on the axle of the roller *e*. The driving-strap is held upon the fast pulley by a drop-catch acting on a weighted lever, one arm of which is connected by a link to the lower end of a strap fork-lever. When it is requisite to stop the machine, the attendant kicks the point of a catch off the end of the lever, which is then raised by the weight, and so moves the driving-strap from the fast to the loose pulley, the stoppage being virtually instantaneous. The mode of working is as follows:—The spinner and assistants stand at opposite sides of the table; the fillers and wrappers being placed on the table, one assistant spreads out the wrapper and pushes the end towards the filler, which the spinner supplies and holds against the sliding-rest *b*; the rotary motion of the segment-rollers *c d e* twists the tobacco, and causes the wrapper to be wound over the filler, and the rest *b*, being movable, enables the spinner to regulate its position according to the quantity and quality of the filler and wrapper. The lateral motion of the segment-rollers passes the roll towards the bobbin, on which it is wound, as described. The combined rotary and traversing motions of the rollers consolidate the tobacco, and put the desired face upon the twist. The roller *e* is supported in a swing-frame, which is lifted off the tobacco when starting the machine. When the machine is at work, the swing-frame is held down by the stud *m* (Fig. 19). The figures represent a machine suitable for manufacturing Limerick roll; for pigtail and other small descriptions, it is necessary to reduce the diameter of one or more of the segment-rollers.

A more recent improvement in this machine, by

J. E. A. Andrew, is shown in Figs. 24 (side view), 25 (transverse section), and 26 (plan). The table *a*,

FIG. 24.

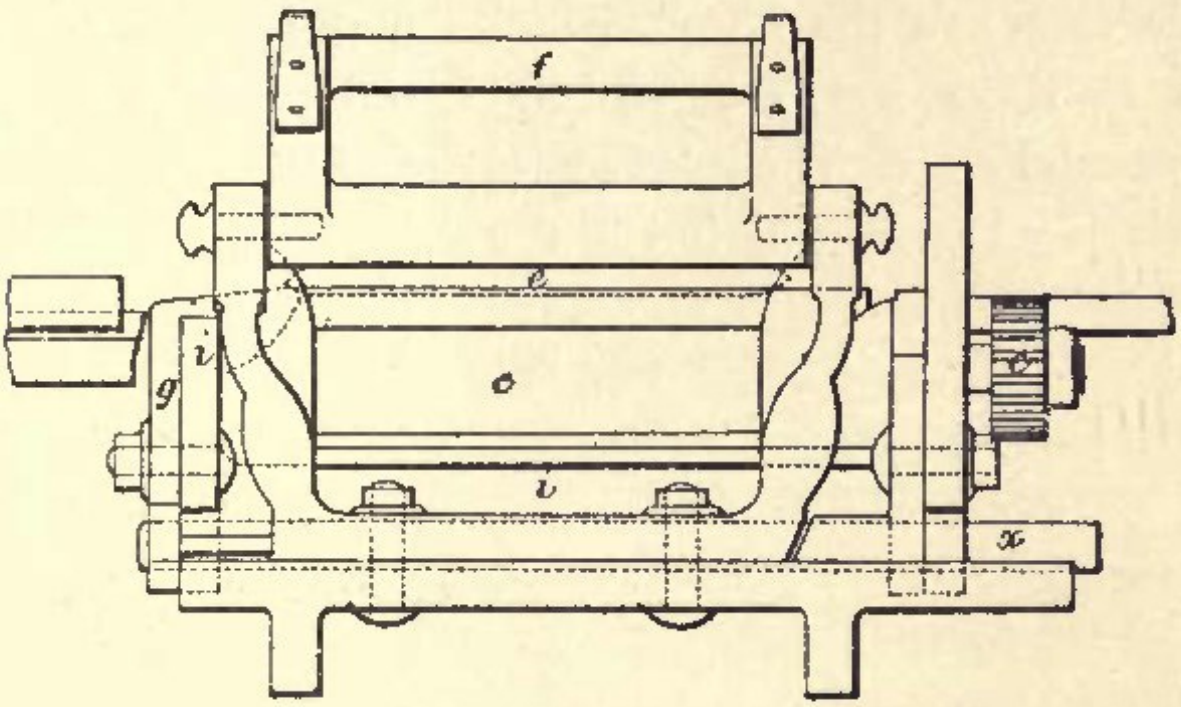
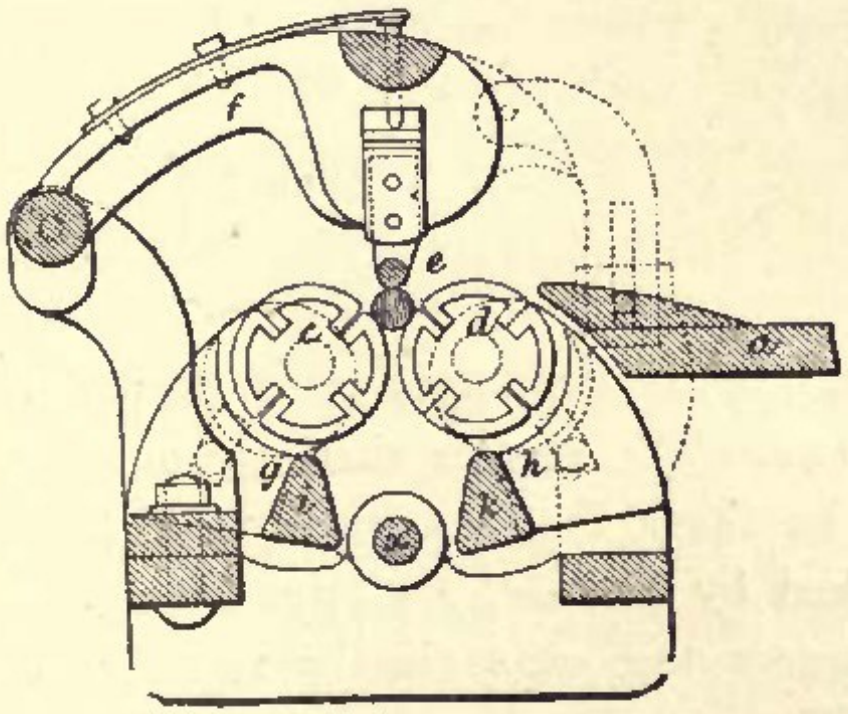


