

# Journal of the Society of Chemical Industry.

No. 7, Vol. XXXIII.

APRIL 15, 1914.

No. 7, Vol. XXXIII.

## Official Notice.

### HEAT TEST COMMITTEE.

The Departmental Committee of the Home Office, having submitted its first report, is now prepared to examine any supplementary test or tests which may be submitted, and asks if any members of this Society have any test which they are disposed to put forward. Up to the present, the Committee has received no suggestions in regard to a supplementary test of explosives containing nitroglycerin. Communications should be addressed to Major H. Coningham, Secretary of the Committee, Home Office, Whitehall, S.W.

## London Section.

Meeting held at Burlington House, on Monday, March 2nd, 1914.

PROF. W. R. HODGKINSON IN THE CHAIR.

### BLASTING GELATINE: SOME NOTES AND THEORIES.

BY W. A. HARGREAVES, M.A., B.Sc., B.C.E., F.I.C.,  
Chief Inspector of Explosives, South Australia.

Blasting gelatine is the most powerful explosive in general use for mining purposes, and it forms a basis for a general class of high explosives called "gelatines." It is officially defined as consisting of nitro-cotton, carefully washed and purified, combined with thoroughly purified nitroglycerin in such proportions that the whole shall be of such character and consistency as not to be liable to liquefaction or exudation, and with or without calcium or magnesium carbonate not exceeding two parts by weight in every 100 parts by weight of the finished explosive. In actual practice blasting gelatine consists only of nitroglycerin and nitro-cotton.

The ordinary process of manufacture is to add to nitro-cotton of known gelatinizing power the calculated quantity of nitroglycerin in the cold and mix roughly by hand; then after standing for some hours the temperature is raised and more complete incorporation is made, usually in a mixing machine. Since different lots of nitro-cotton may appear to have different gelatinizing powers and since the tendency to exudation of nitroglycerin from the finished blasting gelatine appears to depend in some way on the nitro-cotton, manufacturers have used varying percentages of nitro-cotton which have been as low as 7 per cent. and as high as 9 per cent. in blasting gelatines brought to South Australia.

Over 14 years' experience as an Inspector of Explosives has shown me that manufacturers, even the best, have not been able to arrive at a definite quantity of nitro-cotton to use, and also have not been certain of producing every time a blasting gelatine that will comply with the official definition given above. So far as nitroglycerin is concerned there has been no trouble for many years, owing to the fact that it is a homogeneous liquid and can be thoroughly washed free of all the impurities which are liable to make it unstable. In the case of nitro-cotton the difficulties are great, owing to its physical condition, and there is always the possibility of small impure particles remaining in the cotton surrounded and protected from the washing liquid by the colloidal matter of which the nitro-cotton is composed. The particles may be only the size of pin points, but they may serve as centres of instability, so that when the blasting gelatine is subsequently submitted to the "heat test" a low result may be obtained. It is quite a common experience in the case of blasting gelatine

which has been condemned on account of low heat test to find that one portion of a cartridge will give a low test, when other parts of the same cartridge may pass the test. Apart from the difficulty of low test, which can be minimised by extra care in the preparation of the collodion cotton, there is also the more common trouble of exudation of nitroglycerin. This, indeed, may be regarded as the chief difficulty that manufacturers have to face, for no brand of blasting gelatine imported to Australia is free from liability to exude nitroglycerin when subjected to the trials of the voyage and the storage after arrival. Time after time shipments of blasting gelatine have to be condemned, wholly or in part, on account of this exudation.

It is evident, therefore, that either the true nature of blasting gelatine has not been understood or else the means of avoiding this defect have not been known. The usual and accepted remedy has been to increase the proportion of nitro-cotton, but this is open to several grave objections. In the first place, if the percentage of nitro-cotton is too high the risk of getting a low heat-test explosive is increased; secondly, the blasting gelatine is likely to be insensitive to detonation by the ordinary No. 6 detonator; thirdly, the balance of oxygen is likely to be upset, so that owing to the reduced percentage of nitroglycerin the generation of carbon monoxide is increased; and fourthly, the cost of the explosive is greatly increased. The last is by no means the least important from a manufacturer's point of view.

To find what is the real nature of blasting gelatine is, therefore, a problem of importance. Direct experiment and observation can teach much, but the difficulties of arriving at knowledge by pure deduction are very great, and one is perhaps justified in erecting on the foundation of a few observed facts an hypothesis which can be tested by subsequent observations and experiments. As my hypothesis has stood the test of four or five years' careful observation by those who are well qualified to form an opinion, I am now publishing it in the hope that it will help manufacturers to overcome some of their difficulties, and that it will be of assistance to those who, like myself, frequently have the grave responsibility of dealing with explosives which do not completely satisfy the official definition referred to above.

