Generator Rehab

Part 1 – Disassembly and Parts

by Bruce Smith

Despite being old automotive technology, a Bosch generator is part of the originality of our old cars that many of us like to preserve. Like drum brakes, distributor contact points, carburetors, and six-volt electrics, generators can be replaced with more modern alternatives. But such upgrades are weighed against originality and not being able to keep our cars as they were back in the day.

Generators haven't been installed as new equipment in Porsches since the last 912 rolled out of the factory. Replacements, spare parts, and rebuilders were once plentiful, allowing original-equipment generators to be used for decades. But things have changed in recent years as replacement parts have dwindled, and many of the shops that once serviced generators are gone. Though now more difficult to find, there are still some trustworthy rebuilders. Or, following the theme for these tech articles, some DIY work can be carried out to bring new life to a worn-out generator. Though the extent of the DIY will depend on the condition of a generator to begin with, most can indeed be rehabilitated.

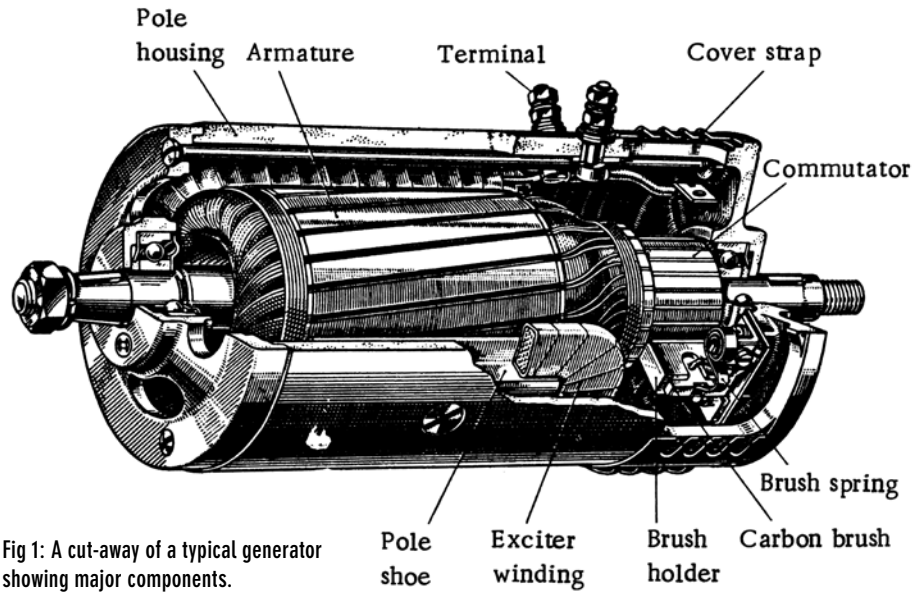

Fig 1: A cut-away of a typical generator showing major components.

Generator Fundamentals

The basic workings of a generator are really the same as an electric motor, though opposite in function. A generator mainly consists of an armature, a field frame with pole shoes, field coil windings, and a commutator with brushes for electrical contact during rotation. The illustration above is of a Bosch generator, but this is typical of the two-brush, series-wound or shunt-wound configurations for most old automotive applications. There are differences between particular designs, but they are not worth worrying about as long as internal wiring layout is preserved (i.e., as long as you put things back together the way that you found them).

The individual components inside a generator's housing are shown in Figure 2. The complete disassembly into these components involves some challenges, but it is necessary in order to inspect, repair, and replace worn parts. Proper rebuilding consists of more than just a new set of brushes and a fresh coat of paint, which is often the extent of the attention that many internet-found, so-called-rebuilt generators receive. We'll go several important steps beyond this by cleaning the entire assembly, re-wrapping the field coils, replacing the bearings, renewing insulators, refinishing the housing, servicing the armature and commutator as needed, and replacing all necessary hardware. Together with measurement and testing along the way, this is a project that will take many hours.

This article is therefore divided into two parts, first addressing disassembly, then following up with repair and reassembly in the next installment. Along the way, a few things may require some outside help. But careful attention to each component will ensure that all is good before putting things back together.

Bosch Parts and Numbers

It's good to decide if the generator that you may already have can be rebuilt before you invest any money on a (potentially suspicious) replacement. But if you're looking for a replacement, there are a few Bosch generators that are correct for our cars, and many more that were used for other makes. Below is a list of 6V and 12V generator models used in Porsches, together with details for each. Although others might work, things like the location of the regulator (which is mounted on the generator for a VW), the physical diameter, the mounting locations, and the wiring studs can require some degree of modification.