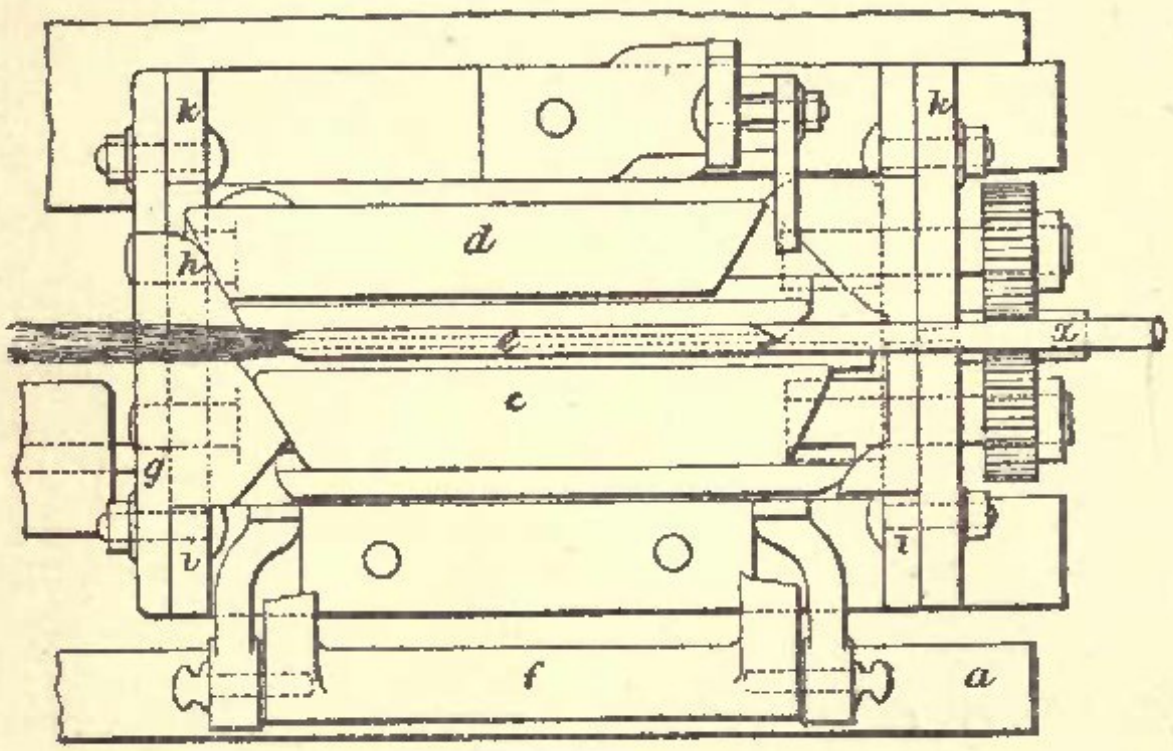
FIG. 25.



rib *n*, and sliding-rest *b*, and two lower segment-rollers *c d*, are constructed as usual; but the axles of the segment-rollers revolve in bearings *g h*, bolted to the flanges

of swivel-frames *i k*, hinged upon the fulcrum-shaft *x*; the object of thus supporting the bottom rollers *c d* is to be able to vary the distance between them according to the thickness of the twist of tobacco that is being rolled. When the distance between the rollers is fixed, the bearings are secured by bolts passing through segmental slots. The solid top roller *e* revolves in centres in sliding bearings fitting in the swing-frame *f*.

