

rest, and we find the time for an average lift to be fifteen seconds.

If the speed of a hoist were doubled, it would at first appear that one-half of this time, or seven and one-half seconds, would be saved. If twenty lifts were made per hour, the result would be a saving of only about four per cent of the time. When it is remembered that many of the lifts must be very slow, regardless of what the crane is capable of doing, and that traverse movements are usually started as soon as the load is clear of surrounding objects and before the hoist movement is stopped, the actual saving is reduced to a very inconsiderable amount of time.

Where a large floor area is covered, a greater saving can be made by increasing speeds of horizontal movements, but the swaying of load which results from high speeds and sudden starting and stopping, sets a limit to the saving that can be made in this direction.

Two objections may be offered to excessively high speeds. First, the accidents that are likely to result from putting a high-speed crane in the hands of an incompetent operator often cause the loss of much more time than is saved by the higher speeds, and greatly increase the cost of repairs. Second, if the crane is not usually run at full speed, there is a constant loss of power in the rheostat, and unnecessary wear and tear on the controller parts, both of which cause expense and loss of time. The above comparisons apply with the most force to cranes in foundries, and with least force to cranes in mills where much higher speeds are necessary and practical.—Harry Sawyer, before the American Foundrymen's Association.

THE NEWMAN VARIABLE SPEED GEAR.*

By EMILE GUARINI.

THIS new gear, recently brought out by an English firm, is intended for application to motor cars, machine tools, textile machinery, electric motors, printing presses, papermaking machinery, hoisting machinery, electric cable-making machinery, and in numerous other cases which will occur to any engineer. In this gear, from a shaft driven at a constant speed by any source of power, a complete range of speeds varying from zero to full speed, by perfect gradual changes, can be obtained, the variation being made without the least difficulty and without any shock.

On the end of the constant-speed shaft a crank or eccentric of variable throw is fixed. The throw of this eccentric can be varied at will by suitable mechanism. Connected with the variable eccentric are four arms or connecting rods, which are joined at their outer ends to studs, each stud being fixed in clutches, which are of the roller type, i.e., they drive in only one direction, and release when turned in the opposite direction. Each clutch turns on a stud or pin which is fixed into the back of the casing surrounding the gearing. The clutches are surrounded by rings having gear teeth formed on them. These four gear rings all gear with one common pinion in the center, this pinion being fixed on the end of the variable speed shaft.

The variable eccentric is not directly connected in any way to the last-named pinion, the constant-speed shaft being supposed to stand out and there being a space between the eccentric and the pinion.

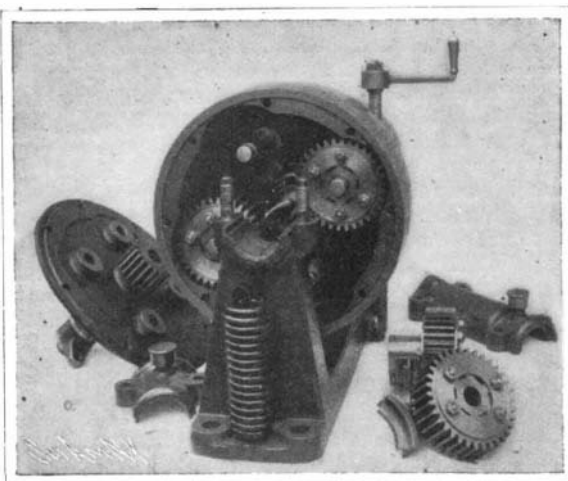
Now, if the eccentric is supposed to revolve, it will be understood that the clutches are moved backward and forward at each revolution of the eccentric through an angle depending on the throw of the eccentric. The greater the throw of the eccentric the greater will be the angle, while if the throw is reduced to zero, i.e., if the center of the eccentric is made to coincide with the center of the constant-speed shaft, the clutches will be at rest. As each clutch moves backward and forward it drives its gear ring through a certain distance and then releases, but it must be observed that before it has released, the next clutch has taken up the driving, and that therefore the motion of the pinion and variable-speed shaft is continuous, and its speed depends on the angle through which the clutch oscillates, this angle being controlled by the throw of the eccentric. With zero throw the variable-speed shaft is at rest, but begins to move as soon as the eccentric is given a slight throw, and attains a maximum speed with the maximum throw of the eccentric.

Different methods are used for varying and controlling the throw of the crank or eccentric, depending on the purpose for which the gearing is intended to be used. It is sometimes assumed by people who have not seen this gear at work that the motion cannot be even, but that this is an entire misconception is proved by the smooth running of the mechanism at speeds of over 1,000 revolutions per minute.