Model	Bosch part number
356A/B to 9/59	LJ/GE 160/6/2500 L2
356B/C from 10/59 6V	LJ/GEG 200/6/2600 L19
356C 12V	LJ/REF 160/12/2600 L18 LJ/GE 160/12/2500 L10 LJ/GEG 200/12/2700 L
Carreras and 550 Spyders	LJ/GE 160/6/2500 L10

Table 1: Generators used in various Porsche 356 models. The Bosch numbering indicates the power (e.g., 160W), voltage (e.g., 6V), the rotation speed (e.g., 2,500 RPM), and the rotation direction (e.g., left-handed).

If originality is important, the date code stamped on the housing should correspond to a range near your car's build date. An old generator might have multiple date stamps, corresponding to when it was previously rebuilt. These dates are often marked as remanufacturing dates (e.g., stamped "REMANUF"), but not necessarily. Bosch date codes can seem confusing, but they do follow particular patterns. The following tables show codes used with Bosch parts prior to 1964, with the "new" coding starting in 1964. Close inspection of the later numbering can reveal the patterns.

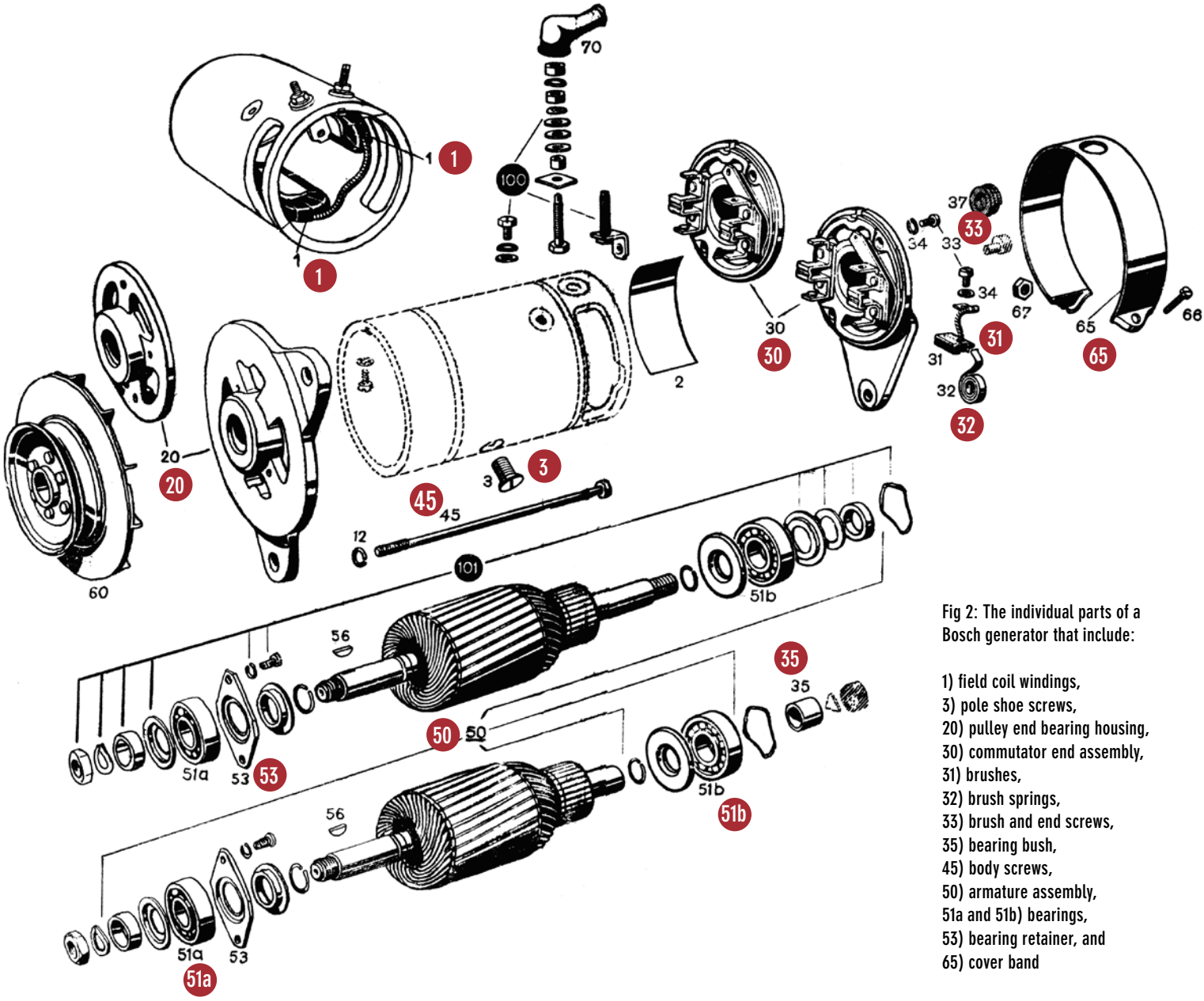

Fig 2: The individual parts of a Bosch generator that include:

1) field coil windings,
3) pole shoe screws,
20) pulley end bearing housing,
30) commutator end assembly,
31) brushes,
32) brush springs,
33) brush and end screws,
35) bearing bush,
45) body screws,
50) armature assembly,
51a and 51b) bearings,
53) bearing retainer, and
65) cover band

Tables 2 and 3 (below), and 4 (following page): Three tables showing the date codes for Bosch components built or re-built between 1955 and 1975. The date codes prior to 1964 begin with the month (1–12) and a letter assigned for each year. Starting in 1964, Bosch used numbers only for month/year or quarter.

PRE-1964 CODES

Code	L	M	N	P	Q	R	S	T	U
Year	1955	1956	1957	1958	1959	1960	1961	1962	1963

1964 AND LATER MONTHLY CODES

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1964	401	402	403	404	405	406	407	408	409	410	411	412
1965	501	502	503	504	505	506	507	508	509	510	511	512
1966	601	602	603	604	605	606	607	608	609	610	611	612
1967	701	702	703	704	705	706	707	708	709	710	711	712
1968	801	802	803	804	805	806	807	808	809	810	811	812
1969	901	902	903	904	905	906	907	908	909	910	911	912
1970	021	022	023	024	025	026	027	028	029	030	031	032
1971	121	122	123	124	125	126	127	128	129	130	131	132
1972	221	222	223	224	225	226	227	228	229	230	231	232
1973	321	322	323	324	325	326	327	328	329	330	331	332