Fig. 26.



As the bobbin is filled, it is removed, and replaced by an empty one. The rope is then unwound, and formed into rolls, by the aid of a spindle with flanges at the sides, worked by a treadle, under a cushioned weight which squeezes the coils closely together as they are wound. The completed rolls are subjected to great pressure in steam-jacketed presses, in the same way, and with the same object, as the cakes or plugs.

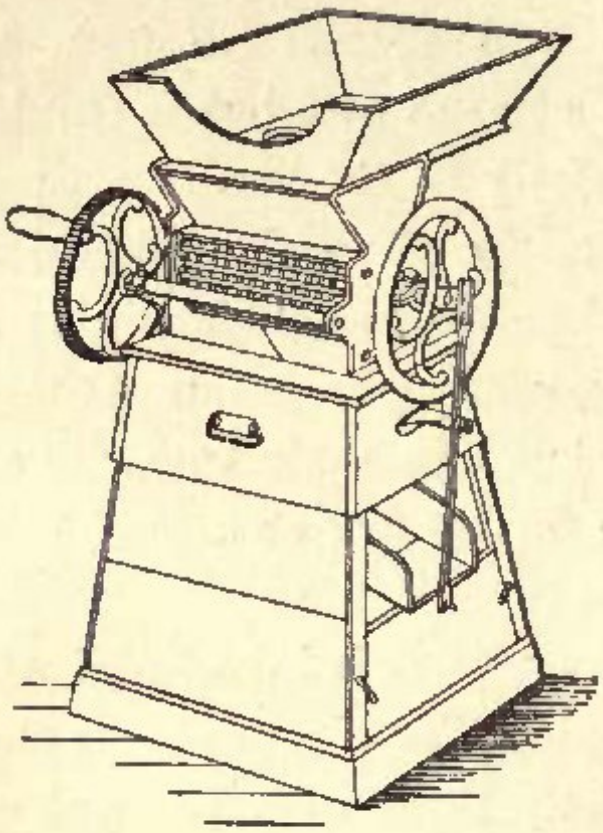
Cigars.—Cigars are composed of two parts, a core

formed of pieces of leaf placed longitudinally, known as "fillers," and a covering formed of perfect leaf, called the "wrapper." Probably all the best cigars are made by hand, the only tools required being a short-bladed sharp knife, a receptacle containing an emulsion of gum, and a square wooden disc or "cutting-board." A portion of perfect leaf is first shaped to form the wrapper of the cigar; then a bunch of fillers is moulded in the hand, and rolled up tightly in the wrapper, the taper end being secured by gumming. Expert workmen make the cigars remarkably uniform in weight and shape. When made, they are sorted according to colour, deftly trimmed at the thick end, and placed in their boxes in cupboards heated by gas-stoves to finally dry or season before being stored for sale.

In America, machinery is introduced wherever possible. Moulds for shaping the cigars are made of hard wood, sometimes partially lined with tin, and of every possible size and form. A machine is made by Dubrul and Co., of Cincinnati, for working 3 sets of moulds at once, 2 being kept filled up under pressure while the 3rd is being filled, or the bunches are being rolled up. A handy little machine for rolling the fillers for cigars is that known as Henneman's, made by Dubrul and Co. The demand for scrap-made cigars, or those manufactured with short fillers, has caused the introduction of machines for cutting and sifting scrap. One made by Dubrul and Co. is shown in Fig. 27. It consists essentially of a cylinder formed of hook-shaped, double-edged steel blades, revolving against 3 series of fixed but adjustable steel blades, thus permitting the size to be regulated at will.