It is perhaps natural to conclude at first sight that the efficiency of this mechanism must be low, i.e., that a considerable amount of power must be lost in internal friction. Experience proves, however, that this is entirely a misconception. If the mechanism is considered in any given position it will be found that one clutch is driving and the other three are over-running, or free-wheeling, i.e., the power is being transmitted from the variable crank or eccentric, through the connecting rod, to the stud on the clutch, which is driving the gear wheel, which in its turn drives the pinion. The clutch is, in this case, locked with the gear ring, and therefore there is no power lost in the clutch itself, and in fact the clutch may practically be left out of consideration and the stud assumed to be fixed to the gear wheel itself. If we consider the other three gear wheels and clutches, we find that they are all over-running or free-wheeling, and it is found from

actual test that the power to over-run these clutches is very small indeed, as the four clutches of the largest gears can be all over-run together by hand with the greatest ease. It is also obvious that the power lost in over-running the clutches is a constant quantity, whatever the power transmitted through the gears which are driving may be, and it therefore becomes a very small proportion at full power.

The power lost in releasing these clutches is said



THE SPEED GEAR DISSECTED.

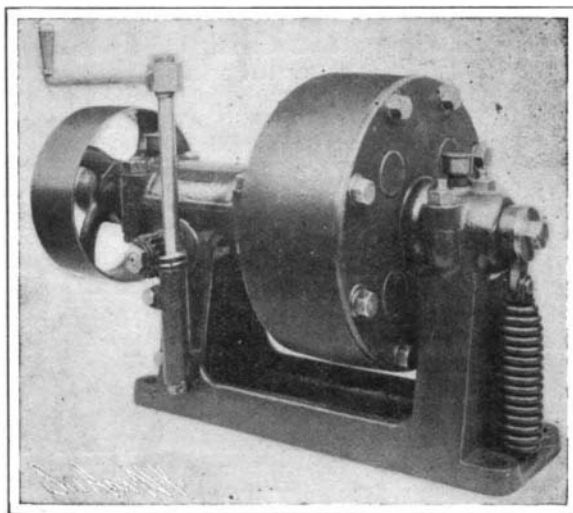
to be inappreciable, there being no sticking whatever, and, in fact, the clutch releases automatically immediately the load is removed. It will therefore be seen that at any given moment, the power lost is that due to the friction of the crankpin or eccentric, the clutch stud, and the gears, the overrunning clutches and the three other clutch studs. As these latter are running light, i.e. with no load, the friction there is not appreciable. The loss of power with well-cut gear teeth is very small, and therefore the chief loss must occur between the crankpin and clutch stud, but will obviously not be large. It is stated that in actual tests which have been carried out results have been obtained giving over 90 per cent efficiency.

Another question which perhaps naturally arises in connection with this gear is "How will the roller clutches wear?" as they are used in this gear under somewhat novel conditions compared to the remainder of the mechanism. To illustrate the inappreciable wear that takes place in these clutches, the makers state that a motor car weighing, with passengers, about 1½ tons, has been driven between 1,000 and 2,000 miles by clutch rings which still have the tool marks left on the gripping surfaces. The unpleasant jarring and damage to the teeth, which often takes place in changing speeds with the usual type of gear, cannot occur in this arrangement, as the gear teeth are always in mesh.

As previously stated, the applications of this gear are very numerous. Among the most important is its application to motor cars. The two principal advantages of this gear in this connection are its complete range of speed and the perfect ease with which it can be manipulated. The large range of speed enables a higher average speed of the car to be maintained, as the motor can always be kept working at its full power if required. Another important advantage in this gear for motor cars is the fact that it is self-locking in one direction, and that therefore a car can be stopped on any hill without applying the brakes and without the slightest fear of its running backward.

THE MANUFACTURE OF SULPHURIC ACID BY THE CONTACT PROCESS.

The manufacture of sulphuric acid, one of the most important industries, is now undergoing a profound



VARIABLE SPEED GEAR ARRANGED AS A COUNTERSHAFT.

modification, which consists not so much in an improvement in the process in use and in that of the present *modus operandi* as in a complete change, the result of the application of new theories.

The manufacture of sulphuric acid by the contact process or catalysis is based upon the principle of the direct oxidation of sulphurous acid by causing this

gas, mixed with oxygen, to come into contact with a catalyzing substance, such as platinized asbestos, oxide of iron, quartz, etc. This principle, which is apparently very simple, is complicated by numerous difficulties when it comes to applying it industrially.