The theory is that blasting gelatine, instead of being a solution of a small quantity of nitro-cotton in a relatively large quantity of nitroglycerin, is in reality a colloidal solution of a certain quantity of nitroglycerin in nitro-cotton intimately mixed with some free ungelatinized nitroglycerin.

Bütschli has described a hydrogel as having a fine webbed micro-structure. This description has not been unanimously endorsed, but it conveys an idea of the mechanical condition of a jelly which explains some facts. Assuming for the present that a hydrogel has some such structure, it may take up in the meshes proportions of water which will vary with the size of the meshes, with the size of the threads or fibres constituting the structure, and possibly with the nature of these jelly "fibres," their power of adsorption, etc. It has been shown that silicic acid and other colloidal substances may be obtained with varying amounts of water of hydration. It may be assumed that a similar thing occurs in the case of blasting gelatine, where a solution of nitroglycerin in nitro-cotton or *vice versa* produces a gel having apparently the properties of a finely webbed structure, which adsorbs or otherwise entangles liquid nitroglycerin in the meshes. The proportion of nitroglycerin so held will vary chiefly with the size of the meshes and the size of the filaments or "fibres" of the gel. Hence blasting gelatines apparently similar in all outward respects may be obtained with varying ratios of nitro-cotton to nitroglycerin and they may lose varying quantities of nitroglycerin by exudation without making any apparent change in the appearance of the jelly. We have assumed that a portion of the nitroglycerin has "dissolved" in the nitro-cotton. As this is not quite the same thing as a chemical combination,

the quantity of nitroglycerin so dissolved will be subject to some amount of variation without making much change in the appearance of the jelly. Assuming that a given quantity of a certain nitro-cotton can "dissolve" a certain quantity of nitroglycerin, but that owing to mode of manufacture it has dissolved or combined with a less quantity and formed a jelly of quite satisfactory appearance, then it is reasonable to suppose that the nitro-cotton will go on "dissolving" more nitroglycerin at a diminishing rate till it is saturated. The saturation point will probably depend on the temperature and on climatic conditions. There will, however, be a difference in this action from the original solution in so much as, while in the first instance nitroglycerin is in contact with nitro-cotton, now nitroglycerin is in contact with a jelly, and owing to the physical nature of this jelly in impeding contact of nitroglycerin with the nitro-cotton unacted upon or not saturated, the final stages of solution will be very slow, and only likely to occur on prolonged storage of the explosive. It seems reasonable to suppose that if a manufacturer has calculated a quantity of nitro-cotton based on its observed gelatinizing power as determined in the laboratory, but that owing to the fact of exudation having occurred with a similarly made blasting gelatine, he is tempted to increase the percentage of nitro-cotton, it may happen that on prolonged storage the whole or almost the whole of the free nitroglycerin goes into solution. The result is that there is produced a blasting gelatine which is either wholly a jelly or is such that the minute particles of free nitroglycerin in the interstices are far apart and separated by walls of jelly.

The second part of my hypothesis is that in blasting gelatine the explosive wave following detonation is transmitted by the free nitroglycerin, and only imperfectly or not at all by the jelly. If there is no free nitroglycerin or the particles of it are too far apart, the blasting gelatine becomes "insensitive." It has been shown by Dr. Comey and others that the nitroglycerin contained in 75 per cent. dynamite transmits the explosive wave at a velocity of between 6,000 and 7,000 metres per second, and nitroglycerin in an iron tube of large enough bore will give a rate of over 7,000 metres per second, but for a 10 per cent. dynamite the rate is only 2,000 metres per second, which is about the rate for gelignite unless the wave gets a greater impetus from the explosion of a dynamite primer. Even then the wave slows down as it progresses, inversely as the percentage of nitroglycerin in the gelignite. It appears therefore, that if the amount of free nitroglycerin in a gelatine is small, and the particles are far apart, or the connecting threads or surfaces have small sectional area, or if there is no free nitroglycerin at all, the rate becomes that of the jelly itself. From its physical nature it presents a buffer to the initial shock and deadens the subsequent wave. Hence the blasting gelatine in these circumstances is "insensitive" and inert and requires a stronger detonator or even a primer to get proper explosion. Such blasting gelatines are condemned by the miner and are dangerous to use on the score of misfires and incomplete detonation producing noxious gases, and are wasteful in failing to do the required work. The hypothesis therefore explains some facts which are common knowledge, namely that some gelatines on prolonged storage become insensitive, that the harder the jelly the more likely it is to be insensitive, and such gelatines require more powerful detonators than those in common use, and even then may not give satisfactory explosions.