Cigarettes.—Cigarettes consist of paper tubes filled with cut tobacco, with or without an external wrapper of leaf tobacco. Preference is usually given to those made by hand, but machines have been introduced with some

FIG. 27.



success for making the commoner kinds. A French machine for making cigarettes is shown in Fig. 28. Its work consists in making the paper tubes, and filling them with tobacco. The paper, previously prepared, in a band about 3 inches wide, is unrolled from the coil *a* by means of the carriage *b*, and cut off in pieces about 1 inch long for presentation to the mandrel *c*, temporarily introduced into one of the tubes of the mould-carrier *d*. The mandrel has a clamp which grasps the paper and rolls it, and, at the moment when the latter escapes from the carriage, its free end is brought upon a rubber pad covered with gum, hidden in the illustration. The paper

tube is left in the mould, the mandrel being extracted by means of the cam *e*; the mould-carrier is then turned $\frac{1}{9}$ revolution by the cam *f*, a new tube comes into line,

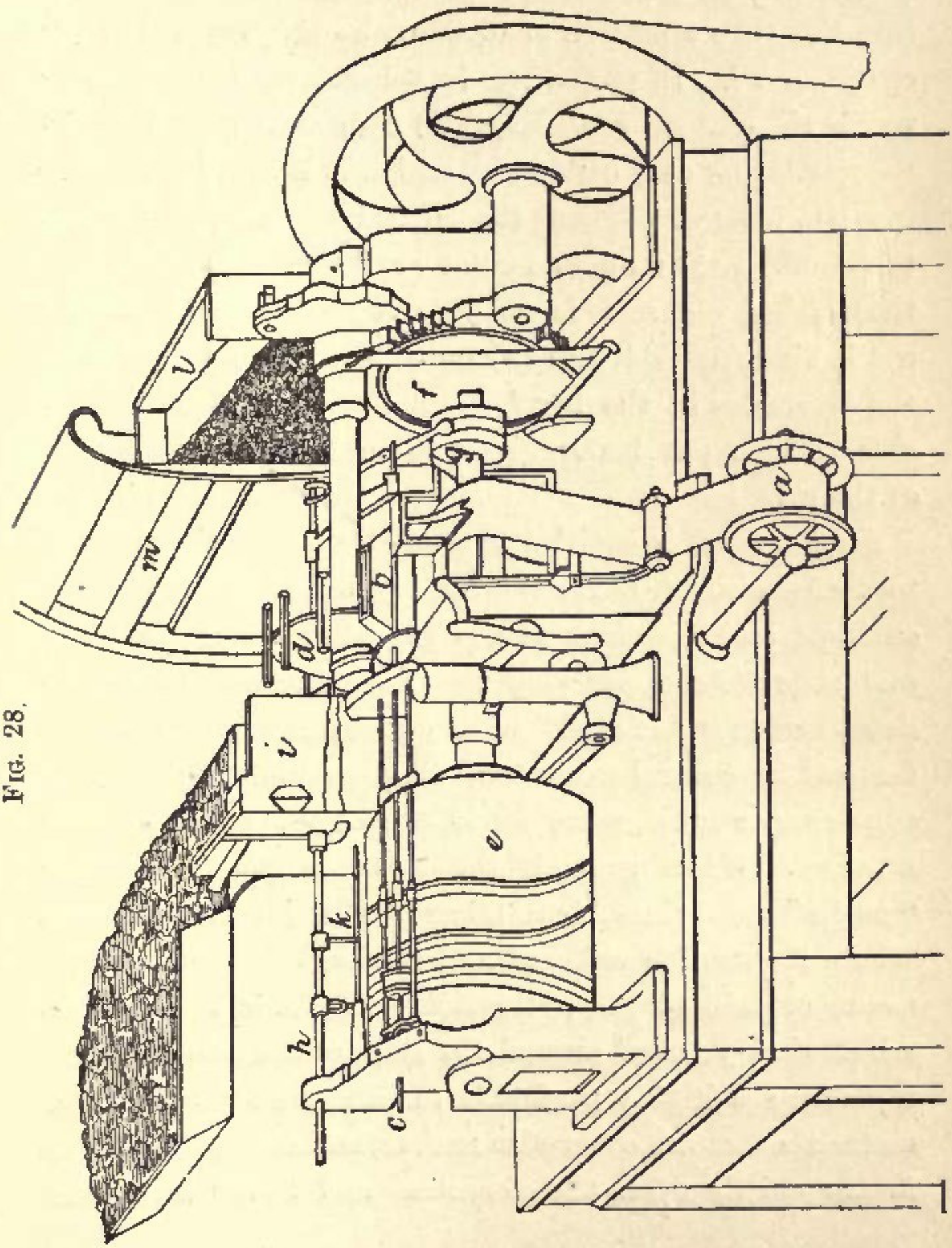


FIG. 28.

and the operation is repeated. When 6 paper tubes are completed, the first one is pushed by a small piston, actuated by the cam *g*, upon the end of the filling-tube; and immediately the rod *h*, actuated by the cam *e*, drives into this tube a portion of tobacco already prepared in the compressor *i*. In preparing the tobacco, a workman, occupying the seat *m*, is necessary to dispose the material in regular layers on a carrier, by which it is transported into the compressor. When the cigarette-envelope is filled, the mould-carrier again makes part of a revolution, and the finished cigarette is pushed out of the mould by the rod *k*, also actuated by the cam *e*; a device finally lodges the cigarettes in the box *l*. One workman is said to be able to turn out 9600 cigarettes in 10 hours by the aid of the machine.

