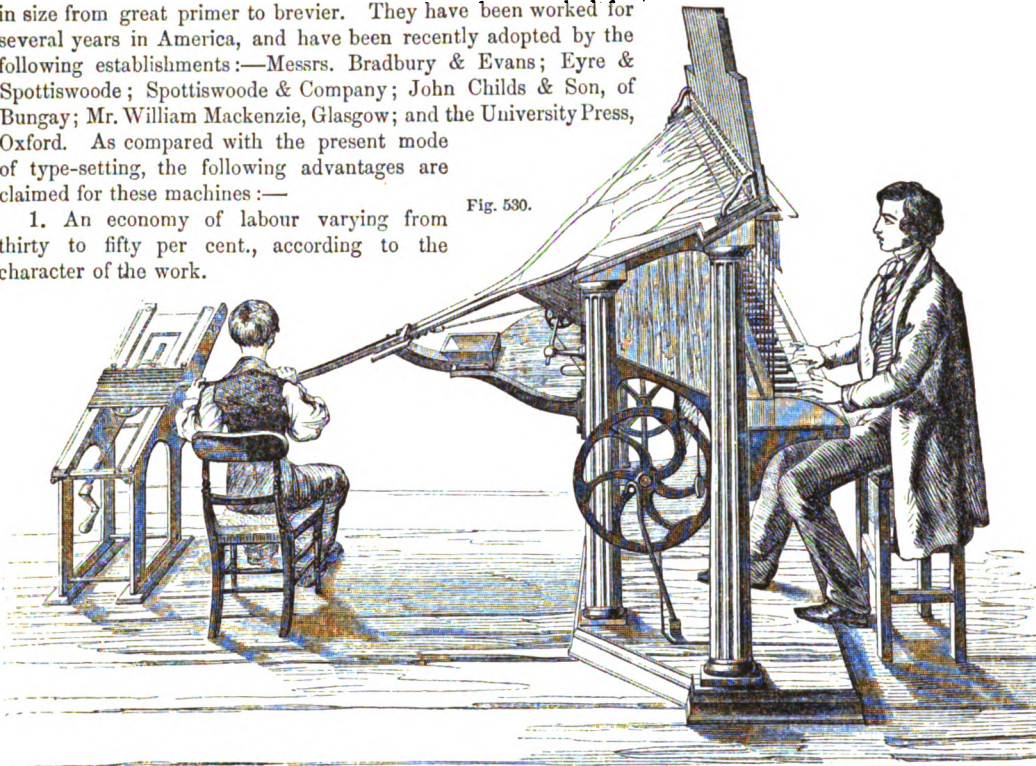
1. An economy of labour varying from thirty to fifty per cent., according to the character of the work.

3. Decrease in the wear of type, and a smaller quantity sufficient for a given amount of work.

As a specimen of work we refer our readers to the elegant photographically-illustrated Bible (5259, Class 28 C) exhibited by Mr. William Mackenzie of Glasgow, who has had a set of these machines in operation under his immediate superintendance for some time.