Mr. C. Napier Hake, late Chief Inspector in Victoria, made the observation that if an insensitive gelatine is "remade" by mixing it with a large percentage of a fresh batch of gelatine, it will infect the mass and the re-made blasting gelatine will soon undergo change and become more or less insensitive. This is explained by the above hypothesis, since the free nitroglycerin of the new batch is added not to nitro-cotton but to an existing jelly having probably excess of nitro-cotton, and the initial trouble is perpetuated because the gelatinization at the time of re-making is thus interfered with, and goes on slowly during storage, and in the end the particles of free nitroglycerin are either separated too far apart or are absent altogether.

The theory assumes the fact of there being free nitroglycerin in blasting gelatine. It is difficult to get direct proof of this, but it is obvious that, since liquid nitro-

glycerin can be obtained from blasting gelatine merely by pressure, and also by means of blotting paper, the nitroglycerin is not chemically combined with the nitro-cotton. Neither could the nitroglycerin which is thus removed have been in solution, or in the colloidal state. Hake has shown (this J., Sept. 15th, 1905) that porous wrappers will cause exudation even in the case of blasting gelatines that show no tendency to exude when in ordinary wrappers. The probability is therefore, that there is generally some nitroglycerin in the "free" or liquid state in the explosive. If the free nitroglycerin is near the limit, the tendency to exudation will be greater than when the nitroglycerin is smaller in quantity.

A sponge can take up a certain amount of water, but if the quantity is near the extreme limit, slight conditions such as gentle pressure will cause some of the water to drip out. By continued pressure all water, but that adsorbed on the fibres of the sponge, can be removed, and even then more water may be removed by contact with blotting paper. Further, the finer the meshes of a sponge and the greater the surface of the fibres, the greater the amount of water adsorbed, and the less is likely to drip out; so also with the blasting gelatine the more complete the jelly the less free nitroglycerin is likely to exude. On the hypothesis that the jelly itself is made by solution of some nitroglycerin in nitro-cotton, the more jelly formed in this way within limits, the more free nitroglycerin will be adsorbed, and the less unmeshed or entangled nitroglycerin there will be, and hence the less tendency to exudation. The particles or "fibres" of the jelly being "wetted" by nitroglycerin by surface action or capillary attraction, the free nitroglycerin can flow or move through the jelly. Suppose the surface of the cartridge is in contact with blotting paper or porous wrappers, the flow of nitroglycerin can continue in the meshes of the paper. The same sort of action occurs at the fold of the cartridge paper, where one thickness of paper overlaps the margin of the first fold, forming a small longitudinal tube attached along one side to the gelatine. The flow of free nitroglycerin is "attracted" by capillary action into this tube. Thus many gelatines show a line of free exuded nitroglycerin along the fold, and exudation does not proceed any further. Again, if this flow is checked by placing an impervious layer round the outside of the cartridge, exudation may be stopped or at any rate considerably reduced. Such a layer might be obtained by the action of a coagulant on the jelly of the cartridge. Absorbents of the nature of French chalk are apt to increase the capillary attraction, although they soak up the exuded nitroglycerin for a time, but substances like magnesium oxide appear to coagulate the jelly surface and thus check exudation. It may be possible to find a surface coagulant which will effectively stop exudation. Blasting gelatine exuding badly has been placed in fresh wrappers and in a few days' time exudation has been as bad as ever, but if the cartridges were dusted with light magnesium oxide before they were placed in fresh wrappers, in some instances there has been practically no further exudation for several weeks. In the meantime the explosives could be put to their legitimate use.

The theory of the constitution of blasting gelatine has already rendered great assistance in elucidating the perplexing behaviour of gelatine explosives.