Snuff.—Snuff is entitled to the last place in the series of tobacco manufactures, as it is largely made up of the scraps, cuttings, and rejections of the preceding processes. The materials are chopped very fine, placed in heaps in warm damp cellars, "doctored" with various flavourings, left to ferment for several weeks, and then ground to powder in edge-runner mills, some kinds even undergoing a slight roasting. When ground, the mass is passed through "mulls," wood-lined, bottomless bowls, let into a bench, where the snuff is softened and rendered less powdery means of pointed pins, resembling domestic rolling-pins, which slowly travel around the sides of the bowls. Snuff represents a highly profitable article manufactured from materials that are otherwise useless, and depending for its favour chiefly upon the perfumes and flavourings used.

Hence these last are kept profoundly secret by the manufacturer.

From refuse tobacco which is unfit for any other purpose, is made a decoction for washing sheep and destroying vermin; often the waste is ground very fine, and used by gardeners, presumably to keep noxious insects away.

Miscellaneous Appliances.—The customary ingenuity of the Americans has invented a profusion of admirable labour-saving machines for almost all the operations of the tobacco manufacturer. A few of these only can be noticed in the present article.

Fig. 29 shows a portable resweating-apparatus, intended for darkening the colour of tobacco to suit the dealer's market. It measures 4 feet long, 3 feet wide, and 5 feet high, being just large enough for one case (400 lb.) of tobacco, including the case; it consists of a water-tank *a*, a pipe *b* for conducting the water into the metallic pan *c*, at the bottom of the apparatus, which is heated by gas-jets *d*. The tobacco is introduced by the door *e*, which is fitted with a thermometer. The roof is sloped so as to determine the flow of the water of condensation. The steaming occupies 3–5 days, and needs occasional watching. The apparatus is made by C. S. Philips and Co., 188 Pearl Street, New York.

FIG. 29.