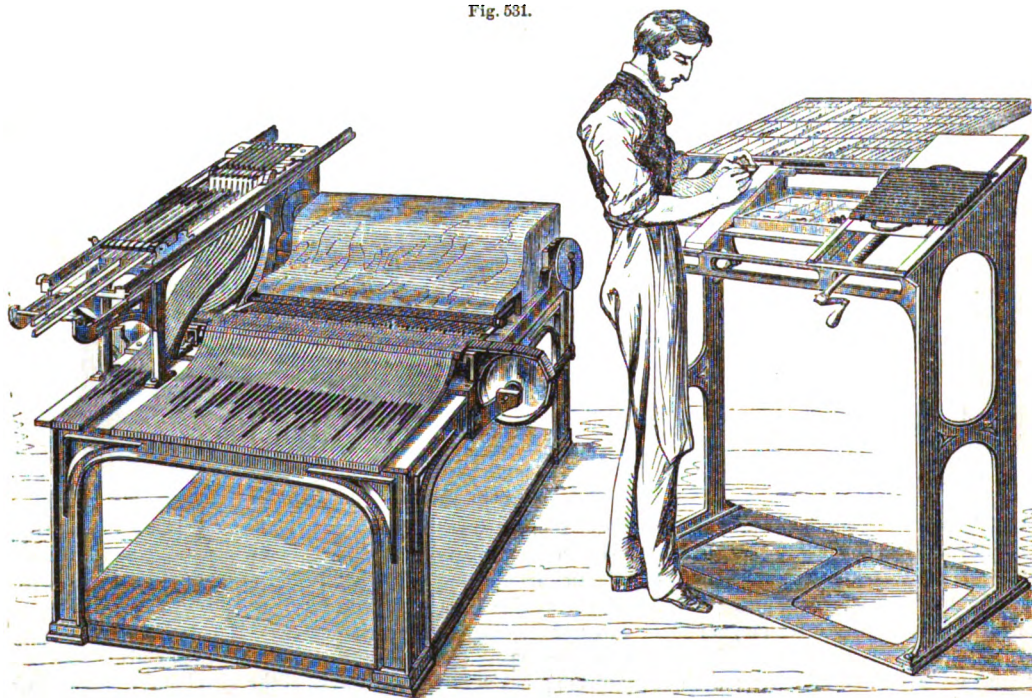
YOUNG (1750 Process Court). — In this type composing machine (Fig. 530) a key-board is also employed for releasing the types, each variety of which in a fount are contained in separate "reservoirs." When a key is struck by the operator it pushes a type out of its reservoir by means of a small lever and rod, and the type is then caused to slide down a special groove or channel in an inclined plane, and thence into a receiver, where it is set up side by side with other types, by means of a beater, at the rate of twelve thousand to fifteen thousand types per hour. The necessary quantity of types are supplied uninterruptedly by means of a boy, who can attend to two composing machines at the same time.

The justifying apparatus is intended to replace the compositor's stick. The compositor places the galley filled with the long lines of type set up by the composing machine, slides one of them into the apparatus, divides it into the proper length of the page, and having justified it, moves a handle, which depresses the completed line, and thus makes room for a succeeding one. It is said that a compositor can by this means, justify at the rate of six thousand to eight thousand types per hour.



Young's Type Composer.

Fig. 531.



Young's Type Distributor.

2. Greater facility in acquiring the printer's art, whilst it renders his occupation comparatively light and healthy.

The distributing machine (Fig. 531) separates all the different letters of a fount, that may have been used for printing, into differ-

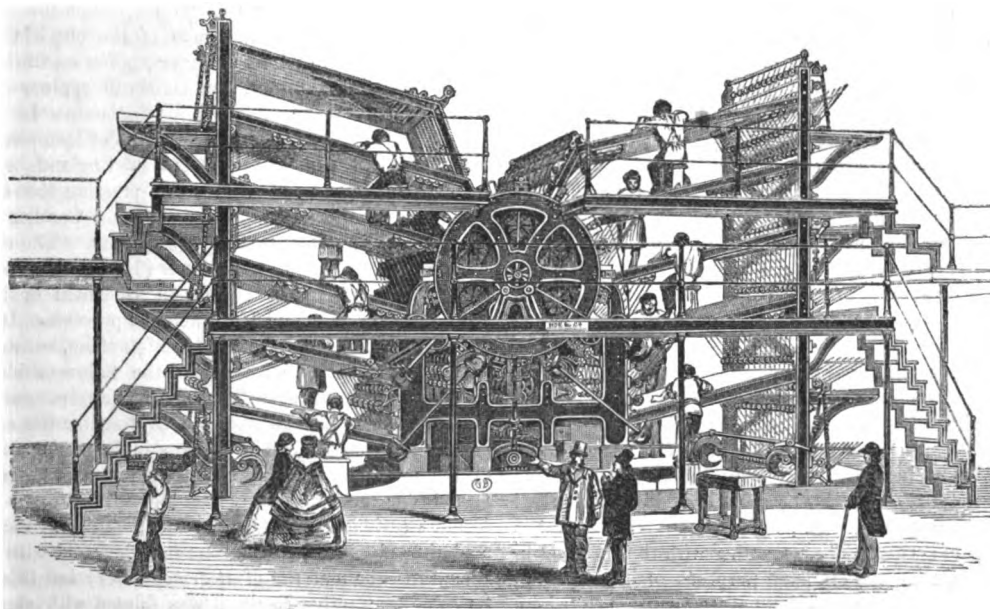
ent channels ready for use in the composing machine. This is effected by one or more pairs of nippers, which takes every type singly from the receiver in which all the types have been placed, and allows it to slide down an inclined plane, the upper part of which moves on a hinge. The thin or lower case types slide down to the bottom of the fixed inclined plane, but the thicker or upper case letters are retained on the movable incline, which, on being raised, drops them into an appropriate receptacle, whence they are then taken and redistributed by passing down a separate channel. The thin or lower case letters that have arrived at the bottom of the inclined plane, are pushed into the grooves of a revolving chain. This chain in moving passes underneath plates which are made of different lengths in order to cover only certain nicks cut or cast on the edge of the types, and situated in different parts of their length, from 1-16th to 12-16ths of an inch from the tail of each type. When, therefore, a type passes underneath a plate which allows its nick to be exposed, it is pushed from off the chain by means of a scraper, which passes over the plate on to a tilting inclined plane. This plane, in its descent, allows the type to slide down, by means of an inclined channel, into a receiver, where it is set up by means of a beater, as in the composing machine. The distinguishing nicks are somewhat like those used by typefounders; about eighty per cent. of the types require only one nick, and these are sorted and ranged in separate columns at the first operation, whilst the remainder, which have two nicks, are only separated in the first instance from those with one nick, and have to pass through the machine a second time in order to be completely distributed and ranged in columns for use in the composing machine. One distributing machine, provided with eight nippers and attended by two boys, is said to be capable of distributing and preparing for the composing machine from fourteen thousand to eighteen thousand types per hour, and an additional distribution of two thousand five hundred types per hour may on an average be added for every additional nipper.