In spite of these difficulties, the necessity of dispensing with very costly processes of concentration led manufacturers to become interested in the contact method, the only one which could permit them to prepare sulphuric acid at once, as free from water as possible. For that reason, while many scientists and technologists who were still occupying themselves with the lead chamber process, brought all their efforts to bear on the improvement of concentrating apparatus (concentration in glass, platinum, lead, etc., according to the processes of Kessner, Zanner, Kuhlmann, etc.), others, on the contrary, strove to convert the contact process (which was then confined to the laboratory) into a commercial method.

Before directly entering upon the technical part of the question it seems to us of interest to cast a glance backward and embrace in a rapid retrospective examination the evolution of this new process. It was Sir Humphry Davy who in 1817 discovered the catalytic action of platinum, and who suggested to Peregrine Phillips, Jr., of Bristol, the idea of employing this metal for the direct combination of oxygen with sulphurous acid. The patent taken out by him in England in 1831 assured him the title of priority in the manufacture of sulphuric acid by the contact process.

In 1846 Jullion proposed platinized asbestos as a catalyzing material; in 1852 Woehler and Mahla detected the same catalyzing properties in the oxides of iron, copper, and chromium, and remarked besides that the formation of sulphuric anhydride was possible by employing dry sulphurous acid and oxygen; at the same epoch, Petrie discovered that quartz heated to 300 deg. C. likewise possessed the catalytic property; but it was Winkler who, putting to profit the experiments of Davy, Woehler, Mahla, Plattner, Reich, Petrie,

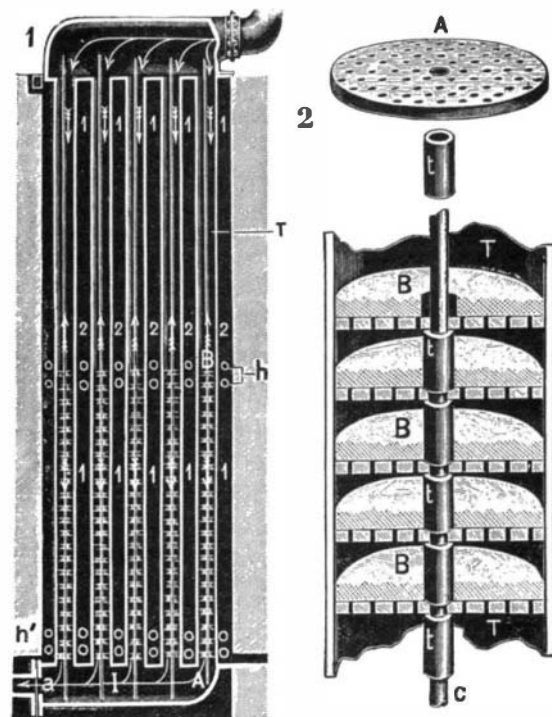


FIG. 1.

FIG. 2.

1. Section of a Badische catalyzer. T, catalyzing tubes open at both ends and filled from A to B with platinized asbestos, h, gas inlets by which the temperature can be regulated. 1, lower part of the catalyzer in which the vapors of sulphuric anhydride accumulate. a, outlet of the vapor toward the absorption apparatus. 2, A, disk of perforated wire plate. T, catalyzing tube. C, central rod on which the disks and sections of pipe, t, t, are strung. B, platinized asbestos.

etc., brought to a focus, at least theoretically, the industrial manufacture of sulphuric acid by the contact process. At present this process is, in the majority of works that are employing it, still in the experimental stage. Many manufacturers, by reason of the economic importance that may result from the least improvement, are keeping their process secret. In spite of this, the question has already been sufficiently studied, and the results obtained in certain cases have been satisfactory enough to allow us to make known to our readers, at least in its broad lines, this recent industry, which seems to realize the hopes expressed in 1835 by Clement Desormes, who said: "I am convinced that in ten years at the most we shall succeed in the industrial preparation of sulphuric acid by means of its constituents, without lead chambers and without having recourse either to nitric acid or to nitrates." The present manufacture of sulphuric acid by the contact process comprises three operations:

1. Preparation and purification of the sulphurous acid.
2. Combination of the sulphurous acid and oxygen in apparatus called catalyzers.
3. Absorption of the vapors of sulphuric anhydride formed.

1. Preparation and Purification of the Sulphurous Acid.—The sulphurous acid is generally prepared, as in the lead chamber process, by roasting pyrites in special furnaces, such as those of Maletta, Hasenderer and Helbig, Eichhorn and Liebig, etc. As there is nothing peculiar about this operation and as it has already been described in numerous treatises, we shall not speak of it. But an essential point is the purification to which the sulphurous acid designed for

* Specially prepared for the SCIENTIFIC AMERICAN SUPPLEMENT.