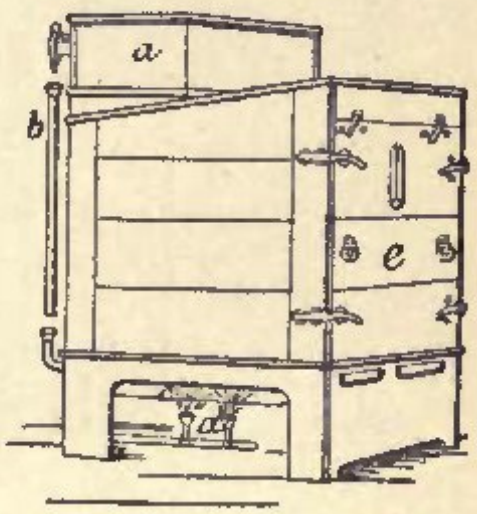
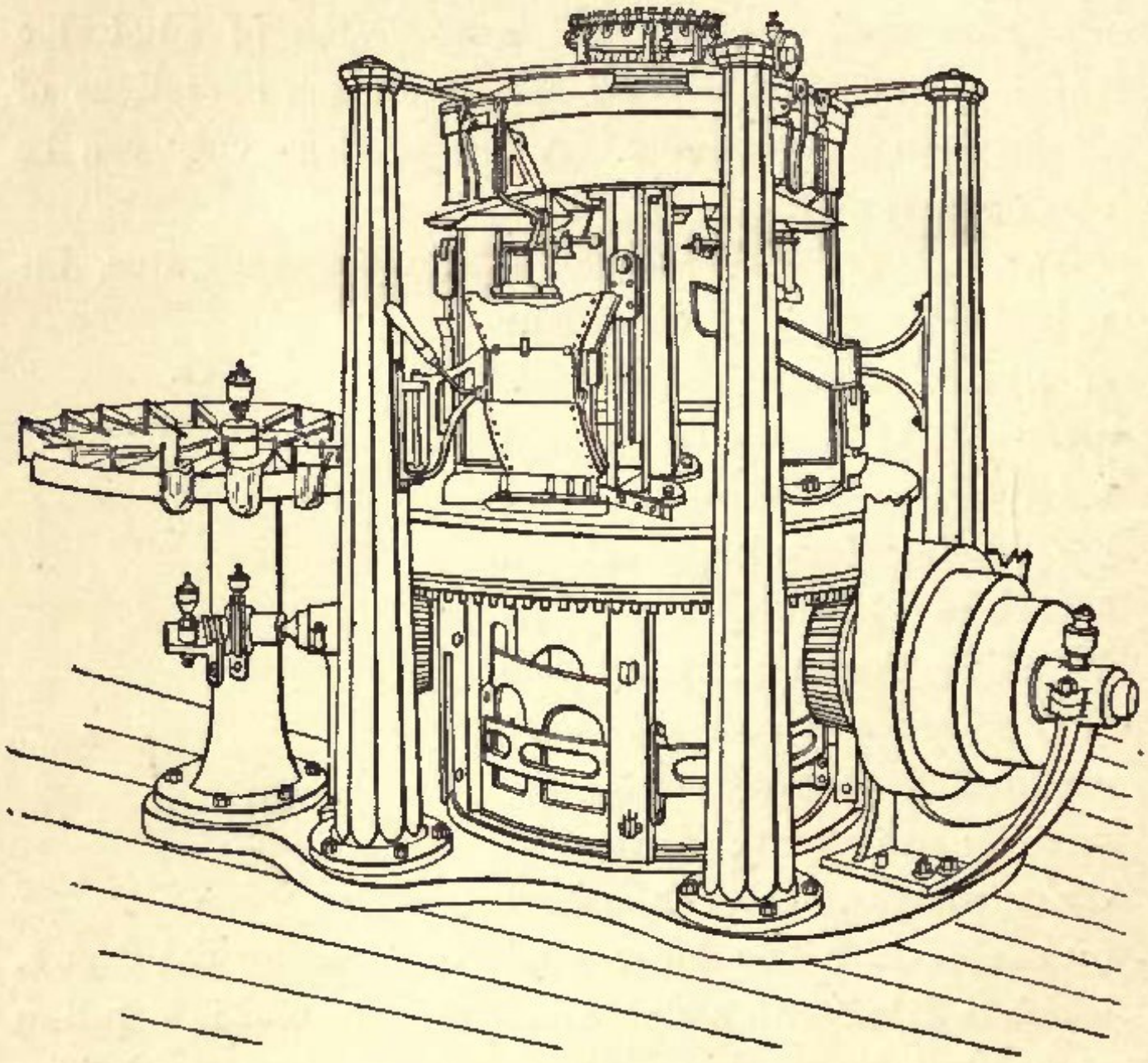


Fig. 30 illustrates a complicated machine, introduced

by C. C. Clawson and Co., of Raleigh, N. Carolina, for putting up large quantities of tobacco in parcels of 2 oz. upwards. It consists of a central table provided with automatic scales for weighing out the portion; four equi-distant guides which determine the form of the package;

Fig. 30.



a plunger for packing, and a follower for raising the package; a side-table carrying tongs for holding the empty bags; and another to receive the packages, and hold them during tying. The hopper being supplied with tobacco, and the machine put in motion, each form

takes a bag from the tong-table, and the article having been weighed, is carried to the form by a shute, when it drops into the bag, is packed by the plunger, and transferred to the tying-table. With 2 girls or boys, it is said to weigh, pack, and tie 30 bags a minute.