The extent of exudation that occurs at any given time with different cartridges, possibly of the same lot of blasting gelatine, may vary considerably. To have ready means of reference various scales have been proposed, but the one adopted in South Australia consists of five degrees based on actual cartridges. According to the theory we assume that excessive exudation represents an unbalanced explosive, and that probably gelatinization has not been complete. Acting on this assumption, one favours lengthy storage under observation of such an explosive, and it frequently happens that when it is subsequently re-wrapped so as to remove the exuded nitroglycerin, no further exudation takes place. It sometimes happens that re-wrapping is unnecessary, the exuded nitroglycerin having been re-absorbed, possibly by capillary action, by the stronger gel produced by the secondary gelatinization. On the other hand, if such material is placed in new wrappers at first there is every probability of further exudation taking place before the secondary gelatinization.

has made any progress, and the condition of the explosive may be soon as bad as it was at first. In these circumstances re-wrapping is not recommended unless the material is to be consumed at once.

In his report on the "Composition of the Gases caused by blasting in mines" (see this J., 1911, 447, 1281), E. A. Mann has drawn attention to the fact that unaltered fragments of nitro-cotton can be seen in blasting gelatine. He further says that the general experience in Western Australia is that an explosive which, on landing from Europe, is soft and plastic, will after a lengthy storage in a magazine become stiff and more rigid to the touch, while the common experience is that such explosives explode only under excessive stimulus, and are very apt to leave unexploded portions in the bottom of the bore holes in mines. This is also the experience in South Australia. I suggested to Mr. Mann that the theory outlined above would explain these phenomena, and his study of the question led him to believe that it was a "rational and convincing explanation for some of the problems involved."

S. Soddy in "Arms and Explosives" (February, 1912), referring to the decrease of sensitiveness of gelatines on prolonged storage, gives the results of lead block tests, which showed that blasting gelatine with a No. 6 detonator which gave a volume of 570 to 600 c.c. when first tested, at the end of twelve months' storage gave only from 420 to 430 c.c. On repeating the experiments with No. 7 detonators all gave normal results. He sees in the theory I have suggested an explanation of these results. It seems to me that Soddy's results might be explained as follows. Assuming that during manufacture the usual plan was followed, by which a preliminary mixing of the nitro-cotton and nitroglycerin would be made, an imperfect gel would be produced. On standing overnight the excess of nitroglycerin would slowly act on the already formed gel and some enclosed nitro-cotton, and at the final mixing more action would take place, but in would not be so complete as it would have been, had the nitroglycerin been thoroughly incorporated with the nitro-cotton in the first instance. The reaction would continue slowly when the explosive was put in store for twelve months. If enough nitro-cotton had been used to prevent exudation at the time the explosive was sent out from the factory, it would in reality have too much nitro-cotton and consequently all the free nitroglycerin would be turned to the gel form, or at any rate the remaining particles of free nitroglycerin in the "meshes" of the gel would be too small in number or too far apart to transmit the explosive wave set up by the No. 6 detonator at sufficient velocity to get complete detonation. A No. 7 detonator, on the other hand, might give sufficient stimulus to reach from one particle of nitroglycerin to another and so normal results would be obtained.

In this connection it is interesting to revert to Comey's experiments on rate of detonation. In determining the rate with nitroglycerin, when  $\frac{1}{2}$  inch bore glass tubes were used for holding the nitroglycerin, the explosive wave was not transmitted. The column could only be detonated for a few inches from the detonator. The velocity of detonation when  $\frac{3}{4}$  inch glass tubes were used was only 654 metres per second, while with 1 inch light sheet iron tubes two kinds of explosive wave were obtained, one with a velocity of only 1451 metres, while the other was about 7690 metres, which is comparable with the rate given by nitroglycerin in No. 1 dynamite. With wrought iron tubes of  $1\frac{1}{2}$  inch diameter a 24 grain cap gave a velocity of 8527 metres while a 12 grain cap gave only 2019 metres. Where paper tubes were used the rate was lower probably on account of the smaller confinement of the nitroglycerin charge. Applying the theory, we see that if the particles of free nitroglycerin are in continuous "threads" or surfaces sufficiently large in diameter or area and thickness, the explosive wave should be transmitted in blasting gelatine at a rate which would be directly comparable with that of nitroglycerin. If, however, the surfaces are thinner or the threads finer, the rate would be less, and may be interfered with and brought as it were to a lower octave of vibration by the buffer action of the gel. Two or more separate rates of detonation may be obtained.

When testing explosives imported into Western Australia, Mann found that some blasting gelatines gave rates of from

3750 to 4225, averaging 4063 metres per second, whereas others gave from 2400 to 2553, averaging 2457. The last figures suggest that very little free nitroglycerin remained in these blasting gelatines, or that such particles as remained were not in contact, but were effectively screened by the intervening gel.