1974	421	422	423	424	425	426	427	428	429	430	431	432
1975	521	522	523	524	525	526	527	528	529	530	531	532

QUARTERLY CODES

Year	1Q	2Q	3Q	4Q
1964	413	414	415	416
1965	513	514	515	516
1966	613	614	615	616
1967	713	714	715	716
1968	813	814	815	816
1969	913	914	915	916
1970	033	034	035	036
1971	133	134	135	136
1972	233	234	235	236
1973	333	334	335	336
1974	433	434	435	436
1975	533	534	535	536

Replacement Parts

If your inspection reveals no other parts that need replacement, the two things you'll at least want to have on hand are new brushes and bearings. Porsche replacement brush part numbers are 616.603.904.02 for 6V and 616.603.905.00 for 12V generators, and these can be found through standard suppliers. Brush part numbers 111903515A for 6V and 113903515A for 12V are also equivalent. Bosch originally installed bearings that were not a protected style, which required repacking during their lifetime. The best replacement bearings now are a shielded type, but not sealed. The correct Porsche bearing part number is 900.052.002.00, which can be found though bearing suppliers as 6202-ZZ. The code ZZ designates the correct shielded type.

First Step – Basic Testing

If you suspect that your generator isn't charging, some initial testing can be done to determine whether there are indeed electrical problems. Some problems can be fixed, while others, like bad windings, are more the purview of an expert. Although several tests can be done with the generator still mounted in place, eventually it will need to be removed.

A good first check is to inspect the brushes for free travel. The brush holders and pressure springs also should be looked over before disassembly. Next, check the resistance of the field coil windings between the DF and D+ terminals. The resistance should be about 1.5–2 Ohms for a 6V generator and 5–8 Ohms for a 12V generator. Next, you can test functionality by briefly running the generator as a motor. In a manner just like you'd use to polarize the generator after rebuilding, a jumper can be installed between DF and D- terminals, and a battery of appropriate voltage connected between the D- and the D+ terminals. The run-time of this test should be limited to just a few seconds. Last, check if excessive play can be felt in the shaft. Wear will later be measured in the end housings after disassembly. This shaft play is typically caused by years of force exerted by the pulley and belt.