We much prefer the arrangement of Mitchell's machine, however, the sliding of the types along inclined planes is not so certain and regular as the positive motion of the tapes.

Both Mitchell's and Young's distributing machines require to have the type specially nicked or prepared for them; the composing machine, however, will operate if desired upon ordinary type.

Before closing our notice of these exceedingly clever and necessarily complex pieces of mechanism, we may briefly direct attention

to a simple little contrivance for *making* and setting up type with words at one operation, exhibited in the Processes Court (1577) by Mr. J. Coryton of Chancery Lane. Mr. Coryton's idea is to stamp singly the letters intended to compose a word upon the edge of a bar of type metal, and when such word is complete to cut it off from the end of the bar, the part cut off forming, really speaking, a "word type," in contradistinction to a single "letter type." In carrying out this idea a matrix bar is first formed, having all the letters of an alphabet sunk therein by a suitable steel punch, the letters being formed with their matrical edges or sides parallel with the length of the matrix bar. This bar is fitted into a transverse slot made in the lower end of the plunger of a lever or fly press, and is free to slide to or fro through this slot, so as to present any one of its letters over the edge of the bar of type metal, which slides forward beneath it in a direction at right angles to the matrix bar. The type metal bar is guided accurately in a groove or channel, and is moved forward step by step as each letter is stamped upon it by a spring, the forward end of the bar abutting always against a steel cutter situate at the end of the groove, so that when the bar is brought home it will be in a proper position for the next letter. An opening is made in the steel cutter sufficiently large only to allow the stamped part of the bar to pass through it, and when a word is completed a lateral traverse is given to the steel cutter, which has the effect of severing the word from the end of the bar. The selection of the proper letters in the matrix bar is left to the skill of the operator, who must be sufficiently expert to slide the bar to or fro in its containing slot, so as to bring instantly the desired letter over the type bar. The accuracy of this adjustment is facilitated by having stops or pins, which take into corresponding recesses in the matrix bar. The severed words are justified in a grooved chase, and may be at once arranged in ordinary chases on the present system. The inventor claims economy and despatch as the advantages of this system, and submits that so long as there is a supply of type metal bars there will always be a supply of type; that to the rapidity of composition there is no limit, but the dexterity of the operator, in adjusting the position of the matrix bar and bringing down the plunger of the press! The printer will see many defects in this apparatus, which will effectually prevent its superseding even the hand compositor. A mistake of a single letter in a word will necessitate the reproduction of the entire series, the abandoned words being for the time so much waste metal until recast into bars.



Model of Hoe's Fast 10-feeder American Printing Machine.

THE



WILLIAM MACKENZIE:
HOWARD STREET, GLASGOW; SOUTH BRIDGE, EDINBURGH;
AND 22 PATERNOSTER ROW, LONDON.