The late W. R. Quinan was of opinion that a maximum rate of detonation implied a perfect detonation, whereas an abnormally low rate denoted insensitiveness and probably incomplete metamorphosis. In America generally, according to Soddy, a sharp detonation is preferred, which means a high rate of detonation. If one desires a lower rate one uses some other explosive than blasting gelatine. It is, therefore, now suggested that the blasting gelatine which has the most free nitroglycerin, has the greatest rate of detonation, and that it is not the extra gelatinization which takes place on storage that makes a blasting gelatine inert, but the lack of free nitroglycerin. Consequently that blasting gelatine is the best which—

(1) Has the most free nitroglycerin, provided that the free nitroglycerin is so held by the gel (by adsorption or otherwise) that the finished explosive is free from all liability to liquefaction or exudation; and

(2) Has all its nitro-cotton completely gelatinized, so that there will not be any reduction of the amount of free nitroglycerin on storage by secondary gelatinization.

The question now arises as to what use the manufacturer can make of the hypothesis. In my opinion it should at least serve as the basis of carefully conducted experiments. In 1909 and 1910 I suggested to the representatives of several manufacturers that experiments should be carried out by thoroughly mixing in the cold, nitro-cotton with quantities of nitroglycerin much short of the total required to form ordinary blasting gelatine, and then after gelatinization, the further quantities of nitroglycerin to make up the total should be mixed with the existing jelly. I also suggested that the thoroughness of the preliminary mixing should be varied. My own experiments with wheat flour and water indicated that it is one thing to add water to flour, and a different thing to add water to a dough. Hence in determining the water absorption of flour it is necessary by preliminary trials to ascertain approximately the amount of water required to make a standard dough, and then to make the actual determination by adding the whole of the water to the flour in one operation. This is not the usual method, which is to add some water and make a dough; if this dough is not the right consistency more water is added little by little until it is right. This gives a fallacious result because the small lots of water being added in this way are added to a dough, and remain as free water in the interstices of the dough for a considerable time. Where the water is added all at once every particle of flour gets its quatum of water before the gel is formed. From analogy with the action of flour and water, assuming the presence of free (ungelatinized) nitroglycerin in blasting gelatine, the remedy for exudation is therefore not to add more nitro-cotton, but to get a larger amount of gelatinization during the initial mixing of the nitro-cotton and nitroglycerin. To obtain this result more thoroughness is necessary in the preliminary mixing, and also immediate and thorough working in a machine is required. I suggest that the remedy for insensitiveness is to reduce the quantity of nitro-cotton and make up for this by more complete mixing, especially in the preliminary stage. One of the manufacturers took the matter up with enthusiasm. There had been trouble on account of exudation. My suggestions respecting thoroughness of the initial mixing were acted upon and the result was a surprising success. It was not known here that any change in the method of manufacture had been made, but the improved quality of the blasting gelatine excited questions and the reply was that "most of the success of the last shipment is due to modified methods of mixing during manufacture, the benefits of which were first brought to our notice by you."

Another manufacturing company discussed the question with me in 1910, and subsequently made a trial of the new direct method of obtaining gelatinization. This year the company reports that "at one time it was not thought possible to manufacture a satisfactory gelatine without overnight standing and final hot gelatinization, but we have

been able for some little time to obtain exceedingly good results by direct gelatinization after mixing nitroglycerin with the nitro-cotton."

It is still too early to say that this modification in manufacture will cure the exudation trouble, but the results so far obtained are very encouraging.

#### DISCUSSION.

Mr. G. W. MACDONALD said that most manufacturers had probably tried experiments on the lines suggested by Mr. Hargreaves, but in the speaker's opinion it was very difficult to arrive at any definite conclusion as to the influence of the temperature of gelatinisation and the time of incorporation on the liability of exudation. Pressure on the cartridges, increase of temperature, rapid alterations of temperature, humidity and previous freezing of the cartridge were all factors likely to produce exudation. As to the theory of free nitroglycerin, his own experience was that cartridges which were freely exuding had not a higher velocity of detonation than cartridges from the same batch which were not exuding, so he could not agree with the author's view that the increase in the collodion cotton content was associated with a fall in the heat test.