Disassembly

Disassembly involves removing the armature, the bearings, and the field coils. There are some tools that you will need that may not be in your toolbox. Specifically, you'll need a medium-size puller, a bearing separator, and an impact driver with a 1/2-inch wide flat bit or drag link socket. With these tools ready to go, the disassembly can proceed as follows:

1. The first step is to remove the armature (part 50 in Figure 2), but a few things should be taken out beforehand. Behind the protective sheet metal band (65), the brushes are held in with springs (32) and small screws (33). Once these are out, the two long, 6mm body screws (45) that go through the entire housing should be removed. The armature can then be taken out of the housing. It may be a bit stuck, so some gentle prying of the pulley end cover (20) may be needed. Be careful when extracting the armature so as to not damage the insulation wrap covering the field coils (1).

Fig. 3: The armature assembly and a two-jaw puller used for removing the end cover bearing housing. The device pictured next to the vise is the growler that will be later used to test the armature.

2. With the armature between soft jaws of a vise, the bearing housing at the pulley end (20) can be removed with a puller, as shown in Figure 3. This can be done from either the outside perimeter or from inside the cover openings, but care should be taken if it's stubborn. Once removed, the small screws holding the bearing retainer (53) can be removed, which allows the bearing (51a) and grease shields to be taken out. Parts locations and orientations should correspond to the components diagram in Fig. 2, but taking photos along the way will also help with reassembly.

3. A bearing separator is needed to remove the commutator end bearing (51b). There is a grease shield outside of the bearing that needs to be removed, which can be done together with the bearing itself. By holding the armature in the vise (see Fig. 4), a small bearing separator can be used to first open a gap beneath the bearing. Then, with a set of short legs, a yoke, and a lead screw, the bearing can be gradually pulled off. The spacer behind the bearing can then be removed.

4. The next step is the removal of the field coil windings (1) and pole shoes. There is a small 5mm screw (33) in the commutator end assembly that is held into the D+ terminal screw bracket. Once that is removed, the end cap (30) can come off. Just as with the pulley end cover, this may need some gentle prying. The nuts and washers on the DF and D+ should then be removed so that the terminals and their wiring can be pushed into the housing. If the generator hasn't been apart before, the ends of the terminal screws will be crimped. These ends will need to be ground or cut before the nuts will thread off. Now comes probably the most stubborn part of the entire teardown. Each pole shoe is mounted into the housing by a large, flat-head slotted screw (3). These will not come out with ordinary measures. Instead, they will probably need a long soak with penetrating fluid and an impact driver with a 1/2-inch flat screwdriver bit. A breaker bar and a 1/2-inch drag link socket, with force applied in an arbor press, will also free them up. The screw slots will likely get mashed in the removal process, but replacement screws are available.

5. Once the pole screws are removed, the pole shoes and field coil windings will come out quite easily. Label the shoes and the coils so that they go back in the same way, as the shoes aren't identical. At this point, all of the parts should be out of the housing and the collection should look something like the arrangement in Figure 5.

Fig. 4: The bearing at the commutator end is removed using a bearing separator and puller.

Fig. 5: The collection of disassembled Bosch generator parts. The field coil windings and pole shoes (top left) are labeled to guide reinstallation.

Assessing for the Rebuild

This particular generator had been taken apart before. The housing and hardware are still in decent shape. The bearings are probably originals and will be replaced. All parts will be cleaned, and the field coils will be tested, re-soldered, and re-wrapped with glass cloth tape. The end caps will be inspected for damage and wear. The details of each of these steps will be discussed in the next article in this series.

The needs of the armature in particular will be closely addressed. It will be tested with a growler—an instrument used to test for armature shorts, opens, and grounds. Mild wear to a commutator can sometimes be removed by hand with crocus cloth (an abrasive sheet). But there is often sufficient wear to the commutator that it needs to be skimmed on a lathe with the insulators re-recessed. In some cases, such as if the commutator has already been turned, a replacement armature may be needed. Next time we'll get into how much of this you can expect to do yourself and how to otherwise find the right resources to help.

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