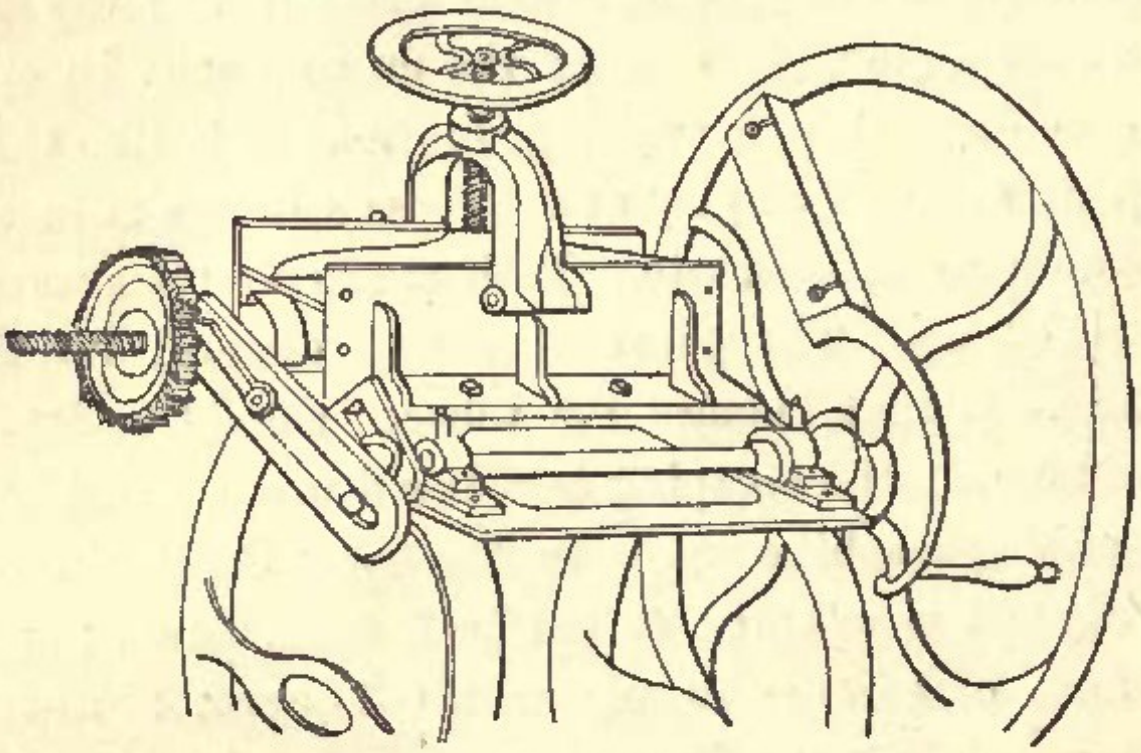
The New York Tobacco Machine Co. make two forms of machines for granulating tobacco, chiefly for making "Killickinick" and cigarettes, their working capacity ranging from 200 to 2000 lb. a day. The cutting-rollers are covered with cross-millings at right angles to each other, those running lengthwise being deep; the fixed cutters are adjustable, so that the cutting may be either coarse or fine. When working, the action is like that of a pair of shears, except that the cross-millings reduce the strips to a granular state. Both stems and leaves may be worked up. The great advantage claimed for these machines is that, though the tobacco should be dry, the percentage of dust escaping is reduced to a nominal figure.

A cutting-machine made by the same Co. is shown in Fig. 31. It is adapted to cut leaf, stem, scrap, plug, or any form of tobacco, to any required degree of fineness, turning out 300–400 lb. a day. The action is almost precisely that of a chaff-cutter. The Co.'s sifting-machine consists of an adjustable cylindrical wire sieve, with a rattan-broom screw-roller revolving inside. The stems are stripped and worked out at one end, while the remainder is broken up, and passed through the sieve, falling upon a perforated tray, through which pass the finest particles for snuff-making. A machine largely used in America is the stem-roller, for crushing and flattening the stems so that they may be used like leaves for making

cigars. Great benefit is anticipated in the United States from the adaptation of Ryerson's "attrition mill" to snuff-grinding, owing to the fact that the pulverization is accomplished without the particles being heated in the least degree. Of cigarette-making machines, there are many kinds; the best are those which deal with the tobacco in a comparatively dry state, thus preventing shrinkage after packing.

Indebtedness is acknowledged to Hy. Archer and Co.,

FIG. 31.



Borough, S.E., and T. Brankston and Co., Carter Lane, Doctors' Commons, for opportunities of inspecting their thoroughly representative works, and for much information readily given concerning the manufacture in this country; to W. Jollyman, of W. D. and H. O. Wills' London house, for having revised these sheets before going to press; and to Hy. A. Forrest, 61 Broadway, agent of the New York Tobacco Machine Co., for valuable material relating to American machines and processes.

CHAPTER VI.

NATURE AND PROPERTIES.

The active principle of tobacco is a volatile, highly poisonous alkaloid, called Nicotine ($C_{10}H_{14}N_2$). Although green tobacco-plants contain generally more nicotine than the leaves after they have been prepared for the market, yet the odour is only perceptible after the fermentation of the leaves has set in. It has been ascertained that young leaves 2 inches long contained 2·8 per cent., and leaves 10½ inches broad and 16 inches long, as much as 5·6 per cent. of their weight of nicotine. The amount increases as the plants become ripe, and decreases on their becoming overripe.