Dr. E. WEISKOPF held that the sensitiveness of blasting gelatin was largely controlled by the physical state of the explosive. A blasting gelatin which contained a small amount of nitro-cotton was less elastic than blasting gelatin which contained a large amount of collodion cotton, and the propagation of the explosive wave in a material like blasting gelatin was very greatly counteracted by the elasticity of the substance itself. He had proved that point by adding to blasting gelatin which contained say 7 per cent. of collodion cotton (perhaps the lowest practical limit to which it could be made), a comparatively small amount of camphor, which had no other effect than making the substance more elastic, more horny, and less suitable to transmit the initial explosion, the result was that the blasting cartridge made of such a mixture was rendered so inert that it would only partly explode when it was detonated. He thought the question of the "liquid nitroglycerin" could be left out of account, because it was well recognised that nitroglycerin itself was insensitive to transmit explosion, so he thought it was quite contrary to accepted ideas that it was necessary to have "liquid nitro-glycerin" present in blasting gelatin in order to have a sensitive explosive. He thought one point had been overlooked in the question of the correct proportion of collodion cotton in blasting gelatin, that was in connection with the fact that nitroglycerin in exploding yielded a certain amount of free oxygen, whilst collodion cotton in exploding left a certain amount of carbon monoxide. The

endeavour of every explosive manufacturer should be to produce an explosive which on detonation yielded no carbon monoxide or other noxious gases. Blasting gelatin, which was almost perfect from a physical point of view, consisting of about 8 per cent. of collodion cotton and 92 per cent. of nitroglycerin—yielded explosion gases which contained no free carbon monoxide, but a small excess of free oxygen.

The CHAIRMAN agreed with the last speaker in regard to the relation between the amount of the nitro-cotton and nitroglycerin.

### Obituary.

#### ROBERT KENNEDY DUNCAN.

Robert Kennedy Duncan was born in Canada in 1868, and educated in the University of Toronto. He was appointed in 1905 to the chair of Chemistry in the Washington and Jefferson College, and in 1906 he became professor of industrial chemistry in the University of Kansas, where he initiated a promising scheme of industrial fellowships and bursaries. Both at Kansas and Pittsburgh the success of the scheme has been remarkable. Professor Duncan gave a full account of it in 1909 in the course of a "Discussion on Industrial Fellowships" before the London Section of this Society (see this Journal, 1909, 685—690). In 1910 he was appointed professor of industrial chemistry in the University of Pittsburgh and subsequently to the directorship of the Mellon Institute of Industrial Research.

Professor Duncan edited the "New Science Series," and was the author of "The Chemistry of Commerce," "The New Knowledge," and other works. He concludes his chapter in "The Chemistry of Commerce" on Industrial Fellowships with the following words:—"Everywhere, wherever man deals with material, there are unsolved, important manufacturing problems, best solved by combining the practical knowledge and large facilities of the factory with the now and special knowledge of the Universities, and with the aid of young men who will find therein the opportunity for success. An Industrial Fellowship affords to a young man every incentive to lay his hands on Science and make it serve the practical needs of the human race."

Professor Duncan died at Pittsburgh, Pa., Feb. 18, 1914.

## Journal and Patent Literature.

PATENT SPECIFICATIONS may be obtained by post by remitting as follows:—

*English.*—8d. each, to the Comptroller of the Patent Office, W. Temple Franks, Esq., Southampton Buildings, Chancery Lane, London, W.C.

*United States.*—1s. each, to the Secretary of the Society.

*French.*—1 fr. 05 c. each, as follows: Patents dated 1902 to 1907 inclusive, Belin et Cie., 56, Rue des Francs Bourgeois, Paris (Se.); Patents from 1908 to date, L'Imprimerie Nationale, 87, Rue Vieille du Temple, Paris.

*German.*—1 mark each (with full particulars) to Kaiserlich Patentamt, Berlin, Germany.

### I.—GENERAL PLANT; MACHINERY.

*Aluminium apparatus; Destruction of — by the galvanocatalytic action of copper.* P. Pikos. Z. angew. Chem., 1914, 27, 152.

MANY liquids, especially conductors of the second class, such as glycerin, formaldehyde, methyl, ethyl and allyl alcohols, acetone, acetic acid, tannin solutions, etc., whilst having no action on pure aluminium, even at high temperatures, rapidly attack that metal if small quantities of copper salts be present; copper, or a mixture of copper and copper oxide is deposited, and exerts catalytic

action, resulting in the evolution of hydrogen and formation of aluminium hydroxide.—A. S.

#### PATENTS.

*Measuring vapours, gases and liquids; Apparatus for —.* H. M. Lieso, Hamburg. Eng. Pat. 2597, Jan. 31, 1913.

In the apparatus described in Eng. Pat. 27,467 of 1911 (this J., 1912, 701) a slide-valve is provided which puts the conduit successively in connection with a series of measuring openings, and the expansion chamber is loaded