Though the narcotic effects of tobacco experienced by the smoker must partly be attributed to nicotine, it cannot be said that they are solely due to it. It is well known that the products of combustion of quite harmless substances are often stupefying. Good Syrian tobacco contains no nicotine, yet smokers consider cigars made from this tobacco to be strong. It is evident that the strength of a cigar, as judged by the smoker, depends greatly on the circumstance whether the tobacco burns well or not. If it burns well, a greater amount of nicotine is consumed and decomposed, and less of the narcotic products of combustion are created, than when it burns badly. Cigars of the latter description, containing little nicotine, are more narcotic in their effects when

smoked than well-burning cigars containing much nicotine.

The amount of nicotine in tobacco varies very much, according to the sort of plant, the climate, the nature of the soil in which the plant grew, the treatment received during its growth, and the course adopted to prepare the leaf for the market. Dr. Nessler found that good Syrian tobacco contained no nicotine, Havana tobaccos between 0·6 and 2·0 per cent., and German tobaccos between 0·7 and 3·3 per cent. Schlösing found in French tobacco nearly 8·0 per cent. of nicotine. Fine tobaccos contain generally little or no nicotine. Broughton found that the amount of nicotine in Indian tobaccos varies very much. The conditions favourable to the development of nicotine in the plants are :—Soil in a bad physical state, strong nitrogenous manure, a dry atmosphere, and probably a low temperature during the growth.

According to Nessler, green and newly-cut tobacco-plants contain no ammonia; it is developed during the drying and fermentation of the leaves, especially when they assume a brown colour. Tobacco-leaves, which have undergone a strong fermentation, contain more ammonia than those slightly fermented. Fine tobaccos contain generally less ammonia than coarser ones. In various smoking-tobaccos, Nessler found :—Havana, 0·2 per cent. of ammonia; Cuba, 0·3; Syrian, 0·6; German, 0·9 per cent. Schlösing found Havana tobacco to contain 0·8 per cent.

Nitric acid, consisting of nitrogen and oxygen, is formed in animal and plant substances when decomposed under the influence of atmospheric air and a sufficiently

high temperature; whereas ammonia, consisting of nitrogen and hydrogen, is formed when those substances decompose in the absence, or nearly so, of atmospheric air. Organic substances decomposing under the latter condition emit an objectionable pungent odour, which must partly be attributed to the formation of ammonia. Tobacco, soon after harvesting, commences, according to the conditions under which it is placed, one of these decompositions. The extent of the decomposition the tobacco has gone through may be partly judged from the colour the leaves have attained. If leaves be dried so rapidly as to remain green, the decomposition is probably confined to the formation of carbonic acid. A yellow colour indicates the formation of nitric acid; and a dark-brown or black colour, that of ammonia. The conditions under which nitric acid and ammonia are formed being known, it is possible to control their development. When the tobacco is hung far apart, so that the air has free access, the formation of nitric acid will take place; but if the air be excluded more or less, by hanging the tobacco very close, or pressing it in heaps or pits, the formation of ammonia is engendered.

Nitric acid generally promotes the combustion of plant substances, by supplying a portion of the needed oxygen, and has undoubtedly a similar effect in tobacco; its occurrence in the tobacco is therefore a desideratum with the cultivator and manufacturer, and to supply any deficiency, the manufacturer often resorts to impregnating his tobacco with a solution of saltpetre. From this, however, it must not be concluded that every tobacco containing a large amount of nitric acid will

necessarily burn well. Schlösing and Nessler have shown that the well-burning of a tobacco does not always correspond with a great amount of nitric acid, thus indicating that other substances or other conditions also affect the combustibility. The effect of the nitric acid will most probably vary with the base with which it is in combination.

The nitrogen in the forms of nicotine, ammonia, and nitric acid, constitutes only a small portion of the total amount present in tobacco; by far the greater portion ($\frac{2}{3}$–$\frac{7}{8}$) exists in the form of albuminoids. Nessler found that the nitrogen under this form varies from 2 to 4 per cent., which is equal to 13–26 per cent. of albuminoids. Substances rich in albuminoids generally burn badly, and emit a pungent noxious odour. On the condition of these albuminoids, and on the presence of other substances, as nitric acid, alkalies, &c., in the tobacco, mostly depend the burning qualities of the leaf, and the flavour of a cigar. The Eastern habit in smoking, from Malaysia, Japan and China, through India, Persia and Turkey, even to Hungary, is to inhale the smoke into the lungs, and natives of these countries maintain that a tobacco should be of full flavour without burning the throat or catching the breath. Western nations do not admit the smoke further than the mouth, and therefore require a strong, rank flavour.

Whilst drying and fermenting, the tobacco undergoes great changes. Some substances are decomposed, others are newly formed. The highly complicated compounds, the albuminoids, undergo first decomposition, and in doing so give rise to more simple combinations. Nitric